SYBASE iAnywhere

SQL Anywhere® Server Programming

Contents

About this book

This book describes how to build and deploy database applications using the C, C++, Java, PHP, Perl, Python, and .NET programming languages such as Visual Basic and Visual C#. A variety of programming interfaces such as ADO.NET and ODBC are described.

About the SQL Anywhere documentation

The complete SQL Anywhere documentation is available in four formats:

- **DocCommentXchange** DocCommentXchange is a community for accessing and discussing SQL Anywhere documentation on the web.

  To access the documentation, go to http://dcx.sybase.com.

- **HTML Help** On Windows platforms, the HTML Help contains the complete SQL Anywhere documentation, including the books and the context-sensitive help for SQL Anywhere tools.

  To access the documentation, choose **Start** » **Programs** » **SQL Anywhere 12** » **Documentation** » **HTML Help (English)**.

- **Eclipse** On Unix platforms, the complete Help is provided in Eclipse format. To access the documentation, run *sadoc* from the *bin32* or *bin64* directory of your SQL Anywhere installation.

- **PDF** The complete set of SQL Anywhere books is provided as a set of Portable Document Format (PDF) files. You must have a PDF reader to view information.

  To access the PDF documentation on Windows operating systems, choose **Start** » **Programs** » **SQL Anywhere 12** » **Documentation** » **PDF (English)**.

  To access the PDF documentation on Unix operating systems, use a web browser to open */documentation/en/pdf/index.html* under the SQL Anywhere installation directory.

Documentation conventions

This section lists the conventions used in this documentation.

Operating systems

SQL Anywhere runs on a variety of platforms. Typically, the behavior of the software is the same on all platforms, but there are variations or limitations. These are commonly based on the underlying operating system (Windows, Unix), and seldom on the particular variant (IBM AIX, Windows Mobile) or version.

To simplify references to operating systems, the documentation groups the supported operating systems as follows:

- **Windows** The Microsoft Windows family includes platforms that are used primarily on server, desktop, and laptop computers, as well as platforms used on mobile devices. Unless otherwise specified, when the documentation refers to Windows, it refers to all supported Windows-based platforms, including Windows Mobile.

  Windows Mobile is based on the Windows CE operating system, which is also used to build a variety of platforms other than Windows Mobile. Unless otherwise specified, when the documentation refers to Windows Mobile, it refers to all supported platforms built using Windows CE.

- **Unix** Unless otherwise specified, when the documentation refers to Unix, it refers to all supported Unix-based platforms, including Linux and Mac OS X.

For the complete list of platforms supported by SQL Anywhere, see "Supported platforms" [*SQL Anywhere 12 - Introduction*].

Directory and file names

Usually references to directory and file names are similar on all supported platforms, with simple transformations between the various forms. In these cases, Windows conventions are used. Where the details are more complex, the documentation shows all relevant forms.

These are the conventions used to simplify the documentation of directory and file names:

- **Uppercase and lowercase directory names** On Windows and Unix, directory and file names may contain uppercase and lowercase letters. When directories and files are created, the file system preserves letter case.

  On Windows, references to directories and files are *not* case sensitive. Mixed case directory and file names are common, but it is common to refer to them using all lowercase letters. The SQL Anywhere installation contains directories such as *Bin32* and *Documentation*.

  On Unix, references to directories and files *are* case sensitive. Mixed case directory and file names are not common. Most use all lowercase letters. The SQL Anywhere installation contains directories such as *bin32* and *documentation*.

  The documentation uses the Windows forms of directory names. You can usually convert a mixed case directory name to lowercase for the equivalent directory name on Unix.

- **Slashes separating directory and file names** The documentation uses backslashes as the directory separator. For example, the PDF form of the documentation is found in *install-dir\Documentation\en\PDF* (Windows form).

  On Unix, replace the backslash with the forward slash. The PDF documentation is found in *install-dir/documentation/en/pdf*.

- **Executable files** The documentation shows executable file names using Windows conventions, with a suffix such as *.exe* or *.bat*. On Unix, executable file names have no suffix.

  For example, on Windows, the network database server is *dbsrv12.exe*. On Unix, it is *dbsrv12*.

- ***install-dir*** During the installation process, you choose where to install SQL Anywhere. The environment variable SQLANY12 is created and refers to this location. The documentation refers to this location as *install-dir*.

  For example, the documentation may refer to the file *install-dir/readme.txt*. On Windows, this is equivalent to *%SQLANY12%\readme.txt*. On Unix, this is equivalent to *$SQLANY12/readme.txt* or *${SQLANY12}/readme.txt*.

  For more information about the default location of *install-dir*, see "SQLANY12 environment variable" [*SQL Anywhere Server - Database Administration*].

- ***samples-dir*** During the installation process, you choose where to install the samples included with SQL Anywhere. The environment variable SQLANYSAMP12 is created and refers to this location. The documentation refers to this location as *samples-dir*.

  To open a Windows Explorer window in *samples-dir*, choose **Start** » **Programs** » **SQL Anywhere 12** » **Sample Applications And Projects**.

  For more information about the default location of *samples-dir*, see "SQLANYSAMP12 environment variable" [*SQL Anywhere Server - Database Administration*].

Command prompts and command shell syntax

Most operating systems provide one or more methods of entering commands and parameters using a command shell or command prompt. Windows command prompts include Command Prompt (DOS prompt) and 4NT. Unix command shells include Korn shell and bash. Each shell has features that extend its capabilities beyond simple commands. These features are driven by special characters. The special characters and features vary from one shell to another. Incorrect use of these special characters often results in syntax errors or unexpected behavior.

The documentation provides command line examples in a generic form. If these examples contain characters that the shell considers special, the command may require modification for the specific shell. The modifications are beyond the scope of this documentation, but generally, use quotes around the parameters containing those characters or use an escape character before the special characters.

These are some examples of command line syntax that may vary between platforms:

- **Parentheses and curly braces** Some command line options require a parameter that accepts detailed value specifications in a list. The list is usually enclosed with parentheses or curly braces. The documentation uses parentheses. For example:

  ```
  -x tcpip(host=127.0.0.1)
  ```

  Where parentheses cause syntax problems, substitute curly braces:

  ```
  -x tcpip{host=127.0.0.1}
  ```

  If both forms result in syntax problems, the entire parameter should be enclosed in quotes as required by the shell:

  ```
  -x "tcpip(host=127.0.0.1)"
  ```

- **Semicolons** On Unix, semicolons should be enclosed in quotes.
- **Quotes** If you must specify quotes in a parameter value, the quotes may conflict with the traditional use of quotes to enclose the parameter. For example, to specify an encryption key whose value contains double-quotes, you might have to enclose the key in quotes and then escape the embedded quote:

  ```
  -ek "my \"secret\" key"
  ```

  In many shells, the value of the key would be `my "secret" key`.
- **Environment variables** The documentation refers to setting environment variables. In Windows shells, environment variables are specified using the syntax *%ENVVAR%*. In Unix shells, environment variables are specified using the syntax *$ENVVAR* or *${ENVVAR}*.

Contacting the documentation team

We would like to receive your opinions, suggestions, and feedback on this Help.

You can leave comments directly on help topics using DocCommentXchange. DocCommentXchange (DCX) is a community for accessing and discussing SQL Anywhere documentation. Use DocCommentXchange to:

- View documentation
- Check for clarifications users have made to sections of documentation
- Provide suggestions and corrections to improve documentation for all users in future releases

Go to http://dcx.sybase.com.

Finding out more and requesting technical support

Newsgroups

If you have questions or need help, you can post messages to the Sybase iAnywhere newsgroups listed below.

When you write to one of these newsgroups, always provide details about your problem, including the build number of your version of SQL Anywhere. You can find this information by running the following command: **dbeng12 -v**.

The newsgroups are located on the *forums.sybase.com* news server.

The newsgroups include the following:

- sybase.public.sqlanywhere.general
- sybase.public.sqlanywhere.linux
- sybase.public.sqlanywhere.mobilink
- sybase.public.sqlanywhere.product_futures_discussion
- sybase.public.sqlanywhere.replication
- sybase.public.sqlanywhere.ultralite
- ianywhere.public.sqlanywhere.qanywhere

For web development issues, see http://groups.google.com/group/sql-anywhere-web-development.

Newsgroup disclaimer
iAnywhere Solutions has no obligation to provide solutions, information, or ideas on its newsgroups, nor is iAnywhere Solutions obliged to provide anything other than a systems operator to monitor the service and ensure its operation and availability.

iAnywhere Technical Advisors, and other staff, assist on the newsgroup service when they have time. They offer their help on a volunteer basis and may not be available regularly to provide solutions and information. Their ability to help is based on their workload.

Developer Centers

The **SQL Anywhere Tech Corner** gives developers easy access to product technical documentation. You can browse technical white papers, FAQs, tech notes, downloads, techcasts and more to find answers to your questions as well as solutions to many common issues. See http://www.sybase.com/developer/library/sql-anywhere-techcorner.

The following table contains a list of the developer centers available for use on the SQL Anywhere Tech Corner:

Name	URL	Description
SQL Anywhere .NET Developer Center	www.sybase.com/developer/library/sql-anywhere-techcorner/microsoft-net	Get started and get answers to specific questions regarding SQL Anywhere and .NET development.
PHP Developer Center	www.sybase.com/developer/library/sql-anywhere-techcorner/php	An introduction to using the PHP (PHP Hypertext Preprocessor) scripting language to query your SQL Anywhere database.

Name	URL	Description
SQL Anywhere Windows Mobile Developer Center	www.sybase.com/developer/library/sql-anywhere-techcorner/windows-mobile	Get started and get answers to specific questions regarding SQL Anywhere and Windows Mobile development.

Using SQL in applications

This section provides information about using SQL in applications.

Executing SQL statements in applications

The way you include SQL statements in your application depends on the application development tool and programming interface you use.

- **ADO.NET** You can execute SQL statements using a variety of ADO.NET objects. The SACommand object is one example:

  ```
  SACommand cmd = new SACommand(
       "DELETE FROM Employees WHERE EmployeeID = 105", conn );
  cmd.ExecuteNonQuery();
  ```

  See "SQL Anywhere .NET Data Provider" on page 39.

- **ODBC** If you are writing directly to the ODBC programming interface, your SQL statements appear in function calls. For example, the following C function call executes a DELETE statement:

  ```
  SQLExecDirect( stmt,
      "DELETE FROM Employees
       WHERE EmployeeID = 105",
      SQL_NTS );
  ```

  See "ODBC support" on page 343.

- **JDBC** If you are using the JDBC programming interface, you can execute SQL statements by invoking methods of the statement object. For example:

  ```
  stmt.executeUpdate(
      "DELETE FROM Employees
       WHERE EmployeeID = 105" );
  ```

  See "JDBC support" on page 397.

- **Embedded SQL** If you are using embedded SQL, you prefix your C language SQL statements with the keyword EXEC SQL. The code is then run through a preprocessor before compiling. For example:

  ```
  EXEC SQL EXECUTE IMMEDIATE
   'DELETE FROM Employees
    WHERE EmployeeID = 105';
  ```

  See "Embedded SQL" on page 429.

- **Sybase Open Client** If you use the Sybase Open Client interface, your SQL statements appear in function calls. For example, the following pair of calls executes a DELETE statement:

  ```
  ret = ct_command( cmd, CS_LANG_CMD,
                    "DELETE FROM Employees
  ```

```
                    WHERE EmployeeID=105"
                  CS_NULLTERM,
                  CS_UNUSED);
ret = ct_send(cmd);
```

See "Sybase Open Client support" on page 719.

For more details about including SQL in your application, see your development tool documentation. If you are using ODBC or JDBC, consult the software development kit for those interfaces.

Applications inside the database server

In many ways, stored procedures and triggers act as applications or parts of applications running inside the database server. You can also use many of the techniques here in stored procedures.

For more information about stored procedures and triggers, see "Using procedures, triggers, and batches" [*SQL Anywhere Server - SQL Usage*].

Java classes in the database can use the JDBC interface in the same way as Java applications outside the server. This section discusses some aspects of JDBC. For more information about using JDBC, see "JDBC support" on page 397.

Preparing statements

Each time a statement is sent to a database, the database server must perform the following steps:

- It must parse the statement and transform it into an internal form. This is sometimes called **preparing** the statement.
- It must verify the correctness of all references to database objects by checking, for example, that columns named in a query actually exist.
- The query optimizer generates an access plan if the statement involves joins or subqueries.
- It executes the statement after all these steps have been carried out.

Reusing prepared statements can improve performance

If you find yourself using the same statement repeatedly, for example inserting many rows into a table, repeatedly preparing the statement causes a significant and unnecessary overhead. To remove this overhead, some database programming interfaces provide ways of using prepared statements. A **prepared statement** is a statement containing a series of placeholders. When you want to execute the statement, all you have to do is assign values to the placeholders, rather than prepare the entire statement over again.

Using prepared statements is particularly useful when carrying out many similar actions, such as inserting many rows.

Generally, using prepared statements requires the following steps:

1. **Prepare the statement**

In this step you generally provide the statement with some placeholder character instead of the values.

2. **Repeatedly execute the prepared statement**

   In this step you supply values to be used each time the statement is executed. The statement does not have to be prepared each time.

3. **Drop the statement**

   In this step you free the resources associated with the prepared statement. Some programming interfaces handle this step automatically.

Do not prepare statements that are used only once

In general, you should not prepare statements if they are only executed once. There is a slight performance penalty for separate preparation and execution, and it introduces unnecessary complexity into your application.

In some interfaces, however, you do need to prepare a statement to associate it with a cursor.

For information about cursors, see "Introduction to cursors" on page 5.

The calls for preparing and executing statements are not a part of SQL, and they differ from interface to interface. Each of the SQL Anywhere programming interfaces provides a method for using prepared statements.

How to use prepared statements

This section provides a brief overview of how to use prepared statements. The general procedure is the same, but the details vary from interface to interface. Comparing how to use prepared statements in different interfaces illustrates this point.

To use a prepared statement (generic)

1. Prepare the statement.
2. Bind the parameters that will hold values in the statement.
3. Assign values to the bound parameters in the statement.
4. Execute the statement.
5. Repeat steps 3 and 4 as needed.
6. Drop the statement when finished. In JDBC the Java garbage collection mechanism drops the statement.

To use a prepared statement (ADO.NET)

1. Create an SACommand object holding the statement.

   ```
   SACommand cmd = new SACommand(
        "SELECT * FROM Employees WHERE Surname=?", conn );
   ```

2. Declare data types for any parameters in the statement.

   Use the SACommand.CreateParameter method.

3. Prepare the statement using the Prepare method.

   ```
   cmd.Prepare();
   ```

4. Execute the statement.

   ```
   SADataReader reader = cmd.ExecuteReader();
   ```

   For an example of preparing statements using ADO.NET, see the source code in *samples-dir\SQLAnywhere\ADO.NET\SimpleWin32*.

To use a prepared statement (ODBC)

1. Prepare the statement using SQLPrepare.
2. Bind the statement parameters using SQLBindParameter.
3. Execute the statement using SQLExecute.
4. Drop the statement using SQLFreeStmt.

   For an example of preparing statements using ODBC, see the source code in *samples-dir\SQLAnywhere\ODBCPrepare*.

   For more information about ODBC prepared statements, see the ODBC SDK documentation, and "Executing prepared statements" on page 362.

To use a prepared statement (JDBC)

1. Prepare the statement using the prepareStatement method of the connection object. This returns a prepared statement object.
2. Set the statement parameters using the appropriate **set***Type* methods of the prepared statement object. Here, *Type* is the data type assigned.
3. Execute the statement using the appropriate method of the prepared statement object. For inserts, updates, and deletes this is the executeUpdate method.

   For an example of preparing statements using JDBC, see the source code file *samples-dir\SQLAnywhere\JDBC\JDBCExample.java*.

For more information about using prepared statements in JDBC, see "Using prepared statements for more efficient access" on page 416.

To use a prepared statement (embedded SQL)

1. Prepare the statement using the EXEC SQL PREPARE statement.
2. Assign values to the parameters in the statement.
3. Execute the statement using the EXEC SQL EXECUTE statement.
4. Free the resources associated with the statement using the EXEC SQL DROP statement.

   For more information about embedded SQL prepared statements, see "PREPARE statement [ESQL]" [*SQL Anywhere Server - SQL Reference*].

To use a prepared statement (Open Client)

1. Prepare the statement using the ct_dynamic function, with a CS_PREPARE type parameter.
2. Set statement parameters using ct_param.
3. Execute the statement using ct_dynamic with a CS_EXECUTE type parameter.
4. Free the resources associated with the statement using ct_dynamic with a CS_DEALLOC type parameter.

   For more information about using prepared statements in Open Client, see "Using SQL in Open Client applications" on page 722.

Introduction to cursors

When you execute a query in an application, the result set consists of several rows. In general, you do not know how many rows the application is going to receive before you execute the query. Cursors provide a way of handling query result sets in applications.

The way you use cursors and the kinds of cursors available to you depend on the programming interface you use. For a list of cursor types available from each interface, see "Availability of cursors" on page 14.

SQL Anywhere provides several system procedures to help determine what cursors are in use for a connection, and what they contain:

- "sa_list_cursors system procedure" [*SQL Anywhere Server - SQL Reference*]
- "sa_describe_cursor system procedure" [*SQL Anywhere Server - SQL Reference*]
- "sa_copy_cursor_to_temp_table system procedure" [*SQL Anywhere Server - SQL Reference*]

With cursors, you can perform the following tasks within any programming interface:

- Loop over the results of a query.
- Perform inserts, updates, and deletes on the underlying data at any point within a result set.

In addition, some programming interfaces allow you to use special features to tune the way result sets return to your application, providing substantial performance benefits for your application.

For more information about the kinds of cursors available through different programming interfaces, see "Availability of cursors" on page 14.

What are cursors?

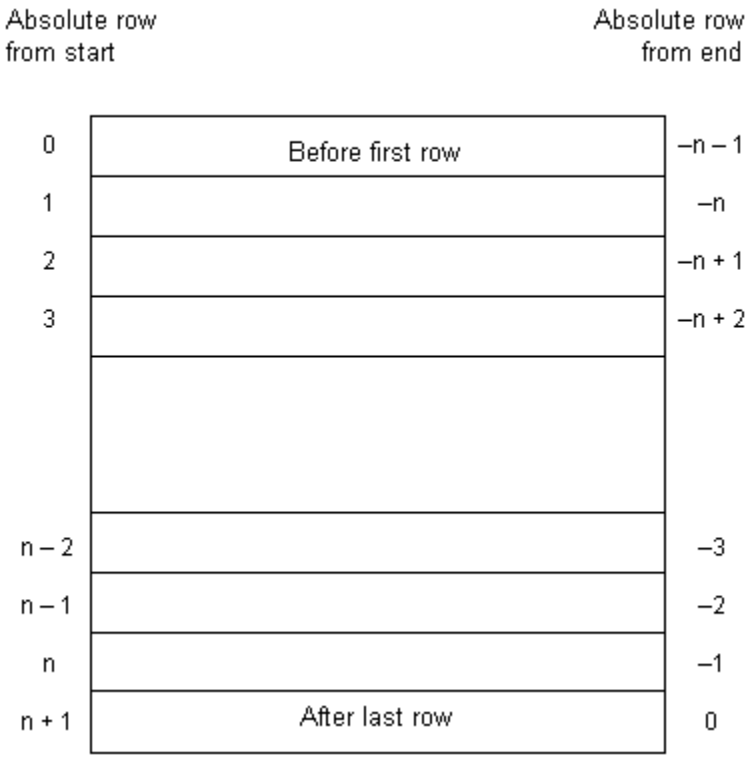
A **cursor** is a name associated with a result set. The result set is obtained from a SELECT statement or stored procedure call.

A cursor is a handle on the result set. At any time, the cursor has a well-defined position within the result set. With a cursor you can examine and possibly manipulate the data one row at a time. SQL Anywhere cursors support forward and backward movement through the query results.

Cursor positions

Cursors can be positioned in the following places:

- Before the first row of the result set.
- On a row in the result set.
- After the last row of the result set.



The cursor position and result set are maintained in the database server. Rows are **fetched** by the client for display and processing either one at a time or a few at a time. The entire result set does not need to be delivered to the client.

Benefits of using cursors

You do not need to use cursors in database applications, but they do provide several benefits. These benefits follow from the fact that if you do not use a cursor, the entire result set must be transferred to the client for processing and display:

- **Client-side memory** For large results, holding the entire result set on the client can lead to demanding memory requirements.
- **Response time** Cursors can provide the first few rows before the whole result set is assembled. If you do not use cursors, the entire result set must be delivered before any rows are displayed by your application.
- **Concurrency control** If you make updates to your data and do not use cursors in your application, you must send separate SQL statements to the database server to apply the changes. This raises the possibility of concurrency problems if the result set has changed since it was queried by the client. In turn, this raises the possibility of lost updates.

Cursors act as pointers to the underlying data, and so impose proper concurrency constraints on any changes you make.

Working with cursors

This section describes how to perform different kinds of operations using cursors.

Using cursors

Using a cursor in embedded SQL is different than using a cursor in other interfaces.

To use a cursor (ADO.NET, ODBC, JDBC, and Open Client)

1. Prepare and execute a statement.

   Execute a statement using the usual method for the interface. You can prepare and then execute the statement, or you can execute the statement directly.

   With ADO.NET, only the SACommand.ExecuteReader method returns a cursor. It provides a read-only, forward-only cursor.

2. Test to see if the statement returns a result set.

   A cursor is implicitly opened when a statement that creates a result set is executed. When the cursor is opened, it is positioned before the first row of the result set.

3. Fetch results.

   Although simple fetch operations move the cursor to the next row in the result set, SQL Anywhere permits more complicated movement around the result set.

4. Close the cursor.

   When you have finished with the cursor, close it to free associated resources.

5. Free the statement.

   If you used a prepared statement, free it to reclaim memory.

To use a cursor (embedded SQL)

1. Prepare a statement.

   Cursors generally use a statement handle rather than a string. You need to prepare a statement to have a handle available.

For information about preparing a statement, see "Preparing statements" on page 2.

2. Declare the cursor.

   Each cursor refers to a single SELECT or CALL statement. When you declare a cursor, you state the name of the cursor and the statement it refers to.

   For more information, see "DECLARE CURSOR statement [ESQL] [SP]" [*SQL Anywhere Server - SQL Reference*].

3. Open the cursor. See "OPEN statement [ESQL] [SP]" [*SQL Anywhere Server - SQL Reference*].

   For a CALL statement, opening the cursor executes the procedure up to the point where the first row is about to be obtained.

4. Fetch results.

   Although simple fetch operations move the cursor to the next row in the result set, SQL Anywhere permits more complicated movement around the result set. How you declare the cursor determines which fetch operations are available to you. See "FETCH statement [ESQL] [SP]" [*SQL Anywhere Server - SQL Reference*] and "Fetching data" on page 469.

5. Close the cursor.

   When you have finished with the cursor, close it. This frees any resources associated with the cursor. See "CLOSE statement [ESQL] [SP]" [*SQL Anywhere Server - SQL Reference*].

6. Drop the statement.

   To free the memory associated with the statement, you must drop the statement. See "DROP STATEMENT statement [ESQL]" [*SQL Anywhere Server - SQL Reference*].

For more information about using cursors in embedded SQL, see "Fetching data" on page 469.

Cursor positioning

When a cursor is opened, it is positioned before the first row. You can move the cursor position to an absolute position from the start or the end of the query results, or to a position relative to the current cursor position. The specifics of how you change cursor position, and what operations are possible, are governed by the programming interface.

The number of row positions you can fetch in a cursor is governed by the size of an integer. You can fetch rows numbered up to number 2147483646, which is one less than the value that can be held in an integer. When using negative numbers (rows from the end) you can fetch down to one more than the largest negative value that can be held in an integer.

You can use special positioned update and delete operations to update or delete the row at the current position of the cursor. If the cursor is positioned before the first row or after the last row, an error is returned indicating that there is no corresponding cursor row.

Cursor positioning problems
Inserts and some updates to asensitive cursors can cause problems with cursor positioning. SQL Anywhere does not put inserted rows at a predictable position within a cursor unless there is an ORDER BY clause on the SELECT statement. Sometimes the inserted row does not appear at all until the cursor is closed and opened again. With SQL Anywhere, this occurs if a work table had to be created to open the cursor. See "Use work tables in query processing (use All-rows optimization goal)" [*SQL Anywhere Server - SQL Usage*].

The UPDATE statement may cause a row to move in the cursor. This happens if the cursor has an ORDER BY clause that uses an existing index (a work table is not created). Using STATIC SCROLL cursors alleviates these problems but requires more memory and processing.

Configuring cursors on opening

You can configure the following aspects of cursor behavior when you open the cursor:

- **Isolation level** You can explicitly set the isolation level of operations on a cursor to be different from the current isolation level of the transaction. To do this, set the isolation_level option. See "isolation_level option" [*SQL Anywhere Server - Database Administration*].

- **Holding** By default, cursors in embedded SQL close at the end of a transaction. Opening a cursor WITH HOLD allows you to keep it open until the end of a connection, or until you explicitly close it. ADO.NET, ODBC, JDBC, and Open Client leave cursors open at the end of transactions by default.

Fetching rows through a cursor

The simplest way of processing the result set of a query using a cursor is to loop through all the rows of the result set until there are no more rows.

To loop through the rows of a result set

1. Declare and open the cursor (embedded SQL), or execute a statement that returns a result set (ODBC, JDBC, Open Client) or SADataReader object (ADO.NET).

2. Continue to fetch the next row until you get a `Row Not Found` error.

3. Close the cursor.

How step 2 of this operation is carried out depends on the interface you use. For example,

- **ADO.NET** Use the SADataReader.NextResult method. See "NextResult method" on page 234.

- **ODBC** SQLFetch, SQLExtendedFetch, or SQLFetchScroll advances the cursor to the next row and returns the data.

For more information about using cursors in ODBC, see "Working with result sets" on page 369.

- **JDBC** The next method of the ResultSet object advances the cursor and returns the data.

  For more information about using the ResultSet object in JDBC, see "Returning result sets" on page 420.

- **Embedded SQL** The FETCH statement carries out the same operation.

  For more information about using cursors in embedded SQL, see "Using cursors in embedded SQL" on page 471.

- **Open Client** The ct_fetch function advances the cursor to the next row and returns the data.

  For more information about using cursors in Open Client applications, see "Using cursors" on page 723.

Fetching multiple rows

Multiple-row fetching should not be confused with prefetching rows. Multiple row fetching is performed by the application, while prefetching is transparent to the application, and provides a similar performance gain. Fetching multiple rows at a time can improve performance.

Multiple-row fetches

Some interfaces provide methods for fetching more than one row at a time into the next several fields in an array. Generally, the fewer separate fetch operations you execute, the fewer individual requests the server must respond to, and the better the performance. A modified FETCH statement that retrieves multiple rows is also sometimes called a **wide fetch**. Cursors that use multiple-row fetches are sometimes called **block cursors** or **fat cursors**.

Using multiple-row fetching

- In ODBC, you can set the number of rows that will be returned on each call to SQLFetchScroll or SQLExtendedFetch by setting the SQL_ATTR_ROW_ARRAY_SIZE or SQL_ROWSET_SIZE attribute.
- In embedded SQL, the FETCH statement uses an ARRAY clause to control the number of rows fetched at a time.
- Open Client and JDBC do not support multi-row fetches. They do use prefetching.

Fetching with scrollable cursors

ODBC and embedded SQL provide methods for using scrollable cursors and dynamic scrollable cursors. These methods allow you to move several rows forward at a time, or to move backward through the result set.

The JDBC and Open Client interfaces do not support scrollable cursors.

Prefetching does not apply to scrollable operations. For example, fetching a row in the reverse direction does not prefetch several previous rows.

Modifying rows through a cursor

Cursors can do more than just read result sets from a query. You can also modify data in the database while processing a cursor. These operations are commonly called **positioned** insert, update, and delete operations, or PUT operations if the action is an insert.

Not all query result sets allow positioned updates and deletes. If you perform a query on a non-updatable view, then no changes occur to the underlying tables. Also, if the query involves a join, then you must specify which table you want to delete from, or which columns you want to update, when you perform the operations.

Inserts through a cursor can only be executed if any non-inserted columns in the table allow NULL or have defaults.

If multiple rows are inserted into a value-sensitive (keyset driven) cursor, they appear at the end of the cursor result set. The rows appear at the end, even if they do not match the WHERE clause of the query or if an ORDER BY clause would normally have placed them at another location in the result set. This behavior is independent of programming interface. For example, it applies when using the embedded SQL PUT statement or the ODBC SQLBulkOperations function. The value of an autoincrement column for the most recent row inserted can be found by selecting the last row in the cursor. For example, in embedded SQL the value could be obtained using `FETCH ABSOLUTE -1 cursor-name`. As a result of this behavior, the first multiple-row insert for a value-sensitive cursor may be expensive.

ODBC, JDBC, embedded SQL, and Open Client permit data modification using cursors, but ADO.NET does not. With Open Client, you can delete and update rows, but you can only insert rows on a single-table query.

Which table are rows deleted from?

If you attempt a positioned delete through a cursor, the table from which rows are deleted is determined as follows:

1. If no FROM clause is included in the DELETE statement, the cursor must be on a single table only.

2. If the cursor is for a joined query (including using a view containing a join), then the FROM clause must be used. Only the current row of the specified table is deleted. The other tables involved in the join are not affected.

3. If a FROM clause is included, and no table owner is specified, the table-spec value is first matched against any correlation names. See "FROM clause" [*SQL Anywhere Server - SQL Reference*].

4. If a correlation name exists, the table-spec value is identified with the correlation name.

5. If a correlation name does not exist, the table-spec value must be unambiguously identifiable as a table name in the cursor.

6. If a FROM clause is included, and a table owner is specified, the table-spec value must be unambiguously identifiable as a table name in the cursor.

7. The positioned DELETE statement can be used on a cursor open on a view as long as the view is updatable.

Understanding updatable statements

This section describes how clauses in the SELECT statement affect updatable statements and cursors.

Updatability of read-only statements

Specifying FOR READ ONLY in the cursor declaration, or including a FOR READ ONLY clause in the statement, renders the statement read-only. In other words, a FOR READ ONLY clause, or the appropriate read-only cursor declaration when using a client API, overrides any other updatability specification.

If the outermost block of a SELECT statement contains an ORDER BY clause, and the statement does not specify FOR UPDATE, then the cursor is read-only. If the SQL SELECT statement specifies FOR XML, then the cursor is read-only. Otherwise, the cursor is updatable.

Updatable statements and concurrency control

For updatable statements, SQL Anywhere provides both optimistic and pessimistic concurrency control mechanisms on cursors to ensure that a result set remains consistent during scrolling operations. These mechanisms are alternatives to using INSENSITIVE cursors or snapshot isolation, although they have different semantics and tradeoffs.

The specification of FOR UPDATE can affect whether a cursor is updatable. However, in SQL Anywhere, the FOR UPDATE syntax has no other effect on concurrency control. If FOR UPDATE is specified with additional parameters, SQL Anywhere alters the processing of the statement to incorporate one of two concurrency control options as follows:

- **Pessimistic** For all rows fetched in the cursor's result set, the database server acquires intent row locks to prevent the rows from being updated by any other transaction.

- **Optimistic** The cursor type used by the database server is changed to a keyset-driven cursor (insensitive row membership, value-sensitive) so that the application can be informed when a row in the result has been modified or deleted by this, or any other transaction.

Pessimistic or optimistic concurrency is specified at the cursor level either through options with DECLARE CURSOR or FOR statements, or though the concurrency setting API for a specific programming interface. If a statement is updatable and the cursor does not specify a concurrency control mechanism, the statement's specification is used. The syntax is as follows:

- **FOR UPDATE BY LOCK** The database server acquires intent row locks on fetched rows of the result set. These are long-term locks that are held until transaction COMMIT or ROLLBACK.
- **FOR UPDATE BY { VALUES | TIMESTAMP }** The database server utilizes a keyset-driven cursor to enable the application to be informed when rows have been modified or deleted as the result set is scrolled.

For more information, see "DECLARE statement" [*SQL Anywhere Server - SQL Reference*], and "FOR statement" [*SQL Anywhere Server - SQL Reference*].

Restricting updatable statements

FOR UPDATE (*column-list*) enforces the restriction that only named result set attributes can be modified in a subsequent UPDATE WHERE CURRENT OF statement.

Canceling cursor operations

You can cancel a request through an interface function. From Interactive SQL, you can cancel a request by clicking Interrupt SQL Statement on the toolbar (or by choosing Stop from the SQL menu).

If you cancel a request that is carrying out a cursor operation, the position of the cursor is indeterminate. After canceling the request, you must locate the cursor by its absolute position, or close it.

Choosing cursor types

This section describes mappings between SQL Anywhere cursors and the options available to you from the programming interfaces supported by SQL Anywhere.

For information about SQL Anywhere cursors, see "SQL Anywhere cursors" on page 16.

Availability of cursors

Not all interfaces provide support for all types of cursors.

- ADO.NET provides only forward-only, read-only cursors.
- ADO/OLE DB and ODBC support all types of cursors.

  For more information, see "Working with result sets" on page 369.
- Embedded SQL supports all types of cursors.
- For JDBC:
  - The SQL Anywhere JDBC driver supports the JDBC 3.0 and JDBC 4.0 specifications and permits the declaration of insensitive, sensitive, and forward-only asensitive cursors.

- jConnect 5.5 and 6.0.5 support the declaration of insensitive, sensitive, and forward-only asensitive cursors in the same manner as the SQL Anywhere JDBC driver. However, the underlying implementation of jConnect only supports asensitive cursor semantics.

  For more information about declaring JDBC cursors, see "Requesting SQL Anywhere cursors" on page 31.

- Sybase Open Client supports only asensitive cursors. Also, a severe performance penalty results when using updatable, non-unique cursors.

Cursor properties

You request a cursor type, either explicitly or implicitly, from the programming interface. Different interface libraries offer different choices of cursor types. For example, JDBC and ODBC specify different cursor types.

Each cursor type is defined by several characteristics:

- **Uniqueness** Declaring a cursor to be unique forces the query to return all the columns required to uniquely identify each row. Often this means returning all the columns in the primary key. Any columns required but not specified are added to the result set. The default cursor type is non-unique.

- **Updatability** A cursor declared as read-only cannot be used in a positioned update or delete operation. The default cursor type is updatable.

- **Scrollability** You can declare cursors to behave different ways as you move through the result set. Some cursors can fetch only the current row or the following row. Others can move backward and forward through the result set.

- **Sensitivity** Changes to the database may or may not be visible through a cursor.

These characteristics may have significant side effects on performance and on database server memory usage.

SQL Anywhere makes available cursors with a variety of mixes of these characteristics. When you request a cursor of a given type, SQL Anywhere tries to match those characteristics.

There are some occasions when not all characteristics can be supplied. For example, insensitive cursors in SQL Anywhere must be read-only. If your application requests an updatable insensitive cursor, a different cursor type (value-sensitive) is supplied instead.

Bookmarks and cursors

ODBC provides **bookmarks**, or values, used to identify rows in a cursor. SQL Anywhere supports bookmarks for value-sensitive and insensitive cursors. For example, this means that the ODBC cursor types SQL_CURSOR_STATIC and SQL_CURSOR_KEYSET_DRIVEN support bookmarks while cursor types SQL_CURSOR_DYNAMIC and SQL_CURSOR_FORWARD_ONLY do not.

Block cursors

ODBC provides a cursor type called a block cursor. When you use a BLOCK cursor, you can use SQLFetchScroll or SQLExtendedFetch to fetch a block of rows, rather than a single row. Block cursors behave identically to embedded SQL ARRAY fetches.

SQL Anywhere cursors

Any cursor, once opened, has an associated result set. The cursor is kept open for a length of time. During that time, the result set associated with the cursor may be changed, either through the cursor itself or, subject to isolation level requirements, by other transactions. Some cursors permit changes to the underlying data to be visible, while others do not reflect these changes. A sensitivity to changes to the underlying data causes different cursor behavior, or **cursor sensitivity**.

SQL Anywhere provides cursors with a variety of sensitivity characteristics. This section describes what sensitivity is, and describes the sensitivity characteristics of cursors.

This section assumes that you have read "What are cursors?" on page 6.

Membership, order, and value changes

Changes to the underlying data can affect the result set of a cursor in the following ways:

- **Membership** The set of rows in the result set, as identified by their primary key values.
- **Order** The order of the rows in the result set.
- **Value** The values of the rows in the result set.

For example, consider the following simple table with employee information (EmployeeID is the primary key column):

EmployeeID	Surname
1	Whitney
2	Cobb
3	Chin

A cursor on the following query returns all results from the table in primary key order:

```
SELECT EmployeeID, Surname
FROM Employees
ORDER BY EmployeeID;
```

The membership of the result set could be changed by adding a new row or deleting a row. The values could be changed by changing one of the names in the table. The order could be changed by changing the primary key value of one of the employees.

Visible and invisible changes

Subject to isolation level requirements, the membership, order, and values of the result set of a cursor can be changed after the cursor is opened. Depending on the type of cursor in use, the result set as seen by the application may or may not change to reflect these changes.

Changes to the underlying data may be **visible** or **invisible** through the cursor. A visible change is a change that is reflected in the result set of the cursor. Changes to the underlying data that are not reflected in the result set seen by the cursor are invisible.

Cursor sensitivity overview

SQL Anywhere cursors are classified by their sensitivity to changes in the underlying data. For example, cursor sensitivity is defined by the changes that are visible.

- **Insensitive cursors** The result set is fixed when the cursor is opened. No changes to the underlying data are visible. See "Insensitive cursors" on page 21.
- **Sensitive cursors** The result set can change after the cursor is opened. All changes to the underlying data are visible. See "Sensitive cursors" on page 22.
- **Asensitive cursors** Changes may be reflected in the membership, order, or values of the result set seen through the cursor, or may not be reflected at all. See "Asensitive cursors" on page 23.
- **Value-sensitive cursors** Changes to the order or values of the underlying data are visible. The membership of the result set is fixed when the cursor is opened. See "Value-sensitive cursors" on page 24.

The differing requirements on cursors place different constraints on execution, and so, performance. See "Cursor sensitivity and performance" on page 26.

Cursor sensitivity example: A deleted row

This example uses a simple query to illustrate how different cursors respond to a row in the result set being deleted.

Consider the following sequence of events:

1. An application opens a cursor on the following query against the sample database.

```
SELECT EmployeeID, Surname
FROM Employees
ORDER BY EmployeeID;
```

EmployeeID	Surname
102	Whitney

EmployeeID	Surname
105	Cobb
160	Breault
...	...

2. The application fetches the first row through the cursor (102).
3. The application fetches the next row through the cursor (105).
4. A separate transaction deletes employee 102 (Whitney) and commits the change.

The results of cursor actions in this situation depend on the cursor sensitivity:

- **Insensitive cursors** The DELETE is not reflected in either the membership or values of the results as seen through the cursor:

Action	Result
Fetch previous row	Returns the original copy of the row (102).
Fetch the first row (absolute fetch)	Returns the original copy of the row (102).
Fetch the second row (absolute fetch)	Returns the unchanged row (105).

- **Sensitive cursors** The membership of the result set has changed so that row 105 is now the first row in the result set:

Action	Result
Fetch previous row	Returns `Row Not Found`. There is no previous row.
Fetch the first row (absolute fetch)	Returns row 105.
Fetch the second row (absolute fetch)	Returns row 160.

- **Value-sensitive cursors** The membership of the result set is fixed, and so row 105 is still the second row of the result set. The DELETE is reflected in the values of the cursor, and creates an effective hole in the result set.

Action	Result
Fetch previous row	Returns `No current row of cursor`. There is a hole in the cursor where the first row used to be.
Fetch the first row (absolute fetch)	Returns `No current row of cursor`. There is a hole in the cursor where the first row used to be.
Fetch the second row (absolute fetch)	Returns row 105.

- **Asensitive cursors** For changes, the membership and values of the result set are indeterminate. The response to a fetch of the previous row, the first row, or the second row depends on the particular optimization method for the query, whether that method involved the formation of a work table, and whether the row being fetched was prefetched from the client.

  The benefit of asensitive cursors is that for many applications, sensitivity is unimportant. In particular, if you are using a forward-only, read-only cursor, no underlying changes are seen. Also, if you are running at a high isolation level, underlying changes are disallowed.

Cursor sensitivity example: An updated row

This example uses a simple query to illustrate how different cursor types respond to a row in the result set being updated in such a way that the order of the result set is changed.

Consider the following sequence of events:

1. An application opens a cursor on the following query against the sample database.

   ```
   SELECT EmployeeID, Surname
   FROM Employees;
   ```

EmployeeID	Surname
102	Whitney
105	Cobb
160	Breault
...	...

2. The application fetches the first row through the cursor (102).

3. The application fetches the next row through the cursor (105).

4. A separate transaction updates the employee ID of employee 102 (Whitney) to 165 and commits the change.

The results of the cursor actions in this situation depend on the cursor sensitivity:

- **Insensitive cursors** The UPDATE is not reflected in either the membership or values of the results as seen through the cursor:

Action	Result
Fetch previous row	Returns the original copy of the row (102).
Fetch the first row (absolute fetch)	Returns the original copy of the row (102).
Fetch the second row (absolute fetch)	Returns the unchanged row (105).

- **Sensitive cursors** The membership of the result set has changed so that row 105 is now the first row in the result set:

Action	Result
Fetch previous row	Returns `Row Not Found`. The membership of the result set has changed so that 105 is now the first row. The cursor is moved to the position before the first row.
Fetch the first row (absolute fetch)	Returns row 105.
Fetch the second row (absolute fetch)	Returns row 160.

  In addition, a fetch on a sensitive cursor returns a SQLE_ROW_UPDATED_WARNING warning if the row has changed since the last reading. The warning is given only once. Subsequent fetches of the same row do not produce the warning.

  Similarly, a positioned update or delete through the cursor on a row since it was last fetched returns the SQLE_ROW_UPDATED_SINCE_READ error. An application must fetch the row again for an update or delete on a sensitive cursor to work.

  An update to any column causes the warning/error, even if the column is not referenced by the cursor. For example, a cursor on a query returning Surname would report the update even if only the Salary column was modified.

- **Value-sensitive cursors** The membership of the result set is fixed, and so row 105 is still the second row of the result set. The UPDATE is reflected in the values of the cursor, and creates an effective "hole" in the result set.

Action	Result
Fetch previous row	Returns `Row Not Found`. The membership of the result set has changed so that 105 is now the first row: The cursor is positioned on the hole: it is before row 105.
Fetch the first row (absolute fetch)	Returns `No current row of cursor`. The membership of the result set has changed so that 105 is now the first row: The cursor is positioned on the hole: it is before row 105.
Fetch the second row (absolute fetch)	Returns row 105.

- **Asensitive cursors** For changes, the membership and values of the result set are indeterminate. The response to a fetch of the previous row, the first row, or the second row depends on the particular optimization method for the query, whether that method involved the formation of a work table, and whether the row being fetched was prefetched from the client.

No warnings or errors in bulk operations mode
Update warning and error conditions do not occur in bulk operations mode (-b database server option).

Insensitive cursors

These cursors have insensitive membership, order, and values. No changes made after cursor open time are visible.

Insensitive cursors are used only for read-only cursor types.

Standards

Insensitive cursors correspond to the ISO/ANSI standard definition of insensitive cursors, and to ODBC static cursors.

Programming interfaces

Interface	Cursor type	Comment
ODBC, ADO/OLE DB	Static	If an updatable static cursor is requested, a value-sensitive cursor is used instead.
Embedded SQL	INSENSITIVE	
JDBC	INSENSITIVE	Insensitive semantics are only supported by the SQL Anywhere JDBC driver.
Open Client	Unsupported	

Description

Insensitive cursors always return rows that match the query's selection criteria, in the order specified by any ORDER BY clause.

The result set of an insensitive cursor is fully materialized as a work table when the cursor is opened. This has the following consequences:

- If the result set is very large, the disk space and memory requirements for managing the result set may be significant.
- No row is returned to the application before the entire result set is assembled as a work table. For complex queries, this may lead to a delay before the first row is returned to the application.
- Subsequent rows can be fetched directly from the work table, and so are returned quickly. The client library may prefetch several rows at a time, further improving performance.
- Insensitive cursors are not affected by ROLLBACK or ROLLBACK TO SAVEPOINT.

Sensitive cursors

Sensitive cursors can be used for read-only or updatable cursor types.

These cursors have sensitive membership, order, and values.

Standards

Sensitive cursors correspond to the ISO/ANSI standard definition of sensitive cursors, and to ODBC dynamic cursors.

Programming interfaces

Interface	Cursor type	Comment
ODBC, ADO/OLE DB	Dynamic	
Embedded SQL	SENSITIVE	Also supplied in response to a request for a DYNAMIC SCROLL cursor when no work table is required and the prefetch option is set to Off.
JDBC	SENSITIVE	Sensitive cursors are fully supported by the SQL Anywhere JDBC driver.

Description

Prefetching is disabled for sensitive cursors. All changes are visible through the cursor, including changes through the cursor and from other transactions. Higher isolation levels may hide some changes made in other transactions because of locking.

Changes to cursor membership, order, and all column values are all visible. For example, if a sensitive cursor contains a join, and one of the values of one of the underlying tables is modified, then all result

rows composed from that base row show the new value. Result set membership and order may change at each fetch.

Sensitive cursors always return rows that match the query's selection criteria, and are in the order specified by any ORDER BY clause. Updates may affect the membership, order, and values of the result set.

The requirements of sensitive cursors place restrictions on the implementation of sensitive cursors:

- Rows cannot be prefetched, as changes to the prefetched rows would not be visible through the cursor. This may impact performance.
- Sensitive cursors must be implemented without any work tables being constructed, as changes to those rows stored as work tables would not be visible through the cursor.
- The no work table limitation restricts the choice of join method by the optimizer and therefore may impact performance.
- For some queries, the optimizer is unable to construct a plan that does not include a work table that would make a cursor sensitive.

  Work tables are commonly used for sorting and grouping intermediate results. A work table is not needed for sorting if the rows can be accessed through an index. It is not possible to state exactly which queries employ work tables, but the following queries do employ them:

  - UNION queries, although UNION ALL queries do not necessarily use work tables.
  - Statements with an ORDER BY clause, if there is no index on the ORDER BY column.
  - Any query that is optimized using a hash join.
  - Many queries involving DISTINCT or GROUP BY clauses.

  In these cases, SQL Anywhere either returns an error to the application, or changes the cursor type to an asensitive cursor and returns a warning.

  For more information about query optimization and the use of work tables, see "Query optimization and execution" [*SQL Anywhere Server - SQL Usage*].

Asensitive cursors

These cursors do not have well-defined sensitivity in their membership, order, or values. The flexibility that is allowed in the sensitivity permits asensitive cursors to be optimized for performance.

Asensitive cursors are used only for read-only cursor types.

Standards

Asensitive cursors correspond to the ISO/ANSI standard definition of asensitive cursors, and to ODBC cursors with unspecific sensitivity.

Programming interfaces

Interface	Cursor type
ODBC, ADO/OLE DB	Unspecified sensitivity
Embedded SQL	DYNAMIC SCROLL

Description

A request for an asensitive cursor places few restrictions on the methods SQL Anywhere can use to optimize the query and return rows to the application. For these reasons, asensitive cursors provide the best performance. In particular, the optimizer is free to employ any measure of materialization of intermediate results as work tables, and rows can be prefetched by the client.

SQL Anywhere makes no guarantees about the visibility of changes to base underlying rows. Some changes may be visible, others not. Membership and order may change at each fetch. In particular, updates to base rows may result in only some of the updated columns being reflected in the cursor's result.

Asensitive cursors do not guarantee to return rows that match the query's selection and order. The row membership is fixed at cursor open time, but subsequent changes to the underlying values are reflected in the results.

Asensitive cursors always return rows that matched the customer's WHERE and ORDER BY clauses at the time the cursor membership is established. If column values change after the cursor is opened, rows may be returned that no longer match WHERE and ORDER BY clauses.

Value-sensitive cursors

For value-sensitive cursors, membership is insensitive, and the order and value of the result set is sensitive.

Value-sensitive cursors can be used for read-only or updatable cursor types.

Standards

Value-sensitive cursors do not correspond to an ISO/ANSI standard definition. They correspond to ODBC keyset-driven cursors.

Programming interfaces

Interface	Cursor type	Comment
ODBC, ADO/OLE DB	Keyset-driven	
Embedded SQL	SCROLL	

Interface	Cursor type	Comment
JDBC	INSENSITIVE and CONCUR_UPDATABLE	With the SQL Anywhere JDBC driver, a request for an updatable INSENSITIVE cursor is answered with a value-sensitive cursor.
Open Client and jConnect	Not supported	

Description

If the application fetches a row composed of a base underlying row that has changed, then the application must be presented with the updated value, and the SQL_ROW_UPDATED status must be issued to the application. If the application attempts to fetch a row that was composed of a base underlying row that was deleted, a SQL_ROW_DELETED status must be issued to the application.

Changes to primary key values remove the row from the result set (treated as a delete, followed by an insert). A special case occurs when a row in the result set is deleted (either from cursor or outside) and a new row with the same key value is inserted. This will result in the new row replacing the old row where it appeared.

There is no guarantee that rows in the result set match the query's selection or order specification. Since row membership is fixed at open time, subsequent changes that make a row not match the WHERE clause or ORDER BY do not change a row's membership nor position.

All values are sensitive to changes made through the cursor. The sensitivity of membership to changes made through the cursor is controlled by the ODBC option SQL_STATIC_SENSITIVITY. If this option is on, then inserts through the cursor add the row to the cursor. Otherwise, they are not part of the result set. Deletes through the cursor remove the row from the result set, preventing a hole returning the SQL_ROW_DELETED status.

Value-sensitive cursors use a **key set table**. When the cursor is opened, SQL Anywhere populates a work table with identifying information for each row contributing to the result set. When scrolling through the result set, the key set table is used to identify the membership of the result set, but values are obtained, if necessary, from the underlying tables.

The fixed membership property of value-sensitive cursors allows your application to remember row positions within a cursor and be assured that these positions will not change. See “Cursor sensitivity example: A deleted row” on page 17.

- If a row was updated or may have been updated since the cursor was opened, SQL Anywhere returns a SQLE_ROW_UPDATED_WARNING when the row is fetched. The warning is generated only once: fetching the same row again does not produce the warning.

  An update to any column of the row causes the warning, even if the updated column is not referenced by the cursor. For example, a cursor on Surname and GivenName would report the update even if only the Birthdate column was modified. These update warning and error conditions do not occur in bulk operations mode (-b database server option) when row locking is disabled. See “Performance aspects

of bulk operations" [*SQL Anywhere Server - SQL Usage*], and "Row has been updated since last time read" [*Error Messages*].

- An attempt to execute a positioned update or delete on a row that has been modified since it was last fetched returns a SQLE_ROW_UPDATED_SINCE_READ error and cancels the statement. An application must FETCH the row again before the UPDATE or DELETE is permitted.

  An update to any column of the row causes the error, even if the updated column is not referenced by the cursor. The error does not occur in bulk operations mode. See "Row has changed since last read -- operation canceled" [*Error Messages*].

- If a row has been deleted after the cursor is opened, either through the cursor or from another transaction, a **hole** is created in the cursor. The membership of the cursor is fixed, so a row position is reserved, but the DELETE operation is reflected in the changed value of the row. If you fetch the row at this hole, you receive a `No Current Row of Cursor` error, indicating that there is no current row, and the cursor is left positioned on the hole. You can avoid holes by using sensitive cursors, as their membership changes along with the values. See "No current row of cursor" [*Error Messages*].

Rows cannot be prefetched for value-sensitive cursors. This requirement may affect performance.

Inserting multiple rows

When inserting multiple rows through a value-sensitive cursor, the new rows appear at the end of the result set. See "Modifying rows through a cursor" on page 12.

Cursor sensitivity and performance

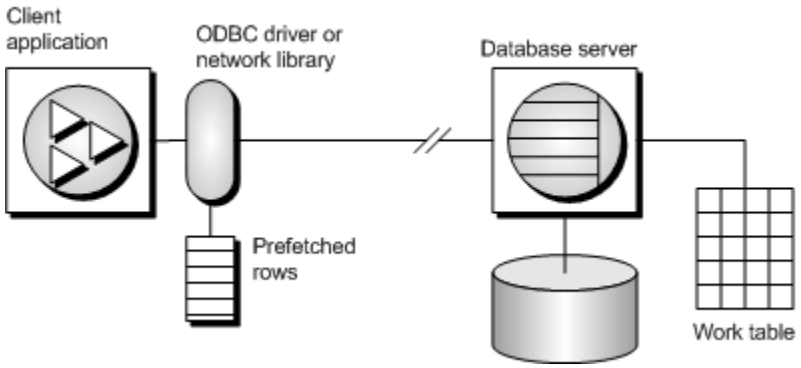
There is a trade-off between performance and other cursor properties. In particular, making a cursor updatable places restrictions on the cursor query processing and delivery that constrain performance. Also, putting requirements on cursor sensitivity may constrain cursor performance.

To understand how the updatability and sensitivity of cursors affects performance, you need to understand how the results that are visible through a cursor are transmitted from the database to the client application.

In particular, results may be stored at two intermediate locations for performance reasons:

- **Work tables** Either intermediate or final results may be stored as work tables. Value-sensitive cursors employ a work table of primary key values. Query characteristics may also lead the optimizer to use work tables in its chosen execution plan.

- **Prefetching** The client side of the communication may retrieve rows into a buffer on the client side to avoid separate requests to the database server for each row.



Sensitivity and updatability limit the use of intermediate locations.

Prefetching rows

Prefetches and multiple-row fetches are different. Prefetches can be carried out without explicit instructions from the client application. Prefetching retrieves rows from the server into a buffer on the client side, but does not make those rows available to the client application until the application fetches the appropriate row.

By default, the SQL Anywhere client library prefetches multiple rows whenever an application fetches a single row. The SQL Anywhere client library stores the additional rows in a buffer.

Prefetching assists performance by cutting down on client/server round trips, and increases throughput by making many rows available without a separate request to the server for each row or block of rows.

For more information about controlling prefetches, see "prefetch option" [*SQL Anywhere Server - Database Administration*].

Controlling prefetching from an application

- The prefetch option controls whether prefetching occurs. You can set the prefetch option to Always, Conditional, or Off for a single connection. By default, it is set to Conditional.
- In embedded SQL, you can control prefetching on a per-cursor basis when you open a cursor on an individual FETCH operation using the BLOCK clause.

  The application can specify a maximum number of rows contained in a single fetch from the server by specifying the BLOCK clause. For example, if you are fetching and displaying 5 rows at a time, you could use BLOCK 5. Specifying BLOCK 0 fetches 1 record at a time and also causes a FETCH RELATIVE 0 to always fetch the row from the server again.

  Although you can also turn off prefetch by setting a connection parameter on the application, it is more efficient to specify BLOCK 0 than to set the prefetch option to Off. See "prefetch option" [*SQL Anywhere Server - Database Administration*].
- Prefetch is disabled by default for value sensitive cursor types.

- In Open Client, you can control prefetching behavior using ct_cursor with CS_CURSOR_ROWS after the cursor is declared, but before it is opened.

Prefetch dynamically increases the number of prefetch rows when improvements in performance could be achieved. This includes cursors that meet the following conditions:

- They use one of the supported cursor types:
  - **ODBC and OLE DB** FORWARD-ONLY and READ-ONLY (default) cursors
  - **Embedded SQL** DYNAMIC SCROLL (default), NO SCROLL, and INSENSITIVE cursors
  - **ADO.NET** all cursors
- They perform only FETCH NEXT operations (no absolute, relative, or backward fetching).
- The application does not change the host variable type between fetches and does not use a GET DATA statement to get column data in chunks (using *one* GET DATA statement to get the value is supported).

Lost updates

When using an updatable cursor, it is important to guard against lost updates. A lost update is a scenario in which two or more transactions update the same row, but neither transaction is aware of the modification made by the other transaction, and the second change overwrites the first modification. The following example illustrates this problem:

1. An application opens a cursor on the following query against the sample database.

```
SELECT ID, Quantity
FROM Products;
```

ID	Quantity
300	28
301	54
302	75
...	...

2. The application fetches the row with ID = 300 through the cursor.
3. A separate transaction updates the row using the following statement:

```
UPDATE Products
SET Quantity = Quantity - 10
WHERE ID = 300;
```


4. The application then updates the row through the cursor to a value of `(Quantity - 5 )`.

5. The correct final value for the row would be 13. If the cursor had prefetched the row, the new value of the row would be 23. The update from the separate transaction is lost.

In a database application, the potential for a lost update exists at any isolation level if changes are made to rows without verification of their values beforehand. At higher isolation levels (2 and 3), locking (read, intent, and write locks) can be used to ensure that changes to rows cannot be made by another transaction once the row has been read by the application. However, at isolation levels 0 and 1, the potential for lost updates is greater: at isolation level 0, read locks are not acquired to prevent subsequent changes to the data, and isolation level 1 only locks the current row. Lost updates cannot occur when using snapshot isolation since any attempt to change an old value results in an update conflict. Also, the use of prefetching at isolation level 1 can also introduce the potential for lost updates, since the result set row that the application is positioned on, which is in the client's prefetch buffer, may not be the same as the current row that the server is positioned on in the cursor.

To prevent lost updates from occurring with cursors at isolation level 1, the database server supports three different concurrency control mechanisms that can be specified by an application:

1. The acquisition of intent row locks on each row in the cursor as it is fetched. Intent locks prevent other transactions from acquiring intent or write locks on the same row, preventing simultaneous updates. However, intent locks do not block read row locks, so they do not affect the concurrency of read-only statements.

2. The use of a value-sensitive cursor. Value-sensitive cursors can be used to track when an underlying row has changed, or has been deleted, so that the application can respond.

3. The use of FETCH FOR UPDATE, which acquires an intent row lock for that specific row.

How these alternatives are specified depends on the interface used by the application. For the first two alternatives that pertain to a SELECT statement:

- In ODBC, lost updates cannot occur because the application must specify a cursor concurrency parameter to the SQLSetStmtAttr function when declaring an updatable cursor. This parameter is one of SQL_CONCUR_LOCK, SQL_CONCUR_VALUES, SQL CONCUR_READ_ONLY, or SQL_CONCUR_TIMESTAMP. For SQL_CONCUR_LOCK, the database server acquires row intent locks. For SQL_CONCUR_VALUES and SQL_CONCUR_TIMESTAMP, a value-sensitive cursor is used. SQL_CONCUR_READ_ONLY is used for read-only cursors, and is the default.

- In JDBC, the concurrency setting for a statement is similar to that of ODBC. The SQL Anywhere JDBC driver supports the JDBC concurrency values RESULTSET_CONCUR_READ_ONLY and RESULTSET_CONCUR_UPDATABLE. The first value corresponds to the ODBC concurrency setting SQL_CONCUR_READ_ONLY and specifies a read-only statement. The second value corresponds to the ODBC SQL_CONCUR_LOCK setting, so row intent locks are used to prevent lost updates. Note that value-sensitive cursors cannot be specified directly in the JDBC 3.0 or 4.0 specification.

- In jConnect, updatable cursors are supported at the API level, but the underlying implementation (using TDS) does not support updates through a cursor. Instead, jConnect sends a separate UPDATE

statement to the database server to update the specific row. To avoid lost updates, the application must run at isolation level 2 or higher. Alternatively, the application can issue separate UPDATE statements from the cursor, but you must ensure that the UPDATE statement verifies that the row values have not been altered since the row was read by placing appropriate conditions in the UPDATE statement's WHERE clause.

- In embedded SQL, a concurrency specification can be set by including syntax within the SELECT statement itself, or in the cursor declaration. In the SELECT statement, the syntax SELECT ... FOR UPDATE BY LOCK causes the database server to acquire intent row locks on the result set.

  Alternatively, SELECT ... FOR UPDATE BY [VALUES | TIMESTAMP] causes the database server to change the cursor type to a value-sensitive cursor, so that if a specific row has been changed since the row was last read through the cursor, the application receives either a warning (SQLE_ROW_UPDATED_WARNING) on a FETCH statement, or an error (SQLE_ROW_UPDATED_SINCE_READ) on an UPDATE WHERE CURRENT OF statement. If the row was deleted, the application also receives an error (SQLE_NO_CURRENT_ROW).

FETCH FOR UPDATE functionality is also supported by the embedded SQL and ODBC interfaces, although the details differ depending on the API that is used.

In embedded SQL, the application uses FETCH FOR UPDATE, rather than FETCH, to cause an intent lock to be acquired on the row. In ODBC, the application uses the API call SQLSetPos with the operation argument SQL_POSITION or SQL_REFRESH, and the lock type argument SQL_LOCK_EXCLUSIVE, to acquire an intent lock on a row. In SQL Anywhere, these are long-term locks that are held until the transaction commits or rolls back.

Cursor sensitivity and isolation levels

Both cursor sensitivity and isolation levels address the problem of concurrency control, but in different ways, and with different sets of tradeoffs.

By choosing an isolation level for a transaction (typically at the connection level), you determine the type and locks to place, and when, on rows in the database. Locks prevent other transactions from accessing or modifying rows in the database. In general, the greater the number of locks held, the lower the expected level of concurrency across concurrent transactions.

However, locks do not prevent updates from other portions of the same transaction from occurring. So, a single transaction that maintains multiple updatable cursors cannot rely on locking to prevent such problems as lost updates.

Snapshot isolation is intended to eliminate the need for read locks by ensuring that each transaction sees a consistent view of the database. The obvious advantage is that a consistent view of the database can be queried without relying on fully serializable transactions (isolation level 3), and the loss of concurrency that comes with using isolation level 3. However, snapshot isolation comes with a significant cost because copies of modified rows must be maintained to satisfy the requirements of both concurrent snapshot transactions already executing, and snapshot transactions that have yet to start. Because of this copy maintenance, the use of snapshot isolation may be inappropriate for heavy-update workloads. See “Choosing a snapshot isolation level” [*SQL Anywhere Server - SQL Usage*].

Cursor sensitivity, on the other hand, determines which changes are visible (or not) to the cursor's result. Because cursor sensitivity is specified on a cursor basis, cursor sensitivity applies to both the effects of other transactions and to update activity of the same transaction, although these effects depend entirely on the cursor type specified. By setting cursor sensitivity, you are not directly determining when locks are placed on rows in the database. However, it is the combination of cursor sensitivity and isolation level that controls the various concurrency scenarios that are possible with a particular application.

Requesting SQL Anywhere cursors

When you request a cursor type from your client application, SQL Anywhere provides a cursor. SQL Anywhere cursors are defined, not by the type as specified in the programming interface, but by the sensitivity of the result set to changes in the underlying data. Depending on the cursor type you ask for, SQL Anywhere provides a cursor with behavior to match the type.

SQL Anywhere cursor sensitivity is set in response to the client cursor type request.

ADO.NET

Forward-only, read-only cursors are available by using SACommand.ExecuteReader. The SADataAdapter object uses a client-side result set instead of cursors. See "SACommand class" on page 117.

ADO/OLE DB and ODBC

The following table illustrates the cursor sensitivity that is set in response to different ODBC scrollable cursor types.

ODBC scrollable cursor type	SQL Anywhere cursor
STATIC	Insensitive
KEYSET-DRIVEN	Value-sensitive
DYNAMIC	Sensitive
MIXED	Value-sensitive

A MIXED cursor is obtained by setting the cursor type to SQL_CURSOR_KEYSET_DRIVEN, and then specifying the number of rows in the keyset for a keyset-driven cursor using SQL_ATTR_KEYSET_SIZE . If the keyset size is 0 (the default), the cursor is fully keyset-driven. If the keyset size is greater than 0, the cursor is mixed (keyset-driven within the keyset and dynamic outside the keyset). The default keyset size is 0. It is an error if the keyset size is greater than 0 and less than the rowset size (SQL_ATTR_ROW_ARRAY_SIZE).

For information about SQL Anywhere cursors and their behavior, see "SQL Anywhere cursors" on page 16.

For information about how to request a cursor type in ODBC, see "Choosing ODBC cursor characteristics" on page 370.

Exceptions

If a STATIC cursor is requested as updatable, a value-sensitive cursor is supplied instead and a warning is issued.

If a DYNAMIC or MIXED cursor is requested and the query cannot be executed without using work tables, a warning is issued and an asensitive cursor is supplied instead.

JDBC

The JDBC 3.0 and 4.0 specifications support three types of cursors: insensitive, sensitive, and forward-only asensitive. The SQL Anywhere JDBC driver is compliant with these JDBC specifications and supports these different cursor types for a JDBC ResultSet object. However, there are cases when the database server cannot construct an access plan with the required semantics for a given cursor type. In these cases, the database server either returns an error or substitutes a different cursor type. See "Sensitive cursors" on page 22.

With jConnect, the underlying protocol (TDS) only supports forward-only, read-only asensitive cursors on the database server, even though jConnect supports the APIs for creating different types of cursors following the JDBC 2.0 specification. All jConnect cursors are asensitive because the TDS protocol buffers the statement's result set in blocks. These blocks of buffered results are scrolled when the application needs to scroll through an insensitive or sensitive cursor type that supports scrollability. If the application scrolls backward past the beginning of the cached result set, the statement is re-executed, which can result in data inconsistencies if the data has been altered between statement executions.

Embedded SQL

To request a cursor from an embedded SQL application, you specify the cursor type on the DECLARE statement. The following table illustrates the cursor sensitivity that is set in response to different requests:

Cursor type	SQL Anywhere cursor
NO SCROLL	Asensitive
DYNAMIC SCROLL	Asensitive
SCROLL	Value-sensitive
INSENSITIVE	Insensitive
SENSITIVE	Sensitive

Exceptions

If a DYNAMIC SCROLL or NO SCROLL cursor is requested as UPDATABLE, then a sensitive or value-sensitive cursor is supplied. It is not guaranteed which of the two is supplied. This uncertainty fits the definition of asensitive behavior.

If an INSENSITIVE cursor is requested as UPDATABLE, then a value-sensitive cursor is supplied.

If a DYNAMIC SCROLL cursor is requested, if the prefetch database option is set to Off, and if the query execution plan involves no work tables, then a sensitive cursor may be supplied. Again, this uncertainty fits the definition of asensitive behavior.

Open Client

As with jConnect, the underlying protocol (TDS) for Open Client only supports forward-only, read-only, asensitive cursors.

Describing result sets

Some applications build SQL statements that cannot be completely specified in the application. Sometimes statements are dependent on a user response before the application knows exactly what information to retrieve, such as when a reporting application allows a user to select which columns to display.

In such a case, the application needs a method for retrieving information about both the nature of the **result set** and the contents of the result set. The information about the nature of the result set, called a **descriptor**, identifies the data structure, including the number and type of columns expected to be returned. Once the application has determined the nature of the result set, retrieving the contents is straightforward.

This **result set metadata** (information about the nature and content of the data) is manipulated using descriptors. Obtaining and managing the result set metadata is called **describing**.

Since cursors generally produce result sets, descriptors and cursors are closely linked, although some interfaces hide the use of descriptors from the user. Typically, statements needing descriptors are either SELECT statements or stored procedures that return result sets.

A sequence for using a descriptor with a cursor-based operation is as follows:

1. Allocate the descriptor. This may be done implicitly, although some interfaces allow explicit allocation as well.

2. Prepare the statement.

3. Describe the statement. If the statement is a stored procedure call or batch, and the result set is not defined by a result clause in the procedure definition, then the describe should occur after opening the cursor.

4. Declare and open a cursor for the statement (embedded SQL) or execute the statement.
5. Get the descriptor and modify the allocated area if necessary. This is often done implicitly.
6. Fetch and process the statement results.
7. Deallocate the descriptor.
8. Close the cursor.
9. Drop the statement. Some interfaces do this automatically.

Implementation notes

- In embedded SQL, a SQLDA (SQL Descriptor Area) structure holds the descriptor information. See "The SQL descriptor area (SQLDA)" on page 460.
- In ODBC, a descriptor handle allocated using SQLAllocHandle provides access to the fields of a descriptor. You can manipulate these fields using SQLSetDescRec, SQLSetDescField, SQLGetDescRec, and SQLGetDescField.

  Alternatively, you can use SQLDescribeCol and SQLColAttributes to obtain column information.
- In Open Client, you can use ct_dynamic to prepare a statement and ct_describe to describe the result set of the statement. However, you can also use ct_command to send a SQL statement without preparing it first and use ct_results to handle the returned rows one by one. This is the more common way of operating in Open Client application development.
- In JDBC, the java.sql.ResultSetMetaData class provides information about result sets.
- You can also use descriptors for sending data to the database server (for example, with the INSERT statement); however, this is a different kind of descriptor than for result sets.

  For more information about input and output parameters of the DESCRIBE statement, see "DESCRIBE statement [ESQL]" [*SQL Anywhere Server - SQL Reference*].

Controlling transactions in applications

Transactions are sets of atomic SQL statements. Either all statements in the transaction are executed, or none. This section describes a few aspects of transactions in applications.

For more information about transactions, see "Using transactions and isolation levels" [*SQL Anywhere Server - SQL Usage*].

Setting autocommit or manual commit mode

Database programming interfaces can operate in either **manual commit** mode or **autocommit** mode.

- **Manual commit mode** Operations are committed only when your application carries out an explicit commit operation or when the database server carries out an automatic commit, for example when executing an ALTER TABLE statement or other data definition statement. Manual commit mode is also sometimes called **chained mode**.

  To use transactions in your application, including nested transactions and savepoints, you must operate in manual commit mode.

- **Autocommit mode** Each statement is treated as a separate transaction. Autocommit mode is equivalent to appending a COMMIT statement to the end of each of your SQL statements. Autocommit mode is also sometimes called **unchained mode**.

Autocommit mode can affect the performance and behavior of your application. Do not use autocommit if your application requires transactional integrity.

For information about how autocommit mode affects performance, see "Turn off autocommit mode" [*SQL Anywhere Server - SQL Usage*].

Controlling autocommit behavior

The way to control the commit behavior of your application depends on the programming interface you are using. The implementation of autocommit may be client-side or server-side, depending on the interface. See "Autocommit implementation details" on page 36.

To control autocommit mode (ADO.NET)

- By default, the ADO.NET provider operates in autocommit mode. To use explicit transactions, use the SAConnection.BeginTransaction method. See "Transaction processing" on page 64.

To control autocommit mode (OLE DB)

- By default, the OLE DB provider operates in autocommit mode. To use explicit transactions, use the ITransactionLocal::StartTransaction, ITransaction::Commit, and ITransaction::Abort methods.

To control autocommit mode (ODBC)

- By default, ODBC operates in autocommit mode. The way you turn off autocommit depends on whether you are using ODBC directly, or using an application development tool. If you are programming directly to the ODBC interface, set the SQL_ATTR_AUTOCOMMIT connection attribute.

To control autocommit mode (JDBC)

- By default, JDBC operates in autocommit mode. To turn off autocommit, use the setAutoCommit method of the connection object:

```
conn.setAutoCommit( false );
```

To control autocommit mode (embedded SQL)

- By default, embedded SQL applications operate in manual commit mode. To turn on autocommit, set the chained database option (a server-side option) to Off using a statement such as the following:

  ```
  SET OPTION chained='Off';
  ```

To control autocommit mode (Open Client)

- By default, a connection made through Open Client operates in autocommit mode. You can change this behavior by setting the chained database option (a server-side option) to On in your application using a statement such as the following:

  ```
  SET OPTION chained='On';
  ```

To control autocommit mode (PHP)

- By default, PHP operates in autocommit mode. To turn off autocommit, use the sqlanywhere_set_option function:

  ```
  $result = sasql_set_option( $conn, "auto_commit", "Off" );
  ```

See “sasql_set_option” on page 661.

To control autocommit mode (on the server)

- By default, the database server operates in manual commit mode. To turn on automatic commits, set the chained database option (a server-side option) to Off using a statement such as the following:

  ```
  SET OPTION chained='Off';
  ```

  If you are using an interface that controls commits on the client side, setting the chained database option (a server-side option) can impact performance and/or behavior of your application. Setting the server's chained mode is not recommended.

See “Setting autocommit or manual commit mode” on page 34.

Autocommit implementation details

Autocommit mode has slightly different behavior depending on the interface you are using and how you control the autocommit behavior.

Autocommit mode can be implemented in one of two ways:

- **Client-side autocommit** When an application uses autocommit, the client-library sends a COMMIT statement after each SQL statement executed.

  ADO.NET, ADO/OLE DB, ODBC, and PHP applications control commit behavior from the client side.

- **Server-side autocommit** When an application turns off chained mode, the database server commits the results of each SQL statement. For JDBC this behavior is controlled by the chained database option.

  Embedded SQL, JDBC, and Open Client applications manipulate server-side commit behavior (for example, they set the chained option).

For compound statements such as stored procedures or triggers there is a difference between client-side and server-side autocommit. From the client side, a stored procedure is a single statement, and so autocommit sends a single commit statement after the whole procedure is executed. From the database server perspective, the stored procedure may be composed of many SQL statements, and so server-side autocommit commits the results of each SQL statement within the procedure.

Do not mix client-side and server-side implementations
Do not combine setting of the chained option with setting of the autocommit option in your ADO.NET, ADO/OLE DB, ODBC, or PHP application.

Controlling the isolation level

You can set the isolation level of a current connection using the isolation_level database option.

Some interfaces, such as ODBC, allow you to set the isolation level for a connection at connection time. You can reset this level later using the isolation_level database option. See "isolation_level option" [*SQL Anywhere Server - Database Administration*].

You can override any temporary or public settings for the isolation_level database option within individual INSERT, UPDATE, DELETE, SELECT, UNION, EXCEPT, and INTERSECT statements by including an OPTION clause in the statement.

Cursors and transactions

In general, a cursor closes when a COMMIT is performed. There are two exceptions to this behavior:

- The close_on_endtrans database option is set to Off.
- A cursor is opened WITH HOLD, which is the default with Open Client and JDBC.

If either of these two cases is true, the cursor remains open on a COMMIT.

ROLLBACK and cursors

If a transaction rolls back, then cursors close except for those cursors opened WITH HOLD. However, don't rely on the contents of any cursor after a rollback.

The draft ISO SQL3 standard states that on a rollback, all cursors (even those cursors opened WITH HOLD) should close. You can obtain this behavior by setting the ansi_close_cursors_on_rollback option to On.

Savepoints

If a transaction rolls back to a savepoint, and if the ansi_close_cursors_on_rollback option is On, then all cursors (even those cursors opened WITH HOLD) opened after the SAVEPOINT close.

Cursors and isolation levels

You can change the isolation level of a connection during a transaction using the SET OPTION statement to alter the isolation_level option. However, this change does not affect open cursors.

A snapshot of all rows committed at the snapshot start time is visible when the WITH HOLD clause is used with the snapshot, statement-snapshot, and readonly-statement-snapshot isolation levels. Also visible are all modifications completed by the current connection since the start of the transaction within which the cursor was open. For more details about supported isolation levels, see "Isolation levels and consistency" [*SQL Anywhere Server - SQL Usage*] and "isolation_level option" [*SQL Anywhere Server - Database Administration*].

.NET application programming

This section describes how to use SQL Anywhere with .NET, and includes the API for the SQL Anywhere .NET Data Provider.

SQL Anywhere .NET Data Provider

This section describes SQL Anywhere Server .NET support, including the API for the SQL Anywhere .NET Data Provider.

SQL Anywhere .NET support

ADO.NET is the latest data access API from Microsoft in the line of ODBC, OLE DB, and ADO. It is the preferred data access component for the Microsoft .NET Framework and allows you to access relational database systems.

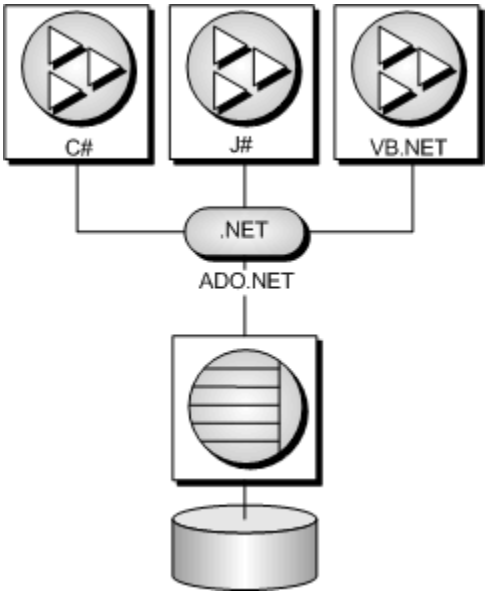
The SQL Anywhere .NET Data Provider implements the iAnywhere.Data.SQLAnywhere namespace and allows you to write programs in any of the .NET supported languages, such as C# and Visual Basic .NET, and access data from SQL Anywhere databases.

For general information about .NET data access, see the Microsoft ".NET Data Access Architecture Guide" at http://msdn.microsoft.com/en-us/library/Ee817654%28pandp.10%29.aspx.

ADO.NET applications

You can develop Internet and intranet applications using object-oriented languages, and then connect these applications to SQL Anywhere using the ADO.NET data provider.

Combine this provider with built-in XML and web services features, .NET scripting capability for MobiLink synchronization, and an UltraLite.NET component for development of handheld database applications, and SQL Anywhere can integrate with the .NET Framework.



See also

- "SQL Anywhere .NET Data Provider features" on page 40
- "Namespace" on page 95
- "Tutorial: Using the SQL Anywhere .NET Data Provider" on page 71

SQL Anywhere .NET Data Provider features

SQL Anywhere supports the Microsoft .NET Framework versions 2.0, 3.0, 3.5, and 4.0 through three distinct namespaces.

- **iAnywhere.Data.SQLAnywhere** The ADO.NET object model is an all-purpose data access model. ADO.NET components were designed to factor data access from data manipulation. There are two central components of ADO.NET that do this: the DataSet, and the .NET Framework data provider, which is a set of components including the Connection, Command, DataReader, and DataAdapter objects. SQL Anywhere includes a .NET Entity Framework Data Provider that communicates directly with a SQL Anywhere database server without adding the overhead of OLE DB or ODBC. The SQL Anywhere .NET Data Provider is represented in the .NET namespace as iAnywhere.Data.SQLAnywhere.

  The Microsoft .NET Compact Framework is the smart device development framework for Microsoft .NET. The SQL Anywhere .NET Compact Framework Data Provider supports devices running Windows Mobile.

  The SQL Anywhere .NET Data Provider namespace is described in this document.

  To read more about how to access data stored inside a SQL Anywhere database using the ADO.NET object model, in particular via the Language Integrated Query (LINQ) to Entities methodology, see

the **SQL Anywhere 11 and the ADO.NET Entity Framework** whitepaper at www.sybase.com/detail?id=1060541.

- **System.Data.Oledb** This namespace supports OLE DB data sources. This namespace is an intrinsic part of the Microsoft .NET Framework. You can use System.Data.Oledb together with the SQL Anywhere OLE DB provider, SAOLEDB, to access SQL Anywhere databases.

- **System.Data.Odbc** This namespace supports ODBC data sources. This namespace is an intrinsic part of the Microsoft .NET Framework. You can use System.Data.Odbc together with the SQL Anywhere ODBC driver to access SQL Anywhere databases.

On Windows Mobile, only the SQL Anywhere .NET Data Provider is supported.

There are some key benefits to using the SQL Anywhere .NET Data Provider:

- In the .NET environment, the SQL Anywhere .NET Data Provider provides native access to a SQL Anywhere database. Unlike the other supported providers, it communicates directly with a SQL Anywhere server and does not require bridge technology.

- As a result, the SQL Anywhere .NET Data Provider is faster than the OLE DB and ODBC Data Providers. It is the recommended Data Provider for accessing SQL Anywhere databases.

Running the .NET sample projects

There are several sample projects included with the SQL Anywhere .NET Data Provider:

- **LinqSample** A .NET Framework sample project for Windows that demonstrates language-integrated query, set, and transform operations using the SQL Anywhere .NET Data Provider and C#.

- **SimpleCE** A .NET Compact Framework sample project for Windows Mobile that demonstrates a simple listbox that is filled with the names from the Employees table when you click **Connect**.

- **SimpleWin32** A .NET Framework sample project for Windows that demonstrates a simple listbox that is filled with the names from the Employees table when you click **Connect**.

- **SimpleXML** A .NET Framework sample project for Windows that demonstrates how to obtain XML data from SQL Anywhere via ADO.NET. Samples for C#, Visual Basic, and Visual C++ are provided.

- **SimpleViewer** A .NET Framework sample project for Windows that is discussed in the section "Tutorial: Developing a simple .NET database application with Visual Studio" on page 86.

- **TableViewer** A .NET Framework sample project for Windows that allows you to enter and execute SQL statements.

For tutorials explaining the sample projects, see "Tutorial: Using the SQL Anywhere .NET Data Provider" on page 71.

Using the .NET Data Provider in a Visual Studio project

The SQL Anywhere .NET Data Provider can be used when developing .NET applications with Visual Studio. To use the SQL Anywhere .NET Data Provider, you must include two items in your Visual Studio project:

- a reference to the SQL Anywhere .NET Data Provider
- a line in your source code referencing the SQL Anywhere .NET Data Provider classes

These steps are explained below.

For information about installing and registering the SQL Anywhere .NET Data Provider, see "Deploying the SQL Anywhere .NET Data Provider" on page 67.

Adding a reference to the Data Provider in your project

Adding a reference tells Visual Studio which provider to include to find the code for the SQL Anywhere .NET Data Provider.

To add a reference to the SQL Anywhere .NET Data Provider in a Visual Studio project

1. Start Visual Studio and open your project.
2. In the **Solution Explorer** window, right-click **References** and choose **Add Reference**.
3. On the **.NET** tab, scroll through the list to locate any of the following:
   - iAnywhere.Data.SQLAnywhere for .NET 2
   - iAnywhere.Data.SQLAnywhere for .NET 3.5
   - iAnywhere.Data.SQLAnywhere for .NET 4

   Note that there is separate version of the provider for Windows Mobile platforms. For the Windows Mobile SQL Anywhere .NET Data Provider, click the **Browse** tab and locate the Windows Mobile version of the provider. The default location is *install-dir\CE\Assembly\V2*.
4. Select the provider of your choice and then click **OK**. The provider is added to the **References** folder in the **Solution Explorer** window of your project.

Using the Data Provider classes in your source code

To assist with the use of the SQL Anywhere .NET Data Provider namespace and the types defined in this namespace, you should add a directive to your source code.

To use the Data Provider namespace in your code

1. Start Visual Studio and open your project.
2. Add the following line to your project:
   - If you are using C#, add the following line to the list of `using` directives at the beginning of your project:


```
using iAnywhere.Data.SQLAnywhere;
```

- If you are using Visual Basic, add the following line at the beginning of your project before the line `Public Class Form1`:

```
Imports iAnywhere.Data.SQLAnywhere
```

This directive is not required, however, it allows you to use short forms for the SQL Anywhere .NET classes. For example:

```
SAConnection conn = new SAConnection()
```

Without this directive, you can still use the following:

```
iAnywhere.Data.SQLAnywhere.SAConnection
 conn = new iAnywhere.Data.SQLAnywhere.SAConnection()
```

Connecting to a database

Before you can perform any operations on the data, your application must connect to the database. This section describes how to write code to connect to a SQL Anywhere database.

To connect to a SQL Anywhere database

1. Allocate an SAConnection object.

   The following C# code creates an SAConnection object named `conn`:

   ```
   SAConnection conn = new SAConnection(connection-string)
   ```

   You can have more than one connection to a database from your application. Some applications use a single connection to a SQL Anywhere database, and keep the connection open all the time. To do this, you can declare a global variable for the connection:

   ```
   private SAConnection  _conn;
   ```

   For more information, see the sample code in *samples-dir\SQLAnywhere\ADO.NET\TableViewer* and "Understanding the Table Viewer sample project" on page 76.

2. Specify the connection string used to connect to the database.

   For example:

   ```
   "Data Source=SQL Anywhere 12 Demo"
   ```

   For a complete list of connection parameters, see "Connection parameters" [*SQL Anywhere Server - Database Administration*].

   Instead of supplying the full connection string, you can prompt users for their user ID and password parameters.

3. Open a connection to the database.

The following code attempts to connect to a database. It automatically starts the database server if necessary.

```
_conn.Open();
```

4. Catch connection errors.

   Your application should be designed to catch any errors that occur when attempting to connect to the database. The following code demonstrates how to catch an error and display its message:

```
try {
    _conn = new SAConnection( txtConnectString.Text );
    _conn.Open();
  } catch( SAException ex ) {
    MessageBox.Show( ex.Errors[0].Source + " : "
     + ex.Errors[0].Message + " (" +
     ex.Errors[0].NativeError.ToString() + ")",
         "Failed to connect" );
```

   Alternately, you can use the ConnectionString property to set the connection string, rather than passing the connection string when the SAConnection object is created:

```
SAConnection _conn;
    _conn = new SAConnection();
    _conn.ConnectionString = txtConnectString.Text;
    _conn.Open();
```

5. Close the connection to the database. Connections to the database stay open until they are explicitly closed using the Close method.

```
_conn.Close();
```

For more information, see "SAConnectionStringBuilder class" on page 177 and "ConnectionName property" on page 186.

Visual Basic connection example

The following Visual Basic code opens a connection to the SQL Anywhere sample database:

```
Private Sub Button1_Click(ByVal sender As _
    System.Object, ByVal e As System.EventArgs) _
    Handles Button1.Click
    ' Declare the connection object
    Dim myConn As New _
      iAnywhere.Data.SQLAnywhere.SAConnection()
    myConn.ConnectionString = _
      "Data Source=SQL Anywhere 12 Demo"
    myConn.Open()
    myConn.Close()
End Sub
```

Connection pooling

The SQL Anywhere .NET Data Provider supports native .NET connection pooling. Connection pooling allows your application to reuse existing connections by saving the connection handle to a pool so it can

be reused, rather than repeatedly creating a new connection to the database. Connection pooling is turned on by default.

The pool size is set in your connection string using the POOLING option. The default maximum pool size is 100, while the default minimum pool size is 0. You can specify the minimum and maximum pool sizes. For example:

```
"Data Source=SQL Anywhere 12 Demo;POOLING=TRUE;Max Pool Size=50;Min Pool
Size=5"
```

When your application first attempts to connect to the database, it checks the pool for an existing connection that uses the same connection parameters you have specified. If a matching connection is found, that connection is used. Otherwise, a new connection is used. When you disconnect, the connection is returned to the pool so that it can be reused.

The SQL Anywhere database server also supports connection pooling. This feature is controlled using the ConnectionPool (CPOOL) connection parameter. However, the SQL Anywhere .NET Data Provider does not use this server feature and disables it (CPOOL=NO). All connection pooling is done in the .NET client application instead (client-side connection pooling).

See also

- "ConnectionName property" on page 186
- "AutoStop (ASTOP) connection parameter" [*SQL Anywhere Server - Database Administration*]

Checking the connection state

Once your application has established a connection to the database, you can check the connection state to ensure that the connection is open before you fetch data from the database to update it. If a connection is lost or is busy, or if another statement is being processed, you can return an appropriate message to the user.

The SAConnection class has a State property that can be used to check the state of the connection. Possible state values are Open and Closed.

The following code checks whether the Connection object has been initialized, and if it has, it ensures that the connection is open. A message is returned to the user if the connection is not open.

```
if( _conn == null || _conn.State !=
  ConnectionState.Open ) {
  MessageBox.Show( "Connect to a database first",
   "Not connected" );
  return;
```

For more information, see "State property" on page 176.

Accessing and manipulating data

With the SQL Anywhere .NET Data Provider, there are two ways you can access data:

- **SACommand object** The SACommand object is the recommended way of accessing and manipulating data in .NET.

  The SACommand object allows you to execute SQL statements that retrieve or modify data directly from the database. Using the SACommand object, you can issue SQL statements and call stored procedures directly against the database.

  Within an SACommand object, an SADataReader is used to return read-only result sets from a query or stored procedure. The SADataReader returns only one row at a time, but this does not degrade performance because the SQL Anywhere client-side libraries use prefetch buffering to prefetch several rows at a time.

  Using the SACommand object allows you to group your changes into transactions rather than operating in autocommit mode. When you use the SATransaction object, locks are placed on the rows so that other users cannot modify them.

  For more information, see "SACommand class" on page 117 and "SADataReader class" on page 211.

- **SADataAdapter object** The SADataAdapter object retrieves the entire result set into a DataSet. A DataSet is a disconnected store for data that is retrieved from a database. You can then edit the data in the DataSet and when you are finished, the SADataAdapter object updates the database with the changes made to the DataSet. When you use the SADataAdapter, there is no way to prevent other users from modifying the rows in your DataSet. You need to include logic within your application to resolve any conflicts that may occur.

  For more information about conflicts, see "Resolving conflicts when using the SADataAdapter" on page 54.

  For more information about the SADataAdapter object, see "SADataAdapter class" on page 202.

There is no performance impact from using the SADataReader within an SACommand object to fetch rows from the database rather than the SADataAdapter object.

Using the SACommand object to retrieve and manipulate data

The following sections describe how to retrieve data and how to insert, update, or delete rows using the SADataReader.

Getting data using the SACommand object

The SACommand object allows you to execute a SQL statement or call a stored procedure against a SQL Anywhere database. You can use any of the following methods to retrieve data from the database:

- **ExecuteReader** Issues a SQL query that returns a result set. This method uses a forward-only, read-only cursor. You can loop quickly through the rows of the result set in one direction.

For more information, see "ExecuteReader method" on page 134.

- **ExecuteScalar** Issues a SQL query that returns a single value. This can be the first column in the first row of the result set, or a SQL statement that returns an aggregate value such as COUNT or AVG. This method uses a forward-only, read-only cursor.

  For more information, see "ExecuteScalar method" on page 135.

When using the SACommand object, you can use the SADataReader to retrieve a result set that is based on a join. However, you can only make changes (inserts, updates, or deletes) to data that is from a single table. You cannot update result sets that are based on joins.

The following instructions use the Simple code sample included with SQL Anywhere.

For more information about the Simple code sample, see "Understanding the Simple sample project" on page 73.

To issue a SQL query that returns a complete result set

1. Declare and initialize a Connection object.

   ```
   SAConnection conn = new SAConnection(
       "Data Source=SQL Anywhere 12 Demo" );
   ```

2. Open the connection.

   ```
   try {
       conn.Open();
   ```

3. Add a Command object to define and execute a SQL statement.

   ```
   SACommand cmd = new SACommand(
        "SELECT Surname FROM Employees", conn );
   ```

   If you are calling a stored procedure, you must specify the parameters for the stored procedure.

   For more information, see "Using stored procedures" on page 63 and "SAParameter class" on page 265.

4. Call the ExecuteReader method to return the DataReader object.

   ```
   SADataReader reader = cmd.ExecuteReader();
   ```

5. Display the results.

   ```
   listEmployees.BeginUpdate();
   while( reader.Read() ) {
        listEmployees.Items.Add( reader.GetString( 0 ) );
   }
   listEmployees.EndUpdate();
   ```

6. Close the DataReader and Connection objects.

   ```
   reader.Close();
   conn.Close();
   ```

To issue a SQL query that returns only one value

1. Declare and initialize an SAConnection object.

```
SAConnection conn = new SAConnection(
    "Data Source=SQL Anywhere 12 Demo" );
```

2. Open the connection.

```
conn.Open();
```

3. Add an SACommand object to define and execute a SQL statement.

```
SACommand cmd = new SACommand(
    "SELECT COUNT(*) FROM Employees WHERE Sex = 'M'",
    conn );
```

   If you are calling a stored procedure, you must specify the parameters for the stored procedure.

   For more information, see "Using stored procedures" on page 63.

4. Call the ExecuteScalar method to return the object containing the value.

```
int count = (int) cmd.ExecuteScalar();
```

5. Close the SAConnection object.

```
conn.Close();
```

When using the SADataReader, there are several Get methods available that you can use to return the results in the specified data type.

For more information, see "SADataReader class" on page 211.

Visual Basic DataReader example

The following Visual Basic code opens a connection to the SQL Anywhere sample database and uses the DataReader to return the last name of the first five employees in the result set:

```
Dim myConn As New SAConnection()
Dim myCmd As _
  New SACommand _
  ("SELECT Surname FROM Employees", myConn)
Dim myReader As SADataReader
Dim counter As Integer
myConn.ConnectionString = _
  "Data Source=SQL Anywhere 12 Demo"
myConn.Open()
myReader = myCmd.ExecuteReader()
counter = 0
Do While (myReader.Read())
  MsgBox(myReader.GetString(0))
  counter = counter + 1
  If counter >= 5 Then Exit Do
Loop
myConn.Close()
```


Inserting, updating, and deleting rows using the SACommand object

To perform an insert, update, or delete with the SACommand object, use the ExecuteNonQuery function. The ExecuteNonQuery function issues a query (SQL statement or stored procedure) that does not return a result set. See "ExecuteNonQuery method" on page 133.

You can only make changes (inserts, updates, or deletes) to data that is from a single table. You cannot update result sets that are based on joins. You must be connected to a database to use the SACommand object.

For information about obtaining primary key values for autoincrement primary keys, see "Obtaining primary key values" on page 59.

If you want to set the isolation level for a SQL statement, you must use the SACommand object as part of an SATransaction object. When you modify data without an SATransaction object, the provider operates in autocommit mode and any changes that you make are applied immediately. See "Transaction processing" on page 64.

To issue a statement that inserts a row

1. Declare and initialize an SAConnection object.

   ```
   SAConnection conn = new SAConnection(
       c_connStr );
   conn.Open();
   ```

2. Open the connection.

   ```
   conn.Open();
   ```

3. Add an SACommand object to define and execute an INSERT statement.

   You can use an INSERT, UPDATE, or DELETE statement with the ExecuteNonQuery method.

   ```
   SACommand insertCmd = new SACommand(
       "INSERT INTO Departments( DepartmentID, DepartmentName )
       VALUES( ?, ? )", conn );
   ```

   If you are calling a stored procedure, you must specify the parameters for the stored procedure.

   For more information, see "Using stored procedures" on page 63 and "SAParameter class" on page 265.

4. Set the parameters for the SACommand object.

   The following code defines parameters for the DepartmentID and DepartmentName columns respectively.

   ```
   SAParameter parm = new SAParameter();
   parm.SADbType = SADbType.Integer;
   insertCmd.Parameters.Add( parm );
   parm = new SAParameter();
   ```



```
parm.SADbType = SADbType.Char;
insertCmd.Parameters.Add( parm );
```

5. Insert the new values and call the ExecuteNonQuery method to apply the changes to the database.

```
insertCmd.Parameters[0].Value = 600;
insertCmd.Parameters[1].Value = "Eastern Sales";
int recordsAffected = insertCmd.ExecuteNonQuery();
insertCmd.Parameters[0].Value = 700;
insertCmd.Parameters[1].Value = "Western Sales";
recordsAffected = insertCmd.ExecuteNonQuery();
```

6. Display the results and bind them to the grid on the screen.

```
SACommand selectCmd = new SACommand(
    "SELECT * FROM Departments", conn );
SADataReader dr = selectCmd.ExecuteReader();

System.Windows.Forms.DataGrid dataGrid;
dataGrid = new System.Windows.Forms.DataGrid();
dataGrid.Location = new Point(10, 10);
dataGrid.Size = new Size(275, 200);
dataGrid.CaptionText = "iAnywhere SACommand Example";
this.Controls.Add(dataGrid);

dataGrid.DataSource = dr;
dataGrid.Show();
```

7. Close the SADataReader and SAConnection objects.

```
dr.Close();
conn.Close();
```

To issue a statement that updates a row

1. Declare and initialize an SAConnection object.

```
SAConnection conn = new SAConnection(
    c_connStr );
```

2. Open the connection.

```
conn.Open();
```

3. Add an SACommand object to define and execute an UPDATE statement.

   You can use an INSERT, UPDATE, or DELETE statement with the ExecuteNonQuery method.

```
SACommand updateCmd = new SACommand(
    "UPDATE Departments SET DepartmentName = 'Engineering'
    WHERE DepartmentID=100", conn );
```

   If you are calling a stored procedure, you must specify the parameters for the stored procedure.

   For more information, see "Using stored procedures" on page 63 and "SAParameter class" on page 265.

4. Call the ExecuteNonQuery method to apply the changes to the database.


```
int recordsAffected = updateCmd.ExecuteNonQuery();
```

5. Display the results and bind them to the grid on the screen.

```
SACommand selectCmd = new SACommand(
    "SELECT * FROM Departments", conn );
SADataReader   dr = selectCmd.ExecuteReader();
dataGrid.DataSource = dr;
```

6. Close the SADataReader and SAConnection objects.

```
dr.Close();
conn.Close();
```

To issue a statement that deletes a row

1. Declare and initialize an SAConnection object.

```
SAConnection conn = new SAConnection(
    c_connStr );
```

2. Open the connection.

```
conn.Open();
```

3. Create an SACommand object to define and execute a DELETE statement.

   You can use an INSERT, UPDATE, or DELETE statement with the ExecuteNonQuery method.

```
SACommand deleteCmd = new SACommand(
    "DELETE FROM Departments WHERE ( DepartmentID > 500 )", conn );
```

   If you are calling a stored procedure, you must specify the parameters for the stored procedure.

   For more information, see "Using stored procedures" on page 63 and "SAParameter class" on page 265.

4. Call the ExecuteNonQuery method to apply the changes to the database.

```
int recordsAffected = deleteCmd.ExecuteNonQuery();
```

5. Close the SAConnection object.

```
conn.Close();
```

Obtaining DataReader schema information

You can obtain schema information about columns in the result set.

If you are using the SADataReader, you can use the GetSchemaTable method to obtain information about the result set. The GetSchemaTable method returns the standard .NET DataTable object, which provides information about all the columns in the result set, including column properties.

For more information about the GetSchemaTable method, see "GetSchemaTable method" on page 227.

To obtain information about a result set using the GetSchemaTable method

1. Declare and initialize a connection object.

```
SAConnection conn = new SAConnection(
    c_connStr );
```

2. Open the connection.

```
conn.Open();
```

3. Create an SACommand object with the SELECT statement you want to use. The schema is returned for the result set of this query.

```
SACommand cmd = new SACommand(
    "SELECT * FROM Employees", conn );
```

4. Create an SADataReader object and execute the Command object you created.

```
SADataReader   dr = cmd.ExecuteReader();
```

5. Fill the DataTable with the schema from the data source.

```
DataTable       schema = dr.GetSchemaTable();
```

6. Close the SADataReader and SAConnection objects.

```
dr.Close();
conn.Close();
```

7. Bind the DataTable to the grid on the screen.

```
dataGrid.DataSource = schema;
```

Using the SADataAdapter object to access and manipulate data

The following sections describe how to retrieve data and how to insert, update, or delete rows using the SADataAdapter.

Getting data using the SADataAdapter object

The SADataAdapter allows you to view the entire result set by using the Fill method to fill a DataSet with the results from a query by binding the DataSet to the display grid.

Using the SADataAdapter, you can pass any string (SQL statement or stored procedure) that returns a result set. When you use the SADataAdapter, all the rows are fetched in one operation using a forward-only, read-only cursor. Once all the rows in the result set have been read, the cursor is closed. The SADataAdapter allows you to make changes to the DataSet. Once your changes are complete, you must reconnect to the database to apply the changes.

You can use the SADataAdapter object to retrieve a result set that is based on a join. However, you can only make changes (inserts, updates, or deletes) to data that is from a single table. You cannot update result sets that are based on joins.

Caution
Any changes you make to the DataSet are made while you are disconnected from the database. This means that your application does not have locks on these rows in the database. Your application must be designed to resolve any conflicts that may occur when changes from the DataSet are applied to the database if another user changes the data you are modifying before your changes are applied to the database.

For more information about the SADataAdapter, see "SADataAdapter class" on page 202.

SADataAdapter example

The following example shows how to fill a DataSet using the SADataAdapter.

To retrieve data using the SADataAdapter object

1. Connect to the database.
2. Create a new DataSet. In this case, the DataSet is called Results.

```
DataSet ds =new DataSet ();
```

3. Create a new SADataAdapter object to execute a SQL statement and fill the DataSet.

```
SADataAdapter da=new SADataAdapter(
     txtSQLStatement.Text, _conn);
da.Fill(ds, "Results")
```

4. Bind the DataSet to the grid on the screen.

```
dgResults.DataSource = ds.Tables["Results"]
```

Inserting, updating, and deleting rows using the SADataAdapter object

The SADataAdapter retrieves the result set into a DataSet. A DataSet is a collection of tables and the relationships and constraints between those tables. The DataSet is built into the .NET Framework, and is independent of the Data Provider used to connect to your database.

When you use the SADataAdapter, you must be connected to the database to fill the DataSet and to update the database with changes made to the DataSet. However, once the DataSet is filled, you can modify the DataSet while disconnected from the database.

If you do not want to apply your changes to the database right away, you can write the DataSet, including the data and/or the schema, to an XML file using the WriteXML method. Then, you can apply the changes at a later time by loading a DataSet with the ReadXML method.

For more information, see the .NET Framework documentation for WriteXML and ReadXML.

When you call the Update method to apply changes from the DataSet to the database, the SADataAdapter analyzes the changes that have been made and then invokes the appropriate statements, INSERT,

UPDATE, or DELETE, as necessary. When you use the DataSet, you can only make changes (inserts, updates, or deletes) to data that is from a single table. You cannot update result sets that are based on joins. If another user has a lock on the row you are trying to update, an exception is thrown.

Caution
Any changes you make to the DataSet are made while you are disconnected. This means that your application does not have locks on these rows in the database. Your application must be designed to resolve any conflicts that may occur when changes from the DataSet are applied to the database if another user changes the data you are modifying before your changes are applied to the database.

Resolving conflicts when using the SADataAdapter

When you use the SADataAdapter, no locks are placed on the rows in the database. This means there is the potential for conflicts to arise when you apply changes from the DataSet to the database. Your application should include logic to resolve or log conflicts that arise.

Some of the conflicts that your application logic should address include:

- **Unique primary keys** If two users insert new rows into a table, each row must have a unique primary key. For tables with autoincrement primary keys, the values in the DataSet may become out of sync with the values in the data source.

  For information about obtaining primary key values for autoincrement primary keys, see "Obtaining primary key values" on page 59.

- **Updates made to the same value** If two users modify the same value, your application should include logic to determine which value is correct.

- **Schema changes** If a user modifies the schema of a table you have updated in the DataSet, the update will fail when you apply the changes to the database.

- **Data concurrency** Concurrent applications should see a consistent set of data. The SADataAdapter does not place a lock on rows that it fetches, so another user can update a value in the database once you have retrieved the DataSet and are working offline.

Many of these potential problems can be avoided by using the SACommand, SADataReader, and SATransaction objects to apply changes to the database. The SATransaction object is recommended because it allows you to set the isolation level for the transaction and it places locks on the rows so that other users cannot modify them.

For more information about using transactions to apply your changes to the database, see "Inserting, updating, and deleting rows using the SACommand object" on page 49.

To simplify the process of conflict resolution, you can design your INSERT, UPDATE, or DELETE statement to be a stored procedure call. By including INSERT, UPDATE, and DELETE statements in stored procedures, you can catch the error if the operation fails. In addition to the statement, you can add error handling logic to the stored procedure so that if the operation fails the appropriate action is taken, such as recording the error to a log file, or trying the operation again.

To insert rows into a table using the SADataAdapter

1. Declare and initialize an SAConnection object.

```
SAConnection   conn = new SAConnection(
    c_connStr );
```

2. Open the connection.

```
conn.Open();
```

3. Create a new SADataAdapter object.

```
SADataAdapter adapter = new SADataAdapter();
adapter.MissingMappingAction =
    MissingMappingAction.Passthrough;
adapter.MissingSchemaAction =
    MissingSchemaAction.Add;
```

4. Create the necessary SACommand objects and define any necessary parameters.

   The following code creates a SELECT and an INSERT statement and defines the parameters for the INSERT statement.

```
adapter.SelectCommand = new SACommand(
    "SELECT * FROM Departments", conn );
adapter.InsertCommand = new SACommand(
    "INSERT INTO Departments( DepartmentID, DepartmentName )
    VALUES( ?, ? )", conn );
adapter.InsertCommand.UpdatedRowSource =
    UpdateRowSource.None;
SAParameter parm = new SAParameter();
parm.SADbType = SADbType.Integer;
parm.SourceColumn = "DepartmentID";
parm.SourceVersion = DataRowVersion.Current;
adapter.InsertCommand.Parameters.Add(
    parm );
parm = new SAParameter();
parm.SADbType = SADbType.Char;
parm.SourceColumn = "DepartmentName";
parm.SourceVersion = DataRowVersion.Current;
adapter.InsertCommand.Parameters.Add( parm );
```

5. Fill the DataTable with the results of the SELECT statement.

```
DataTable dataTable = new DataTable( "Departments" );
int rowCount = adapter.Fill( dataTable );
```

6. Insert the new rows into the DataTable and apply the changes to the database.

```
DataRow row1 = dataTable.NewRow();
row1[0] = 600;
row1[1] = "Eastern Sales";
dataTable.Rows.Add( row1 );
DataRow row2 = dataTable.NewRow();
row2[0] = 700;
row2[1] = "Western Sales";
dataTable.Rows.Add( row2 );
recordsAffected = adapter.Update( dataTable );
```

7. Display the results of the updates.

```
dataTable.Clear();
rowCount = adapter.Fill( dataTable );
dataGrid.DataSource = dataTable;
```

8. Close the connection.

```
conn.Close();
```

To update rows using the SADataAdapter object

1. Declare and initialize an SAConnection object.

```
SAConnection conn = new SAConnection( c_connStr );
```

2. Open the connection.

```
conn.Open();
```

3. Create a new SADataAdapter object.

```
SADataAdapter adapter = new SADataAdapter();
adapter.MissingMappingAction =
    MissingMappingAction.Passthrough;
adapter.MissingSchemaAction =
    MissingSchemaAction.Add;
```

4. Create an SACommand object and define its parameters.

   The following code creates a SELECT and an UPDATE statement and defines the parameters for the UPDATE statement.

```
adapter.SelectCommand = new SACommand(
    "SELECT * FROM Departments WHERE DepartmentID > 500",
    conn );
adapter.UpdateCommand = new SACommand(
    "UPDATE Departments SET DepartmentName = ?
    WHERE DepartmentID = ?", conn );
adapter.UpdateCommand.UpdatedRowSource =
    UpdateRowSource.None;
SAParameter parm = new SAParameter();
parm.SADbType = SADbType.Char;
parm.SourceColumn = "DepartmentName";
parm.SourceVersion = DataRowVersion.Current;
adapter.UpdateCommand.Parameters.Add( parm );
parm = new SAParameter();
parm.SADbType = SADbType.Integer;
parm.SourceColumn = "DepartmentID";
parm.SourceVersion = DataRowVersion.Original;
adapter.UpdateCommand.Parameters.Add( parm );
```

5. Fill the DataTable with the results of the SELECT statement.

```
DataTable dataTable = new DataTable( "Departments" );
int rowCount = adapter.Fill( dataTable );
```

6. Update the DataTable with the updated values for the rows and apply the changes to the database.


```
foreach ( DataRow row in dataTable.Rows )
{
row[1] = ( string ) row[1] + "_Updated";
}
recordsAffected = adapter.Update( dataTable );
```

7. Bind the results to the grid on the screen.

```
dataTable.Clear();
adapter.SelectCommand.CommandText =
    "SELECT * FROM Departments";
rowCount = adapter.Fill( dataTable );
dataGrid.DataSource = dataTable;
```

8. Close the connection.

```
conn.Close();
```

To delete rows from a table using the SADataAdapter object

1. Declare and initialize an SAConnection object.

```
SAConnection conn = new SAConnection( c_connStr );
```

2. Open the connection.

```
conn.Open();
```

3. Create an SADataAdapter object.

```
SADataAdapter adapter = new SADataAdapter();
adapter.MissingMappingAction =
    MissingMappingAction.Passthrough;
adapter.MissingSchemaAction =
    MissingSchemaAction.AddWithKey;
```

4. Create the required SACommand objects and define any necessary parameters.

   The following code creates a SELECT and a DELETE statement and defines the parameters for the DELETE statement.

```
adapter.SelectCommand = new SACommand(
    "SELECT * FROM Departments WHERE DepartmentID > 500",
    conn );
adapter.DeleteCommand = new SACommand(
    "DELETE FROM Departments WHERE DepartmentID = ?",
    conn );
adapter.DeleteCommand.UpdatedRowSource =
    UpdateRowSource.None;
SAParameter parm = new SAParameter();
parm.SADbType = SADbType.Integer;
parm.SourceColumn = "DepartmentID";
parm.SourceVersion = DataRowVersion.Original;
adapter.DeleteCommand.Parameters.Add( parm );
```

5. Fill the DataTable with the results of the SELECT statement.

```
DataTable dataTable = new DataTable( "Departments" );
int rowCount = adapter.Fill( dataTable );
```

6. Modify the DataTable and apply the changes to the database.

```
for each ( DataRow in dataTable.Rows )
{
    row.Delete();
}
recordsAffected = adapter.Update( dataTable )
```

7. Bind the results to the grid on the screen.

```
dataTable.Clear();
rowCount = adapter.Fill( dataTable );
dataGrid.DataSource = dataTable;
```

8. Close the connection.

```
conn.Close();
```

Obtaining SADataAdapter schema information

When using the SADataAdapter, you can use the FillSchema method to obtain schema information about the result set in the DataSet. The FillSchema method returns the standard .NET DataTable object, which provides the names of all the columns in the result set.

To obtain DataSet schema information using the FillSchema method

1. Declare and initialize an SAConnection object.

```
SAConnection   conn = new SAConnection(
    c_connStr );
```

2. Open the connection.

```
conn.Open();
```

3. Create an SADataAdapter with the SELECT statement you want to use. The schema is returned for the result set of this query.

```
SADataAdapter  adapter = new SADataAdapter(
    "SELECT * FROM Employees", conn );
```

4. Create a new DataTable object, in this case called Table, to fill with the schema.

```
DataTable       dataTable = new DataTable(
    "Table" );
```

5. Fill the DataTable with the schema from the data source.

```
adapter.FillSchema( dataTable, SchemaType.Source );
```

6. Close the SAConnection object.

```
conn.Close();
```


7. Bind the DataSet to the grid on the screen.

```
dataGrid.DataSource = dataTable;
```

Obtaining primary key values

If the table you are updating has an autoincremented primary key, uses UUIDs, or if the primary key comes from a primary key pool, you can use a stored procedure to obtain values generated by the data source.

When using the SADataAdapter, this technique can be used to fill the columns in the DataSet with the primary key values generated by the data source. If you want to use this technique with the SACommand object, you can either get the key columns from the parameters or reopen the DataReader.

Examples

The following examples use a table called adodotnet_primarykey that contains two columns, ID and Name. The primary key for the table is ID. It is an INTEGER and contains an autoincremented value. The Name column is CHAR(40).

These examples call the following stored procedure to retrieve the autoincremented primary key value from the database.

```
CREATE PROCEDURE sp_adodotnet_primarykey( out p_id int, in p_name char(40) )
BEGIN
    INSERT INTO adodotnet_primarykey( name ) VALUES(
      p_name );
    SELECT @@IDENTITY INTO p_id;
END
```

To insert a new row with an autoincremented primary key using the SACommand object

1. Connect to the database.

```
SAConnection   conn = OpenConnection();
```

2. Create a new SACommand object to insert new rows into the DataTable. In the following code, the line `int id1 = ( int ) parmId.Value;` verifies the primary key value of the row.

```
SACommand      cmd = conn.CreateCommand();
cmd.CommandText = "sp_adodotnet_primarykey";
cmd.CommandType = CommandType.StoredProcedure;
SAParameter parmId = new SAParameter();
parmId.SADbType = SADbType.Integer;
parmId.Direction = ParameterDirection.Output;
cmd.Parameters.Add( parmId );
SAParameter parmName = new SAParameter();
parmName.SADbType = SADbType.Char;
parmName.Direction = ParameterDirection.Input;
cmd.Parameters.Add( parmName );
parmName.Value = "R & D --- Command";
cmd.ExecuteNonQuery();
int id1 = ( int ) parmId.Value;
parmName.Value = "Marketing --- Command";
cmd.ExecuteNonQuery();
int id2 = ( int ) parmId.Value;
```

```
parmName.Value = "Sales --- Command";
cmd.ExecuteNonQuery();
int id3 = ( int ) parmId.Value;
parmName.Value = "Shipping --- Command";
cmd.ExecuteNonQuery();
int id4 = ( int ) parmId.Value;
```

3. Bind the results to the grid on the screen and apply the changes to the database.

```
cmd.CommandText = "SELECT * FROM " +
    adodotnet_primarykey";
cmd.CommandType = CommandType.Text;
SADataReader dr = cmd.ExecuteReader();
dataGrid.DataSource = dr;
```

4. Close the connection.

```
conn.Close();
```

To insert a new row with an autoincremented primary key using the SADataAdapter object

1. Create a new SADataAdapter.

```
DataSet         dataSet = new DataSet();
SAConnection   conn = OpenConnection();
SADataAdapter  adapter = new SADataAdapter();
adapter.MissingMappingAction =
    MissingMappingAction.Passthrough;
adapter.MissingSchemaAction =
    MissingSchemaAction.AddWithKey;
```

2. Fill the data and schema of the DataSet. The SelectCommand is called by the SADataAdapter.Fill method to do this. You can also create the DataSet manually without using the Fill method and SelectCommand if you do not need the existing records.

```
adapter.SelectCommand = new SACommand( "select * from  +
adodotnet_primarykey", conn );
```

3. Create a new SACommand to obtain the primary key values from the database.

```
adapter.InsertCommand = new SACommand(
    "sp_adodotnet_primarykey", conn );
adapter.InsertCommand.CommandType =
    CommandType.StoredProcedure;
adapter.InsertCommand.UpdatedRowSource =
    UpdateRowSource.OutputParameters;
SAParameter parmId = new SAParameter();
parmId.SADbType = SADbType.Integer;
parmId.Direction = ParameterDirection.Output;
parmId.SourceColumn = "ID";
parmId.SourceVersion = DataRowVersion.Current;
adapter.InsertCommand.Parameters.Add( parmId );
SAParameter parmName = new SAParameter();
parmName.SADbType = SADbType.Char;
parmName.Direction = ParameterDirection.Input;
parmName.SourceColumn = "name";
parmName.SourceVersion = DataRowVersion.Current;
adapter.InsertCommand.Parameters.Add( parmName );
```

4. Fill the DataSet.


```
adapter.Fill( dataSet );
```

5. Insert the new rows into the DataSet.

```
DataRow row = dataSet.Tables[0].NewRow();
row[0] = -1;
row[1] = "R & D --- Adapter";
dataSet.Tables[0].Rows.Add( row );
row = dataSet.Tables[0].NewRow();
row[0] = -2;
row[1] = "Marketing --- Adapter";
dataSet.Tables[0].Rows.Add( row );
row = dataSet.Tables[0].NewRow();
row[0] = -3;
row[1] = "Sales --- Adapter";
dataSet.Tables[0].Rows.Add( row );
row = dataSet.Tables[0].NewRow();
row[0] = -4;
row[1] = "Shipping --- Adapter";
dataSet.Tables[0].Rows.Add( row );
```

6. Apply the changes in the DataSet to the database. When the Update method is called, the primary key values are changed to the values obtained from the database.

```
adapter.Update( dataSet );
dataGrid.DataSource = dataSet.Tables[0];
```

   When you add new rows to the DataTable and call the Update method, the SADataAdapter calls the InsertCommand and maps the output parameters to the key columns for each new row. The Update method is called only once, but the InsertCommand is called by the Update method as many times as necessary for each new row being added.

7. Close the connection to the database.

```
conn.Close();
```

Handling BLOBs

When fetching long string values or binary data, there are methods that you can use to fetch the data in pieces. For binary data, use the GetBytes method, and for string data, use the GetChars method. Otherwise, BLOB data is treated in the same manner as any other data you fetch from the database.

For more information, see "GetBytes method" on page 217 and "GetChars method" on page 219.

To issue a statement that returns a string using the GetChars method

1. Declare and initialize a Connection object.

2. Open the connection.

3. Add a Command object to define and execute a SQL statement.

```
SACommand cmd = new SACommand(
    "SELECT int_col, blob_col FROM test", conn );
```

4. Call the ExecuteReader method to return the DataReader object.

```
SADataReader reader = cmd.ExecuteReader();
```

   The following code reads the two columns from the result set. The first column is an integer (`GetInt32( 0 )`), while the second column is a LONG VARCHAR. GetChars is used to read 100 characters at a time from the LONG VARCHAR column.

```
int length = 100;
char[] buf = new char[ length ];
int intValue;
long dataIndex = 0;
long charsRead = 0;
long blobLength = 0;
while( reader.Read() ) {
    intValue = reader.GetInt32( 0 );
    while ( ( charsRead = reader.GetChars(
        1, dataIndex, buf, 0, length ) ) == ( long )
            length ) {
    dataIndex += length;
}
blobLength = dataIndex + charsRead;
}
```

5. Close the DataReader and Connection objects.

```
reader.Close();
conn.Close();
```

Obtaining time values

The .NET Framework does not have a Time structure. If you want to fetch time values from SQL Anywhere, you must use the GetTimeSpan method. Using this method returns the data as a .NET Framework TimeSpan object.

For more information about the GetTimeSpan method, see "GetTimeSpan method" on page 230.

To convert a time value using the GetTimeSpan method

1. Declare and initialize a connection object.

```
SAConnection conn = new SAConnection(
    "Data Source=dsn-time-test;UID=DBA;PWD=sql" );
```

2. Open the connection.

```
conn.Open();
```

3. Add a Command object to define and execute a SQL statement.

```
SACommand cmd = new SACommand(
    "SELECT ID, time_col FROM time_test", conn )
```

4. Call the ExecuteReader method to return the DataReader object.

```
SADataReader reader = cmd.ExecuteReader();
```


The following code uses the GetTimeSpan method to return the time as TimeSpan.

```
while ( reader.Read() )
{
    int ID = reader.GetInt32();
    TimeSpan time = reader.GetTimeSpan();
}
```

5. Close the DataReader and Connection objects.

```
reader.Close();
conn.Close();
```

Using stored procedures

You can use stored procedures with the SQL Anywhere .NET Data Provider. The ExecuteReader method is used to call stored procedures that return a result set, while the ExecuteNonQuery method is used to call stored procedures that do not return a result set. The ExecuteScalar method is used to call stored procedures that return only a single value.

When you call a stored procedure, you must create an SAParameter object. Use a question mark as a placeholder for parameters, as follows:

```
sp_producttype( ?, ? )
```

For more information about the Parameter object, see “SAParameter class” on page 265.

To execute a stored procedure

1. Declare and initialize an SAConnection object.

```
SAConnection conn = new SAConnection(
    "Data Source=SQL Anywhere 12 Demo" );
```

2. Open the connection.

```
conn.Open();
```

3. Add an SACommand object to define and execute a SQL statement. The following code uses the CommandType property to identify the statement as a stored procedure.

```
SACommand cmd = new SACommand( "ShowProductInfo",
    conn );
cmd.CommandType = CommandType.StoredProcedure;
```

If you do not specify the CommandType property, then you must use a question mark as a placeholder for parameters, as follows:

```
SACommand cmd = new SACommand(
    "call ShowProductInfo(?)", conn );
cmd.CommandType = CommandType.Text;
```

4. Add an SAParameter object to define the parameters for the stored procedure. You must create a new SAParameter object for each parameter the stored procedure requires.

```
SAParameter param = cmd.CreateParameter();
param.SADbType = SADbType.Int32;
param.Direction = ParameterDirection.Input;
param.Value = 301;
cmd.Parameters.Add( param );
```

For more information about the Parameter object, see "SAParameter class" on page 265.

5. Call the ExecuteReader method to return the DataReader object. The Get methods are used to return the results in the specified data type.

```
SADataReader reader = cmd.ExecuteReader();
reader.Read();
int ID = reader.GetInt32(0);
string name = reader.GetString(1);
string description = reader.GetString(2);
decimal price = reader.GetDecimal(6);
```

6. Close the SADataReader and SAConnection objects.

```
reader.Close();
conn.Close();
```

Alternative way to call a stored procedure

Step 3 in the above instructions presents two ways you can call a stored procedure. Another way you can call a stored procedure, without using a Parameter object, is to call the stored procedure from your source code, as follows:

```
SACommand cmd = new SACommand(
    "call ShowProductInfo( 301 )", conn );
```

For information about calling stored procedures that return a result set or a single value, see "Getting data using the SACommand object" on page 46.

For information about calling stored procedures that do not return a result set, see "Inserting, updating, and deleting rows using the SACommand object" on page 49.

Transaction processing

With the SQL Anywhere .NET Data Provider, you can use the SATransaction object to group statements together. Each transaction ends with a COMMIT or ROLLBACK, which either makes your changes to the database permanent or cancels all the operations in the transaction. Once the transaction is complete, you must create a new SATransaction object to make further changes. This behavior is different from ODBC and embedded SQL, where a transaction persists after you execute a COMMIT or ROLLBACK until the transaction is closed.

If you do not create a transaction, the SQL Anywhere .NET Data Provider operates in autocommit mode by default. There is an implicit COMMIT after each insert, update, or delete, and once an operation is completed, the change is made to the database. In this case, the changes cannot be rolled back.

For more information about the SATransaction object, see "SATransaction class" on page 310.

Setting the isolation level for transactions

The database isolation level is used by default for transactions. However, you can choose to specify the isolation level for a transaction using the IsolationLevel property when you begin the transaction. The isolation level applies to all statements executed within the transaction. The SQL Anywhere .NET Data Provider supports snapshot isolation.

For more information about isolation levels, see "Isolation levels and consistency" [*SQL Anywhere Server - SQL Usage*].

The locks that SQL Anywhere uses when you enter a SELECT statement depend on the transaction's isolation level.

For more information about locking and isolation levels, see "Locking during queries" [*SQL Anywhere Server - SQL Usage*].

The following example uses an SATransaction object to issue and then roll back a SQL statement. The transaction uses isolation level 2 (RepeatableRead), which places a write lock on the row being modified so that no other database user can update the row.

To use an SATransaction object to issue a statement

1. Declare and initialize an SAConnection object.

   ```
   SAConnection conn = new SAConnection(
       "Data Source=SQL Anywhere 12 Demo" );
   ```

2. Open the connection.

   ```
   conn.Open();
   ```

3. Issue a SQL statement to change the price of Tee shirts.

   ```
   string stmt = "UPDATE Products SET UnitPrice =
       2000.00 WHERE name = 'Tee shirt'";
   ```

4. Create an SATransaction object to issue the SQL statement using a Command object.

   Using a transaction allows you to specify the isolation level. Isolation level 2 (RepeatableRead) is used in this example so that another database user cannot update the row.

   ```
   SATransaction trans = conn.BeginTransaction(
       IsolationLevel.RepeatableRead );
   SACommand cmd = new SACommand( stmt, conn,
       trans );
   int rows = cmd.ExecuteNonQuery();
   ```

5. Roll back the changes.

   ```
   trans.Rollback();
   ```

   The SATransaction object allows you to commit or roll back your changes to the database. If you do not use a transaction, the SQL Anywhere .NET Data Provider operates in autocommit mode and you cannot roll back any changes that you make to the database. If you want to make the changes permanent, you would use the following:

```
trans.Commit();
```

6. Close the SAConnection object.

```
conn.Close();
```

Distributed transaction processing

The .NET 2.0 framework introduced a new namespace System.Transactions, which contains classes for writing transactional applications. Client applications can create and participate in distributed transactions with one or multiple participants. Client applications can implicitly create transactions using the TransactionScope class. The connection object can detect the existence of an ambient transaction created by the TransactionScope and automatically enlist. The client applications can also create a CommittableTransaction and call the EnlistTransaction method to enlist. This feature is supported by the SQL Anywhere .NET 2.0 Data Provider. Distributed transaction has significant performance overhead. It is recommended that you use database transactions for non-distributed transactions.

Error handling and the SQL Anywhere .NET Data Provider

Your application must be designed to handle any errors that occur, including ADO.NET errors. ADO.NET errors are handled within your code in the same way that you handle other errors in your application.

The SQL Anywhere .NET Data Provider throws SAException objects whenever errors occur during execution. Each SAException object consists of a list of SAError objects, and these error objects include the error message and code.

Errors are different from conflicts. Conflicts arise when changes are applied to the database. Your application should include a process to compute correct values or to log conflicts when they arise.

For more information about handling conflicts, see “Resolving conflicts when using the SADataAdapter” on page 54.

Error handling example

The following example is from the Simple sample project. Any errors that occur during execution and that originate with SQL Anywhere .NET Data Provider objects are handled by displaying them in a window. The following code catches the error and displays its message:

```
catch( SAException ex ) {
    MessageBox.Show( ex.Errors[0].Message );
}
```

Connection error handling example

The following example is from the Table Viewer sample project. If there is an error when the application attempts to connect to the database, the following code uses a try and catch block to catch the error and display its message:

```
try {
    _conn = new SAConnection( txtConnectString.Text );
    _conn.Open();
```



```
} catch( SAException ex ) {
  MessageBox.Show( ex.Errors[0].Source + " : "
   + ex.Errors[0].Message + " (" +
   ex.Errors[0].NativeError.ToString() + ")",
       "Failed to connect" );
```

For more error handling examples, see "Understanding the Simple sample project" on page 73 and "Understanding the Table Viewer sample project" on page 76.

For more information about error handling, see "SAFactory class" on page 248 and "SAError class" on page 241.

Deploying the SQL Anywhere .NET Data Provider

The following sections describe how to deploy the SQL Anywhere .NET Data Provider.

SQL Anywhere .NET Data Provider system requirements

To use the SQL Anywhere .NET Data Provider, you must have the following installed on your computer or handheld device:

- The .NET Framework and/or .NET Compact Framework version 2.0 or later.
- Visual Studio 2005 or later, or a .NET language compiler, such as C# (required only for development).

SQL Anywhere .NET Data Provider required files

The SQL Anywhere .NET Data Provider code resides in a DLL for each platform.

Windows required file

For Windows (except Windows Mobile), one of the following DLLs is required:

- *install-dir\Assembly\V2\iAnywhere.Data.SQLAnywhere.dll*
- *install-dir\Assembly\V3.5\iAnywhere.Data.SQLAnywhere.v3.5.dll*
- *install-dir\Assembly\V4\iAnywhere.Data.SQLAnywhere.v4.0.dll*

The choice of DLL depends on the version of .NET that you are targeting.

Windows Mobile required files

For Windows Mobile, the following DLL is required:

- *install-dir\CE\Assembly\V2\iAnywhere.Data.SQLAnywhere.dll*

The Window Mobile version of the DLL is required for .NET Compact Framework version 2.0 or later applications.

Visual Studio deploys the .NET Data Provider DLL (*iAnywhere.Data.SQLAnywhere.dll*) to your device along with your program. If you are not using Visual Studio, you must copy the Data Provider DLL to the device along with your application. It can go in the same directory as your application, or in the *\Windows* directory.

The provider also requires the following DLLs.

- ***policy.12.0.iAnywhere.Data.SQLAnywhere.dll*** The policy file can be used to override the provider version that the application was built with. The policy file is updated by Sybase whenever an update to the provider is released. There are also policy files for the version 3.5 provider (*policy.12.0.iAnywhere.Data.SQLAnywhere.v3.5.dll*) and the version 4.0 provider (*policy.12.0.iAnywhere.Data.SQLAnywhere.v4.0.dll*).
- ***dblgen12.dll*** This language DLL contains English (en) messages issued by the provider. It is available in many other languages including Chinese (zh), French (fr), German (de), and Japanese (jp).
- ***dbcon12.dll*** The connection dialog is contained in this DLL.

The SQL Anywhere .NET Data Provider dbdata DLL

When the SQL Anywhere .NET Data Provider is first loaded by a .NET application (usually when making a database connection using SAConnection), it unloads a DLL that contains the provider's unmanaged code. The file *dbdata.dll* is placed in a directory by the provider using the following strategy.

1. The first directory it attempts to use for unloading is the one returned by the first of the following:
   - The path identified by the **TMP** environment variable.
   - The path identified by the **TEMP** environment variable.
   - The path identified by the **USERPROFILE** environment variable.
   - The Windows directory.
2. If the identified directory is inaccessible, then the provider will attempt to use the current working directory.
3. If the current working directory is inaccessible, then the provider will attempt to use the directory from where the application itself was loaded.

Registering the SQL Anywhere .NET Data Provider DLL

The Windows version of the SQL Anywhere .NET Data Provider DLL (*install-dir\Assembly\V2\iAnywhere.Data.SQLAnywhere.dll*) is registered in the Global Assembly Cache when you install the SQL Anywhere software. On Windows Mobile, you do not need to register the DLL.

If you are deploying the SQL Anywhere .NET Data Provider, you can register it using the **gacutil** utility that is included with the .NET Framework.

Tracing support

The SQL Anywhere .NET provider supports tracing using the .NET tracing feature. Note that tracing is not supported on Windows Mobile.

By default, tracing is disabled. To enable tracing, specify the trace source in your application's configuration file. Here's an example of the configuration file:

```
<?xml version="1.0" encoding="utf-8" ?>
<configuration>
<system.diagnostics>
<sources>
 <source name="iAnywhere.Data.SQLAnywhere"
         switchName="SASourceSwitch"
         switchType="System.Diagnostics.SourceSwitch">
  <listeners>
   <add name="ConsoleListener"
        type="System.Diagnostics.ConsoleTraceListener"/>
   <add name="EventListener"
        type="System.Diagnostics.EventLogTraceListener"
        initializeData="MyEventLog"/>
   <add name="TraceLogListener"
        type="System.Diagnostics.TextWriterTraceListener"
        initializeData="myTrace.log"
        traceOutputOptions="ProcessId, ThreadId, Timestamp"/>
   <remove name="Default"/>
  </listeners>
 </source>
</sources>
<switches>
 <add name="SASourceSwitch" value="All"/>
 <add name="SATraceAllSwitch" value="1" />
 <add name="SATraceExceptionSwitch" value="1" />
 <add name="SATraceFunctionSwitch" value="1" />
 <add name="SATracePoolingSwitch" value="1" />
 <add name="SATracePropertySwitch" value="1" />
</switches>
</system.diagnostics>
</configuration>
```

The trace configuration information is placed in the application's *bin\debug* folder under the name *app.exe.config*.

The `traceOutputOptions` that can be specified include the following:

- **Callstack** Write the call stack, which is represented by the return value of the Environment.StackTrace property.
- **DateTime** Write the date and time.
- **LogicalOperationStack** Write the logical operation stack, which is represented by the return value of the CorrelationManager.LogicalOperationStack property.
- **None** Do not write any elements.

- **ProcessId** Write the process identity, which is represented by the return value of the Process.Id property.
- **ThreadId** Write the thread identity, which is represented by the return value of the Thread.ManagedThreadId property for the current thread.
- **Timestamp** Write the timestamp, which is represented by the return value of the System.Diagnostics.Stopwatch.GetTimeStamp method.

You can limit what is traced by setting specific trace options. By default the trace option settings are all 0. The trace options that can be set include the following:

- **SATraceAllSwitch** The Trace All switch. When specified, all the trace options are enabled. You do not need to set any other options since they are all selected. You cannot disable individual options if you choose this option. For example, the following will not disable exception tracing.

  ```
  <add name="SATraceAllSwitch" value="1" />
  <add name="SATraceExceptionSwitch" value="0" />
  ```

- **SATraceExceptionSwitch** All exceptions are logged. Trace messages have the following form.

  ```
  <Type|ERR> message='message_text'[ nativeError=error_number]
  ```

  The nativeError=error_number text will only be displayed if there is an SAException object.

- **SATraceFunctionSwitch** All function scope entry/exits are logged. Trace messages have any of the following forms.

  ```
  enter_nnn <sa.class_name.method_name|API> [object_id#][parameter_names]
  leave_nnn
  ```

  The nnn is an integer representing the scope nesting level 1, 2, 3,... The optional parameter_names is a list of parameter names separated by spaces.

- **SATracePoolingSwitch** All connection pooling is logged. Trace messages have any of the following forms.

  ```
  <sa.ConnectionPool.AllocateConnection|CPOOL>
  connectionString='connection_text'
  <sa.ConnectionPool.RemoveConnection|CPOOL>
  connectionString='connection_text'
  <sa.ConnectionPool.ReturnConnection|CPOOL>
  connectionString='connection_text'
  <sa.ConnectionPool.ReuseConnection|CPOOL>
  connectionString='connection_text'
  ```

- **SATracePropertySwitch** All property setting and retrieval is logged. Trace messages have any of the following forms.

  ```
  <sa.class_name.get_property_name|API> object_id#
  <sa.class_name.set_property_name|API> object_id#
  ```

You can try application tracing using the TableViewer sample.

To configure an application for tracing

1. Start Visual Studio and open the TableViewer project file (*TableViewer.sln*) in *samples-dir\SQLAnywhere\ADO.NET\TableViewer*.

2. Place a copy of the configuration file shown above in the application's *bin\debug* folder under the name *TableViewer.exe.config*.

3. From the Debug menu, select Start Debugging.

When the application finishes execution, you will find a trace output file in *samples-dir\SQLAnywhere\ADO.NET\TableViewer\bin\Debug\myTrace.log*.

Tracing is not supported on Windows Mobile.

For more information, see "Tracing Data Access" at http://msdn.microsoft.com/library/default.asp?url=/library/en-us/dnadonet/html/tracingdataaccess.asp.

Tutorial: Using the SQL Anywhere .NET Data Provider

This section explains how to use the Simple and Table Viewer sample projects that are included with the SQL Anywhere .NET Data Provider. The sample projects can be used with Visual Studio 2005 or later versions. The sample projects were developed with Visual Studio 2005. If you use a later version, you may have to run the Visual Studio **Upgrade Wizard**.

Using the Simple code sample

This tutorial is based on the Simple project that is included with SQL Anywhere.

The complete application can be found in your SQL Anywhere samples directory at *samples-dir\SQLAnywhere\ADO.NET\SimpleWin32*.

For information about the default location of *samples-dir*, see "Samples directory" [*SQL Anywhere Server - Database Administration*].

The Simple project illustrates the following features:

- connecting to a database using the SAConnection object
- executing a query using the SACommand object
- obtaining the results using the SADataReader object
- basic error handling

For more information about how the sample works, see "Understanding the Simple sample project" on page 73.

To run the Simple code sample in Visual Studio

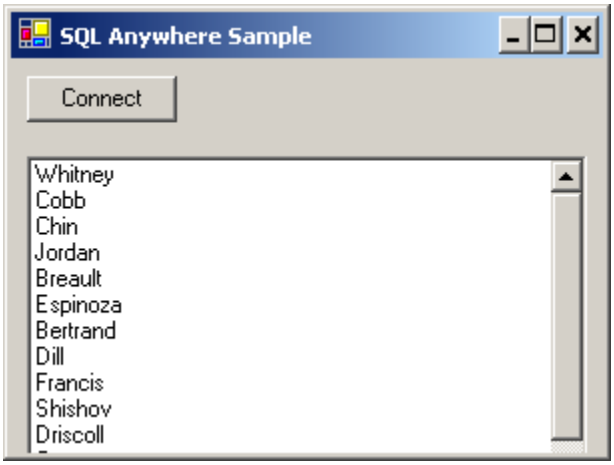
1. Start Visual Studio.
2. Choose **File** » **Open** » **Project**.
3. Browse to *samples-dir\SQLAnywhere\ADO.NET\SimpleWin32* and open the *Simple.sln* project.
4. When you use the SQL Anywhere .NET Data Provider in a project, you must add a reference to the Data Provider DLL. This has already been done in the Simple code sample. You can view the reference to the Data Provider DLL in the following location:
   - In the **Solution Explorer** window, open the **References** folder.
   - You should see iAnywhere.Data.SQLAnywhere in the list.

     For instructions about adding a reference to the Data Provider DLL, see "Adding a reference to the Data Provider in your project" on page 42.
5. You must also add a `using` directive to your source code to reference the Data Provider classes. This has already been done in the Simple code sample. To view the `using` directive:
   - Open the source code for the project. In the **Solution Explorer** window, right-click *Form1.cs* and choose **View Code**.
   - In the `using` directives in the top section, you should see the following line:

     ```
     using iAnywhere.Data.SQLAnywhere;
     ```

     This line is required for C# projects. If you are using Visual Basic .NET, you need to add an `Imports` line to your source code.
6. Choose **Debug** » **Start Without Debugging** or press Ctrl+F5 to run the Simple sample.
7. In the **SQL Anywhere Sample** window, click **Connect**.

   The application connects to the SQL Anywhere sample database and puts the last name of each employee in the window, as follows:



8. Click the **X** in the upper right corner of the screen to shut down the application and disconnect from the sample database. This also shuts down the database server.

You have now run the application. The next section describes the application code.

Understanding the Simple sample project

This section illustrates some key features of the SQL Anywhere .NET Data Provider by walking through some of the code from the Simple code sample. The Simple code sample uses the SQL Anywhere sample database, *demo.db*, which is held in your SQL Anywhere samples directory.

For information about the location of the SQL Anywhere samples directory, see "Samples directory" [*SQL Anywhere Server - Database Administration*].

For information about the sample database, including the tables in the database and the relationships between them, see "SQL Anywhere sample database" [*SQL Anywhere 12 - Introduction*].

In this section, the code is described a few lines at a time. Not all code from the sample is included here. To see all the code, open the sample project in *samples-dir\SQLAnywhere\ADO.NET\SimpleWin32*.

Declaring controls The following code declares a button named btnConnect and a listbox named listEmployees.

```
private System.Windows.Forms.Button btnConnect;
private System.Windows.Forms.ListBox listEmployees;
```

Connecting to the database The btnConnect_Click method declares and initializes an SAConnection connection object.

```
private void btnConnect_Click(object sender,
   System.EventArgs e)
   SAConnection conn = new SAConnection(
    "Data Source=SQL Anywhere 12 Demo;UID=DBA;PWD=sql" );
```

The SAConnection object uses the connection string to connect to the SQL Anywhere sample database when the Open method is called.

```
conn.Open();
```

For more information about the SAConnection object, see "SAConnection class" on page 156.

Defining a query A SQL statement is executed using an SACommand object. The following code declares and creates a command object using the SACommand constructor. This constructor accepts a string representing the query to be executed, along with the SAConnection object that represents the connection that the query is executed on.

```
SACommand cmd = new SACommand(
     "SELECT Surname FROM Employees", conn );
```

For more information about the SACommand object, see "SACommand class" on page 117.

Displaying the results The results of the query are obtained using an SADataReader object. The following code declares and creates an SADataReader object using the ExecuteReader constructor. This constructor is a member of the SACommand object, cmd, that was declared previously. ExecuteReader sends the command text to the connection for execution and builds an SADataReader.

```
SADataReader reader = cmd.ExecuteReader();
```

The following code loops through the rows held in the SADataReader object and adds them to the listbox control. Each time the Read method is called, the data reader gets another row back from the result set. A new item is added to the listbox for each row that is read. The data reader uses the GetString method with an argument of 0 to get the first column from the result set row.

```
listEmployees.BeginUpdate();
while( reader.Read() ) {
     listEmployees.Items.Add( reader.GetString( 0 ) );
}
listEmployees.EndUpdate();
```

For more information about the SADataReader object, see "SADataReader class" on page 211.

Finishing off The following code at the end of the method closes the data reader and connection objects.

```
reader.Close();
conn.Close();
```

Error handling Any errors that occur during execution and that originate with SQL Anywhere .NET Data Provider objects are handled by displaying them in a window. The following code catches the error and displays its message:

```
catch( SAException ex ) {
    MessageBox.Show( ex.Errors[0].Message );
}
```

For more information about the SAException object, see "SAException class" on page 245.

Using the Table Viewer code sample

This tutorial is based on the Table Viewer project that is included with the SQL Anywhere .NET Data Provider.

The complete application can be found in your SQL Anywhere samples directory in *samples-dir\SQLAnywhere\ADO.NET\TableViewer*.

For information about the default location of *samples-dir*, see "Samples directory" [*SQL Anywhere Server - Database Administration*].

The Table Viewer project is more complex than the Simple project. It illustrates the following features:

- connecting to a database using the SAConnection object
- executing a query using the SACommand object
- obtaining the results using the SADataReader object
- using a grid to display the results using the DataGrid object
- more advanced error handling and result checking

For more information about how the sample works, see "Understanding the Table Viewer sample project" on page 76.

To run the Table Viewer code sample in Visual Studio

1. Start Visual Studio.
2. Choose **File** » **Open** » **Project**.
3. Browse to *samples-dir\SQLAnywhere\ADO.NET\TableViewer* and open the *TableViewer.sln* project.
4. If you want to use the SQL Anywhere .NET Data Provider in a project, you must add a reference to the Data Provider DLL. This has already been done in the Table Viewer code sample. You can view the reference to the Data Provider DLL in the following location:
   - In the **Solution Explorer** window, open the **References** folder.
   - You should see iAnywhere.Data.SQLAnywhere in the list.

     For instructions about adding a reference to the Data Provider DLL, see "Adding a reference to the Data Provider in your project" on page 42.
5. You must also add a `using` directive to your source code to reference the Data Provider classes. This has already been done in the Table Viewer code sample. To view the `using` directive:
   - Open the source code for the project. In the **Solution Explorer** window, right-click *TableViewer.cs* and choose **View Code**.
   - In the `using` directives in the top section, you should see the following line:

     ```
     using iAnywhere.Data.SQLAnywhere;
     ```

     This line is required for C# projects. If you are using Visual Basic, you need to add an `Imports` line to your source code.

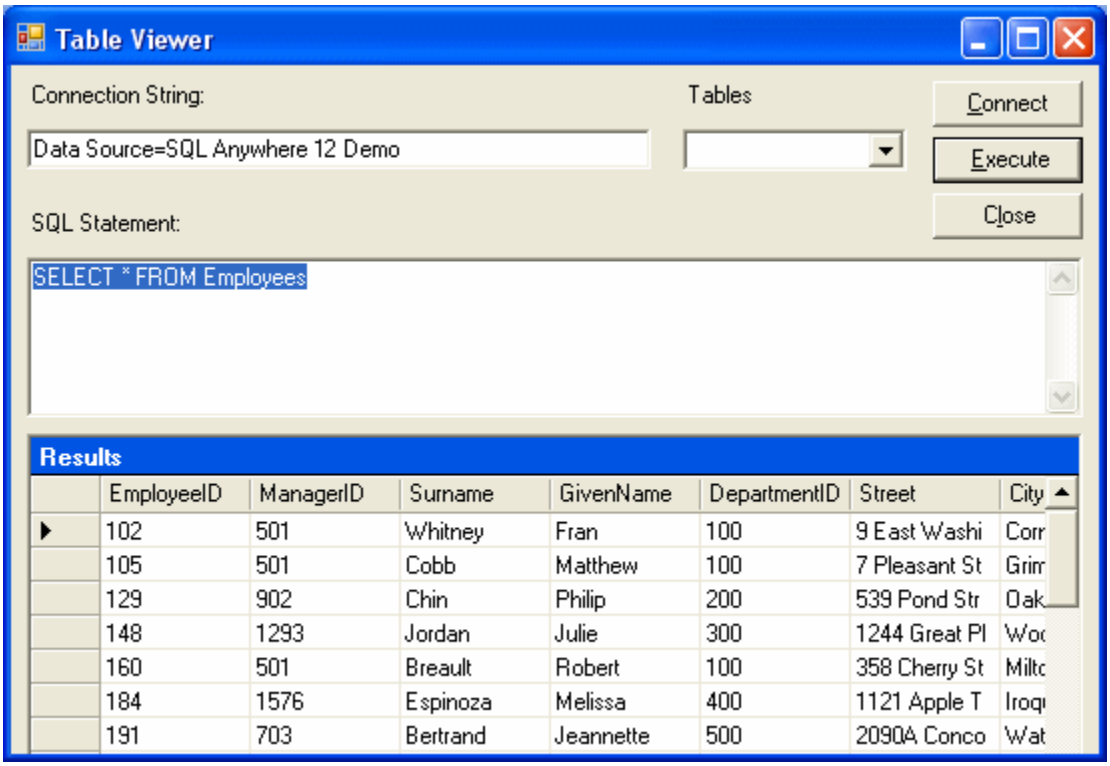
6. Choose **Debug** » **Start Without Debugging** or press Ctrl+F5 to run the Table Viewer sample.

   The application connects to the SQL Anywhere sample database.

7. In the **Table Viewer** window, click **Connect**.

8. In the **Table Viewer** window, click **Execute**.

   The application retrieves the data from the Employees table in the sample database and puts the query results in the **Results** datagrid, as follows:



   You can also execute other SQL statements from this application: type a SQL statement in the **SQL Statement** pane, and then click **Execute**.

9. In the upper right corner of the window, click **X** to shut down the application and disconnect from the SQL Anywhere sample database. This also shuts down the database server.

You have now run the application. The next section describes the application code.

Understanding the Table Viewer sample project

This section illustrates some key features of the SQL Anywhere .NET Data Provider by walking through some of the code from the Table Viewer code sample. The Table Viewer project uses the SQL Anywhere sample database, *demo.db*, which is held in your SQL Anywhere samples directory.

For information about the location of the SQL Anywhere samples directory, see "Samples directory" [*SQL Anywhere Server - Database Administration*].

For information about the sample database, including the tables in the database and the relationships between them, see "SQL Anywhere sample database" [*SQL Anywhere 12 - Introduction*].

In this section the code is described a few lines at a time. Not all code from the sample is included here. To see all the code, open the sample project in *samples-dir\SQLAnywhere\ADO.NET\TableViewer*.

Declaring controls The following code declares a couple of Labels named label1 and label2, a TextBox named txtConnectString, a button named btnConnect, a TextBox named txtSQLStatement, a button named btnExecute, and a DataGrid named dgResults.

```
private System.Windows.Forms.Label label1;
private System.Windows.Forms.TextBox txtConnectString;
private System.Windows.Forms.Label label2;
private System.Windows.Forms.Button btnConnect;
private System.Windows.Forms.TextBox txtSQLStatement;
private System.Windows.Forms.Button btnExecute;
private System.Windows.Forms.DataGrid dgResults;
```

Declaring a connection object The SAConnection type is used to declare an uninitialized SQL Anywhere connection object. The SAConnection object is used to represent a unique connection to a SQL Anywhere data source.

```
private SAConnection _conn;
```

For more information about the SAConnection class, see "SAConnection class" on page 156.

Connecting to the database The Text property of the txtConnectString object has a default value of "Data Source=SQL Anywhere 12 Demo". This value can be overridden by the application user by typing a new value into the txtConnectString text box. You can see how this default value is set by opening up the region or section in *TableViewer.cs* labeled Windows Form Designer Generated Code. In this section, you find the following line of code.

```
this.txtConnectString.Text = "Data Source=SQL Anywhere 12 Demo";
```

Later, the SAConnection object uses the connection string to connect to a database. The following code creates a new connection object with the connection string using the SAConnection constructor. It then establishes the connection by using the Open method.

```
_conn = new SAConnection( txtConnectString.Text );
_conn.Open();
```

For more information about the SAConnection constructor, see "SAConnection constructor" on page 158.

Defining a query The Text property of the txtSQLStatement object has a default value of "SELECT * FROM Employees". This value can be overridden by the application user by typing a new value into the txtSQLStatement text box.

The SQL statement is executed using an SACommand object. The following code declares and creates a command object using the SACommand constructor. This constructor accepts a string representing the

query to be executed, along with the SAConnection object that represents the connection that the query is executed on.

```
SACommand cmd = new SACommand( txtSQLStatement.Text.Trim(),
                                          _conn );
```

For more information about the SACommand object, see "SACommand class" on page 117.

Displaying the results The results of the query are obtained using an SADataReader object. The following code declares and creates an SADataReader object using the ExecuteReader constructor. This constructor is a member of the SACommand object, cmd, that was declared previously. ExecuteReader sends the command text to the connection for execution and builds an SADataReader.

```
SADataReader dr = cmd.ExecuteReader();
```

The following code connects the SADataReader object to the DataGrid object, which causes the result columns to appear on the screen. The SADataReader object is then closed.

```
dgResults.DataSource = dr;
dr.Close();
```

For more information about the SADataReader object, see "SADataReader class" on page 211.

Error handling If there is an error when the application attempts to connect to the database or when it populates the Tables combo box, the following code catches the error and displays its message:

```
try {
  _conn = new SAConnection( txtConnectString.Text );
  _conn.Open();

  SACommand cmd = new SACommand(
    "SELECT table_name FROM SYS.SYSTAB where creator = 101", _conn );
  SADataReader   dr = cmd.ExecuteReader();

  comboBoxTables.Items.Clear();
  while ( dr.Read() ) {
    comboBoxTables.Items.Add( dr.GetString( 0 ) );
  }
  dr.Close();
} catch( SAException ex ) {
  MessageBox.Show( ex.Errors[0].Source + " : " +
       ex.Errors[0].Message + " (" +
       ex.Errors[0].NativeError.ToString() + ")",
       "Failed to connect" );
}
```

For more information about the SAException object, see "SAException class" on page 245.

SQL Anywhere ASP.NET Providers

The SQL Anywhere ASP.NET providers replace the standard ASP.NET providers for SQL Server, and allow you to run your website on a SQL Anywhere database. There are five providers:

- **Membership Provider** The membership provider provides authentication and authorization services. Use the membership provider to create new users and passwords, and validate the identity of users.
- **Roles Provider** The roles provider provides methods for creating roles, adding users to roles, and deleting roles. Use the roles provider to assign users to groups and manage permissions.
- **Profiles Provider** The profiles provider provides methods for reading, storing, and retrieving user information. Use the profiles provider to save user preferences.
- **Web Parts Personalization Provider** The web parts personalization provider provides methods for loading and storing the personalized content and layout of web pages. Use the web parts personalization provider to allow users to create personalized views of your website.
- **Health Monitoring Provider** The health monitoring provider provides methods for monitoring the status of deployed web applications. Use the health monitoring provider to monitor application performance, identify failing applications or systems, and log and review significant events.

The SQL Anywhere database server schema used by the SQL Anywhere ASP.NET providers is identical to the schema used by the standard ASP.NET providers. The methodology used to manipulate and store data are identical.

When you have finished setting up the SQL Anywhere ASP.NET providers, you can use the Visual Studio ASP.NET Web Site Administration Tool to create and manage users and roles. You can also use the Visual Studio Login, LoginView, and PasswordRecovery tools to add security your web site. Use the static wrapper classes to access more advanced provider functions, or to make your own login controls.

Note
A whitepaper called **Tutorial: Creating an ASP.NET Web Page using SQL Anywhere** is available to demonstrate how to use SQL Anywhere and Visual Studio 2010 to build a database-driven ASP.NET web site. See www.sybase.com/detail?id=1080238.

Adding the SQL Anywhere ASP.NET provider schema to the database

To implement the SQL Anywhere ASP.NET providers you can create a new database, or add the schema to an existing database.

To add the schema to an existing SQL Anywhere database, run *SASetupAspNet.exe*. When executed, *SASetupAspNet.exe* connects to an existing SQL Anywhere database and creates tables and stored procedures required by the SQL Anywhere ASP.NET providers. All SQL Anywhere ASP.NET provider resources are prefixed with *aspnet_*. To minimize naming conflicts with existing database resources you can install provider database resources under any database user.

You can use a wizard or the command line to run *SASetupAspNet.exe*. To access the wizard, run the application, or execute a command line statement without arguments. When using the command line to

access the *SASetupAspNet.exe*, use the question mark (-?) argument to display detailed help for configuring the database.

Setting up the database connection

It is recommended that you specify a connection string for a user with DBA authority. A user with DBA authority can create resources for other users that might not have the necessary permissions. Alternatively, specify a connection string for a user with RESOURCE authority. The RESOURCE authority allows a user to create database objects, such as tables, views, stored procedures, and triggers. The RESOURCE authority is not inherited through group membership, and can be granted only by a user with DBA authority.

Specifying a resource owner

The wizard and command line allow you to specify the owner of the new resources. By default, the owner of new resources is DBA. When you specify the connection string for the SQL Anywhere ASP.NET providers, specify the user as DBA. You do not need to grant the user any permissions; the DBA owns the resources and has full permissions on the tables and stored procedures.

Selecting features and preserving data

You can add or remove specific features. Common components are installed automatically. Selecting **Remove** for an uninstalled feature has no effect; selecting **Add** for a feature already installed reinstalls the feature. By default, the data in tables associated with the selected feature is preserved. If a user significantly changes the schema of a table, it might not be possible to automatically preserve the data stored in it. If a clean reinstall is required, data preservation can be turned off.

It is recommended that the membership and roles providers are installed together. The effectiveness of the Visual Studio ASP.NET Web Site Administration Tool is reduced when the membership provider is not installed with the roles provider.

Note
A whitepaper called **Tutorial: Creating an ASP.NET Web Page using SQL Anywhere** is available to demonstrate how to use SQL Anywhere and Visual Studio 2010 to build a database-driven ASP.NET web site. See www.sybase.com/detail?id=1080238.

Registering the connection string

There are two methods for registering the connection string:

- You can register an ODBC data source in the ODBC Data Source Administrator, and reference it by name.
- You can specify a full SQL Anywhere connection string. For example:

```
connectionString="SERVER=MyServer;DBN=MyDatabase;UID=DBA;PWD=sql"
```

When you add the `<connectionStrings>` element to the *web.config* file, the connection string and its provider can be referenced by the application. Updates can be implemented in a single location.

XML code sample for connection string registration

```
<connectionStrings>
   <add name="MyConnectionString"
      connectionString="DSN=MyDataSource"
      providerName="iAnywhere.Data.SQLAnywhere"/>
</connectionStrings>
```

Registering the SQL Anywhere ASP.NET providers

Your web application must be configured to use the SQL Anywhere ASP.NET providers and not the default providers. To register SQL Anywhere ASP.NET providers:

- Add a reference to the iAnywhere.Web.Security assembly to your web site.
- Add an entry for each provider to the `<system.web>` element in *web.config* file.
- Add the name of the SQL Anywhere ASP.NET provider to the `defaultProvider` attribute in the application.

The provider database can store data for multiple applications. For each application, the `applicationName` attribute must be the same for each SQL Anywhere ASP.NET provider. If you do not specify an `applicationName` value, an identical name is assigned to each provider in the provider database.

To reference a previously registered connection string, replace the `connectionString` attribute with the `connectionStringName` attribute.

XML code sample for Membership Provider registration

```
<membership defaultProvider="SAMembershipProvider">
   <providers>
      <add name="SAMembershipProvider"
         type="iAnywhere.Web.Security.SAMembershipProvider"
         connectionStringName="MyConnectionString"
         applicationName="MyApplication"
         commandTimeout="30"
                  enablePasswordReset="true"
         enablePasswordRetrieval="false"
         maxInvalidPasswordAttempts="5"
         minRequiredNonalphanumericCharacters="1"
         minRequiredPasswordLength="7"
         passwordAttemptWindow="10"
         passwordFormat="Hashed"
         requiresQuestionAndAnswer="true"
         requiresUniqueEmail="true"
         passwordStrengthRegularExpression="" />
   </providers>
</membership>
```

For column descriptions, see “Membership provider XML attributes” on page 83.

XML code sample for Roles Provider registration

```
<roleManager enabled="true" defaultProvider="SARoleProvider">
   <providers>
```

```
      <add name="SARoleProvider"
         type="iAnywhere.Web.Security.SARoleProvider"
         connectionStringName="MyConnectionString"
         applicationName="MyApplication"
         commandTimeout="30" />
   </providers>
</roleManager>
```

For column descriptions, see "Roles provider table schema" on page 84.

XML code sample for Profiles Provider registration

```
<profile defaultProvider="SAProfileProvider">
   <providers>
      <add name="SAProfileProvider"
         type="iAnywhere.Web.Security.SAProfileProvider"
         connectionStringName="MyConnectionString"
         applicationName="MyApplication"
         commandTimeout="30" />
   </providers>
      <properties>
         <add name="UserString" type="string"
            serializeAs="Xml" />
         <add name="UserObject" type="object"
            serializeAs="Binary" />
   </properties>
</profile>
```

For column descriptions, see "Profile provider table schema" on page 84.

XML code sample for Personalization Provider registration

```
<webParts>
   <personalization defaultProvider="SAPersonalizationProvider">
      <providers>
               <add name="SAPersonalizationProvider"
         type="iAnywhere.Web.Security.SAPersonalizationProvider"
         connectionStringName="MyConnectionString"
         applicationName="MyApplication"
         commandTimeout="30" />
            </providers>
   </personalization>
</webParts>
```

For column descriptions, see "Web Part Personalization provider table schema" on page 85.

XML code sample for Health Monitoring Provider registration

For more information about setting up health monitoring, see the Microsoft web page How To: Use Health Monitoring in ASP.NET 2.0 (http://msdn.microsoft.com/en-us/library/ms998306.aspx).

```
<healthMonitoring enabled="true">
                  ...
   <providers>
      <add name="SAWebEventProvider"
         type="iAnywhere.Web.Security.SAWebEventProvider"
         connectionStringName="MyConnectionString"
         commandTimeout="30"
         bufferMode="Notification"
         maxEventDetailsLength="Infinite" /
   </providers>
```



```
                    ...
</healthMonitoring>
```

For column descriptions, see "Health Monitoring provider table schema" on page 85.

Membership provider XML attributes

Column Name	Description
name	The name of the provider.
type	`iAnywhere.Web.Security.SAMembershipProvider`
connectionStringName	The name of a connection string specified in the `<connection-Strings>` element.
connectionString	The connection string. Optional. Required if `connectionString-Name` is not specified.
applicationName	The application name with which to associate provider data.
commandTimeout	The timeout value, in seconds, for server calls.
enablePasswordReset	Valid entries are true or false.
enablePasswordRetrieval	Valid entries are true or false.
maxInvalidPasswordAt-tempts	Valid entries are true or false.
minRequiredNonalphanu-mericCharacters	The minimum number of special characters that must be present in a valid password.
minRequiredPasswor-dLength	The minimum length required for a password.
passwordAttemptWindow	The time window between which consecutive failed attempts to provide a valid password or password answer are tracked.
passwordFormat	Valid entries are Clear, Hashed, or Encrypted.
requiresQuestionAn-dAnswer	Valid entries are true or false.
requiresUniqueEmail	Valid entries are true or false.
passwordStrengthRegular-Expression	The regular expression used to evaluate a password.

Roles provider table schema

SARoleProvider stores role information in the aspnet_Roles table of the provider database. The namespace associated with SARoleProvider is iAnywhere.Web.Security. Each record in the Roles table corresponds to one role.

SARoleProvider uses the aspnet_UsersInRoles table to map roles to users.

Column Name	Description
name	The name of the provider.
type	`iAnywhere.Web.Security.SARoleProvider`
connectionString-Name	The name of a connection string specified in the `<connectionStrings>` element.
connectionString	The connection string. Optional. Required if `connectionStringName` is not specified.
applicationName	The application name with which to associate provider data.
commandTime-out	The timeout value, in seconds, for server calls.

Profile provider table schema

SAProfileProvider stores profile data in the aspnet_Profile table of the provider database. The namespace associated with SAProfileProvider is iAnywhere.Web.Security. Each record in the Profile table corresponds to one user's persisted profile properties.

Column Name	Description
name	The name of the provider.
type	`iAnywhere.Web.Security.SAProfileProvider`
connectionString-Name	The name of a connection string specified in the `<connectionStrings>` element.
connectionString	The connection string. Optional. Required if `connectionStringName` is not specified.
applicationName	The application name with which to associate provider data.

Column Name	Description
commandTime-out	The timeout value, in seconds, for server calls.

Web Part Personalization provider table schema

SAPersonalizationProvider preserves personalized user content in the aspnet_Paths table of the provider database. The namespace associated with SAPersonalizationProvider is iAnywhere.Web.Security.

SAPersonalizationProvider uses the aspnet_PersonalizationPerUser and aspnet_PersonalizationAllUsers tables to define the path for which the Web Parts personalization state has been saved. The PathID columns point to the column of the same name in the aspnet_Paths table.

Column Name	Description
name	The name of the provider.
type	`iAnywhere.Web.Security.SAPersonalizationProvider`
connectionString-Name	The name of a connection string specified in the `<connectionStrings>` element.
connectionString	The connection string. Optional. Required if `connectionStringName` is not specified.
applicationName	The application name with which to associate provider data.
commandTime-out	The timeout value, in seconds, for server calls.

Health Monitoring provider table schema

SAWebEventProvider logs web events in the aspnet_WebEvent_Events table of the provider database. The namespace associated with SAWebEventProvider is iAnywhere.Web.Security. Each record in the WebEvents_Events table corresponds to one web event.

For more information about setting up health monitoring, see the Microsoft web page How To: Use Health Monitoring in ASP.NET 2.0 (http://msdn.microsoft.com/en-us/library/ms998306.aspx).

Column Name	Description
name	The name of the provider.

Column Name	Description
type	`iAnywhere.Web.Security.SAWebEventProvider`
connectionString-Name	The name of a connection string specified in the `<connectionStrings>` element.
connectionString	The connection string. Optional. Required if `connectionStringName` is not specified.
commandTimeout	The timeout value, in seconds, for server calls.
maxEventDetail-sLength	The maximum length of the details string for each event or Infinite

Tutorial: Developing a simple .NET database application with Visual Studio

Lesson 1: Create a table viewer

This tutorial is based on Visual Studio and the .NET Framework. The complete application can be found in the ADO.NET project *samples-dir\SQLAnywhere\ADO.NET\SimpleViewer\SimpleViewer.sln*.

In this tutorial, you use Microsoft Visual Studio, the Server Explorer, and the SQL Anywhere .NET Data Provider to create an application that accesses one of the tables in the SQL Anywhere sample database, allowing you to examine rows and perform updates.

To develop a database application with Visual Studio

1. Start Visual Studio.
2. From the Visual Studio **File** menu, choose **New** » **Project**.

   The **New Project** window appears.

   a. In the left pane of the **New Project** window, choose either **Visual Basic** or **Visual C#** for the programming language.

   b. From the **Windows** subcategory, choose **Windows Application** (VS 2005) or **Windows Forms Application** (VS 2008).

   c. In the project **Name** field, type **MySimpleViewer**.

   d. Click **OK** to create the new project.
3. In the Visual Studio **View** menu, choose **Server Explorer**.

4. In the **Server Explorer** window, right-click **Data Connections** and choose **Add Connection**.

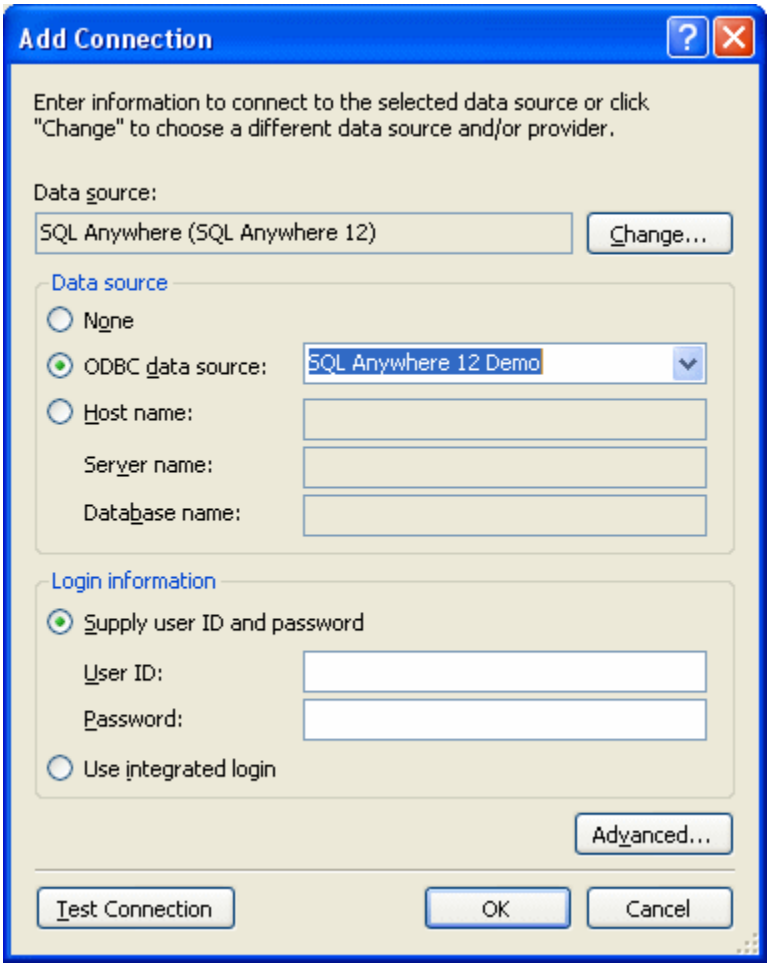
   A new connection named **SQL Anywhere.demo12** appears in the **Server Explorer** window.

5. In the **Add Connection** window:

   a. If you have never used **Add Connection** for other projects, then you will see a list of data sources. Choose **SQL Anywhere** from the list of data sources presented.

      If you have used **Add Connection** before, then click **Change** to change the data source to **SQL Anywhere**.

   b. Under **Data Source**, choose **ODBC Data Source Name** and type **SQL Anywhere 12 Demo**.



   c. Click **Test Connection** to verify that you can connect to the sample database.

   d. Click **OK**.

6. Expand the **SQL Anywhere.demo12** connection in the **Server Explorer** window until you see the table names. If you are using Visual Studio 2005, then try the following:

a. Right-click the Products table and choose **Show Table Data**.

   This shows the rows and columns of the Products table in a window.

b. Close the table data window.

7. From the Visual Studio **Data** menu, choose **Add New Data Source**.

8. In the **Data Source Configuration Wizard**, do the following:

   a. On the **Data Source Type** page, choose **Database** and click **Next**.

   b. On the **Data Connection** page, choose **SQL Anywhere.demo12** and click **Next**.

   c. On the **Save The Connection String** page, make sure that **Yes, Save The Connection As** is chosen and click **Next**.

   d. On the **Choose Your Database Objects** page, choose **Tables** and click **Finish**.

9. From the Visual Studio **Data** menu, choose **Show Data Sources**.

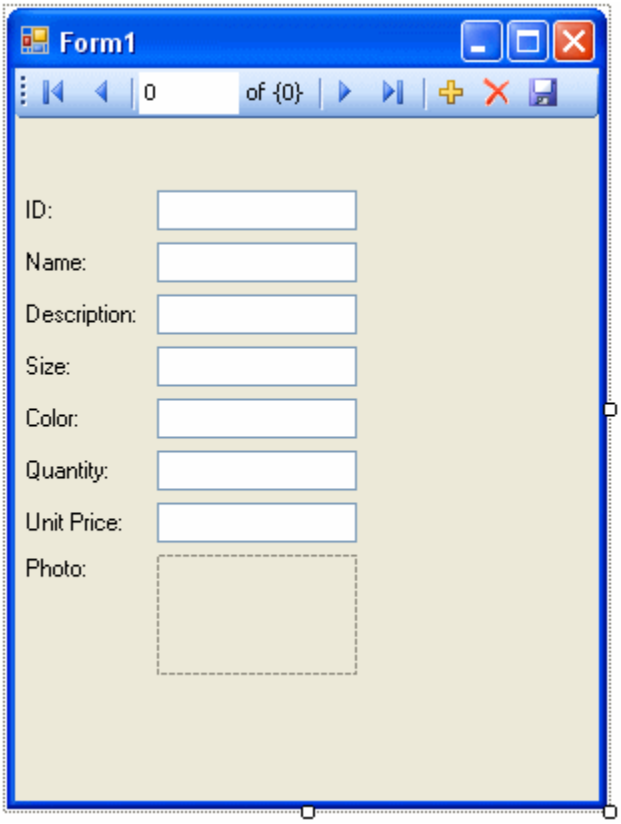
   The **Data Sources** window appears.

   Expand the Products table in the **Data Sources** window.

   a. Click Products and choose **Details** from the dropdown list.

   b. Click Photo and choose **Picture Box** from the dropdown list.

   c. Click Products and drag it to your form (Form1).

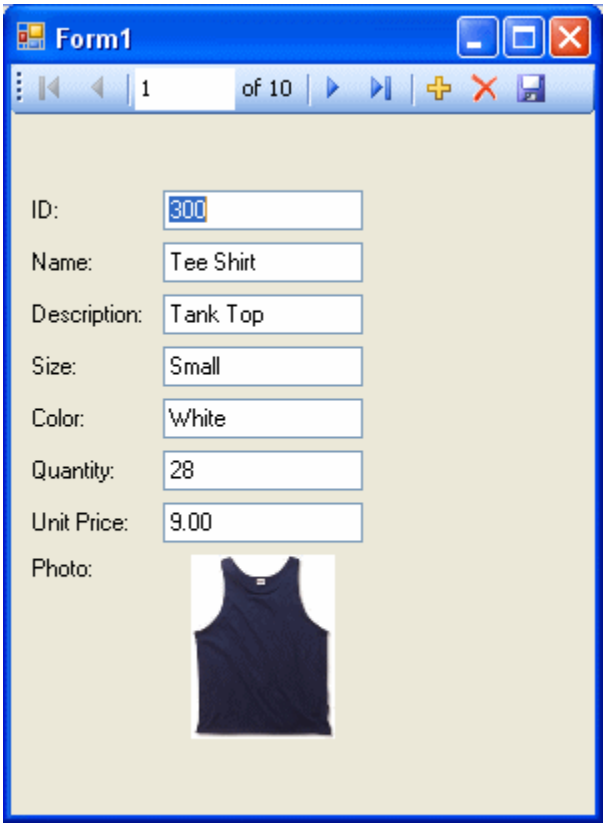


A dataset control and several labeled text fields appear on the form.

10. On the form, choose the picture box next to Photo.
    a. Change the shape of the box to a square.
    b. Click the right-arrow in the upper-right corner of the picture box.

       The **Picture Box Tasks** window opens.
    c. From the **Size Mode** dropdown list, choose **Zoom**.
    d. To close the **Picture Box Tasks** window, click anywhere outside the window.
11. Build and run the project.
    a. From the Visual Studio **Build** menu, choose **Build Solution**.
    b. From the Visual Studio **Debug** menu, choose **Start Debugging**.

       The application connects to the SQL Anywhere sample database and displays the first row of the Products table in the text boxes and picture box.



c. You can use the buttons on the control to scroll through the rows of the result set.

d. You can go directly to a row in the result set by entering the row number in the scroll control.

e. You can update values in the result set using the text boxes and save them by clicking the diskette icon.

You have now created a simple, yet powerful, .NET application using Visual Studio, the Server Explorer, and the SQL Anywhere .NET Data Provider.

12. Shut down the application and then save your project.

Lesson 2: Add a synchronizing data control

This tutorial is a continuation of the tutorial described in "Lesson 1: Create a table viewer" on page 86. The complete application can be found in the ADO.NET project *samples-dir\SQLAnywhere\ADO.NET \SimpleViewer\SimpleViewer.sln*.

In this tutorial, you add a datagrid control to the form developed in the previous tutorial. This control updates automatically as you navigate through the result set.

To add a datagrid control

1. Start Visual Studio and load your MySimpleViewer project that you created in "Lesson 1: Create a table viewer" on page 86.
2. Right-click DataSet1 in the **Data Sources** window and choose **Edit DataSet With Designer**.
3. Right-click an empty area in the **DataSet Designer** window and choose **Add** » **TableAdapter**.
4. In the **TableAdapter Configuration Wizard**:
   a. On the **Choose Your Data Connection** page, click **Next**.
   b. On the **Choose A Command Type** page, make sure **Use SQL Statements** is chosen and then click **Next**.
   c. On the **Enter A SQL Statement** page, click **Query Builder**.
   d. On the **Add Table** window, click the **Views** tab, choose **ViewSalesOrders**, and click **Add**.
   e. Click **Close** to close the **Add Table** window.
5. Expand the **Query Builder** window so that all sections of the window are visible.
   a. Expand the **ViewSalesOrders** window so that all the checkboxes are visible.
   b. Choose **Region**.
   c. Choose **Quantity**.
   d. Choose **ProductID**.
   e. In the grid below the **ViewSalesOrders** window, clear the checkbox under **Output** for the ProductID column.
   f. For the ProductID column, type a question mark (?) in the **Filter** cell. This generates a WHERE clause for ProductID.

   A SQL query has been built that looks like the following:

   ```
   SELECT   Region, Quantity
   FROM     GROUPO.ViewSalesOrders
   WHERE    (ProductID = :Param1)
   ```

6. Modify the SQL query as follows:
   a. Change `Quantity` to `SUM(Quantity) AS TotalSales`.
   b. Add `GROUP BY Region` to the end of the query following the WHERE clause.

   The modified SQL query now looks like this:

   ```
   SELECT   Region, SUM(Quantity) as TotalSales
   FROM     GROUPO.ViewSalesOrders
   WHERE    (ProductID = :Param1)
   GROUP BY Region
   ```

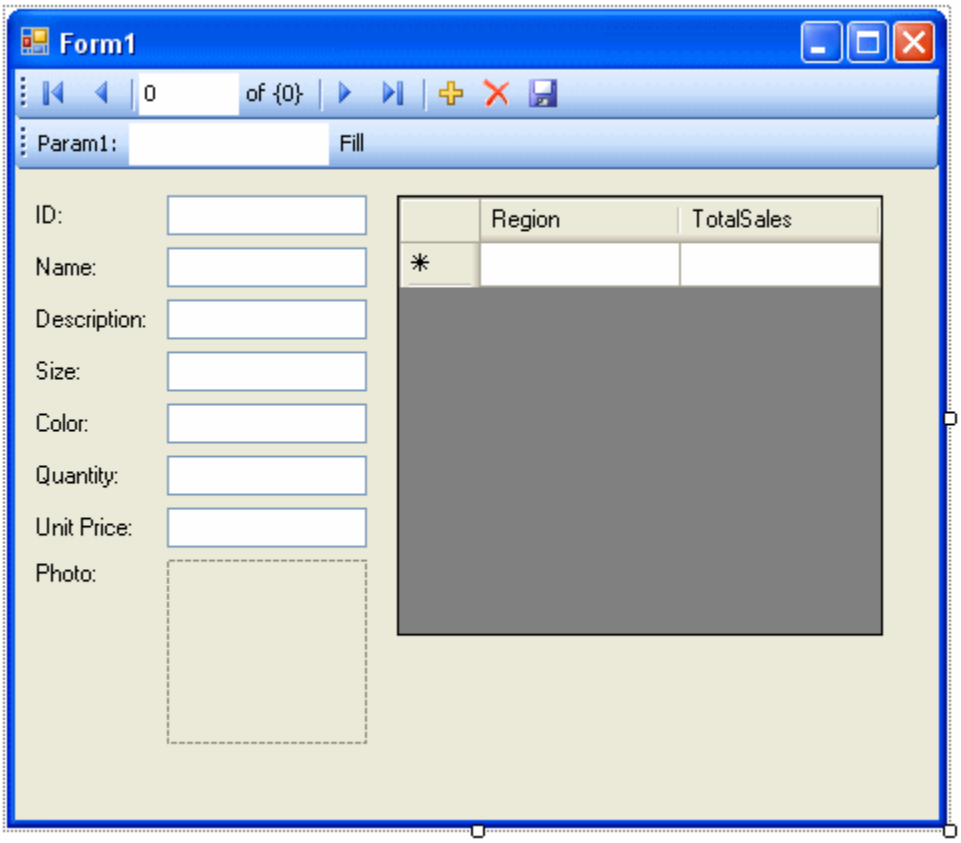
7. Click **OK**.

8. Click **Finish**.

   A new **TableAdapter** called **ViewSalesOrders** has been added to the **DataSet Designer** window.

9. Click the form design tab (Form1).
   - Stretch the form to the right to make room for a new control.

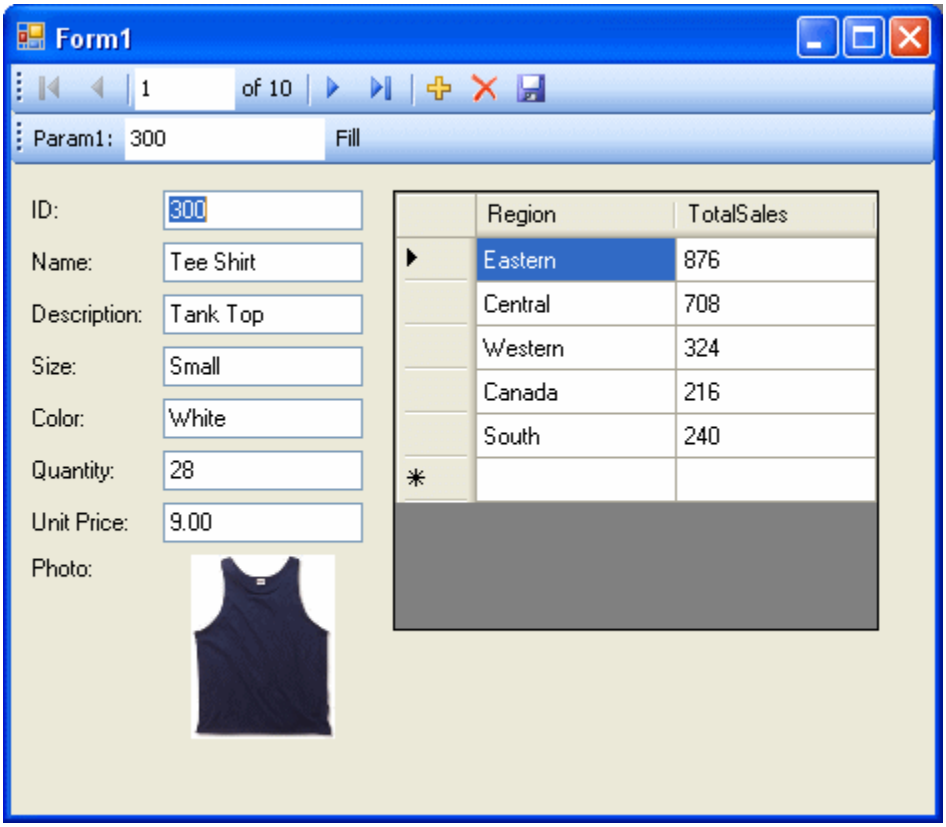
10. Expand ViewSalesOrders in the **Data Sources** window.
    a. Click ViewSalesOrders and choose **DataGridView** from the dropdown list.
    b. Click ViewSalesOrders and drag it to your form (Form1).



   A datagrid view control appears on the form.

11. Build and run the project.
    - From the Visual Studio **Build** menu, choose **Build Solution**.
    - From the Visual Studio **Debug** menu, choose **Start Debugging**.
    - In the **Param1** text box, enter a product ID number such as 300 and click **Fill**.

      The datagrid view displays a summary of sales by region for the product ID entered.



You can also use the other control on the form to move through the rows of the result set.

It would be ideal, however, if both controls could stay synchronized with each other. The next few steps show how to do this.

12. Shut down the application and then save your project.

13. Delete the Fill strip on the form since you do not need it.

    - On the design form (Form1), right-click the Fill strip to the right of the word **Fill** and choose **Delete**.

      The Fill strip is removed from the form.

14. Synchronize the two controls as follows.

    a. On the design form (Form1), right-click the ID text box and choose **Properties**.

    b. Click the **Events** icon (it appears as a lightning bolt).

    c. Scroll down until you find the **TextChanged** event.

    d. Click **TextChanged** and choose **FillToolStripButton_Click** from the dropdown list. If you are using Visual Basic, the event is called **FillToolStripButton_Click**.

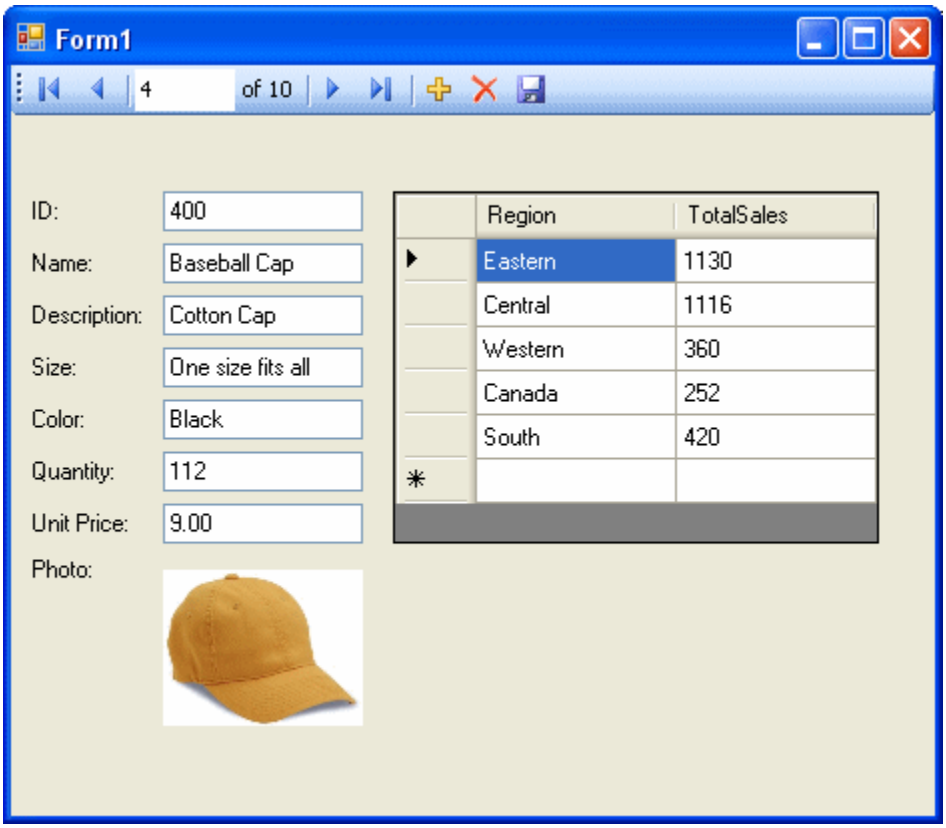
e. Double-click **FillToolStripButton_Click** and the form's code window opens on the `fillToolStripButton_Click` event handler.

f. Find the reference to `param1ToolStripTextBox` and change this to `iDTextBox`. If you are using Visual Basic, the text box is called `IDTextBox`.

g. Rebuild and run the project.

15. The application form now appears with a single navigation control.

- The datagrid view displays an updated summary of sales by region corresponding to the current product as you move through the result set.



You have now added a control that updates automatically as you navigate through the result set.

16. Shut down the application and then save your project.

In these tutorials, you saw how the powerful combination of Microsoft Visual Studio, the Server Explorer, and the SQL Anywhere .NET Data Provider can be used to create database applications.

SQL Anywhere .NET API reference

Namespace

```
iAnywhere.Data.SQLAnywhere
```

SABulkCopy class

Efficiently bulk load a SQL Anywhere table with data from another source.

Visual Basic syntax

```
Public NotInheritable Class SABulkCopy Implements System.IDisposable
```

C# syntax

```
public sealed class SABulkCopy : System.IDisposable
```

Base classes

- System.IDisposable

Members

All members of SABulkCopy class, including all inherited members.

Name	Description
"SABulkCopy constructor"	Initializes an SABulkCopy object.
"Close method"	Closes the SABulkCopy instance.
"Dispose method"	Disposes of the SABulkCopy instance.
"WriteToServer method"	Copies all rows in the supplied array of System.Data.DataRow objects to a destination table specified by the DestinationTableName property of the SABulkCopy object.
"BatchSize property"	Gets or sets the number of rows in each batch.
"BulkCopyTimeout property"	Gets or sets the number of seconds for the operation to complete before it times out.
"ColumnMappings property"	Returns a collection of SABulkCopyColumnMapping items.
"DestinationTableName property"	Gets or sets the name of the destination table on the server.
"NotifyAfter property"	Gets or sets the number of rows to be processed before generating a notification event.
"SARowsCopied event"	This event occurs every time the number of rows specified by the NotifyAfter property have been processed.

Remarks

The SABulkCopy class is not available in the .NET Compact Framework 2.0.

Implements: System.IDisposable

SABulkCopy constructor

Initializes an SABulkCopy object.

Overload list

Name	Description
"SABulkCopy(SAConnection) constructor"	Initializes an SABulkCopy object.
"SABulkCopy(SAConnection, SABulkCopyOptions, SATransaction) constructor"	Initializes an SABulkCopy object.
"SABulkCopy(string) constructor"	Initializes an SABulkCopy object.
"SABulkCopy(string, SABulkCopyOptions) constructor"	Initializes an SABulkCopy object.

SABulkCopy(SAConnection) constructor

Initializes an SABulkCopy object.

Visual Basic syntax

```
Public Sub New(ByVal connection As SAConnection)
```

C# syntax

```
public SABulkCopy(SAConnection connection)
```

Parameters

- **connection** The already open SAConnection that will be used to perform the bulk-copy operation. If the connection is not open, an exception is thrown in WriteToServer.

Remarks

The SABulkCopy class is not available in the .NET Compact Framework 2.0.

SABulkCopy(SAConnection, SABulkCopyOptions, SATransaction) constructor

Initializes an SABulkCopy object.

Visual Basic syntax

```
Public Sub New(
    ByVal connection As SAConnection,
    ByVal copyOptions As SABulkCopyOptions,
    ByVal externalTransaction As SATransaction
)
```

C# syntax

```
public SABulkCopy(
    SAConnection connection,
    SABulkCopyOptions copyOptions,
    SATransaction externalTransaction
)
```

Parameters

- **connection** The already open SAConnection that will be used to perform the bulk-copy operation. If the connection is not open, an exception is thrown in WriteToServer.
- **copyOptions** A combination of values from the SABulkCopyOptions enumeration that determines which data source rows are copied to the destination table.
- **externalTransaction** An existing SATransaction instance under which the bulk copy will occur. If externalTransaction is not NULL, then the bulk-copy operation is done within it. It is an error to specify both an external transaction and the UseInternalTransaction option.

Remarks

The SABulkCopy class is not available in the .NET Compact Framework 2.0.

SABulkCopy(string) constructor

Initializes an SABulkCopy object.

Visual Basic syntax

```
Public Sub New(ByVal connectionString As String)
```

C# syntax

```
public SABulkCopy(string connectionString)
```

Parameters

- **connectionString** The string defining the connection that will be opened for use by the SABulkCopy instance. A connection string is a semicolon-separated list of keyword=value pairs.

Remarks

This syntax opens a connection during WriteToServer using connectionString. The connection is closed at the end of WriteToServer.

The SABulkCopy class is not available in the .NET Compact Framework 2.0.

SABulkCopy(string, SABulkCopyOptions) constructor

Initializes an SABulkCopy object.

Visual Basic syntax

```
Public Sub New(
    ByVal connectionString As String,
    ByVal copyOptions As SABulkCopyOptions
)
```

C# syntax

```
public SABulkCopy(
    string connectionString,
    SABulkCopyOptions copyOptions
)
```

Parameters

- **connectionString** The string defining the connection that will be opened for use by the SABulkCopy instance. A connection string is a semicolon-separated list of keyword=value pairs.
- **copyOptions** A combination of values from the SABulkCopyOptions enumeration that determines which data source rows are copied to the destination table.

Remarks

This syntax opens a connection during WriteToServer using connectionString. The connection is closed at the end of WriteToServer. The copyOptions parameter has the effects described above.

The SABulkCopy class is not available in the .NET Compact Framework 2.0.

Close method

Closes the SABulkCopy instance.

Visual Basic syntax

```
Public Sub Close()
```

C# syntax

```
public void Close()
```

Dispose method

Disposes of the SABulkCopy instance.

Visual Basic syntax

```
Public Sub Dispose()
```


C# syntax

```
public void Dispose()
```

WriteToServer method

Copies all rows in the supplied array of System.Data.DataRow objects to a destination table specified by the DestinationTableName property of the SABulkCopy object.

Overload list

Name	Description
"WriteToServer(DataRow[]) method"	Copies all rows in the supplied array of System.Data.DataRow objects to a destination table specified by the DestinationTableName property of the SABulkCopy object.
"WriteToServer(DataTable) method"	Copies all rows in the supplied System.Data.DataTable to a destination table specified by the DestinationTableName property of the SABulkCopy object.
"WriteToServer(DataTable, DataRowState) method"	Copies all rows in the supplied System.Data.DataTable with the specified row state to a destination table specified by the DestinationTableName property of the SABulkCopy object.
"WriteToServer(IDataReader) method"	Copies all rows in the supplied System.Data.IDataReader to a destination table specified by the DestinationTableName property of the SABulkCopy object.

WriteToServer(DataRow[]) method

Copies all rows in the supplied array of System.Data.DataRow objects to a destination table specified by the DestinationTableName property of the SABulkCopy object.

Visual Basic syntax

```
Public Sub WriteToServer(ByVal rows As DataRow())
```

C# syntax

```
public void WriteToServer(DataRow[] rows)
```

Parameters

- **rows** An array of System.Data.DataRow objects that will be copied to the destination table.

Remarks

The SABulkCopy class is not available in the .NET Compact Framework 2.0.

See also

- "DestinationTableName property" on page 102

WriteToServer(DataTable) method

Copies all rows in the supplied System.Data.DataTable to a destination table specified by the DestinationTableName property of the SABulkCopy object.

Visual Basic syntax

```
Public Sub WriteToServer(ByVal table As DataTable)
```

C# syntax

```
public void WriteToServer(DataTable table)
```

Parameters

- **table** A System.Data.DataTable whose rows will be copied to the destination table.

Remarks

The SABulkCopy class is not available in the .NET Compact Framework 2.0.

See also

- "DestinationTableName property" on page 102

WriteToServer(DataTable, DataRowState) method

Copies all rows in the supplied System.Data.DataTable with the specified row state to a destination table specified by the DestinationTableName property of the SABulkCopy object.

Visual Basic syntax

```
Public Sub WriteToServer(
    ByVal table As DataTable,
    ByVal rowState As DataRowState
)
```

C# syntax

```
public void WriteToServer(DataTable table, DataRowState rowState)
```

Parameters

- **table** A System.Data.DataTable whose rows will be copied to the destination table.
- **rowState** A value from the System.Data.DataRowState enumeration. Only rows matching the row state are copied to the destination.

Remarks

Only those rows matching the row state are copied.

The SABulkCopy class is not available in the .NET Compact Framework 2.0.

See also

- "DestinationTableName property" on page 102

WriteToServer(IDataReader) method

Copies all rows in the supplied System.Data.IDataReader to a destination table specified by the DestinationTableName property of the SABulkCopy object.

Visual Basic syntax

```
Public Sub WriteToServer(ByVal reader As IDataReader)
```

C# syntax

```
public void WriteToServer(IDataReader reader)
```

Parameters

- **reader** A System.Data.IDataReader whose rows will be copied to the destination table.

Remarks

The SABulkCopy class is not available in the .NET Compact Framework 2.0.

See also

- "DestinationTableName property" on page 102

BatchSize property

Gets or sets the number of rows in each batch.

Visual Basic syntax

```
Public Property BatchSize As Integer
```

C# syntax

```
public int BatchSize {get;set;}
```

Remarks

At the end of each batch, the rows in the batch are sent to the server.

The number of rows in each batch. The default is 0.

Setting this property to zero causes all the rows to be sent in one batch.

Setting this property to a value less than zero is an error.

If this value is changed while a batch is in progress, the current batch completes and any further batches use the new value.

BulkCopyTimeout property

Gets or sets the number of seconds for the operation to complete before it times out.

Visual Basic syntax

```
Public Property BulkCopyTimeout As Integer
```

C# syntax

```
public int BulkCopyTimeout {get;set;}
```

Remarks

The default value is 30 seconds.

A value of zero indicates no limit. This should be avoided because it may cause an indefinite wait.

If the operation times out, then all rows in the current transaction are rolled back and an SAException is raised.

Setting this property to a value less than zero is an error.

ColumnMappings property

Returns a collection of SABulkCopyColumnMapping items.

Visual Basic syntax

```
Public ReadOnly Property ColumnMappings As
SABulkCopyColumnMappingCollection
```

C# syntax

```
public SABulkCopyColumnMappingCollection ColumnMappings {get;}
```

Remarks

Column mappings define the relationships between columns in the data source and columns in the destination.

By default, it is an empty collection.

The property cannot be modified while WriteToServer is executing.

If ColumnMappings is empty when WriteToServer is executed, then the first column in the source is mapped to the first column in the destination, the second to the second, and so on. This takes place as long as the column types are convertible, there are at least as many destination columns as source columns, and any extra destination columns are nullable.

DestinationTableName property

Gets or sets the name of the destination table on the server.

Visual Basic syntax

```
Public Property DestinationTableName As String
```


C# syntax

```
public string DestinationTableName {get;set;}
```

Remarks

The default value is a null reference. In Visual Basic it is Nothing.

If the value is changed while WriteToServer is executing, the change has no effect.

If the value has not been set before a call to WriteToServer, an InvalidOperationException is raised.

It is an error to set the value to NULL or the empty string.

NotifyAfter property

Gets or sets the number of rows to be processed before generating a notification event.

Visual Basic syntax

```
Public Property NotifyAfter As Integer
```

C# syntax

```
public int NotifyAfter {get;set;}
```

Remarks

Zero is returned if the property has not been set.

Changes made to NotifyAfter, while executing WriteToServer, do not take effect until after the next notification.

Setting this property to a value less than zero is an error.

The values of NotifyAfter and BulkCopyTimeout are mutually exclusive, so the event can fire even if no rows have been sent to the database or committed.

See also

- "BulkCopyTimeout property" on page 101

SARowsCopied event

This event occurs every time the number of rows specified by the NotifyAfter property have been processed.

Visual Basic syntax

```
Public Event SARowsCopied As SARowsCopiedEventHandler
```

C# syntax

```
public event SARowsCopiedEventHandler SARowsCopied;
```

Remarks

The receipt of an SARowsCopied event does not imply that any rows have been sent to the database server or committed. You cannot call the Close method from this event.

See also

- "NotifyAfter property" on page 103

SABulkCopyColumnMapping class

Defines the mapping between a column in an SABulkCopy instance's data source and a column in the instance's destination table.

Visual Basic syntax

```
Public NotInheritable Class SABulkCopyColumnMapping
```

C# syntax

```
public sealed class SABulkCopyColumnMapping
```

Members

All members of SABulkCopyColumnMapping class, including all inherited members.

Name	Description
"SABulkCopyColumnMapping constructor"	Creates a new column mapping, using column ordinals or names to refer to source and destination columns.
"DestinationColumn property"	Gets or sets the name of the column in the destination database table being mapped to.
"DestinationOrdinal property"	Gets or sets the ordinal value of the column in the destination table being mapped to.
"SourceColumn property"	Gets or sets the name of the column being mapped in the data source.
"SourceOrdinal property"	Gets or sets ordinal position of the source column within the data source.

Remarks

The SABulkCopyColumnMapping class is not available in the .NET Compact Framework 2.0.

SABulkCopyColumnMapping constructor

Creates a new column mapping, using column ordinals or names to refer to source and destination columns.

Overload list

Name	Description
"SABulkCopyColumnMapping() constructor"	Creates a new column mapping, using column ordinals or names to refer to source and destination columns.
"SABulkCopyColumnMapping(int, int) constructor"	Creates a new column mapping, using column ordinals to refer to source and destination columns.
"SABulkCopyColumnMapping(int, string) constructor"	Creates a new column mapping, using a column ordinal to refer to the source column and a column name to refer to the destination column.
"SABulkCopyColumnMapping(string, int) constructor"	Creates a new column mapping, using a column name to refer to the source column and a column ordinal to refer to the destination column.
"SABulkCopyColumnMapping(string, string) constructor"	Creates a new column mapping, using column names to refer to source and destination columns.

SABulkCopyColumnMapping() constructor

Creates a new column mapping, using column ordinals or names to refer to source and destination columns.

Visual Basic syntax

```
Public Sub New()
```

C# syntax

```
public SABulkCopyColumnMapping()
```

Remarks

The SABulkCopyColumnMapping class is not available in the .NET Compact Framework 2.0.

SABulkCopyColumnMapping(int, int) constructor

Creates a new column mapping, using column ordinals to refer to source and destination columns.

Visual Basic syntax

```
Public Sub New(
    ByVal sourceColumnOrdinal As Integer,
    ByVal destinationColumnOrdinal As Integer
)
```

C# syntax

```
public SABulkCopyColumnMapping(
    int sourceColumnOrdinal,
    int destinationColumnOrdinal
)
```

Parameters

- **sourceColumnOrdinal** The ordinal position of the source column within the data source. The first column in a data source has ordinal position zero.
- **destinationColumnOrdinal** The ordinal position of the destination column within the destination table. The first column in a table has ordinal position zero.

Remarks

The SABulkCopyColumnMapping class is not available in the .NET Compact Framework 2.0.

SABulkCopyColumnMapping(int, string) constructor

Creates a new column mapping, using a column ordinal to refer to the source column and a column name to refer to the destination column.

Visual Basic syntax

```
Public Sub New(
    ByVal sourceColumnOrdinal As Integer,
    ByVal destinationColumn As String
)
```

C# syntax

```
public SABulkCopyColumnMapping(
    int sourceColumnOrdinal,
    string destinationColumn
)
```

Parameters

- **sourceColumnOrdinal** The ordinal position of the source column within the data source. The first column in a data source has ordinal position zero.
- **destinationColumn** The name of the destination column within the destination table.

Remarks

The SABulkCopyColumnMapping class is not available in the .NET Compact Framework 2.0.

SABulkCopyColumnMapping(string, int) constructor

Creates a new column mapping, using a column name to refer to the source column and a column ordinal to refer to the destination column.

Visual Basic syntax

```
Public Sub New(
    ByVal sourceColumn As String,
    ByVal destinationColumnOrdinal As Integer
)
```


C# syntax

```
public SABulkCopyColumnMapping(
    string sourceColumn,
    int destinationColumnOrdinal
)
```

Parameters

- **sourceColumn** The name of the source column within the data source.
- **destinationColumnOrdinal** The ordinal position of the destination column within the destination table. The first column in a table has ordinal position zero.

Remarks

The SABulkCopyColumnMapping class is not available in the .NET Compact Framework 2.0.

SABulkCopyColumnMapping(string, string) constructor

Creates a new column mapping, using column names to refer to source and destination columns.

Visual Basic syntax

```
Public Sub New(
    ByVal sourceColumn As String,
    ByVal destinationColumn As String
)
```

C# syntax

```
public SABulkCopyColumnMapping(
    string sourceColumn,
    string destinationColumn
)
```

Parameters

- **sourceColumn** The name of the source column within the data source.
- **destinationColumn** The name of the destination column within the destination table.

Remarks

The SABulkCopyColumnMapping class is not available in the .NET Compact Framework 2.0.

DestinationColumn property

Gets or sets the name of the column in the destination database table being mapped to.

Visual Basic syntax

```
Public Property DestinationColumn As String
```

C# syntax

```
public string DestinationColumn {get;set;}
```

Remarks

A string specifying the name of the column in the destination table or a null reference (Nothing in Visual Basic) if the DestinationOrdinal property has priority.

The DestinationColumn property and DestinationOrdinal property are mutually exclusive. The most recently set value takes priority.

Setting the DestinationColumn property causes the DestinationOrdinal property to be set to -1. Setting the DestinationOrdinal property causes the DestinationColumn property to be set to a null reference (Nothing in Visual Basic).

It is an error to set DestinationColumn to null or the empty string.

See also

- "DestinationOrdinal property" on page 108

DestinationOrdinal property

Gets or sets the ordinal value of the column in the destination table being mapped to.

Visual Basic syntax

```
Public Property DestinationOrdinal As Integer
```

C# syntax

```
public int DestinationOrdinal {get;set;}
```

Remarks

An integer specifying the ordinal of the column being mapped to in the destination table or -1 if the property is not set.

The DestinationColumn property and DestinationOrdinal property are mutually exclusive. The most recently set value takes priority.

Setting the DestinationColumn property causes the DestinationOrdinal property to be set to -1. Setting the DestinationOrdinal property causes the DestinationColumn property to be set to a null reference (Nothing in Visual Basic).

See also

- "DestinationColumn property" on page 107

SourceColumn property

Gets or sets the name of the column being mapped in the data source.

Visual Basic syntax

```
Public Property SourceColumn As String
```

C# syntax

```
public string SourceColumn {get;set;}
```

Remarks

A string specifying the name of the column in the data source or a null reference (Nothing in Visual Basic) if the SourceOrdinal property has priority.

The SourceColumn property and SourceOrdinal property are mutually exclusive. The most recently set value takes priority.

Setting the SourceColumn property causes the SourceOrdinal property to be set to -1. Setting the SourceOrdinal property causes the SourceColumn property to be set to a null reference (Nothing in Visual Basic).

It is an error to set SourceColumn to null or the empty string.

See also

- "SourceOrdinal property" on page 109

SourceOrdinal property

Gets or sets ordinal position of the source column within the data source.

Visual Basic syntax

```
Public Property SourceOrdinal As Integer
```

C# syntax

```
public int SourceOrdinal {get;set;}
```

Remarks

An integer specifying the ordinal of the column in the data source or -1 if the property is not set.

The SourceColumn property and SourceOrdinal property are mutually exclusive. The most recently set value takes priority.

Setting the SourceColumn property causes the SourceOrdinal property to be set to -1. Setting the SourceOrdinal property causes the SourceColumn property to be set to a null reference (Nothing in Visual Basic).

See also

- "SourceColumn property" on page 108

SABulkCopyColumnMappingCollection class

A collection of SABulkCopyColumnMapping objects that inherits from System.Collections.CollectionBase.

Visual Basic syntax

```
Public NotInheritable Class SABulkCopyColumnMappingCollection
    Inherits System.Collections.CollectionBase
```

C# syntax

```
public sealed class SABulkCopyColumnMappingCollection :
    System.Collections.CollectionBase
```

Base classes

- System.Collections.CollectionBase

Members

All members of SABulkCopyColumnMappingCollection class, including all inherited members.

Name	Description
"Add method"	Adds the specified SABulkCopyColumnMapping object to the collection.
Clear method (Inherited from System.Collections.CollectionBase)	Removes all objects from the System.Collections.CollectionBase instance.
"Contains method"	Gets a value indicating whether a specified SABulkCopyColumnMapping object exists in the collection.
"CopyTo method"	Copies the elements of the SABulkCopyColumnMappingCollection to an array of SABulkCopyColumnMapping items, starting at a particular index.
GetEnumerator method (Inherited from System.Collections.CollectionBase)	Returns an enumerator that iterates through the System.Collections.CollectionBase instance.
"IndexOf method"	Gets or sets the index of the specified SABulkCopyColumnMapping object within the collection.
OnClear method (Inherited from System.Collections.CollectionBase)	Performs additional custom processes when clearing the contents of the System.Collections.CollectionBase instance.
OnClearComplete method (Inherited from System.Collections.CollectionBase)	Performs additional custom processes after clearing the contents of the System.Collections.CollectionBase instance.

Name	Description
OnInsert method (Inherited from System.Collections.CollectionBase)	Performs additional custom processes before inserting a new element into the System.Collections.CollectionBase instance.
OnInsertComplete method (Inherited from System.Collections.CollectionBase)	Performs additional custom processes after inserting a new element into the System.Collections.CollectionBase instance.
OnRemove method (Inherited from System.Collections.CollectionBase)	Performs additional custom processes when removing an element from the System.Collections.CollectionBase instance.
OnRemoveComplete method (Inherited from System.Collections.CollectionBase)	Performs additional custom processes after removing an element from the System.Collections.CollectionBase instance.
OnSet method (Inherited from System.Collections.CollectionBase)	Performs additional custom processes before setting a value in the System.Collections.CollectionBase instance.
OnSetComplete method (Inherited from System.Collections.CollectionBase)	Performs additional custom processes after setting a value in the System.Collections.CollectionBase instance.
OnValidate method (Inherited from System.Collections.CollectionBase)	Performs additional custom processes when validating a value.
“Remove method”	Removes the specified SABulkCopyColumnMapping element from the SABulkCopyColumnMappingCollection.
“RemoveAt method”	Removes the mapping at the specified index from the collection.
Capacity property (Inherited from System.Collections.CollectionBase)	Gets or sets the number of elements that the System.Collections.CollectionBase can contain.
Count property (Inherited from System.Collections.CollectionBase)	Gets the number of elements contained in the System.Collections.CollectionBase instance.
InnerList property (Inherited from System.Collections.CollectionBase)	Gets an System.Collections.ArrayList containing the list of elements in the System.Collections.CollectionBase instance.
List property (Inherited from System.Collections.CollectionBase)	Gets an System.Collections.IList containing the list of elements in the System.Collections.CollectionBase instance.
“this property”	Gets the SABulkCopyColumnMapping object at the specified index.

Remarks

The SABulkCopyColumnMappingCollection class is not available in the .NET Compact Framework 2.0.

Add method

Adds the specified SABulkCopyColumnMapping object to the collection.

Overload list

Name	Description
"Add(int, int) method"	Creates a new SABulkCopyColumnMapping object using ordinals to specify both source and destination columns, and adds the mapping to the collection.
"Add(int, string) method"	Creates a new SABulkCopyColumnMapping object using a column ordinal to refer to the source column and a column name to refer to the destination column, and adds mapping to the collection.
"Add(SABulkCopyColumnMapping) method"	Adds the specified SABulkCopyColumnMapping object to the collection.
"Add(string, int) method"	Creates a new SABulkCopyColumnMapping object using a column name to refer to the source column and a column ordinal to refer to the destination the column, and adds the mapping to the collection.
"Add(string, string) method"	Creates a new SABulkCopyColumnMapping object using column names to specify both source and destination columns, and adds the mapping to the collection.

Add(int, int) method

Creates a new SABulkCopyColumnMapping object using ordinals to specify both source and destination columns, and adds the mapping to the collection.

Visual Basic syntax

```
Public Function Add(
    ByVal sourceColumnOrdinal As Integer,
    ByVal destinationColumnOrdinal As Integer
) As SABulkCopyColumnMapping
```

C# syntax

```
public SABulkCopyColumnMapping Add(
    int sourceColumnOrdinal,
    int destinationColumnOrdinal
)
```


Parameters

- **sourceColumnOrdinal** The ordinal position of the source column within the data source.
- **destinationColumnOrdinal** The ordinal position of the destination column within the destination table.

Remarks

The SABulkCopyColumnMappingCollection class is not available in the .NET Compact Framework 2.0.

Add(int, string) method

Creates a new SABulkCopyColumnMapping object using a column ordinal to refer to the source column and a column name to refer to the destination column, and adds mapping to the collection.

Visual Basic syntax

```
Public Function Add(
    ByVal sourceColumnOrdinal As Integer,
    ByVal destinationColumn As String
) As SABulkCopyColumnMapping
```

C# syntax

```
public SABulkCopyColumnMapping Add(
    int sourceColumnOrdinal,
    string destinationColumn
)
```

Parameters

- **sourceColumnOrdinal** The ordinal position of the source column within the data source.
- **destinationColumn** The name of the destination column within the destination table.

Remarks

The SABulkCopyColumnMappingCollection class is not available in the .NET Compact Framework 2.0.

Add(SABulkCopyColumnMapping) method

Adds the specified SABulkCopyColumnMapping object to the collection.

Visual Basic syntax

```
Public Function Add(
    ByVal bulkCopyColumnMapping As SABulkCopyColumnMapping
) As SABulkCopyColumnMapping
```

C# syntax

```
public SABulkCopyColumnMapping Add(
    SABulkCopyColumnMapping bulkCopyColumnMapping
)
```

Parameters

- **bulkCopyColumnMapping** The SABulkCopyColumnMapping object that describes the mapping to be added to the collection.

Remarks

The SABulkCopyColumnMappingCollection class is not available in the .NET Compact Framework 2.0.

See also

- "SABulkCopyColumnMapping class" on page 104

Add(string, int) method

Creates a new SABulkCopyColumnMapping object using a column name to refer to the source column and a column ordinal to refer to the destination the column, and adds the mapping to the collection.

Visual Basic syntax

```
Public Function Add(
    ByVal sourceColumn As String,
    ByVal destinationColumnOrdinal As Integer
) As SABulkCopyColumnMapping
```

C# syntax

```
public SABulkCopyColumnMapping Add(
    string sourceColumn,
    int destinationColumnOrdinal
)
```

Parameters

- **sourceColumn** The name of the source column within the data source.
- **destinationColumnOrdinal** The ordinal position of the destination column within the destination table.

Remarks

Creates a new column mapping, using column ordinals or names to refer to source and destination columns.

The SABulkCopyColumnMappingCollection class is not available in the .NET Compact Framework 2.0.

Add(string, string) method

Creates a new SABulkCopyColumnMapping object using column names to specify both source and destination columns, and adds the mapping to the collection.

Visual Basic syntax

```
Public Function Add(
    ByVal sourceColumn As String,
```



```
        ByVal destinationColumn As String
    ) As SABulkCopyColumnMapping
```

C# syntax

```
public SABulkCopyColumnMapping Add(
    string sourceColumn,
    string destinationColumn
)
```

Parameters

- **sourceColumn** The name of the source column within the data source.
- **destinationColumn** The name of the destination column within the destination table.

Remarks

The SABulkCopyColumnMappingCollection class is not available in the .NET Compact Framework 2.0.

Contains method

Gets a value indicating whether a specified SABulkCopyColumnMapping object exists in the collection.

Visual Basic syntax

```
Public Function Contains(
    ByVal value As SABulkCopyColumnMapping
) As Boolean
```

C# syntax

```
public bool Contains(SABulkCopyColumnMapping value)
```

Parameters

- **value** A valid SABulkCopyColumnMapping object.

Returns

True if the specified mapping exists in the collection; otherwise, false.

CopyTo method

Copies the elements of the SABulkCopyColumnMappingCollection to an array of SABulkCopyColumnMapping items, starting at a particular index.

Visual Basic syntax

```
Public Sub CopyTo(
    ByVal array As SABulkCopyColumnMapping(),
    ByVal index As Integer
)
```

C# syntax

```
public void CopyTo(SABulkCopyColumnMapping[] array, int index)
```

Parameters

- **array** The one-dimensional SABulkCopyColumnMapping array that is the destination of the elements copied from SABulkCopyColumnMappingCollection. The array must have zero-based indexing.
- **index** The zero-based index in the array at which copying begins.

IndexOf method

Gets or sets the index of the specified SABulkCopyColumnMapping object within the collection.

Visual Basic syntax

```
Public Function IndexOf(
    ByVal value As SABulkCopyColumnMapping
) As Integer
```

C# syntax

```
public int IndexOf(SABulkCopyColumnMapping value)
```

Parameters

- **value** The SABulkCopyColumnMapping object to search for.

Returns

The zero-based index of the column mapping is returned, or -1 is returned if the column mapping is not found in the collection.

Remove method

Removes the specified SABulkCopyColumnMapping element from the SABulkCopyColumnMappingCollection.

Visual Basic syntax

```
Public Sub Remove(ByVal value As SABulkCopyColumnMapping)
```

C# syntax

```
public void Remove(SABulkCopyColumnMapping value)
```

Parameters

- **value** The SABulkCopyColumnMapping object to be removed from the collection.

RemoveAt method

Removes the mapping at the specified index from the collection.

Visual Basic syntax

```
Public Shadows Sub RemoveAt(ByVal index As Integer)
```

C# syntax

```
public new void RemoveAt(int index)
```

Parameters

- **index** The zero-based index of the SABulkCopyColumnMapping object to be removed from the collection.

this property

Gets the SABulkCopyColumnMapping object at the specified index.

Visual Basic syntax

```
Public ReadOnly Property Item(
    ByVal index As Integer
) As SABulkCopyColumnMapping
```

C# syntax

```
public SABulkCopyColumnMapping this[int index] {get;}
```

Parameters

- **index** The zero-based index of the SABulkCopyColumnMapping object to find.

Returns

An SABulkCopyColumnMapping object is returned.

SACommand class

A SQL statement or stored procedure that is executed against a SQL Anywhere database.

Visual Basic syntax

```
Public NotInheritable Class SACommand
    Inherits System.Data.Common.DbCommand
    Implements System.ICloneable
```

C# syntax

```
public sealed class SACommand :
    System.Data.Common.DbCommand,
    System.ICloneable
```

Base classes

- System.Data.Common.DbCommand
- System.ICloneable

Members

All members of SACommand class, including all inherited members.

Name	Description
"SACommand constructor"	Initializes an SACommand object.
"BeginExecuteNonQuery method"	Initiates the asynchronous execution of a SQL statement or stored procedure that is described by this SACommand.
"BeginExecuteReader method"	Initiates the asynchronous execution of a SQL statement or stored procedure that is described by this SACommand, and retrieves one or more result sets from the database server.
"Cancel method"	Cancels the execution of an SACommand object.
"CreateParameter method"	Provides an SAParameter object for supplying parameters to SACommand objects.

Name	Description
"EndExecuteNonQuery method"	Finishes asynchronous execution of a SQL statement or stored procedure.
"EndExecuteReader method"	Finishes asynchronous execution of a SQL statement or stored procedure, returning the requested SADataReader.
ExecuteDbDataReader method (Inherited from System.Data.Common.DbCommand)	Executes the command text against the connection.
"ExecuteNonQuery method"	Executes a statement that does not return a result set, such as an INSERT, UPDATE, DELETE, or data definition statement.
"ExecuteReader method"	Executes a SQL statement that returns a result set.
"ExecuteScalar method"	Executes a statement that returns a single value.
"Prepare method"	Prepares or compiles the SACommand on the data source.
"ResetCommandTimeout method"	Resets the CommandTimeout property to its default value of 30 seconds.
"CommandText property"	Gets or sets the text of a SQL statement or stored procedure.

Name	Description
“CommandTimeout property”	This feature is not supported by the SQL Anywhere .NET Data Provider.
“CommandType property”	Gets or sets the type of command represented by an SACommand.
“Connection property”	Gets or sets the connection object to which the SACommand object applies.
“DesignTimeVisible property”	Gets or sets a value that indicates if the SACommand should be visible in a Windows Form Designer control.
“Parameters property”	A collection of parameters for the current statement.
“Transaction property”	Specifies the SATransaction object in which the SACommand executes.
“UpdatedRowSource property”	Gets or sets how command results are applied to the DataRow when used by the Update method of the SADataAdapter.

Remarks

Implements: ICloneable

For more information, see “Accessing and manipulating data” on page 45.

SACommand constructor

Initializes an SACommand object.

Overload list

Name	Description
"SACommand() constructor"	Initializes an SACommand object.
"SACommand(string) constructor"	Initializes an SACommand object.
"SACommand(string, SAConnection) constructor"	A SQL statement or stored procedure that is executed against a SQL Anywhere database.
"SACommand(string, SAConnection, SATransaction) constructor"	A SQL statement or stored procedure that is executed against a SQL Anywhere database.

SACommand() constructor

Initializes an SACommand object.

Visual Basic syntax

```
Public Sub New()
```

C# syntax

```
public SACommand()
```

SACommand(string) constructor

Initializes an SACommand object.

Visual Basic syntax

```
Public Sub New(ByVal cmdText As String)
```

C# syntax

```
public SACommand(string cmdText)
```

Parameters

- **cmdText** The text of the SQL statement or stored procedure. For parameterized statements, use a question mark (?) placeholder to pass parameters.

SACommand(string, SAConnection) constructor

A SQL statement or stored procedure that is executed against a SQL Anywhere database.

Visual Basic syntax

```
Public Sub New(
    ByVal cmdText As String,
    ByVal connection As SAConnection
)
```

C# syntax

```
public SACommand(string cmdText, SAConnection connection)
```

Parameters

- **cmdText** The text of the SQL statement or stored procedure. For parameterized statements, use a question mark (?) placeholder to pass parameters.
- **connection** The current connection.

SACommand(string, SAConnection, SATransaction) constructor

A SQL statement or stored procedure that is executed against a SQL Anywhere database.

Visual Basic syntax

```
Public Sub New(
    ByVal cmdText As String,
    ByVal connection As SAConnection,
    ByVal transaction As SATransaction
)
```

C# syntax

```
public SACommand(
    string cmdText,
    SAConnection connection,
    SATransaction transaction
)
```

Parameters

- **cmdText** The text of the SQL statement or stored procedure. For parameterized statements, use a question mark (?) placeholder to pass parameters.
- **connection** The current connection.
- **transaction** The SATransaction object in which the SAConnection executes.

See also

- "SATransaction class" on page 310

BeginExecuteNonQuery method

Initiates the asynchronous execution of a SQL statement or stored procedure that is described by this SACommand.

Overload list

Name	Description
"BeginExecuteNonQuery() method"	Initiates the asynchronous execution of a SQL statement or stored procedure that is described by this SACommand.
"BeginExecuteNon-Query(AsyncCallback, object) method"	Initiates the asynchronous execution of a SQL statement or stored procedure that is described by this SACommand, given a callback procedure and state information.

BeginExecuteNonQuery() method

Initiates the asynchronous execution of a SQL statement or stored procedure that is described by this SACommand.

Visual Basic syntax

```
Public Function BeginExecuteNonQuery() As IAsyncResult
```

C# syntax

```
public IAsyncResult BeginExecuteNonQuery()
```

Returns

An System.IAsyncResult that can be used to poll, wait for results, or both; this value is also needed when invoking EndExecuteNonQuery(IAsyncResult), which returns the number of affected rows.

Exceptions

- **"SAException class"** Any error that occurred while executing the command text.

Remarks

For asynchronous command, the order of parameters must be consistent with CommandText.

See also

- "EndExecuteNonQuery method" on page 129

BeginExecuteNonQuery(AsyncCallback, object) method

Initiates the asynchronous execution of a SQL statement or stored procedure that is described by this SACommand, given a callback procedure and state information.

Visual Basic syntax

```
Public Function BeginExecuteNonQuery(
    ByVal callback As AsyncCallback,
```

```
    ByVal stateObject As Object
) As IAsyncResult
```

C# syntax

```
public IAsyncResult BeginExecuteNonQuery(
    AsyncCallback callback,
    object stateObject
)
```

Parameters

- **callback** An System.AsyncCallback delegate that is invoked when the command's execution has completed. Pass null (Nothing in Microsoft Visual Basic) to indicate that no callback is required.
- **stateObject** A user-defined state object that is passed to the callback procedure. Retrieve this object from within the callback procedure using the System.IAsyncResult.AsyncState property.

Returns

An System.IAsyncResult that can be used to poll, wait for results, or both; this value is also needed when invoking EndExecuteNonQuery(IAsyncResult), which returns the number of affected rows.

Exceptions

- **"SAException class"** Any error that occurred while executing the command text.

Remarks

For asynchronous command, the order of parameters must be consistent with CommandText.

See also

- "EndExecuteNonQuery method" on page 129

BeginExecuteReader method

Initiates the asynchronous execution of a SQL statement or stored procedure that is described by this SACommand, and retrieves one or more result sets from the database server.

Overload list

Name	Description
"BeginExecuteReader() method"	Initiates the asynchronous execution of a SQL statement or stored procedure that is described by this SACommand, and retrieves one or more result sets from the database server.
"BeginExecuteReader(AsyncCallback, object) method"	Initiates the asynchronous execution of a SQL statement that is described by the SACommand object, and retrieves the result set, given a callback procedure and state information.

Name	Description
"BeginExecuteReader(AsyncCallback, object, CommandBehavior) method"	Initiates the asynchronous execution of a SQL statement or stored procedure that is described by this SACommand, and retrieves one or more result sets from the server.
"BeginExecuteReader(CommandBehavior) method"	Initiates the asynchronous execution of a SQL statement or stored procedure that is described by this SACommand, and retrieves one or more result sets from the server.

BeginExecuteReader() method

Initiates the asynchronous execution of a SQL statement or stored procedure that is described by this SACommand, and retrieves one or more result sets from the database server.

Visual Basic syntax

```
Public Function BeginExecuteReader() As IAsyncResult
```

C# syntax

```
public IAsyncResult BeginExecuteReader()
```

Returns

An System.IAsyncResult that can be used to poll, wait for results, or both; this value is also needed when invoking EndExecuteReader(IAsyncResult), which returns an SADataReader object that can be used to retrieve the returned rows.

Exceptions

- **"SAException class"** Any error that occurred while executing the command text.

Remarks

For asynchronous command, the order of parameters must be consistent with CommandText.

See also

- "EndExecuteReader method" on page 131
- "SADataReader class" on page 211

BeginExecuteReader(AsyncCallback, object) method

Initiates the asynchronous execution of a SQL statement that is described by the SACommand object, and retrieves the result set, given a callback procedure and state information.

Visual Basic syntax

```
Public Function BeginExecuteReader(
    ByVal callback As AsyncCallback,
```

```
    ByVal stateObject As Object
) As IAsyncResult
```

C# syntax

```
public IAsyncResult BeginExecuteReader(
    AsyncCallback callback,
    object stateObject
)
```

Parameters

- **callback** An System.AsyncCallback delegate that is invoked when the command's execution has completed. Pass null (Nothing in Microsoft Visual Basic) to indicate that no callback is required.
- **stateObject** A user-defined state object that is passed to the callback procedure. Retrieve this object from within the callback procedure using the System.IAsyncResult.AsyncState property.

Returns

An System.IAsyncResult that can be used to poll, wait for results, or both; this value is also needed when invoking EndExecuteReader(IAsyncResult), which returns an SADataReader object that can be used to retrieve the returned rows.

Exceptions

- **"SAException class"** Any error that occurred while executing the command text.

Remarks

For asynchronous command, the order of parameters must be consistent with CommandText.

See also

- "EndExecuteReader method" on page 131
- "SADataReader class" on page 211

BeginExecuteReader(AsyncCallback, object, CommandBehavior) method

Initiates the asynchronous execution of a SQL statement or stored procedure that is described by this SACommand, and retrieves one or more result sets from the server.

Visual Basic syntax

```
Public Function BeginExecuteReader(
    ByVal callback As AsyncCallback,
    ByVal stateObject As Object,
    ByVal behavior As CommandBehavior
) As IAsyncResult
```

C# syntax

```
public IAsyncResult BeginExecuteReader(
    AsyncCallback callback,
    object stateObject,
```



```
    CommandBehavior behavior
)
```

Parameters

- **callback** An System.AsyncCallback delegate that is invoked when the command's execution has completed. Pass null (Nothing in Microsoft Visual Basic) to indicate that no callback is required.
- **stateObject** A user-defined state object that is passed to the callback procedure. Retrieve this object from within the callback procedure using the System.IAsyncResult.AsyncState property.
- **behavior** A bitwise combination of System.Data.CommandBehavior flags describing the results of the query and its effect on the connection.

Returns

An System.IAsyncResult that can be used to poll, wait for results, or both; this value is also needed when invoking EndExecuteReader(IAsyncResult), which returns an SADataReader object that can be used to retrieve the returned rows.

Exceptions

- **"SAException class"** Any error that occurred while executing the command text.

Remarks

For asynchronous command, the order of parameters must be consistent with CommandText.

See also

- "EndExecuteReader method" on page 131
- "SADataReader class" on page 211

BeginExecuteReader(CommandBehavior) method

Initiates the asynchronous execution of a SQL statement or stored procedure that is described by this SACommand, and retrieves one or more result sets from the server.

Visual Basic syntax

```
Public Function BeginExecuteReader(
    ByVal behavior As CommandBehavior
) As IAsyncResult
```

C# syntax

```
public IAsyncResult BeginExecuteReader(CommandBehavior behavior)
```

Parameters

- **behavior** A bitwise combination of System.Data.CommandBehavior flags describing the results of the query and its effect on the connection.

Returns

An System.IAsyncResult that can be used to poll, wait for results, or both; this value is also needed when invoking EndExecuteReader(IAsyncResult), which returns an SADataReader object that can be used to retrieve the returned rows.

Exceptions

- **"SAException class"** Any error that occurred while executing the command text.

Remarks

For asynchronous command, the order of parameters must be consistent with CommandText.

See also

- "EndExecuteReader method" on page 131
- "SADataReader class" on page 211

Cancel method

Cancels the execution of an SACommand object.

Visual Basic syntax

```
Public Overrides Sub Cancel()
```

C# syntax

```
public override void Cancel()
```

Remarks

If there is nothing to cancel, nothing happens. If there is a command in process, a "Statement interrupted by user" exception is thrown.

CreateParameter method

Provides an SAParameter object for supplying parameters to SACommand objects.

Visual Basic syntax

```
Public Shadows Function CreateParameter() As SAParameter
```

C# syntax

```
public new SAParameter CreateParameter()
```

Returns

A new parameter, as an SAParameter object.

Remarks

Stored procedures and some other SQL statements can take parameters, indicated in the text of a statement by a question mark (?).

The CreateParameter method provides an SAParameter object. You can set properties on the SAParameter to specify the value, data type, and so on for the parameter.

See also

- "SAParameter class" on page 265

EndExecuteNonQuery method

Finishes asynchronous execution of a SQL statement or stored procedure.

Visual Basic syntax

```
Public Function EndExecuteNonQuery(
    ByVal asyncResult As IAsyncResult
) As Integer
```

C# syntax

```
public int EndExecuteNonQuery(IAsyncResult asyncResult)
```

Parameters

- **asyncResult** The IAsyncResult returned by the call to SACommand.BeginExecuteNonQuery.

Returns

The number of rows affected (the same behavior as SACommand.ExecuteNonQuery).

Exceptions

- **ArgumentException** The asyncResult parameter is null (Nothing in Microsoft Visual Basic).
- **InvalidOperationException** The SACommand.EndExecuteNonQuery(IAsyncResult) was called more than once for a single command execution, or the method was mismatched against its execution method.

Remarks

You must call EndExecuteNonQuery once for every call to BeginExecuteNonQuery. The call must be after BeginExecuteNonQuery has returned. ADO.NET is not thread safe; it is your responsibility to ensure that BeginExecuteNonQuery has returned. The IAsyncResult passed to EndExecuteNonQuery must be the same as the one returned from the BeginExecuteNonQuery call that is being completed. It is an error to call EndExecuteNonQuery to end a call to BeginExecuteReader, and vice versa.

If an error occurs while executing the command, the exception is thrown when EndExecuteNonQuery is called.

There are four ways to wait for execution to complete:

(1) Call EndExecuteNonQuery.

Calling EndExecuteNonQuery blocks until the command completes. For example:

```
SAConnection conn = new SAConnection("DSN=SQL Anywhere 12 Demo");
conn.Open();
SACommand cmd = new SACommand(
    "UPDATE Departments"
        + " SET DepartmentName = 'Engineering'"
        + " WHERE DepartmentID=100",
    conn );
IAsyncResult res = cmd.BeginExecuteNonQuery();
// perform other work
// this will block until the command completes
int rowCount reader = cmd.EndExecuteNonQuery( res );
```

(2) Poll the IsCompleted property of the IAsyncResult.

You can poll the IsCompleted property of the IAsyncResult. For example:

```
SAConnection conn = new SAConnection("DSN=SQL Anywhere 12 Demo");
conn.Open();
SACommand cmd = new SACommand(
    "UPDATE Departments"
        + " SET DepartmentName = 'Engineering'"
        + " WHERE DepartmentID=100",
    conn );
IAsyncResult res = cmd.BeginExecuteNonQuery();
while( !res.IsCompleted ) {
    // do other work
}
// this will not block because the command is finished
int rowCount = cmd.EndExecuteNonQuery( res );
```

(3) Use the IAsyncResult.AsyncWaitHandle property to get a synchronization object.

You can use the IAsyncResult.AsyncWaitHandle property to get a synchronization object, and wait on that. For example:

```
SAConnection conn = new SAConnection("DSN=SQL Anywhere 12 Demo");
conn.Open();
SACommand cmd = new SACommand(
    "UPDATE Departments"
        + " SET DepartmentName = 'Engineering'"
        + " WHERE DepartmentID=100",
    conn );
IAsyncResult res = cmd.BeginExecuteNonQuery();
// perform other work
WaitHandle wh = res.AsyncWaitHandle;
wh.WaitOne();
// this will not block because the command is finished
int rowCount = cmd.EndExecuteNonQuery( res );
```

(4) Specify a callback function when calling BeginExecuteNonQuery.

You can specify a callback function when calling BeginExecuteNonQuery. For example:

```
private void callbackFunction( IAsyncResult ar ) {
    SACommand cmd = (SACommand) ar.AsyncState;
    // this won't block since the command has completed
```



```
    int rowCount = cmd.EndExecuteNonQuery();
}

// elsewhere in the code
private void DoStuff() {
    SAConnection conn = new SAConnection("DSN=SQL Anywhere 12 Demo");
    conn.Open();
    SACommand cmd = new SACommand(
        "UPDATE Departments"
            + " SET DepartmentName = 'Engineering'"
            + " WHERE DepartmentID=100",
        conn );
    IAsyncResult res = cmd.BeginExecuteNonQuery( callbackFunction, cmd );
    // perform other work.  The callback function will be
    // called when the command completes
}
```

The callback function executes in a separate thread, so the usual caveats related to updating the user interface in a threaded program apply.

See also

- "BeginExecuteNonQuery method" on page 122

EndExecuteReader method

Finishes asynchronous execution of a SQL statement or stored procedure, returning the requested SADataReader.

Visual Basic syntax

```
Public Function EndExecuteReader(
    ByVal asyncResult As IAsyncResult
) As SADataReader
```

C# syntax

```
public SADataReader EndExecuteReader(IAsyncResult asyncResult)
```

Parameters

- **asyncResult** The IAsyncResult returned by the call to SACommand.BeginExecuteReader.

Returns

An SADataReader object that can be used to retrieve the requested rows (the same behavior as SACommand.ExecuteReader).

Exceptions

- **ArgumentException** The asyncResult parameter is null (Nothing in Microsoft Visual Basic)
- **InvalidOperationException** The SACommand.EndExecuteReader(IAsyncResult) was called more than once for a single command execution, or the method was mismatched against its execution method.

Remarks

You must call EndExecuteReader once for every call to BeginExecuteReader. The call must be after BeginExecuteReader has returned. ADO.NET is not thread safe; it is your responsibility to ensure that BeginExecuteReader has returned. The IAsyncResult passed to EndExecuteReader must be the same as the one returned from the BeginExecuteReader call that is being completed. It is an error to call EndExecuteReader to end a call to BeginExecuteNonQuery, and vice versa.

If an error occurs while executing the command, the exception is thrown when EndExecuteReader is called.

There are four ways to wait for execution to complete:

(1) Call EndExecuteReader.

Calling EndExecuteReader blocks until the command completes. For example:

```
SAConnection conn = new SAConnection("DSN=SQL Anywhere 12 Demo");
conn.Open();
SACommand cmd = new SACommand( "SELECT * FROM Departments", conn );
IAsyncResult res = cmd.BeginExecuteReader();
// perform other work
// this blocks until the command completes
SADataReader reader = cmd.EndExecuteReader( res );
```

(2) Poll the IsCompleted property of the IAsyncResult.

You can poll the IsCompleted property of the IAsyncResult. For example:

```
SAConnection conn = new SAConnection("DSN=SQL Anywhere 12 Demo");
conn.Open();
SACommand cmd = new SACommand( "SELECT * FROM Departments", conn );
IAsyncResult res = cmd.BeginExecuteReader();
while( !res.IsCompleted ) {
    // do other work
}
// this does not block because the command is finished
SADataReader reader = cmd.EndExecuteReader( res );
```

(3) Use the IAsyncResult.AsyncWaitHandle property to get a synchronization object.

You can use the IAsyncResult.AsyncWaitHandle property to get a synchronization object, and wait on that. For example:

```
SAConnection conn = new SAConnection("DSN=SQL Anywhere 12 Demo");
conn.Open();
SACommand cmd = new SACommand( "SELECT * FROM Departments", conn );
IAsyncResult res = cmd.BeginExecuteReader();
// perform other work
WaitHandle wh = res.AsyncWaitHandle;
wh.WaitOne();
// this does not block because the command is finished
SADataReader reader = cmd.EndExecuteReader( res );
```

(4) Specify a callback function when calling BeginExecuteReader

You can specify a callback function when calling BeginExecuteReader. For example:

```
private void callbackFunction( IAsyncResult ar ) {
    SACommand cmd = (SACommand) ar.AsyncState;
```



```
        // this does not block since the command has completed
        SADataReader reader = cmd.EndExecuteReader();
    }

    // elsewhere in the code
    private void DoStuff() {
        SAConnection conn = new SAConnection("DSN=SQL Anywhere 12 Demo");
        conn.Open();
        SACommand cmd = new SACommand( "SELECT * FROM Departments", conn );
        IAsyncResult res = cmd.BeginExecuteReader( callbackFunction, cmd );
        // perform other work.  The callback function will be
        // called when the command completes
    }
```

The callback function executes in a separate thread, so the usual caveats related to updating the user interface in a threaded program apply.

See also

- "BeginExecuteReader method" on page 124
- "SADataReader class" on page 211

ExecuteNonQuery method

Executes a statement that does not return a result set, such as an INSERT, UPDATE, DELETE, or data definition statement.

Visual Basic syntax

```
Public Overrides Function ExecuteNonQuery() As Integer
```

C# syntax

```
public override int ExecuteNonQuery()
```

Returns

The number of rows affected.

Remarks

You can use ExecuteNonQuery to change the data in a database without using a DataSet. Do this by executing UPDATE, INSERT, or DELETE statements.

Although ExecuteNonQuery does not return any rows, output parameters or return values that are mapped to parameters are populated with data.

For UPDATE, INSERT, and DELETE statements, the return value is the number of rows affected by the command. For all other types of statements, and for rollbacks, the return value is -1.

See also

- "ExecuteReader method" on page 134

ExecuteReader method

Executes a SQL statement that returns a result set.

Overload list

Name	Description
"ExecuteReader() method"	Executes a SQL statement that returns a result set.
"ExecuteReader(CommandBehavior) method"	Executes a SQL statement that returns a result set.

ExecuteReader() method

Executes a SQL statement that returns a result set.

Visual Basic syntax

```
Public Shadows Function ExecuteReader() As SADataReader
```

C# syntax

```
public new SADataReader ExecuteReader()
```

Returns

The result set as an SADataReader object.

Remarks

The statement is the current SACommand object, with CommandText and Parameters as needed. The SADataReader object is a read-only, forward-only result set. For modifiable result sets, use an SADataAdapter.

See also

- "ExecuteNonQuery method" on page 133
- "SADataReader class" on page 211
- "SADataAdapter class" on page 202
- "CommandText property" on page 137
- "Parameters property" on page 139

ExecuteReader(CommandBehavior) method

Executes a SQL statement that returns a result set.

Visual Basic syntax

```
Public Shadows Function ExecuteReader(
    ByVal behavior As CommandBehavior
) As SADataReader
```


C# syntax

```
public new SADataReader ExecuteReader(CommandBehavior behavior)
```

Parameters

- **behavior** One of CloseConnection, Default, KeyInfo, SchemaOnly, SequentialAccess, SingleResult, or SingleRow. For more information about this parameter, see the .NET Framework documentation for CommandBehavior Enumeration.

Returns

The result set as an SADataReader object.

Remarks

The statement is the current SACommand object, with CommandText and Parameters as needed. The SADataReader object is a read-only, forward-only result set. For modifiable result sets, use an SADataAdapter.

See also

- "ExecuteNonQuery method" on page 133
- "SADataReader class" on page 211
- "SADataAdapter class" on page 202
- "CommandText property" on page 137
- "Parameters property" on page 139

ExecuteScalar method

Executes a statement that returns a single value.

Visual Basic syntax

```
Public Overrides Function ExecuteScalar() As Object
```

C# syntax

```
public override object ExecuteScalar()
```

Returns

The first column of the first row in the result set, or a null reference if the result set is empty.

Remarks

If this method is called on a query that returns multiple rows and columns, only the first column of the first row is returned.

Prepare method

Prepares or compiles the SACommand on the data source.

Visual Basic syntax

```
Public Overrides Sub Prepare()
```

C# syntax

```
public override void Prepare()
```

Remarks

If you call one of the ExecuteNonQuery, ExecuteReader, or ExecuteScalar methods after calling Prepare, any parameter value that is larger than the value specified by the Size property is automatically truncated to the original specified size of the parameter, and no truncation errors are returned.

The truncation only happens for the following data types:

- **CHAR**
- **VARCHAR**
- **LONG VARCHAR**
- **TEXT**
- **NCHAR**
- **NVARCHAR**
- **LONG NVARCHAR**
- **NTEXT**
- **BINARY**
- **LONG BINARY**
- **VARBINARY**
- **IMAGE**

If the size property is not specified, and so is using the default value, the data is not truncated.

See also

- "ExecuteNonQuery method" on page 133
- "ExecuteReader method" on page 134
- "ExecuteScalar method" on page 135

ResetCommandTimeout method

Resets the CommandTimeout property to its default value of 30 seconds.

Visual Basic syntax

```
Public Sub ResetCommandTimeout()
```

C# syntax

```
public void ResetCommandTimeout()
```

CommandText property

Gets or sets the text of a SQL statement or stored procedure.

Visual Basic syntax

```
Public Overrides Property CommandText As String
```

C# syntax

```
public override string CommandText {get;set;}
```

Remarks

The SQL statement or the name of the stored procedure to execute. The default is an empty string.

See also

- "SACommand constructor" on page 121

CommandTimeout property

This feature is not supported by the SQL Anywhere .NET Data Provider.

Visual Basic syntax

```
Public Overrides Property CommandTimeout As Integer
```

C# syntax

```
public override int CommandTimeout {get;set;}
```

Remarks

To set a request timeout, use the following example.

```
cmd.CommandText = "SET OPTION request_timeout = 30";
    cmd.ExecuteNonQuery();
```

CommandType property

Gets or sets the type of command represented by an SACommand.

Visual Basic syntax

```
Public Overrides Property CommandType As CommandType
```

C# syntax

```
public override CommandType CommandType {get;set;}
```

Remarks

One of the System.Data.CommandType values. The default is System.Data.CommandType.Text.

Supported command types are as follows:

- **System.Data.CommandType.StoredProcedure** When you specify this CommandType, the command text must be the name of a stored procedure and you must supply any arguments as SAParameter objects.
- **System.Data.CommandType.Text** This is the default value.

When the CommandType property is set to StoredProcedure, the CommandText property should be set to the name of the stored procedure. The command executes this stored procedure when you call one of the Execute methods.

Use a question mark (?) placeholder to pass parameters. For example:

```
SELECT * FROM Customers WHERE ID = ?
```

The order in which SAParameter objects are added to the SAParameterCollection must directly correspond to the position of the question mark placeholder for the parameter.

Connection property

Gets or sets the connection object to which the SACommand object applies.

Visual Basic syntax

```
Public Shadows Property Connection As SAConnection
```

C# syntax

```
public new SAConnection Connection {get;set;}
```

Remarks

The default value is a null reference. In Visual Basic it is Nothing.

DesignTimeVisible property

Gets or sets a value that indicates if the SACommand should be visible in a Windows Form Designer control.

Visual Basic syntax

```
Public Overrides Property DesignTimeVisible As Boolean
```

C# syntax

```
public override bool DesignTimeVisible {get;set;}
```

Remarks

The default is true.

True if this SACommand instance should be visible, false if this instance should not be visible. The default is false.

Parameters property

A collection of parameters for the current statement.

Visual Basic syntax

```
Public ReadOnly Shadows Property Parameters As SAParameterCollection
```

C# syntax

```
public new SAParameterCollection Parameters {get;}
```

Remarks

Use question marks in the CommandText to indicate parameters.

The parameters of the SQL statement or stored procedure. The default value is an empty collection.

When CommandType is set to Text, pass parameters using the question mark placeholder. For example:

```
SELECT * FROM Customers WHERE ID = ?
```

The order in which SAParameter objects are added to the SAParameterCollection must directly correspond to the position of the question mark placeholder for the parameter in the command text.

When the parameters in the collection do not match the requirements of the query to be executed, an error may result or an exception may be thrown.

See also

- "SAParameterCollection class" on page 276

Transaction property

Specifies the SATransaction object in which the SACommand executes.

Visual Basic syntax

```
Public Shadows Property Transaction As SATransaction
```

C# syntax

```
public new SATransaction Transaction {get;set;}
```

Remarks

The default value is a null reference. In Visual Basic, this is Nothing.

You cannot set the Transaction property if it is already set to a specific value and the command is executing. If you set the transaction property to an SATransaction object that is not connected to the same SAConnection object as the SACommand object, an exception will be thrown the next time you attempt to execute a statement.

For more information, see "Transaction processing" on page 64.

See also

- "SATransaction class" on page 310

UpdatedRowSource property

Gets or sets how command results are applied to the DataRow when used by the Update method of the SADataAdapter.

Visual Basic syntax

```
Public Overrides Property UpdatedRowSource As UpdateRowSource
```

C# syntax

```
public override UpdateRowSource UpdatedRowSource {get;set;}
```

Remarks

One of the UpdatedRowSource values. The default value is UpdateRowSource.OutputParameters. If the command is automatically generated, this property is UpdateRowSource.None.

UpdatedRowSource.Both, which returns both resultset and output parameters, is not supported.

SACommandBuilder class

A way to generate single-table SQL statements that reconcile changes made to a DataSet with the data in the associated database.

Visual Basic syntax

```
Public NotInheritable Class SACommandBuilder
    Inherits System.Data.Common.DbCommandBuilder
```

C# syntax

```
public sealed class SACommandBuilder :
    System.Data.Common.DbCommandBuilder
```


Base classes

- System.Data.Common.DbCommandBuilder

Members

All members of SACommandBuilder class, including all inherited members.

Name	Description
"SACommandBuilder constructor"	Initializes an SACommandBuilder object.
ApplyParameterInfo method (Inherited from System.Data.Common.DbCommandBuilder)	Allows the provider implementation of the System.Data.Common.DbCommandBuilder class to handle additional parameter properties.
"DeriveParameters method"	Populates the Parameters collection of the specified SACommand object.
Dispose method (Inherited from System.Data.Common.DbCommandBuilder)	Releases the unmanaged resources used by the System.Data.Common.DbCommandBuilder and optionally releases the managed resources.
"GetDeleteCommand method"	Returns the generated SACommand object that performs DELETE operations on the database when SADataAdapter.Update is called.
"GetInsertCommand method"	Returns the generated SACommand object that performs INSERT operations on the database when an Update is called.
GetParameterName method (Inherited from System.Data.Common.DbCommandBuilder)	Returns the name of the specified parameter in the format of @p#.
GetParameterPlaceholder method (Inherited from System.Data.Common.DbCommandBuilder)	Returns the placeholder for the parameter in the associated SQL statement.
GetSchemaTable method (Inherited from System.Data.Common.DbCommandBuilder)	Returns the schema table for the System.Data.Common.DbCommandBuilder.
"GetUpdateCommand method"	Returns the generated SACommand object that performs UPDATE operations on the database when an Update is called.
InitializeCommand method (Inherited from System.Data.Common.DbCommandBuilder)	Resets the System.Data.Common.DbCommand.CommandTimeout, System.Data.Common.DbCommand.Transaction, System.Data.Common.DbCommand.CommandType, and System.Data.UpdateRowSource properties on the System.Data.Common.DbCommand.

Name	Description
"QuoteIdentifier method"	Returns the correct quoted form of an unquoted identifier, including properly escaping any embedded quotes in the identifier.
RefreshSchema method (Inherited from System.Data.Common.DbCommandBuilder)	Clears the commands associated with this System.Data.Common.DbCommandBuilder.
RowUpdatingHandler method (Inherited from System.Data.Common.DbCommandBuilder)	Adds an event handler for the System.Data.OleDb.OleDbDataAdapter.RowUpdating event.
SetRowUpdatingHandler method (Inherited from System.Data.Common.DbCommandBuilder)	Registers the System.Data.Common.DbCommandBuilder to handle the System.Data.OleDb.OleDbDataAdapter.RowUpdating event for a System.Data.Common.DbDataAdapter.
"UnquoteIdentifier method"	Returns the correct unquoted form of a quoted identifier, including properly un-escaping any embedded quotes in the identifier.
CatalogLocation property (Inherited from System.Data.Common.DbCommandBuilder)	Sets or gets the System.Data.Common.CatalogLocation for an instance of the System.Data.Common.DbCommandBuilder class.
CatalogSeparator property (Inherited from System.Data.Common.DbCommandBuilder)	Sets or gets a string used as the catalog separator for an instance of the System.Data.Common.DbCommandBuilder class.
ConflictOption property (Inherited from System.Data.Common.DbCommandBuilder)	Specifies which System.Data.ConflictOption is to be used by the System.Data.Common.DbCommandBuilder.
"DataAdapter property"	Specifies the SADataAdapter for which to generate statements.
QuotePrefix property (Inherited from System.Data.Common.DbCommandBuilder)	Gets or sets the beginning character or characters to use when specifying database objects (for example, tables or columns) whose names contain characters such as spaces or reserved tokens.

Name	Description
QuoteSuffix property (Inherited from System.Data.Common.DbCommandBuilder)	Gets or sets the beginning character or characters to use when specifying database objects (for example, tables or columns) whose names contain characters such as spaces or reserved tokens.
SchemaSeparator property (Inherited from System.Data.Common.DbCommandBuilder)	Gets or sets the character to be used for the separator between the schema identifier and any other identifiers.
SetAllValues property (Inherited from System.Data.Common.DbCommandBuilder)	Specifies whether all column values in an update statement are included or only changed ones.

SACommandBuilder constructor

Initializes an SACommandBuilder object.

Overload list

Name	Description
"SACommandBuilder() constructor"	Initializes an SACommandBuilder object.
"SACommandBuilder(SADataAdapter) constructor"	Initializes an SACommandBuilder object.

SACommandBuilder() constructor

Initializes an SACommandBuilder object.

Visual Basic syntax

```
Public Sub New()
```

C# syntax

```
public SACommandBuilder()
```

SACommandBuilder(SADataAdapter) constructor

Initializes an SACommandBuilder object.

Visual Basic syntax

```
Public Sub New(ByVal adapter As SADataAdapter)
```

C# syntax

```
public SACommandBuilder(SADataAdapter adapter)
```

Parameters

- **adapter** An SADataAdapter object for which to generate reconciliation statements.

DeriveParameters method

Populates the Parameters collection of the specified SACommand object.

Visual Basic syntax

```
Public Shared Sub DeriveParameters(ByVal command As SACommand)
```

C# syntax

```
public static void DeriveParameters(SACommand command)
```

Parameters

- **command** An SACommand object for which to derive parameters.

Remarks

This is used for the stored procedure specified in the SACommand.

DeriveParameters overwrites any existing parameter information for the SACommand.

DeriveParameters requires an extra call to the database server. If the parameter information is known in advance, it is more efficient to populate the Parameters collection by setting the information explicitly.

GetDeleteCommand method

Returns the generated SACommand object that performs DELETE operations on the database when SADataAdapter.Update is called.

Overload list

Name	Description
"GetDeleteCommand() method"	Returns the generated SACommand object that performs DELETE operations on the database when SADataAdapter.Update is called.
"GetDeleteCommand(bool) method"	Returns the generated SACommand object that performs DELETE operations on the database when SADataAdapter.Update is called.

GetDeleteCommand() method

Returns the generated SACommand object that performs DELETE operations on the database when SADataAdapter.Update is called.

Visual Basic syntax

```
Public Shadows Function GetDeleteCommand() As SACommand
```

C# syntax

```
public new SACommand GetDeleteCommand()
```

Returns

The automatically generated SACommand object required to perform deletions.

Remarks

The GetDeleteCommand method returns the SACommand object to be executed, so it may be useful for informational or troubleshooting purposes.

You can also use GetDeleteCommand as the basis of a modified command. For example, you might call GetDeleteCommand and modify the CommandTimeout value, and then explicitly set that value on the SADataAdapter.

SQL statements are first generated when the application calls Update or GetDeleteCommand. After the SQL statement is first generated, the application must explicitly call RefreshSchema if it changes the statement in any way. Otherwise, the GetDeleteCommand will still be using information from the previous statement.

See also

- System.Data.Common.DbCommandBuilder.RefreshSchema

GetDeleteCommand(bool) method

Returns the generated SACommand object that performs DELETE operations on the database when SADataAdapter.Update is called.

Visual Basic syntax

```
Public Shadows Function GetDeleteCommand(
    ByVal useColumnsForParameterNames As Boolean
) As SACommand
```

C# syntax

```
public new SACommand GetDeleteCommand(bool useColumnsForParameterNames)
```

Parameters

- **useColumnsForParameterNames** If true, generate parameter names matching column names if possible. If false, generate @p1, @p2, and so on.

Returns

The automatically generated SACommand object required to perform deletions.

Remarks

The GetDeleteCommand method returns the SACommand object to be executed, so it may be useful for informational or troubleshooting purposes.

You can also use GetDeleteCommand as the basis of a modified command. For example, you might call GetDeleteCommand and modify the CommandTimeout value, and then explicitly set that value on the SADataAdapter.

SQL statements are first generated when the application calls Update or GetDeleteCommand. After the SQL statement is first generated, the application must explicitly call RefreshSchema if it changes the statement in any way. Otherwise, the GetDeleteCommand will still be using information from the previous statement.

See also

- System.Data.Common.DbCommandBuilder.RefreshSchema

GetInsertCommand method

Returns the generated SACommand object that performs INSERT operations on the database when an Update is called.

Overload list

Name	Description
"GetInsertCommand() method"	Returns the generated SACommand object that performs INSERT operations on the database when an Update is called.
"GetInsertCommand(bool) method"	Returns the generated SACommand object that performs INSERT operations on the database when an Update is called.

GetInsertCommand() method

Returns the generated SACommand object that performs INSERT operations on the database when an Update is called.

Visual Basic syntax

```
Public Shadows Function GetInsertCommand() As SACommand
```

C# syntax

```
public new SACommand GetInsertCommand()
```


Returns

The automatically generated SACommand object required to perform insertions.

Remarks

The GetInsertCommand method returns the SACommand object to be executed, so it may be useful for informational or troubleshooting purposes.

You can also use GetInsertCommand as the basis of a modified command. For example, you might call GetInsertCommand and modify the CommandTimeout value, and then explicitly set that value on the SADataAdapter.

SQL statements are first generated either when the application calls Update or GetInsertCommand. After the SQL statement is first generated, the application must explicitly call RefreshSchema if it changes the statement in any way. Otherwise, the GetInsertCommand will be still be using information from the previous statement, which might not be correct.

See also

- "GetDeleteCommand method" on page 144

GetInsertCommand(bool) method

Returns the generated SACommand object that performs INSERT operations on the database when an Update is called.

Visual Basic syntax

```
Public Shadows Function GetInsertCommand(
    ByVal useColumnsForParameterNames As Boolean
) As SACommand
```

C# syntax

```
public new SACommand GetInsertCommand(bool useColumnsForParameterNames)
```

Parameters

- **useColumnsForParameterNames** If true, generate parameter names matching column names if possible. If false, generate @p1, @p2, and so on.

Returns

The automatically generated SACommand object required to perform insertions.

Remarks

The GetInsertCommand method returns the SACommand object to be executed, so it may be useful for informational or troubleshooting purposes.

You can also use GetInsertCommand as the basis of a modified command. For example, you might call GetInsertCommand and modify the CommandTimeout value, and then explicitly set that value on the SADataAdapter.

SQL statements are first generated either when the application calls Update or GetInsertCommand. After the SQL statement is first generated, the application must explicitly call RefreshSchema if it changes the statement in any way. Otherwise, the GetInsertCommand will be still be using information from the previous statement, which might not be correct.

See also

- "GetDeleteCommand method" on page 144

GetUpdateCommand method

Returns the generated SACommand object that performs UPDATE operations on the database when an Update is called.

Overload list

Name	Description
"GetUpdateCommand() method"	Returns the generated SACommand object that performs UPDATE operations on the database when an Update is called.
"GetUpdateCommand(bool) method"	Returns the generated SACommand object that performs UPDATE operations on the database when an Update is called.

GetUpdateCommand() method

Returns the generated SACommand object that performs UPDATE operations on the database when an Update is called.

Visual Basic syntax

```
Public Shadows Function GetUpdateCommand() As SACommand
```

C# syntax

```
public new SACommand GetUpdateCommand()
```

Returns

The automatically generated SACommand object required to perform updates.

Remarks

The GetUpdateCommand method returns the SACommand object to be executed, so it may be useful for informational or troubleshooting purposes.

You can also use GetUpdateCommand as the basis of a modified command. For example, you might call GetUpdateCommand and modify the CommandTimeout value, and then explicitly set that value on the SADataAdapter.

SQL statements are first generated when the application calls Update or GetUpdateCommand. After the SQL statement is first generated, the application must explicitly call RefreshSchema if it changes the statement in any way. Otherwise, the GetUpdateCommand will be still be using information from the previous statement, which might not be correct.

See also

- System.Data.Common.DbCommandBuilder.RefreshSchema

GetUpdateCommand(bool) method

Returns the generated SACommand object that performs UPDATE operations on the database when an Update is called.

Visual Basic syntax

```
Public Shadows Function GetUpdateCommand(
    ByVal useColumnsForParameterNames As Boolean
) As SACommand
```

C# syntax

```
public new SACommand GetUpdateCommand(bool useColumnsForParameterNames)
```

Parameters

- **useColumnsForParameterNames** If true, generate parameter names matching column names if possible. If false, generate @p1, @p2, and so on.

Returns

The automatically generated SACommand object required to perform updates.

Remarks

The GetUpdateCommand method returns the SACommand object to be executed, so it may be useful for informational or troubleshooting purposes.

You can also use GetUpdateCommand as the basis of a modified command. For example, you might call GetUpdateCommand and modify the CommandTimeout value, and then explicitly set that value on the SADataAdapter.

SQL statements are first generated when the application calls Update or GetUpdateCommand. After the SQL statement is first generated, the application must explicitly call RefreshSchema if it changes the statement in any way. Otherwise, the GetUpdateCommand will be still be using information from the previous statement, which might not be correct.

See also

- System.Data.Common.DbCommandBuilder.RefreshSchema

QuoteIdentifier method

Returns the correct quoted form of an unquoted identifier, including properly escaping any embedded quotes in the identifier.

Visual Basic syntax

```
Public Overrides Function QuoteIdentifier(
    ByVal unquotedIdentifier As String
) As String
```

C# syntax

```
public override string QuoteIdentifier(string unquotedIdentifier)
```

Parameters

- **unquotedIdentifier** The string representing the unquoted identifier that will have be quoted.

Returns

Returns a string representing the quoted form of an unquoted identifier with embedded quotes properly escaped.

UnquoteIdentifier method

Returns the correct unquoted form of a quoted identifier, including properly un-escaping any embedded quotes in the identifier.

Visual Basic syntax

```
Public Overrides Function UnquoteIdentifier(
    ByVal quotedIdentifier As String
) As String
```

C# syntax

```
public override string UnquoteIdentifier(string quotedIdentifier)
```

Parameters

- **quotedIdentifier** The string representing the quoted identifier that will have its embedded quotes removed.

Returns

Returns a string representing the unquoted form of a quoted identifier with embedded quotes properly un-escaped.

DataAdapter property

Specifies the SADataAdapter for which to generate statements.

Visual Basic syntax

```
Public Shadows Property DataAdapter As SADataAdapter
```

C# syntax

```
public new SADataAdapter DataAdapter {get;set;}
```

Remarks

An SADataAdapter object.

When you create a new instance of SACommandBuilder, any existing SACommandBuilder that is associated with this SADataAdapter is released.

SACommLinksOptionsBuilder class

Provides a simple way to create and manage the CommLinks options portion of connection strings used by the SAConnection class.

Visual Basic syntax

```
Public NotInheritable Class SACommLinksOptionsBuilder
```

C# syntax

```
public sealed class SACommLinksOptionsBuilder
```

Members

All members of SACommLinksOptionsBuilder class, including all inherited members.

Name	Description
"SACommLinksOptionsBuilder constructor"	Initializes an SACommLinksOptionsBuilder object.
"GetUseLongNameAsKeyword method"	Gets a boolean values that indicates whether long connection parameter names are used in the connection string.
"SetUseLongNameAsKeyword method"	Sets a boolean value that indicates whether long connection parameter names are used in the connection string.
"ToString method"	Converts the SACommLinksOptionsBuilder object to a string representation.
"All property"	Gets or sets the ALL CommLinks option.
"ConnectionString property"	Gets or sets the connection string being built.
"SharedMemory property"	Gets or sets the SharedMemory protocol.

Name	Description
"TcpOptionsBuilder property"	Gets or sets a TcpOptionsBuilder object used to create a TCP options string.
"TcpOptionsString property"	Gets or sets a string of TCP options.

Remarks

The SACommLinksOptionsBuilder class is not available in the .NET Compact Framework 2.0.

For a list of connection parameters, see "Connection parameters" [*SQL Anywhere Server - Database Administration*].

SACommLinksOptionsBuilder constructor

Initializes an SACommLinksOptionsBuilder object.

Overload list

Name	Description
"SACommLinksOptionsBuilder() constructor"	Initializes an SACommLinksOptionsBuilder object.
"SACommLinksOptionsBuilder(string) constructor"	Initializes an SACommLinksOptionsBuilder object.

SACommLinksOptionsBuilder() constructor

Initializes an SACommLinksOptionsBuilder object.

Visual Basic syntax

```
Public Sub New()
```

C# syntax

```
public SACommLinksOptionsBuilder()
```

Remarks

The SACommLinksOptionsBuilder class is not available in the .NET Compact Framework 2.0.

Example

The following statement initializes an SACommLinksOptionsBuilder object.

```
SACommLinksOptionsBuilder commLinks = new SACommLinksOptionsBuilder( );
```


SACommLinksOptionsBuilder(string) constructor

Initializes an SACommLinksOptionsBuilder object.

Visual Basic syntax

```
Public Sub New(ByVal options As String)
```

C# syntax

```
public SACommLinksOptionsBuilder(string options)
```

Parameters

- **options** A SQL Anywhere CommLinks connection parameter string. For a list of connection parameters, see "Connection parameters" [*SQL Anywhere Server - Database Administration*].

Remarks

The SACommLinksOptionsBuilder class is not available in the .NET Compact Framework 2.0.

Example

The following statement initializes an SACommLinksOptionsBuilder object.

```
SACommLinksOptionsBuilder commLinks =
    new SACommLinksOptionsBuilder("TCPIP(DoBroadcast=ALL;Timeout=20)");
```

GetUseLongNameAsKeyword method

Gets a boolean values that indicates whether long connection parameter names are used in the connection string.

Visual Basic syntax

```
Public Function GetUseLongNameAsKeyword() As Boolean
```

C# syntax

```
public bool GetUseLongNameAsKeyword()
```

Returns

True if long connection parameter names are used to build connection strings; otherwise, false.

Remarks

SQL Anywhere connection parameters have both long and short forms of their names. For example, to specify the name of an ODBC data source in your connection string, you can use either of the following values: DataSourceName or DSN. By default, long connection parameter names are used to build connection strings.

See also

- "SetUseLongNameAsKeyword method" on page 154

SetUseLongNameAsKeyword method

Sets a boolean value that indicates whether long connection parameter names are used in the connection string.

Visual Basic syntax

```
Public Sub SetUseLongNameAsKeyword(
    ByVal useLongNameAsKeyword As Boolean
)
```

C# syntax

```
public void SetUseLongNameAsKeyword(bool useLongNameAsKeyword)
```

Parameters

- **useLongNameAsKeyword** A boolean value that indicates whether the long connection parameter name is used in the connection string.

Remarks

Long connection parameter names are used by default.

See also

- "GetUseLongNameAsKeyword method" on page 153

ToString method

Converts the SACommLinksOptionsBuilder object to a string representation.

Visual Basic syntax

```
Public Overrides Function ToString() As String
```

C# syntax

```
public override string ToString()
```

Returns

The options string being built.

All property

Gets or sets the ALL CommLinks option.

Visual Basic syntax

```
Public Property All As Boolean
```


C# syntax

```
public bool All {get;set;}
```

Remarks

Attempt to connect using the shared memory protocol first, followed by all remaining and available communication protocols. Use this setting if you are unsure of which communication protocol(s) to use.

The SACommLinksOptionsBuilder class is not available in the .NET Compact Framework 2.0.

ConnectionString property

Gets or sets the connection string being built.

Visual Basic syntax

```
Public Property ConnectionString As String
```

C# syntax

```
public string ConnectionString {get;set;}
```

Remarks

The SACommLinksOptionsBuilder class is not available in the .NET Compact Framework 2.0.

SharedMemory property

Gets or sets the SharedMemory protocol.

Visual Basic syntax

```
Public Property SharedMemory As Boolean
```

C# syntax

```
public bool SharedMemory {get;set;}
```

Remarks

The SACommLinksOptionsBuilder class is not available in the .NET Compact Framework 2.0.

TcpOptionsBuilder property

Gets or sets a TcpOptionsBuilder object used to create a TCP options string.

Visual Basic syntax

```
Public Property TcpOptionsBuilder As SATcpOptionsBuilder
```

C# syntax

```
public SATcpOptionsBuilder TcpOptionsBuilder {get;set;}
```

TcpOptionsString property

Gets or sets a string of TCP options.

Visual Basic syntax

```
Public Property TcpOptionsString As String
```

C# syntax

```
public string TcpOptionsString {get;set;}
```

SAConnection class

Represents a connection to a SQL Anywhere database.

Visual Basic syntax

```
Public NotInheritable Class SAConnection
    Inherits System.Data.Common.DbConnection
```

C# syntax

```
public sealed class SAConnection : System.Data.Common.DbConnection
```

Base classes

- System.Data.Common.DbConnection

Members

All members of SAConnection class, including all inherited members.

Name	Description
"SAConnection constructor"	Initializes an SAConnection object.
BeginDbTransaction method (Inherited from System.Data.Common.DbConnection)	Starts a database transaction.
"BeginTransaction method"	Returns a transaction object.
"ChangeDatabase method"	Changes the current database for an open SAConnection.

Name	Description
"ChangePassword method"	Changes the password for the user indicated in the connection string to the supplied new password.
"ClearAllPools method"	Empties all connection pools.
"ClearPool method"	Empties the connection pool associated with the specified connection.
"Close method"	Closes a database connection.
"CreateCommand method"	Initializes an SACommand object.
"EnlistDistributedTransaction method"	Enlists in the specified transaction as a distributed transaction.
"EnlistTransaction method"	Enlists in the specified transaction as a distributed transaction.
"GetSchema method"	Returns the list of supported schema collections.
OnStateChange method (Inherited from System.Data.Common.DbConnection)	Raises the System.Data.Common.DbConnection.StateChange event.
"Open method"	Opens a database connection with the property settings specified by the SAConnection.ConnectionString.
"ConnectionString property"	Provides the database connection string.
"ConnectionTimeout property"	Gets the number of seconds before a connection attempt times out with an error.
"Database property"	Gets the name of the current database.
"DataSource property"	Gets the name of the database server.

Name	Description
DbProviderFactory property (Inherited from System.Data.Common.DbConnection)	Gets the System.Data.Common.DbProviderFactory for this System.Data.Common.DbConnection.
"InitString property"	A command that is executed immediately after the connection is established.
"ServerVersion property"	Gets a string that contains the version of the instance of SQL Anywhere to which the client is connected.
"State property"	Indicates the state of the SAConnection object.
"InfoMessage event"	Occurs when the SQL Anywhere database server returns a warning or informational message.
"StateChange event"	Occurs when the state of the SAConnection object changes.

Remarks

For a list of connection parameters, see "Connection parameters" [*SQL Anywhere Server - Database Administration*].

SAConnection constructor

Initializes an SAConnection object.

Overload list

Name	Description
"SAConnection() constructor"	Initializes an SAConnection object.
"SAConnection(string) constructor"	Initializes an SAConnection object.

SAConnection() constructor

Initializes an SAConnection object.

Visual Basic syntax

```
Public Sub New()
```

C# syntax

```
public SAConnection()
```

Remarks

The connection must be opened before you can perform any operations against the database.

SAConnection(string) constructor

Initializes an SAConnection object.

Visual Basic syntax

```
Public Sub New(ByVal connectionString As String)
```

C# syntax

```
public SAConnection(string connectionString)
```

Parameters

- **connectionString** A SQL Anywhere connection string. A connection string is a semicolon-separated list of keyword=value pairs. For a list of connection parameters, see "Connection parameters" [*SQL Anywhere Server - Database Administration*].

Remarks

The connection must then be opened before you can perform any operations against the database.

See also

- "SAConnection class" on page 156

Example

The following statement initializes an SAConnection object for a connection to a database named policies running on a SQL Anywhere database server named hr. The connection uses the user ID admin and the password money.

```
SAConnection conn = new SAConnection(
    "UID=admin;PWD=money;SERVER=hr;DBN=policies" );
conn.Open();
```

BeginTransaction method

Returns a transaction object.

Overload list

Name	Description
"BeginTransaction() method"	Returns a transaction object.
"BeginTransaction(IsolationLevel) method"	Returns a transaction object.
"BeginTransaction(SAIsolationLevel) method"	Returns a transaction object.

BeginTransaction() method

Returns a transaction object.

Visual Basic syntax

```
Public Shadows Function BeginTransaction() As SATransaction
```

C# syntax

```
public new SATransaction BeginTransaction()
```

Returns

An SATransaction object representing the new transaction.

Remarks

Commands associated with a transaction object are executed as a single transaction. The transaction is terminated with a call to the Commit or Rollback methods.

To associate a command with a transaction object, use the SACommand.Transaction property.

See also

- "SATransaction class" on page 310

See also

- "Transaction property" on page 139

BeginTransaction(IsolationLevel) method

Returns a transaction object.

Visual Basic syntax

```
Public Shadows Function BeginTransaction(
    ByVal isolationLevel As IsolationLevel
) As SATransaction
```

C# syntax

```
public new SATransaction BeginTransaction(IsolationLevel isolationLevel)
```


Parameters

- **isolationLevel** A member of the SAIsolationLevel enumeration. The default value is ReadCommitted.

Returns

An SATransaction object representing the new transaction.

Remarks

Commands associated with a transaction object are executed as a single transaction. The transaction is terminated with a call to the Commit or Rollback methods.

To associate a command with a transaction object, use the SACommand.Transaction property.

See also

- "SATransaction class" on page 310

See also

- "Transaction property" on page 139

See also

- "SAIsolationLevel enumeration" on page 322

Example

```
SATransaction tx =
    conn.BeginTransaction( SAIsolationLevel.ReadUncommitted );
```

BeginTransaction(SAIsolationLevel) method

Returns a transaction object.

Visual Basic syntax

```
Public Function BeginTransaction(
    ByVal isolationLevel As SAIsolationLevel
) As SATransaction
```

C# syntax

```
public SATransaction BeginTransaction(SAIsolationLevel isolationLevel)
```

Parameters

- **isolationLevel** A member of the SAIsolationLevel enumeration. The default value is ReadCommitted.

Returns

An SATransaction object representing the new transaction.

Remarks

Commands associated with a transaction object are executed as a single transaction. The transaction is terminated with a call to the Commit or Rollback methods.

To associate a command with a transaction object, use the SACommand.Transaction property.

For more information, see "Transaction processing" on page 64.

For more information, see "Typical types of inconsistency" [*SQL Anywhere Server - SQL Usage*].

See also

- "SATransaction class" on page 310

See also

- "Transaction property" on page 139

See also

- "SAIsolationLevel enumeration" on page 322

See also

- "Commit method" on page 311

See also

- "Rollback method" on page 312

See also

- "Rollback method" on page 312

ChangeDatabase method

Changes the current database for an open SAConnection.

Visual Basic syntax

```
Public Overrides Sub ChangeDatabase(ByVal database As String)
```

C# syntax

```
public override void ChangeDatabase(string database)
```

Parameters

- **database** The name of the database to use instead of the current database.

ChangePassword method

Changes the password for the user indicated in the connection string to the supplied new password.

Visual Basic syntax

```
Public Shared Sub ChangePassword(
    ByVal connectionString As String,
    ByVal newPassword As String
)
```

C# syntax

```
public static void ChangePassword(
    string connectionString,
    string newPassword
)
```

Parameters

- **connectionString** The connection string that contains enough information to connect to the database server that you want. The connection string may contain the user ID and the current password.
- **newPassword** The new password to set. This password must comply with any password security policy set on the server, including minimum length, requirements for specific characters, and so on.

Exceptions

- **ArgumentNullException** Either the connectionString or the newPassword parameter is null.
- **ArgumentException** The connection string includes the option to use integrated security.

ClearAllPools method

Empties all connection pools.

Visual Basic syntax

```
Public Shared Sub ClearAllPools()
```

C# syntax

```
public static void ClearAllPools()
```

ClearPool method

Empties the connection pool associated with the specified connection.

Visual Basic syntax

```
Public Shared Sub ClearPool(ByVal connection As SAConnection)
```

C# syntax

```
public static void ClearPool(SAConnection connection)
```

Parameters

- **connection** The SAConnection object to be cleared from the pool.

See also

- "SAConnection class" on page 156

Close method

Closes a database connection.

Visual Basic syntax

```
Public Overrides Sub Close()
```

C# syntax

```
public override void Close()
```

Remarks

The Close method rolls back any pending transactions. It then releases the connection to the connection pool, or closes the connection if connection pooling is disabled. If Close is called while handling a StateChange event, no additional StateChange events are fired. An application can call Close multiple times.

CreateCommand method

Initializes an SACommand object.

Visual Basic syntax

```
Public Shadows Function CreateCommand() As SACommand
```

C# syntax

```
public new SACommand CreateCommand()
```

Returns

An SACommand object.

Remarks

The command object is associated with the SAConnection object.

See also

- "SACommand class" on page 117

See also

- "SAConnection class" on page 156

EnlistDistributedTransaction method

Enlists in the specified transaction as a distributed transaction.

Visual Basic syntax

```
Public Sub EnlistDistributedTransaction(
    ByVal transaction As System.EnterpriseServices.ITransaction
)
```

C# syntax

```
public void EnlistDistributedTransaction(
    System.EnterpriseServices.ITransaction transaction
)
```

Parameters

- **transaction** A reference to an existing System.EnterpriseServices.ITransaction in which to enlist.

EnlistTransaction method

Enlists in the specified transaction as a distributed transaction.

Visual Basic syntax

```
Public Overrides Sub EnlistTransaction(
    ByVal transaction As System.Transactions.Transaction
)
```

C# syntax

```
public override void EnlistTransaction(
    System.Transactions.Transaction transaction
)
```

Parameters

- **transaction** A reference to an existing System.Transactions.Transaction in which to enlist.

GetSchema method

Returns the list of supported schema collections.

Overload list

Name	Description
"GetSchema() method"	Returns the list of supported schema collections.

Name	Description
"GetSchema(string) method"	Returns information for the specified metadata collection for this SAConnection object.
"GetSchema(string, string[]) method"	Returns schema information for the data source of this SAConnection object and, if specified, uses the specified string for the schema name and the specified string array for the restriction values.

GetSchema() method

Returns the list of supported schema collections.

Visual Basic syntax

```
Public Overrides Function GetSchema() As DataTable
```

C# syntax

```
public override DataTable GetSchema()
```

Remarks

See GetSchema(string,string[]) for a description of the available metadata.

GetSchema(string) method

Returns information for the specified metadata collection for this SAConnection object.

Visual Basic syntax

```
Public Overrides Function GetSchema(
    ByVal collection As String
) As DataTable
```

C# syntax

```
public override DataTable GetSchema(string collection)
```

Parameters

- **collection** Name of the metadata collection. If a name is not provided, MetaDataCollections is used.

Remarks

See GetSchema(string,string[]) for a description of the available metadata.

See also

- "SAConnection class" on page 156

GetSchema(string, string[]) method

Returns schema information for the data source of this SAConnection object and, if specified, uses the specified string for the schema name and the specified string array for the restriction values.

Visual Basic syntax

```
Public Overrides Function GetSchema(
    ByVal collection As String,
    ByVal restrictions As String()
) As DataTable
```

C# syntax

```
public override DataTable GetSchema(
    string collection,
    string[] restrictions
)
```

Returns

A DataTable that contains schema information.

Remarks

These methods are used to query the database server for various metadata. Each type of metadata is given a collection name, which must be passed to receive that data. The default collection name is MetaDataCollections.

You can query the SQL Anywhere SQL Anywhere .NET Data Provider to determine the list of supported schema collections by calling the GetSchema method with no arguments, or with the schema collection name MetaDataCollections. This will return a DataTable with a list of the supported schema collections (CollectionName), the number of restrictions that they each support (NumberOfRestrictions), and the number of identifier parts that they use (NumberOfIdentifierParts).

Collection	Metadata
Columns	Returns information on all columns in the database.
DataSourceInformation	Returns information about the database server.
DataTypes	Returns a list of supported data types.
ForeignKeys	Returns information on all foreign keys in the database.
IndexColumns	Returns information on all index columns in the database.
Indexes	Returns information on all indexes in the database.
MetaDataCollections	Returns a list of all collection names.
ProcedureParameters	Returns information on all procedure parameters in the database.

Collection	Metadata
Procedures	Returns information on all procedures in the database.
ReservedWords	Returns a list of reserved words used by SQL Anywhere.
Restrictions	Returns information on restrictions used in GetSchema.
Tables	Returns information on all tables in the database.
UserDefinedTypes	Returns information on all user-defined data types in the database.
Users	Returns information on all users in the database.
ViewColumns	Returns information on all columns in views in the database.
Views	Returns information on all views in the database.

These collection names are also available as read-only properties in the SAMetaDataCollectionNames class.

The results returned can be filtered by specifying an array of restrictions in the call to GetSchema.

The restrictions available with each collection can be queried by calling:

```
GetSchema( "Restrictions" )
```

If the collection requires four restrictions, then the restrictions parameter must be either NULL, or a string with four values.

To filter on a particular restriction, place the string to filter by in its place in the array and leave any unused places NULL. For example, the Tables collection has three restrictions: Owner, Table, and TableType.

To filter the Table collection by table_name:

```
GetSchema( "Tables", new string[ ] { NULL, "my_table", NULL } )
```

This returns information on all tables named my_table.

```
GetSchema( "Tables", new string[ ] { "DBA", "my_table", NULL } )
```

This returns information on all tables named my_table owned by the user DBA.

The following is a summary of the columns returned by each collection. If the number of rows returned in a collection can be reduced by specifying a restriction on a column, the restriction name for that column is shown in parenthesis. The order in which restrictions are specified is the order in which they are presented in the lists below.

Columns collection

- table_schema (Owner)

- table_name (Table)
- column_name (Column)
- ordinal_position
- column_default
- is_nullable
- data_type
- precision
- scale
- column_size

DataSourceInformation collection

- CompositeIdentifierSeparatorPattern
- DataSourceProductName
- DataSourceProductVersion
- DataSourceProductVersionNormalized
- GroupByBehavior
- IdentifierPattern
- IdentifierCase
- OrderByColumnsInSelect
- ParameterMarkerFormat
- ParameterMarkerPattern
- ParameterNameMaxLength
- ParameterNamePattern
- QuotedIdentifierPattern
- QuotedIdentifierCase
- StatementSeparatorPattern
- StringLiteralPattern

- SupportedJoinOperators

DataTypes collection

- TypeName
- ProviderDbType
- ColumnSize
- CreateFormat
- CreateParameters
- DataType
- IsAutoIncrementable
- IsBestMatch
- IsCaseSensitive
- IsFixedLength
- IsFixedPrecisionScale
- IsLong
- IsNullable
- IsSearchable
- IsSearchableWithLike
- IsUnsigned
- MaximumScale
- MinimumScale
- IsConcurrencyType
- IsLiteralSupported
- LiteralPrefix
- LiteralSuffix

ForeignKeys collection

- table_schema (Owner)

- table_name (Table)
- column_name (Column)

IndexColumns collection

- table_schema (Owner)
- table_name (Table)
- index_name (Name)
- column_name (Column)
- order

Indexes collection

- table_schema (Owner)
- table_name (Table)
- index_name (Name)
- primary_key
- is_unique

MetaDataCollections collection

- CollectionName
- NumberOfRestrictions
- NumberOfIdentifierParts

ProcedureParameters collection

- procedure_schema (Owner)
- procedure_name (Name)
- parameter_name (Parameter)
- data_type
- parameter_type
- is_input
- is_output

Procedures collection

- procedure_schema (Owner)
- procedure_name (Name)

ReservedWords collection

- reserved_word

Restrictions collection

- CollectionName
- RestrictionName
- RestrictionDefault
- RestrictionNumber

Tables collection

- table_schema (Owner)
- table_name (Table)
- table_type (TableType)

UserDefinedTypes collection

- data_type
- default
- precision
- scale

Users collection

- user_name (UserName)
- resource_auth
- database_auth
- schedule_auth
- user_group

ViewColumns collection

- view_schema (Owner)

- view_name (Name)
- column_name (Column)

Views collection

- view_schema (Owner)
- view_name (Name)

See also

- "SAConnection class" on page 156

Open method

Opens a database connection with the property settings specified by the SAConnection.ConnectionString.

Visual Basic syntax

```
Public Overrides Sub Open()
```

C# syntax

```
public override void Open()
```

See also

- "ConnectionString property" on page 173

ConnectionString property

Provides the database connection string.

Visual Basic syntax

```
Public Overrides Property ConnectionString As String
```

C# syntax

```
public override string ConnectionString {get;set;}
```

Remarks

The ConnectionString is designed to match the SQL Anywhere connection string format as closely as possible with the following exception: when the Persist Security Info value is set to false (the default), the connection string that is returned is the same as the user-set ConnectionString minus security information. The SQL Anywhere SQL Anywhere .NET Data Provider does not persist the password in a returned connection string unless you set Persist Security Info to true.

You can use the ConnectionString property to connect to a variety of data sources.

You can set the ConnectionString property only when the connection is closed. Many of the connection string values have corresponding read-only properties. When the connection string is set, all of these properties are updated, unless an error is detected. If an error is detected, none of the properties are updated. SAConnection properties return only those settings contained in the ConnectionString.

If you reset the ConnectionString on a closed connection, all connection string values and related properties are reset, including the password.

When the property is set, a preliminary validation of the connection string is performed. When an application calls the Open method, the connection string is fully validated. A runtime exception is generated if the connection string contains invalid or unsupported properties.

Values can be delimited by single or double quotes. Either single or double quotes may be used within a connection string by using the other delimiter, for example, name="value's" or name= 'value"s', but not name='value's' or name= ""value". Blank characters are ignored unless they are placed within a value or within quotes. keyword=value pairs must be separated by a semicolon. If a semicolon is part of a value, it must also be delimited by quotes. Escape sequences are not supported, and the value type is irrelevant. Names are not case sensitive. If a property name occurs more than once in the connection string, the value associated with the last occurrence is used.

You should use caution when constructing a connection string based on user input, such as when retrieving a user ID and password from a window, and appending it to the connection string. The application should not allow a user to embed extra connection string parameters in these values.

The default value of connection pooling is true (pooling=true).

See also

- "SAConnection class" on page 156

See also

- "Open method" on page 173

Example

The following statements set a connection string for an ODBC data source named SQL Anywhere 12 Demo and open the connection.

```
SAConnection conn = new SAConnection();
conn.ConnectionString = "DSN=SQL Anywhere 12 Demo";
conn.Open();
```

ConnectionTimeout property

Gets the number of seconds before a connection attempt times out with an error.

Visual Basic syntax

```
Public ReadOnly Overrides Property ConnectionTimeout As Integer
```


C# syntax

```
public override int ConnectionTimeout {get;}
```

Remarks

15 seconds

Example

The following statement displays the value of the ConnectionTimeout.

```
MessageBox.Show( conn.ConnectionTimeout.ToString( ) );
```

Database property

Gets the name of the current database.

Visual Basic syntax

```
Public ReadOnly Overrides Property Database As String
```

C# syntax

```
public override string Database {get;}
```

Remarks

If the connection is opened, SAConnection returns the name of the current database. Otherwise, SAConnection looks in the connection string in the following order: DatabaseName, DBN, DataSourceName, DataSource, DSN, DatabaseFile, DBF.

DataSource property

Gets the name of the database server.

Visual Basic syntax

```
Public ReadOnly Overrides Property DataSource As String
```

C# syntax

```
public override string DataSource {get;}
```

Remarks

If the connection is opened, the SAConnection object returns the ServerName server property. Otherwise, the SAConnection object looks in the connection string in the following order: EngineName, ServerName, Server, ENG.

See also

- "SAConnection class" on page 156

InitString property

A command that is executed immediately after the connection is established.

Visual Basic syntax

```
Public Property InitString As String
```

C# syntax

```
public string InitString {get;set;}
```

Remarks

The InitString will be executed immediately after the connection is opened.

ServerVersion property

Gets a string that contains the version of the instance of SQL Anywhere to which the client is connected.

Visual Basic syntax

```
Public ReadOnly Overrides Property ServerVersion As String
```

C# syntax

```
public override string ServerVersion {get;}
```

Returns

The version of the instance of SQL Anywhere.

Remarks

The version is ##.##.####, where the first two digits are the major version, the next two digits are the minor version, and the last four digits are the release version. The appended string is of the form major.minor.build, where major and minor are two digits, and build is four digits.

State property

Indicates the state of the SAConnection object.

Visual Basic syntax

```
Public ReadOnly Overrides Property State As ConnectionState
```

C# syntax

```
public override ConnectionState State {get;}
```

Returns

A System.Data.ConnectionState enumeration.

InfoMessage event

Occurs when the SQL Anywhere database server returns a warning or informational message.

Visual Basic syntax

```
Public Event InfoMessage As SAInfoMessageEventHandler
```

C# syntax

```
public event SAInfoMessageEventHandler InfoMessage;
```

Remarks

The event handler receives an argument of type SAInfoMessageEventArgs containing data related to this event. The following SAInfoMessageEventArgs properties provide information specific to this event: NativeError, Errors, Message, MessageType, and Source.

For more information, see the .NET Framework documentation for OleDbConnection.InfoMessage Event.

StateChange event

Occurs when the state of the SAConnection object changes.

Visual Basic syntax

```
Public Event StateChange As StateChangeEventHandler
```

C# syntax

```
public event override StateChangeEventHandler StateChange;
```

Remarks

The event handler receives an argument of type StateChangeEventArgs with data related to this event. The following StateChangeEventArgs properties provide information specific to this event: CurrentState and OriginalState.

For more information, see the .NET Framework documentation for OleDbConnection.StateChange Event.

SAConnectionStringBuilder class

Provides a simple way to create and manage the contents of connection strings used by the SAConnection class.

Visual Basic syntax

```
Public NotInheritable Class SAConnectionStringBuilder
    Inherits SAConnectionStringBuilderBase
```

C# syntax

```
public sealed class SAConnectionStringBuilder :
    SAConnectionStringBuilderBase
```

Base classes

- "SAConnectionStringBuilderBase class" on page 196

Members

All members of SAConnectionStringBuilder class, including all inherited members.

Name	Description
"SAConnectionStringBuilder constructor"	Initializes a new instance of the SAConnectionStringBuilder class.
Add method (Inherited from System.Data.Common.DbConnectionStringBuilder)	Adds an entry with the specified key and value into the System.Data.Common.DbConnectionStringBuilder.
AppendKeyValuePair method (Inherited from System.Data.Common.DbConnectionStringBuilder)	Provides an efficient and safe way to append a key and value to an existing System.Text.StringBuilder object.
Clear method (Inherited from System.Data.Common.DbConnectionStringBuilder)	Clears the contents of the System.Data.Common.DbConnectionStringBuilder instance.
ClearPropertyDescriptors method (Inherited from System.Data.Common.DbConnectionStringBuilder)	Clears the collection of System.ComponentModel.PropertyDescriptor objects on the associated System.Data.Common.DbConnectionStringBuilder.
"ContainsKey method"	Determines whether the SAConnectionStringBuilder object contains a specific keyword.
EquivalentTo method (Inherited from System.Data.Common.DbConnectionStringBuilder)	Compares the connection information in this System.Data.Common.DbConnectionStringBuilder object with the connection information in the supplied object.
"GetKeyword method"	Gets the keyword for specified SAConnectionStringBuilder property.
GetProperties method (Inherited from System.Data.Common.DbConnectionStringBuilder)	Fills a supplied System.Collections.Hashtable with information about all the properties of this System.Data.Common.DbConnectionStringBuilder.

Name	Description
"GetUseLongNameAsKeyword method"	Gets a boolean values that indicates whether long connection parameter names are used in the connection string.
"Remove method"	Removes the entry with the specified key from the SAConnectionStringBuilder instance.
"SetUseLongNameAsKeyword method"	Sets a boolean value that indicates whether long connection parameter names are used in the connection string.
"ShouldSerialize method"	Indicates whether the specified key exists in this SAConnectionStringBuilder instance.
ToString method (Inherited from System.Data.Common.DbConnectionStringBuilder)	Returns the connection string associated with this System.Data.Common.DbConnectionStringBuilder.
"TryGetValue method"	Retrieves a value corresponding to the supplied key from this SAConnectionStringBuilder.
"AppInfo property"	Gets or sets the AppInfo connection property.
"AutoStart property"	Gets or sets the AutoStart connection property.
"AutoStop property"	Gets or sets the AutoStop connection property.
BrowsableConnectionString property (Inherited from System.Data.Common.DbConnectionStringBuilder)	Gets or sets a value that indicates whether the System.Data.Common.DbConnectionStringBuilder.ConnectionString property is visible in Visual Studio designers.
"Charset property"	Gets or sets the Charset connection property.
"CommBufferSize property"	Gets or sets the CommBufferSize connection property.
"CommLinks property"	Gets or sets the CommLinks property.
"Compress property"	Gets or sets the Compress connection property.

Name	Description
"CompressionThreshold property"	Gets or sets the CompressionThreshold connection property.
"ConnectionLifetime property"	Gets or sets the ConnectionLifetime connection property.
"ConnectionName property"	Gets or sets the ConnectionName connection property.
"ConnectionPool property"	Gets or sets the ConnectionPool property.
"ConnectionReset property"	Gets or sets the ConnectionReset connection property.
ConnectionString property (Inherited from System.Data.Common.DbConnectionStringBuilder)	Gets or sets the connection string associated with the System.Data.Common.DbConnectionStringBuilder.
"ConnectionTimeout property"	Gets or sets the ConnectionTimeout connection property.
Count property (Inherited from System.Data.Common.DbConnectionStringBuilder)	Gets the current number of keys that are contained within the System.Data.Common.DbConnectionStringBuilder.ConnectionString property.
"DatabaseFile property"	Gets or sets the DatabaseFile connection property.
"DatabaseKey property"	Gets or sets the DatabaseKey connection property.
"DatabaseName property"	Gets or sets the DatabaseName connection property.
"DatabaseSwitches property"	Gets or sets the DatabaseSwitches connection property.
"DataSourceName property"	Gets or sets the DataSourceName connection property.
"DisableMultiRowFetch property"	Gets or sets the DisableMultiRowFetch connection property.
"Elevate property"	Gets or sets the Elevate connection property.

Name	Description
"EncryptedPassword property"	Gets or sets the EncryptedPassword connection property.
"Encryption property"	Gets or sets the Encryption connection property.
"Enlist property"	Gets or sets the Enlist connection property.
"FileDataSourceName property"	Gets or sets the FileDataSourceName connection property.
"ForceStart property"	Gets or sets the ForceStart connection property.
"Host property"	Gets or sets the Host property.
"IdleTimeout property"	Gets or sets the IdleTimeout connection property.
"Integrated property"	Gets or sets the Integrated connection property.
IsFixedSize property (Inherited from System.Data.Common.DbConnectionStringBuilder)	Gets a value that indicates whether the System.Data.Common.DbConnectionStringBuilder has a fixed size.
IsReadOnly property (Inherited from System.Data.Common.DbConnectionStringBuilder)	Gets a value that indicates whether the System.Data.Common.DbConnectionStringBuilder is read-only.
"Kerberos property"	Gets or sets the Kerberos connection property.
"Keys property"	Gets an System.Collections.ICollection that contains the keys in the SAConnectionStringBuilder.
"Language property"	Gets or sets the Language connection property.
"LazyClose property"	Gets or sets the LazyClose connection property.
"LivenessTimeout property"	Gets or sets the LivenessTimeout connection property.
"LogFile property"	Gets or sets the LogFile connection property.

Name	Description
"MaxPoolSize property"	Gets or sets the MaxPoolSize connection property.
"MinPoolSize property"	Gets or sets the MinPoolSize connection property.
"NewPassword property"	Gets or sets the NewPassword connection property.
"NodeType property"	Gets or sets the NodeType property.
"Password property"	Gets or sets the Password connection property.
"PersistSecurityInfo property"	Gets or sets the PersistSecurityInfo connection property.
"Pooling property"	Gets or sets the Pooling connection property.
"PrefetchBuffer property"	Gets or sets the PrefetchBuffer connection property.
"PrefetchRows property"	Gets or sets the PrefetchRows connection property.
"RetryConnectionTimeout property"	Gets or sets the RetryConnectionTimeout property.
"ServerName property"	Gets or sets the ServerName connection property.
"StartLine property"	Gets or sets the StartLine connection property.
"this property"	Gets or sets the value of the connection keyword.
"Unconditional property"	Gets or sets the Unconditional connection property.
"UserID property"	Gets or sets the UserID connection property.
Values property (Inherited from System.Data.Common.DbConnectionStringBuilder)	Gets an System.Collections.ICollection that contains the values in the System.Data.Common.DbConnectionStringBuilder.

Remarks

The SAConnectionStringBuilder class inherits SAConnectionStringBuilderBase, which inherits DbConnectionStringBuilder.

The SAConnectionStringBuilder class is not available in the .NET Compact Framework 2.0.

For a list of connection parameters, see "Connection parameters" [*SQL Anywhere Server - Database Administration*].

SAConnectionStringBuilder constructor

Initializes a new instance of the SAConnectionStringBuilder class.

Overload list

Name	Description
"SAConnectionStringBuilder() constructor"	Initializes a new instance of the SAConnectionStringBuilder class.
"SAConnectionStringBuilder(string) constructor"	Initializes a new instance of the SAConnectionStringBuilder class.

SAConnectionStringBuilder() constructor

Initializes a new instance of the SAConnectionStringBuilder class.

Visual Basic syntax

```
Public Sub New()
```

C# syntax

```
public SAConnectionStringBuilder()
```

Remarks

The SAConnectionStringBuilder class is not available in the .NET Compact Framework 2.0.

SAConnectionStringBuilder(string) constructor

Initializes a new instance of the SAConnectionStringBuilder class.

Visual Basic syntax

```
Public Sub New(ByVal connectionString As String)
```

C# syntax

```
public SAConnectionStringBuilder(string connectionString)
```

Parameters

- **connectionString** The basis for the object's internal connection information. Parsed into keyword=value pairs. For a list of connection parameters, see "Connection parameters" [*SQL Anywhere Server - Database Administration*].

Remarks

The SAConnectionStringBuilder class is not available in the .NET Compact Framework 2.0.

Example

The following statement initializes an SAConnection object for a connection to a database named policies running on a SQL Anywhere database server named hr. The connection uses the user ID admin and the password money.

```
SAConnectionStringBuilder conn = new SAConnectionStringBuilder(
    "UID=admin;PWD=money;SERVER=hr;DBN=policies" );
```

AppInfo property

Gets or sets the AppInfo connection property.

Visual Basic syntax

```
Public Property AppInfo As String
```

C# syntax

```
public string AppInfo {get;set;}
```

AutoStart property

Gets or sets the AutoStart connection property.

Visual Basic syntax

```
Public Property AutoStart As String
```

C# syntax

```
public string AutoStart {get;set;}
```

AutoStop property

Gets or sets the AutoStop connection property.

Visual Basic syntax

```
Public Property AutoStop As String
```


C# syntax

```
public string AutoStop {get;set;}
```

Charset property

Gets or sets the Charset connection property.

Visual Basic syntax

```
Public Property Charset As String
```

C# syntax

```
public string Charset {get;set;}
```

CommBufferSize property

Gets or sets the CommBufferSize connection property.

Visual Basic syntax

```
Public Property CommBufferSize As Integer
```

C# syntax

```
public int CommBufferSize {get;set;}
```

CommLinks property

Gets or sets the CommLinks property.

Visual Basic syntax

```
Public Property CommLinks As String
```

C# syntax

```
public string CommLinks {get;set;}
```

Compress property

Gets or sets the Compress connection property.

Visual Basic syntax

```
Public Property Compress As String
```

C# syntax

```
public string Compress {get;set;}
```

CompressionThreshold property

Gets or sets the CompressionThreshold connection property.

Visual Basic syntax

```
Public Property CompressionThreshold As Integer
```

C# syntax

```
public int CompressionThreshold {get;set;}
```

ConnectionLifetime property

Gets or sets the ConnectionLifetime connection property.

Visual Basic syntax

```
Public Property ConnectionLifetime As Integer
```

C# syntax

```
public int ConnectionLifetime {get;set;}
```

ConnectionName property

Gets or sets the ConnectionName connection property.

Visual Basic syntax

```
Public Property ConnectionName As String
```

C# syntax

```
public string ConnectionName {get;set;}
```

ConnectionPool property

Gets or sets the ConnectionPool property.

Visual Basic syntax

```
Public Property ConnectionPool As String
```


C# syntax

```
public string ConnectionPool {get;set;}
```

ConnectionReset property

Gets or sets the ConnectionReset connection property.

Visual Basic syntax

```
Public Property ConnectionReset As Boolean
```

C# syntax

```
public bool ConnectionReset {get;set;}
```

Returns

A DataTable that contains schema information.

ConnectionTimeout property

Gets or sets the ConnectionTimeout connection property.

Visual Basic syntax

```
Public Property ConnectionTimeout As Integer
```

C# syntax

```
public int ConnectionTimeout {get;set;}
```

Example

The following statement displays the value of the ConnectionTimeout property.

```
MessageBox.Show( connString.ConnectionTimeout.ToString() );
```

DatabaseFile property

Gets or sets the DatabaseFile connection property.

Visual Basic syntax

```
Public Property DatabaseFile As String
```

C# syntax

```
public string DatabaseFile {get;set;}
```

DatabaseKey property

Gets or sets the DatabaseKey connection property.

Visual Basic syntax

```
Public Property DatabaseKey As String
```

C# syntax

```
public string DatabaseKey {get;set;}
```

DatabaseName property

Gets or sets the DatabaseName connection property.

Visual Basic syntax

```
Public Property DatabaseName As String
```

C# syntax

```
public string DatabaseName {get;set;}
```

DatabaseSwitches property

Gets or sets the DatabaseSwitches connection property.

Visual Basic syntax

```
Public Property DatabaseSwitches As String
```

C# syntax

```
public string DatabaseSwitches {get;set;}
```

DataSourceName property

Gets or sets the DataSourceName connection property.

Visual Basic syntax

```
Public Property DataSourceName As String
```

C# syntax

```
public string DataSourceName {get;set;}
```

DisableMultiRowFetch property

Gets or sets the DisableMultiRowFetch connection property.

Visual Basic syntax

```
Public Property DisableMultiRowFetch As String
```

C# syntax

```
public string DisableMultiRowFetch {get;set;}
```

Elevate property

Gets or sets the Elevate connection property.

Visual Basic syntax

```
Public Property Elevate As String
```

C# syntax

```
public string Elevate {get;set;}
```

EncryptedPassword property

Gets or sets the EncryptedPassword connection property.

Visual Basic syntax

```
Public Property EncryptedPassword As String
```

C# syntax

```
public string EncryptedPassword {get;set;}
```

Encryption property

Gets or sets the Encryption connection property.

Visual Basic syntax

```
Public Property Encryption As String
```

C# syntax

```
public string Encryption {get;set;}
```

Enlist property

Gets or sets the Enlist connection property.

Visual Basic syntax

```
Public Property Enlist As Boolean
```

C# syntax

```
public bool Enlist {get;set;}
```

FileDataSourceName property

Gets or sets the FileDataSourceName connection property.

Visual Basic syntax

```
Public Property FileDataSourceName As String
```

C# syntax

```
public string FileDataSourceName {get;set;}
```

ForceStart property

Gets or sets the ForceStart connection property.

Visual Basic syntax

```
Public Property ForceStart As String
```

C# syntax

```
public string ForceStart {get;set;}
```

Host property

Gets or sets the Host property.

Visual Basic syntax

```
Public Property Host As String
```

C# syntax

```
public string Host {get;set;}
```

IdleTimeout property

Gets or sets the IdleTimeout connection property.

Visual Basic syntax

```
Public Property IdleTimeout As Integer
```

C# syntax

```
public int IdleTimeout {get;set;}
```

Integrated property

Gets or sets the Integrated connection property.

Visual Basic syntax

```
Public Property Integrated As String
```

C# syntax

```
public string Integrated {get;set;}
```

Kerberos property

Gets or sets the Kerberos connection property.

Visual Basic syntax

```
Public Property Kerberos As String
```

C# syntax

```
public string Kerberos {get;set;}
```

Language property

Gets or sets the Language connection property.

Visual Basic syntax

```
Public Property Language As String
```

C# syntax

```
public string Language {get;set;}
```

LazyClose property

Gets or sets the LazyClose connection property.

Visual Basic syntax

```
Public Property LazyClose As String
```

C# syntax

```
public string LazyClose {get;set;}
```

LivenessTimeout property

Gets or sets the LivenessTimeout connection property.

Visual Basic syntax

```
Public Property LivenessTimeout As Integer
```

C# syntax

```
public int LivenessTimeout {get;set;}
```

LogFile property

Gets or sets the LogFile connection property.

Visual Basic syntax

```
Public Property LogFile As String
```

C# syntax

```
public string LogFile {get;set;}
```

MaxPoolSize property

Gets or sets the MaxPoolSize connection property.

Visual Basic syntax

```
Public Property MaxPoolSize As Integer
```

C# syntax

```
public int MaxPoolSize {get;set;}
```

MinPoolSize property

Gets or sets the MinPoolSize connection property.

Visual Basic syntax

```
Public Property MinPoolSize As Integer
```

C# syntax

```
public int MinPoolSize {get;set;}
```

NewPassword property

Gets or sets the NewPassword connection property.

Visual Basic syntax

```
Public Property NewPassword As String
```

C# syntax

```
public string NewPassword {get;set;}
```

NodeType property

Gets or sets the NodeType property.

Visual Basic syntax

```
Public Property NodeType As String
```

C# syntax

```
public string NodeType {get;set;}
```

Password property

Gets or sets the Password connection property.

Visual Basic syntax

```
Public Property Password As String
```

C# syntax

```
public string Password {get;set;}
```

PersistSecurityInfo property

Gets or sets the PersistSecurityInfo connection property.

Visual Basic syntax

```
Public Property PersistSecurityInfo As Boolean
```

C# syntax

```
public bool PersistSecurityInfo {get;set;}
```

Pooling property

Gets or sets the Pooling connection property.

Visual Basic syntax

```
Public Property Pooling As Boolean
```

C# syntax

```
public bool Pooling {get;set;}
```

PrefetchBuffer property

Gets or sets the PrefetchBuffer connection property.

Visual Basic syntax

```
Public Property PrefetchBuffer As Integer
```

C# syntax

```
public int PrefetchBuffer {get;set;}
```

PrefetchRows property

Gets or sets the PrefetchRows connection property.

Visual Basic syntax

```
Public Property PrefetchRows As Integer
```

C# syntax

```
public int PrefetchRows {get;set;}
```

Remarks

The default value is 200.

RetryConnectionTimeout property

Gets or sets the RetryConnectionTimeout property.

Visual Basic syntax

```
Public Property RetryConnectionTimeout As Integer
```

C# syntax

```
public int RetryConnectionTimeout {get;set;}
```

ServerName property

Gets or sets the ServerName connection property.

Visual Basic syntax

```
Public Property ServerName As String
```

C# syntax

```
public string ServerName {get;set;}
```

StartLine property

Gets or sets the StartLine connection property.

Visual Basic syntax

```
Public Property StartLine As String
```

C# syntax

```
public string StartLine {get;set;}
```

Unconditional property

Gets or sets the Unconditional connection property.

Visual Basic syntax

```
Public Property Unconditional As String
```

C# syntax

```
public string Unconditional {get;set;}
```

UserID property

Gets or sets the UserID connection property.

Visual Basic syntax

```
Public Property UserID As String
```

C# syntax

```
public string UserID {get;set;}
```

SAConnectionStringBuilderBase class

Base class of the SAConnectionStringBuilder class.

Visual Basic syntax

```
Public MustInherit Class SAConnectionStringBuilderBase
    Inherits System.Data.Common.DbConnectionStringBuilder
```

C# syntax

```
public abstract class SAConnectionStringBuilderBase :
    System.Data.Common.DbConnectionStringBuilder
```

Base classes

- System.Data.Common.DbConnectionStringBuilder

Derived classes

- "SAConnectionStringBuilder class" on page 177
- "SATcpOptionsBuilder class" on page 302

Members

All members of SAConnectionStringBuilderBase class, including all inherited members.

Name	Description
Add method (Inherited from System.Data.Common.DbConnectionStringBuilder)	Adds an entry with the specified key and value into the System.Data.Common.DbConnectionStringBuilder.
AppendKeyValuePair method (Inherited from System.Data.Common.DbConnectionStringBuilder)	Provides an efficient and safe way to append a key and value to an existing System.Text.StringBuilder object.
Clear method (Inherited from System.Data.Common.DbConnectionStringBuilder)	Clears the contents of the System.Data.Common.DbConnectionStringBuilder instance.
ClearPropertyDescriptors method (Inherited from System.Data.Common.DbConnectionStringBuilder)	Clears the collection of System.ComponentModel.PropertyDescriptor objects on the associated System.Data.Common.DbConnectionStringBuilder.

Name	Description
"ContainsKey method"	Determines whether the SAConnectionStringBuilder object contains a specific keyword.
EquivalentTo method (Inherited from System.Data.Common.DbConnectionStringBuilder)	Compares the connection information in this System.Data.Common.DbConnectionStringBuilder object with the connection information in the supplied object.
"GetKeyword method"	Gets the keyword for specified SAConnectionStringBuilder property.
GetProperties method (Inherited from System.Data.Common.DbConnectionStringBuilder)	Fills a supplied System.Collections.Hashtable with information about all the properties of this System.Data.Common.DbConnectionStringBuilder.
"GetUseLongNameAsKeyword method"	Gets a boolean values that indicates whether long connection parameter names are used in the connection string.
"Remove method"	Removes the entry with the specified key from the SAConnectionStringBuilder instance.
"SetUseLongNameAsKeyword method"	Sets a boolean value that indicates whether long connection parameter names are used in the connection string.
"ShouldSerialize method"	Indicates whether the specified key exists in this SAConnectionStringBuilder instance.
ToString method (Inherited from System.Data.Common.DbConnectionStringBuilder)	Returns the connection string associated with this System.Data.Common.DbConnectionStringBuilder.
"TryGetValue method"	Retrieves a value corresponding to the supplied key from this SAConnectionStringBuilder.
BrowsableConnectionString property (Inherited from System.Data.Common.DbConnectionStringBuilder)	Gets or sets a value that indicates whether the System.Data.Common.DbConnectionStringBuilder.ConnectionString property is visible in Visual Studio designers.
ConnectionString property (Inherited from System.Data.Common.DbConnectionStringBuilder)	Gets or sets the connection string associated with the System.Data.Common.DbConnectionStringBuilder.
Count property (Inherited from System.Data.Common.DbConnectionStringBuilder)	Gets the current number of keys that are contained within the System.Data.Common.DbConnectionStringBuilder.ConnectionString property.

Name	Description
IsFixedSize property (Inherited from System.Data.Common.DbConnectionStringBuilder)	Gets a value that indicates whether the System.Data.Common.DbConnectionStringBuilder has a fixed size.
IsReadOnly property (Inherited from System.Data.Common.DbConnectionStringBuilder)	Gets a value that indicates whether the System.Data.Common.DbConnectionStringBuilder is read-only.
"Keys property"	Gets an System.Collections.ICollection that contains the keys in the SAConnectionStringBuilder.
"this property"	Gets or sets the value of the connection keyword.
Values property (Inherited from System.Data.Common.DbConnectionStringBuilder)	Gets an System.Collections.ICollection that contains the values in the System.Data.Common.DbConnectionStringBuilder.

ContainsKey method

Determines whether the SAConnectionStringBuilder object contains a specific keyword.

Visual Basic syntax

```
Public Overrides Function ContainsKey(
    ByVal keyword As String
) As Boolean
```

C# syntax

```
public override bool ContainsKey(string keyword)
```

Parameters

- **keyword** The keyword to locate in the SAConnectionStringBuilder.

Returns

True if the value associated with keyword has been set; otherwise, false.

Example

The following statement determines whether the SAConnectionStringBuilder object contains the UserID keyword.

```
connectString.ContainsKey("UserID")
```

GetKeyword method

Gets the keyword for specified SAConnectionStringBuilder property.

Visual Basic syntax

```
Public Function GetKeyword(ByVal propName As String) As String
```

C# syntax

```
public string GetKeyword(string propName)
```

Parameters

- **propName** The name of the SAConnectionStringBuilder property.

Returns

The keyword for specified SAConnectionStringBuilder property.

GetUseLongNameAsKeyword method

Gets a boolean values that indicates whether long connection parameter names are used in the connection string.

Visual Basic syntax

```
Public Function GetUseLongNameAsKeyword() As Boolean
```

C# syntax

```
public bool GetUseLongNameAsKeyword()
```

Returns

True if long connection parameter names are used to build connection strings; otherwise, false.

Remarks

SQL Anywhere connection parameters have both long and short forms of their names. For example, to specify the name of an ODBC data source in your connection string, you can use either of the following values: DataSourceName or DSN. By default, long connection parameter names are used to build connection strings.

See also

- "SetUseLongNameAsKeyword method" on page 200

Remove method

Removes the entry with the specified key from the SAConnectionStringBuilder instance.

Visual Basic syntax

```
Public Overrides Function Remove(ByVal keyword As String) As Boolean
```

C# syntax

```
public override bool Remove(string keyword)
```

Parameters

- **keyword** The key of the key/value pair to be removed from the connection string in this SAConnectionStringBuilder.

Returns

True if the key existed within the connection string and was removed; false if the key did not exist.

SetUseLongNameAsKeyword method

Sets a boolean value that indicates whether long connection parameter names are used in the connection string.

Visual Basic syntax

```
Public Sub SetUseLongNameAsKeyword(
    ByVal useLongNameAsKeyword As Boolean
)
```

C# syntax

```
public void SetUseLongNameAsKeyword(bool useLongNameAsKeyword)
```

Parameters

- **useLongNameAsKeyword** A boolean value that indicates whether the long connection parameter name is used in the connection string.

Remarks

Long connection parameter names are used by default.

See also

- "GetUseLongNameAsKeyword method" on page 199

ShouldSerialize method

Indicates whether the specified key exists in this SAConnectionStringBuilder instance.

Visual Basic syntax

```
Public Overrides Function ShouldSerialize(
    ByVal keyword As String
) As Boolean
```

C# syntax

```
public override bool ShouldSerialize(string keyword)
```


Parameters

- **keyword** The key to locate in the SAConnectionStringBuilder.

Returns

True if the SAConnectionStringBuilder contains an entry with the specified key; otherwise false.

TryGetValue method

Retrieves a value corresponding to the supplied key from this SAConnectionStringBuilder.

Visual Basic syntax

```
Public Overrides Function TryGetValue(
    ByVal keyword As String,
    ByVal value As Object
) As Boolean
```

C# syntax

```
public override bool TryGetValue(string keyword, out object value)
```

Parameters

- **keyword** The key of the item to retrieve.
- **value** The value corresponding to keyword.

Returns

true if keyword was found within the connection string; otherwise false.

Keys property

Gets an System.Collections.ICollection that contains the keys in the SAConnectionStringBuilder.

Visual Basic syntax

```
Public ReadOnly Overrides Property Keys As ICollection
```

C# syntax

```
public override ICollection Keys {get;}
```

Returns

An System.Collections.ICollection that contains the keys in the SAConnectionStringBuilder.

this property

Gets or sets the value of the connection keyword.

Visual Basic syntax

```
Public Overrides Property Item(ByVal keyword As String) As Object
```

C# syntax

```
public override object this[string keyword] {get;set;}
```

Parameters

- **keyword** The name of the connection keyword.

Remarks

An object representing the value of the specified connection keyword.

If the keyword or type is invalid, an exception is raised. keyword is case insensitive.

When setting the value, passing NULL clears the value.

SADataAdapter class

Represents a set of commands and a database connection used to fill a System.Data.DataSet and to update a database.

Visual Basic syntax

```
Public NotInheritable Class SADataAdapter
    Inherits System.Data.Common.DbDataAdapter
    Implements System.ICloneable
```

C# syntax

```
public sealed class SADataAdapter :
    System.Data.Common.DbDataAdapter,
    System.ICloneable
```

Base classes

- System.Data.Common.DbDataAdapter
- System.ICloneable

Members

All members of SADataAdapter class, including all inherited members.

Name	Description
"SADataAdapter constructor"	Initializes an SADataAdapter object.
AddToBatch method (Inherited from System.Data.Common.DbDataAdapter)	Adds a System.Data.IDbCommand to the current batch.

Name	Description
CreateRowUpdatedEvent method (Inherited from System.Data.Common.DbDataAdapter)	Initializes a new instance of the System.Data.Common.RowUpdatedEventArgs class.
CreateRowUpdatingEvent method (Inherited from System.Data.Common.DbDataAdapter)	Initializes a new instance of the System.Data.Common.RowUpdatingEventArgs class.
Dispose method (Inherited from System.Data.Common.DbDataAdapter)	Releases the unmanaged resources used by the System.Data.Common.DbDataAdapter and optionally releases the managed resources.
ExecuteBatch method (Inherited from System.Data.Common.DbDataAdapter)	Executes the current batch.
Fill method (Inherited from System.Data.Common.DbDataAdapter)	Adds or refreshes rows in the System.Data.DataSet.
FillSchema method (Inherited from System.Data.Common.DbDataAdapter)	Adds a System.Data.DataTable named "Table" to the specified System.Data.DataSet and configures the schema to match that in the data source based on the specified System.Data.SchemaType.
GetBatchedParameter method (Inherited from System.Data.Common.DbDataAdapter)	Returns a System.Data.IDataParameter from one of the commands in the current batch.
GetBatchedRecordsAffected method (Inherited from System.Data.Common.DbDataAdapter)	Returns information about an individual update attempt within a larger batched update.
“GetFillParameters method”	Returns the parameters set by you when executing a SELECT statement.
FillError (Inherited from System.Data.Common.DbDataAdapter)OnFillError method (Inherited from System.Data.Common.DbDataAdapter)	
OnRowUpdated method (Inherited from System.Data.Common.DbDataAdapter)	Raises the RowUpdated event of a .NET Framework data provider.
OnRowUpdating method (Inherited from System.Data.Common.DbDataAdapter)	Raises the RowUpdating event of a .NET Framework data provider.

Name	Description
Update method (Inherited from System.Data.Common.DbDataAdapter)	Calls the respective INSERT, UPDATE, or DELETE statements for each inserted, updated, or deleted row in the specified array of System.Data.DataRow objects.
"DeleteCommand property"	Specifies an SACommand object that is executed against the database when the Update method is called to delete rows in the database that correspond to deleted rows in the DataSet.
FillCommandBehavior property (Inherited from System.Data.Common.DbDataAdapter)	Gets or sets the behavior of the command used to fill the data adapter.
"InsertCommand property"	Specifies an SACommand that is executed against the database when the Update method is called that adds rows to the database to correspond to rows that were inserted in the DataSet.
"SelectCommand property"	Specifies an SACommand that is used during Fill or FillSchema to obtain a result set from the database for copying into a DataSet.
"TableMappings property"	Specifies a collection that provides the master mapping between a source table and a DataTable.
"UpdateBatchSize property"	Gets or sets the number of rows that are processed in each round-trip to the server.
"UpdateCommand property"	Specifies an SACommand that is executed against the database when the Update method is called to update rows in the database that correspond to updated rows in the DataSet.
"RowUpdated event"	Occurs during an update after a command is executed against the data source.
"RowUpdating event"	Occurs during an update before a command is executed against the data source.

Remarks

The System.Data.DataSet provides a way to work with data offline. The SADataAdapter provides methods to associate a DataSet with a set of SQL statements.

Implements: IDbDataAdapter, IDataAdapter, ICloneable

For more information, see "Using the SADataAdapter object to access and manipulate data" on page 52 and "Accessing and manipulating data" on page 45.

SADataAdapter constructor

Initializes an SADataAdapter object.

Overload list

Name	Description
"SADataAdapter() constructor"	Initializes an SADataAdapter object.
"SADataAdapter(SACommand) constructor"	Initializes an SADataAdapter object with the specified SELECT statement.
"SADataAdapter(string, SAConnection) constructor"	Initializes an SADataAdapter object with the specified SELECT statement and connection.
"SADataAdapter(string, string) constructor"	Initializes an SADataAdapter object with the specified SELECT statement and connection string.

SADataAdapter() constructor

Initializes an SADataAdapter object.

Visual Basic syntax

```
Public Sub New()
```

C# syntax

```
public SADataAdapter()
```

See also

- "SADataAdapter constructor" on page 205

SADataAdapter(SACommand) constructor

Initializes an SADataAdapter object with the specified SELECT statement.

Visual Basic syntax

```
Public Sub New(ByVal selectCommand As SACommand)
```

C# syntax

```
public SADataAdapter(SACommand selectCommand)
```

Parameters

- **selectCommand** An SACommand object that is used during System.Data.Common.DbDataAdapter.Fill(System.Data.DataSet) to select records from the data source for placement in the System.Data.DataSet.

See also

- "SADataAdapter constructor" on page 205

SADataAdapter(string, SAConnection) constructor

Initializes an SADataAdapter object with the specified SELECT statement and connection.

Visual Basic syntax

```
Public Sub New(
    ByVal selectCommandText As String,
    ByVal selectConnection As SAConnection
)
```

C# syntax

```
public SADataAdapter(
    string selectCommandText,
    SAConnection selectConnection
)
```

Parameters

- **selectCommandText** A SELECT statement to be used to set the SADataAdapter.SelectCommand property of the SADataAdapter object.
- **selectConnection** An SAConnection object that defines a connection to a database.

See also

- "SADataAdapter constructor" on page 205
- "SelectCommand property" on page 208
- "SAConnection class" on page 156

SADataAdapter(string, string) constructor

Initializes an SADataAdapter object with the specified SELECT statement and connection string.

Visual Basic syntax

```
Public Sub New(
    ByVal selectCommandText As String,
    ByVal selectConnectionString As String
)
```

C# syntax

```
public SADataAdapter(
    string selectCommandText,
    string selectConnectionString
)
```

Parameters

- **selectCommandText** A SELECT statement to be used to set the SADataAdapter.SelectCommand property of the SADataAdapter object.
- **selectConnectionString** A connection string for a SQL Anywhere database.

See also

- "SADataAdapter constructor" on page 205
- "SelectCommand property" on page 208

GetFillParameters method

Returns the parameters set by you when executing a SELECT statement.

Visual Basic syntax

```
Public Shadows Function GetFillParameters() As SAParameter()
```

C# syntax

```
public new SAParameter[] GetFillParameters()
```

Returns

An array of IDataParameter objects that contains the parameters set by the user.

DeleteCommand property

Specifies an SACommand object that is executed against the database when the Update method is called to delete rows in the database that correspond to deleted rows in the DataSet.

Visual Basic syntax

```
Public Shadows Property DeleteCommand As SACommand
```

C# syntax

```
public new SACommand DeleteCommand {get;set;}
```

Remarks

If this property is not set and primary key information is present in the DataSet during Update, DeleteCommand can be generated automatically by setting SelectCommand and using the SACommandBuilder. In that case, the SACommandBuilder generates any additional commands that you do not set. This generation logic requires key column information to be present in the SelectCommand.

When DeleteCommand is assigned to an existing SACommand object, the SACommand object is not cloned. The DeleteCommand maintains a reference to the existing SACommand.

See also

- "SelectCommand property" on page 208

InsertCommand property

Specifies an SACommand that is executed against the database when the Update method is called that adds rows to the database to correspond to rows that were inserted in the DataSet.

Visual Basic syntax

```
Public Shadows Property InsertCommand As SACommand
```

C# syntax

```
public new SACommand InsertCommand {get;set;}
```

Remarks

The SACommandBuilder does not require key columns to generate InsertCommand.

When InsertCommand is assigned to an existing SACommand object, the SACommand is not cloned. The InsertCommand maintains a reference to the existing SACommand.

If this command returns rows, the rows may be added to the DataSet depending on how you set the UpdatedRowSource property of the SACommand object.

SelectCommand property

Specifies an SACommand that is used during Fill or FillSchema to obtain a result set from the database for copying into a DataSet.

Visual Basic syntax

```
Public Shadows Property SelectCommand As SACommand
```

C# syntax

```
public new SACommand SelectCommand {get;set;}
```


Remarks

When SelectCommand is assigned to a previously-created SACommand, the SACommand is not cloned. The SelectCommand maintains a reference to the previously-created SACommand object.

If the SelectCommand does not return any rows, no tables are added to the DataSet, and no exception is raised.

The SELECT statement can also be specified in the SADataAdapter constructor.

TableMappings property

Specifies a collection that provides the master mapping between a source table and a DataTable.

Visual Basic syntax

```
Public ReadOnly Shadows Property TableMappings As
DataTableMappingCollection
```

C# syntax

```
public new DataTableMappingCollection TableMappings {get;}
```

Remarks

The default value is an empty collection.

When reconciling changes, the SADataAdapter uses the DataTableMappingCollection collection to associate the column names used by the data source with the column names used by the DataSet.

The TableMappings property is not available in the .NET Compact Framework 2.0.

UpdateBatchSize property

Gets or sets the number of rows that are processed in each round-trip to the server.

Visual Basic syntax

```
Public Overrides Property UpdateBatchSize As Integer
```

C# syntax

```
public override int UpdateBatchSize {get;set;}
```

Remarks

The default value is 1.

Setting the value to something greater than 1 causes SADataAdapter.Update to execute all the insert statements in batches. The deletions and updates are executed sequentially as before, but insertions are executed afterward in batches of size equal to the value of UpdateBatchSize. Setting the value to 0 causes Update to send the insert statements in a single batch.

Setting the value to something greater than 1 causes SADataAdapter.Fill to execute all the insert statements in batches. The deletions and updates are executed sequentially as before, but insertions are executed afterward in batches of size equal to the value of UpdateBatchSize.

Setting the value to 0 causes Fill to send the insert statements in a single batch.

Setting it less than 0 is an error.

If UpdateBatchSize is set to something other than one, and the InsertCommand property is set to something that is not an INSERT statement, then an exception is thrown when calling Fill.

This behavior is different from SqlDataAdapter. It batches all types of commands.

UpdateCommand property

Specifies an SACommand that is executed against the database when the Update method is called to update rows in the database that correspond to updated rows in the DataSet.

Visual Basic syntax

```
Public Shadows Property UpdateCommand As SACommand
```

C# syntax

```
public new SACommand UpdateCommand {get;set;}
```

Remarks

During Update, if this property is not set and primary key information is present in the SelectCommand, the UpdateCommand can be generated automatically if you set the SelectCommand property and use the SACommandBuilder. Then, any additional commands that you do not set are generated by the SACommandBuilder. This generation logic requires key column information to be present in the SelectCommand.

When UpdateCommand is assigned to a previously-created SACommand, the SACommand is not cloned. The UpdateCommand maintains a reference to the previously-created SACommand object.

If execution of this command returns rows, these rows can be merged with the DataSet depending on how you set the UpdatedRowSource property of the SACommand object.

RowUpdated event

Occurs during an update after a command is executed against the data source.

Visual Basic syntax

```
Public Event RowUpdated As SARowUpdatedEventHandler
```

C# syntax

```
public event SARowUpdatedEventHandler RowUpdated;
```


Remarks

When an attempt to update is made, the event fires.

The event handler receives an argument of type SARowUpdatedEventArgs containing data related to this event.

For more information, see the .NET Framework documentation for OleDbDataAdapter.RowUpdated Event.

RowUpdating event

Occurs during an update before a command is executed against the data source.

Visual Basic syntax

```
Public Event RowUpdating As SARowUpdatingEventHandler
```

C# syntax

```
public event SARowUpdatingEventHandler RowUpdating;
```

Remarks

When an attempt to update is made, the event fires.

The event handler receives an argument of type SARowUpdatingEventArgs containing data related to this event.

For more information, see the .NET Framework documentation for OleDbDataAdapter.RowUpdating Event.

SADataReader class

A read-only, forward-only result set from a query or stored procedure.

Visual Basic syntax

```
Public NotInheritable Class SADataReader
    Inherits System.Data.Common.DbDataReader
    Implements System.ComponentModel.IListSource
```

C# syntax

```
public sealed class SADataReader :
    System.Data.Common.DbDataReader,
    System.ComponentModel.IListSource
```

Base classes

- System.Data.Common.DbDataReader
- System.ComponentModel.IListSource

Members

All members of SADataReader class, including all inherited members.

Name	Description
"Close method"	Closes the SADataReader.
Dispose method (Inherited from System.Data.Common.DbDataReader)	Releases all resources used by the current instance of the System.Data.Common.DbDataReader class.
"GetBoolean method"	Returns the value of the specified column as a Boolean.
"GetByte method"	Returns the value of the specified column as a Byte.
"GetBytes method"	Reads a stream of bytes from the specified column offset into the buffer as an array, starting at the given buffer offset.
"GetChar method"	Returns the value of the specified column as a character.
"GetChars method"	Reads a stream of characters from the specified column offset into the buffer as an array starting at the given buffer offset.
"GetData method"	This method is not supported.
"GetDataTypeName method"	Returns the name of the source data type.
"GetDateTime method"	Returns the value of the specified column as a DateTime object.
"GetDateTimeOffset method"	Returns the value of the specified column as a DateTimeOffset object.

Name	Description
GetDbDataReader method (Inherited from System.Data.Common.DbDataReader)	Returns a System.Data.Common.DbDataReader object for the requested column ordinal that can be overridden with a provider-specific implementation.
"GetDecimal method"	Returns the value of the specified column as a Decimal object.
"GetDouble method"	Returns the value of the specified column as a double-precision floating-point number.
"GetEnumerator method"	Returns a System.Collections.IEnumerator that iterates through the SADataReader object.
"GetFieldType method"	Returns the Type that is the data type of the object.
"GetFloat method"	Returns the value of the specified column as a single-precision floating-point number.
"GetGuid method"	Returns the value of the specified column as a global unique identifier (GUID).
"GetInt16 method"	Returns the value of the specified column as a 16-bit signed integer.
"GetInt32 method"	Returns the value of the specified column as a 32-bit signed integer.
"GetInt64 method"	Returns the value of the specified column as a 64-bit signed integer.
"GetName method"	Returns the name of the specified column.
"GetOrdinal method"	Returns the column ordinal, given the column name.

Name	Description
GetProviderSpecificFieldType method (Inherited from System.Data.Common.DbDataReader)	Returns the provider-specific field type of the specified column.
GetProviderSpecificValue method (Inherited from System.Data.Common.DbDataReader)	Gets the value of the specified column as an instance of System.Object.
GetProviderSpecificValues method (Inherited from System.Data.Common.DbDataReader)	Gets all provider-specific attribute columns in the collection for the current row.
“GetSchemaTable method”	Returns a DataTable that describes the column metadata of the SADataReader.
“GetString method”	Returns the value of the specified column as a string.
“GetTimeSpan method”	Returns the value of the specified column as a TimeSpan object.
“GetUInt16 method”	Returns the value of the specified column as a 16-bit unsigned integer.
“GetUInt32 method”	Returns the value of the specified column as a 32-bit unsigned integer.
“GetUInt64 method”	Returns the value of the specified column as a 64-bit unsigned integer.
“GetValue method”	Returns the value of the specified column as an Object.
“GetValues method”	Gets all the columns in the current row.
“IsDBNull method”	Returns a value indicating whether the column contains NULL values.

Name	Description
"myDispose method"	Frees the resources associated with the object.
"NextResult method"	Advances the SADataReader to the next result, when reading the results of batch SQL statements.
"Read method"	Reads the next row of the result set and moves the SADataReader to that row.
"Depth property"	Gets a value indicating the depth of nesting for the current row.
"FieldCount property"	Gets the number of columns in the result set.
"HasRows property"	Gets a value that indicates whether the SADataReader contains one or more rows.
"IsClosed property"	Gets a values that indicates whether the SADataReader is closed.
"RecordsAffected property"	The number of rows changed, inserted, or deleted by execution of the SQL statement.
"this property"	Returns the value of a column in its native format.
VisibleFieldCount property (Inherited from System.Data.Common.DbDataReader)	Gets the number of fields in the System.Data.Common.DbDataReader that are not hidden.

Remarks

There is no constructor for SADataReader. To get an SADataReader object, execute an SACommand:

```
SACommand cmd = new SACommand(
    "SELECT EmployeeID FROM Employees", conn );
SADataReader reader = cmd.ExecuteReader();
```

You can only move forward through an SADataReader. If you need a more flexible object to manipulate results, use an SADataAdapter.

The SADataReader retrieves rows as needed, whereas the SADataAdapter must retrieve all rows of a result set before you can carry out any action on the object. For large result sets, this difference gives the SADataReader a much faster response time.

Implements: IDataReader, IDisposable, IDataRecord, IListSource

For more information, see "Accessing and manipulating data" on page 45.

See also

- "ExecuteReader method" on page 134

Close method

Closes the SADataReader.

Visual Basic syntax

```
Public Overrides Sub Close()
```

C# syntax

```
public override void Close()
```

Remarks

You must explicitly call the Close method when you are finished using the SADataReader.

When running in autocommit mode, a COMMIT is issued as a side effect of closing the SADataReader.

GetBoolean method

Returns the value of the specified column as a Boolean.

Visual Basic syntax

```
Public Overrides Function GetBoolean(
    ByVal ordinal As Integer
) As Boolean
```

C# syntax

```
public override bool GetBoolean(int ordinal)
```

Parameters

- **ordinal** An ordinal number indicating the column from which the value is obtained. The numbering is zero-based.

Returns

The value of the column.

Remarks

No conversions are performed, so the data retrieved must already be a Boolean.

See also

- "GetOrdinal method" on page 227
- "GetFieldType method" on page 223

GetByte method

Returns the value of the specified column as a Byte.

Visual Basic syntax

```
Public Overrides Function GetByte(ByVal ordinal As Integer) As Byte
```

C# syntax

```
public override byte GetByte(int ordinal)
```

Parameters

- **ordinal** An ordinal number indicating the column from which the value is obtained. The numbering is zero-based.

Returns

The value of the column.

Remarks

No conversions are performed, so the data retrieved must already be a byte.

GetBytes method

Reads a stream of bytes from the specified column offset into the buffer as an array, starting at the given buffer offset.

Visual Basic syntax

```
Public Overrides Function GetBytes(
    ByVal ordinal As Integer,
    ByVal dataIndex As Long,
    ByVal buffer As Byte(),
    ByVal bufferIndex As Integer,
    ByVal length As Integer
) As Long
```

C# syntax

```
public override long GetBytes(
    int ordinal,
    long dataIndex,
```

```
        byte[] buffer,
        int bufferIndex,
        int length
    )
```

Parameters

- **ordinal** An ordinal number indicating the column from which the value is obtained. The numbering is zero-based.
- **dataIndex** The index within the column value from which to read bytes.
- **buffer** An array in which to store the data.
- **bufferIndex** The index in the array to start copying data.
- **length** The maximum length to copy into the specified buffer.

Returns

The number of bytes read.

Remarks

GetBytes returns the number of available bytes in the field. In most cases this is the exact length of the field. However, the number returned may be less than the true length of the field if GetBytes has already been used to obtain bytes from the field. This may be the case, for example, when the SADataReader is reading a large data structure into a buffer.

If you pass a buffer that is a null reference (Nothing in Visual Basic), GetBytes returns the length of the field in bytes.

No conversions are performed, so the data retrieved must already be a byte array.

GetChar method

Returns the value of the specified column as a character.

Visual Basic syntax

```
Public Overrides Function GetChar(ByVal ordinal As Integer) As Char
```

C# syntax

```
public override char GetChar(int ordinal)
```

Parameters

- **ordinal** An ordinal number indicating the column from which the value is obtained. The numbering is zero-based.

Returns

The value of the column.

Remarks

No conversions are performed, so the data retrieved must already be a character.

Call the SADataReader.IsDBNull method to check for null values before calling this method.

See also

- "IsDBNull method" on page 234

GetChars method

Reads a stream of characters from the specified column offset into the buffer as an array starting at the given buffer offset.

Visual Basic syntax

```
Public Overrides Function GetChars(
    ByVal ordinal As Integer,
    ByVal dataIndex As Long,
    ByVal buffer As Char(),
    ByVal bufferIndex As Integer,
    ByVal length As Integer
) As Long
```

C# syntax

```
public override long GetChars(
    int ordinal,
    long dataIndex,
    char[] buffer,
    int bufferIndex,
    int length
)
```

Parameters

- **ordinal** The zero-based column ordinal.
- **dataIndex** The index within the row from which to begin the read operation.
- **buffer** The buffer into which to copy data.
- **bufferIndex** The index for buffer to begin the read operation.
- **length** The number of characters to read.

Returns

The actual number of characters read.

Remarks

GetChars returns the number of available characters in the field. In most cases this is the exact length of the field. However, the number returned may be less than the true length of the field if GetChars has

already been used to obtain characters from the field. This may be the case, for example, when the SADataReader is reading a large data structure into a buffer.

If you pass a buffer that is a null reference (Nothing in Visual Basic), GetChars returns the length of the field in characters.

No conversions are performed, so the data retrieved must already be a character array.

For information about handling BLOBs, see "Handling BLOBs" on page 61.

GetData method

This method is not supported.

Visual Basic syntax

```
Public Shadows Function GetData(ByVal i As Integer) As IDataReader
```

C# syntax

```
public new IDataReader GetData(int i)
```

Remarks

When called, it throws an InvalidOperationException.

See also

- System.InvalidOperationException

GetDataTypeName method

Returns the name of the source data type.

Visual Basic syntax

```
Public Overrides Function GetDataTypeName(
    ByVal index As Integer
) As String
```

C# syntax

```
public override string GetDataTypeName(int index)
```

Parameters

- **index** The zero-based column ordinal.

Returns

The name of the back-end data type.

GetDateTime method

Returns the value of the specified column as a DateTime object.

Visual Basic syntax

```
Public Overrides Function GetDateTime(ByVal ordinal As Integer) As Date
```

C# syntax

```
public override DateTime GetDateTime(int ordinal)
```

Parameters

- **ordinal** The zero-based column ordinal.

Returns

The value of the specified column.

Remarks

No conversions are performed, so the data retrieved must already be a DateTime object.

Call the SADataReader.IsDBNull method to check for null values before calling this method.

See also

- "IsDBNull method" on page 234

GetDateTimeOffset method

Returns the value of the specified column as a DateTimeOffset object.

Visual Basic syntax

```
Public Function GetDateTimeOffset(
    ByVal ordinal As Integer
) As DateTimeOffset
```

C# syntax

```
public DateTimeOffset GetDateTimeOffset(int ordinal)
```

Parameters

- **ordinal** The zero-based column ordinal.

Returns

The value of the specified column.

Remarks

No conversions are performed, so the data retrieved must already be a DateTimeOffset object.

Call the SADataReader.IsDBNull method to check for null values before calling this method.

See also

- "IsDBNull method" on page 234

GetDecimal method

Returns the value of the specified column as a Decimal object.

Visual Basic syntax

```
Public Overrides Function GetDecimal(
    ByVal ordinal As Integer
) As Decimal
```

C# syntax

```
public override decimal GetDecimal(int ordinal)
```

Parameters

- **ordinal** An ordinal number indicating the column from which the value is obtained. The numbering is zero-based.

Returns

The value of the specified column.

Remarks

No conversions are performed, so the data retrieved must already be a Decimal object.

Call the SADataReader.IsDBNull method to check for null values before calling this method.

See also

- "IsDBNull method" on page 234

GetDouble method

Returns the value of the specified column as a double-precision floating-point number.

Visual Basic syntax

```
Public Overrides Function GetDouble(ByVal ordinal As Integer) As Double
```

C# syntax

```
public override double GetDouble(int ordinal)
```


Parameters

- **ordinal** An ordinal number indicating the column from which the value is obtained. The numbering is zero-based.

Returns

The value of the specified column.

Remarks

No conversions are performed, so the data retrieved must already be a double-precision floating-point number.

Call the SADataReader.IsDBNull method to check for null values before calling this method.

See also

- "IsDBNull method" on page 234

GetEnumerator method

Returns a System.Collections.IEnumerator that iterates through the SADataReader object.

Visual Basic syntax

```
Public Overrides Function GetEnumerator()
    As System.Collections.IEnumerator
```

C# syntax

```
public override IEnumerator GetEnumerator()
```

Returns

A System.Collections.IEnumerator for the SADataReader object.

See also

- "SADataReader class" on page 211

GetFieldType method

Returns the Type that is the data type of the object.

Visual Basic syntax

```
Public Overrides Function GetFieldType(ByVal index As Integer) As Type
```

C# syntax

```
public override Type GetFieldType(int index)
```

Parameters

- **index** The zero-based column ordinal.

Returns

The type that is the data type of the object.

GetFloat method

Returns the value of the specified column as a single-precision floating-point number.

Visual Basic syntax

```
Public Overrides Function GetFloat(ByVal ordinal As Integer) As Single
```

C# syntax

```
public override float GetFloat(int ordinal)
```

Parameters

- **ordinal** An ordinal number indicating the column from which the value is obtained. The numbering is zero-based.

Returns

The value of the specified column.

Remarks

No conversions are performed, so the data retrieved must already be a single-precision floating-point number.

Call the SADataReader.IsDBNull method to check for null values before calling this method.

See also

- "IsDBNull method" on page 234

GetGuid method

Returns the value of the specified column as a global unique identifier (GUID).

Visual Basic syntax

```
Public Overrides Function GetGuid(ByVal ordinal As Integer) As Guid
```

C# syntax

```
public override Guid GetGuid(int ordinal)
```


Parameters

- **ordinal** An ordinal number indicating the column from which the value is obtained. The numbering is zero-based.

Returns

The value of the specified column.

Remarks

The data retrieved must already be a globally-unique identifier or binary(16).

Call the SADataReader.IsDBNull method to check for null values before calling this method.

See also

- "IsDBNull method" on page 234

GetInt16 method

Returns the value of the specified column as a 16-bit signed integer.

Visual Basic syntax

```
Public Overrides Function GetInt16(ByVal ordinal As Integer) As Short
```

C# syntax

```
public override short GetInt16(int ordinal)
```

Parameters

- **ordinal** An ordinal number indicating the column from which the value is obtained. The numbering is zero-based.

Returns

The value of the specified column.

Remarks

No conversions are performed, so the data retrieved must already be a 16-bit signed integer.

GetInt32 method

Returns the value of the specified column as a 32-bit signed integer.

Visual Basic syntax

```
Public Overrides Function GetInt32(ByVal ordinal As Integer) As Integer
```

C# syntax

```
public override int GetInt32(int ordinal)
```

Parameters

- **ordinal** An ordinal number indicating the column from which the value is obtained. The numbering is zero-based.

Returns

The value of the specified column.

Remarks

No conversions are performed, so the data retrieved must already be a 32-bit signed integer.

GetInt64 method

Returns the value of the specified column as a 64-bit signed integer.

Visual Basic syntax

```
Public Overrides Function GetInt64(ByVal ordinal As Integer) As Long
```

C# syntax

```
public override long GetInt64(int ordinal)
```

Parameters

- **ordinal** An ordinal number indicating the column from which the value is obtained. The numbering is zero-based.

Returns

The value of the specified column.

Remarks

No conversions are performed, so the data retrieved must already be a 64-bit signed integer.

GetName method

Returns the name of the specified column.

Visual Basic syntax

```
Public Overrides Function GetName(ByVal index As Integer) As String
```

C# syntax

```
public override string GetName(int index)
```


Parameters

- **index** The zero-based index of the column.

Returns

The name of the specified column.

GetOrdinal method

Returns the column ordinal, given the column name.

Visual Basic syntax

```
Public Overrides Function GetOrdinal(ByVal name As String) As Integer
```

C# syntax

```
public override int GetOrdinal(string name)
```

Parameters

- **name** The column name.

Returns

The zero-based column ordinal.

Remarks

GetOrdinal performs a case-sensitive lookup first. If it fails, a second case-insensitive search is made.

GetOrdinal is Japanese kana-width insensitive.

Because ordinal-based lookups are more efficient than named lookups, it is inefficient to call GetOrdinal within a loop. You can save time by calling GetOrdinal once and assigning the results to an integer variable for use within the loop.

GetSchemaTable method

Returns a DataTable that describes the column metadata of the SADataReader.

Visual Basic syntax

```
Public Overrides Function GetSchemaTable() As DataTable
```

C# syntax

```
public override DataTable GetSchemaTable()
```

Returns

A DataTable that describes the column metadata.

Remarks

This method returns metadata about each column in the following order:

DataTable column	Description
ColumnName	The name of the column or a null reference (Nothing in Visual Basic) if the column has no name. If the column is aliased in the SQL query, the alias is returned. Note that in result sets, not all columns have names and not all column names are unique.
ColumnOrdinal	The ID of the column. The value is in the range [0, FieldCount -1].
ColumnSize	For sized columns, the maximum length of a value in the column. For other columns, this is the size in bytes of the data type.
NumericPrecision	The precision of a numeric column or DBNull if the column is not numeric.
NumericScale	The scale of a numeric column or DBNull if the column is not numeric.
IsUnique	True if the column is a non-computed unique column in the table (BaseTableName) it is taken from.
IsKey	True if the column is one of a set of columns in the result set that taken together from a unique key for the result set. The set of columns with IsKey set to true does not need to be the minimal set that uniquely identifies a row in the result set.
BaseServerName	The name of the SQL Anywhere database server used by the SADataReader.
BaseCatalogName	The name of the catalog in the database that contains the column. This value is always DBNull.
BaseColumnName	The original name of the column in the table BaseTableName of the database or DBNull if the column is computed or if this information cannot be determined.
BaseSchemaName	The name of the schema in the database that contains the column.
BaseTableName	The name of the table in the database that contains the column, or DBNull if column is computed or if this information cannot be determined.
DataType	The .NET data type that is most appropriate for this type of column.
AllowDBNull	True if the column is nullable, false if the column is not nullable or if this information cannot be determined.
ProviderType	The type of the column.
IsAliased	True if the column name is an alias, false if it is not an alias.
IsExpression	True if the column is an expression, false if it is a column value.

DataTable column	Description
IsIdentity	True if the column is an identity column, false if it is not an identity column.
IsAutoIncrement	True if the column is an autoincrement or global autoincrement column, false otherwise (or if this information cannot be determined).
IsRowVersion	True if the column contains a persistent row identifier that cannot be written to, and has no meaningful value except to identify the row.
IsHidden	True if the column is hidden, false otherwise.
IsLong	True if the column is a long varchar, long nvarchar, or a long binary column, false otherwise.
IsReadOnly	True if the column is read-only, false if the column is modifiable or if its access cannot be determined.

For more information about these columns, see the .NET Framework documentation for SqlDataReader.GetSchemaTable.

For more information, see "Obtaining DataReader schema information" on page 51.

GetString method

Returns the value of the specified column as a string.

Visual Basic syntax

```
Public Overrides Function GetString(ByVal ordinal As Integer) As String
```

C# syntax

```
public override string GetString(int ordinal)
```

Parameters

- **ordinal** An ordinal number indicating the column from which the value is obtained. The numbering is zero-based.

Returns

The value of the specified column.

Remarks

No conversions are performed, so the data retrieved must already be a string.

Call the SADataReader.IsDBNull method to check for NULL values before calling this method.

See also

- "IsDBNull method" on page 234

GetTimeSpan method

Returns the value of the specified column as a TimeSpan object.

Visual Basic syntax

```
Public Function GetTimeSpan(ByVal ordinal As Integer) As TimeSpan
```

C# syntax

```
public TimeSpan GetTimeSpan(int ordinal)
```

Parameters

- **ordinal** An ordinal number indicating the column from which the value is obtained. The numbering is zero-based.

Returns

The value of the specified column.

Remarks

The column must be a SQL Anywhere TIME data type. The data is converted to TimeSpan. The Days property of TimeSpan is always set to 0.

Call SADataReader.IsDBNull method to check for NULL values before calling this method.

For more information, see "Obtaining time values" on page 62.

See also

- "IsDBNull method" on page 234

GetUInt16 method

Returns the value of the specified column as a 16-bit unsigned integer.

Visual Basic syntax

```
Public Function GetUInt16(ByVal ordinal As Integer) As UShort
```

C# syntax

```
public ushort GetUInt16(int ordinal)
```


Parameters

- **ordinal** An ordinal number indicating the column from which the value is obtained. The numbering is zero-based.

Returns

The value of the specified column.

Remarks

No conversions are performed, so the data retrieved must already be a 16-bit unsigned integer.

GetUInt32 method

Returns the value of the specified column as a 32-bit unsigned integer.

Visual Basic syntax

```
Public Function GetUInt32(ByVal ordinal As Integer) As UInteger
```

C# syntax

```
public uint GetUInt32(int ordinal)
```

Parameters

- **ordinal** An ordinal number indicating the column from which the value is obtained. The numbering is zero-based.

Returns

The value of the specified column.

Remarks

No conversions are performed, so the data retrieved must already be a 32-bit unsigned integer.

GetUInt64 method

Returns the value of the specified column as a 64-bit unsigned integer.

Visual Basic syntax

```
Public Function GetUInt64(ByVal ordinal As Integer) As ULong
```

C# syntax

```
public ulong GetUInt64(int ordinal)
```

Parameters

- **ordinal** An ordinal number indicating the column from which the value is obtained. The numbering is zero-based.

Returns

The value of the specified column.

Remarks

No conversions are performed, so the data retrieved must already be a 64-bit unsigned integer.

GetValue method

Returns the value of the specified column as an Object.

Overload list

Name	Description
"GetValue(int) method"	Returns the value of the specified column as an Object.
"GetValue(int, long, int) method"	Returns a substring of the value of the specified column as an Object.

GetValue(int) method

Returns the value of the specified column as an Object.

Visual Basic syntax

```
Public Overrides Function GetValue(ByVal ordinal As Integer) As Object
```

C# syntax

```
public override object GetValue(int ordinal)
```

Parameters

- **ordinal** An ordinal number indicating the column from which the value is obtained. The numbering is zero-based.

Returns

The value of the specified column as an object.

Remarks

This method returns DBNull for NULL database columns.

GetValue(int, long, int) method

Returns a substring of the value of the specified column as an Object.

Visual Basic syntax

```
Public Function GetValue(
    ByVal ordinal As Integer,
    ByVal index As Long,
    ByVal length As Integer
) As Object
```

C# syntax

```
public object GetValue(int ordinal, long index, int length)
```

Parameters

- **ordinal** An ordinal number indicating the column from which the value is obtained. The numbering is zero-based.
- **index** A zero-based index of the substring of the value to be obtained.
- **length** The length of the substring of the value to be obtained.

Returns

The substring value is returned as an object.

Remarks

This method returns DBNull for NULL database columns.

GetValues method

Gets all the columns in the current row.

Visual Basic syntax

```
Public Overrides Function GetValues(ByVal values As Object()) As Integer
```

C# syntax

```
public override int GetValues(object[] values)
```

Parameters

- **values** An array of objects that holds an entire row of the result set.

Returns

The number of objects in the array.

Remarks

For most applications, the GetValues method provides an efficient means for retrieving all columns, rather than retrieving each column individually.

You can pass an Object array that contains fewer than the number of columns contained in the resulting row. Only the amount of data the Object array holds is copied to the array. You can also pass an Object array whose length is more than the number of columns contained in the resulting row.

This method returns DBNull for NULL database columns.

IsDBNull method

Returns a value indicating whether the column contains NULL values.

Visual Basic syntax

```
Public Overrides Function IsDBNull(ByVal ordinal As Integer) As Boolean
```

C# syntax

```
public override bool IsDBNull(int ordinal)
```

Parameters

- **ordinal** The zero-based column ordinal.

Returns

Returns true if the specified column value is equivalent to DBNull. Otherwise, it returns false.

Remarks

Call this method to check for NULL column values before calling the typed get methods (for example, GetByte, GetChar, and so on) to avoid raising an exception.

myDispose method

Frees the resources associated with the object.

Visual Basic syntax

```
Public Sub myDispose()
```

C# syntax

```
public void myDispose()
```

NextResult method

Advances the SADataReader to the next result, when reading the results of batch SQL statements.

Visual Basic syntax

```
Public Overrides Function NextResult() As Boolean
```

C# syntax

```
public override bool NextResult()
```

Returns

Returns true if there are more result sets. Otherwise, it returns false.

Remarks

Used to process multiple results, which can be generated by executing batch SQL statements.

By default, the data reader is positioned on the first result.

Read method

Reads the next row of the result set and moves the SADataReader to that row.

Visual Basic syntax

```
Public Overrides Function Read() As Boolean
```

C# syntax

```
public override bool Read()
```

Returns

Returns true if there are more rows. Otherwise, it returns false.

Remarks

The default position of the SADataReader is prior to the first record. Therefore, you must call Read to begin accessing any data.

Example

The following code fills a listbox with the values in a single column of results.

```
while( reader.Read() ) {
    listResults.Items.Add( reader.GetValue( 0 ).ToString() );
}
listResults.EndUpdate();
reader.Close();
```

Depth property

Gets a value indicating the depth of nesting for the current row.

Visual Basic syntax

```
Public ReadOnly Overrides Property Depth As Integer
```

C# syntax

```
public override int Depth {get;}
```

Remarks

The outermost table has a depth of zero.

The depth of nesting for the current row.

FieldCount property

Gets the number of columns in the result set.

Visual Basic syntax

```
Public ReadOnly Overrides Property FieldCount As Integer
```

C# syntax

```
public override int FieldCount {get;}
```

Remarks

The number of columns in the current record.

HasRows property

Gets a value that indicates whether the SADataReader contains one or more rows.

Visual Basic syntax

```
Public ReadOnly Overrides Property HasRows As Boolean
```

C# syntax

```
public override bool HasRows {get;}
```

Remarks

True if the SADataReader contains one or more rows; otherwise, false.

IsClosed property

Gets a values that indicates whether the SADataReader is closed.

Visual Basic syntax

```
Public ReadOnly Overrides Property IsClosed As Boolean
```


C# syntax

```
public override bool IsClosed {get;}
```

Remarks

True if the SADataReader is closed; otherwise, false.

IsClosed and RecordsAffected are the only properties that you can call after the SADataReader is closed.

RecordsAffected property

The number of rows changed, inserted, or deleted by execution of the SQL statement.

Visual Basic syntax

```
Public ReadOnly Overrides Property RecordsAffected As Integer
```

C# syntax

```
public override int RecordsAffected {get;}
```

Remarks

The number of rows changed, inserted, or deleted. This is 0 if no rows were affected or the statement failed, or -1 for SELECT statements.

The number of rows changed, inserted, or deleted. The value is 0 if no rows were affected or the statement failed, and -1 for SELECT statements.

The value of this property is cumulative. For example, if two records are inserted in batch mode, the value of RecordsAffected will be two.

IsClosed and RecordsAffected are the only properties that you can call after the SADataReader is closed.

this property

Returns the value of a column in its native format.

Overload list

Name	Description
“this[int] property”	Returns the value of a column in its native format.
“this[string] property”	Returns the value of a column in its native format.

this[int] property

Returns the value of a column in its native format.

Visual Basic syntax

```
Public ReadOnly Overrides Property Item(
    ByVal index As Integer
) As Object
```

C# syntax

```
public override object this[int index] {get;}
```

Parameters

- **index** The column ordinal.

Remarks

In C#, this property is the indexer for the SADataReader class.

this[string] property

Returns the value of a column in its native format.

Visual Basic syntax

```
Public ReadOnly Overrides Property Item(ByVal name As String) As Object
```

C# syntax

```
public override object this[string name] {get;}
```

Parameters

- **name** The column name.

Remarks

In C#, this property is the indexer for the SADataReader class.

SADataSourceEnumerator class

Provides a mechanism for enumerating all available instances of SQL Anywhere database servers within the local network.

Visual Basic syntax

```
Public NotInheritable Class SADataSourceEnumerator
    Inherits System.Data.Common.DbDataSourceEnumerator
```

C# syntax

```
public sealed class SADataSourceEnumerator :
    System.Data.Common.DbDataSourceEnumerator
```


Base classes

- System.Data.Common.DbDataSourceEnumerator

Members

All members of SADataSourceEnumerator class, including all inherited members.

Name	Description
"GetDataSources method"	Retrieves a DataTable containing information about all visible SQL Anywhere database servers.
"Instance property"	Gets an instance of SADataSourceEnumerator, which can be used to retrieve information about all visible SQL Anywhere database servers.

Remarks

There is no constructor for SADataSourceEnumerator.

The SADataSourceEnumerator class is not available in the .NET Compact Framework 2.0.

GetDataSources method

Retrieves a DataTable containing information about all visible SQL Anywhere database servers.

Visual Basic syntax

```
Public Overrides Function GetDataSources() As DataTable
```

C# syntax

```
public override DataTable GetDataSources()
```

Remarks

The returned table has four columns: ServerName, IPAddress, PortNumber, and DataBaseNames. There is a row in the table for each available database server.

Example

The following code fills a DataTable with information for each database server that is available.

```
DataTable servers = SADataSourceEnumerator.Instance.GetDataSources();
```

Instance property

Gets an instance of SADataSourceEnumerator, which can be used to retrieve information about all visible SQL Anywhere database servers.

Visual Basic syntax

```
Public Shared ReadOnly Property Instance As SADataSourceEnumerator
```

C# syntax

```
public SADataSourceEnumerator Instance {get;}
```

SADefault class

Represents a parameter with a default value.

Visual Basic syntax

```
Public NotInheritable Class SADefault
```

C# syntax

```
public sealed class SADefault
```

Members

All members of SADefault class, including all inherited members.

Name	Description
"Value field"	Gets the value for a default parameter.

Remarks

There is no constructor for SADefault.

```
SAParameter parm = new SAParameter();
parm.Value = SADefault.Value;
```

Value field

Gets the value for a default parameter.

Visual Basic syntax

```
Public Shared ReadOnly Value As SADefault
```

C# syntax

```
public static readonly SADefault Value;
```

Remarks

This field is read-only and static.

SAError class

Collects information relevant to a warning or error returned by the data source.

Visual Basic syntax

```
Public NotInheritable Class SAError
```

C# syntax

```
public sealed class SAError
```

Members

All members of SAError class, including all inherited members.

Name	Description
"ToString method"	The complete text of the error message.
"Message property"	Returns a short description of the error.
"NativeError property"	Returns database-specific error information.
"Source property"	Returns the name of the provider that generated the error.
"SqlState property"	The SQL Anywhere five-character SQLSTATE following the ANSI SQL standard.

Remarks

There is no constructor for SAError.

For information about error handling, see "Error handling and the SQL Anywhere .NET Data Provider" on page 66.

ToString method

The complete text of the error message.

Visual Basic syntax

```
Public Overrides Function ToString() As String
```

C# syntax

```
public override string ToString()
```

Example

The return value is a string is in the form **SAError:**, followed by the Message. For example:

```
SAError:UserId or Password not valid.
```

Message property

Returns a short description of the error.

Visual Basic syntax

```
Public ReadOnly Property Message As String
```

C# syntax

```
public string Message {get;}
```

NativeError property

Returns database-specific error information.

Visual Basic syntax

```
Public ReadOnly Property NativeError As Integer
```

C# syntax

```
public int NativeError {get;}
```

Source property

Returns the name of the provider that generated the error.

Visual Basic syntax

```
Public ReadOnly Property Source As String
```

C# syntax

```
public string Source {get;}
```

SqlState property

The SQL Anywhere five-character SQLSTATE following the ANSI SQL standard.

Visual Basic syntax

```
Public ReadOnly Property SqlState As String
```

C# syntax

```
public string SqlState {get;}
```


SAErrorCollection class

Collects all errors generated by the SQL Anywhere .NET Data Provider.

Visual Basic syntax

```
Public NotInheritable Class SAErrorCollection
    Implements System.Collections.ICollection
    Implements System.Collections.IEnumerable
```

C# syntax

```
public sealed class SAErrorCollection :
    System.Collections.ICollection,
    System.Collections.IEnumerable
```

Base classes

- System.Collections.ICollection
- System.Collections.IEnumerable

Members

All members of SAErrorCollection class, including all inherited members.

Name	Description
"CopyTo method"	Copies the elements of the SAErrorCollection into an array, starting at the given index within the array.
"GetEnumerator method"	Returns an enumerator that iterates through the SAErrorCollection.
"Count property"	Returns the number of errors in the collection.
"this property"	Returns the error at the specified index.

Remarks

There is no constructor for SAErrorCollection. Typically, an SAErrorCollection is obtained from the SAException.Errors property.

Implements: ICollection, IEnumerable

For information about error handling, see "Error handling and the SQL Anywhere .NET Data Provider" on page 66.

See also

- "Errors property" on page 247

CopyTo method

Copies the elements of the SAErrorCollection into an array, starting at the given index within the array.

Visual Basic syntax

```
Public Sub CopyTo(ByVal array As Array, ByVal index As Integer)
```

C# syntax

```
public void CopyTo(Array array, int index)
```

Parameters

- **array** The array into which to copy the elements.
- **index** The starting index of the array.

GetEnumerator method

Returns an enumerator that iterates through the SAErrorCollection.

Visual Basic syntax

```
Public Function GetEnumerator() As System.Collections.IEnumerator
```

C# syntax

```
public System.Collections.IEnumerator GetEnumerator()
```

Returns

An System.Collections.IEnumerator for the SAErrorCollection.

Count property

Returns the number of errors in the collection.

Visual Basic syntax

```
Public ReadOnly Property Count As Integer
```

C# syntax

```
public int Count {get;}
```

this property

Returns the error at the specified index.

Visual Basic syntax

```
Public ReadOnly Property Item(ByVal index As Integer) As SAError
```


C# syntax

```
public SAError this[int index] {get;}
```

Parameters

- **index** The zero-based index of the error to retrieve.

Remarks

An SAError object that contains the error at the specified index.

See also

- "SAError class" on page 241

SAException class

The exception that is thrown when SQL Anywhere returns a warning or error.

Visual Basic syntax

```
Public Class SAException Inherits System.Exception
```

C# syntax

```
public class SAException : System.Exception
```

Base classes

- System.Exception

Members

All members of SAException class, including all inherited members.

Name	Description
GetBaseException method (Inherited from System.Exception)	When overridden in a derived class, returns the System.Exception that is the root cause of one or more subsequent exceptions.
"GetObjectData method"	Sets the SerializationInfo with information about the exception.
GetType method (Inherited from System.Exception)	Gets the runtime type of the current instance.
ToString method (Inherited from System.Exception)	Creates and returns a string representation of the current exception.

Name	Description
Data property (Inherited from System.Exception)	Gets a collection of key/value pairs that provide additional user-defined information about the exception.
"Errors property"	Returns a collection of one or more SAError objects.
HelpLink property (Inherited from System.Exception)	Gets or sets a link to the help file associated with this exception.
HResult property (Inherited from System.Exception)	Gets or sets HRESULT, a coded numerical value that is assigned to a specific exception.
InnerException property (Inherited from System.Exception)	Gets the System.Exception instance that caused the current exception.
"Message property"	Returns the text describing the error.
"NativeError property"	Returns database-specific error information.
"Source property"	Returns the name of the provider that generated the error.
StackTrace property (Inherited from System.Exception)	Gets a string representation of the frames on the call stack at the time the current exception was thrown.
TargetSite property (Inherited from System.Exception)	Gets the method that throws the current exception.

Remarks

There is no constructor for SAException. Typically, an SAException object is declared in a catch. For example:

```
...
catch( SAException ex )
{
    MessageBox.Show( ex.Errors[0].Message, "Error" );
}
```

For information about error handling, see "Error handling and the SQL Anywhere .NET Data Provider" on page 66.

GetObjectData method

Sets the SerializationInfo with information about the exception.

Visual Basic syntax

```
Public Overrides Sub GetObjectData(
    ByVal info As SerializationInfo,
    ByVal context As StreamingContext
)
```

C# syntax

```
public override void GetObjectData(
    SerializationInfo info,
    StreamingContext context
)
```

Parameters

- **info** The SerializationInfo that holds the serialized object data about the exception being thrown.
- **context** The StreamingContext that contains contextual information about the source or destination.

Remarks

Overrides Exception.GetObjectData.

Errors property

Returns a collection of one or more SAError objects.

Visual Basic syntax

```
Public ReadOnly Property Errors As SAErrorCollection
```

C# syntax

```
public SAErrorCollection Errors {get;}
```

Remarks

The SAErrorCollection object always contains at least one instance of the SAError object.

See also

- “SAErrorCollection class” on page 243
- “SAError class” on page 241

Message property

Returns the text describing the error.

Visual Basic syntax

```
Public ReadOnly Overrides Property Message As String
```

C# syntax

```
public override string Message {get;}
```

Remarks

This method returns a single string that contains a concatenation of all of the Message properties of all of the SAError objects in the Errors collection. Each message, except the last one, is followed by a carriage return.

See also

- "SAError class" on page 241

NativeError property

Returns database-specific error information.

Visual Basic syntax

```
Public ReadOnly Property NativeError As Integer
```

C# syntax

```
public int NativeError {get;}
```

Source property

Returns the name of the provider that generated the error.

Visual Basic syntax

```
Public ReadOnly Overrides Property Source As String
```

C# syntax

```
public override string Source {get;}
```

SAFactory class

Represents a set of methods for creating instances of the iAnywhere.Data.SQLAnywhere provider's implementation of the data source classes.

Visual Basic syntax

```
Public NotInheritable Class SAFactory
    Inherits System.Data.Common.DbProviderFactory
```

C# syntax

```
public sealed class SAFactory : System.Data.Common.DbProviderFactory
```


Base classes

- System.Data.Common.DbProviderFactory

Members

All members of SAFactory class, including all inherited members.

Name	Description
"CreateCommand method"	Returns a strongly typed System.Data.Common.DbCommand instance.
"CreateCommandBuilder method"	Returns a strongly typed System.Data.Common.DbCommandBuilder instance.
"CreateConnection method"	Returns a strongly typed System.Data.Common.DbConnection instance.
"CreateConnectionStringBuilder method"	Returns a strongly typed System.Data.Common.DbConnectionStringBuilder instance.
"CreateDataAdapter method"	Returns a strongly typed System.Data.Common.DbDataAdapter instance.
"CreateDataSourceEnumerator method"	Returns a strongly typed System.Data.Common.DbDataSourceEnumerator instance.
"CreateParameter method"	Returns a strongly typed System.Data.Common.DbParameter instance.
"CreatePermission method"	Returns a strongly-typed CodeAccessPermission instance.
"CanCreateDataSourceEnumerator property"	Always returns true, which indicates that an SADataSourceEnumerator object can be created.
"Instance field"	Represents the singleton instance of the SAFactory class.

Remarks

There is no constructor for SAFactory.

ADO.NET 2.0 adds two new classes, DbProviderFactories and DbProviderFactory, to make provider independent code easier to write. To use them with SQL Anywhere specify iAnywhere.Data.SQLAnywhere as the provider invariant name passed to GetFactory. For example:

```
' Visual Basic
Dim factory As DbProviderFactory = _
  DbProviderFactories.GetFactory( "iAnywhere.Data.SQLAnywhere" )
Dim conn As DbConnection = _
  factory.CreateConnection()
```

```
// C#
DbProviderFactory factory =
        DbProviderFactories.GetFactory("iAnywhere.Data.SQLAnywhere" );
DbConnection conn = factory.CreateConnection();
```

In this example, conn is created as an SAConnection object.

For an explanation of provider factories and generic programming in ADO.NET 2.0, see http://msdn2.microsoft.com/en-us/library/ms379620.aspx.

The SAFactory class is not available in the .NET Compact Framework 2.0.

CreateCommand method

Returns a strongly typed System.Data.Common.DbCommand instance.

Visual Basic syntax

```
Public Overrides Function CreateCommand() As DbCommand
```

C# syntax

```
public override DbCommand CreateCommand()
```

Returns

A new SACommand object typed as DbCommand.

See also

- "SACommand class" on page 117

CreateCommandBuilder method

Returns a strongly typed System.Data.Common.DbCommandBuilder instance.

Visual Basic syntax

```
Public Overrides Function CreateCommandBuilder() As DbCommandBuilder
```

C# syntax

```
public override DbCommandBuilder CreateCommandBuilder()
```

Returns

A new SACommand object typed as DbCommand.

See also

- "SACommand class" on page 117

CreateConnection method

Returns a strongly typed System.Data.Common.DbConnection instance.

Visual Basic syntax

```
Public Overrides Function CreateConnection() As DbConnection
```

C# syntax

```
public override DbConnection CreateConnection()
```

Returns

A new SACommand object typed as DbCommand.

See also

- "SACommand class" on page 117

CreateConnectionStringBuilder method

Returns a strongly typed System.Data.Common.DbConnectionStringBuilder instance.

Visual Basic syntax

```
Public Overrides Function CreateConnectionStringBuilder()
    As DbConnectionStringBuilder
```

C# syntax

```
public override DbConnectionStringBuilder CreateConnectionStringBuilder()
```

Returns

A new SACommand object typed as DbCommand.

See also

- "SACommand class" on page 117

CreateDataAdapter method

Returns a strongly typed System.Data.Common.DbDataAdapter instance.

Visual Basic syntax

```
Public Overrides Function CreateDataAdapter() As DbDataAdapter
```

C# syntax

```
public override DbDataAdapter CreateDataAdapter()
```

Returns

A new SACommand object typed as DbCommand.

See also

- "SACommand class" on page 117

CreateDataSourceEnumerator method

Returns a strongly typed System.Data.Common.DbDataSourceEnumerator instance.

Visual Basic syntax

```
Public Overrides Function CreateDataSourceEnumerator()
    As DbDataSourceEnumerator
```

C# syntax

```
public override DbDataSourceEnumerator CreateDataSourceEnumerator()
```

Returns

A new SACommand object typed as DbCommand.

See also

- "SACommand class" on page 117

CreateParameter method

Returns a strongly typed System.Data.Common.DbParameter instance.

Visual Basic syntax

```
Public Overrides Function CreateParameter() As DbParameter
```

C# syntax

```
public override DbParameter CreateParameter()
```

Returns

A new SACommand object typed as DbCommand.

See also

- "SACommand class" on page 117

CreatePermission method

Returns a strongly-typed CodeAccessPermission instance.

Visual Basic syntax

```
Public Overrides Function CreatePermission(
    ByVal state As PermissionState
) As CodeAccessPermission
```

C# syntax

```
public override CodeAccessPermission CreatePermission(
    PermissionState state
)
```

Parameters

- **state** A member of the System.Security.Permissions.PermissionState enumeration.

Returns

A new SACommand object typed as DbCommand.

See also

- "SACommand class" on page 117

CanCreateDataSourceEnumerator property

Always returns true, which indicates that an SADataSourceEnumerator object can be created.

Visual Basic syntax

```
Public ReadOnly Overrides Property CanCreateDataSourceEnumerator As
Boolean
```

C# syntax

```
public override bool CanCreateDataSourceEnumerator {get;}
```

Returns

A new SACommand object typed as DbCommand.

See also

- "SADataSourceEnumerator class" on page 238
- "SACommand class" on page 117

Instance field

Represents the singleton instance of the SAFactory class.

Visual Basic syntax

```
Public Shared ReadOnly Instance As SAFactory
```

C# syntax

```
public static readonly SAFactory Instance;
```

Remarks

SAFactory is a singleton class, which means only this instance of this class can exist.

Normally you would not use this field directly. Instead, you get a reference to this instance of SAFactory using System.Data.Common.DbProviderFactories.GetFactory(String). For an example, see the SAFactory description.

The SAFactory class is not available in the .NET Compact Framework 2.0.

See also

- "SAFactory class" on page 248

SAInfoMessageEventArgs class

Provides data for the InfoMessage event.

Visual Basic syntax

```
Public NotInheritable Class SAInfoMessageEventArgs
    Inherits System.EventArgs
```

C# syntax

```
public sealed class SAInfoMessageEventArgs : System.EventArgs
```

Base classes

- System.EventArgs

Members

All members of SAInfoMessageEventArgs class, including all inherited members.

Name	Description
"ToString method"	Retrieves a string representation of the InfoMessage event.
"Errors property"	Returns the collection of messages sent from the data source.
"Message property"	Returns the full text of the error sent from the data source.
"MessageType property"	Returns the type of the message.

Name	Description
"NativeError property"	Returns the SQLCODE returned by the database.
"Source property"	Returns the name of the SQL Anywhere .NET Data Provider.
Empty field (Inherited from System.EventArgs)	Represents an event with no event data.

Remarks

There is no constructor for SAInfoMessageEventArgs.

ToString method

Retrieves a string representation of the InfoMessage event.

Visual Basic syntax

```
Public Overrides Function ToString() As String
```

C# syntax

```
public override string ToString()
```

Returns

A string representing the InfoMessage event.

Errors property

Returns the collection of messages sent from the data source.

Visual Basic syntax

```
Public ReadOnly Property Errors As SAErrorCollection
```

C# syntax

```
public SAErrorCollection Errors {get;}
```

Message property

Returns the full text of the error sent from the data source.

Visual Basic syntax

```
Public ReadOnly Property Message As String
```

C# syntax

```
public string Message {get;}
```

MessageType property

Returns the type of the message.

Visual Basic syntax

```
Public ReadOnly Property MessageType As SAMessageType
```

C# syntax

```
public SAMessageType MessageType {get;}
```

Remarks

This can be one of: Action, Info, Status, or Warning.

NativeError property

Returns the SQLCODE returned by the database.

Visual Basic syntax

```
Public ReadOnly Property NativeError As Integer
```

C# syntax

```
public int NativeError {get;}
```

Source property

Returns the name of the SQL Anywhere .NET Data Provider.

Visual Basic syntax

```
Public ReadOnly Property Source As String
```

C# syntax

```
public string Source {get;}
```

SAMetaDataCollectionNames class

Provides a list of constants for use with the SAConnection.GetSchema(String,String[]) method to retrieve metadata collections.

Visual Basic syntax

```
Public NotInheritable Class SAMetaDataCollectionNames
```

C# syntax

```
public sealed class SAMetaDataCollectionNames
```

Members

All members of SAMetaDataCollectionNames class, including all inherited members.

Name	Description
"Columns field"	Provides a constant for use with the SAConnection.GetSchema(String,String[]) method that represents the Columns collection.
"DataSourceInformation field"	Provides a constant for use with the SAConnection.GetSchema(String,String[]) method that represents the DataSourceInformation collection.
"DataTypes field"	Provides a constant for use with the SAConnection.GetSchema(String,String[]) method that represents the DataTypes collection.
"ForeignKeys field"	Provides a constant for use with the SAConnection.GetSchema(String,String[]) method that represents the ForeignKeys collection.
"IndexColumns field"	Provides a constant for use with the SAConnection.GetSchema(String,String[]) method that represents the IndexColumns collection.
"Indexes field"	Provides a constant for use with the SAConnection.GetSchema(String,String[]) method that represents the Indexes collection.
"MetaDataCollections field"	Provides a constant for use with the SAConnection.GetSchema(String,String[]) method that represents the MetaDataCollections collection.
"ProcedureParameters field"	Provides a constant for use with the SAConnection.GetSchema(String,String[]) method that represents the ProcedureParameters collection.
"Procedures field"	Provides a constant for use with the SAConnection.GetSchema(String,String[]) method that represents the Procedures collection.
"ReservedWords field"	Provides a constant for use with the SAConnection.GetSchema(String,String[]) method that represents the ReservedWords collection.
"Restrictions field"	Provides a constant for use with the SAConnection.GetSchema(String,String[]) method that represents the Restrictions collection.

Name	Description
"Tables field"	Provides a constant for use with the SAConnection.GetSchema(String,String[]) method that represents the Tables collection.
"UserDefinedTypes field"	Provides a constant for use with the SAConnection.GetSchema(String,String[]) method that represents the UserDefinedTypes collection.
"Users field"	Provides a constant for use with the SAConnection.GetSchema(String,String[]) method that represents the Users collection.
"ViewColumns field"	Provides a constant for use with the SAConnection.GetSchema(String,String[]) method that represents the ViewColumns collection.
"Views field"	Provides a constant for use with the SAConnection.GetSchema(String,String[]) method that represents the Views collection.

Remarks

This field is constant and read-only.

See also

- "GetSchema method" on page 165

Columns field

Provides a constant for use with the SAConnection.GetSchema(String,String[]) method that represents the Columns collection.

Visual Basic syntax

```
Public Shared ReadOnly Columns As String
```

C# syntax

```
public static readonly string Columns;
```

See also

- "GetSchema method" on page 165

Example

The following code fills a DataTable with the Columns collection.

```
DataTable schema = GetSchema( SAMetaDataCollectionNames.Columns );
```


DataSourceInformation field

Provides a constant for use with the SAConnection.GetSchema(String,String[]) method that represents the DataSourceInformation collection.

Visual Basic syntax

```
Public Shared ReadOnly DataSourceInformation As String
```

C# syntax

```
public static readonly string DataSourceInformation;
```

See also

- "GetSchema method" on page 165

Example

The following code fills a DataTable with the DataSourceInformation collection.

```
DataTable schema =
    GetSchema( SAMetaDataCollectionNames.DataSourceInformation );
```

DataTypes field

Provides a constant for use with the SAConnection.GetSchema(String,String[]) method that represents the DataTypes collection.

Visual Basic syntax

```
Public Shared ReadOnly DataTypes As String
```

C# syntax

```
public static readonly string DataTypes;
```

See also

- "GetSchema method" on page 165

Example

The following code fills a DataTable with the DataTypes collection.

```
DataTable schema = GetSchema( SAMetaDataCollectionNames.DataTypes );
```

ForeignKeys field

Provides a constant for use with the SAConnection.GetSchema(String,String[]) method that represents the ForeignKeys collection.

Visual Basic syntax

```
Public Shared ReadOnly ForeignKeys As String
```

C# syntax

```
public static readonly string ForeignKeys;
```

See also

- "GetSchema method" on page 165

Example

The following code fills a DataTable with the ForeignKeys collection.

```
DataTable schema = GetSchema( SAMetaDataCollectionNames.ForeignKeys );
```

IndexColumns field

Provides a constant for use with the SAConnection.GetSchema(String,String[]) method that represents the IndexColumns collection.

Visual Basic syntax

```
Public Shared ReadOnly IndexColumns As String
```

C# syntax

```
public static readonly string IndexColumns;
```

See also

- "GetSchema method" on page 165

Example

The following code fills a DataTable with the IndexColumns collection.

```
DataTable schema = GetSchema( SAMetaDataCollectionNames.IndexColumns );
```

Indexes field

Provides a constant for use with the SAConnection.GetSchema(String,String[]) method that represents the Indexes collection.

Visual Basic syntax

```
Public Shared ReadOnly Indexes As String
```

C# syntax

```
public static readonly string Indexes;
```


See also

- "GetSchema method" on page 165

Example

The following code fills a DataTable with the Indexes collection.

```
DataTable schema = GetSchema( SAMetaDataCollectionNames.Indexes );
```

MetaDataCollections field

Provides a constant for use with the SAConnection.GetSchema(String,String[]) method that represents the MetaDataCollections collection.

Visual Basic syntax

```
Public Shared ReadOnly MetaDataCollections As String
```

C# syntax

```
public static readonly string MetaDataCollections;
```

See also

- "GetSchema method" on page 165

Example

The following code fills a DataTable with the MetaDataCollections collection.

```
DataTable schema =
    GetSchema( SAMetaDataCollectionNames.MetaDataCollections );
```

ProcedureParameters field

Provides a constant for use with the SAConnection.GetSchema(String,String[]) method that represents the ProcedureParameters collection.

Visual Basic syntax

```
Public Shared ReadOnly ProcedureParameters As String
```

C# syntax

```
public static readonly string ProcedureParameters;
```

See also

- "GetSchema method" on page 165

Example

The following code fills a DataTable with the ProcedureParameters collection.

```
DataTable schema =
    GetSchema( SAMetaDataCollectionNames.ProcedureParameters );
```

Procedures field

Provides a constant for use with the SAConnection.GetSchema(String,String[]) method that represents the Procedures collection.

Visual Basic syntax

```
Public Shared ReadOnly Procedures As String
```

C# syntax

```
public static readonly string Procedures;
```

See also

- "GetSchema method" on page 165

Example

The following code fills a DataTable with the Procedures collection.

```
DataTable schema = GetSchema( SAMetaDataCollectionNames.Procedures );
```

ReservedWords field

Provides a constant for use with the SAConnection.GetSchema(String,String[]) method that represents the ReservedWords collection.

Visual Basic syntax

```
Public Shared ReadOnly ReservedWords As String
```

C# syntax

```
public static readonly string ReservedWords;
```

See also

- "GetSchema method" on page 165

Example

The following code fills a DataTable with the ReservedWords collection.

```
DataTable schema = GetSchema( SAMetaDataCollectionNames.ReservedWords );
```

Restrictions field

Provides a constant for use with the SAConnection.GetSchema(String,String[]) method that represents the Restrictions collection.

Visual Basic syntax

```
Public Shared ReadOnly Restrictions As String
```

C# syntax

```
public static readonly string Restrictions;
```

See also

- "GetSchema method" on page 165

Example

The following code fills a DataTable with the Restrictions collection.

```
DataTable schema = GetSchema( SAMetaDataCollectionNames.Restrictions );
```

Tables field

Provides a constant for use with the SAConnection.GetSchema(String,String[]) method that represents the Tables collection.

Visual Basic syntax

```
Public Shared ReadOnly Tables As String
```

C# syntax

```
public static readonly string Tables;
```

See also

- "GetSchema method" on page 165

Example

The following code fills a DataTable with the Tables collection.

```
DataTable schema = GetSchema( SAMetaDataCollectionNames.Tables );
```

UserDefinedTypes field

Provides a constant for use with the SAConnection.GetSchema(String,String[]) method that represents the UserDefinedTypes collection.

Visual Basic syntax

```
Public Shared ReadOnly UserDefinedTypes As String
```

C# syntax

```
public static readonly string UserDefinedTypes;
```

See also

- "GetSchema method" on page 165

Example

The following code fills a DataTable with the Users collection.

```
DataTable schema =
    GetSchema( SAMetaDataCollectionNames.UserDefinedTypes );
```

Users field

Provides a constant for use with the SAConnection.GetSchema(String,String[]) method that represents the Users collection.

Visual Basic syntax

```
Public Shared ReadOnly Users As String
```

C# syntax

```
public static readonly string Users;
```

See also

- "GetSchema method" on page 165

Example

The following code fills a DataTable with the Users collection.

```
DataTable schema = GetSchema( SAMetaDataCollectionNames.Users );
```

ViewColumns field

Provides a constant for use with the SAConnection.GetSchema(String,String[]) method that represents the ViewColumns collection.

Visual Basic syntax

```
Public Shared ReadOnly ViewColumns As String
```

C# syntax

```
public static readonly string ViewColumns;
```

See also

- "GetSchema method" on page 165

Example

The following code fills a DataTable with the ViewColumns collection.

```
DataTable schema = GetSchema( SAMetaDataCollectionNames.ViewColumns );
```

Views field

Provides a constant for use with the SAConnection.GetSchema(String,String[]) method that represents the Views collection.

Visual Basic syntax

```
Public Shared ReadOnly Views As String
```

C# syntax

```
public static readonly string Views;
```

See also

- "GetSchema method" on page 165

Example

The following code fills a DataTable with the Views collection.

```
DataTable schema = GetSchema( SAMetaDataCollectionNames.Views );
```

SAParameter class

Represents a parameter to an SACommand, and optionally, its mapping to a DataSet column.

Visual Basic syntax

```
Public NotInheritable Class SAParameter
    Inherits System.Data.Common.DbParameter
    Implements System.ICloneable
```

C# syntax

```
public sealed class SAParameter :
    System.Data.Common.DbParameter,
    System.ICloneable
```

Base classes

- System.Data.Common.DbParameter
- System.ICloneable

Members

All members of SAParameter class, including all inherited members.

Name	Description
“SAParameter constructor”	Initializes an SAParameter object with null (Nothing in Visual Basic) as its value.
“ResetDbType method”	Resets the type (the values of DbType and SADbType) associated with this SAParameter.
“ToString method”	Returns a string containing the ParameterName.
“DbType property”	Gets and sets the DbType of the parameter.
“Direction property”	Gets and sets a value indicating whether the parameter is input-only, output-only, bidirectional, or a stored procedure return value parameter.
“IsNullable property”	Gets and sets a value indicating whether the parameter accepts null values.
“Offset property”	Gets and sets the offset to the Value property.
“ParameterName property”	Gets and sets the name of the SAParameter.
“Precision property”	Gets and sets the maximum number of digits used to represent the Value property.
“SADbType property”	The SADbType of the parameter.
“Scale property”	Gets and sets the number of decimal places to which Value is resolved.
“Size property”	Gets and sets the maximum size, in bytes, of the data within the column.
“SourceColumn property”	Gets and sets the name of the source column mapped to the DataSet and used for loading or returning the value.
“SourceColumnNullMapping property”	Gets and sets value that indicates whether the source column is nullable.
“SourceVersion property”	Gets and sets the DataRowVersion to use when loading Value.
“Value property”	Gets and sets the value of the parameter.

Remarks

Implements: IDbDataParameter, IDataParameter, ICloneable

SAParameter constructor

Initializes an SAParameter object with null (Nothing in Visual Basic) as its value.

Overload list

Name	Description
"SAParameter() constructor"	Initializes an SAParameter object with null (Nothing in Visual Basic) as its value.
"SAParameter(string, object) constructor"	Initializes an SAParameter object with the specified parameter name and value.
"SAParameter(string, SADbType) constructor"	Initializes an SAParameter object with the specified parameter name and data type.
"SAParameter(string, SADbType, int) constructor"	Initializes an SAParameter object with the specified parameter name and data type.
"SAParameter(string, SADbType, int, ParameterDirection, bool, byte, byte, string, DataRowVersion, object) constructor"	Initializes an SAParameter object with the specified parameter name, data type, length, direction, nullability, numeric precision, numeric scale, source column, source version, and value.
"SAParameter(string, SADbType, int, string) constructor"	Initializes an SAParameter object with the specified parameter name, data type, and length.

SAParameter() constructor

Initializes an SAParameter object with null (Nothing in Visual Basic) as its value.

Visual Basic syntax

```
Public Sub New()
```

C# syntax

```
public SAParameter()
```

SAParameter(string, object) constructor

Initializes an SAParameter object with the specified parameter name and value.

Visual Basic syntax

```
Public Sub New(ByVal parameterName As String, ByVal value As Object)
```

C# syntax

```
public SAParameter(string parameterName, object value)
```

Parameters

- **parameterName** The name of the parameter.
- **value** An Object that is the value of the parameter.

Remarks

This constructor is not recommended; it is provided for compatibility with other data providers.

SAParameter(string, SADbType) constructor

Initializes an SAParameter object with the specified parameter name and data type.

Visual Basic syntax

```
Public Sub New(ByVal parameterName As String, ByVal dbType As SADbType)
```

C# syntax

```
public SAParameter(string parameterName, SADbType dbType)
```

Parameters

- **parameterName** The name of the parameter.
- **dbType** One of the SADbType values.

See also

- "SADbType property" on page 273

SAParameter(string, SADbType, int) constructor

Initializes an SAParameter object with the specified parameter name and data type.

Visual Basic syntax

```
Public Sub New(
    ByVal parameterName As String,
    ByVal dbType As SADbType,
    ByVal size As Integer
)
```

C# syntax

```
public SAParameter(string parameterName, SADbType dbType, int size)
```

Parameters

- **parameterName** The name of the parameter.
- **dbType** One of the SADbType values
- **size** The length of the parameter.

SAParameter(string, SADbType, int, ParameterDirection, bool, byte, byte, string, DataRowVersion, object) constructor

Initializes an SAParameter object with the specified parameter name, data type, length, direction, nullability, numeric precision, numeric scale, source column, source version, and value.

Visual Basic syntax

```
Public Sub New(
    ByVal parameterName As String,
    ByVal dbType As SADbType,
    ByVal size As Integer,
    ByVal direction As ParameterDirection,
    ByVal isNullable As Boolean,
    ByVal precision As Byte,
    ByVal scale As Byte,
    ByVal sourceColumn As String,
    ByVal sourceVersion As DataRowVersion,
    ByVal value As Object
)
```

C# syntax

```
public SAParameter(
    string parameterName,
    SADbType dbType,
    int size,
    ParameterDirection direction,
    bool isNullable,
    byte precision,
    byte scale,
    string sourceColumn,
    DataRowVersion sourceVersion,
    object value
)
```

Parameters

- **parameterName** The name of the parameter.
- **dbType** One of the SADbType values
- **size** The length of the parameter.
- **direction** One of the ParameterDirection values.
- **isNullable** True if the value of the field can be null; otherwise, false.
- **precision** The total number of digits to the left and right of the decimal point to which Value is resolved.
- **scale** The total number of decimal places to which Value is resolved.
- **sourceColumn** The name of the source column to map.

- **sourceVersion** One of the DataRowVersion values.
- **value** An Object that is the value of the parameter.

SAParameter(string, SADbType, int, string) constructor

Initializes an SAParameter object with the specified parameter name, data type, and length.

Visual Basic syntax

```
Public Sub New(
    ByVal parameterName As String,
    ByVal dbType As SADbType,
    ByVal size As Integer,
    ByVal sourceColumn As String
)
```

C# syntax

```
public SAParameter(
    string parameterName,
    SADbType dbType,
    int size,
    string sourceColumn
)
```

Parameters

- **parameterName** The name of the parameter.
- **dbType** One of the SADbType values
- **size** The length of the parameter.
- **sourceColumn** The name of the source column to map.

ResetDbType method

Resets the type (the values of DbType and SADbType) associated with this SAParameter.

Visual Basic syntax

```
Public Overrides Sub ResetDbType()
```

C# syntax

```
public override void ResetDbType()
```

ToString method

Returns a string containing the ParameterName.

Visual Basic syntax

```
Public Overrides Function ToString() As String
```

C# syntax

```
public override string ToString()
```

Returns

The name of the parameter.

DbType property

Gets and sets the DbType of the parameter.

Visual Basic syntax

```
Public Overrides Property DbType As DbType
```

C# syntax

```
public override DbType DbType {get;set;}
```

Remarks

The SADbType and DbType are linked. Therefore, setting the DbType changes the SADbType to a supporting SADbType.

The value must be a member of the SADbType enumerator.

Direction property

Gets and sets a value indicating whether the parameter is input-only, output-only, bidirectional, or a stored procedure return value parameter.

Visual Basic syntax

```
Public Overrides Property Direction As ParameterDirection
```

C# syntax

```
public override ParameterDirection Direction {get;set;}
```

Remarks

One of the ParameterDirection values.

If the ParameterDirection is output, and execution of the associated SACommand does not return a value, the SAParameter contains a null value. After the last row from the last result set is read, the Output, InputOut, and ReturnValue parameters are updated.

IsNullable property

Gets and sets a value indicating whether the parameter accepts null values.

Visual Basic syntax

```
Public Overrides Property IsNullable As Boolean
```

C# syntax

```
public override bool IsNullable {get;set;}
```

Remarks

This property is true if null values are accepted; otherwise, it is false. The default is false. Null values are handled using the DBNull class.

Offset property

Gets and sets the offset to the Value property.

Visual Basic syntax

```
Public Property Offset As Integer
```

C# syntax

```
public int Offset {get;set;}
```

Remarks

The offset to the value. The default is 0.

ParameterName property

Gets and sets the name of the SAParameter.

Visual Basic syntax

```
Public Overrides Property ParameterName As String
```

C# syntax

```
public override string ParameterName {get;set;}
```

Remarks

The default is an empty string.

The SQL Anywhere .NET Data Provider uses positional parameters that are marked with a question mark (?) instead of named parameters.

Precision property

Gets and sets the maximum number of digits used to represent the Value property.

Visual Basic syntax

```
Public Property Precision As Byte
```

C# syntax

```
public byte Precision {get;set;}
```

Remarks

The value of this property is the maximum number of digits used to represent the Value property. The default value is 0, which indicates that the data provider sets the precision for the Value property.

The Precision property is only used for decimal and numeric input parameters.

SADbType property

The SADbType of the parameter.

Visual Basic syntax

```
Public Property SADbType As SADbType
```

C# syntax

```
public SADbType SADbType {get;set;}
```

Remarks

The SADbType and DbType are linked. Therefore, setting the SADbType changes the DbType to a supporting DbType.

The value must be a member of the SADbType enumerator.

Scale property

Gets and sets the number of decimal places to which Value is resolved.

Visual Basic syntax

```
Public Property Scale As Byte
```

C# syntax

```
public byte Scale {get;set;}
```

Remarks

The number of decimal places to which Value is resolved. The default is 0.

The Scale property is only used for decimal and numeric input parameters.

Size property

Gets and sets the maximum size, in bytes, of the data within the column.

Visual Basic syntax

```
Public Overrides Property Size As Integer
```

C# syntax

```
public override int Size {get;set;}
```

Remarks

The value of this property is the maximum size, in bytes, of the data within the column. The default value is inferred from the parameter value.

The value of this property is the maximum size, in bytes, of the data within the column. The default value is inferred from the parameter value.

The Size property is used for binary and string types.

For variable length data types, the Size property describes the maximum amount of data to transmit to the server. For example, the Size property can be used to limit the amount of data sent to the server for a string value to the first one hundred bytes.

If not explicitly set, the size is inferred from the actual size of the specified parameter value. For fixed width data types, the value of Size is ignored. It can be retrieved for informational purposes, and returns the maximum amount of bytes the provider uses when transmitting the value of the parameter to the server.

SourceColumn property

Gets and sets the name of the source column mapped to the DataSet and used for loading or returning the value.

Visual Basic syntax

```
Public Overrides Property SourceColumn As String
```

C# syntax

```
public override string SourceColumn {get;set;}
```

Remarks

A string specifying the name of the source column mapped to the DataSet and used for loading or returning the value.

When SourceColumn is set to anything other than an empty string, the value of the parameter is retrieved from the column with the SourceColumn name. If Direction is set to Input, the value is taken from the

DataSet. If Direction is set to Output, the value is taken from the data source. A Direction of InputOutput is a combination of both.

SourceColumnNullMapping property

Gets and sets value that indicates whether the source column is nullable.

Visual Basic syntax

```
Public Overrides Property SourceColumnNullMapping As Boolean
```

C# syntax

```
public override bool SourceColumnNullMapping {get;set;}
```

Remarks

This allows SACommandBuilder to generate Update statements for nullable columns correctly.

If the source column is nullable, true is returned; otherwise, false.

SourceVersion property

Gets and sets the DataRowVersion to use when loading Value.

Visual Basic syntax

```
Public Overrides Property SourceVersion As DataRowVersion
```

C# syntax

```
public override DataRowVersion SourceVersion {get;set;}
```

Remarks

Used by UpdateCommand during an Update operation to determine whether the parameter value is set to Current or Original. This allows primary keys to be updated. This property is ignored by InsertCommand and DeleteCommand. This property is set to the version of the DataRow used by the Item property, or the GetChildRows method of the DataRow object.

Value property

Gets and sets the value of the parameter.

Visual Basic syntax

```
Public Overrides Property Value As Object
```

C# syntax

```
public override object Value {get;set;}
```

Remarks

An Object that specifies the value of the parameter.

For input parameters, the value is bound to the SACommand that is sent to the server. For output and return value parameters, the value is set on completion of the SACommand and after the SADataReader is closed.

When sending a null parameter value to the server, you must specify DBNull, not null. The null value in the system is an empty object that has no value. DBNull is used to represent null values.

If the application specifies the database type, the bound value is converted to that type when the SQL Anywhere .NET Data Provider sends the data to the server. The provider attempts to convert any type of value if it supports the IConvertible interface. Conversion errors may result if the specified type is not compatible with the value.

Both the DbType and SADbType properties can be inferred by setting the Value.

The Value property is overwritten by Update.

SAParameterCollection class

Represents all parameters to an SACommand object and, optionally, their mapping to a DataSet column.

Visual Basic syntax

```
Public NotInheritable Class SAParameterCollection
    Inherits System.Data.Common.DbParameterCollection
```

C# syntax

```
public sealed class SAParameterCollection :
    System.Data.Common.DbParameterCollection
```

Base classes

- System.Data.Common.DbParameterCollection

Members

All members of SAParameterCollection class, including all inherited members.

Name	Description
"Add method"	Adds an SAParameter object to this collection.
"AddRange method"	Adds an array of values to the end of the SAParameterCollection.

Name	Description
"AddWithValue method"	Adds a value to the end of this collection.
"Clear method"	Removes all items from the collection.
"Contains method"	Indicates whether an SAParameter object exists in the collection.
"CopyTo method"	Copies SAParameter objects from the SAParameterCollection to the specified array.
"GetEnumerator method"	Returns an enumerator that iterates through the SAParameterCollection.
GetParameter method (Inherited from System.Data.Common.DbParameterCollection)	Returns the System.Data.Common.DbParameter object at the specified index in the collection.
"IndexOf method"	Returns the location of the SAParameter object in the collection.
"Insert method"	Inserts an SAParameter object in the collection at the specified index.
"Remove method"	Removes the specified SAParameter object from the collection.
"RemoveAt method"	Removes the specified SAParameter object from the collection.
SetParameter method (Inherited from System.Data.Common.DbParameterCollection)	Sets the System.Data.Common.DbParameter object at the specified index to a new value.
"Count property"	Returns the number of SAParameter objects in the collection.

Name	Description
"IsFixedSize property"	Gets a value that indicates whether the SAParameterCollection has a fixed size.
"IsReadOnly property"	Gets a value that indicates whether the SAParameterCollection is read-only.
"IsSynchronized property"	Gets a value that indicates whether the SAParameterCollection object is synchronized.
"SyncRoot property"	Gets an object that can be used to synchronize access to the SAParameterCollection.
"this property"	Gets and sets the SAParameter object at the specified index.

Remarks

There is no constructor for SAParameterCollection. You obtain an SAParameterCollection object from the SACommand.Parameters property of an SACommand object.

See also

- "SACommand class" on page 117
- "Parameters property" on page 139
- "SAParameter class" on page 265
- "SAParameterCollection class" on page 276

Add method

Adds an SAParameter object to this collection.

Overload list

Name	Description
"Add(object) method"	Adds an SAParameter object to this collection.
"Add(SAParameter) method"	Adds an SAParameter object to this collection.
"Add(string, object) method"	Adds an SAParameter object to this collection, created using the specified parameter name and value, to the collection.

Name	Description
"Add(string, SADbType) method"	Adds an SAParameter object to this collection, created using the specified parameter name and data type, to the collection.
"Add(string, SADbType, int) method"	Adds an SAParameter object to this collection, created using the specified parameter name, data type, and length, to the collection.
"Add(string, SADbType, int, string) method"	Adds an SAParameter object to this collection, created using the specified parameter name, data type, length, and source column name, to the collection.

Add(object) method

Adds an SAParameter object to this collection.

Visual Basic syntax

```
Public Overrides Function Add(ByVal value As Object) As Integer
```

C# syntax

```
public override int Add(object value)
```

Parameters

- **value** The SAParameter object to add to the collection.

Returns

The index of the new SAParameter object.

See also

- "SAParameter class" on page 265

Add(SAParameter) method

Adds an SAParameter object to this collection.

Visual Basic syntax

```
Public Function Add(ByVal value As SAParameter) As SAParameter
```

C# syntax

```
public SAParameter Add(SAParameter value)
```

Parameters

- **value** The SAParameter object to add to the collection.

Returns

The new SAParameter object.

Add(string, object) method

Adds an SAParameter object to this collection, created using the specified parameter name and value, to the collection.

Visual Basic syntax

```
Public Function Add(
    ByVal parameterName As String,
    ByVal value As Object
) As SAParameter
```

C# syntax

```
public SAParameter Add(string parameterName, object value)
```

Parameters

- **parameterName** The name of the parameter.
- **value** The value of the parameter to add to the connection.

Returns

The new SAParameter object.

Remarks

Because of the special treatment of the 0 and 0.0 constants and the way overloaded methods are resolved, it is highly recommended that you explicitly cast constant values to type object when using this method.

See also

- "SAParameter class" on page 265

Add(string, SADbType) method

Adds an SAParameter object to this collection, created using the specified parameter name and data type, to the collection.

Visual Basic syntax

```
Public Function Add(
    ByVal parameterName As String,
    ByVal saDbType As SADbType
) As SAParameter
```

C# syntax

```
public SAParameter Add(string parameterName, SADbType saDbType)
```

Parameters

- **parameterName** The name of the parameter.
- **saDbType** One of the SADbType values.

Returns

The new SAParameter object.

See also

- "SADbType enumeration" on page 317
- "Add method" on page 278

Add(string, SADbType, int) method

Adds an SAParameter object to this collection, created using the specified parameter name, data type, and length, to the collection.

Visual Basic syntax

```
Public Function Add(
    ByVal parameterName As String,
    ByVal saDbType As SADbType,
    ByVal size As Integer
) As SAParameter
```

C# syntax

```
public SAParameter Add(
    string parameterName,
    SADbType saDbType,
    int size
)
```

Parameters

- **parameterName** The name of the parameter.
- **saDbType** One of the SADbType values.
- **size** The length of the parameter.

Returns

The new SAParameter object.

See also

- "SADbType enumeration" on page 317
- "Add method" on page 278

Add(string, SADbType, int, string) method

Adds an SAParameter object to this collection, created using the specified parameter name, data type, length, and source column name, to the collection.

Visual Basic syntax

```
Public Function Add(
    ByVal parameterName As String,
    ByVal saDbType As SADbType,
    ByVal size As Integer,
    ByVal sourceColumn As String
) As SAParameter
```

C# syntax

```
public SAParameter Add(
    string parameterName,
    SADbType saDbType,
    int size,
    string sourceColumn
)
```

Parameters

- **parameterName** The name of the parameter.
- **saDbType** One of the SADbType values.
- **size** The length of the column.
- **sourceColumn** The name of the source column to map.

Returns

The new SAParameter object.

See also

- "SADbType enumeration" on page 317
- "Add method" on page 278

AddRange method

Adds an array of values to the end of the SAParameterCollection.

Overload list

Name	Description
"AddRange(Array) method"	Adds an array of values to the end of the SAParameterCollection.
"AddRange(SAParameter[]) method"	Adds an array of values to the end of the SAParameterCollection.

AddRange(Array) method

Adds an array of values to the end of the SAParameterCollection.

Visual Basic syntax

```
Public Overrides Sub AddRange(ByVal values As Array)
```

C# syntax

```
public override void AddRange(Array values)
```

Parameters

- **values** The values to add.

AddRange(SAParameter[]) method

Adds an array of values to the end of the SAParameterCollection.

Visual Basic syntax

```
Public Sub AddRange(ByVal values As SAParameter())
```

C# syntax

```
public void AddRange(SAParameter[] values)
```

Parameters

- **values** An array of SAParameter objects to add to the end of this collection.

AddWithValue method

Adds a value to the end of this collection.

Visual Basic syntax

```
Public Function AddWithValue(
    ByVal parameterName As String,
    ByVal value As Object
) As SAParameter
```

C# syntax

```
public SAParameter AddWithValue(string parameterName, object value)
```

Parameters

- **parameterName** The name of the parameter.
- **value** The value to be added.

Returns

The new SAParameter object.

Clear method

Removes all items from the collection.

Visual Basic syntax

```
Public Overrides Sub Clear()
```

C# syntax

```
public override void Clear()
```

Contains method

Indicates whether an SAParameter object exists in the collection.

Overload list

Name	Description
"Contains(object) method"	Indicates whether an SAParameter object exists in the collection.
"Contains(string) method"	Indicates whether an SAParameter object exists in the collection.

Contains(object) method

Indicates whether an SAParameter object exists in the collection.

Visual Basic syntax

```
Public Overrides Function Contains(ByVal value As Object) As Boolean
```

C# syntax

```
public override bool Contains(object value)
```

Parameters

- **value** The SAParameter object to find.

Returns

True if the collection contains the SAParameter object. Otherwise, false.

See also

- "SAParameter class" on page 265
- "Contains method" on page 284

Contains(string) method

Indicates whether an SAParameter object exists in the collection.

Visual Basic syntax

```
Public Overrides Function Contains(ByVal value As String) As Boolean
```

C# syntax

```
public override bool Contains(string value)
```

Parameters

- **value** The name of the parameter to search for.

Returns

True if the collection contains the SAParameter object. Otherwise, false.

See also

- "SAParameter class" on page 265
- "Contains method" on page 284

CopyTo method

Copies SAParameter objects from the SAParameterCollection to the specified array.

Visual Basic syntax

```
Public Overrides Sub CopyTo(
    ByVal array As Array,
    ByVal index As Integer
)
```

C# syntax

```
public override void CopyTo(Array array, int index)
```

Parameters

- **array** The array to copy the SAParameter objects into.
- **index** The starting index of the array.

See also

- "SAParameter class" on page 265
- "SAParameterCollection class" on page 276

GetEnumerator method

Returns an enumerator that iterates through the SAParameterCollection.

Visual Basic syntax

```
Public Overrides Function GetEnumerator()
    As System.Collections.IEnumerator
```

C# syntax

```
public override IEnumerator GetEnumerator()
```

Returns

An System.Collections.IEnumerator for the SAParameterCollection object.

See also

- "SAParameterCollection class" on page 276

IndexOf method

Returns the location of the SAParameter object in the collection.

Overload list

Name	Description
"IndexOf(object) method"	Returns the location of the SAParameter object in the collection.
"IndexOf(string) method"	Returns the location of the SAParameter object in the collection.

IndexOf(object) method

Returns the location of the SAParameter object in the collection.

Visual Basic syntax

```
Public Overrides Function IndexOf(ByVal value As Object) As Integer
```

C# syntax

```
public override int IndexOf(object value)
```

Parameters

- **value** The SAParameter object to locate.

Returns

The zero-based location of the SAParameter object in the collection.

See also

- "SAParameter class" on page 265
- "IndexOf method" on page 286

IndexOf(string) method

Returns the location of the SAParameter object in the collection.

Visual Basic syntax

```
Public Overrides Function IndexOf(
    ByVal parameterName As String
) As Integer
```

C# syntax

```
public override int IndexOf(string parameterName)
```

Parameters

- **parameterName** The name of the parameter to locate.

Returns

The zero-based index of the SAParameter object in the collection.

See also

- "SAParameter class" on page 265
- "IndexOf method" on page 286

Insert method

Inserts an SAParameter object in the collection at the specified index.

Visual Basic syntax

```
Public Overrides Sub Insert(
    ByVal index As Integer,
    ByVal value As Object
)
```

C# syntax

```
public override void Insert(int index, object value)
```

Parameters

- **index** The zero-based index where the parameter is to be inserted within the collection.
- **value** The SAParameter object to add to the collection.

Remove method

Removes the specified SAParameter object from the collection.

Visual Basic syntax

```
Public Overrides Sub Remove(ByVal value As Object)
```

C# syntax

```
public override void Remove(object value)
```

Parameters

- **value** The SAParameter object to remove from the collection.

RemoveAt method

Removes the specified SAParameter object from the collection.

Overload list

Name	Description
"RemoveAt(int) method"	Removes the specified SAParameter object from the collection.
"RemoveAt(string) method"	Removes the specified SAParameter object from the collection.

RemoveAt(int) method

Removes the specified SAParameter object from the collection.

Visual Basic syntax

```
Public Overrides Sub RemoveAt(ByVal index As Integer)
```

C# syntax

```
public override void RemoveAt(int index)
```

Parameters

- **index** The zero-based index of the parameter to remove.

See also

- "RemoveAt method" on page 288

RemoveAt(string) method

Removes the specified SAParameter object from the collection.

Visual Basic syntax

```
Public Overrides Sub RemoveAt(ByVal parameterName As String)
```


C# syntax

```
public override void RemoveAt(string parameterName)
```

Parameters

- **parameterName** The name of the SAParameter object to remove.

See also

- "RemoveAt method" on page 288

Count property

Returns the number of SAParameter objects in the collection.

Visual Basic syntax

```
Public ReadOnly Overrides Property Count As Integer
```

C# syntax

```
public override int Count {get;}
```

Remarks

The number of SAParameter objects in the collection.

See also

- "SAParameter class" on page 265
- "SAParameterCollection class" on page 276

IsFixedSize property

Gets a value that indicates whether the SAParameterCollection has a fixed size.

Visual Basic syntax

```
Public ReadOnly Overrides Property IsFixedSize As Boolean
```

C# syntax

```
public override bool IsFixedSize {get;}
```

Remarks

True if this collection has a fixed size, false otherwise.

IsReadOnly property

Gets a value that indicates whether the SAParameterCollection is read-only.

Visual Basic syntax

```
Public ReadOnly Overrides Property IsReadOnly As Boolean
```

C# syntax

```
public override bool IsReadOnly {get;}
```

Remarks

True if this collection is read-only, false otherwise.

IsSynchronized property

Gets a value that indicates whether the SAParameterCollection object is synchronized.

Visual Basic syntax

```
Public ReadOnly Overrides Property IsSynchronized As Boolean
```

C# syntax

```
public override bool IsSynchronized {get;}
```

Remarks

True if this collection is synchronized, false otherwise.

SyncRoot property

Gets an object that can be used to synchronize access to the SAParameterCollection.

Visual Basic syntax

```
Public ReadOnly Overrides Property SyncRoot As Object
```

C# syntax

```
public override object SyncRoot {get;}
```

this property

Gets and sets the SAParameter object at the specified index.

Overload list

Name	Description
"this[int] property"	Gets and sets the SAParameter object at the specified index.

Name	Description
"this[string] property"	Gets and sets the SAParameter object at the specified index.

this[int] property

Gets and sets the SAParameter object at the specified index.

Visual Basic syntax

```
Public Shadows Property Item(ByVal index As Integer) As SAParameter
```

C# syntax

```
public new SAParameter this[int index] {get;set;}
```

Parameters

- **index** The zero-based index of the parameter to retrieve.

Returns

The SAParameter at the specified index.

Remarks

An SAParameter object.

In C#, this property is the indexer for the SAParameterCollection object.

See also

- "SAParameter class" on page 265
- "SAParameterCollection class" on page 276

this[string] property

Gets and sets the SAParameter object at the specified index.

Visual Basic syntax

```
Public Shadows Property Item(
    ByVal parameterName As String
) As SAParameter
```

C# syntax

```
public new SAParameter this[string parameterName] {get;set;}
```

Parameters

- **parameterName** The name of the parameter to retrieve.

Returns

The SAParameter object with the specified name.

Remarks

An SAParameter object.

In C#, this property is the indexer for the SAParameterCollection object.

See also

- "SAParameter class" on page 265
- "SAParameterCollection class" on page 276
- "GetOrdinal method" on page 227
- "GetValue method" on page 232
- "GetFieldType method" on page 223

SAPermission class

Enables the SQL Anywhere .NET Data Provider to ensure that a user has a security level adequate to access a SQL Anywhere data source.

Visual Basic syntax

```
Public NotInheritable Class SAPermission
    Inherits System.Data.Common.DBDataPermission
```

C# syntax

```
public sealed class SAPermission : System.Data.Common.DBDataPermission
```

Base classes

- System.Data.Common.DBDataPermission

Members

All members of SAPermission class, including all inherited members.

Name	Description
"SAPermission constructor"	Initializes a new instance of the SAPermission class.
Add method (Inherited from System.Data.Common.DBDataPermission)	Adds access for the specified connection string to the existing state of the DBDataPermission.

Name	Description
Clear method (Inherited from System.Data.Common.DBDataPermission)	Removes all permissions that were previous added using the System.Data.Common.DBDataPermission.Add(System.String,System.String,System.Data.KeyRestrictionBehavior) method.
Copy method (Inherited from System.Data.Common.DBDataPermission)	Creates and returns an identical copy of the current permission object.
FromXml method (Inherited from System.Data.Common.DBDataPermission)	Reconstructs a security object with a specified state from an XML encoding.
Intersect method (Inherited from System.Data.Common.DBDataPermission)	Returns a new permission object representing the intersection of the current permission object and the specified permission object.
IsSubsetOf method (Inherited from System.Data.Common.DBDataPermission)	Returns a value indicating whether the current permission object is a subset of the specified permission object.
IsUnrestricted method (Inherited from System.Data.Common.DBDataPermission)	Returns a value indicating whether the permission can be represented as unrestricted without any knowledge of the permission semantics.
ToXml method (Inherited from System.Data.Common.DBDataPermission)	Creates an XML encoding of the security object and its current state.
Union method (Inherited from System.Data.Common.DBDataPermission)	Returns a new permission object that is the union of the current and specified permission objects.
AllowBlankPassword property (Inherited from System.Data.Common.DBDataPermission)	Gets a value indicating whether a blank password is allowed.

Remarks

Base classes DBDataPermission

SAPermission constructor

Initializes a new instance of the SAPermission class.

Visual Basic syntax

```
Public Sub New(ByVal state As PermissionState)
```

C# syntax

```
public SAPermission(PermissionState state)
```

Parameters

- **state** One of the PermissionState values.

SAPermissionAttribute class

Associates a security action with a custom security attribute.

Visual Basic syntax

```
Public NotInheritable Class SAPermissionAttribute
    Inherits System.Data.Common.DBDataPermissionAttribute
```

C# syntax

```
public sealed class SAPermissionAttribute :
    System.Data.Common.DBDataPermissionAttribute
```

Base classes

- System.Data.Common.DBDataPermissionAttribute

Members

All members of SAPermissionAttribute class, including all inherited members.

Name	Description
"SAPermissionAttribute constructor"	Initializes a new instance of the SAPermissionAttribute class.
"CreatePermission method"	Returns an SAPermission object that is configured according to the attribute properties.

Name	Description
ShouldSerializeConnectionString method (Inherited from System.Data.Common.DBDataPermissionAttribute)	Identifies whether the attribute should serialize the connection string.
ShouldSerializeKeyRestrictions method (Inherited from System.Data.Common.DBDataPermissionAttribute)	Identifies whether the attribute should serialize the set of key restrictions.
AllowBlankPassword property (Inherited from System.Data.Common.DBDataPermissionAttribute)	Gets or sets a value indicating whether a blank password is allowed.
ConnectionString property (Inherited from System.Data.Common.DBDataPermissionAttribute)	Gets or sets a permitted connection string.
KeyRestrictionBehavior property (Inherited from System.Data.Common.DBDataPermissionAttribute)	Identifies whether the list of connection string parameters identified by the System.Data.Common.DBDataPermissionAttribute.KeyRestrictions property are the only connection string parameters allowed.
KeyRestrictions property (Inherited from System.Data.Common.DBDataPermissionAttribute)	Gets or sets connection string parameters that are allowed or disallowed.

SAPermissionAttribute constructor

Initializes a new instance of the SAPermissionAttribute class.

Visual Basic syntax

```
Public Sub New(ByVal action As SecurityAction)
```

C# syntax

```
public SAPermissionAttribute(SecurityAction action)
```

Parameters

- **action** One of the SecurityAction values representing an action that can be performed using declarative security.

Returns

An SAPermissionAttribute object.

CreatePermission method

Returns an SAPermission object that is configured according to the attribute properties.

Visual Basic syntax

```
Public Overrides Function CreatePermission() As IPermission
```

C# syntax

```
public override IPermission CreatePermission()
```

SARowsCopiedEventArgs class

Represents the set of arguments passed to the SARowsCopiedEventHandler.

Visual Basic syntax

```
Public NotInheritable Class SARowsCopiedEventArgs
```

C# syntax

```
public sealed class SARowsCopiedEventArgs
```

Members

All members of SARowsCopiedEventArgs class, including all inherited members.

Name	Description
"SARowsCopiedEventArgs constructor"	Creates a new instance of the SARowsCopiedEventArgs object.
"Abort property"	Gets or sets a value that indicates whether the bulk-copy operation should be aborted.
"RowsCopied property"	Gets the number of rows copied during the current bulk-copy operation.

Remarks

The SARowsCopiedEventArgs class is not available in the .NET Compact Framework 2.0.

SARowsCopiedEventArgs constructor

Creates a new instance of the SARowsCopiedEventArgs object.

Visual Basic syntax

```
Public Sub New(ByVal rowsCopied As Long)
```

C# syntax

```
public SARowsCopiedEventArgs(long rowsCopied)
```

Parameters

- **rowsCopied** An 64-bit integer value that indicates the number of rows copied during the current bulk-copy operation.

Remarks

The SARowsCopiedEventArgs class is not available in the .NET Compact Framework 2.0.

Abort property

Gets or sets a value that indicates whether the bulk-copy operation should be aborted.

Visual Basic syntax

```
Public Property Abort As Boolean
```

C# syntax

```
public bool Abort {get;set;}
```

Remarks

The SARowsCopiedEventArgs class is not available in the .NET Compact Framework 2.0.

RowsCopied property

Gets the number of rows copied during the current bulk-copy operation.

Visual Basic syntax

```
Public ReadOnly Property RowsCopied As Long
```

C# syntax

```
public long RowsCopied {get;}
```

Remarks

The SARowsCopiedEventArgs class is not available in the .NET Compact Framework 2.0.

SARowUpdatedEventArgs class

Provides data for the RowUpdated event.

Visual Basic syntax

```
Public NotInheritable Class SARowUpdatedEventArgs
    Inherits System.Data.Common.RowUpdatedEventArgs
```

C# syntax

```
public sealed class SARowUpdatedEventArgs :
    System.Data.Common.RowUpdatedEventArgs
```

Base classes

- System.Data.Common.RowUpdatedEventArgs

Members

All members of SARowUpdatedEventArgs class, including all inherited members.

Name	Description
"SARowUpdatedEventArgs constructor"	Initializes a new instance of the SARowUpdatedEventArgs class.
CopyToRows method (Inherited from System.Data.Common.RowUpdatedEventArgs)	Copies references to the modified rows into the provided array.
"Command property"	Gets the SACommand that is executed when DataAdapter.Update is called.
Errors property (Inherited from System.Data.Common.RowUpdatedEventArgs)	Gets any errors generated by the .NET Framework data provider when the System.Data.Common.RowUpdatedEventArgs.Command was executed.
"RecordsAffected property"	Returns the number of rows changed, inserted, or deleted by execution of the SQL statement.
Row property (Inherited from System.Data.Common.RowUpdatedEventArgs)	Gets the System.Data.DataRow sent through an System.Data.Common.DbDataAdapter.Update(System.Data.DataSet).
RowCount property (Inherited from System.Data.Common.RowUpdatedEventArgs)	Gets the number of rows processed in a batch of updated records.
StatementType property (Inherited from System.Data.Common.RowUpdatedEventArgs)	Gets the type of SQL statement executed.

Name	Description
Status property (Inherited from System.Data.Common.RowUpdatedEventArgs)	Gets the System.Data.UpdateStatus of the System.Data.Common.RowUpdatedEventArgs.Command property.
TableMapping property (Inherited from System.Data.Common.RowUpdatedEventArgs)	Gets the System.Data.Common.DataTableMapping sent through an System.Data.Common.DbDataAdapter.Update(System.Data.DataSet).

SARowUpdatedEventArgs constructor

Initializes a new instance of the SARowUpdatedEventArgs class.

Visual Basic syntax

```
Public Sub New(
    ByVal row As DataRow,
    ByVal command As IDbCommand,
    ByVal statementType As StatementType,
    ByVal tableMapping As DataTableMapping
)
```

C# syntax

```
public SARowUpdatedEventArgs(
    DataRow row,
    IDbCommand command,
    StatementType statementType,
    DataTableMapping tableMapping
)
```

Parameters

- **row** The DataRow sent through an Update.
- **command** The IDbCommand executed when Update is called.
- **statementType** One of the StatementType values that specifies the type of query executed.
- **tableMapping** The DataTableMapping sent through an Update.

Command property

Gets the SACommand that is executed when DataAdapter.Update is called.

Visual Basic syntax

```
Public ReadOnly Shadows Property Command As SACommand
```

C# syntax

```
public new SACommand Command {get;}
```

RecordsAffected property

Returns the number of rows changed, inserted, or deleted by execution of the SQL statement.

Visual Basic syntax

```
Public ReadOnly Shadows Property RecordsAffected As Integer
```

C# syntax

```
public new int RecordsAffected {get;}
```

Remarks

The number of rows changed, inserted, or deleted; 0 if no rows were affected or the statement failed; and -1 for SELECT statements.

SARowUpdatingEventArgs class

Provides data for the RowUpdating event.

Visual Basic syntax

```
Public NotInheritable Class SARowUpdatingEventArgs
    Inherits System.Data.Common.RowUpdatingEventArgs
```

C# syntax

```
public sealed class SARowUpdatingEventArgs :
    System.Data.Common.RowUpdatingEventArgs
```

Base classes

- System.Data.Common.RowUpdatingEventArgs

Members

All members of SARowUpdatingEventArgs class, including all inherited members.

Name	Description
"SARowUpdatingEventArgs constructor"	Initializes a new instance of the SARowUpdatingEventArgs class.
BaseCommand property (Inherited from System.Data.Common.RowUpdatingEventArgs)	Gets or sets the System.Data.IDbCommand object for an instance of this class.

Name	Description
"Command property"	Specifies the SACommand to execute when performing the Update.
Errors property (Inherited from System.Data.Common.RowUpdatingEventArgs)	Gets any errors generated by the .NET Framework data provider when the System.Data.Common.RowUpdatedEventArgs.Command executes.
Row property (Inherited from System.Data.Common.RowUpdatingEventArgs)	Gets the System.Data.DataRow that will be sent to the server as part of an insert, update, or delete operation.
StatementType property (Inherited from System.Data.Common.RowUpdatingEventArgs)	Gets the type of SQL statement to execute.
Status property (Inherited from System.Data.Common.RowUpdatingEventArgs)	Gets or sets the System.Data.UpdateStatus of the System.Data.Common.RowUpdatedEventArgs.Command property.
TableMapping property (Inherited from System.Data.Common.RowUpdatingEventArgs)	Gets the System.Data.Common.DataTableMapping to send through the System.Data.Common.DbDataAdapter.Update(System.Data.DataSet).

SARowUpdatingEventArgs constructor

Initializes a new instance of the SARowUpdatingEventArgs class.

Visual Basic syntax

```
Public Sub New(
    ByVal row As DataRow,
    ByVal command As IDbCommand,
    ByVal statementType As StatementType,
    ByVal tableMapping As DataTableMapping
)
```

C# syntax

```
public SARowUpdatingEventArgs(
    DataRow row,
    IDbCommand command,
    StatementType statementType,
    DataTableMapping tableMapping
)
```

Parameters

- **row** The DataRow to update.
- **command** The IDbCommand to execute during update.
- **statementType** One of the StatementType values that specifies the type of query executed.
- **tableMapping** The DataTableMapping sent through an Update.

Command property

Specifies the SACommand to execute when performing the Update.

Visual Basic syntax

```
Public Shadows Property Command As SACommand
```

C# syntax

```
public new SACommand Command {get;set;}
```

SATcpOptionsBuilder class

Provides a simple way to create and manage the TCP options portion of connection strings used by the SAConnection object.

Visual Basic syntax

```
Public NotInheritable Class SATcpOptionsBuilder
    Inherits SAConnectionStringBuilderBase
```

C# syntax

```
public sealed class SATcpOptionsBuilder : SAConnectionStringBuilderBase
```

Base classes

- "SAConnectionStringBuilderBase class" on page 196

Members

All members of SATcpOptionsBuilder class, including all inherited members.

Name	Description
"SATcpOptionsBuilder constructor"	Initializes an SATcpOptionsBuilder object.
Add method (Inherited from System.Data.Common.DbConnectionStringBuilder)	Adds an entry with the specified key and value into the System.Data.Common.DbConnectionStringBuilder.

Name	Description
AppendKeyValuePair method (Inherited from System.Data.Common.DbConnectionStringBuilder)	Provides an efficient and safe way to append a key and value to an existing System.Text.StringBuilder object.
Clear method (Inherited from System.Data.Common.DbConnectionStringBuilder)	Clears the contents of the System.Data.Common.DbConnectionStringBuilder instance.
ClearPropertyDescriptors method (Inherited from System.Data.Common.DbConnectionStringBuilder)	Clears the collection of System.ComponentModel.PropertyDescriptor objects on the associated System.Data.Common.DbConnectionStringBuilder.
"ContainsKey method"	Determines whether the SAConnectionStringBuilder object contains a specific keyword.
EquivalentTo method (Inherited from System.Data.Common.DbConnectionStringBuilder)	Compares the connection information in this System.Data.Common.DbConnectionStringBuilder object with the connection information in the supplied object.
"GetKeyword method"	Gets the keyword for specified SAConnectionStringBuilder property.
GetProperties method (Inherited from System.Data.Common.DbConnectionStringBuilder)	Fills a supplied System.Collections.Hashtable with information about all the properties of this System.Data.Common.DbConnectionStringBuilder.
"GetUseLongNameAsKeyword method"	Gets a boolean values that indicates whether long connection parameter names are used in the connection string.
"Remove method"	Removes the entry with the specified key from the SAConnectionStringBuilder instance.
"SetUseLongNameAsKeyword method"	Sets a boolean value that indicates whether long connection parameter names are used in the connection string.
"ShouldSerialize method"	Indicates whether the specified key exists in this SAConnectionStringBuilder instance.
"ToString method"	Converts the TcpOptionsBuilder object to a string representation.

Name	Description
"TryGetValue method"	Retrieves a value corresponding to the supplied key from this SAConnectionStringBuilder.
"Broadcast property"	Gets or sets the Broadcast option.
"BroadcastListener property"	Gets or sets the BroadcastListener option.
BrowsableConnectionString property (Inherited from System.Data.Common.DbConnectionStringBuilder)	Gets or sets a value that indicates whether the System.Data.Common.DbConnectionStringBuilder.ConnectionString property is visible in Visual Studio designers.
"ClientPort property"	Gets or sets the ClientPort option.
ConnectionString property (Inherited from System.Data.Common.DbConnectionStringBuilder)	Gets or sets the connection string associated with the System.Data.Common.DbConnectionStringBuilder.
Count property (Inherited from System.Data.Common.DbConnectionStringBuilder)	Gets the current number of keys that are contained within the System.Data.Common.DbConnectionStringBuilder.ConnectionString property.
"DoBroadcast property"	Gets or sets the DoBroadcast option.
"Host property"	Gets or sets the Host option.
"IPV6 property"	Gets or sets the IPV6 option.
IsFixedSize property (Inherited from System.Data.Common.DbConnectionStringBuilder)	Gets a value that indicates whether the System.Data.Common.DbConnectionStringBuilder has a fixed size.
IsReadOnly property (Inherited from System.Data.Common.DbConnectionStringBuilder)	Gets a value that indicates whether the System.Data.Common.DbConnectionStringBuilder is read-only.
"Keys property"	Gets an System.Collections.ICollection that contains the keys in the SAConnectionStringBuilder.
"LDAP property"	Gets or sets the LDAP option.
"LocalOnly property"	Gets or sets the LocalOnly option.
"MyIP property"	Gets or sets the MyIP option.
"ReceiveBufferSize property"	Gets or sets the ReceiveBufferSize option.

Name	Description
"SendBufferSize property"	Gets or sets the Send BufferSize option.
"ServerPort property"	Gets or sets the ServerPort option.
"TDS property"	Gets or sets the TDS option.
"this property"	Gets or sets the value of the connection keyword.
"Timeout property"	Gets or sets the Timeout option.
Values property (Inherited from System.Data.Common.DbConnectionStringBuilder)	Gets an System.Collections.ICollection that contains the values in the System.Data.Common.DbConnectionStringBuilder.
"VerifyServerName property"	Gets or sets the VerifyServerName option.

Remarks

The SATcpOptionsBuilder class is not available in the .NET Compact Framework 2.0.

See also

- "SAConnection class" on page 156

SATcpOptionsBuilder constructor

Initializes an SATcpOptionsBuilder object.

Overload list

Name	Description
"SATcpOptionsBuilder() constructor"	Initializes an SATcpOptionsBuilder object.
"SATcpOptionsBuilder(string) constructor"	Initializes an SATcpOptionsBuilder object.

SATcpOptionsBuilder() constructor

Initializes an SATcpOptionsBuilder object.

Visual Basic syntax

```
Public Sub New()
```

C# syntax

```
public SATcpOptionsBuilder()
```

Remarks

The SATcpOptionsBuilder class is not available in the .NET Compact Framework 2.0.

Example

The following statement initializes an SATcpOptionsBuilder object.

```
SATcpOptionsBuilder options = new SATcpOptionsBuilder( );
```

SATcpOptionsBuilder(string) constructor

Initializes an SATcpOptionsBuilder object.

Visual Basic syntax

```
Public Sub New(ByVal options As String)
```

C# syntax

```
public SATcpOptionsBuilder(string options)
```

Parameters

- **options** A SQL Anywhere TCP connection parameter options string. For a list of connection parameters, see "Connection parameters" [*SQL Anywhere Server - Database Administration*].

Remarks

The SATcpOptionsBuilder class is not available in the .NET Compact Framework 2.0.

Example

The following statement initializes an SATcpOptionsBuilder object.

```
SATcpOptionsBuilder options = new SATcpOptionsBuilder( );
```

ToString method

Converts the TcpOptionsBuilder object to a string representation.

Visual Basic syntax

```
Public Overrides Function ToString() As String
```

C# syntax

```
public override string ToString()
```

Returns

The options string being built.

Broadcast property

Gets or sets the Broadcast option.

Visual Basic syntax

```
Public Property Broadcast As String
```

C# syntax

```
public string Broadcast {get;set;}
```

BroadcastListener property

Gets or sets the BroadcastListener option.

Visual Basic syntax

```
Public Property BroadcastListener As String
```

C# syntax

```
public string BroadcastListener {get;set;}
```

ClientPort property

Gets or sets the ClientPort option.

Visual Basic syntax

```
Public Property ClientPort As String
```

C# syntax

```
public string ClientPort {get;set;}
```

DoBroadcast property

Gets or sets the DoBroadcast option.

Visual Basic syntax

```
Public Property DoBroadcast As String
```

C# syntax

```
public string DoBroadcast {get;set;}
```

Host property

Gets or sets the Host option.

Visual Basic syntax

```
Public Property Host As String
```

C# syntax

```
public string Host {get;set;}
```

IPV6 property

Gets or sets the IPV6 option.

Visual Basic syntax

```
Public Property IPV6 As String
```

C# syntax

```
public string IPV6 {get;set;}
```

LDAP property

Gets or sets the LDAP option.

Visual Basic syntax

```
Public Property LDAP As String
```

C# syntax

```
public string LDAP {get;set;}
```

LocalOnly property

Gets or sets the LocalOnly option.

Visual Basic syntax

```
Public Property LocalOnly As String
```

C# syntax

```
public string LocalOnly {get;set;}
```

MyIP property

Gets or sets the MyIP option.

Visual Basic syntax

```
Public Property MyIP As String
```

C# syntax

```
public string MyIP {get;set;}
```

ReceiveBufferSize property

Gets or sets the ReceiveBufferSize option.

Visual Basic syntax

```
Public Property ReceiveBufferSize As Integer
```

C# syntax

```
public int ReceiveBufferSize {get;set;}
```

SendBufferSize property

Gets or sets the Send BufferSize option.

Visual Basic syntax

```
Public Property SendBufferSize As Integer
```

C# syntax

```
public int SendBufferSize {get;set;}
```

ServerPort property

Gets or sets the ServerPort option.

Visual Basic syntax

```
Public Property ServerPort As String
```

C# syntax

```
public string ServerPort {get;set;}
```

TDS property

Gets or sets the TDS option.

Visual Basic syntax

```
Public Property TDS As String
```

C# syntax

```
public string TDS {get;set;}
```

Timeout property

Gets or sets the Timeout option.

Visual Basic syntax

```
Public Property Timeout As Integer
```

C# syntax

```
public int Timeout {get;set;}
```

VerifyServerName property

Gets or sets the VerifyServerName option.

Visual Basic syntax

```
Public Property VerifyServerName As String
```

C# syntax

```
public string VerifyServerName {get;set;}
```

SATransaction class

Represents a SQL transaction.

Visual Basic syntax

```
Public NotInheritable Class SATransaction
    Inherits System.Data.Common.DbTransaction
```

C# syntax

```
public sealed class SATransaction : System.Data.Common.DbTransaction
```

Base classes

- System.Data.Common.DbTransaction

Members

All members of SATransaction class, including all inherited members.

Name	Description
"Commit method"	Commits the database transaction.
Dispose method (Inherited from System.Data.Common.DbTransaction)	Releases the unmanaged resources used by the System.Data.Common.DbTransaction.
"Rollback method"	Rolls back a transaction from a pending state.
"Save method"	Creates a savepoint in the transaction that can be used to roll back a portion of the transaction, and specifies the savepoint name.
"Connection property"	The SAConnection object associated with the transaction, or a null reference (Nothing in Visual Basic) if the transaction is no longer valid.
"IsolationLevel property"	Specifies the isolation level for this transaction.
"SAIsolationLevel property"	Specifies the isolation level for this transaction.

Remarks

There is no constructor for SATransaction. To obtain an SATransaction object, use one of the BeginTransaction methods. To associate a command with a transaction, use the SACommand.Transaction property.

For more information, see "Transaction processing" on page 64 and "Inserting, updating, and deleting rows using the SACommand object" on page 49.

See also

- "BeginTransaction method" on page 159
- "Transaction property" on page 139

Commit method

Commits the database transaction.

Visual Basic syntax

```
Public Overrides Sub Commit()
```

C# syntax

```
public override void Commit()
```

Rollback method

Rolls back a transaction from a pending state.

Overload list

Name	Description
"Rollback() method"	Rolls back a transaction from a pending state.
"Rollback(string) method"	Rolls back a transaction from a pending state.

Rollback() method

Rolls back a transaction from a pending state.

Visual Basic syntax

```
Public Overrides Sub Rollback()
```

C# syntax

```
public override void Rollback()
```

Remarks

The transaction can only be rolled back from a pending state (after BeginTransaction has been called, but before Commit is called).

Rollback(string) method

Rolls back a transaction from a pending state.

Visual Basic syntax

```
Public Sub Rollback(ByVal savePoint As String)
```

C# syntax

```
public void Rollback(string savePoint)
```

Parameters

- **savePoint** The name of the savepoint to roll back to.

Remarks

The transaction can only be rolled back from a pending state (after BeginTransaction has been called, but before Commit is called).

Save method

Creates a savepoint in the transaction that can be used to roll back a portion of the transaction, and specifies the savepoint name.

Visual Basic syntax

```
Public Sub Save(ByVal savePoint As String)
```

C# syntax

```
public void Save(string savePoint)
```

Parameters

- **savePoint** The name of the savepoint to which to roll back.

Connection property

The SAConnection object associated with the transaction, or a null reference (Nothing in Visual Basic) if the transaction is no longer valid.

Visual Basic syntax

```
Public ReadOnly Shadows Property Connection As SAConnection
```

C# syntax

```
public new SAConnection Connection {get;}
```

Remarks

A single application can have multiple database connections, each with zero or more transactions. This property enables you to determine the connection object associated with a particular transaction created by BeginTransaction.

IsolationLevel property

Specifies the isolation level for this transaction.

Visual Basic syntax

```
Public ReadOnly Overrides Property IsolationLevel As
System.Data.IsolationLevel
```

C# syntax

```
public override System.Data.IsolationLevel IsolationLevel {get;}
```

Remarks

The isolation level for this transaction. This can be one of:

- **ReadCommitted**
- **ReadUncommitted**
- **RepeatableRead**
- **Serializable**
- **Snapshot**
- **ReadOnlySnapshot**
- **StatementSnapshot**

The default is ReadCommitted.

SAIsolationLevel property

Specifies the isolation level for this transaction.

Visual Basic syntax

```
Public ReadOnly Property SAIsolationLevel As SAIsolationLevel
```

C# syntax

```
public SAIsolationLevel SAIsolationLevel {get;}
```

Remarks

The IsolationLevel for this transaction. This can be one of:

- **Chaos**
- Read **ReadCommitted**
- **ReadOnlySnapshot**
- **ReadUncommitted**
- **RepeatableRead**
- **Serializable**
- **Snapshot**

- **StatementSnapshot**
- **Unspecified**

The default is ReadCommitted.

Parallel transactions are not supported. Therefore, the IsolationLevel applies to the entire transaction.

SAInfoMessageEventHandler delegate

Represents the method that handles the SAConnection.InfoMessage event of an SAConnection object.

Visual Basic syntax

```
Public Delegate Sub SAInfoMessageEventHandler(
    ByVal obj As Object,
    ByVal args As SAInfoMessageEventArgs
)
```

C# syntax

```
public delegate void SAInfoMessageEventHandler(
    object obj,
    SAInfoMessageEventArgs args
);
```

See also

- "SAConnection class" on page 156
- "InfoMessage event" on page 177

SARowUpdatedEventHandler delegate

Represents the method that handles the RowUpdated event of an SADataAdapter.

Visual Basic syntax

```
Public Delegate Sub SARowUpdatedEventHandler(
    ByVal sender As Object,
    ByVal e As SARowUpdatedEventArgs
)
```

C# syntax

```
public delegate void SARowUpdatedEventHandler(
    object sender,
    SARowUpdatedEventArgs e
);
```

SARowUpdatingEventHandler delegate

Represents the method that handles the RowUpdating event of an SADataAdapter.

Visual Basic syntax

```
Public Delegate Sub SARowUpdatingEventHandler(
    ByVal sender As Object,
    ByVal e As SARowUpdatingEventArgs
)
```

C# syntax

```
public delegate void SARowUpdatingEventHandler(
    object sender,
    SARowUpdatingEventArgs e
);
```

SARowsCopiedEventHandler delegate

Represents the method that handles the SABulkCopy.SARowsCopied event of an SABulkCopy.

Visual Basic syntax

```
Public Delegate Sub SARowsCopiedEventHandler(
    ByVal sender As Object,
    ByVal rowsCopiedEventArgs As SARowsCopiedEventArgs
)
```

C# syntax

```
public delegate void SARowsCopiedEventHandler(
    object sender,
    SARowsCopiedEventArgs rowsCopiedEventArgs
);
```

Remarks

The SARowsCopiedEventHandler delegate is not available in the .NET Compact Framework 2.0.

See also

- "SABulkCopy class" on page 95

SABulkCopyOptions enumeration

A bitwise flag that specifies one or more options to use with an instance of SABulkCopy.

Visual Basic syntax

```
Public Enum SABulkCopyOptions
```


C# syntax

```
public enum SABulkCopyOptions
```

Members

Member name	Description	Value
Default	Specifying only this value causes the default behavior to be used. By default, triggers are enabled.	0x0
DoNotFireTriggers	When specified, triggers are not fired. Disabling triggers requires DBA permission. Triggers are disabled for the connection at the start of WriteToServer and the value is restored at the end of the method.	0x1
KeepIdentity	When specified, the source values to be copied into an identity column are preserved. By default, new identity values are generated in the destination table.	0x2
TableLock	When specified the table is locked using the command LOCK TABLE table_name WITH HOLD IN SHARE MODE. This lock is in place until the connection is closed.	0x4
UseInternalTransaction	When specified, each batch of the bulk-copy operation is executed within a transaction. When not specified, transaction aren't used. If you indicate this option and also provide an SATransaction object to the constructor, a System.ArgumentException occurs.	0x8

Remarks

The SABulkCopyOptions enumeration is used when you construct an SABulkCopy object to specify how the WriteToServer methods will behave.

The SABulkCopyOptions class is not available in the .NET Compact Framework 2.0.

The CheckConstraints and KeepNulls options are not supported.

See also

- "SABulkCopy class" on page 95

SADbType enumeration

Enumerates the SQL Anywhere .NET database data types.

Visual Basic syntax

```
Public Enum SADbType
```

C# syntax

```
public enum SADbType
```

Members

Member name	Description
BigInt	Signed 64-bit integer.
Binary	Binary data, with a specified maximum length. The enumeration values Binary and VarBinary are aliases of each other.
Bit	1-bit flag.
Char	Character data, with a specified length. This type always supports Unicode characters. The types Char and VarChar are fully compatible.
Date	Date information.
DateTime	Timestamp information (date, time). The enumeration values DateTime and TimeStamp are aliases of each other.
DateTi-meOffset	Timestamp information (date, time) offset.
Decimal	Exact numerical data, with a specified precision and scale. The enumeration values Decimal and Numeric are aliases of each other.
Double	Double-precision floating-point number (8 bytes).
Float	Single-precision floating-point number (4 bytes). The enumeration values Float and Real are aliases of each other.
Image	Stores binary data of arbitrary length.
Integer	Unsigned 32-bit integer.
LongBinary	Binary data, with variable length.

Member name	Description
Long-NVarchar	Character data in the NCHAR character set, with variable length. This type always supports Unicode characters.
LongVarbit	Bit arrays, with variable length.
LongVarchar	Character data, with variable length. This type always supports Unicode characters.
Money	Monetary data.
NChar	Stores Unicode character data, up to 32767 characters.
NText	Stores Unicode character data of arbitrary length.
Numeric	Exact numerical data, with a specified precision and scale. The enumeration values Decimal and Numeric are aliases of each other.
NVarChar	Stores Unicode character data, up to 32767 characters.
Real	Single-precision floating-point number (4 bytes). The enumeration values Float and Real are aliases of each other.
SmallDate-Time	A domain, implemented as TIMESTAMP.
SmallInt	Signed 16-bit integer.
SmallMoney	Stores monetary data that is less than one million currency units.
SysName	Stores character data of arbitrary length.
Text	Stores character data of arbitrary length.
Time	Time information.
TimeStamp	Timestamp information (date, time). The enumeration values DateTime and TimeStamp are aliases of each other.
TimeStamp-WithTime-Zone	Timestamp information (date, time, time zone). The enumeration values DateTime and TimeStamp are aliases of each other.

Member name	Description
TinyInt	Unsigned 8-bit integer.
UniqueIdentifier	Universally Unique Identifier (UUID/GUID).
UniqueIdentifierStr	A domain, implemented as CHAR(36). UniqueIdentifierStr is used for remote data access when mapping Microsoft SQL Server uniqueidentifier columns.
UnsignedBigInt	Unsigned 64-bit integer.
UnsignedInt	Unsigned 32-bit integer.
UnsignedSmallInt	Unsigned 16-bit integer.
VarBinary	Binary data, with a specified maximum length. The enumeration values **Binary** and **VarBinary** are aliases of each other.
VarBit	Bit arrays that are from 1 to 32767 bits in length.
VarChar	Character data, with a specified maximum length. This type always supports Unicode characters. The types Char and VarChar are fully compatible.
Xml	XML data. This type stores character data of arbitrary length, and is used to store XML documents.

Remarks

The table below lists which .NET types are compatible with each SADbType. In the case of integral types, table columns can always be set using smaller integer types, but can also be set using larger types as long as the actual value is within the range of the type.

SADbType	Compatible .NET type	C# built-in type	Visual Basic built-in type
BigInt	System.Int64	long	Long
Binary, VarBinary	System.Byte[], or System.Guid if size is 16	byte[]	Byte()

SADbType	Compatible .NET type	C# built-in type	Visual Basic built-in type
Bit	System.Boolean	bool	Boolean
Char, VarChar	System.String	String	String
Date	System.DateTime	DateTime (no built-in type)	Date
DateTime, TimeStamp	System.DateTime	DateTime (no built-in type)	DateTime
DateTimeOffset, DateTimeOffset	System.DateTimeOffset	DateTimeOffset (no built-in type)	DateTimeOffset
Decimal, Numeric	System.String	decimal	Decimal
Double	System.Double	double	Double
Float, Real	System.Single	float	Single
Image	System.Byte[]	byte[]	Byte()
Integer	System.Int32	int	Integer
LongBinary	System.Byte[]	byte[]	Byte()
LongNVarChar	System.String	String	String
LongVarChar	System.String	String	String
Money	System.String	decimal	Decimal
NChar	System.String	String	String
NText	System.String	String	String
Numeric	System.String	decimal	Decimal
NVarChar	System.String	String	String
SmallDateTime	System.DateTime	DateTime (no built-in type)	Date
SmallInt	System.Int16	short	Short
SmallMoney	System.String	decimal	Decimal
SysName	System.String	String	String

SADbType	Compatible .NET type	C# built-in type	Visual Basic built-in type
Text	System.String	String	String
Time	System.TimeSpan	TimeSpan (no built-in type)	TimeSpan (no built-in type)
TimeStamp	System.DateTime	DateTime (no built-in type)	Date
TimeStampWithTime-Zone	System.DateTimeOffset	DateTimeOffset (no built-in type)	DateTimeOffset
TinyInt	System.Byte	byte	Byte
UniqueIdentifier	System.Guid	Guid (no built-in type)	Guid (no built-in type)
UniqueIdentifierStr	System.String	String	String
UnsignedBigInt	System.UInt64	ulong	UInt64 (no built-in type)
UnsignedInt	System.UInt32	uint	UInt64 (no built-in type)
UnsignedSmallInt	System.UInt16	ushort	UInt64 (no built-in type)
Xml	System.Xml	String	String

Binary columns of length 16 are fully compatible with the UniqueIdentifier type.

See also

- "GetFieldType method" on page 223
- "GetDataTypeName method" on page 220

SAIsolationLevel enumeration

Specifies SQL Anywhere isolation levels.

Visual Basic syntax

```
Public Enum SAIsolationLevel
```

C# syntax

```
public enum SAIsolationLevel
```


Members

Member name	Description
Chaos	This isolation level is unsupported. If you call SAConnection.BeginTransaction with this isolation level, an exception is thrown. For more information, see "BeginTransaction method" on page 159.
ReadCommitted	Sets the behavior to be equivalent to isolation level 1. This isolation level prevents dirty reads, but allows non-repeatable reads and phantom rows. For more information, see "Isolation levels and consistency" [*SQL Anywhere Server - SQL Usage*].
ReadUncommitted	Sets the behavior to be equivalent to isolation level 0. This isolation level allows dirty reads, non-repeatable reads, and phantom rows. For more information, see "Isolation levels and consistency" [*SQL Anywhere Server - SQL Usage*].
RepeatableRead	Sets the behavior to be equivalent to isolation level 2. This isolation level prevents dirty reads and guarantees repeatable reads. However, it allows phantom rows. For more information, see "Isolation levels and consistency" [*SQL Anywhere Server - SQL Usage*].
Serializable	Sets the behavior to be equivalent to isolation level 3. This isolation level prevents dirty reads, guarantees repeatable reads, and prevents phantom rows. For more information, see "Isolation levels and consistency" [*SQL Anywhere Server - SQL Usage*].
Snapshot	Uses a snapshot of committed data from the time when the first row is read, inserted, updated, or deleted by the transaction. This isolation level uses a snapshot of committed data from the time when the first row is read or updated by the transaction. For more information, see "Isolation levels and consistency" [*SQL Anywhere Server - SQL Usage*].

Member name	Description
Unspecified	This isolation level is unsupported. If you call SAConnection.BeginTransaction with this isolation level, an exception is thrown. For more information, see "BeginTransaction method" on page 159.
ReadOnlySnapshot	For read-only statements, use a snapshot of committed data from the time when the first row is read from the database. Non-repeatable reads and phantom rows can occur within a transaction, but not within a single statement. For updatable statements, use the isolation level specified by the updatable_statement_isolation option (can be one of 0 (the default), 1, 2, or 3). For more information, see "Isolation levels and consistency" [*SQL Anywhere Server - SQL Usage*].
StatementSnapshot	Use a snapshot of committed data from the time when the first row is read by the statement. Each statement within the transaction sees a snapshot of data from a different time. For each statement, use a snapshot of committed data from the time when the first row is read from the database. Non-repeatable reads and phantom rows can occur within a transaction, but not within a single statement. For more information, see "Isolation levels and consistency" [*SQL Anywhere Server - SQL Usage*].

Remarks

This class augments the System.Data.IsolationLevel class.

The SQL Anywhere .NET Data Provider supports all SQL Anywhere isolation levels, including the snapshot isolation levels. To use snapshot isolation, specify one of SAIsolationLevel.Snapshot, SAIsolationLevel.ReadOnlySnapshot, or SAIsolationLevel.StatementSnapshot as the parameter to BeginTransaction. BeginTransaction has been overloaded so it can take either an IsolationLevel or an SAIsolationLevel. The values in the two enumerations are the same, except for ReadOnlySnapshot and StatementSnapshot which exist only in SAIsolationLevel. There is a new property in SATransaction called SAIsolationLevel that gets the SAIsolationLevel.

For more information, see "Snapshot isolation" [*SQL Anywhere Server - SQL Usage*].

SAMessageType enumeration

Identifies the type of message.

Visual Basic syntax

```
Public Enum SAMessageType
```

C# syntax

```
public enum SAMessageType
```

Members

Member name	Description	Value
Action	Message of type ACTION.	2
Info	Message of type INFO.	0
Status	Message of type STATUS.	3
Warning	Message of type WARNING.	1

Remarks

This can be one of: Action, Info, Status, or Warning.

OLE DB and ADO development

SQL Anywhere includes an OLE DB provider for OLE DB and ADO.

OLE DB is a set of Component Object Model (COM) interfaces developed by Microsoft, which provide applications with uniform access to data stored in diverse information sources and that also provide the ability to implement additional database services. These interfaces support the amount of DBMS functionality appropriate to the data store, enabling it to share its data.

ADO is an object model for programmatically accessing, editing, and updating a wide variety of data sources through OLE DB system interfaces. ADO is also developed by Microsoft. Most developers using the OLE DB programming interface do so by writing to the ADO API rather than directly to the OLE DB API.

Do not confuse the ADO interface with ADO.NET. ADO.NET is a separate interface. For more information, see "SQL Anywhere .NET support" on page 39.

Refer to the Microsoft Developer Network for documentation on OLE DB and ADO programming. For SQL Anywhere-specific information about OLE DB and ADO development, use this document.

Introduction to OLE DB

OLE DB is a data access model from Microsoft. It uses the Component Object Model (COM) interfaces and, unlike ODBC, OLE DB does not assume that the data source uses a SQL query processor.

SQL Anywhere includes an **OLE DB provider** named **SAOLEDB**. This provider is available for current Windows platforms. The provider is not available for Windows Mobile platforms.

You can also access SQL Anywhere using the Microsoft OLE DB Provider for ODBC (MSDASQL), together with the SQL Anywhere ODBC driver.

Using the SQL Anywhere OLE DB provider brings several benefits:

- Some features, such as updating through a cursor, are not available using the OLE DB/ODBC bridge.
- If you use the SQL Anywhere OLE DB provider, ODBC is not required in your deployment.
- MSDASQL allows OLE DB clients to work with any ODBC driver, but does not guarantee that you can use the full range of functionality of each ODBC driver. Using the SQL Anywhere provider, you can get full access to SQL Anywhere features from OLE DB programming environments.

Supported platforms

The SQL Anywhere OLE DB provider is designed to work with Microsoft Data Access Components (MDAC) 2.8 and later versions.

For a list of supported platforms, see http://www.sybase.com/detail?id=1061806.

Distributed transactions

The OLE DB driver can be used as a resource manager in a distributed transaction environment.

For more information, see "Three-tier computing and distributed transactions" on page 857.

ADO programming with SQL Anywhere

ADO (ActiveX Data Objects) is a data access object model exposed through an Automation interface, which allows client applications to discover the methods and properties of objects at runtime without any prior knowledge of the object. Automation allows scripting languages like Visual Basic to use a standard data access object model. ADO uses OLE DB to provide data access.

Using the SQL Anywhere OLE DB provider, you get full access to SQL Anywhere features from an ADO programming environment.

This section describes how to perform basic tasks while using ADO from Visual Basic. It is not a complete guide to programming using ADO.

Code samples from this section can be found in the *samples-dir\SQLAnywhere\VBSampler\vbsampler.sln* project file.

For information about programming in ADO, see your development tool documentation.

Connecting to a database with the Connection object

This section describes a simple Visual Basic routine that connects to a database.

Sample code

You can try this routine by placing a command button named Command1 on a form, and pasting the routine into its Click event. Run the program and click the button to connect and then disconnect.

```
Private Sub cmdTestConnection_Click( _
        ByVal eventSender As System.Object, _
        ByVal eventArgs As System.EventArgs) _
        Handles cmdTestConnection.Click

    ' Declare variables
    Dim myConn As New ADODB.Connection
    Dim myCommand As New ADODB.Command
    Dim cAffected As Integer

    On Error GoTo HandleError

    ' Establish the connection
    myConn.Provider = "SAOLEDB"
```



```
        myConn.ConnectionString = _
            "Data Source=SQL Anywhere 12 Demo"
        myConn.Open()
        MsgBox("Connection succeeded")
        myConn.Close()
        Exit Sub

    HandleError:
        MsgBox(ErrorToString(Err.Number))
        Exit Sub
    End Sub
```

Notes

The sample carries out the following tasks:

- It declares the variables used in the routine.
- It establishes a connection, using the SQL Anywhere OLE DB provider, to the sample database.
- It uses a Command object to execute a simple statement, which displays a message in the database server messages window.
- It closes the connection.

Register the OLE DB provider

When the SAOLEDB provider is installed, it registers itself. This registration process includes making registry entries in the COM section of the registry, so that ADO can locate the DLL when the SAOLEDB provider is called. If you change the location of your DLL, you must re-register it.

To register the OLE DB provider

1. Open a command prompt.
2. Change to the directory where the OLE DB provider is installed.
3. Enter the following commands to register the provider:

```
regsvr32 dboledb12.dll
regsvr32 dboledba12.dll
```

For more information about connecting to a database using OLE DB, see "Connecting to a database using OLE DB" [*SQL Anywhere Server - Database Administration*].

Executing statements with the Command object

This section describes a simple routine that sends a simple SQL statement to the database.

Sample code

You can try this routine by placing a command button named Command2 on a form, and pasting the routine into its Click event. Run the program and click the button to connect, display a message in the database server messages window, and then disconnect.

```
Private Sub cmdUpdate_Click( _
        ByVal eventSender As System.Object, _
        ByVal eventArgs As System.EventArgs) _
        Handles cmdUpdate.Click

    ' Declare variables
    Dim myConn As New ADODB.Connection
    Dim myCommand As New ADODB.Command
    Dim cAffected As Integer

    On Error GoTo HandleError

    ' Establish the connection
    myConn.Provider = "SAOLEDB"
    myConn.ConnectionString = _
        "Data Source=SQL Anywhere 12 Demo"
    myConn.Open()

    'Execute a command
    myCommand.CommandText = _
        "UPDATE Customers SET GivenName='Liz' WHERE ID=102"
    myCommand.ActiveConnection = myConn
    myCommand.Execute(cAffected)
    MsgBox(CStr(cAffected) & " rows affected.", _
        MsgBoxStyle.Information)

    myConn.Close()
    Exit Sub

HandleError:
    MsgBox(ErrorToString(Err.Number))
    Exit Sub
End Sub
```

Notes

After establishing a connection, the example code creates a Command object, sets its CommandText property to an update statement, and sets its ActiveConnection property to the current connection. It then executes the update statement and displays the number of rows affected by the update in a window.

In this example, the update is sent to the database and committed when it is executed.

For information about using transactions within ADO, see "Using transactions" on page 333.

You can also perform updates through a cursor.

For more information, see "Updating data through a cursor" on page 332.

Querying the database with the Recordset object

The ADO Recordset object represents the result set of a query. You can use it to view data from a database.

Sample code

You can try this routine by placing a command button named cmdQuery on a form and pasting the routine into its Click event. Run the program and click the button to connect, display a message in the database server messages window, execute a query and display the first few rows in windows, and then disconnect.


```
Private Sub cmdQuery_Click( _
        ByVal eventSender As System.Object, _
        ByVal eventArgs As System.EventArgs) _
        Handles cmdQuery.Click

    ' Declare variables
    Dim i As Integer
    Dim myConn As New ADODB.Connection
    Dim myCommand As New ADODB.Command
    Dim myRS As New ADODB.Recordset

    On Error GoTo ErrorHandler

    ' Establish the connection
    myConn.Provider = "SAOLEDB"
    myConn.ConnectionString = _
        "Data Source=SQL Anywhere 12 Demo"
    myConn.CursorLocation = _
        ADODB.CursorLocationEnum.adUseServer
    myConn.Mode = _
        ADODB.ConnectModeEnum.adModeReadWrite
    myConn.IsolationLevel = _
        ADODB.IsolationLevelEnum.adXactCursorStability
    myConn.Open()

    'Execute a query
    myRS = New ADODB.Recordset
    myRS.CacheSize = 50
    myRS.let_Source("SELECT * FROM Customers")
    myRS.let_ActiveConnection(myConn)
    myRS.CursorType = ADODB.CursorTypeEnum.adOpenKeyset
    myRS.LockType = ADODB.LockTypeEnum.adLockOptimistic
    myRS.Open()

    'Scroll through the first few results
    myRS.MoveFirst()
    For i = 1 To 5
        MsgBox(myRS.Fields("CompanyName").Value, _
            MsgBoxStyle.Information)
        myRS.MoveNext()
    Next

    myRS.Close()
    myConn.Close()
    Exit Sub

ErrorHandler:
    MsgBox(ErrorToString(Err.Number))
    Exit Sub
End Sub
```

Notes

The Recordset object in this example holds the results from a query on the Customers table. The For loop scrolls through the first several rows and displays the CompanyName value for each row.

This is a simple example of using a cursor from ADO.

For more advanced examples of using a cursor from ADO, see "Working with the Recordset object" on page 332.

Working with the Recordset object

When working with SQL Anywhere, the ADO Recordset represents a cursor. You can choose the type of cursor by declaring a CursorType property of the Recordset object before you open the Recordset. The choice of cursor type controls the actions you can take on the Recordset and has performance implications.

Cursor types

ADO has its own naming convention for cursor types. The set of cursor types supported by SQL Anywhere is described in "Cursor properties" on page 15.

The available cursor types, the corresponding cursor type constants, and the SQL Anywhere types they are equivalent to, are as follows:

ADO cursor type	ADO constant	SQL Anywhere type
Dynamic cursor	adOpenDynamic	Dynamic scroll cursor
Keyset cursor	adOpenKeyset	Scroll cursor
Static cursor	adOpenStatic	Insensitive cursor
Forward only	adOpenForwardOnly	No-scroll cursor

For information about choosing a cursor type that is suitable for your application, see "Choosing cursor types" on page 14.

Sample code

The following code sets the cursor type for an ADO Recordset object:

```
Dim myRS As New ADODB.Recordset
myRS.CursorType = ADODB.CursorTypeEnum.adOpenDynamic
```

Updating data through a cursor

The SQL Anywhere OLE DB provider lets you update a result set through a cursor. This capability is not available through the MSDASQL provider.

Updating record sets

You can update the database through a Recordset.

```
Private Sub cmdUpdateThroughCursor_Click( _
        ByVal eventSender As System.Object, _
        ByVal eventArgs As System.EventArgs) _
        Handles cmdUpdateThroughCursor.Click

    ' Declare variables
    Dim i As Integer
    Dim myConn As New ADODB.Connection
```



```
    Dim myRS As New ADODB.Recordset
    Dim SQLString As String

    On Error GoTo HandleError

    ' Connect
    myConn.Provider = "SAOLEDB"
    myConn.ConnectionString = _
        "Data Source=SQL Anywhere 12 Demo"
    myConn.Open()
    myConn.BeginTrans()
    SQLString = "SELECT * FROM Customers"
    myRS.Open(SQLString, myConn, _
        ADODB.CursorTypeEnum.adOpenDynamic, _
        ADODB.LockTypeEnum.adLockBatchOptimistic)

    If myRS.BOF And myRS.EOF Then
        MsgBox("Recordset is empty!", 16, "Empty Recordset")
    Else
        MsgBox("Cursor type: " & CStr(myRS.CursorType), _
            MsgBoxStyle.Information)
        myRS.MoveFirst()
        For i = 1 To 3
            MsgBox("Row: " & CStr(myRS.Fields("ID").Value), _
                MsgBoxStyle.Information)
            If i = 2 Then
                myRS.Update("City", "Toronto")
                myRS.UpdateBatch()
            End If
            myRS.MoveNext()
        Next i
        myRS.Close()
    End If
    myConn.CommitTrans()
    myConn.Close()
    Exit Sub

HandleError:
    MsgBox(ErrorToString(Err.Number))
    Exit Sub

End Sub
```

Notes

If you use the adLockBatchOptimistic setting on the Recordset, the myRS.Update method does not make any changes to the database itself. Instead, it updates a local copy of the Recordset.

The myRS.UpdateBatch method makes the update to the database server, but does not commit it, because it is inside a transaction. If an UpdateBatch method was invoked outside a transaction, the change would be committed.

The myConn.CommitTrans method commits the changes. The Recordset object has been closed by this time, so there is no issue of whether the local copy of the data is changed or not.

Using transactions

By default, any change you make to the database using ADO is committed when it is executed. This includes explicit updates, and the UpdateBatch method on a Recordset. However, the previous section illustrated that you can use the BeginTrans and RollbackTrans or CommitTrans methods on the Connection object to use transactions.

The transaction isolation level is set as a property of the Connection object. The IsolationLevel property can take on one of the following values:

ADO isolation level	Constant	SQL Anywhere level
Unspecified	adXactUnspecified	Not applicable. Set to 0
Chaos	adXactChaos	Unsupported. Set to 0
Browse	adXactBrowse	0
Read uncommitted	adXactReadUncommitted	0
Cursor stability	adXactCursorStability	1
Read committed	adXactReadCommitted	1
Repeatable read	adXactRepeatableRead	2
Isolated	adXactIsolated	3
Serializable	adXactSerializable	3
Snapshot	2097152	4
Statement snapshot	4194304	5
Readonly statement snapshot	8388608	6

For more information about isolation levels, see "Isolation levels and consistency" [*SQL Anywhere Server - SQL Usage*].

OLE DB Connection Pooling

You should note that the .NET Framework Data Provider for OLE DB automatically pools connections using OLE DB session pooling. When the application closes the connection, it is not actually closed. Instead, the connection is held for a period of time. When your application re-opens a connection, ADO/OLE DB recognizes that the application is using an identical connection string and reuses the open connection. For example, if the application does an Open/Execute/Close 100 times, there is only 1 actual open and 1 actual close. The final close occurs after about 1 minute of idle time.

If a connection is terminated by external means (such as a forced disconnect using an administrative tool such as Sybase Central), ADO/OLE DB does not know that this has occurred until the next interaction with the server. Caution should be exercised before resorting to forcible disconnects.

For more on ADO connection pooling, refer to SQL Server Connection Pooling (ADO.NET). Also see Overriding Provider Service Defaults and OLE DB, ODBC, and Oracle Connection Pooling (ADO.NET).

The flag that controls connection pooling is DBPROPVAL_OS_RESOURCEPOOLING (1). This flag can be turned off using a connection parameter in the connection string.

If you specify **OLE DB Services=-2** in your connection string, then connection pooling is disabled. Here is a sample connect string:

```
Provider=SAOLEDB;OLE DB Services=-2;...
```

If you specify **OLE DB Services=-4** in your connection string, then connection pooling and transaction enlistment are disabled. Here is a sample connect string:

```
Provider=SAOLEDB;OLE DB Services=-4;...
```

Note that if you disable connection pooling, there will be a performance penalty if your application frequently opens/closes connections using the same connect string.

Setting up a Microsoft Linked Server using OLE DB

A Microsoft Linked Server can be created that uses the SQL Anywhere OLE DB provider to obtain access to a SQL Anywhere database. SQL queries can be issued using either the Microsoft 4-part table referencing syntax or the Microsoft OPENQUERY SQL function. An example of the 4-part syntax follows.

```
SELECT * FROM SADATABASE..GROUPO.Customers
```

In this example, SADATABASE is the name of the Linked Server, GROUPO is the table owner in the SQL Anywhere database, and Customers is the table name in the SQL Anywhere database. The catalog name is omitted (as indicated by two consecutive dots) since catalog names are not a feature of SQL Anywhere databases.

The other form uses the Microsoft OPENQUERY function.

```
SELECT * FROM OPENQUERY( SADATABASE, 'SELECT * FROM Customers' )
```

In the OPENQUERY syntax, the second SELECT statement ('SELECT * FROM Customers') is passed to the SQL Anywhere server for execution.

You can set up a Linked Server that uses the SQL Anywhere OLE DB provider using a Microsoft SQL Server interactive application or a SQL Server script.

To set up a Linked Server interactively

1. For Microsoft SQL Server 2005, start Microsoft SQL Server Management Studio. For other versions of SQL Server, the name of this application and the steps to setting up a Linked Server may vary.

In the **Object Explorer** pane, drill down to **Server Objects** » **Linked Servers** in the tree view. Right-click in the **Linked Servers** area and select **New Linked Server**.

2. Fill in the **General** page.

   The **Linked Server** field on the **General** page should contain a **Linked Server** name (like SADATABASE used above). The **Other Data Source** option should be chosen, and SQL Anywhere OLE DB Provider 12 should be chosen from the list. The **Product Name** field can be anything you like (for example, SQL Anywhere). The **Data Source** field should contain an ODBC data source name (for example, SQL Anywhere 12 Demo). The **Provider String** field can contain additional connection parameters such as **DATABASEFILE** (**DBF**). Other fields, such as **Location**, on the **General** page should be left empty.

3. Instead of specifying the database password as a connection parameter in the **Provider String** field where it would be exposed in plain text, you can fill in the **Security** page.

   In SQL Server 2005, choose the **Be made using this security context** option and fill in the **Remote login** and **With password** fields (the password is displayed as asterisks).

4. Choose the **RPC** and **RPC Out** options.

   The technique for doing this varies with different versions of Microsoft SQL Server. In SQL Server 2000, there are two checkboxes that must be checked for these two options. These check boxes are found on the **Server Options** page. In SQL Server 2005, the options are True/False settings. Make sure that they are set True. The **Remote Procedure Call** (**RPC**) options must be set if you want to execute stored procedure/function calls in a SQL Anywhere database and pass parameters in and out successfully.

5. Choose the **Allow Inprocess** provider option.

   The technique for doing this varies with different versions of Microsoft SQL Server. In SQL Server 2000, there is a **Provider Options** button that takes you to the page where you can choose this option. For SQL Server 2005, right-click the SAOLEDB.12 provider in the **Linked Servers** » **Providers** tree view and choose **Properties**. Make sure the **Allow Inprocess** checkbox is selected. If the **Inprocess** option is not selected, queries fail.

To set up a Linked Server using a script

- A Linked Server may be set up using a SQL Server script similar to the following. Make the appropriate changes to the script before running it under SQL Server. You should select a new Linked Server name (SADATABASE is used in the example), a data source name (SQL Anywhere 12 Demo is used in the example), and a remote user ID and password.

```
USE [master]
GO
EXEC master.dbo.sp_addlinkedserver @server=N'SADATABASE',
     @srvproduct=N'SQL Anywhere', @provider=N'SAOLEDB.12',
     @datasrc=N'SQL Anywhere 12 Demo'
GO
EXEC master.dbo.sp_serveroption @server=N'SADATABASE',
     @optname=N'rpc', @optvalue=N'true'
GO
```



```
EXEC master.dbo.sp_serveroption @server=N'SADATABASE',
     @optname=N'rpc out', @optvalue=N'true'
GO
-- Set remote login
EXEC master.dbo.sp_addlinkedsrvlogin @rmtsrvname = N'SADATABASE',
     @locallogin = NULL , @useself = N'False',
     @rmtuser = N'DBA', @rmtpassword = N'sql'
GO
-- Set global provider "allow in process" flag
EXEC master.dbo.sp_MSset_oledb_prop N'SAOLEDB.12', N'AllowInProcess', 1
```

Supported OLE DB interfaces

The OLE DB API consists of a set of interfaces. The following table describes the support for each interface in the SQL Anywhere OLE DB driver.

Interface	Purpose	Limitations
IAccessor	Define bindings between client memory and data store values.	DBACCESSOR_PASSBYREF not supported.DBACCESSOR_OPTIMIZED not supported.
IAlterIndex IAlterTable	Alter tables, indexes, and columns.	Not supported.
IChapteredRowset	A chaptered rowset allows rows of a rowset to be accessed in separate chapters.	Not supported. SQL Anywhere does not support chaptered rowsets.
IColumnsInfo	Get simple information about the columns in a rowset.	Supported.
IColumnsRowset	Get information about optional metadata columns in a rowset, and get a rowset of column metadata.	Supported.
ICommand	Execute SQL statements.	Does not support calling. ICommandProperties: GetProperties with DBPROPSET_PROPERTIESINERROR to find properties that could not have been set.

Interface	Purpose	Limitations
ICommandPersist	Persist the state of a command object (but not any active rowsets). These persistent command objects can subsequently be enumerated using the PROCEDURES or VIEWS rowset.	Supported.
ICommandPrepare	Prepare commands.	Supported.
ICommandProperties	Set Rowset properties for rowsets created by a command. Most commonly used to specify the interfaces the rowset should support.	Supported.
ICommandText	Set the SQL statement text for ICommand.	Only the DBGUID_DEFAULT SQL dialect is supported.
ICommandWithParameters	Set or get parameter information for a command.	No support for parameters stored as vectors of scalar values. No support for BLOB parameters.
IConvertType		Supported.
IDBAsynchNotify IDBAsynchStatus	Asynchronous processing. Notify client of events in the asynchronous processing of data source initialization, populating rowsets, and so on.	Not supported.
IDBCreateCommand	Create commands from a session.	Supported.
IDBCreateSession	Create a session from a data source object.	Supported.
IDBDataSourceAdmin	Create/destroy/modify data source objects, which are COM objects used by clients. This interface is not used to manage data stores (databases).	Not supported.

Interface	Purpose	Limitations
IDBInfo	Find information about keywords unique to this provider (that is, to find non-standard SQL keywords). Also, find information about literals, special characters used in text matching queries, and other literal information.	Supported.
IDBInitialize	Initialize data source objects and enumerators.	Supported.
IDBProperties	Manage properties on a data source object or enumerator.	Supported.
IDBSchemaRowset	Get information about system tables, in a standard form (a rowset).	Supported.
IErrorInfo IErrorLookup IErrorRecords	ActiveX error object support.	Supported.
IGetDataSource	Returns an interface pointer to the session's data source object.	Supported.
IIndexDefinition	Create or drop indexes in the data store.	Not supported.
IMultipleResults	Retrieve multiple results (rowsets or row counts) from a command.	Supported.
IOpenRowset	Non-SQL way to access a database table by its name.	Supported. Opening a table by its name is supported, not by a GUID.
IParentRowset	Access chaptered/hierarchical rowsets.	Not supported.
IRowset	Access rowsets.	Supported.
IRowsetChange	Allow changes to rowset data, reflected back to the data store. InsertRow/SetData for BLOBs are not implemented.	Supported.

Interface	Purpose	Limitations
IRowsetChapterMember	Access chaptered/hierarchical rowsets.	Not supported.
IRowsetCurrentIndex	Dynamically change the index for a rowset.	Not supported.
IRowsetFind	Find a row within a rowset matching a specified value.	Not supported.
IRowsetIdentity	Compare row handles.	Not supported.
IRowsetIndex	Access database indexes.	Not supported.
IRowsetInfo	Find information about rowset properties or to find the object that created the rowset.	Supported.
IRowsetLocate	Position on rows of a rowset, using bookmarks.	Supported.
IRowsetNotify	Provides a COM callback interface for rowset events.	Supported.
IRowsetRefresh	Get the latest value of data that is visible to a transaction.	Not supported.
IRowsetResynch	Old OLE DB 1.x interface, superseded by IRowsetRefresh.	Not supported.
IRowsetScroll	Scroll through rowset to fetch row data.	Not supported.
IRowsetUpdate	Delay changes to rowset data until Update is called.	Supported.
IRowsetView	Use views on an existing rowset.	Not supported.
ISequentialStream	Retrieve a BLOB column.	Supported for reading only. No support for SetData with this interface.
ISessionProperties	Get session property information.	Supported.
ISourcesRowset	Get a rowset of data source objects and enumerators.	Supported.

Interface	Purpose	Limitations
ISQLErrorInfo ISupportErrorInfo	ActiveX error object support.	Supported.
ITableDefinition ITableDefinitionWithConstraints	Create, drop, and alter tables, with constraints.	Supported.
ITransaction	Commit or abort transactions.	Not all the flags are supported.
ITransactionJoin	Support distributed transactions.	Not all the flags are supported.
ITransactionLocal	Handle transactions on a session. Not all the flags are supported.	Supported.
ITransactionOptions	Get or set options on a transaction.	Supported.
IViewChapter	Work with views on an existing rowset, specifically to apply post-processing filters/sorting on rows.	Not supported.
IViewFilter	Restrict contents of a rowset to rows matching a set of conditions.	Not supported.
IViewRowset	Restrict contents of a rowset to rows matching a set of conditions, when opening a rowset.	Not supported.
IViewSort	Apply sort order to a view.	Not supported.

ODBC support

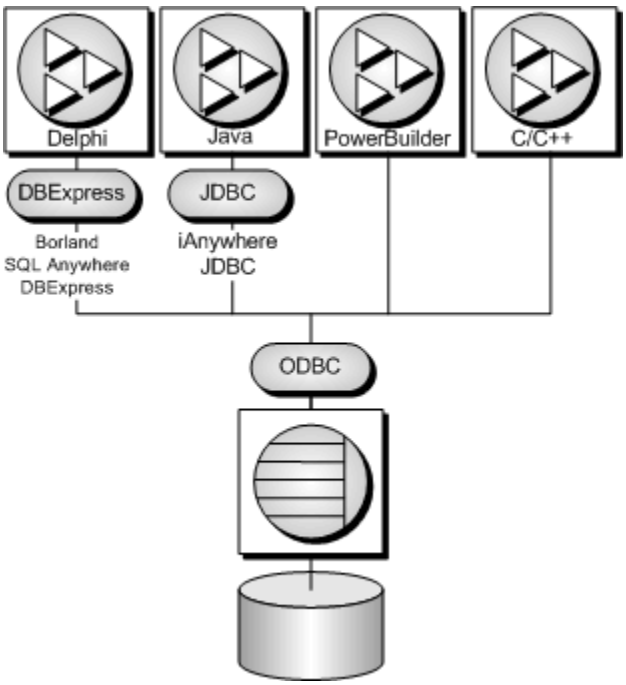
ODBC (Open Database Connectivity) is a standard call level interface (CLI) developed by Microsoft Corporation. It is based on the SQL Access Group CLI specification. ODBC applications can run against any data source that provides an ODBC driver. ODBC is a good choice for a programming interface if you want your application to be portable to other data sources that have ODBC drivers.

ODBC is a low-level interface. Almost all the SQL Anywhere functionality is available with this interface. ODBC is available as a DLL under Windows operating systems. It is provided as a shared object library for Unix.

The core documentation for the ODBC API can be found on the Microsoft Developer Network website at http://msdn.microsoft.com/en-us/library/ms710252.aspx.

Requirements for developing ODBC applications

You can develop applications using a variety of development tools and programming languages, as shown in the figure below, and access the SQL Anywhere database server using the ODBC API.



To write ODBC applications for SQL Anywhere, you need:

- SQL Anywhere.

- A C compiler capable of creating programs for your environment.
- The Microsoft ODBC Software Development Kit. This is available on the Microsoft Developer Network, and provides documentation and additional tools for testing ODBC applications.

> **Note**
> Some application development tools, that already have ODBC support, provide their own programming interface that hides the ODBC interface. The SQL Anywhere documentation does not describe how to use those tools.

The ODBC driver manager

Microsoft Windows includes an ODBC driver manager. There is no driver manager for Windows Mobile. For Unix, a driver manager is supplied with SQL Anywhere.

ODBC conformance

SQL Anywhere provides support for ODBC 3.5, which is supplied as part of the Microsoft Data Access Kit 2.7.

Levels of ODBC support

ODBC features are arranged according to level of conformance. Features are either **Core**, **Level 1**, or **Level 2**, with Level 2 being the most complete level of ODBC support. These features are listed in the Microsoft *ODBC Programmer's Reference* at http://msdn.microsoft.com/en-us/library/ms714177.aspx.

Features supported by SQL Anywhere

SQL Anywhere supports the ODBC 3.5 specification as follows:

- **Core conformance** SQL Anywhere supports all Core level features.
- **Level 1 conformance** SQL Anywhere supports all Level 1 features, except for asynchronous execution of ODBC functions.

  SQL Anywhere supports multiple threads sharing a single connection. The requests from the different threads are serialized by SQL Anywhere.
- **Level 2 conformance** SQL Anywhere supports all Level 2 features, except for the following ones:
  - Three part names of tables and views. This is not applicable for SQL Anywhere.
  - Asynchronous execution of ODBC functions for specified individual statements.
  - Ability to time out login requests and SQL queries.

Building ODBC applications

This section describes how to compile and link simple ODBC applications.

Including the ODBC header file

Every C source file that calls ODBC functions must include a platform-specific ODBC header file. Each platform-specific header file includes the main ODBC header file *odbc.h*, which defines all the functions, data types, and constant definitions required to write an ODBC program.

To include the ODBC header file in a C source file

1. Add an include line referencing the appropriate platform-specific header file to your source file. The lines to use are as follows:

Operating system	Include line
Windows	#include "ntodbc.h"
Unix	#include "unixodbc.h"
Windows Mobile	#include "ntodbc.h"

2. Add the directory containing the header file to the include path for your compiler.

   Both the platform-specific header files and *odbc.h* are installed in the *SDK\Include* subdirectory of your SQL Anywhere installation directory.

3. When building ODBC applications for Unix, you might have to define the macro "UNIX" for 32-bit applications or "UNIX64" for 64-bit applications to obtain the correct data alignment and sizes. This step is not required if you are using one of the following supported compilers:

   - GNU C/C++ compiler on any of our supported platforms
   - Intel C/C++ compiler for Linux (icc)
   - SunPro C/C++ compiler for Linux or Solaris
   - VisualAge C/C++ compiler for AIX
   - C/C++ compiler (cc/aCC) for HP-UX

Linking ODBC applications on Windows

This section does not apply to Windows Mobile. For Windows Mobile information, see "Linking ODBC applications on Windows Mobile" on page 346.

When linking your application, you must link against the appropriate import library file to have access to the ODBC functions. The import library defines entry points for the ODBC driver manager *odbc32.dll*. The driver manager in turn loads the SQL Anywhere ODBC driver *dbodbc12.dll*.

To link an ODBC application (Windows)

1. Add the directory containing the platform-specific import library to the list of library directories in your LIB environment variable.

   Typically, the import library is stored under the *Lib* directory structure of the Microsoft platform SDK:

Operating system	Import library
Windows (32-bit)	*Lib\odbc32.lib*
Windows (64-bit)	*Lib\x64\odbc32.lib*

   Here is an example for a command prompt.

```
set LIB=%LIB%;C:\mssdk\v6.1\lib
```

2. To compile and link a simple ODBC application using the Microsoft compile and link tool, you can issue a single command from the command prompt. The following example compiles and links the application stored in *odbc.c*.

```
cl odbc.c /Ic:\sa12\SDK\Include odbc32.lib
```

Linking ODBC applications on Windows Mobile

On Windows Mobile operating systems, there is no ODBC driver manager. The import library (*dbodbc12.lib*) defines entry points directly into the SQL Anywhere ODBC driver *dbodbc12.dll*. This file is located in the *SDK\Lib\CE\Arm.50* subdirectory of your SQL Anywhere installation.

Since there is no ODBC driver manager for Windows Mobile, you must specify the location of the SQL Anywhere ODBC driver DLL with the DRIVER= parameter in the connection string supplied to the SQLDriverConnect function. The following is an example.

```
szConnStrIn = "driver=ospath\\dbodbc12.dll;dbf=\\samples-dir\\demo.db"
```

Here, *ospath* is the full path to the Windows directory on the Windows Mobile device. For example:

```
\\Windows
```

To link an ODBC application (Windows Mobile)

- Add the directory containing the platform-specific import library to the list of library directories.

For a list of supported versions of Windows Mobile, see the SQL Anywhere for PC Platforms table at http://www.sybase.com/detail?id=1002288.

The sample program (*odbc_sample.cpp*) uses a File Data Source (FileDSN connection parameter) called *SQL Anywhere 12 Demo.dsn*. This file placed in the root directory of your Windows Mobile device when you install SQL Anywhere for Windows Mobile to your device. You can create file data sources on your desktop system with the ODBC Data Source Administrator, but they must be set up for your desktop

environment and then edited to match the Windows Mobile environment. After appropriate edits, you can copy them to your Windows Mobile device.

For information about the default location of *samples-dir*, see "Samples directory" [*SQL Anywhere Server - Database Administration*].

Windows Mobile and Unicode

SQL Anywhere uses an encoding known as UTF-8, a multibyte character encoding that can be used to encode Unicode.

The SQL Anywhere ODBC driver supports either ASCII (8-bit) strings or Unicode code (wide character) strings. The UNICODE macro controls whether ODBC functions expect ASCII or Unicode strings. If your application must be built with the UNICODE macro defined, but you want to use the ASCII ODBC functions, then the SQL_NOUNICODEMAP macro must also be defined.

The sample file *samples-dir\SQLAnywhere\C\odbc.c* illustrates how to use the Unicode ODBC features.

Linking ODBC applications on Unix

An ODBC driver manager for Unix is included with SQL Anywhere and there are third party driver managers available. This section describes how to build ODBC applications that do not use an ODBC driver manager.

ODBC driver

The ODBC driver is a shared object or shared library. Separate versions of the SQL Anywhere ODBC driver are supplied for single-threaded and multithreaded applications. A generic SQL Anywhere ODBC driver is supplied that will detect the threading model in use and direct calls to the appropriate single-threaded or multithreaded library.

The ODBC drivers are the following files:

Operating system	Threading model	ODBC driver
(all Unix except Mac OS X and HP-UX)	Generic	*libdbodbc12.so (libdbodbc12.so.1)*
(all Unix except Mac OS X and HP-UX)	Single threaded	*libdbodbc12_n.so (libdbodbc12_n.so.1)*
(all Unix except Mac OS X and HP-UX)	Multithreaded	*libdbodbc12_r.so (libdbodbc12_r.so.1)*
HP-UX	Generic	*libdbodbc12.sl (libdbodbc12.sl.1)*
HP-UX	Single threaded	*libdbodbc12_n.sl (libdbodbc12_n.sl.1)*

Operating system	Threading model	ODBC driver
HP-UX	Multithreaded	*libdbodbc12_r.sl (libdbodbc12_r.sl.1)*
Mac OS X	Generic	*libdbodbc12.dylib*
Mac OS X	Single threaded	*libdbodbc12_n.dylib*
Mac OS X	Multithreaded	*libdbodbc12_r.dylib*

The libraries are installed as symbolic links to the shared library with a version number (shown in parentheses).

In addition, the following bundles are also provided for Mac OS X:

Operating system	Threading model	ODBC driver
Mac OS X	Single threaded	*dbodbc12.bundle*
Mac OS X	Multithreaded	*dbodbc12_r.bundle*

To link an ODBC application (Unix)

1. Link your application against the generic ODBC driver *libdbodbc12*.
2. When deploying your application, ensure that the appropriate (or all) ODBC driver versions (non-threaded or threaded) are available in the user's library path.

Data source information

If SQL Anywhere does not detect the presence of an ODBC driver manager, it uses the system information file for data source information. See "Using ODBC data sources on Unix" [*SQL Anywhere Server - Database Administration*].

Using the SQL Anywhere ODBC driver manager on Unix

SQL Anywhere includes an ODBC driver manager for Unix. The *libdbodm12* shared object can be used on all supported Unix platforms as an ODBC driver manager. The iAnywhere ODBC driver manager can be used to load any version 3.0 or later ODBC driver. The driver manager will not perform mappings between ODBC 1.0/2.0 calls and ODBC 3.x calls; therefore, applications using the iAnywhere ODBC driver manager must restrict their use of the ODBC feature set to version 3.0 and later. Also, the iAnywhere ODBC driver manager can be used by both threaded and non-threaded applications.

The iAnywhere ODBC driver manager can perform tracing of ODBC calls for any given connection. To turn on tracing, a user can use the TraceLevel and TraceLog directives. These directives can be part of a connection string (in the case where SQLDriverConnect is being used) or within a DSN entry. The TraceLog is a log file where the traced output for the connection goes while the TraceLevel is the amount of tracing information wanted. The trace levels are:

- **NONE** No tracing information is printed.
- **MINIMAL** Routine name and parameters are included in the output.
- **LOW** In addition to the above, return values are included in the output.
- **MEDIUM** In addition to the above, the date and time of execution are included in the output.
- **HIGH** In addition to the above, parameter types are included in the output.

Also, third-party ODBC driver managers for Unix are available. Consult the documentation that accompanies these driver managers for information about their use.

See also "Using the unixODBC driver manager" on page 349 and "Using a UTF-32 ODBC driver manager on Unix" on page 350.

Using the unixODBC driver manager

Versions of the unixODBC release before version 2.2.14 have incorrectly implemented some aspects of the 64-bit ODBC specification as defined by Microsoft. These differences will cause problems when using the unixODBC driver manager with the SQL Anywhere 64-bit ODBC driver.

To avoid these problems, you should be aware of the differences. One of them is the definition of SQLLEN and SQLULEN. These are 64-bit types in the Microsoft 64-bit ODBC specification, and are expected to be 64-bit quantities by the SQL Anywhere 64-bit ODBC driver. Some implementations of unixODBC define these two types as 32-bit quantities and this will result in problems when interfacing to the SQL Anywhere 64-bit ODBC driver.

There are three things that you must do to avoid problems on 64-bit platforms.

1. Instead of including the unixODBC headers like *sql.h* and *sqlext.h*, you should include the SQL Anywhere ODBC header file *unixodbc.h*. This will guarantee that you have the correct definitions for SQLLEN and SQLULEN. The header files in unixODBC 2.2.14 or later versions correct this problem.

2. You must ensure that you have used the correct types for all parameters. Use of the correct header file and the strong type checking of your C/C++ compiler should help in this area. You must also ensure that you have used the correct types for all variables that are set by the SQL Anywhere driver indirectly through pointers. See "64-bit ODBC considerations" on page 364.

3. Do not use versions of the unixODBC driver manager before release 2.2.14. Link directly to the SQL Anywhere ODBC driver instead. For example, ensure that the libodbc shared object is linked to the SQL Anywhere driver.

   ```
   libodbc.so.1 -> libdbodbc12_r.so.1
   ```

   Alternatively, you can use the SQL Anywhere driver manager on platforms where it is available. See "Using the SQL Anywhere ODBC driver manager on Unix" on page 348.

For more information, see "Linking ODBC applications on Unix" on page 347.

Using a UTF-32 ODBC driver manager on Unix

Versions of ODBC driver managers that define SQLWCHAR as 32-bit (UTF-32) quantities cannot be used with the SQL Anywhere ODBC driver that supports wide calls since this driver is built for 16-bit SQLWCHAR. For these cases, an ANSI-only version of the SQL Anywhere ODBC driver is provided. This version of the ODBC driver does not support the wide call interface (e.g., SQLConnectW).

The shared object name of the driver is *libdbodbcansi12_r*. Only a threaded variant of the driver is provided. On Mac OS X, in addition to the dylib, the driver is also available in bundle form (*dbodbcansi12_r.bundle*). Certain frameworks, such as Real Basic, do not work with the dylib and require the bundle.

Our regular ODBC driver treats SQLWCHAR strings as UTF-16 strings. This driver can not be used with some ODBC driver managers, such as iODBC, which treat SQLWCHAR strings as UTF-32 strings. When dealing with Unicode-enabled drivers, these driver managers translate narrow calls from the application to wide calls into the driver. An ANSI-only driver gets around this behavior, allowing the driver to be used with such driver managers, as long as the application does not make any wide calls. Wide calls through iODBC, or any other driver manager with similar semantics, remain unsupported.

ODBC samples

Several ODBC samples are included with SQL Anywhere. You can find the samples in the *samples-dir\SQLAnywhere* subdirectories.

The samples in directories starting with ODBC illustrate separate and simple ODBC tasks, such as connecting to a database and executing statements. A complete sample ODBC program is supplied in *samples-dir\SQLAnywhere\C\odbc.c*. This program performs the same actions as the embedded SQL dynamic cursor example program that is in the same directory.

For a description of the associated embedded SQL program, see "Sample embedded SQL programs" on page 435.

Building the sample ODBC program

The ODBC sample program is located in *samples-dir\SQLAnywhere\C*. A batch file (shell script for Unix) is included that can be used to compile and link all the sample applications located in this folder.

To build the sample ODBC program

1. Open a command prompt and change directory to the *samples-dir\SQLAnywhere\C* directory.
2. Run the *build.bat* or *build64.bat* batch file.

   For x64 platform builds, you may need to set up the correct environment for compiling and linking. Here is an example that builds the sample programs for an x64 platform.


```
set mssdk=c:\MSSDK\v6.1
build64
```

To build the sample ODBC program for Unix

1. Open a command shell and change directory to the *samples-dir/SQLAnywhere/C* directory.
2. Run the *build.sh* shell script.

Running the sample ODBC program

To run the ODBC sample

1. Start the program:
   - For 32-bit Windows, run the file *samples-dir\SQLAnywhere\C\odbcwin.exe*.
   - For 64-bit Windows, run the file *samples-dir\SQLAnywhere\C\odbcx64.exe*.
   - For Unix, run the file *samples-dir/SQLAnywhere/C/odbc*.
2. Choose a table:
   - Choose one of the tables in the sample database. For example, you can enter **Customers** or **Employees**.

ODBC handles

ODBC applications use a small set of **handles** to define basic features such as database connections and SQL statements. A handle is a 32-bit value.

The following handles are used in essentially all ODBC applications:

- **Environment** The environment handle provides a global context in which to access data. Every ODBC application must allocate exactly one environment handle upon starting, and must free it at the end.

  The following code illustrates how to allocate an environment handle:

  ```
  SQLHENV env;
  SQLRETURN rc;
  rc = SQLAllocHandle( SQL_HANDLE_ENV, SQL
     _NULL_HANDLE, &env );
  ```

- **Connection** A connection is specified by an ODBC driver and a data source. An application can have several connections associated with its environment. Allocating a connection handle does not establish a connection; a connection handle must be allocated first and then used when the connection is established.

  The following code illustrates how to allocate a connection handle:

```
SQLHDBC  dbc;
SQLRETURN rc;
rc = SQLAllocHandle( SQL_HANDLE_DBC, env, &dbc );
```

- **Statement** A statement handle provides access to a SQL statement and any information associated with it, such as result sets and parameters. Each connection can have several statements. Statements are used both for cursor operations (fetching data) and for single statement execution (for example, INSERT, UPDATE, and DELETE).

  The following code illustrates how to allocate a statement handle:

```
SQLHSTMT stmt;
SQLRETURN rc;
rc = SQLAllocHandle( SQL_HANDLE_STMT, dbc, &stmt );
```

Allocating ODBC handles

The handle types required for ODBC programs are as follows:

Item	Handle type
Environment	SQLHENV
Connection	SQLHDBC
Statement	SQLHSTMT
Descriptor	SQLHDESC

To use an ODBC handle

1. Call the SQLAllocHandle function.

   SQLAllocHandle takes the following parameters:

   - an identifier for the type of item being allocated
   - the handle of the parent item
   - a pointer to the location of the handle to be allocated

   For a full description, see SQLAllocHandle in the Microsoft *ODBC API Reference* at http://msdn.microsoft.com/en-us/library/ms712455.aspx.

2. Use the handle in subsequent function calls.

3. Free the object using SQLFreeHandle.

   SQLFreeHandle takes the following parameters:

   - an identifier for the type of item being freed

- the handle of the item being freed

  For a full description, see SQLFreeHandle in the Microsoft *ODBC API Reference* at http://msdn.microsoft.com/en-us/library/ms710123.aspx.

Example

The following code fragment allocates and frees an environment handle:

```
SQLHENV env;
SQLRETURN retcode;
retcode = SQLAllocHandle(
      SQL_HANDLE_ENV,
      SQL_NULL_HANDLE,
      &env );
if( retcode == SQL_SUCCESS
    || retcode == SQL_SUCCESS_WITH_INFO ) {
  // success: application Code here
}
SQLFreeHandle( SQL_HANDLE_ENV, env );
```

For more information about return codes and error handling, see "Handling errors" on page 375.

A first ODBC example

The following is a simple ODBC program that connects to the SQL Anywhere sample database and immediately disconnects.

You can find this sample in *samples-dir\SQLAnywhere\ODBCConnect\odbcconnect.cpp*.

```
#include <stdio.h>
#include "ntodbc.h"

int main(int argc, char* argv[])
{
  SQLHENV  env;
  SQLHDBC  dbc;
  SQLRETURN retcode;

  retcode = SQLAllocHandle( SQL_HANDLE_ENV,
            SQL_NULL_HANDLE,
            &env );
  if (retcode == SQL_SUCCESS
      || retcode == SQL_SUCCESS_WITH_INFO) {
    printf( "env allocated\n" );
    /* Set the ODBC version environment attribute */
    retcode = SQLSetEnvAttr( env,
                SQL_ATTR_ODBC_VERSION,
                (void*)SQL_OV_ODBC3, 0);
      retcode = SQLAllocHandle( SQL_HANDLE_DBC, env, &dbc );
      if (retcode == SQL_SUCCESS
          || retcode == SQL_SUCCESS_WITH_INFO) {
        printf( "dbc allocated\n" );
        retcode = SQLConnect( dbc,
          (SQLCHAR*) "SQL Anywhere 12 Demo", SQL_NTS,
          (SQLCHAR* ) "DBA", SQL_NTS,
          (SQLCHAR*) "sql", SQL_NTS );
        if (retcode == SQL_SUCCESS
```

```
            || retcode == SQL_SUCCESS_WITH_INFO) {
          printf( "Successfully connected\n" );
        }
        SQLDisconnect( dbc );
      }
      SQLFreeHandle( SQL_HANDLE_DBC, dbc );
    }
    SQLFreeHandle( SQL_HANDLE_ENV, env );
  return 0;
}
```

Choosing an ODBC connection function

ODBC supplies a set of connection functions. Which one you use depends on how you expect your application to be deployed and used:

- **SQLConnect** The simplest connection function.

  SQLConnect takes a data source name and optional user ID and password. You may want to use SQLConnect if you hard-code a data source name into your application.

  For more information, see SQLConnect in the Microsoft *ODBC API Reference* at http://msdn.microsoft.com/en-us/library/ms711810.aspx.

- **SQLDriverConnect** Connects to a data source using a connection string.

  SQLDriverConnect allows the application to use SQL Anywhere-specific connection information that is external to the data source. Also, you can use SQLDriverConnect to request that the SQL Anywhere driver prompt for connection information.

  SQLDriverConnect can also be used to connect without specifying a data source. The SQL Anywhere ODBC driver name is specified instead. The following example connects to a server and database that is already running.

  ```
  SQLSMALLINT cso;
  SQLCHAR     scso[2048];

  SQLDriverConnect( hdbc, NULL,
     "Driver=SQL Anywhere 12;UID=DBA;PWD=sql", SQL_NTS,
     scso, sizeof(scso)-1,
     &cso, SQL_DRIVER_NOPROMPT );
  ```

  For more information, see SQLDriverConnect in the Microsoft *ODBC API Reference* at http://msdn.microsoft.com/en-us/library/ms715433.aspx.

- **SQLBrowseConnect** Connects to a data source using a connection string, like SQLDriverConnect.

  SQLBrowseConnect allows your application to build its own windows to prompt for connection information and to browse for data sources used by a particular driver (in this case the SQL Anywhere driver).

For more information, see SQLBrowseConnect in the Microsoft *ODBC API Reference* at http://msdn.microsoft.com/en-us/library/ms714565.aspx.

For a complete list of connection parameters that can be used in connection strings, see "Connection parameters" [*SQL Anywhere Server - Database Administration*].

Establishing a connection

Your application must establish a connection before it can perform any database operations.

To establish an ODBC connection

1. Allocate an ODBC environment.

   For example:

   ```
   SQLHENV   env;
   SQLRETURN retcode;
   retcode = SQLAllocHandle( SQL_HANDLE_ENV,
     SQL_NULL_HANDLE, &env );
   ```

2. Declare the ODBC version.

   By declaring that the application follows ODBC version 3, SQLSTATE values and some other version-dependent features are set to the proper behavior. For example:

   ```
   retcode = SQLSetEnvAttr( env,
     SQL_ATTR_ODBC_VERSION, (void*)SQL_OV_ODBC3, 0);
   ```

3. If necessary, assemble the data source or connection string.

   Depending on your application, you may have a hard-coded data source or connection string, or you may store it externally for greater flexibility.

4. Allocate an ODBC connection item.

   For example:

   ```
   retcode = SQLAllocHandle( SQL_HANDLE_DBC, env, &dbc );
   ```

5. Set any connection attributes that must be set before connecting.

   Some connection attributes must be set before establishing a connection or after establishing a connection, while others can be set either before or after. The SQL_AUTOCOMMIT attribute is one that can be set before or after:

   ```
   retcode = SQLSetConnectAttr( dbc,
      SQL_AUTOCOMMIT,
      (SQLPOINTER)SQL_AUTOCOMMIT_OFF, 0 );
   ```

   For more information, see "Setting connection attributes" on page 356.

6. Call the ODBC connection function.

   For example:

```
if (retcode == SQL_SUCCESS
    || retcode == SQL_SUCCESS_WITH_INFO) {
   printf( "dbc allocated\n" );
   retcode = SQLConnect( dbc,
      (SQLCHAR*) "SQL Anywhere 12 Demo", SQL_NTS,
      (SQLCHAR* ) "DBA", SQL_NTS,
      (SQLCHAR*) "sql", SQL_NTS );
   if (retcode == SQL_SUCCESS
         || retcode == SQL_SUCCESS_WITH_INFO){
   // successfully connected.
```

You can find a complete sample in *samples-dir\SQLAnywhere\ODBCConnect\odbcconnect.cpp*.

Notes

- **SQL_NTS** Every string passed to ODBC has a corresponding length. If the length is unknown, you can pass SQL_NTS indicating that it is a **Null Terminated String** whose end is marked by the null character (\0).
- **SQLSetConnectAttr** By default, ODBC operates in autocommit mode. This mode is turned off by setting SQL_AUTOCOMMIT to false.

  For more information, see "Setting connection attributes" on page 356.

Setting connection attributes

You use the SQLSetConnectAttr function to control details of the connection. For example, the following statement turns off ODBC autocommit behavior.

```
retcode = SQLSetConnectAttr( dbc, SQL_AUTOCOMMIT,
   (SQLPOINTER)SQL_AUTOCOMMIT_OFF, 0 );
```

For more information, see SQLSetConnectAttr in the Microsoft *ODBC API Reference* at http://msdn.microsoft.com/en-us/library/ms713605.aspx.

Many aspects of the connection can be controlled through the connection parameters. For information, see "Connection parameters" [*SQL Anywhere Server - Database Administration*].

Getting connection attributes

You use the SQLGetConnectAttr function to get details of the connection. For example, the following statement returns the connection state.

```
retcode = SQLGetConnectAttr( dbc, SQL_ATTR_CONNECTION_DEAD,
   (SQLPOINTER)&closed, SQL_IS_INTEGER, 0 );
```

When using the SQLGetConnectAttr function to get the SQL_ATTR_CONNECTION_DEAD attribute, the value SQL_CD_TRUE is returned if the connection has been dropped even if no request has been sent

to the server since the connection was dropped. Determining if the connection has been dropped is done without making a request to the server, and the dropped connection is detected within a few seconds. The connection can be dropped for several reasons, such as an idle timeout.

For more information, including a list of connection attributes, see SQLGetConnectAttr in the Microsoft *ODBC API Reference* at http://msdn.microsoft.com/en-us/library/ms710297.aspx.

Threads and connections in ODBC applications

You can develop multithreaded ODBC applications for SQL Anywhere. It is recommended that you use a separate connection for each thread.

You can use a single connection for multiple threads. However, the database server does not allow more than one active request for any one connection at a time. If one thread executes a statement that takes a long time, all other threads must wait until the request is complete.

Server options changed by ODBC

The SQL Anywhere ODBC driver sets some temporary server options when connecting to a SQL Anywhere database. The following options are set as indicated.

- **date_format** yyyy-mm-dd
- **date_order** ymd
- **isolation_level** based on the SQL_ATTR_TXN_ISOLATION/ SA_SQL_ATTR_TXN_ISOLATION attribute setting of SQLSetConnectAttr. The following options are available.

  ```
  SQL_TXN_READ_UNCOMMITTED
  SQL_TXN_READ_COMMITTED
  SQL_TXN_REPEATABLE_READ
  SQL_TXN_SERIALIZABLE
  SA_SQL_TXN_SNAPSHOT
  SA_SQL_TXN_STATEMENT_SNAPSHOT
  SA_SQL_TXN_READONLY_STATEMENT_SNAPSHOT
  ```

  For more information, see "Choosing ODBC transaction isolation level" on page 369.

- **time_format** hh:nn:ss
- **timestamp_format** yyyy-mm-dd hh:nn:ss.ssssss
- **timestamp_with_time_zone_format** yyyy-mm-dd hh:nn:ss.ssssss +hh:nn

To restore the default option setting, execute a SET statement. Here is an example of a statement that will reset the timestamp_format option.

```
set temporary option timestamp_format =
```

SQLSetConnectAttr extended connection attributes

The SQL Anywhere ODBC driver supports some extended connection attributes.

- **SA_REGISTER_MESSAGE_CALLBACK** Messages can be sent to the client application from the database server using the SQL MESSAGE statement. Messages can also be generated by long running database server statements. For more information, see "MESSAGE statement" [*SQL Anywhere Server - SQL Reference*].

  A message handler routine can be created to intercept these messages. The message handler callback prototype is as follows:

  void SQL_CALLBACK *message_handler*(
  SQLHDBC *sqlany_dbc*,
  unsigned char *msg_type*,
  long *code*,
  unsigned short *length*,
  char * *message*
  );

  The following possible values for *msg_type* are defined in *sqldef.h*.

  - **MESSAGE_TYPE_INFO** The message type was INFO.
  - **MESSAGE_TYPE_WARNING** The message type was WARNING.
  - **MESSAGE_TYPE_ACTION** The message type was ACTION.
  - **MESSAGE_TYPE_STATUS** The message type was STATUS.
  - **MESSAGE_TYPE_PROGRESS** The message type was PROGRESS. This type of message is generated by long running database server statements such as BACKUP DATABASE and LOAD TABLE. See "progress_messages option" [*SQL Anywhere Server - Database Administration*].

  A SQLCODE associated with the message may be provided in*code*. When not available, the*code* parameter value is 0.

  The length of the message is contained in *length*.

  A pointer to the message is contained in *message*. Note that *message* is not null-terminated. Your application must be designed to handle this. The following is an example.

  ```
  memcpy( mybuff, msg, len );
  mybuff[ len ] = '\0';
  ```

  To register the message handler in ODBC, call the SQLSetConnectAttr function as follows:

  ```
  rc = SQLSetConnectAttr(
     hdbc,
  ```



```
    SA_REGISTER_MESSAGE_CALLBACK,
    (SQLPOINTER) &message_handler, SQL_IS_POINTER );
```

To unregister the message handler in ODBC, call the SQLSetConnectAttr function as follows:

```
rc = SQLSetConnectAttr(
    hdbc,
    SA_REGISTER_MESSAGE_CALLBACK,
    NULL, SQL_IS_POINTER );
```

- **SA_GET_MESSAGE_CALLBACK_PARM** To retrieve the value of the SQLHDBC connection handle that will be passed to message handler callback routine, use SQLGetConnectAttr with the SA_GET_MESSAGE_CALLBACK_PARM parameter.

  ```
  SQLHDBC callback_hdbc = NULL;
  rc = SQLGetConnectAttr(
      hdbc,
      SA_GET_MESSAGE_CALLBACK_PARM,
      (SQLPOINTER) &callback_hdbc, 0, 0 );
  ```

  The returned value will be the same as the parameter value that is passed to the message handler callback routine.

- **SA_REGISTER_VALIDATE_FILE_TRANSFER_CALLBACK** This is used to register a file transfer validation callback function. Before allowing any transfer to take place, the ODBC driver will invoke the validation callback, if it exists. If the client data transfer is being requested during the execution of indirect statements such as from within a stored procedure, the ODBC driver will not allow a transfer unless the client application has registered a validation callback. The conditions under which a validation call is made are described more fully below.

  The callback prototype is as follows:

  int SQL_CALLBACK *file_transfer_callback*(
  void * *sqlca*,
  char * *file_name*,
  int *is_write*
  );

  The *file_name* parameter is the name of the file to be read or written. The *is_write* parameter is 0 if a read is requested (transfer from the client to the server), and non-zero for a write. The callback function should return 0 if the file transfer is not allowed, non-zero otherwise.

  For data security, the server tracks the origin of statements requesting a file transfer. The server determines if the statement was received directly from the client application. When initiating the transfer of data from the client, the server sends the information about the origin of the statement to the client software. On its part, the ODBC driver allows unconditional transfer of data only if the data transfer is being requested due to the execution of a statement sent directly by the client application. Otherwise, the application must have registered the validation callback described above, in the absence of which the transfer is denied and the statement fails with an error. Note that if the client statement invokes a stored procedure already existing in the database, then the execution of the stored procedure itself is considered not to have been for a client initiated statement. However, if the client application explicitly creates a temporary stored procedure then the execution of the stored procedure results in the server treating the procedure as having been client initiated. Similarly, if the client

application executes a batch statement, then the execution of the batch statement is considered as being done directly by the client application.

- **SA_SQL_ATTR_TXN_ISOLATION** This is used to set an extended transaction isolation level. The following example sets a Snapshot isolation level:

```
SQLAllocHandle( SQL_HANDLE_DBC, env, &dbc );
SQLSetConnectAttr( dbc, SA_SQL_ATTR_TXN_ISOLATION,
      SA_SQL_TXN_SNAPSHOT, SQL_IS_UINTEGER );
```

  For more information, see "Choosing ODBC transaction isolation level" on page 369.

Calling SQLFreeEnv

Note that SQLFreeEnv must not be called directly or indirectly from the Windows DllMain function. The calls that can be made from DllMain are limited, and in particular attempting to communicate with other threads (which SQLFreeEnv may do) can cause the application to hang.

Executing SQL statements

ODBC includes several functions for executing SQL statements:

- **Direct execution** SQL Anywhere parses the SQL statement, prepares an access plan, and executes the statement. Parsing and access plan preparation are called **preparing** the statement.
- **Prepared execution** The statement preparation is carried out separately from the execution. For statements that are to be executed repeatedly, this avoids repeated preparation and so improves performance.

  For more information, see "Executing prepared statements" on page 362.

Executing statements directly

The SQLExecDirect function prepares and executes a SQL statement. The statement may include parameters.

The following code fragment illustrates how to execute a statement without parameters. The SQLExecDirect function takes a statement handle, a SQL string, and a length or termination indicator, which in this case is a null-terminated string indicator.

The procedure described in this section is straightforward but inflexible. The application cannot take any input from the user to modify the statement. For a more flexible method of constructing statements, see "Executing statements with bound parameters" on page 361.

To execute a SQL statement in an ODBC application

1. Allocate a handle for the statement using **SQLAllocHandle**.

   For example, the following statement allocates a handle of type `SQL_HANDLE_STMT` with name `stmt`, on a connection with handle `dbc`:

   ```
   SQLAllocHandle( SQL_HANDLE_STMT, dbc, &stmt );
   ```

2. Call the SQLExecDirect function to execute the statement:

   For example, the following lines declare a statement and execute it. The declaration of `deletestmt` would usually occur at the beginning of the function:

   ```
   SQLCHAR deletestmt[ STMT_LEN ] =
     "DELETE FROM Departments WHERE DepartmentID = 201";
   SQLExecDirect( stmt, deletestmt, SQL_NTS) ;
   ```

For a complete sample with error checking, see *samples-dir\SQLAnywhere\ODBCExecute\odbcexecute.cpp*.

For more information about SQLExecDirect, see SQLExecDirect in the Microsoft *ODBC API Reference* at http://msdn.microsoft.com/en-us/library/ms713611.aspx.

Executing statements with bound parameters

This section describes how to construct and execute a SQL statement, using bound parameters to set values for statement parameters at runtime.

To execute a SQL statement with bound parameters in an ODBC application

1. Allocate a handle for the statement using SQLAllocHandle.

   For example, the following statement allocates a handle of type `SQL_HANDLE_STMT` with name `stmt`, on a connection with handle `dbc`:

   ```
   SQLAllocHandle( SQL_HANDLE_STMT, dbc, &stmt );
   ```

2. Bind parameters for the statement using SQLBindParameter.

   For example, the following lines declare variables to hold the values for the department ID, department name, and manager ID, and for the statement string. They then bind parameters to the first, second, and third parameters of a statement executed using the stmt statement handle.

   ```
   #defined DEPT_NAME_LEN 40
   SQLLEN cbDeptID = 0,
      cbDeptName = SQL_NTS, cbManagerID = 0;
   SQLCHAR deptName[ DEPT_NAME_LEN + 1 ];
   SQLSMALLINT deptID, managerID;
   SQLCHAR insertstmt[ STMT_LEN ] =
     "INSERT INTO Departments "
     "( DepartmentID, DepartmentName, DepartmentHeadID )"
   ```

```
  "VALUES (?, ?, ?)";
SQLBindParameter( stmt, 1, SQL_PARAM_INPUT,
    SQL_C_SSHORT, SQL_INTEGER, 0, 0,
    &deptID, 0, &cbDeptID);
SQLBindParameter( stmt, 2, SQL_PARAM_INPUT,
    SQL_C_CHAR, SQL_CHAR, DEPT_NAME_LEN, 0,
    deptName, 0,&cbDeptName);
SQLBindParameter( stmt, 3, SQL_PARAM_INPUT,
    SQL_C_SSHORT, SQL_INTEGER, 0, 0,
    &managerID, 0, &cbManagerID);
```

3. Assign values to the parameters.

   For example, the following lines assign values to the parameters for the fragment of step 2.

   ```
   deptID = 201;
   strcpy( (char * ) deptName, "Sales East" );
   managerID = 902;
   ```

   Commonly, these variables would be set in response to user action.

4. Execute the statement using SQLExecDirect.

   For example, the following line executes the statement string held in `insertstmt` on the statement handle `stmt`.

   ```
   SQLExecDirect( stmt, insertstmt, SQL_NTS) ;
   ```

Bind parameters are also used with prepared statements to provide performance benefits for statements that are executed more than once. For more information, see "Executing prepared statements" on page 362.

The above code fragments do not include error checking. For a complete sample, including error checking, see *samples-dir\SQLAnywhere\ODBCExecute\odbcexecute.cpp*.

For more information about SQLExecDirect, see SQLExecDirect in the Microsoft *ODBC API Reference* at http://msdn.microsoft.com/en-us/library/ms713611.aspx.

Executing prepared statements

Prepared statements provide performance advantages for statements that are used repeatedly. ODBC provides a full set of functions for using prepared statements.

For an introduction to prepared statements, see "Preparing statements" on page 2.

To execute a prepared SQL statement

1. Prepare the statement using SQLPrepare.

   For example, the following code fragment illustrates how to prepare an INSERT statement:

   ```
   SQLRETURN   retcode;
   SQLHSTMT    stmt;
   ```



```
retcode = SQLPrepare( stmt,
            "INSERT INTO Departments
             ( DepartmentID, DepartmentName, DepartmentHeadID )
             VALUES (?, ?, ?,)",
          SQL_NTS);
```

In this example:

- **retcode** Holds a return code that should be tested for success or failure of the operation.
- **stmt** Provides a handle to the statement so that it can be referenced later.
- **?** The question marks are placeholders for statement parameters.

2. Set statement parameter values using SQLBindParameter.

   For example, the following function call sets the value of the DepartmentID variable:

```
SQLBindParameter( stmt,
                  1,
                  SQL_PARAM_INPUT,
                  SQL_C_SSHORT,
                  SQL_INTEGER,
                  0,
                  0,
                  &sDeptID,
                  0,
                  &cbDeptID);
```

   In this example:

   - **stmt** is the statement handle.
   - **1** indicates that this call sets the value of the first placeholder.
   - **SQL_PARAM_INPUT** indicates that the parameter is an input statement.
   - **SQL_C_SHORT** indicates the C data type being used in the application.
   - **SQL_INTEGER** indicates SQL data type being used in the database.

     The next two parameters indicate the column precision and the number of decimal digits: both zero for integers.

   - **&sDeptID** is a pointer to a buffer for the parameter value.
   - **0** indicates the length of the buffer, in bytes.
   - **&cbDeptID** is a pointer to a buffer for the length of the parameter value.

3. Bind the other two parameters and assign values to sDeptId.

4. Execute the statement:

```
retcode = SQLExecute( stmt);
```

   Steps 2 to 4 can be carried out multiple times.

5. Drop the statement.

Dropping the statement frees resources associated with the statement itself. You drop statements using SQLFreeHandle.

For a complete sample, including error checking, see *samples-dir\SQLAnywhere\ODBCPrepare \odbcprepare.cpp*.

For more information about SQLPrepare, see SQLPrepare in the Microsoft *ODBC API Reference* at http://msdn.microsoft.com/en-us/library/ms710926.aspx.

64-bit ODBC considerations

When you use an ODBC function like SQLBindCol, SQLBindParameter, or SQLGetData, some of the parameters are typed as SQLLEN or SQLULEN in the function prototype. Depending on the date of the Microsoft ODBC API Reference documentation that you are looking at, you might see the same parameters described as SQLINTEGER or SQLUINTEGER.

SQLLEN and SQLULEN data items are 64 bits in a 64-bit ODBC application and 32 bits in a 32-bit ODBC application. SQLINTEGER and SQLUINTEGER data items are 32 bits on all platforms.

To illustrate the problem, the following ODBC function prototype was excerpted from an older copy of the Microsoft ODBC API Reference.

```
SQLRETURN SQLGetData(
     SQLHSTMT     StatementHandle,
     SQLUSMALLINT ColumnNumber,
     SQLSMALLINT  TargetType,
     SQLPOINTER   TargetValuePtr,
     SQLINTEGER   BufferLength,
     SQLINTEGER  *StrLen_or_IndPtr);
```

Compare this with the actual function prototype found in *sql.h* in Microsoft Visual Studio version 8.

```
SQLRETURN  SQL_API SQLGetData(
    SQLHSTMT      StatementHandle,
    SQLUSMALLINT  ColumnNumber,
    SQLSMALLINT   TargetType,
    SQLPOINTER    TargetValue,
    SQLLEN        BufferLength,
    SQLLEN       *StrLen_or_Ind);
```

As you can see, the BufferLength and StrLen_or_Ind parameters are now typed as SQLLEN, not SQLINTEGER. For the 64-bit platform, these are 64-bit quantities, not 32-bit quantities as indicated in the Microsoft documentation.

To avoid issues with cross-platform compilation, SQL Anywhere provides its own ODBC header files. For Windows platforms, you should include the *ntodbc.h* header file. For Unix platforms such as Linux, you should include the *unixodbc.h* header file. Use of these header files ensures compatibility with the corresponding SQL Anywhere ODBC driver for the target platform.

The following table lists some common ODBC types that have the same or different storage sizes on 64-bit and 32-bit platforms.

ODBC API	64-bit platform	32-bit platform
SQLINTEGER	32 bits	32 bits
SQLUINTEGER	32 bits	32 bits
SQLLEN	64 bits	32 bits
SQLULEN	64 bits	32 bits
SQLSETPOSIROW	64 bits	16 bits
SQL_C_BOOKMARK	64 bits	32 bits
BOOKMARK	64 bits	32 bits

If you declare data variables and parameters incorrectly, then you may encounter incorrect software behavior.

The following table summarizes the ODBC API function prototypes that have changed with the introduction of 64-bit support. The parameters that are affected are noted. The parameter name as documented by Microsoft is shown in parentheses when it differs from the actual parameter name used in the function prototype. The parameter names are those used in the Microsoft Visual Studio version 8 header files.

ODBC API	Parameter (Documented Parameter Name)
SQLBindCol	SQLLEN BufferLength SQLLEN *Strlen_or_Ind
SQLBindParam	SQLULEN LengthPrecision SQLLEN *Strlen_or_Ind
SQLBindParameter	SQLULEN cbColDef (ColumnSize) SQLLEN cbValueMax (BufferLength) SQLLEN *pcbValue (Strlen_or_IndPtr)
SQLColAttribute	SQLLEN *NumericAttribute
SQLColAttributes	SQLLEN *pfDesc
SQLDescribeCol	SQLULEN *ColumnSize (ColumnSizePtr)
SQLDescribeParam	SQLULEN *pcbParamDef (ParameterSizePtr)

ODBC API	Parameter (Documented Parameter Name)
SQLExtendedFetch	SQLLEN irow (FetchOffset) SQLULEN *pcrow (RowCountPtr)
SQLFetchScroll	SQLLEN FetchOffset
SQLGetData	SQLLEN BufferLength SQLLEN *Strlen_or_Ind (Strlen_or_IndPtr)
SQLGetDescRec	SQLLEN *Length (LengthPtr)
SQLParamOptions	SQLULEN crow, SQLULEN *pirow
SQLPutData	SQLLEN Strlen_or_Ind
SQLRowCount	SQLLEN *RowCount (RowCountPtr)
SQLSetConnectOption	SQLULEN Value
SQLSetDescRec	SQLLEN Length SQLLEN *StringLength (StringLengthPtr) SQLLEN *Indicator (IndicatorPtr)
SQLSetParam	SQLULEN LengthPrecision SQLLEN *Strlen_or_Ind (Strlen_or_IndPtr)
SQLSetPos	SQLSETPOSIROW irow (RowNumber)
SQLSetScrollOptions	SQLLEN crowKeyset
SQLSetStmtOption	SQLULEN Value

Some values passed into and returned from ODBC API calls through pointers have changed to accommodate 64-bit applications. For example, the following values for the SQLSetStmtAttr and SQLSetDescField functions are no longer SQLINTEGER/SQLUINTEGER. The same rule applies to the corresponding parameters for the SQLGetStmtAttr and SQLGetDescField functions.

ODBC API	Type for Value/ValuePtr variable
SQLSetStmtAttr(SQL_ATTR_FETCH_BOOKMARK_PTR)	SQLLEN * value

ODBC API	Type for Value/ValuePtr variable
SQLSetStmtAttr(SQL_ATTR_KEYSET_SIZE)	SQLULEN value
SQLSetStmtAttr(SQL_ATTR_MAX_LENGTH)	SQLULEN value
SQLSetStmtAttr(SQL_ATTR_MAX_ROWS)	SQLULEN value
SQLSetStmtAttr(SQL_ATTR_PARAM_BIND_OFF-SET_PTR)	SQLULEN * value
SQLSetStmtAttr(SQL_ATTR_PARAMS_PROCESSED_PTR)	SQLULEN * value
SQLSetStmtAttr(SQL_ATTR_PARAMSET_SIZE)	SQLULEN value
SQLSetStmtAttr(SQL_ATTR_ROW_ARRAY_SIZE)	SQLULEN value
SQLSetStmtAttr(SQL_ATTR_ROW_BIND_OFFSET_PTR)	SQLULEN * value
SQLSetStmtAttr(SQL_ATTR_ROW_NUMBER)	SQLULEN value
SQLSetStmtAttr(SQL_ATTR_ROWS_FETCHED_PTR)	SQLULEN * value
SQLSetDescField(SQL_DESC_ARRAY_SIZE)	SQLULEN value
SQLSetDescField(SQL_DESC_BIND_OFFSET_PTR)	SQLLEN * value
SQLSetDescField(SQL_DESC_ROWS_PROCESSED_PTR)	SQLULEN * value
SQLSetDescField(SQL_DESC_DISPLAY_SIZE)	SQLLEN value
SQLSetDescField(SQL_DESC_INDICATOR_PTR)	SQLLEN * value
SQLSetDescField(SQL_DESC_LENGTH)	SQLLEN value
SQLSetDescField(SQL_DESC_OCTET_LENGTH)	SQLLEN value
SQLSetDescField(SQL_DESC_OCTET_LENGTH_PTR)	SQLLEN * value

Note that the current Microsoft ODBC API Reference for SQLSetConnectAttr/SQLGetConnectAttr describes the numeric attribute values as SQLUINTEGER. Note that the type of these attribute values differs from the SQLSetStmtAttr/SQLGetStmtAttr attribute values which are described as SQLULEN.

Caution
There is one connection attribute, SQL_ATTR_ODBC_CURSORS, that is handled by the Microsoft ODBC Driver Manager. Although the Microsoft ODBC API Reference says the attribute is a SQLUINTEGER value specifying how the Driver Manager uses the ODBC cursor library, the 64-bit version of the Driver Manager returns a 64-bit SQLULEN value for SQLGetConnectAttr.

```
__int64 datavalue = 0x1234567812345678;
rc = SQLGetConnectAttr( hdbc, attr, &datavalue, 0, 0 );
```

After the call to SQLGetConnectAttr, the value of `datavalue` is `0x0000000000000002` which demonstrates that a 64-bit value is stored. Care must be exercised to avoid this Microsoft Driver Manager bug. Other attribute values are handled by the SQL Anywhere ODBC driver which returns SQLUINTEGER values as described by the ODBC API Reference.

For more information, see the Microsoft article "ODBC 64-Bit API Changes in MDAC 2.7" at http://support.microsoft.com/kb/298678.

Data alignment requirements

When you use SQLBindCol, SQLBindParameter, or SQLGetData, a C data type is specified for the column or parameter. On certain platforms, the storage (memory) provided for each column must be properly aligned to fetch or store a value of the specified type. The following table lists memory alignment requirements for processors such as Sun Sparc, Itanium-IA64, and ARM-based devices.

C Data Type	Alignment required
SQL_C_CHAR	none
SQL_C_BINARY	none
SQL_C_GUID	none
SQL_C_BIT	none
SQL_C_STINYINT	none
SQL_C_UTINYINT	none
SQL_C_TINYINT	none
SQL_C_NUMERIC	none
SQL_C_DEFAULT	none
SQL_C_SSHORT	2
SQL_C_USHORT	2

C Data Type	Alignment required
SQL_C_SHORT	2
SQL_C_DATE	2
SQL_C_TIME	2
SQL_C_TIMESTAMP	2
SQL_C_TYPE_DATE	2
SQL_C_TYPE_TIME	2
SQL_C_TYPE_TIMESTAMP	2
SQL_C_WCHAR	2 (buffer size must be a multiple of 2 on all platforms)
SQL_C_SLONG	4
SQL_C_ULONG	4
SQL_C_LONG	4
SQL_C_FLOAT	4
SQL_C_DOUBLE	8
SQL_C_SBIGINT	8
SQL_C_UBIGINT	8

The x86, x64, and PowerPC platforms do not require memory alignment. The x64 platform includes Advanced Micro Devices (AMD) AMD64 processors and Intel Extended Memory 64 Technology (EM64T) processors.

Working with result sets

ODBC applications use cursors to manipulate and update result sets. SQL Anywhere provides extensive support for different kinds of cursors and cursor operations.

For an introduction to cursors, see “Working with cursors” on page 8.

Choosing ODBC transaction isolation level

You can use SQLSetConnectAttr to set the transaction isolation level for a connection. The characteristics that determine the transaction isolation level that SQL Anywhere provides include the following:

- **SQL_TXN_READ_UNCOMMITTED** Set isolation level to 0. When this attribute value is set, it isolates any data read from changes by others and changes made by others cannot be seen. The re-execution of the read statement is affected by others. This does not support a repeatable read. This is the default value for isolation level.
- **SQL_TXN_READ_COMMITTED** Set isolation level to 1. When this attribute value is set, it does not isolate data read from changes by others, and changes made by others can be seen. The re-execution of the read statement is affected by others. This does not support a repeatable read.
- **SQL_TXN_REPEATABLE_READ** Set isolation level to 2. When this attribute value is set, it isolates any data read from changes by others, and changes made by others cannot be seen. The re-execution of the read statement is affected by others. This supports a repeatable read.
- **SQL_TXN_SERIALIZABLE** Set isolation level to 3. When this attribute value is set, it isolates any data read from changes by others, and changes made by others cannot be seen. The re-execution of the read statement is not affected by others. This supports a repeatable read.
- **SA_SQL_TXN_SNAPSHOT** Set isolation level to Snapshot. When this attribute value is set, it provides a single view of the database for the entire transaction.
- **SA_SQL_TXN_STATEMENT_SNAPSHOT** Set isolation level to Statement-snapshot. When this attribute value is set, it provides less consistency than Snapshot isolation, but may be useful when long running transactions result in too much space being used in the temporary file by the version store.
- **SA_SQL_TXN_READONLY_STATEMENT_SNAPSHOT** Set isolation level to Readonly-statement-snapshot. When this attribute value is set, it provides less consistency than Statement-snapshot isolation, but avoids the possibility of update conflicts. Therefore, it is most appropriate for porting applications originally intended to run under different isolation levels.

Note that the allow_snapshot_isolation database option must be set to On to use the Snapshot, Statement-snapshot, or Readonly-statement-snapshot settings.

For more information, see SQLSetConnectAttr in the Microsoft *ODBC API Reference* at http://msdn.microsoft.com/en-us/library/ms713605.aspx.

Example

The following fragment sets the isolation level to Snapshot:

```
SQLAllocHandle( SQL_HANDLE_DBC, env, &dbc );
SQLSetConnectAttr( dbc, SQL_ATTR_TXN_ISOLATION,
      SA_SQL_TXN_SNAPSHOT, SQL_IS_UINTEGER );
```

Choosing ODBC cursor characteristics

ODBC functions that execute statements and manipulate result sets, use cursors to perform their tasks. Applications open a cursor implicitly whenever they execute a SQLExecute or SQLExecDirect function.

For applications that move through a result set only in a forward direction and do not update the result set, cursor behavior is relatively straightforward. By default, ODBC applications request this behavior. ODBC defines a read-only, forward-only cursor, and SQL Anywhere provides a cursor optimized for performance in this case.

For a simple example of a forward-only cursor, see "Retrieving data" on page 371.

For applications that need to scroll both forward and backward through a result set, such as many graphical user interface applications, cursor behavior is more complex. What does the application when it returns to a row that has been updated by some other application? ODBC defines a variety of **scrollable cursors** to allow you to build in the behavior that suits your application. SQL Anywhere provides a full set of cursors to match the ODBC scrollable cursor types.

You set the required ODBC cursor characteristics by calling the SQLSetStmtAttr function that defines statement attributes. You must call SQLSetStmtAttr before executing a statement that creates a result set.

You can use SQLSetStmtAttr to set many cursor characteristics. The characteristics that determine the cursor type that SQL Anywhere supplies include the following:

- **SQL_ATTR_CURSOR_SCROLLABLE** Set to SQL_SCROLLABLE for a scrollable cursor and SQL_NONSCROLLABLE for a forward-only cursor. SQL_NONSCROLLABLE is the default.
- **SQL_ATTR_CONCURRENCY** Set to one of the following values:
  - **SQL_CONCUR_READ_ONLY** Disallow updates. SQL_CONCUR_READ_ONLY is the default.
  - **SQL_CONCUR_LOCK** Use the lowest level of locking sufficient to ensure that the row can be updated.
  - **SQL_CONCUR_ROWVER** Use optimistic concurrency control, comparing row versions such as SQLBase ROWID or Sybase TIMESTAMP.
  - **SQL_CONCUR_VALUES** Use optimistic concurrency control, comparing values.

For more information, see SQLSetStmtAttr in the Microsoft *ODBC API Reference* at http://msdn.microsoft.com/en-us/library/ms712631.aspx.

Example

The following fragment requests a read-only, scrollable cursor:

```
SQLAllocHandle( SQL_HANDLE_STMT, dbc, &stmt );
SQLSetStmtAttr( stmt, SQL_ATTR_CURSOR_SCROLLABLE,
      SQL_SCROLLABLE, SQL_IS_UINTEGER );
```

Retrieving data

To retrieve rows from a database, you execute a SELECT statement using SQLExecute or SQLExecDirect. This opens a cursor on the statement.

You then use SQLFetch or SQLFetchScroll to fetch rows through the cursor. These functions fetch the next rowset of data from the result set and return data for all bound columns. Using SQLFetchScroll, rowsets can be specified at an absolute or relative position or by bookmark. SQLFetchScroll replaces the older SQLExtendedFetch from the ODBC 2.0 specification.

When an application frees the statement using SQLFreeHandle, it closes the cursor.

To fetch values from a cursor, your application can use either SQLBindCol or SQLGetData. If you use SQLBindCol, values are automatically retrieved on each fetch. If you use SQLGetData, you must call it for each column after each fetch.

SQLGetData is used to fetch values in pieces for columns such as LONG VARCHAR or LONG BINARY. As an alternative, you can set the SQL_ATTR_MAX_LENGTH statement attribute to a value large enough to hold the entire value for the column. The default value for SQL_ATTR_MAX_LENGTH is 256 KB.

The SQL Anywhere ODBC driver implements SQL_ATTR_MAX_LENGTH in a different way than intended by the ODBC specification. The intended meaning for SQL_ATTR_MAX_LENGTH is that it be used as a mechanism to truncate large fetches. This might be done for a "preview" mode where only the first part of the data is displayed. For example, instead of transmitting a 4 MB blob from the server to the client application, only the first 500 bytes of it might be transmitted (by setting SQL_ATTR_MAX_LENGTH to 500). The SQL Anywhere ODBC driver does not support this implementation.

The following code fragment opens a cursor on a query and retrieves data through the cursor. Error checking has been omitted to make the example easier to read. The fragment is taken from a complete sample, which can be found in *samples-dir\SQLAnywhere\ODBCSelect\odbcselect.cpp*.

```
SQLINTEGER cbDeptID = 0, cbDeptName = SQL_NTS, cbManagerID = 0;
SQLCHAR deptName[ DEPT_NAME_LEN + 1 ];
SQLSMALLINT deptID, managerID;
SQLHENV  env;
SQLHDBC  dbc;
SQLHSTMT stmt;
SQLRETURN retcode;
SQLAllocHandle( SQL_HANDLE_ENV, SQL_NULL_HANDLE, &env );
SQLSetEnvAttr( env,
            SQL_ATTR_ODBC_VERSION,
            (void*)SQL_OV_ODBC3, 0);
SQLAllocHandle( SQL_HANDLE_DBC, env, &dbc );
SQLConnect( dbc,
            (SQLCHAR*) "SQL Anywhere 12 Demo", SQL_NTS,
            (SQLCHAR*) "DBA", SQL_NTS,
            (SQLCHAR*) "sql", SQL_NTS );
SQLAllocHandle( SQL_HANDLE_STMT, dbc, &stmt );
SQLBindCol( stmt, 1,
            SQL_C_SSHORT, &deptID, 0, &cbDeptID);
SQLBindCol( stmt, 2,
            SQL_C_CHAR, deptName,
            sizeof(deptName), &cbDeptName);
SQLBindCol( stmt, 3,
            SQL_C_SSHORT, &managerID, 0, &cbManagerID);
SQLExecDirect( stmt, (SQLCHAR * )
"SELECT DepartmentID, DepartmentName, DepartmentHeadID FROM Departments "
               "ORDER BY DepartmentID", SQL_NTS );
while( ( retcode = SQLFetch( stmt ) ) != SQL_NO_DATA ){
```



```
   printf( "%d %20s %d\n", deptID, deptName, managerID );
}
SQLFreeHandle( SQL_HANDLE_STMT, stmt );
SQLDisconnect( dbc );
SQLFreeHandle( SQL_HANDLE_DBC, dbc );
SQLFreeHandle( SQL_HANDLE_ENV, env );
```

The number of row positions you can fetch in a cursor is governed by the size of an integer. You can fetch rows numbered up to number 2147483646, which is one less than the value that can be held in a 32-bit integer. When using negative numbers (rows from the end) you can fetch down to one more than the largest negative value that can be held in an integer.

Updating and deleting rows through a cursor

The Microsoft *ODBC Programmer's Reference* suggests that you use SELECT ... FOR UPDATE to indicate that a query is updatable using positioned operations. You do not need to use the FOR UPDATE clause in SQL Anywhere: SELECT statements are automatically updatable as long as the following conditions are met:

- The underlying query supports updates.

  That is to say, as long as a data modification statement on the columns in the result is meaningful, then positioned data modification statements can be carried out on the cursor.

  The ansi_update_constraints database option limits the type of queries that are updatable.

  For more information, see “ansi_update_constraints option” [*SQL Anywhere Server - Database Administration*].

- The cursor type supports updates.

  If you are using a read-only cursor, you cannot update the result set.

ODBC provides two alternatives for carrying out positioned updates and deletes:

- Use the SQLSetPos function.

  Depending on the parameters supplied (SQL_POSITION, SQL_REFRESH, SQL_UPDATE, SQL_DELETE) SQLSetPos sets the cursor position and allows an application to refresh data, or update, or delete data in the result set.

  This is the method to use with SQL Anywhere.

- Send positioned UPDATE and DELETE statements using SQLExecute. This method should not be used with SQL Anywhere.

Using bookmarks

ODBC provides **bookmarks**, which are values used to identify rows in a cursor. SQL Anywhere supports bookmarks for value-sensitive and insensitive cursors. For example, this means that the ODBC cursor

types SQL_CURSOR_STATIC and SQL_CURSOR_KEYSET_DRIVEN support bookmarks while cursor types SQL_CURSOR_DYNAMIC and SQL_CURSOR_FORWARD_ONLY do not.

Before ODBC 3.0, a database could specify only whether it supported bookmarks or not: there was no interface to provide this information for each cursor type. There was no way for a database server to indicate for what kind of cursor bookmarks were supported. For ODBC 2 applications, SQL Anywhere returns that it does support bookmarks. There is therefore nothing to prevent you from trying to use bookmarks with dynamic cursors; however, you should not use this combination.

Calling stored procedures

This section describes how to create and call stored procedures and process the results from an ODBC application.

For a full description of stored procedures and triggers, see "Using procedures, triggers, and batches" [*SQL Anywhere Server - SQL Usage*].

Procedures and result sets

There are two types of procedures: those that return result sets and those that do not. You can use SQLNumResultCols to tell the difference: the number of result columns is zero if the procedure does not return a result set. If there is a result set, you can fetch the values using SQLFetch or SQLExtendedFetch just like any other cursor.

Parameters to procedures should be passed using parameter markers (question marks). Use SQLBindParameter to assign a storage area for each parameter marker, whether it is an INPUT, OUTPUT, or INOUT parameter.

To handle multiple result sets, ODBC must describe the currently executing cursor, not the procedure-defined result set. Therefore, ODBC does not always describe column names as defined in the RESULT clause of the stored procedure definition. To avoid this problem, you can use column aliases in your procedure result set cursor.

Example 1

This example creates and calls a procedure that does not return a result set. The procedure takes one INOUT parameter, and increments its value. In the example, the variable num_col has the value zero, since the procedure does not return a result set. Error checking has been omitted to make the example easier to read.

```
HDBC dbc;
HSTMT stmt;
long I;
SWORD num_col;

/* Create a procedure */
SQLAllocStmt( dbc, &stmt );
SQLExecDirect( stmt,
      "CREATE PROCEDURE Increment( INOUT a INT )" \
      " BEGIN" \
         " SET a = a + 1" \
```



```
      " END", SQL_NTS );

/* Call the procedure to increment 'I' */
I = 1;
SQLBindParameter( stmt, 1, SQL_C_LONG, SQL_INTEGER, 0,
            0, &I, NULL );
SQLExecDirect( stmt, "CALL Increment( ? )",
            SQL_NTS );
SQLNumResultCols( stmt, &num_col );
do_something( I );
```

Example 2

This example calls a procedure that returns a result set. In the example, the variable **num_col** will have the value 2 since the procedure returns a result set with two columns. Again, error checking has been omitted to make the example easier to read.

```
HDBC dbc;
HSTMT stmt;
SWORD num_col;
RETCODE retcode;
char ID[ 10 ];
char Surname[ 20 ];

/* Create the procedure */
SQLExecDirect( stmt,
      "CREATE PROCEDURE employees()" \
      " RESULT( ID CHAR(10), Surname CHAR(20))"\
      " BEGIN" \
      " SELECT EmployeeID, Surname FROM Employees" \
      " END", SQL_NTS );

/* Call the procedure - print the results */
SQLExecDirect( stmt, "CALL employees()", SQL_NTS );
SQLNumResultCols( stmt, &num_col );
SQLBindCol( stmt, 1, SQL_C_CHAR, &ID,
            sizeof(ID), NULL );
SQLBindCol( stmt, 2, SQL_C_CHAR, &Surname,
            sizeof(Surname), NULL );

for( ;; ) {
   retcode = SQLFetch( stmt );
   if( retcode == SQL_NO_DATA_FOUND ) {
      retcode = SQLMoreResults( stmt );
   if( retcode == SQL_NO_DATA_FOUND ) break;
}  else {
      do_something( ID, Surname );
   }
}
```

Handling errors

Errors in ODBC are reported using the return value from each of the ODBC function calls and either the SQLError function or the SQLGetDiagRec function. The SQLError function was used in ODBC versions up to, but not including, version 3. As of version 3 the SQLError function has been deprecated and replaced by the SQLGetDiagRec function.

Every ODBC function returns a SQLRETURN, which is one of the following status codes:

Status code	Description
SQL_SUCCESS	No error.
SQL_SUCCESS_WITH_INFO	The function completed, but a call to SQLError will indicate a warning. The most common case for this status is that a value being returned is too long for the buffer provided by the application.
SQL_ERROR	The function did not complete because of an error. Call SQLError to get more information about the problem.
SQL_INVALID_HANDLE	An invalid environment, connection, or statement handle was passed as a parameter. This often happens if a handle is used after it has been freed, or if the handle is the null pointer.
SQL_NO_DATA_FOUND	There is no information available. The most common use for this status is when fetching from a cursor; it indicates that there are no more rows in the cursor.
SQL_NEED_DATA	Data is needed for a parameter. This is an advanced feature described in the ODBC SDK documentation under SQLParamData and SQLPutData.

Every environment, connection, and statement handle can have one or more errors or warnings associated with it. Each call to SQLError or SQLGetDiagRec returns the information for one error and removes the information for that error. If you do not call SQLError or SQLGetDiagRec to remove all errors, the errors are removed on the next function call that passes the same handle as a parameter.

Each call to SQLError passes three handles for an environment, connection, and statement. The first call uses SQL_NULL_HSTMT to get the error associated with a connection. Similarly, a call with both SQL_NULL_DBC and SQL_NULL_HSTMT get any error associated with the environment handle.

Each call to SQLGetDiagRec can pass either an environment, connection or statement handle. The first call passes in a handle of type SQL_HANDLE_DBC to get the error associated with a connection. The second call passes in a handle of type SQL_HANDLE_STMT to get the error associated with the statement that was just executed.

SQLError and SQLGetDiagRec return SQL_SUCCESS if there is an error to report (*not* SQL_ERROR), and SQL_NO_DATA_FOUND if there are no more errors to report.

Example 1

The following code fragment uses SQLError and return codes:


```
/* Declare required variables */
SQLHDBC dbc;
SQLHSTMT stmt;
SQLRETURN retcode;
UCHAR errmsg[100];
/* Code omitted here */
retcode = SQLAllocHandle(SQL_HANDLE_STMT, dbc, &stmt );
if( retcode == SQL_ERROR ){
   SQLError( env, dbc, SQL_NULL_HSTMT, NULL, NULL,
         errmsg, sizeof(errmsg), NULL );
   /* Assume that print_error is defined */
   print_error( "Allocation failed", errmsg );
   return;
}

/* Delete items for order 2015 */
retcode = SQLExecDirect( stmt,
       "DELETE FROM SalesOrderItems WHERE ID=2015",
       SQL_NTS );
if( retcode == SQL_ERROR ) {
   SQLError( env, dbc, stmt, NULL, NULL,
            errmsg, sizeof(errmsg), NULL );
   /* Assume that print_error is defined */
   print_error( "Failed to delete items", errmsg );
   return;
}
```

Example 2

The following code fragment uses SQLGetDiagRec and return codes:

```
/* Declare required variables */
SQLHDBC dbc;
SQLHSTMT stmt;
SQLRETURN retcode;
SQLSMALLINT errmsglen;
SQLINTEGER errnative;
UCHAR errmsg[255];
UCHAR errstate[5];
/* Code omitted here */
retcode = SQLAllocHandle(SQL_HANDLE_STMT, dbc, &stmt );
if( retcode == SQL_ERROR ){
   SQLGetDiagRec(SQL_HANDLE_DBC, dbc, 1, errstate,
       &errnative, errmsg, sizeof(errmsg), &errmsglen);
    /* Assume that print_error is defined */
   print_error( "Allocation failed",
errstate, errnative, errmsg );
   return;

}
/* Delete items for order 2015 */
retcode = SQLExecDirect( stmt,
       "DELETE FROM SalesOrderItems WHERE ID=2015",
       SQL_NTS );
if( retcode == SQL_ERROR ) {
   SQLGetDiagRec(SQL_HANDLE_STMT, stmt,
       recnum, errstate,
       &errnative, errmsg, sizeof(errmsg), &errmsglen);
   /* Assume that print_error is defined */
   print_error("Failed to delete items",
       errstate, errnative, errmsg );
   return;
}
```

Java in the database

SQL Anywhere provides a mechanism for executing Java classes from within the database server environment. Using Java methods in the database server provides powerful ways of adding programming logic to a database.

Java support in the database offers the following:

- Reuse Java components in the different layers of your application—client, middle-tier, or server—and use them wherever it makes the most sense to you. SQL Anywhere becomes a platform for distributed computing.
- Java provides a more powerful language than the SQL stored procedure language for building logic into the database.
- Java can be used in the database server without jeopardizing the integrity, security, or robustness of the database and the server.

The SQLJ standard

Java in the database is based on the SQLJ Part 1 proposed standard (ANSI/INCITS 331.1-1999). SQLJ Part 1 provides specifications for calling Java static methods as SQL stored procedures and functions.

Learning about Java in the database

The following table outlines the documentation regarding the use of Java in the database.

Title	Purpose
“Java in the database” on page 379 (this chapter)	Java concepts and how to apply them in SQL Anywhere.
“Creating a Java class for use with SQL Anywhere” on page 382	Practical steps for using Java in the database.
“JDBC support” on page 397	Accessing data from Java classes, including distributed computing.

The following table is a guide to which parts of the Java documentation apply to you, depending on your interests and background.

If you ...	Consider reading ...
are a Java developer who wants to just get started.	“Creating a Java class for use with SQL Anywhere” on page 382
want to know the key features of Java in the database.	“Java in the database Q & A” on page 380

If you ...	Consider reading ...
want to find out how to access data from Java.	“JDBC support” on page 397

Java in the database Q & A

This section describes the key features of Java in the database.

What are the key features of Java in the database?

Detailed explanations of all the following points appear in later sections.

- **You can run Java in the database** An external Java VM runs Java code on behalf of the database server.
- **You can access data from Java** SQL Anywhere lets you access data from Java.
- **SQL is preserved** The use of Java does not alter the behavior of existing SQL statements or other aspects of non-Java relational database behavior.

How do I store Java classes in the database?

Java is an object-oriented language, so its instructions (source code) come in the form of classes. To execute Java in a database, you write the Java instructions outside the database and compile them outside the database into compiled classes (**byte code**), which are binary files holding Java instructions.

You then install these compiled classes into a database. Once installed, you can execute these classes from the database server as a stored procedure. For example, the following statement creates the interface to a Java procedure:

```
CREATE PROCEDURE insertfix()
EXTERNAL NAME 'JDBCExample.InsertFixed()V'
LANGUAGE JAVA;
```

SQL Anywhere facilitates a runtime environment for Java classes, not a Java development environment. You need a Java development environment, such as the Sun Microsystems Java Development Kit, to write and compile Java. You also need a Java Runtime Environment to execute Java classes.

For more information, see “Installing Java classes into a database” on page 389.

How does Java get executed in a database?

SQL Anywhere launches a Java VM. The Java VM interprets compiled Java instructions and runs them on behalf of the database server. The database server starts the Java VM automatically when needed: you do not have to take any explicit action to start or stop the Java VM.

The SQL request processor in the database server has been extended so it can call into the Java VM to execute Java instructions. It can also process requests from the Java VM to enable data access from Java.

Why Java?

Java provides several features that make it ideal for use in the database:

- Thorough error checking at compile time.
- Built-in error handing with a well-defined error handling methodology.
- Built-in garbage collection (memory recovery).
- Elimination of many bug-prone programming techniques.
- Strong security features.
- Platform-independent execution of Java code.

On what platforms is Java in the database supported?

Java in the database is supported on all Unix and Windows operating systems except Windows Mobile.

How do I use Java and SQL together?

Java methods are declared as stored procedures, and can then be called just like SQL stored procedures.

You must create a stored procedure that runs your method. For example:

```
CREATE PROCEDURE javaproc()
EXTERNAL NAME 'JDBCExample.MyMethod ()V'
LANGUAGE JAVA;
```

You can use many of the classes that are part of the Java API as included in the Sun Microsystems Java Development Kit. You can also use classes created and compiled by Java developers.

For more information, see “CREATE PROCEDURE statement (external procedures)” [*SQL Anywhere Server - SQL Reference*].

How can I use my own Java classes in databases?

You can install your own Java classes into a database. For example, you could design, write in Java, and compile with a Java compiler, a user-created Employees class or Package class.

User-created Java classes can contain both information about the subject and some computational logic. Once installed in a database, SQL Anywhere lets you use these classes in all parts and operations of the database and execute their functionality (in the form of class or instance methods) as easily as calling a stored procedure.

Java classes and stored procedures are different
Java classes are different from stored procedures. Whereas stored procedures are written in SQL, Java classes provide a more powerful language, and can be called from client applications as easily and in the same way as stored procedures.

For more information, see "Installing Java classes into a database" on page 389.

Java error handling

Java error handling code is separate from the code for normal processing.

Errors generate an exception object representing the error. This is called **throwing an exception**. A thrown exception terminates a Java program unless it is caught and handled properly at some level of the application.

Both Java API classes and custom-created classes can throw exceptions. In fact, users can create their own exception classes that throw their own custom-created classes.

If there is no exception handler in the body of the method where the exception occurred, then the search for an exception handler continues up the call stack. If the top of the call stack is reached and no exception handler has been found, the default exception handler of the Java interpreter running the application is called and the program terminates.

In SQL Anywhere, if a SQL statement calls a Java method, and an unhandled exception is thrown, a SQL error is generated. The full text of the Java exception plus the Java stack trace is displayed in the server messages window.

Creating a Java class for use with SQL Anywhere

The following sections describe the steps involved in creating Java methods and calling them from SQL. It shows you how to compile and install a Java class into the database to make it available for use in SQL Anywhere. It also shows you how to access the class and its members and methods from SQL statements.

The following sections assume that you have a Java Development Kit (JDK) installed, including the Java compiler (javac) and Java VM.

Source code and batch files for the sample are provided in *samples-dir\SQLAnywhere\JavaInvoice*.

The first step to using Java in the database is to write the Java code and compile it. This is done outside the database.

To create and compile the class

1. Create the sample Java class source file.

   For your convenience, the sample code is included here. You can paste the following code into *Invoice.java* or obtain the file from *samples-dir\SQLAnywhere\JavaInvoice*.

```
import java.io.*;

public class Invoice
{
    public static String lineItem1Description;
    public static double lineItem1Cost;

    public static String lineItem2Description;
    public static double lineItem2Cost;

    public static double totalSum() {
        double runningsum;
        double taxfactor = 1 + Invoice.rateOfTaxation();

        runningsum = lineItem1Cost + lineItem2Cost;
        runningsum = runningsum * taxfactor;

        return runningsum;
    }

    public static double rateOfTaxation()
    {
        double rate;
        rate = .15;

        return rate;
    }

    public static void init(
      String item1desc, double item1cost,
      String item2desc, double item2cost )
    {
        lineItem1Description = item1desc;
        lineItem1Cost = item1cost;
        lineItem2Description = item2desc;
        lineItem2Cost = item2cost;
    }

    public static String getLineItem1Description()
    {
        return lineItem1Description;
    }

    public static double getLineItem1Cost()
    {
        return lineItem1Cost;
    }

    public static String getLineItem2Description()
    {
        return lineItem2Description;
    }

    public static double getLineItem2Cost()
    {
```

```
        return lineItem2Cost;
    }

    public static boolean testOut( int[] param )
    {
        param[0] = 123;
        return true;
    }

    public static void main( String[] args )
    {
        System.out.print( "Hello" );
        for ( int i = 0; i  < args.length; i++ )
            System.out.print( " " + args[i] );
        System.out.println();
    }
}
```

2. Compile the file to create the file *Invoice.class*.

   ```
   javac Invoice.java
   ```

   The class is now compiled and ready to be installed into the database.

Choosing a Java VM

The database server must be set up to locate a Java VM. Since you can specify different Java VMs for each database, the ALTER EXTERNAL ENVIRONMENT statement can be used to indicate the location (path) of the Java VM.

```
ALTER EXTERNAL ENVIRONMENT JAVA
LOCATION 'c:\\jdk1.5.0_06\\jre\\bin\\java.exe';
```

If the location is not set, the database server searches for the location of the Java VM, as follows:

- Check the JAVA_HOME environment variable.
- Check the JAVAHOME environment variable.
- Check the path.
- If the information is not in the path, return an error.

See "ALTER EXTERNAL ENVIRONMENT statement" [*SQL Anywhere Server - SQL Reference*].

Note
JAVA_HOME and JAVAHOME are environment variables commonly created when installing a Java VM. If neither of these exist, you can create them manually, and point them to the root directory of your Java VM. However, this is not required if you use the ALTER EXTERNAL ENVIRONMENT statement.

To specify the location of the Java VM (Interactive SQL)

1. Start Interactive SQL and connect to the database.
2. In the SQL Statements pane, type the following statement:

   ```
   ALTER EXTERNAL ENVIRONMENT JAVA
   LOCATION 'path\\java.exe';
   ```

   Here, *path* indicates the location of the Java VM (for example, *c:\\jdk1.5.0_06\\jre\\bin*).

For more information, see "ALTER EXTERNAL ENVIRONMENT statement" [*SQL Anywhere Server - SQL Reference*].

Use the java_vm_options option to specify any additional command line options that are required to start the Java VM.

```
SET OPTION PUBLIC.java_vm_options='java-options';
```

For more information, see "java_vm_options option" [*SQL Anywhere Server - Database Administration*].

If you want to use JAVA in the database, but do not have a Java Runtime Environment (JRE) installed, you can install and use any Java JRE that you want to. Once installed, it is best to set the JAVA_HOME or JAVAHOME environment variable to point to the root of the installed JRE. Note that most Java installers set one of these environment variables by default. Once a JRE is installed and JAVA_HOME or JAVAHOME is set correctly, you should then be able to use Java in the database without performing any additional steps.

Install the sample Java class

Java classes must be installed into a database before they can be used. You can install classes from Sybase Central or Interactive SQL.

To install the class to the SQL Anywhere sample database (Sybase Central)

1. Start Sybase Central and connect to the sample database.
2. In the left pane, expand the **External Environments** folder.
3. Click **Java**.
4. Choose **File** » **New** » **Java Class**.
5. Click **Browse** and browse to the location of *Invoice.class*.
6. Click **Finish**.

To install the class to the SQL Anywhere sample database (Interactive SQL)

1. Start Interactive SQL and connect to the sample database.

2. In the **SQL Statements** pane of Interactive SQL, type the following statement:

```
INSTALL JAVA NEW
FROM FILE 'path\\Invoice.class';
```

   Here *path* is the location of your compiled class file.

3. Press F5 to execute the statement.

The class is now installed into the sample database.

Notes

- At this point, no Java in the database operations have taken place. The class has been installed into the database and is ready for use.
- Changes made to the class file from now on are *not* automatically reflected in the copy of the class in the database. You must update the classes in the database if you want the changes reflected.

For more information about installing classes, and for information about updating an installed class, see "Installing Java classes into a database" on page 389.

Using the CLASSPATH variable

The Sun Java Runtime Environment and the Sun JDK Java compiler use the CLASSPATH environment variable to locate classes referenced within Java code. A CLASSPATH variable provides the link between Java code and the actual file path or URL location of the classes being referenced. For example, `import java.io.*` allows all the classes in the java.io package to be referenced without a fully qualified name. Only the class name is required in the following Java code to use classes from the java.io package. The CLASSPATH environment variable on the system where the Java class declaration is to be compiled must include the location of the Java directory, the root of the java.io package.

CLASSPATH used to install classes

The CLASSPATH variable can be used to locate a file during the installation of classes. For example, the following statement installs a user-created Java class to a database, but only specifies the name of the file, not its full path and name. (Note that this statement involves no Java operations.)

```
INSTALL JAVA NEW
FROM FILE 'Invoice.class';
```

If the file specified is in a directory or ZIP file specified by the CLASSPATH environmental variable, SQL Anywhere successfully locates the file and install the class.

Accessing methods in the Java class

To access the Java methods in the class, you must create stored procedures or functions that act as wrappers for the methods in the class.

To call a Java method using Interactive SQL

1. Create the following SQL stored procedure to call the Invoice.main method in the sample class:

   ```
   CREATE PROCEDURE InvoiceMain( IN arg1 CHAR(50) )
   EXTERNAL NAME 'Invoice.main([Ljava/lang/String;)V'
   LANGUAGE JAVA;
   ```

   This stored procedure acts as a wrapper to the Java method.

   For more information about the syntax of this statement, see "CREATE PROCEDURE statement (external procedures)" [*SQL Anywhere Server - SQL Reference*].

2. Call the stored procedure to call the Java method:

   ```
   CALL InvoiceMain('to you');
   ```

   If you examine the database server message log, you see the message "Hello to you" written there. The database server has redirected the output there from System.out.

Accessing fields and methods of the Java object

Here are more examples of how to call Java methods, pass arguments, and return values.

To create stored procedures/functions for the methods in the Invoice class

1. Create the following SQL stored procedures to pass arguments to and retrieve return values from the Java methods in the Invoice class:

   ```
   -- Invoice.init takes a string argument (Ljava/lang/String;)
   -- a double (D), a string argument (Ljava/lang/String;), and
   -- another double (D), and returns nothing (V)
   CREATE PROCEDURE init( IN arg1 CHAR(50),
                          IN arg2 DOUBLE,
                          IN arg3 CHAR(50),
                          IN arg4 DOUBLE)
   EXTERNAL NAME
     'Invoice.init(Ljava/lang/String;DLjava/lang/String;D)V'
   LANGUAGE JAVA;
   -- Invoice.rateOfTaxation take no arguments ()
   -- and returns a double (D)
   CREATE FUNCTION rateOfTaxation()
   RETURNS DOUBLE
   EXTERNAL NAME
     'Invoice.rateOfTaxation()D'
   LANGUAGE JAVA;
   -- Invoice.rateOfTaxation take no arguments ()
   -- and returns a double (D)
   CREATE FUNCTION totalSum()
   RETURNS DOUBLE
   EXTERNAL NAME
     'Invoice.totalSum()D'
   LANGUAGE JAVA;
   -- Invoice.getLineItem1Description take no arguments ()
   -- and returns a string (Ljava/lang/String;)
   ```

```
CREATE FUNCTION getLineItem1Description()
RETURNS CHAR(50)
EXTERNAL NAME
  'Invoice.getLineItem1Description()Ljava/lang/String;'
LANGUAGE JAVA;
-- Invoice.getLineItem1Cost take no arguments ()
-- and returns a double (D)
CREATE FUNCTION getLineItem1Cost()
RETURNS DOUBLE
EXTERNAL NAME
  'Invoice.getLineItem1Cost()D'
LANGUAGE JAVA;
-- Invoice.getLineItem2Description take no arguments ()
-- and returns a string (Ljava/lang/String;)
CREATE FUNCTION getLineItem2Description()
RETURNS CHAR(50)
EXTERNAL NAME
  'Invoice.getLineItem2Description()Ljava/lang/String;'
LANGUAGE JAVA;
-- Invoice.getLineItem2Cost take no arguments ()
-- and returns a double (D)
CREATE FUNCTION getLineItem2Cost()
RETURNS DOUBLE
EXTERNAL NAME
  'Invoice.getLineItem2Cost()D'
LANGUAGE JAVA;
```

The descriptors for arguments to and return values from Java methods have the following meanings:

Field type	Java data type
B	byte
C	char
D	double
F	float
I	int
J	long
L *class-name*;	An instance of the class *class-name*. The class name must be fully qualified, and any dot in the name must be replaced by a /. For example, **java/lang/String**.
S	short
V	void
Z	Boolean
[	Use one for each dimension of an array.

For more information about the syntax of these statements, see "CREATE PROCEDURE statement (external procedures)" [*SQL Anywhere Server - SQL Reference*] and "CREATE FUNCTION statement (external procedures)" [*SQL Anywhere Server - SQL Reference*].

2. Call the stored procedure that is acting as a wrapper to call the Java method:

```
CALL init('Shirt',10.00,'Jacket',25.00);
SELECT getLineItem1Description() as Item1,
       getLineItem1Cost() as Item1Cost,
       getLineItem2Description() as Item2,
       getLineItem2Cost() as Item2Cost,
       rateOfTaxation() as TaxRate,
       totalSum() as Cost;
```

The query returns six columns with values as follows:

Item1	Item1Cost	Item2	Item2Cost	TaxRate	Cost
Shirt	10	Jacket	25	0.15	40.25

Installing Java classes into a database

You can install Java classes into a database as:

- **A single class** You can install a single class into a database from a compiled class file. Class files typically have extension *.class*.
- **A JAR** You can install a set of classes all at once if they are in either a compressed or uncompressed JAR file. JAR files typically have the extension *.jar* or *.zip*. SQL Anywhere supports all compressed JAR files created with the Sun JAR utility, and some other JAR compression schemes.

Creating a class

Although the details of each step may differ depending on whether you are using a Java development tool, the steps involved in creating your own class generally include the following:

To create a class

1. Define your class.

   Write the Java code that defines your class. If you are using the Sun Java SDK then you can use a text editor. If you are using a development tool, the development tool provides instructions.

   Use only supported classes
   User classes must be 100% Java. Native methods are not allowed.

2. Name and save your class.

   Save your class declaration (Java code) in a file with the extension *.java*. Make certain the name of the file is the same as the name of the class and that the case of both names is identical.

   For example, a class called Utility should be saved in a file called *Utility.java*.

3. Compile your class.

   This step turns your class declaration containing Java code into a new, separate file containing byte code. The name of the new file is the same as the Java code file, but has an extension of *.class*. You can run a compiled Java class in a Java Runtime Environment, regardless of the platform you compiled it on or the operating system of the runtime environment.

   The Sun JDK contains a Java compiler, *javac*.

Installing a class

To make your Java class available within the database, you install the class into the database either from Sybase Central, or using the INSTALL JAVA statement from Interactive SQL or another application. You must know the path and file name of the class you want to install.

You require DBA authority to install a class.

To install a class (Sybase Central)

1. Connect to a database as a DBA user.
2. Open the **External Environments** folder.
3. Under this folder, open the **Java** folder.
4. Right-click the right pane and choose **New** » **Java Class**.
5. Follow the instructions in the wizard.

To install a class (SQL)

1. Connect to the database as a DBA user.
2. Execute the following statement:

   ```
   INSTALL JAVA NEW
   FROM FILE 'path\\ClassName.class';
   ```

   path is the directory where the class file is located, and *ClassName.class* is the name of the class file.

   The double backslash ensures that the backslash is not treated as an escape character.

For example, to install a class in a file named *Utility.class*, held in the directory *c:\source*, you would execute the following statement:

```
INSTALL JAVA NEW
FROM FILE 'c:\\source\\Utility.class';
```

If you use a relative path, it must be relative to the current working directory of the database server.

For more information, see "INSTALL JAVA statement" [*SQL Anywhere Server - SQL Reference*].

Installing a JAR

It is useful and common practice to collect sets of related classes together in packages, and to store one or more packages in a **JAR file**.

You install a JAR file the same way as you install a class file. A JAR file can have the extension JAR or ZIP. Each JAR file must have a name in the database. Usually, you use the same name as the JAR file, without the extension. For example, if you install a JAR file named *myjar.zip*, you would generally give it a JAR name of *myjar*.

For more information, see "INSTALL JAVA statement" [*SQL Anywhere Server - SQL Reference*].

To install a JAR (Sybase Central)

1. Connect to the database as a DBA user.
2. Open the **External Environments** folder.
3. Under this folder, open the **Java** folder.
4. Right-click the right pane and choose **New** » **JAR File**.
5. Follow the instructions in the wizard.

To install a JAR (SQL)

1. Connect to a database as a DBA user.
2. Execute the following statement:

```
INSTALL JAVA NEW
JAR 'jarname'
FROM FILE 'path\\JarName.jar';
```

Updating classes and JAR files

You can update classes and JAR files using Sybase Central or by executing an INSTALL JAVA statement from Interactive SQL or some other client application.

To update a class or JAR, you must have DBA authority and a newer version of the compiled class file or JAR file available in a file on disk.

When updated classes take effect

Only new connections established after installing the class, or that use the class for the first time after installing the class, use the new definition. Once the Java VM loads a class definition, it stays in memory until the connection closes.

If you have been using a Java class or objects based on a class in the current connection, you need to disconnect and reconnect to use the new class definition.

Update a class or JAR

To update a class or JAR (Sybase Central)

1. Connect to the database as a DBA user.
2. Open the **External Environments** folder.
3. Under this folder, open the **Java** folder.
4. Locate the subfolder containing the class or JAR file you want to update.
5. Select the class or JAR file and the choose **File** » **Update**.
6. In the **Update** window, specify the name and location of the class or JAR file to be updated. You can click **Browse** to search for it.

Tips

You can also update a Java class or JAR file by right-clicking the class or JAR file name and choosing **Update**.

As well, you can update a Java class or JAR file by clicking **Update Now** on the **General** tab of its **Properties** window.

To update a class or JAR (SQL)

1. Connect to a database as a DBA user.
2. Execute the following statement:

```
INSTALL JAVA UPDATE
[ JAR 'jarname' ]
FROM FILE 'filename';
```

If you are updating a JAR, you must enter the name by which the JAR is known in the database. See "INSTALL JAVA statement" [*SQL Anywhere Server - SQL Reference*].

Special features of Java classes in the database

This section describes features of Java classes when used in the database.

Calling the main method

You typically start Java applications (outside the database) by running the Java VM on a class that has a main method.

For example, the Invoice class in the file *samples-dir\SQLAnywhere\JavaInvoice\Invoice.java* has a main method. When you execute the class from the command line using a command such as the following, it is the main method that executes:

```
java Invoice
```

To call the main method of a class from SQL

1. Declare the method with an array of strings as an argument:

   ```
   public static void main( java.lang.String args[] )
   {
   ...
   }
   ```

2. Create a stored procedure that wraps this method.

   ```
   CREATE PROCEDURE JavaMain( in arg char(50) )
   EXTERNAL NAME 'JavaClass.main([Ljava/lang/String;)V'
   LANGUAGE JAVA;
   ```

   For more information, see "CREATE PROCEDURE statement (external procedures)" [*SQL Anywhere Server - SQL Reference*].

3. Invoke the main method using the CALL statement.

   ```
   call JavaMain( 'Hello world' );
   ```

   Due to the limitations of the SQL language, only a single string can be passed.

Using threads in Java applications

With features of the java.lang.Thread package, you can use multiple threads in a Java application.

You can synchronize, suspend, resume, interrupt, or stop threads in Java applications.

No Such Method Exception

If you supply an incorrect number of arguments when calling a Java method, or if you use an incorrect data type, the Java VM responds with a `java.lang.NoSuchMethodException` error. You should check the number and type of arguments.

For more information, see "Accessing fields and methods of the Java object" on page 387.

Returning result sets from Java methods

This section describes how to make result sets available from Java methods. You must write a Java method that returns a result set to the calling environment, and wrap this method in a SQL stored procedure declared to be EXTERNAL NAME of LANGUAGE JAVA.

To return result sets from a Java method

1. Ensure that the Java method is declared as public and static in a public class.
2. For each result set you expect the method to return, ensure that the method has a parameter of type java.sql.ResultSet[]. These result set parameters must all occur at the end of the parameter list.
3. In the method, first create an instance of java.sql.ResultSet and then assign it to one of the ResultSet[] parameters.
4. Create a SQL stored procedure of type EXTERNAL NAME LANGUAGE JAVA. This type of procedure is a wrapper around a Java method. You can use a cursor on the SQL procedure result set in the same way as any other procedure that returns result sets.

   For more information about the syntax for stored procedures that are wrappers for Java methods, see "CREATE PROCEDURE statement (external procedures)" [*SQL Anywhere Server - SQL Reference*].

Example

The following simple class has a single method that executes a query and passes the result set back to the calling environment.

```
import java.sql.*;

public class MyResultSet
{
  public static void return_rset( ResultSet[] rset1 )
       throws SQLException
  {
    Connection conn = DriverManager.getConnection(
                      "jdbc:default:connection" );
    Statement stmt = conn.createStatement();
    ResultSet rset =
      stmt.executeQuery (
                      "SELECT Surname " +
                      "FROM Customers" );
    rset1[0] = rset;
  }
}
```


You can expose the result set using a CREATE PROCEDURE statement that indicates the number of result sets returned from the procedure and the signature of the Java method.

A CREATE PROCEDURE statement indicating a result set could be defined as follows:

```
CREATE PROCEDURE result_set()
  RESULT (SurName person_name_t)
  DYNAMIC RESULT SETS 1
  EXTERNAL NAME
     'MyResultSet.return_rset([Ljava/sql/ResultSet;)V'
  LANGUAGE JAVA
```

You can open a cursor on this procedure, just as you can with any SQL Anywhere procedure returning result sets.

The string `([Ljava/sql/ResultSet;)V` is a Java method signature that is a compact character representation of the number and type of the parameters and return value.

For more information about Java method signatures, see "CREATE PROCEDURE statement (external procedures)" [*SQL Anywhere Server - SQL Reference*].

For more information about returning result sets, see "Returning result sets" on page 420.

Returning values from Java via stored procedures

You can use stored procedures created using the EXTERNAL NAME LANGUAGE JAVA as wrappers around Java methods. This section describes how to write your Java method to exploit OUT or INOUT parameters in the stored procedure.

Java does not have explicit support for INOUT or OUT parameters. Instead, you can use an array of the parameter. For example, to use an integer OUT parameter, create an array of exactly one integer:

```
public class Invoice
{
  public static boolean testOut( int[] param )
  {
    param[0] = 123;
    return true;
  }
}
```

The following procedure uses the testOut method:

```
CREATE PROCEDURE testOut( OUT p INTEGER )
EXTERNAL NAME 'Invoice.testOut([I)Z'
LANGUAGE JAVA;
```

The string `([I)Z` is a Java method signature, indicating that the method has a single parameter, which is an array of integers, and returns a Boolean value. You must define the method so that the method parameter you want to use as an OUT or INOUT parameter is an array of a Java data type that corresponds to the SQL data type of the OUT or INOUT parameter.

To test this, call the stored procedure with an uninitialized variable.

```
CREATE VARIABLE zap INTEGER;
CALL testOut( zap );
SELECT zap;
```

The result set is `123`.

For more information about the syntax, including the method signature, see "CREATE PROCEDURE statement (external procedures)" [*SQL Anywhere Server - SQL Reference*].

Security management for Java

Java provides security managers than you can use to control user access to security-sensitive features of your applications, such as file access and network access. You should take advantage of the security management features supported by your Java VM.

Starting and stopping the Java VM

The Java VM loads automatically whenever the first Java operation is carried out. If you want to load it explicitly in readiness for carrying out Java operations, you can do so by executing the following statement:

```
START JAVA;
```

You can unload the Java VM when Java is not in use using the STOP JAVA statement. Only a user with DBA authority can execute this statement. The syntax is:

```
STOP JAVA;
```


JDBC support

JDBC is a call-level interface for Java applications. Developed by Sun Microsystems, JDBC provides you with a uniform interface to a wide range of relational databases, and provides a common base on which higher level tools and interfaces can be built. JDBC is now a standard part of Java and is included in the JDK.

SQL Anywhere includes JDBC 3.0 and 4.0 drivers, which are both Type 2 drivers.

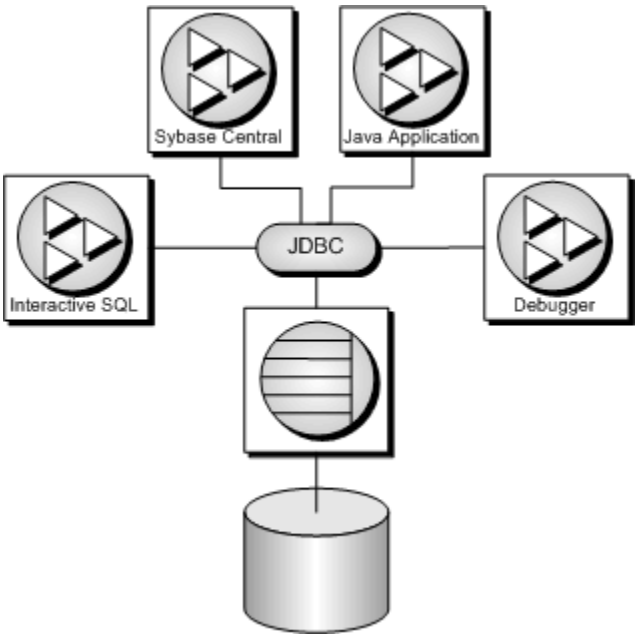
SQL Anywhere also supports a pure Java JDBC driver, named jConnect, which is available from Sybase.

For information about choosing a driver, see "Choosing a JDBC driver" on page 398.

In addition to using JDBC as a client-side application programming interface, you can also use JDBC inside the database server to access data by using Java in the database.

JDBC applications

You can develop Java applications that use the JDBC API to connect to SQL Anywhere. Several of the applications supplied with SQL Anywhere use JDBC, such as the debugger, Sybase Central, and Interactive SQL.



Java and JDBC are also important programming languages for developing UltraLite applications.

JDBC can be used both from client applications and inside the database. Java classes using JDBC provide a more powerful alternative to SQL stored procedures for incorporating programming logic into the database.

JDBC provides a SQL interface for Java applications: if you want to access relational data from Java, you do so using JDBC calls.

The phrase **client application** applies both to applications running on a user's computer and to logic running on a middle-tier application server.

The examples illustrate the distinctive features of using JDBC in SQL Anywhere. For more information about JDBC programming, see any JDBC programming book.

You can use JDBC with SQL Anywhere in the following ways:

- **JDBC on the client** Java client applications can make JDBC calls to SQL Anywhere. The connection takes place through a JDBC driver.

  SQL Anywhere includes JDBC 3.0 and 4.0 drivers, which are Type 2 JDBC drivers, and also supports the jConnect driver for pure Java applications, which is a Type 4 JDBC driver.

- **JDBC in the database** Java classes installed into a database can make JDBC calls to access and modify data in the database using an internal JDBC driver.

JDBC resources

- **Example source code** You can find source code for the examples in this section in the directory *samples-dir\SQLAnywhere\JDBC*.

- **JDBC Specification** You can find more information about the JDBC Data Access API at http://java.sun.com/javase/technologies/database/index.jsp.

- **Required software** You need TCP/IP to use the jConnect driver.

  The jConnect driver is available at http://www.sybase.com/products/allproductsa-z/softwaredeveloperkit/jconnect.

  For more information about the jConnect driver and its location, see "Using the jConnect JDBC driver" on page 402.

Choosing a JDBC driver

SQL Anywhere supports the following JDBC drivers:

- **3.0 SQL Anywhere JDBC driver** This driver communicates with SQL Anywhere using the Command Sequence client/server protocol. Its behavior is consistent with ODBC, embedded SQL, and OLE DB applications. The SQL Anywhere JDBC 3.0 driver can be used only with JRE 1.4 or later. Note that the SQL Anywhere JDBC 4.0 driver is recommended for applications using JRE 1.6 or later.

- **4.0 SQL Anywhere JDBC driver** This driver communicates with SQL Anywhere using the Command Sequence client/server protocol. Its behavior is consistent with ODBC, embedded SQL,

and OLE DB applications. The 4.0 SQL Anywhere JDBC driver is the recommended JDBC driver for connecting to SQL Anywhere databases. The JDBC 4.0 driver can be used only with JRE 1.6 or later.

It is strongly recommended that applications using JRE 1.6 or later switch to the JDBC 4.0 driver instead of continuing to use the JDBC 3.0 driver. The JDBC 4.0 driver takes advantage of the new automatic JDBC driver registration. Hence, if an application wants to make use of the JDBC 4.0 driver, it no longer needs to perform a Class.forName call to get the JDBC driver loaded. It is instead sufficient to have the *sajdbc4.jar* file in the class file path and simply call DriverManager.getConnection() with a URL that begins with jdbc:sqlanywhere.

With the JDBC 4.0 driver, metadata for NCHAR data now returns the column type as java.sql.Types.NCHAR, NVARCHAR, or LONGNVARCHAR. In addition, applications can now fetch NCHAR data using the Get/SetNString or Get/SetNClob methods instead of the Get/SetString and Get/SetClob methods.

- **jConnect** This driver is a 100% pure Java driver. It communicates with SQL Anywhere using the TDS client/server protocol.

  jConnect and jConnect documentation are available at http://www.sybase.com/products/allproductsa-z/softwaredeveloperkit/jconnect.

When choosing which driver to use, you should consider the following factors:

- **Features** Both the 3.0 SQL Anywhere JDBC driver and jConnect 6.0.5 are JDBC 3.0 compliant and the 4.0 SQL Anywhere JDBC driver is JDBC 4.0 compliant. However, both versions of the SQL Anywhere JDBC driver provide fully-scrollable cursors when connected to a SQL Anywhere database. The jConnect JDBC driver provides fully-scrollable cursors only when connected to an Adaptive Server Enterprise database.

  The JDBC 3.0 and 4.0 API documentation is available at http://java.sun.com/products/jdbc/download.html. For a summary of the JDBC API methods supported by the SQL Anywhere JDBC driver, see "JDBC 3.0/4.0 API support" on page 428.

- **Pure Java** The jConnect driver is a pure Java solution. The SQL Anywhere JDBC drivers are based on the SQL Anywhere ODBC driver and are not pure Java solutions.

- **Performance** The SQL Anywhere JDBC drivers provide better performance for most purposes than the jConnect driver.

- **Compatibility** The TDS protocol used by the jConnect driver is shared with Adaptive Server Enterprise. Some aspects of the driver's behavior are governed by this protocol, and are configured to be compatible with Adaptive Server Enterprise.

For information about platform availability for the SQL Anywhere JDBC drivers and jConnect, see http://www.sybase.com/detail?id=1061806.

For information about using jConnect with Windows Mobile, see "Using jConnect on Windows Mobile" [*SQL Anywhere Server - Database Administration*].

JDBC program structure

The following sequence of events typically occurs in JDBC applications:

1. **Create a Connection object**

   Calling a getConnection class method of the DriverManager class creates a Connection object, and establishes a connection with a database.

2. **Generate a Statement object**

   The Connection object generates a Statement object.

3. **Pass a SQL statement**

   A SQL statement that executes within the database environment is passed to the Statement object. If the statement is a query, this action returns a ResultSet object.

   The ResultSet object contains the data returned from the SQL statement, but exposes it one row at a time (similar to the way a cursor works).

4. **Loop over the rows of the result set**

   The next method of the ResultSet object performs two actions:

   - The current row (the row in the result set exposed through the ResultSet object) advances one row.
   - A boolean value returns to indicate whether there is a row to advance to.

5. **For each row, retrieve the values**

   Values are retrieved for each column in the ResultSet object by identifying either the name or position of the column. You can use the getData method to get the value from a column on the current row.

Java objects can use JDBC objects to interact with a database and get data for their own use.

Differences between client- and server-side JDBC connections

A difference between JDBC on the client and in the database server lies in establishing a connection with the database environment.

- **Client side** In client-side JDBC, establishing a connection requires a SQL Anywhere JDBC driver or the jConnect JDBC driver. Passing arguments to DriverManager.getConnection establishes the connection. The database environment is an external application from the perspective of the client application.

- **Server-side** When using JDBC within the database server, a connection already exists. The string "jdbc:default:connection" is passed to DriverManager.getConnection, which allows the JDBC application to work within the current user connection. This is a quick, efficient, and safe operation because the client application has already passed the database security to establish the connection. The user ID and password, having been provided once, do not need to be provided again. The server-side JDBC driver can only connect to the database of the current connection.

You can write JDBC classes so that they can run both at the client and at the server by employing a single conditional statement for constructing the URL. An external connection requires the host name and port number, while the internal connection requires "jdbc:default:connection".

Using a SQL Anywhere JDBC driver

The SQL Anywhere JDBC 3.0 and 4.0 drivers provide some performance benefits and feature benefits compared to the pure Java jConnect JDBC driver, however, these drivers do not provide a pure-Java solution. Usually, SQL Anywhere JDBC 4.0 driver is recommended.

For information about choosing which JDBC driver to use, see “Choosing a JDBC driver” on page 398.

Loading the SQL Anywhere JDBC 3.0 driver

Ensure that the SQL Anywhere JDBC 3.0 driver is in your class file path.

```
set classpath=install-dir\java\sajdbc.jar;%classpath%
```

Before you can use the SQL Anywhere JDBC 3.0 driver in your application, you must load the appropriate driver. Load the SQL Anywhere JDBC 3.0 driver with the following statement:

```
DriverManager.registerDriver( (Driver)
    Class.forName(
    "sybase.jdbc.sqlanywhere.IDriver").newInstance()
    );
```

Using the newInstance method works around issues in some browsers.

- As the classes are loaded using Class.forName, the package containing the SQL Anywhere JDBC driver does not have to be imported using import statements.
- *sajdbc.jar* must be in your class file path when you run the application.

  ```
  set classpath=%classpath%;install-dir\java\sajdbc.jar
  ```

Required files

The Java component of the SQL Anywhere JDBC 3.0 driver is included in the *sajdbc.jar* file installed into the *Java* subdirectory of your SQL Anywhere installation. For Windows, the native component is *dbjdbc12.dll* in the *bin32* or *bin64* subdirectory of your SQL Anywhere installation; for Unix, the native component is *libdbjdbc12.so*. This component must be in the system path.

Loading the SQL Anywhere JDBC 4.0 driver

Ensure that the SQL Anywhere JDBC 4.0 driver is in your class file path.

```
set classpath=install-dir\java\sajdbc4.jar;%classpath%
```

The JDBC 4.0 driver takes advantage of the new automatic JDBC driver registration. The driver will be automatically loaded at execution startup when it is in the class file path.

Required files

The Java component of the SQL Anywhere JDBC 4.0 driver is included in the *sajdbc4.jar* file installed into the *Java* subdirectory of your SQL Anywhere installation. For Windows, the native component is *dbjdbc12.dll* in the *bin32* or *bin64* subdirectory of your SQL Anywhere installation; for Unix, the native component is *libdbjdbc12.so*. This component must be in the system path.

Supplying a URL to the driver

To connect to a database via a SQL Anywhere JDBC driver, you need to supply a URL for the database. For example:

```
Connection con = DriverManager.getConnection(
      "jdbc:sqlanywhere:DSN=SQL Anywhere 12 Demo" );
```

The URL contains **jdbc:sqlanywhere:** followed by a connection string. If the *sajdbc4.jar* file is in your class file path, then the JDBC 4.0 driver will have been loaded by default and it will handle the URL. Otherwise, the JDBC 3.0 driver will respond to the same URL, provided that it is in the class file path and has been successfully loaded. As shown in the example, an ODBC data source (**DSN**) may be specified for convenience, but you can also use explicit connection parameters, separated by semicolons, in addition to or instead of the data source connection parameter. For more information about the parameters that you can use in a connection string, see "Connection parameters" [*SQL Anywhere Server - Database Administration*].

If you do not use a data source, you must specify all required connection parameters in the connection string:

```
Connection con = DriverManager.getConnection(
      "jdbc:sqlanywhere:UserID=DBA;Password=sql;Start=..." );
```

The **Driver** connection parameter is not required since neither the ODBC driver nor ODBC driver manager is used. If present, it will be ignored.

Using the jConnect JDBC driver

SQL Anywhere supports one version of jConnect: jConnect 6.0.5. The jConnect driver is available as a separate download at http://www.sybase.com/products/allproductsa-z/softwaredeveloperkit/jconnect. Documentation for jConnect can also be found on the same page.

If you want to use JDBC from an applet, you must use the jConnect JDBC driver to connect to SQL Anywhere databases.

The jConnect driver files

SQL Anywhere supports the following version of jConnect:

- **jConnect 6.0.5** This version of jConnect is for developing JDK 1.4 or later applications. jConnect 6.0.5 is JDBC 3.0 compliant. jConnect 6.0.5 is supplied as a JAR file named *jconn3.jar*.

Note
This documentation assumes that you are developing JDK 1.5 applications and using the jConnect 6.0.5 driver.

There is a copy of *jconn3.jar* in the *install-dir\java* folder. However, it is recommended that you use the version of the file included with jConnect 6.0.5 since it will be current with the version of jConnect that you have installed.

Setting the class file path for jConnect

For your application to use jConnect, the jConnect classes must be in your class file path at compile time and run time, so that the Java compiler and Java runtime can locate the necessary files.

The following command adds the jConnect 6.0.5 driver to an existing CLASSPATH environment variable (where *path* is your jConnect installation directory).

```
set classpath=path\jConnect-6_0\classes\jconn3.jar;%classpath%
```

Importing the jConnect classes

The classes in jConnect 6.0.5 are all in com.sybase.jdbc3.jdbc. You must import these classes at the beginning of each source file:

```
import com.sybase.jdbc3.jdbc.*
```

Encrypting passwords

SQL Anywhere supports password encryption for jConnect connections.

Installing jConnect system objects into a database

If you want to use jConnect to access system table information (database metadata), you must add the jConnect system objects to your database.

You can add the jConnect system objects to the database when creating the database or at a later time by upgrading the database. You can upgrade a database from Sybase Central or by using the dbupgrad utility.

Windows Mobile
Do not add jConnect system objects to your Windows Mobile database. See "Using jConnect on Windows Mobile" [*SQL Anywhere Server - Database Administration*].

Caution
You should always back up your database files before upgrading. If you apply the upgrade to the existing files, then these files become unusable if the upgrade fails. For information about backing up your database, see "Backup and data recovery" [*SQL Anywhere Server - Database Administration*].

To add jConnect system objects to a database (Sybase Central)

1. Connect to the database from Sybase Central as a DBA user.
2. Select the database, if necessary, and then from the **Tools** menu choose **SQL Anywhere 12** and then **Upgrade Database**.
3. Follow the instructions in the **Upgrade Database Wizard**.

To add jConnect system objects to a database (dbupgrad)

- From a command prompt, run the following command:

  ```
  dbupgrad -c "connection-string"
  ```

  In this command, *connection-string* is a suitable connection string that enables access to a database and server as a DBA user.

Loading the jConnect driver

Before you can use jConnect in your application, load the driver with the following statement:

```
DriverManager.registerDriver( (Driver)
    Class.forName(
    "com.sybase.jdbc3.jdbc.SybDriver").newInstance()
    );
```

Using the newInstance method works around issues in some browsers.

- As the classes are loaded using Class.forName, the package containing the jConnect driver does not have to be imported using import statements.
- To use jConnect 6.0.5, *jconn3.jar* must be in your class file path when you run the application. *jconn3.jar* is located in the *classes* subdirectory of your jConnect 6.0.5 installation (typically, *jConnect-6_0\classes*).

Supplying a URL to the driver

To connect to a database via jConnect, you need to supply a URL for the database. For example:

```
Connection con = DriverManager.getConnection(
      "jdbc:sybase:Tds:localhost:2638", "DBA", "sql");
```


The URL is composed in the following way:

```
jdbc:sybase:Tds:host:port
```

The individual components are:

- **jdbc:sybase:Tds** The jConnect JDBC driver, using the TDS application protocol.
- **host** The IP address or name of the computer on which the server is running. If you are establishing a same-host connection, you can use localhost, which means the computer system you are logged into.
- **port** The port number on which the database server listens. The port number assigned to SQL Anywhere is 2638. Use that number unless there are specific reasons not to do so.

The connection string must be less than 253 characters in length.

If you are using the SQL Anywhere personal server, make sure to include TCP/IP support on the command line.

Specifying a database on a server

Each SQL Anywhere database server can have one or more databases loaded at a time. If the URL you supply when connecting via jConnect specifies a server, but does not specify a database, then the connection attempt is made to the default database on the server.

You can specify a particular database by providing an extended form of the URL in one of the following ways.

Using the ServiceName parameter

```
jdbc:sybase:Tds:host:port?ServiceName=database
```

The question mark followed by a series of assignments is a standard way of providing arguments to a URL. The case of ServiceName is not significant, and there must be no spaces around the = sign. The *database* parameter is the database name, not the server name. The database name must not include the path or file suffix. For example:

```
Connection con = DriverManager.getConnection(
      "jdbc:sybase:Tds:localhost:2638?ServiceName=demo", "DBA", "sql");
```

Using the RemotePWD parameter

A workaround exists for passing additional connection parameters to the server.

This technique allows you to provide additional connection parameters such as the database name, or a database file, using the RemotePWD field. You set RemotePWD as a Properties field using the put method.

The following code illustrates how to use the field.

```
import java.util.Properties;
.
.
```

```
.
DriverManager.registerDriver( (Driver)
    Class.forName(
    "com.sybase.jdbc3.jdbc.SybDriver").newInstance()
    );

Properties props = new Properties();
props.put( "User", "DBA" );
props.put( "Password", "sql" );
props.put( "RemotePWD", ",DatabaseFile=mydb.db" );

Connection con = DriverManager.getConnection(
    "jdbc:sybase:Tds:localhost:2638", props );
```

As shown in the example, a comma must precede the DatabaseFile connection parameter. Using the DatabaseFile parameter, you can start a database on a server using jConnect. By default, the database is started with AutoStop=YES. If you specify utility_db with a DatabaseFile (DBF) or DatabaseName (DBN) connection parameter (for example, DBN=utility_db), then the utility database is started automatically.

For more information about the utility database, see "Using the utility database" [*SQL Anywhere Server - Database Administration*].

Database options set for jConnect connections

When an application connects to the database using the jConnect driver, the sp_tsql_environment stored procedure is called. The sp_tsql_environment procedure sets some database options for compatibility with Adaptive Server Enterprise behavior.

See also

- "Characteristics of Sybase Open Client and jConnect connections" [*SQL Anywhere Server - Database Administration*]
- "sp_tsql_environment system procedure" [*SQL Anywhere Server - SQL Reference*]

Connecting from a JDBC client application

Database metadata is always available when using a SQL Anywhere JDBC driver.

If you want to access database system tables (database metadata) from a JDBC application that uses jConnect, you must add a set of jConnect system objects to your database. These procedures are installed to all databases by default. The dbinit -i option prevents this installation.

For more information about adding the jConnect system objects to a database, see "Using the jConnect JDBC driver" on page 402.

The following complete Java application is a command line program that connects to a running database, prints a set of information to your command line, and terminates.

Establishing a connection is the first step any JDBC application must take when working with database data.

This example illustrates an external connection, which is a regular client/server connection. For information about how to create an internal connection from Java classes running inside the database server, see "Establishing a connection from a server-side JDBC class" on page 410.

Connection example code

The following example uses the JDBC 4.0 version of the SQL Anywhere JDBC driver by default to connect to the database. To use a different driver, you can pass in the driver name (jdbc4, jdbc3, jConnect) on the command line. Examples for using the JDBC 4.0 driver, the JDBC 3.0 driver, and jConnect are included in the code. This example assumes that a database server has already been started using the sample database. The source code can be found in the file *JDBCConnect.java* in the *samples-dir\SQLAnywhere\JDBC* directory.

```
import java.io.*;
import java.sql.*;

public class JDBCConnect
{
    public static void main( String args[] )
    {
        try
        {
            String arg;
            Connection con;

            // Select the JDBC driver and create a connection.
            // May throw a SQLException.
            // Choices are:
            // 1. jConnect 6.0 driver
            // 2. SQL Anywhere JDBC 3.0 driver
            // 3. SQL Anywhere JDBC 4.0 driver
            arg = "jdbc4";
            if( args.length > 0 ) arg = args[0];
            if( arg.compareToIgnoreCase( "jconnect" ) == 0 )
            {
                DriverManager.registerDriver( (Driver)
                    Class.forName(
                    "com.sybase.jdbc3.jdbc.SybDriver").newInstance()
                    );
                con = DriverManager.getConnection(
                    "jdbc:sybase:Tds:localhost:2638", "DBA", "sql");
            }
            else if( arg.compareToIgnoreCase( "jdbc3" ) == 0 )
            {
                DriverManager.registerDriver( (Driver)
                    Class.forName(
                    "sybase.jdbc.sqlanywhere.IDriver").newInstance()
                    );
                con = DriverManager.getConnection(
                    "jdbc:sqlanywhere:uid=DBA;pwd=sql" );
            }
            else
            {
                con = DriverManager.getConnection(
                    "jdbc:sqlanywhere:uid=DBA;pwd=sql" );
            }

            System.out.println("Using "+arg+" driver");

            // Create a statement object, the container for the SQL
```

```
            // statement. May throw a SQLException.
            Statement stmt = con.createStatement();

            // Create a result set object by executing the query.
            // May throw a SQLException.
            ResultSet rs = stmt.executeQuery(
                "SELECT ID, GivenName, Surname FROM Customers");

            // Process the result set.
            while (rs.next())
            {
                int value = rs.getInt(1);
                String FirstName = rs.getString(2);
                String LastName = rs.getString(3);
                System.out.println(value+" "+FirstName+" "+LastName);
            }
            rs.close();
            stmt.close();
            con.close();
        }
        catch (SQLException sqe)
        {
            System.out.println("Unexpected exception : " +
                               sqe.toString() + ", sqlstate = " +
                               sqe.getSQLState());
            System.exit(1);
        }
        catch (Exception e)
        {
            e.printStackTrace();
            System.exit(1);
        }

        System.exit(0);
    }
}
```

How the connection example works

The external connection example is a Java command line program.

Importing packages

The application requires a couple of packages, which are imported in the first lines of *JDBCConnect.java*:

- The java.io package contains the Sun Microsystems io classes, which are required for printing to the console window.
- The java.sql package contains the Sun Microsystems JDBC classes, which are required for all JDBC applications.

The main method

Each Java application requires a class with a method named main, which is the method invoked when the program starts. In this simple example, JDBCConnect.main is the only public method in the application.

The JDBCConnect.main method carries out the following tasks:

1. Determines which driver to load based on the command line argument. For jConnect and the SQL Anywhere JDBC 3.0 driver, it loads the requested driver (using the Class.forName method). The SQL Anywhere JDBC 4.0 driver is automatically loaded at startup if it is in the class file path.
2. Connects to the default running database using the selected JDBC driver URL. The getConnection method establishes a connection using the specified URL.
3. Creates a statement object, which is the container for the SQL statement.
4. Creates a result set object by executing a SQL query.
5. Iterates through the result set, printing the column information.
6. Closes each of the result set, statement, and connection objects.

Running the connection example

To create and execute the external connection example application

1. At a command prompt, change to the *samples-dir\SQLAnywhere\JDBC* directory.
2. Start a database server with the sample database on your local computer using the following command:

   ```
   dbsrv12 samples-dir\demo.db
   ```

3. Set the CLASSPATH environment variable. The SQL Anywhere JDBC 4.0 driver contained in *sajdbc4.jar* is used in this example.

   ```
   set classpath=.;install-dir\java\sajdbc4.jar
   ```

   If you are using the SQL Anywhere JDBC 3.0 driver instead, then use the following:

   ```
   set classpath=.;install-dir\java\sajdbc.jar
   ```

   If you are using the jConnect driver instead, then use the following (where *path* is your jConnect installation directory):

   ```
   set classpath=.;path\jConnect-6_0\classes\jconn3.jar
   ```

4. Run the following command to compile the example:

   ```
   javac JDBCConnect.java
   ```

5. Run the following command to execute the example:

   ```
   java JDBCConnect
   ```

   Add a command line argument such as **jconnect** or **jdbc3** to load a different JDBC driver.

   ```
   java JDBCConnect jconnect
   ```

6. Confirm that a list of identification numbers with customer's names appears at the command prompt.

   If the attempt to connect fails, an error message appears instead. Confirm that you have executed all the steps as required. Check that your class file path is correct. An incorrect setting may result in a failure to locate a class.

Establishing a connection from a server-side JDBC class

SQL statements in JDBC are built using the createStatement method of a Connection object. Even classes running inside the server need to establish a connection to create a Connection object.

Establishing a connection from a server-side JDBC class is more straightforward than establishing an external connection. Because the user is already connected to the database, the class simply uses the current connection.

Server-side connection example code

The following is the source code for the server-side connection example. It is a modified version of the source code in *samples-dir\SQLAnywhere\JDBC\JDBCConnect.java*.

```
import java.io.*;
import java.sql.*;

public class JDBCConnect2
{
  public static void main( String args[] )
  {
    try
    {
      // Open the connection. May throw a SQLException.
      Connection con = DriverManager.getConnection(
          "jdbc:default:connection" );

      // Create a statement object, the container for the SQL
      // statement. May throw a SQLException.
      Statement stmt = con.createStatement();
      // Create a result set object by executing the query.
      // May throw a SQLException.
      ResultSet rs = stmt.executeQuery(
        "SELECT ID, GivenName, Surname FROM Customers");

      // Process the result set.
      while (rs.next())
      {
        int value = rs.getInt(1);
        String FirstName = rs.getString(2);
        String LastName = rs.getString(3);
        System.out.println(value+" "+FirstName+" "+LastName);
      }
      rs.close();
      stmt.close();
      con.close();
    }
    catch (SQLException sqe)
    {
```



```
            System.out.println("Unexpected exception : " +
                               sqe.toString() + ", sqlstate = " +
                               sqe.getSQLState());
          }
          catch (Exception e)
          {
            e.printStackTrace();
          }
        }
      }
```

How the server-side connection example differs

The server-side connection example is almost identical to the client-side connection example, with the following exceptions:

1. The JDBC driver does not need to be loaded. The DriverManager.registerDriver and Class.forName calls have been removed from the example.

2. It connects to the default running database using the current connection. The URL in the getConnection call has been changed as follows:

   ```
   Connection con = DriverManager.getConnection(
              "jdbc:default:connection" );
   ```

3. The `System.exit()` statements have been removed.

Running the server-side connection example

To create and execute the internal connection example application

1. At a command prompt, change to the *samples-dir\SQLAnywhere\JDBC* directory.

2. Start a database server with the sample database on your local computer using the following command:

   ```
   dbeng12 samples-dir\demo.db
   ```

3. For server-side JDBC, it is not necessary to set the CLASSPATH environment variable.

4. Enter the following command to compile the example:

   ```
   javac JDBCConnect2.java
   ```

5. Install the class into the sample database using Interactive SQL. Run the following statement:

   ```
   INSTALL JAVA NEW
   FROM FILE 'samples-dir\SQLAnywhere\JDBC\JDBCConnect2.class';
   ```

   You can also install the class using Sybase Central. While connected to the sample database, open the **Java** subfolder under **External Environments** and choose **File** » **New** » **Java Class**. Then follow the instructions in the wizard.

6. Define a stored procedure named JDBCConnect that acts as a wrapper for the JDBCConnect2.main method in the class:

```
CREATE PROCEDURE JDBCConnect()
  EXTERNAL NAME 'JDBCConnect2.main([Ljava/lang/String;)V'
  LANGUAGE JAVA;
```

7. Call the JDBCConnect2.main method as follows:

```
CALL JDBCConnect();
```

   The first time a Java class is called in a session, the Java VM must be loaded. This might take a few seconds.

8. Confirm that a list of identification numbers with customers' names appears in the database server messages window.

   If the attempt to connect fails, an error message appears instead. Confirm that you have executed all the steps as required.

Notes on JDBC connections

- **Autocommit behavior** The JDBC specification requires that, by default, a COMMIT is performed after each data modification statement. Currently, the client-side JDBC behavior is to commit (autocommit is true) and the server-side behavior is to not commit (autocommit is false). To obtain the same behavior in both client-side and server-side applications, you can use a statement such as the following:

  ```
  con.setAutoCommit( false );
  ```

  In this statement, con is the current connection object. You could also set autocommit to true.

- **Setting transaction isolation level** To set the transaction isolation level, the application must call the Connection.setTransactionIsolation method with one of the following values.

  For the SQL Anywhere JDBC 4.0 driver use:

  - sybase.jdbc4.sqlanywhere.IConnection.SA_TRANSACTION_SNAPSHOT
  - sybase.jdbc4.sqlanywhere.IConnection.SA_TRANSACTION_STATEMENT_SNAPSHOT
  - sybase.jdb4c.sqlanywhere.IConnection.SA_TRANSACTION_STATEMENT_READONLY_SNAPSHOT

  For the SQL Anywhere JDBC 3.0 driver use:

  - sybase.jdbc.sqlanywhere.IConnection.SA_TRANSACTION_SNAPSHOT
  - sybase.jdbc.sqlanywhere.IConnection.SA_TRANSACTION_STATEMENT_SNAPSHOT
  - sybase.jdbc.sqlanywhere.IConnection.SA_TRANSACTION_STATEMENT_READONLY_SNAPSHOT

  The following example sets the transaction isolation level to SNAPSHOT using the JDBC 4.0 driver.


```
try
{
    connection.setTransactionIsolation(
        sybase.jdbc4.sqlanywhere.IConnection.SA_TRANSACTION_SNAPSHOT
    );
}
catch( Exception e )
{
    System.err.println( "Error! Could not set isolation level" );
    System.err.println( e.getMessage() );
    printExceptions( (SQLException)e );
}
```

For more information about the getTransactionIsolation and setTransactionIsolation, see documentation on the java.sql.Connection interface at Java.com.

- **Connection defaults** From server-side JDBC, only the first call to `getConnection( "jdbc:default:connection" )` creates a new connection with the default values. Subsequent calls return a wrapper of the current connection with all connection properties unchanged. If you set autocommit to false in your initial connection, any subsequent getConnection calls within the same Java code return a connection with autocommit set to false.

  You may want to ensure that closing a connection restores the connection properties to their default values, so that subsequent connections are obtained with standard JDBC values. The following code achieves this:

  ```
  Connection con =
      DriverManager.getConnection("jdbc:default:connection");

  boolean oldAutoCommit = con.getAutoCommit();
  try
  {
       // main body of code here
  }
  finally
  {
      con.setAutoCommit( oldAutoCommit );
  }
  ```

  This discussion applies not only to autocommit, but also to other connection properties such as transaction isolation level and read-only mode.

  For more information about the getTransactionIsolation, setTransactionIsolation, and isReadOnly methods, see documentation on the java.sql.Connection interface at Java.com.

Using JDBC to access data

Java applications that hold some or all classes in the database have significant advantages over traditional SQL stored procedures. At an introductory level, however, it may be helpful to use the parallels with SQL stored procedures to demonstrate the capabilities of JDBC. In the following examples, you write Java classes that insert a row into the Departments table.

As with other interfaces, SQL statements in JDBC can be either **static** or **dynamic**. Static SQL statements are constructed in the Java application and sent to the database. The database server parses the statement,

selects an execution plan, and executes the statement. Together, parsing and selecting an execution plan are referred to as **preparing** the statement.

If a similar statement has to be executed many times (many inserts into one table, for example), there can be significant overhead in static SQL because the preparation step has to be executed each time.

In contrast, a dynamic SQL statement contains placeholders. The statement, prepared once using these placeholders, can be executed many times without the additional expense of preparing. Dynamic SQL is discussed in "Using prepared statements for more efficient access" on page 416.

Preparing for the examples

Sample code

The code fragments in this section are taken from the complete class in *samples-dir\SQLAnywhere\JDBC\JDBCExample.java*.

To install the JDBCExample class

1. Compile the *JDBCExample.java* source code.
2. Using Interactive SQL, connect to the sample database as the DBA.
3. Install the *JDBCExample.class* file into the sample database by executing the following statement in Interactive SQL (*samples-dir* represents the SQL Anywhere samples directory):

   ```
   INSTALL JAVA NEW
   FROM FILE 'samples-dir\SQLAnywhere\JDBC\JDBCExample.class'
   ```

   You can also install the class using Sybase Central. While connected to the sample database, open the **Java** subfolder under **External Environments** and choose **File** » **New** » **Java Class**. Follow the instructions in the wizard.

Inserts, updates, and deletes using JDBC

Static SQL statements such as INSERT, UPDATE, and DELETE, which do not return result sets, are executed using the executeUpdate method of the Statement class. Statements, such as CREATE TABLE and other data definition statements, can also be executed using executeUpdate.

The addBatch, clearBatch, and executeBatch methods of the Statement class may also be used. Due to the fact that the JDBC specification is unclear on the behavior of the executeBatch method of the Statement class, the following notes should be considered when using this method with the SQL Anywhere JDBC drivers:

- Processing of the batch stops immediately upon encountering a SQL exception or result set. If processing of the batch stops, then a BatchUpdateException will be thrown by the executeBatch method. Calling the getUpdateCounts method on the BatchUpdateException will return an integer

array of row counts where the set of counts prior to the batch failure will contain a valid non-negative update count; while all counts at the point of the batch failure and beyond will contain a -1 value. Casting the BatchUpdateException to a SQLException will provide additional details as to why batch processing was stopped.

- The batch is only cleared when the clearBatch method is explicitly called. As a result, calling the executeBatch method repeatedly will re-execute the batch over and over again. In addition, calling execute(sql_query) or executeQuery(sql_query) will correctly execute the specified SQL query, but will not clear the underlying batch. Hence, calling the executeBatch method followed by execute(sql_query) followed by the executeBatch method again will execute the set of batched statements, then execute the specified SQL query, and then execute the set of batched statements again.

The following code fragment illustrates how to execute an INSERT statement. It uses a Statement object that has been passed to the InsertStatic method as an argument.

```
public static void InsertStatic( Statement stmt )
{
  try
  {
    int iRows = stmt.executeUpdate(
      "INSERT INTO Departments (DepartmentID, DepartmentName)"
      + " VALUES (201, 'Eastern Sales')" );
    // Print the number of rows inserted
    System.out.println(iRows + " rows inserted");
  }
  catch (SQLException sqe)
  {
    System.out.println("Unexpected exception : " +
              sqe.toString() + ", sqlstate = " +
              sqe.getSQLState());
  }
  catch (Exception e)
  {
    e.printStackTrace();
  }
}
```

Source code available
This code fragment is part of the JDBCExample Java file included in the *samples-dir\SQLAnywhere\JDBC* directory.

Notes

- The executeUpdate method returns an integer that reflects the number of rows affected by the operation. In this case, a successful INSERT would return a value of one (1).
- When run as a server-side class, the output from `System.out.println` goes to the database server messages window.

Run the JDBC Insert example

To run the JDBC Insert example

1. Using Interactive SQL, connect to the sample database as the DBA.
2. Ensure the JDBCExample class has been installed.

   For more information about installing the Java examples classes, see "Preparing for the examples" on page 414.
3. Define a stored procedure named JDBCExample that acts as a wrapper for the JDBCExample.main method in the class:

   ```
   CREATE PROCEDURE JDBCExample( IN arg CHAR(50) )
     EXTERNAL NAME 'JDBCExample.main([Ljava/lang/String;)V'
     LANGUAGE JAVA;
   ```
4. Call the JDBCExample.main method as follows:

   ```
   CALL JDBCExample( 'insert' );
   ```

   The argument string `'insert'` causes the InsertStatic method to be invoked.
5. Confirm that a row has been added to the Departments table.

   ```
   SELECT * FROM Departments;
   ```

   The example program displays the updated contents of the Departments table in the database server messages window.
6. There is a similar method in the example class called DeleteStatic that shows how to delete the row that has just been added. Call the JDBCExample.main method as follows:

   ```
   CALL JDBCExample( 'delete' );
   ```

   The argument string `'delete'` causes the DeleteStatic method to be invoked.
7. Confirm that the row has been deleted from the Departments table.

   ```
   SELECT * FROM Departments;
   ```

   The example program displays the updated contents of the Departments table in the database server messages window.

Using prepared statements for more efficient access

If you use the Statement interface, you parse each statement that you send to the database, generate an access plan, and execute the statement. The steps before execution are called **preparing** the statement.

You can achieve performance benefits if you use the PreparedStatement interface. This allows you to prepare a statement using placeholders, and then assign values to the placeholders when executing the statement.

Using prepared statements is particularly useful when carrying out many similar actions, such as inserting many rows.

For more information about prepared statements, see "Preparing statements" on page 2.

Example

The following example illustrates how to use the PreparedStatement interface, although inserting a single row is not a good use of prepared statements.

The following InsertDynamic method of the JDBCExample class carries out a prepared statement:

```
public static void InsertDynamic( Connection con,
              String ID, String name )
{
  try
  {
    // Build the INSERT statement
    // ? is a placeholder character
    String sqlStr = "INSERT INTO Departments " +
            "( DepartmentID, DepartmentName ) " +
            "VALUES ( ? , ? )";

    // Prepare the statement
    PreparedStatement stmt =
      con.prepareStatement( sqlStr );

    // Set some values
    int idValue = Integer.valueOf( ID );
    stmt.setInt( 1, idValue );
    stmt.setString( 2, name );

    // Execute the statement
    int iRows = stmt.executeUpdate();

    // Print the number of rows inserted
    System.out.println(iRows + " rows inserted");
  }
  catch (SQLException sqe)
  {
    System.out.println("Unexpected exception : " +
              sqe.toString() + ", sqlstate = " +
              sqe.getSQLState());
  }
  catch (Exception e)
  {
    e.printStackTrace();
  }
}
```

Source code available
This code fragment is part of the JDBCExample Java file included in the *samples-dir\SQLAnywhere\JDBC* directory.

Notes

- The executeUpdate method returns an integer that reflects the number of rows affected by the operation. In this case, a successful INSERT would return a value of one (1).

- When run as a server-side class, the output from `System.out.println` goes to the database server messages window.

Run the JDBC Insert example

To run the JDBC Insert example

1. Using Interactive SQL, connect to the sample database as the DBA.
2. Ensure the JDBCExample class has been installed.

   For more information about installing the Java examples classes, see "Preparing for the examples" on page 414.
3. Define a stored procedure named JDBCInsert that acts as a wrapper for the JDBCExample.Insert method in the class:

   ```
   CREATE PROCEDURE JDBCInsert( IN arg1 INTEGER, IN arg2 CHAR(50) )
     EXTERNAL NAME 'JDBCExample.Insert(ILjava/lang/String;)V'
     LANGUAGE JAVA;
   ```
4. Call the JDBCExample.Insert method as follows:

   ```
   CALL JDBCInsert( 202, 'Southeastern Sales' );
   ```

   The Insert method causes the InsertDynamic method to be invoked.
5. Confirm that a row has been added to the Departments table.

   ```
   SELECT * FROM Departments;
   ```

   The example program displays the updated contents of the Departments table in the database server messages window.
6. There is a similar method in the example class called DeleteDynamic that shows how to delete the row that has just been added.

   Define a stored procedure named JDBCDelete that acts as a wrapper for the JDBCExample.Delete method in the class:

   ```
   CREATE PROCEDURE JDBCDelete( in arg1 integer )
     EXTERNAL NAME 'JDBCExample.Delete(I)V'
     LANGUAGE JAVA;
   ```
7. Call the JDBCExample.Delete method as follows:

   ```
   CALL JDBCDelete( 202 );
   ```

   The Delete method causes the DeleteDynamic method to be invoked.
8. Confirm that the row has been deleted from the Departments table.

   ```
   SELECT * FROM Departments;
   ```


The example program displays the updated contents of the Departments table in the database server messages window.

Using JDBC batch methods

The addBatch method of the PreparedStatement class is used for performing batched (or wide) inserts. The following are some guidelines to using this method.

1. An INSERT statement should be prepared using one of the prepareStatement methods of the Connection class.

```
// Build the INSERT statement
String sqlStr = "INSERT INTO Departments " +
            "( DepartmentID, DepartmentName ) " +
            "VALUES ( ? , ? )";
// Prepare the statement
PreparedStatement stmt =
     con.prepareStatement( sqlStr );
```

2. The parameters for the prepared insert statement should be set and batched as follows:

```
// loop to batch "n" sets of parameters
for( i=0; i < n; i++ )
{
    // Note "stmt" is the original prepared insert statement from step 1.
    stmt.setSomeType( 1, param_1 );
    stmt.setSomeType( 2, param_2 );
    .
    .
    .
    // Note that there are "m" parameters in the statement.
    stmt.setSomeType( m , param_m );

    // Add the set of parameters to the batch and
    // move to the next row of parameters.
    stmt.addBatch();
}
```

   Example:

```
for( i=0; i < 5; i++ )
{
    stmt.setInt( 1, idValue );
    stmt.setString( 2, name );
    stmt.addBatch();
}
```

3. The batch must be executed using the executeBatch method of the PreparedStatement class.

Note that BLOB parameters are not supported in batches.

When using the SQL Anywhere JDBC driver to perform batched inserts, it is recommended that you use a small column size. Using batched inserts to insert large binary or character data into long binary or long varchar columns is not recommended and may degrade performance. The performance can decrease because the SQL Anywhere JDBC driver must allocate large amounts of memory to hold each of the

batched insert rows. In all other cases, using batched inserts should provide better performance than using individual inserts.

Returning result sets

This section describes how to make one or more result sets available from Java methods.

You must write a Java method that returns one or more result sets to the calling environment, and wrap this method in a SQL stored procedure. The following code fragment illustrates how multiple result sets can be returned to the calling SQL script. It uses three executeQuery statements to obtain three different result sets.

```
public static void Results( ResultSet[] rset )
       throws SQLException
{
    // Demonstrate returning multiple result sets

    Connection con = DriverManager.getConnection(
                     "jdbc:default:connection" );
    rset[0] = con.createStatement().executeQuery(
        "SELECT * FROM Employees" +
        "   ORDER BY EmployeeID" );
    rset[1] = con.createStatement().executeQuery(
        "SELECT * FROM Departments" +
        "   ORDER BY DepartmentID" );
    rset[2] = con.createStatement().executeQuery(
        "SELECT i.ID,i.LineID,i.ProductID,i.Quantity," +
        "       s.OrderDate,i.ShipDate," +
        "       s.Region,e.GivenName||' '||e.Surname" +
        "   FROM SalesOrderItems AS i" +
        "   JOIN SalesOrders AS s" +
        "   JOIN Employees AS e" +
        "   WHERE s.ID=i.ID" +
        "         AND s.SalesRepresentative=e.EmployeeID" );
    con.close();
}
```

Source code available
This code fragment is part of the JDBCExample Java file included in the *samples-dir\SQLAnywhere \JDBC* directory.

Notes

- This server-side JDBC example connects to the default running database using the current connection using getConnection.
- The executeQuery methods return result sets.

Run the JDBC result set example

To run the JDBC result set example

1. Using Interactive SQL, connect to the sample database as the DBA.

2. Ensure the JDBCExample class has been installed.

   For more information about installing the Java examples classes, see "Preparing for the examples" on page 414.

3. Define a stored procedure named JDBCResults that acts as a wrapper for the JDBCExample.Results method in the class:

```
CREATE PROCEDURE JDBCResults()
  DYNAMIC RESULT SETS 3
  EXTERNAL NAME 'JDBCExample.Results([Ljava/sql/ResultSet;)V'
  LANGUAGE JAVA;
```

4. Set the following Interactive SQL options so you can see all the results of the query:
   a. From the **Tools** menu, choose **Options**.
   b. Click **SQL Anywhere**.
   c. Click the **Results** tab.
   d. Set the value for **Maximum Number Of Rows To Display** to **5000**.
   e. Select **Show All Result Sets**.
   f. Click **OK**.

5. Call the JDBCExample.Results method as follows:

```
CALL JDBCResults();
```

6. Check each of the three results tabs, Result Set 1, Result Set 2, and Result Set 3.

Miscellaneous JDBC notes

- **Access permissions** Like all Java classes in the database, classes containing JDBC statements can be accessed by any user if the GRANT EXECUTE statement has granted them permission to execute the stored procedure that is acting as a wrapper for the Java method.

- **Execution permissions** Java classes are executed with the permissions of the connection executing them. This behavior is different from that of stored procedures, which execute with the permissions of the owner.

Using JDBC callbacks

The SQL Anywhere JDBC driver supports two asynchronous callbacks, one for handling the SQL MESSAGE statement and the other for validating requests for file transfers. These are similar to the callbacks supported by the SQL Anywhere ODBC driver.

Messages can be sent to the client application from the database server using the SQL MESSAGE statement. Messages can also be generated by long running database server statements. For more information, see "MESSAGE statement" [*SQL Anywhere Server - SQL Reference*].

A message handler routine can be created to intercept these messages. The following is an example of a message handler callback routine.

```
class T_message_handler implements sybase.jdbc4.sqlanywhere.ASAMessageHandler
{
    private final int MSG_INFO      = 0x80 | 0;
    private final int MSG_WARNING   = 0x80 | 1;
    private final int MSG_ACTION    = 0x80 | 2;
    private final int MSG_STATUS    = 0x80 | 3;
    T_message_handler()
    {
    }

    public SQLException messageHandler(SQLException sqe)
    {
        String msg_type = "unknown";

        switch( sqe.getErrorCode() ) {
            case MSG_INFO:      msg_type = "INFO   ";   break;
            case MSG_WARNING:   msg_type = "WARNING";   break;
            case MSG_ACTION:    msg_type = "ACTION ";   break;
            case MSG_STATUS:    msg_type = "STATUS ";   break;
        }

        System.out.println( msg_type + ": " + sqe.getMessage() );
        return sqe;
    }
}
```

A client file transfer request can be validated. Before allowing any transfer to take place, the JDBC driver will invoke the validation callback, if it exists. If the client data transfer is being requested during the execution of indirect statements such as from within a stored procedure, the JDBC driver will not allow a transfer unless the client application has registered a validation callback. The conditions under which a validation call is made are described more fully below. The following is an example of a file transfer validation callback routine.

```
class T_filetrans_callback implements
sybase.jdbc4.sqlanywhere.SAValidateFileTransferCallback
{
    T_filetrans_callback()
    {
    }

    public int callback(String filename, int is_write)
    {
        System.out.println( "File transfer granted for file " + filename
+
                            " with an is_write value of " +
is_write );
        return( 1 ); // 0 to disallow, non-zero to allow
    }
}
```

The filename argument is the name of the file to be read or written. The is_write parameter is 0 if a read is requested (transfer from the client to the server), and non-zero for a write. The callback function should return 0 if the file transfer is not allowed, non-zero otherwise.

For data security, the server tracks the origin of statements requesting a file transfer. The server determines if the statement was received directly from the client application. When initiating the transfer of data from the client, the server sends the information about the origin of the statement to the client software. On its part, the JDBC driver allows unconditional transfer of data only if the data transfer is being requested due to the execution of a statement sent directly by the client application. Otherwise, the application must have registered the validation callback described above, in the absence of which the transfer is denied and the statement fails with an error. Note that if the client statement invokes a stored procedure already existing in the database, then the execution of the stored procedure itself is considered not to have been for a client initiated statement. However, if the client application explicitly creates a temporary stored procedure then the execution of the stored procedure results in the server treating the procedure as having been client initiated. Similarly, if the client application executes a batch statement, then the execution of the batch statement is considered as being done directly by the client application.

The following sample Java application demonstrates the use of the callbacks supported by the SQL Anywhere JDBC 4.0 driver.

```
import java.io.*;
import java.sql.*;
import java.util.*;

// Place <install-dir>\java\sajdbc4.jar in your classpath.

public class callback
{
    public static void main (String args[]) throws IOException
    {
        Connection          con = null;
        Statement           stmt;

        System.out.println ( "Starting... " );
        con = connect();
        if( con == null )
        {
            return; // exception should already have been reported
        }
        System.out.println ( "Connected... " );
        try
        {
            // create and register message handler callback
            T_message_handler message_worker = new T_message_handler();

((sybase.jdbc4.sqlanywhere.IConnection)con).setASAMessageHandler( message_wor
ker );

            // create and register validate file transfer callback
            T_filetrans_callback filetran_worker = new
T_filetrans_callback();

((sybase.jdbc4.sqlanywhere.IConnection)con).setSAValidateFileTransferCallback
( filetran_worker );

            stmt = con.createStatement();

            // execute message statements to force message handler to be
called
            stmt.execute( "MESSAGE 'this is an info   message' TYPE INFO TO
CLIENT" );
           stmt.execute( "MESSAGE 'this is an action message' TYPE ACTION TO
CLIENT" );
```

```
            stmt.execute( "MESSAGE 'this is a warning message' TYPE WARNING
TO CLIENT" );
            stmt.execute( "MESSAGE 'this is a status  message' TYPE STATUS TO
CLIENT" );

            System.out.println( "\n==================\n" );

            stmt.execute( "set temporary option
allow_read_client_file='on'" );
            try
            {
                stmt.execute( "drop procedure read_client_file_test" );
            }
            catch( SQLException dummy )
            {
                // ignore exception if procedure does not exist
            }
            // create procedure that will force file transfer callback to be
called
            stmt.execute( "create procedure read_client_file_test()" +
                          "begin" +
                          "    declare v long binary;" +
                          "    set v = read_client_file('sample.txt');" +
                          "end" );

            // call procedure to force validate file transfer callback to be
called
            try
            {
                stmt.execute( "call read_client_file_test()" );
            }
            catch( SQLException filetrans_exception )
            {
                // Note: Since the file transfer callback returns 1, we
                // do not expect a SQL exception to be thrown
                System.out.println( "SQLException: " +
                                    filetrans_exception.getMessage() );
            }
            stmt.close();
            con.close();
            System.out.println( "Disconnected" );
        }
        catch( SQLException sqe )
        {
            printExceptions(sqe);
        }
    }

    private static Connection connect()
    {
        Connection  connection;

        System.out.println( "Using jdbc4 driver"  );
        try
        {
            connection = DriverManager.getConnection(
                    "jdbc:sqlanywhere:uid=DBA;pwd=sql" );
        }
        catch( Exception e )
        {
            System.err.println( "Error! Could not connect" );
            System.err.println( e.getMessage() );
            printExceptions( (SQLException)e );
            connection = null;
```



```
            }
            return connection;
        }

        static private void printExceptions(SQLException sqe)
        {
            while (sqe != null)
            {

                System.out.println("Unexpected exception : " +
                    "SqlState: " + sqe.getSQLState()  +
                    " " + sqe.toString() +
                    ", ErrorCode: " + sqe.getErrorCode());
                System.out.println( "==================\n" );
                sqe = sqe.getNextException();
            }
        }
    }
```

Using JDBC escape syntax

You can use JDBC escape syntax from any JDBC application, including Interactive SQL. This escape syntax allows you to call stored procedures regardless of the database management system you are using. The general form for the escape syntax is

{ **keyword** *parameters* }

You can use the escape syntax to access a library of functions implemented by the JDBC driver that includes number, string, time, date, and system functions.

For example, to obtain the current date in a database management system-neutral way, you would execute the following:

```
SELECT { FN CURDATE() }
```

In Interactive SQL, the braces *must* be doubled. There must not be a space between successive braces: "{{" is acceptable, but "{ {" is not. As well, you cannot use newline characters in the statement. The escape syntax cannot be used in stored procedures because they are not executed by Interactive SQL.

The functions that are available depend on the JDBC driver that you are using. The following tables list the functions that are supported by the SQL Anywhere JDBC driver and by the jConnect driver.

SQL Anywhere JDBC driver supported functions

Numeric functions	String functions	System functions	Time/date functions
ABS	ASCII	DATABASE	CURDATE
ACOS	BIT_LENGTH	IFNULL	CURRENT_DATE
ASIN	CHAR	USER	CURRENT_TIME

Numeric functions	String functions	System functions	Time/date functions
ATAN	CHAR_LENGTH		CURRENT_TIME-STAMP
ATAN2	CHARAC-TER_LENGTH		CURTIME
CEILING	CONCAT		DAYNAME
COS	DIFFERENCE		DAYOFMONTH
COT	INSERT		DAYOFWEEK
DEGREES	LCASE		DAYOFYEAR
EXP	LEFT		EXTRACT
FLOOR	LENGTH		HOUR
LOG	LOCATE		MINUTE
LOG10	LTRIM		MONTH
MOD	OCTET_LENGTH		MONTHNAME
PI	POSITION		NOW
POWER	REPEAT		QUARTER
RADIANS	REPLACE		SECOND
RAND	RIGHT		WEEK
ROUND	RTRIM		YEAR
SIGN	SOUNDEX		
SIN	SPACE		
SQRT	SUBSTRING		
TAN	UCASE		
TRUNCATE			

jConnect supported functions

Numeric functions	String functions	System functions	Time/date functions
ABS	ASCII	DATABASE	CURDATE
ACOS	CHAR	IFNULL	CURTIME
ASIN	CONCAT	USER	DAYNAME
ATAN	DIFFERENCE	CONVERT	DAYOFMONTH
ATAN2	LCASE		DAYOFWEEK
CEILING	LENGTH		HOUR
COS	REPEAT		MINUTE
COT	RIGHT		MONTH
DEGREES	SOUNDEX		MONTHNAME
EXP	SPACE		NOW
FLOOR	SUBSTRING		QUARTER
LOG	UCASE		SECOND
LOG10			TIMESTAMPADD
PI			TIMESTAMPDIFF
POWER			YEAR
RADIANS			
RAND			
ROUND			
SIGN			
SIN			
SQRT			
TAN			

A statement using the escape syntax should work in SQL Anywhere, Adaptive Server Enterprise, Oracle, SQL Server, or another database management system to which you are connected.

For example, to obtain database properties with the sa_db_info procedure using SQL escape syntax, you would execute the following in Interactive SQL:

```
{{CALL sa_db_info( 0 ) }}
```

JDBC 3.0/4.0 API support

All mandatory classes and methods of the JDBC 3.0 and 4.0 specifications are supported by the SQL Anywhere JDBC driver. Some optional methods of the java.sql.Blob interface are not supported. These optional methods are:

- long position(Blob pattern, long start);
- long position(byte[] pattern, long start);
- OutputStream setBinaryStream(long pos)
- int setBytes(long pos, byte[] bytes)
- int setBytes(long pos, byte[] bytes, int offset, int len);
- void truncate(long len);

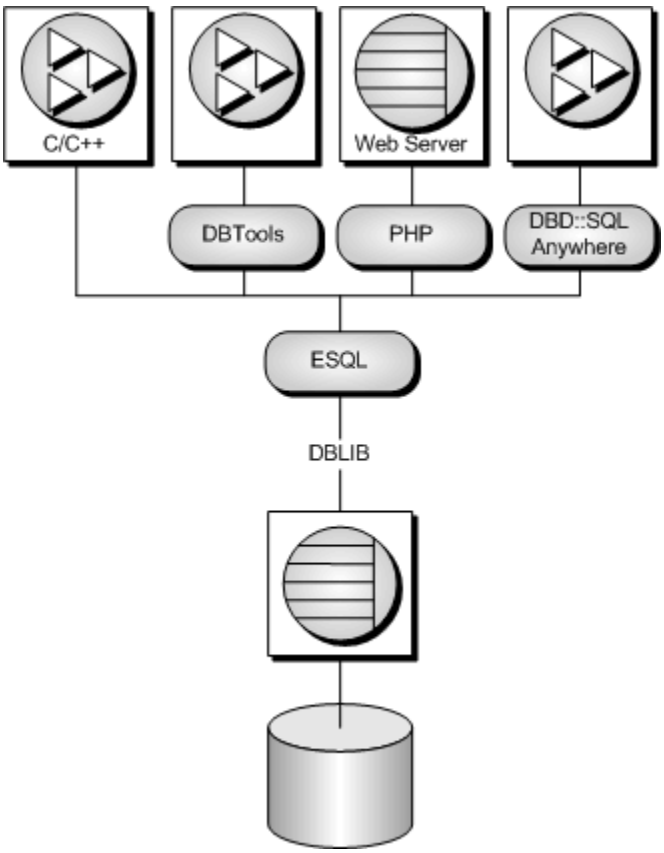
Embedded SQL

SQL statements embedded in a C or C++ source file are referred to as embedded SQL. A preprocessor translates these statements into calls to a runtime library. Embedded SQL is an ISO/ANSI and IBM standard.

Embedded SQL is portable to other databases and other environments, and is functionally equivalent in all operating environments. It is a comprehensive, low-level interface that provides all the functionality available in the product. Embedded SQL requires knowledge of C or C++ programming languages.

Embedded SQL applications

You can develop C or C++ applications that access the SQL Anywhere server using the SQL Anywhere embedded SQL interface. The command line database tools are examples of applications developed in this manner.



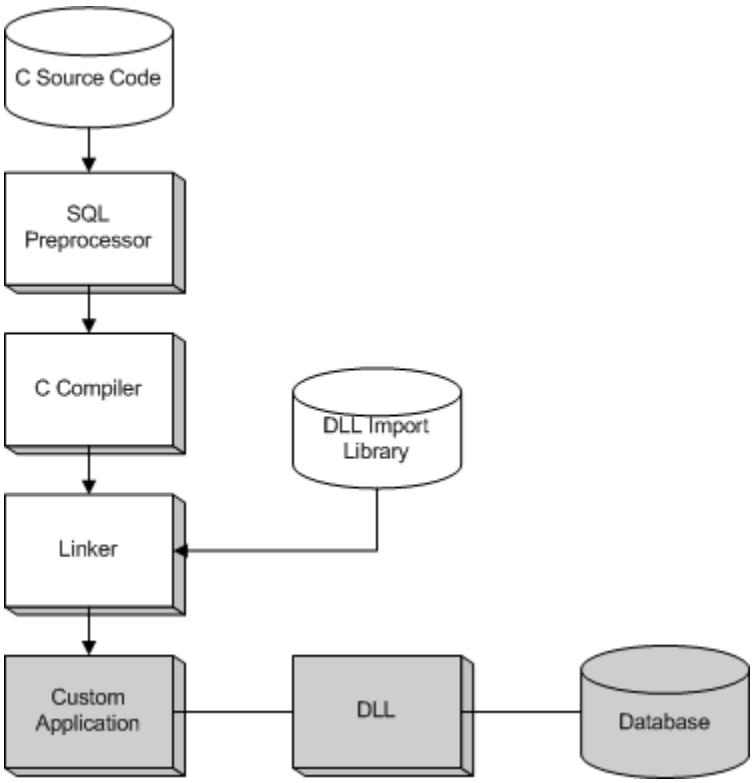
Embedded SQL is a database programming interface for the C and C++ programming languages. It consists of SQL statements intermixed with (embedded in) C or C++ source code. These SQL statements are translated by a **SQL preprocessor** into C or C++ source code, which you then compile.

At runtime, embedded SQL applications use a SQL Anywhere **interface library** called DBLIB to communicate with a database server. DBLIB is a dynamic link library (**DLL**) or shared object on most platforms.

- On Windows operating systems, the interface library is *dblib12.dll*.
- On Unix operating systems, the interface library is *libdblib12.so*, *libdblib12.sl*, or *libdblib12.a*, depending on the operating system.
- On Mac OS X, the interface library is *libdblib12.dylib.1*.

SQL Anywhere provides two flavors of embedded SQL. Static embedded SQL is simpler to use, but is less flexible than dynamic embedded SQL.

Development process overview



Once the program has been successfully preprocessed and compiled, it is linked with the **import library** for DBLIB to form an executable file. When the database server is running, this executable file uses DBLIB to interact with the database server. The database server does not have to be running when the program is preprocessed.

For Windows, there are 32-bit and 64-bit import libraries for Microsoft Visual C++. The use of import libraries is one method for developing applications that call functions in DLLs. SQL Anywhere also provides an alternative, and recommended method which avoids the use of import libraries. For more information, see "Loading DBLIB dynamically under Windows" on page 434.

Running the SQL preprocessor

The SQL preprocessor is an executable named *sqlpp*.

The SQLPP command line is as follows:

sqlpp [*options*] *sql-filename* [*output-filename*]

The SQL preprocessor processes a C program with embedded SQL before the C or C++ compiler is run. The preprocessor translates the SQL statements into C/C++ language source that is put into the output file. The normal extension for source programs with embedded SQL is *.sqc*. The default output file name is the *sql-filename* with an extension of *.c*. If the *sql-filename* already has a *.c* extension, then the output file name extension is *.cc* by default.

Reprocessing embedded SQL
When an application is rebuilt to use a new major version of the database interface library, the embedded SQL files must be preprocessed with the same version's SQL preprocessor.

For a full listing of the command line options, see "SQL preprocessor" on page 484.

Supported compilers

The C language SQL preprocessor has been used in conjunction with the following compilers:

Operating system	Compiler	Version
Windows	Microsoft Visual C++	6.0 or later
Windows Mobile	Microsoft Visual C++	2005
Unix	GNU or native compiler	

Embedded SQL header files

All header files are installed in the *SDK\Include* subdirectory of your SQL Anywhere installation directory.

File name	Description
sqlca.h	Main header file included in all embedded SQL programs. This file includes the structure definition for the SQL Communication Area (SQLCA) and prototypes for all embedded SQL database interface functions.
sqlda.h	SQL Descriptor Area structure definition included in embedded SQL programs that use dynamic SQL.
sqldef.h	Definition of embedded SQL interface data types. This file also contains structure definitions and return codes needed for starting the database server from a C program.
sqlerr.h	Definitions for error codes returned in the sqlcode field of the SQLCA.
sqlstate.h	Definitions for ANSI/ISO SQL standard error states returned in the sqlstate field of the SQLCA.
pshpk1.h, pshpk4.h, poppk.h	These headers ensure that structure packing is handled correctly.

Import libraries

On Windows platforms, all import libraries are installed in the *SDK\Lib* subdirectories, under the SQL Anywhere installation directory. Windows import libraries are stored in the *SDK\Lib\x86* and *SDK\Lib\x64* subdirectories. Windows Mobile import libraries are installed in the *SDK\Lib\CE\Arm.50* subdirectory. An export definition list is stored in *SDK\Lib\Def\dblib.def*.

On Unix platforms, all import libraries are installed in the *lib32* and *lib64* subdirectories, under the SQL Anywhere installation directory.

On Mac OS X platforms, all import libraries are installed in the *System/lib32* and *System/lib64* subdirectories, under the SQL Anywhere installation directory.

Operating system	Compiler	Import library
Windows	Microsoft Visual C++	*dblibtm.lib*
Windows Mobile	Microsoft Visual C++ 2005	*dblib12.lib*
Unix (unthreaded applications)	All compilers	*libdblib12.so, libdbtasks12.so, libdblib12.sl, libdbtasks12.sl*

Operating system	Compiler	Import library
Unix (threaded applications)	All compilers	*libdblib12_r.so*, *libdb-tasks12_r.so*,*libd-blib12_r.sl*, *libdb-tasks12_r.sl*
Mac OS X (threaded applications)	All compilers	*libdblib12.dylib*, *libdb-tasks12.dylib*
Mac OS X (threaded applications)	All compilers	*libdblib12_r.dylib*, *libdb-tasks12_r.dylib*

The *libdbtasks12* libraries are called by the *libdblib12* libraries. Some compilers locate *libdbtasks12* automatically. For others, you need to specify it explicitly.

Sample embedded SQL program

The following is a very simple example of an embedded SQL program.

```
#include <stdio.h>
EXEC SQL INCLUDE SQLCA;
main()
{
 db_init( &sqlca );
 EXEC SQL WHENEVER SQLERROR GOTO error;
 EXEC SQL CONNECT "DBA" IDENTIFIED BY "sql";
 EXEC SQL UPDATE Employees
  SET Surname =  'Plankton'
  WHERE EmployeeID = 195;
 EXEC SQL COMMIT WORK;
 EXEC SQL DISCONNECT;
 db_fini( &sqlca );
 return( 0 );
error:
 printf( "update unsuccessful -- sqlcode = %ld\n",
  sqlca.sqlcode );
 db_fini( &sqlca );
 return( -1 );
}
```

This example connects to the database, updates the last name of employee number 195, commits the change, and exits. There is virtually no interaction between the SQL and C code. The only thing the C code is used for in this example is control flow. The WHENEVER statement is used for error checking. The error action (GOTO in this example) is executed after any SQL statement that causes an error.

For a description of fetching data, see "Fetching data" on page 469.

Structure of embedded SQL programs

SQL statements are placed (embedded) within regular C or C++ code. All embedded SQL statements start with the words EXEC SQL and end with a semicolon (;). Normal C language comments are allowed in the middle of embedded SQL statements.

Every C program using embedded SQL must contain the following statement before any other embedded SQL statements in the source file.

```
EXEC SQL INCLUDE SQLCA;
```

Every C program using embedded SQL must initialize a SQLCA first:

```
db_init( &sqlca );
```

One of the first embedded SQL statements executed by the C program must be a CONNECT statement. The CONNECT statement is used to establish a connection with the database server and to specify the user ID that is used for authorizing all statements executed during the connection.

Some embedded SQL statements do not generate any C code, or do not involve communication with the database. These statements are allowed before the CONNECT statement. Most notable are the INCLUDE statement and the WHENEVER statement for specifying error processing.

Every C program using embedded SQL must finalize any SQLCA that has been initialized.

```
db_fini( &sqlca );
```

Loading DBLIB dynamically under Windows

The usual practice for developing applications that use functions from DLLs is to link the application against an **import library**, which contains the required function definitions.

This section describes an alternative to using an import library for developing SQL Anywhere applications. DBLIB can be loaded dynamically, without having to link against the import library, using the *esqldll.c* module in the *SDK\C* subdirectory of your installation directory.

A similar technique could be used to dynamically load DBLIB on Unix platforms.

To load the interface DLL dynamically

1. Your program must call db_init_dll to load the DLL, and must call db_fini_dll to free the DLL. The db_init_dll call must be before any function in the database interface, and no function in the interface can be called after db_fini_dll.

   You must still call the db_init and db_fini library functions.

2. You must #include the *esqldll.h* header file before the EXEC SQL INCLUDE SQLCA statement or #include <*sqlca.h*> line in your embedded SQL program. The *esqldll.h* header file includes *sqlca.h*.

3. A SQL OS macro must be defined. The header file *sqlos.h*, which is included by *sqlca.h*, attempts to determine the appropriate macro and define it. However, certain combinations of platforms and

compilers may cause this to fail. In this case, you must add a #define to the top of this file, or make the definition using a compiler option. The macro that must be defined for Windows is shown below.

Macro	Platforms
_SQL_OS_WINDOWS	All Windows operating systems

4. Compile *esqldll.c*.
5. Instead of linking against the imports library, link the object module *esqldll.obj* with your embedded SQL application objects.

Sample

You can find a sample program illustrating how to load the interface library dynamically in the *samples-dir\SQLAnywhere\ESQLDynamicLoad* directory. The source code is in *sample.sqc*.

Sample embedded SQL programs

Sample embedded SQL programs are included with the SQL Anywhere installation. They are placed in the *samples-dir\SQLAnywhere\C* directory. For Windows Mobile, an additional example is located in the *samples-dir\SQLAnywhere\CE\esql_sample* directory.

- The static cursor embedded SQL example, *cur.sqc*, demonstrates the use of static SQL statements.
- The dynamic cursor embedded SQL example, *dcur.sqc*, demonstrates the use of dynamic SQL statements.

To reduce the amount of code that is duplicated by the sample programs, the mainlines and the data printing functions have been placed into a separate file. This is *mainch.c* for character mode systems and *mainwin.c* for windowing environments.

The sample programs each supply the following three routines, which are called from the mainlines:

- **WSQLEX_Init** Connects to the database and opens the cursor.
- **WSQLEX_Process_Command** Processes commands from the user, manipulating the cursor as necessary.
- **WSQLEX_Finish** Closes the cursor and disconnects from the database.

The function of the mainline is to:

1. Call the WSQLEX_Init routine.
2. Loop, getting commands from the user and calling WSQL_Process_Command until the user quits.
3. Call the WSQLEX_Finish routine.

Connecting to the database is done with the embedded SQL CONNECT statement supplying the appropriate user ID and password.

In addition to these samples, you may find other programs and source files as part of SQL Anywhere that demonstrate features available for particular platforms.

Building the sample programs

Files to build the sample programs are supplied with the sample code.

- For Windows, use *build.bat* or *build64.bat* to compile the sample programs.

  For x64 platform builds, you may need to set up the correct environment for compiling and linking. Here is an example that builds the sample programs for an x64 platform.

  ```
  set mssdk=c:\MSSDK\v6.1
  build64
  ```

- For Unix, use the shell script *build.sh*.
- For Windows Mobile, use the *esql_sample.sln* project file for Microsoft Visual C++. This file appears in *samples-dir\SQLAnywhere\CE\esql_sample*.

This builds the following examples.

- **CUR** An embedded SQL static cursor example.
- **DCUR** An embedded SQL dynamic cursor example.
- **ODBC** An ODBC example which is discussing in "ODBC samples" on page 350.

Running the sample programs

The executable files and corresponding source code are located in the *samples-dir\SQLAnywhere\C* directory. For Windows Mobile, an additional example is located in the *samples-dir\SQLAnywhere\CE\esql_sample* directory.

To run the static cursor sample program

1. Start the SQL Anywhere sample database, *demo.db*.
2. For 32-bit Windows, run the file *curwin.exe*.

   For 64-bit Windows, run the file *curx64.exe*.

   For Unix, run the file *cur*.
3. Follow the on-screen instructions.

The various commands manipulate a database cursor and print the query results on the screen. Enter the letter of the command that you want to perform. Some systems may require you to press Enter after the letter.

To run the dynamic cursor sample program

1. For 32-bit Windows, run the file *dcurwin.exe*.

   For 64-bit Windows, run the file *dcurx64.exe*.

   For Unix, run the file *dcur*.

2. Each sample program presents a console-type user interface and prompts you for a command. Enter the following connection string to connect to the sample database:

   ```
   DSN=SQL Anywhere 12 Demo
   ```

3. Each sample program prompts you for a table. Choose one of the tables in the sample database. For example, you can enter **Customers** or **Employees**.

4. Follow the on-screen instructions.

   The various commands manipulate a database cursor and print the query results on the screen. Enter the letter of the command you want to perform. Some systems may require you to press Enter after the letter.

Windows samples

The Windows versions of the example programs use the Windows graphical user interface. However, to keep the user interface code relatively simple, some simplifications have been made. In particular, these applications do not repaint their Windows on WM_PAINT messages except to reprint the prompt.

Static cursor sample

This example demonstrates the use of cursors. The particular cursor used here retrieves certain information from the Employees table in the sample database. The cursor is declared statically, meaning that the actual SQL statement to retrieve the information is hard coded into the source program. This is a good starting point for learning how cursors work. The Dynamic Cursor sample takes this first example and converts it to use dynamic SQL statements. See “Dynamic cursor sample” on page 438.

For information about where the source code can be found and how to build this example program, see “Sample embedded SQL programs” on page 435.

The open_cursor routine both declares a cursor for the specific SQL query and also opens the cursor.

Printing a page of information is done by the print routine. It loops *pagesize* times, fetching a single row from the cursor and printing it out. Note that the fetch routine checks for warning conditions (such as `Row not found`) and prints appropriate messages when they arise. In addition, the cursor is repositioned by this program to the row before the one that appears at the top of the current page of data.

The move, top, and bottom routines use the appropriate form of the FETCH statement to position the cursor. Note that this form of the FETCH statement doesn't actually get the data—it only positions the cursor. Also, a general relative positioning routine, move, has been implemented to move in either direction depending on the sign of the parameter.

When the user quits, the cursor is closed and the database connection is also released. The cursor is closed by a ROLLBACK WORK statement, and the connection is released by a DISCONNECT.

Dynamic cursor sample

This sample demonstrates the use of cursors for a dynamic SQL SELECT statement. It is a slight modification of the static cursor example. If you have not yet looked at Static Cursor sample, it would be helpful to do so before looking at this sample. See "Static cursor sample" on page 437.

For information about where the source code can be found and how to build this sample program, see "Sample embedded SQL programs" on page 435.

The dcur program allows the user to select a table to look at with the n command. The program then presents as much information from that table as fits on the screen.

When this program is run, it prompts for a connection string of the form:

```
UID=DBA;PWD=sql;DBF=samples-dir\demo.db
```

The C program with the embedded SQL is held in the *samples-dir\SQLAnywhere\C* directory. For Windows Mobile, a dynamic cursor example is located in the *samples-dir\SQLAnywhere\CE\esql_sample* directory. The program looks much like the static cursor sample with the exception of the connect, open_cursor, and print functions.

The connect function uses the embedded SQL interface function db_string_connect to connect to the database. This function provides the extra functionality to support the connection string that is used to connect to the database.

The open_cursor routine first builds the SELECT statement

```
SELECT * FROM table-name
```

where *table-name* is a parameter passed to the routine. It then prepares a dynamic SQL statement using this string.

The embedded SQL DESCRIBE statement is used to fill in the SQLDA structure with the results of the SELECT statement.

Size of the SQLDA
An initial guess is taken for the size of the SQLDA (3). If this is not big enough, the actual size of the select list returned by the database server is used to allocate a SQLDA of the correct size.

The SQLDA structure is then filled with buffers to hold strings that represent the results of the query. The fill_s_sqlda routine converts all data types in the SQLDA to DT_STRING and allocates buffers of the appropriate size.

A cursor is then declared and opened for this statement. The rest of the routines for moving and closing the cursor remain the same.

The fetch routine is slightly different: it puts the results into the SQLDA structure instead of into a list of host variables. The print routine has changed significantly to print results from the SQLDA structure up to the width of the screen. The print routine also uses the name fields of the SQLDA to print headings for each column.

Embedded SQL data types

To transfer information between a program and the database server, every piece of data must have a data type. The embedded SQL data type constants are prefixed with DT_, and can be found in the *sqldef.h* header file. You can create a host variable of any one of the supported types. You can also use these types in a SQLDA structure for passing data to and from the database.

You can define variables of these data types using the DECL_ macros listed in *sqlca.h*. For example, a variable holding a BIGINT value could be declared with DECL_BIGINT.

The following data types are supported by the embedded SQL programming interface:

- **DT_BIT** 8-bit signed integer.
- **DT_SMALLINT** 16-bit signed integer.
- **DT_UNSSMALLINT** 16-bit unsigned integer.
- **DT_TINYINT** 8-bit signed integer.
- **DT_BIGINT** 64-bit signed integer.
- **DT_UNSBIGINT** 64-bit unsigned integer.
- **DT_INT** 32-bit signed integer.
- **DT_UNSINT** 32-bit unsigned integer.
- **DT_FLOAT** 4-byte floating-point number.
- **DT_DOUBLE** 8-byte floating-point number.
- **DT_DECIMAL** Packed decimal number (proprietary format).

  ```
  typedef struct TYPE_DECIMAL {
    char array[1];
  } TYPE_DECIMAL;
  ```

- **DT_STRING** Null-terminated character string, in the CHAR character set. The string is blank-padded if the database is initialized with blank-padded strings.

- **DT_NSTRING** Null-terminated character string, in the NCHAR character set. The string is blank-padded if the database is initialized with blank-padded strings.
- **DT_DATE** Null-terminated character string that is a valid date.
- **DT_TIME** Null-terminated character string that is a valid time.
- **DT_TIMESTAMP** Null-terminated character string that is a valid timestamp.
- **DT_FIXCHAR** Fixed-length blank-padded character string, in the CHAR character set. The maximum length, specified in bytes, is 32767. The data is not null-terminated.
- **DT_NFIXCHAR** Fixed-length blank-padded character string, in the NCHAR character set. The maximum length, specified in bytes, is 32767. The data is not null-terminated.
- **DT_VARCHAR** Varying length character string, in the CHAR character set, with a two-byte length field. The maximum length is 32765 bytes. When sending data, you must set the length field. When fetching data, the database server sets the length field. The data is not null-terminated or blank-padded.

  ```
  typedef struct VARCHAR {
   a_sql_ulen len;
   char       array[1];
  } VARCHAR;
  ```

- **DT_NVARCHAR** Varying length character string, in the NCHAR character set, with a two-byte length field. The maximum length is 32765 bytes. When sending data, you must set the length field. When fetching data, the database server sets the length field. The data is not null-terminated or blank-padded.

  ```
  typedef struct NVARCHAR {
   a_sql_ulen len;
   char       array[1];
  } NVARCHAR;
  ```

- **DT_LONGVARCHAR** Long varying length character string, in the CHAR character set.

  ```
  typedef struct LONGVARCHAR {
   a_sql_uint32 array_len;  /* number of allocated bytes in array */
   a_sql_uint32 stored_len; /* number of bytes stored in array
                             * (never larger than array_len) */
   a_sql_uint32 untrunc_len;/* number of bytes in untruncated expression
                             * (may be larger than array_len) */
   char         array[1];   /* the data */
  } LONGVARCHAR, LONGNVARCHAR, LONGBINARY;
  ```

  The LONGVARCHAR structure can be used with more than 32767 bytes of data. Large data can be fetched all at once, or in pieces using the GET DATA statement. Large data can be supplied to the server all at once, or in pieces by appending to a database variable using the SET statement. The data is not null-terminated or blank-padded.

  For more information, see "Sending and retrieving long values" on page 477.

- **DT_LONGNVARCHAR** Long varying length character string, in the NCHAR character set. The macro defines a structure, as follows:


```
typedef struct LONGVARCHAR {
 a_sql_uint32 array_len;  /* number of allocated bytes in array */
 a_sql_uint32 stored_len; /* number of bytes stored in array
                           * (never larger than array_len) */
 a_sql_uint32 untrunc_len;/* number of bytes in untruncated expression
                           * (may be larger than array_len) */
 char         array[1];   /* the data */
} LONGVARCHAR, LONGNVARCHAR, LONGBINARY;
```

The LONGNVARCHAR structure can be used with more than 32767 bytes of data. Large data can be fetched all at once, or in pieces using the GET DATA statement. Large data can be supplied to the server all at once, or in pieces by appending to a database variable using the SET statement. The data is not null-terminated or blank-padded.

For more information, see "Sending and retrieving long values" on page 477.

- **DT_BINARY** Varying length binary data with a two-byte length field. The maximum length is 32765 bytes. When supplying information to the database server, you must set the length field. When fetching information from the database server, the server sets the length field.

  ```
  typedef struct BINARY {
   a_sql_ulen len;
   char       array[1];
  } BINARY;
  ```

- **DT_LONGBINARY** Long binary data. The macro defines a structure, as follows:

  ```
  typedef struct LONGVARCHAR {
   a_sql_uint32 array_len;  /* number of allocated bytes in array */
   a_sql_uint32 stored_len; /* number of bytes stored in array
                             * (never larger than array_len) */
   a_sql_uint32 untrunc_len;/* number of bytes in untruncated expression
                             * (may be larger than array_len) */
   char         array[1];   /* the data */
  } LONGVARCHAR, LONGNVARCHAR, LONGBINARY;
  ```

  The LONGBINARY structure may be used with more than 32767 bytes of data. Large data can be fetched all at once, or in pieces using the GET DATA statement. Large data can be supplied to the server all at once, or in pieces by appending to a database variable using the SET statement.

  For more information, see "Sending and retrieving long values" on page 477.

- **DT_TIMESTAMP_STRUCT** SQLDATETIME structure with fields for each part of a timestamp.

  ```
  typedef struct sqldatetime {
   unsigned short year; /* for example 1999 */
   unsigned char  month; /* 0-11 */
   unsigned char  day_of_week; /* 0-6 0=Sunday */
   unsigned short day_of_year; /* 0-365 */
   unsigned char  day; /* 1-31 */
   unsigned char  hour; /* 0-23 */
   unsigned char  minute; /* 0-59 */
   unsigned char  second; /* 0-59 */
   unsigned long  microsecond; /* 0-999999 */
  } SQLDATETIME;
  ```

  The SQLDATETIME structure can be used to retrieve fields of DATE, TIME, and TIMESTAMP type (or anything that can be converted to one of these). Often, applications have their own formats

and date manipulation code. Fetching data in this structure makes it easier for you to manipulate this data. Note that DATE, TIME, and TIMESTAMP fields can also be fetched and updated with any character type.

If you use a SQLDATETIME structure to enter a date, time, or timestamp into the database, the day_of_year and day_of_week members are ignored.

See:

- "date_format option" [*SQL Anywhere Server - Database Administration*]
- "date_order option" [*SQL Anywhere Server - Database Administration*]
- "time_format option" [*SQL Anywhere Server - Database Administration*]
- "timestamp_format option" [*SQL Anywhere Server - Database Administration*]

- **DT_VARIABLE** Null-terminated character string. The character string must be the name of a SQL variable whose value is used by the database server. This data type is used only for supplying data to the database server. It cannot be used when fetching data from the database server.

The structures are defined in the *sqlca.h* file. The VARCHAR, NVARCHAR, BINARY, DECIMAL, and LONG data types are not useful for declaring host variables because they contain a one-character array. However, they are useful for allocating variables dynamically or typecasting other variables.

DATE and TIME database types

There are no corresponding embedded SQL interface data types for the various DATE and TIME database types. These database types are all fetched and updated using either the SQLDATETIME structure or character strings.

For more information, see "GET DATA statement [ESQL]" [*SQL Anywhere Server - SQL Reference*] and "SET statement" [*SQL Anywhere Server - SQL Reference*].

Using host variables

Host variables are C variables that are identified to the SQL preprocessor. Host variables can be used to send values to the database server or receive values from the database server.

Host variables are quite easy to use, but they have some restrictions. Dynamic SQL is a more general way of passing information to and from the database server using a structure known as the SQL Descriptor Area (SQLDA). The SQL preprocessor automatically generates a SQLDA for each statement in which host variables are used.

Host variables cannot be used in batches. Host variables cannot be used within a subquery in a SET statement.

For information about dynamic SQL, see "Static and dynamic SQL" on page 456.

Declaring host variables

Host variables are defined by putting them into a **declaration section**. According to the ANSI embedded SQL standard, host variables are defined by surrounding the normal C variable declarations with the following:

```
EXEC SQL BEGIN DECLARE SECTION;
/* C variable declarations */
EXEC SQL END DECLARE SECTION;
```

These host variables can then be used in place of value constants in any SQL statement. When the database server executes the statement, the value of the host variable is used. Note that host variables cannot be used in place of table or column names: dynamic SQL is required for this. The variable name is prefixed with a colon (:) in a SQL statement to distinguish it from other identifiers allowed in the statement.

In the SQL preprocessor, C language code is only scanned inside a DECLARE SECTION. So, TYPEDEF types and structures are not allowed, but initializers on the variables are allowed inside a DECLARE SECTION.

Example

The following sample code illustrates the use of host variables on an INSERT statement. The variables are filled in by the program and then inserted into the database:

```
EXEC SQL BEGIN DECLARE SECTION;
long employee_number;
char employee_name[50];
char employee_initials[8];
char employee_phone[15];
EXEC SQL END DECLARE SECTION;
/* program fills in variables with appropriate values
*/
EXEC SQL INSERT INTO Employees
VALUES (:employee_number, :employee_name,
:employee_initials, :employee_phone );
```

For a more extensive example, see "Static cursor sample" on page 437.

C host variable types

Only a limited number of C data types are supported as host variables. Also, certain host variable types do not have a corresponding C type.

Macros defined in the *sqlca.h* header file can be used to declare host variables of the following types: NCHAR, VARCHAR, NVARCHAR, LONGVARCHAR, LONGNVARCHAR, BINARY, LONGBINARY, DECIMAL, DT_FIXCHAR, DT_NFIXCHAR, DATETIME (SQLDATETIME), BIT, BIGINT, or UNSIGNED BIGINT. They are used as follows:

```
EXEC SQL BEGIN DECLARE SECTION;
DECL_NCHAR                v_nchar[10];
DECL_VARCHAR( 10 )        v_varchar;
DECL_NVARCHAR( 10 )       v_nvarchar;
DECL_LONGVARCHAR( 32768 ) v_longvarchar;
DECL_LONGNVARCHAR( 32768 ) v_longnvarchar;
DECL_BINARY( 4000 )       v_binary;
DECL_LONGBINARY( 128000 ) v_longbinary;
```



```
DECL_DECIMAL( 30, 6 )      v_decimal;
DECL_FIXCHAR( 10 )         v_fixchar;
DECL_NFIXCHAR( 10 )        v_nfixchar;
DECL_DATETIME              v_datetime;
DECL_BIT                   v_bit;
DECL_BIGINT                v_bigint;
DECL_UNSIGNED_BIGINT       v_ubigint;
EXEC SQL END DECLARE SECTION;
```

The preprocessor recognizes these macros within a declaration section and treats the variable as the appropriate type. It is recommended that the DECIMAL (DT_DECIMAL, DECL_DECIMAL) type not be used since the format of decimal numbers is proprietary.

The following table lists the C variable types that are allowed for host variables and their corresponding embedded SQL interface data types.

C data type	Embedded SQL interface type	Description
`short si;` `short int si;`	DT_SMALLINT	16-bit signed integer.
`unsigned short int usi;`	DT_UNSSMALLINT	16-bit unsigned integer.
`long l;` `long int l;`	DT_INT	32-bit signed integer.
`unsigned long int ul;`	DT_UNSINT	32-bit unsigned integer.
`DECL_BIGINT ll;`	DT_BIGINT	64-bit signed integer.
`DECL_UNSIGNED_BIGINT ull;`	DT_UNSBIGINT	64-bit unsigned integer.
`float f;`	DT_FLOAT	4-byte single-precision floating-point value.
`double d;`	DT_DOUBLE	8-byte double-precision floating-point value.
`char a[n]; /*n>=1*/`	DT_STRING	Null-terminated string, in CHAR character set. The string is blank-padded if the database is initialized with blank-padded strings. This variable holds n-1 bytes plus the null terminator.
`char *a;`	DT_STRING	Null-terminated string, in CHAR character set. This variable points to an area that can hold up to 32766 bytes plus the null terminator.

C data type	Embedded SQL interface type	Description
`DECL_NCHAR a[n]; /*n>=1*/`	DT_NSTRING	Null-terminated string, in NCHAR character set. The string is blank-padded if the database is initialized with blank-padded strings. This variable holds n-1 bytes plus the null terminator.
`DECL_NCHAR *a;`	DT_NSTRING	Null-terminated string, in NCHAR character set. This variable points to an area that can hold up to 32766 bytes plus the null terminator.
`DECL_VARCHAR(n) a;`	DT_VARCHAR	Varying length character string, in CHAR character set, with 2-byte length field. Not null-terminated or blank-padded. The maximum value for n is 32765 (bytes).
`DECL_NVARCHAR(n) a;`	DT_NVARCHAR	Varying length character string, in NCHAR character set, with 2-byte length field. Not null-terminated or blank-padded. The maximum value for n is 32765 (bytes).
`DECL_LONGVARCHAR(n) a;`	DT_LONGVARCHAR	Varying length long character string, in CHAR character set, with three 4-byte length fields. Not null-terminated or blank-padded.
`DECL_LONGNVARCHAR(n) a;`	DT_LONGNVARCHAR	Varying length long character string, in NCHAR character set, with three 4-byte length fields. Not null-terminated or blank-padded.
`DECL_BINARY(n) a;`	DT_BINARY	Varying length binary data with 2-byte length field. The maximum value for n is 32765 (bytes).

C data type	Embedded SQL interface type	Description
`DECL_LONGBINARY(n) a;`	DT_LONGBINARY	Varying length long binary data with three 4-byte length fields.
`char a; /*n=1*/` `DECL_FIXCHAR(n) a;`	DT_FIXCHAR	Fixed length character string, in CHAR character set. Blank-padded but not null-terminated. The maximum value for n is 32767 (bytes).
`DECL_NCHAR a; /*n=1*/` `DECL_NFIXCHAR(n) a;`	DT_NFIXCHAR	Fixed length character string, in NCHAR character set. Blank-padded but not null-terminated. The maximum value for n is 32767 (bytes).
`DECL_DATETIME a;`	DT_TIMESTAMP_STRUCT	SQLDATETIME structure

Character sets

For DT_FIXCHAR, DT_STRING, DT_VARCHAR, and DT_LONGVARCHAR, character data is in the application's CHAR character set, which is usually the character set of the application's locale. An application can change the CHAR character set either by using the CHARSET connection parameter, or by calling the db_change_char_charset function.

For DT_NFIXCHAR, DT_NSTRING, DT_NVARCHAR, and DT_LONGNVARCHAR, data is in the application's NCHAR character set. By default, the application's NCHAR character set is the same as the CHAR character set. An application can change the NCHAR character set by calling the db_change_nchar_charset function.

For more information about locales and character sets, see "Understanding locales" [*SQL Anywhere Server - Database Administration*].

For more information about changing the CHAR character set, see "CharSet (CS) connection parameter" [*SQL Anywhere Server - Database Administration*] or "db_change_char_charset function" on page 493.

For more information about changing the NCHAR character set, see "db_change_nchar_charset function" on page 494.

Data lengths

Regardless of the CHAR and NCHAR character sets in use, all data lengths are specified in bytes.

If character set conversion occurs between the server and the application, it is the application's responsibility to ensure that buffers are sufficiently large to handle the converted data, and to issue additional GET DATA statements if data is truncated.

Pointers to char

The database interface considers a host variable declared as a **pointer to char** (*char * a*) to be 32767 bytes long. Any host variable of type pointer to char used to retrieve information from the database must point to a buffer large enough to hold any value that could possibly come back from the database.

This is potentially quite dangerous because someone could change the definition of the column in the database to be larger than it was when the program was written. This could cause random memory corruption problems. It is better to use a declared array, even as a parameter to a function, where it is passed as a pointer to char. This technique allows the embedded SQL statements to know the size of the array.

Scope of host variables

A standard host-variable declaration section can appear anywhere that C variables can normally be declared. This includes the parameter declaration section of a C function. The C variables have their normal scope (available within the block in which they are defined). However, since the SQL preprocessor does not scan C code, it does not respect C blocks.

As far as the SQL preprocessor is concerned, host variables are global to the source file; two host variables cannot have the same name.

Host variable usage

Host variables can be used in the following circumstances:

- SELECT, INSERT, UPDATE, and DELETE statements in any place where a number or string constant is allowed.
- The INTO clause of SELECT and FETCH statements.
- Host variables can also be used in place of a statement name, a cursor name, or an option name in statements specific to embedded SQL.
- For CONNECT, DISCONNECT, and SET CONNECT statements, a host variable can be used in place of a server name, database name, connection name, user ID, password, or connection string.
- For SET OPTION and GET OPTION, a host variable can be used in place of the option value.

Host variables cannot be used in the following circumstances:

- Host variables cannot be used in place of a table name or a column name in any statement.
- Host variables cannot be used in batches.
- Host variables cannot be used within a subquery in a SET statement.

SQLCODE and SQLSTATE host variables

The ISO/ANSI standard allows an embedded SQL source file to declare the following special host variables within a declaration section:

```
long SQLCODE;
char SQLSTATE[6];
```

If used, these variables are set after any embedded SQL statement that makes a database request (EXEC SQL statements other than DECLARE SECTION, INCLUDE, WHENEVER SQLCODE, and so on).

The SQLCODE and SQLSTATE host variables must be visible in the scope of every embedded SQL statement that generates database requests.

For more information, see the description of the sqlpp -k option in "SQL preprocessor" on page 484.

The following is valid embedded SQL:

```
EXEC SQL INCLUDE SQLCA;
EXEC SQL BEGIN DECLARE SECTION;
long SQLCODE;
EXEC SQL END DECLARE SECTION;
sub1() {
 EXEC SQL BEGIN DECLARE SECTION;
 char SQLSTATE[6];
 EXEC SQL END DECLARE SECTION;
 exec SQL CREATE TABLE ...
}
```

The following is not valid embedded SQL:

```
EXEC SQL INCLUDE SQLCA;
sub1() {
 EXEC SQL BEGIN DECLARE SECTION;
 char SQLSTATE[6];
 EXEC SQL END DECLARE SECTION;
 exec SQL CREATE TABLE...
}
sub2() {
 exec SQL DROP TABLE...
 // No SQLSTATE in scope of this statement
}
```

Indicator variables

Indicator variables are C variables that hold supplementary information when you are fetching or putting data. There are several distinct uses for indicator variables:

- **NULL values** To enable applications to handle NULL values.
- **String truncation** To enable applications to handle cases when fetched values must be truncated to fit into host variables.
- **Conversion errors** To hold error information.

An indicator variable is a host variable of type a_sql_len that is placed immediately following a regular host variable in a SQL statement. For example, in the following INSERT statement, :ind_phone is an indicator variable:


```
EXEC SQL INSERT INTO Employees
 VALUES (:employee_number, :employee_name,
 :employee_initials, :employee_phone:ind_phone );
```

On a fetch or execute where no rows are received from the database server (such as when an error or end of result set occurs), then indicator values are unchanged.

Note
To allow for the future use of 32 and 64-bit lengths and indicators, the use of short int for embedded SQL indicator variables is deprecated. Use a_sql_len instead.

Using indicator variables to handle NULL

Do not confuse the SQL concept of NULL with the C-language constant of the same name. In the SQL language, NULL represents either an unknown attribute or inapplicable information. The C-language constant represents a pointer value that does not point to a memory location.

When NULL is used in the SQL Anywhere documentation, it refers to the SQL database meaning given above. The C language constant is referred to as the null pointer (lowercase).

NULL is not the same as any value of the column's defined type. So, something extra is required beyond regular host variables to pass NULL values to the database or receive NULL results back. **Indicator variables** are used for this purpose.

Using indicator variables when inserting NULL

An INSERT statement could include an indicator variable as follows:

```
EXEC SQL BEGIN DECLARE SECTION;
short int employee_number;
char employee_name[50];
char employee_initials[6];
char employee_phone[15];
a_sql_len ind_phone;
EXEC SQL END DECLARE SECTION;
/*
This program fills in the employee number,
name, initials, and phone number.
*/
if( /* Phone number is unknown */ ) {
 ind_phone = -1;
} else {
 ind_phone = 0;
}
EXEC SQL INSERT INTO Employees
 VALUES (:employee_number, :employee_name,
 :employee_initials, :employee_phone:ind_phone );
```

If the indicator variable has a value of -1, a NULL is written. If it has a value of 0, the actual value of employee_phone is written.

Using indicator variables when fetching NULL

Indicator variables are also used when receiving data from the database. They are used to indicate that a NULL value was fetched (indicator is negative). If a NULL value is fetched from the database and an indicator variable is not supplied, an error is generated (SQLE_NO_INDICATOR).

Using indicator variables for truncated values

Indicator variables indicate whether any fetched values were truncated to fit into a host variable. This enables applications to handle truncation appropriately.

If a value is truncated on fetching, the indicator variable is set to a positive value, containing the actual length of the database value before truncation. If the length of the value is greater than 32767 bytes, then the indicator variable contains 32767.

Using indicator values for conversion errors

By default, the conversion_error database option is set to On, and any data type conversion failure leads to an error, with no row returned.

You can use indicator variables to tell which column produced a data type conversion failure. If you set the database option conversion_error to Off, any data type conversion failure gives a CANNOT_CONVERT warning, rather than an error. If the column that suffered the conversion error has an indicator variable, that variable is set to a value of -2.

If you set the conversion_error option to Off when inserting data into the database, a value of NULL is inserted when a conversion failure occurs.

Summary of indicator variable values

The following table provides a summary of indicator variable usage.

Indicator value	Supplying value to database	Receiving value from database
> 0	Host variable value	Retrieved value was truncated—actual length in indicator variable
0	Host variable value	Fetch successful, or conversion_error set to On
-1	NULL value	NULL result

Indicator value	Supplying value to database	Receiving value from database
-2	NULL value	Conversion error (when conversion_error is set to Off only). SQLCODE indicates a CANNOT_CONVERT warning
< -2	NULL value	NULL result

For more information about retrieving long values, see "GET DATA statement [ESQL]" [*SQL Anywhere Server - SQL Reference*].

The SQL Communication Area (SQLCA)

The **SQL Communication Area** (**SQLCA**) is an area of memory that is used on every database request for communicating statistics and errors from the application to the database server and back to the application. The SQLCA is used as a handle for the application-to-database communication link. It is passed in to all database library functions that need to communicate with the database server. It is implicitly passed on all embedded SQL statements.

A global SQLCA variable is defined in the interface library. The preprocessor generates an external reference for the global SQLCA variable and an external reference for a pointer to it. The external reference is named sqlca and is of type SQLCA. The pointer is named sqlcaptr. The actual global variable is declared in the imports library.

The SQLCA is defined by the *sqlca.h* header file, included in the *SDK\Include* subdirectory of your installation directory.

SQLCA provides error codes

You reference the SQLCA to test for a particular error code. The sqlcode and sqlstate fields contain error codes when a database request has an error. Some C macros are defined for referencing the sqlcode field, the sqlstate field, and some other fields.

SQLCA fields

The fields in the SQLCA have the following meanings:

- **sqlcaid** An 8-byte character field that contains the string SQLCA as an identification of the SQLCA structure. This field helps in debugging when you are looking at memory contents.
- **sqlcabc** A long integer that contains the length of the SQLCA structure (136 bytes).
- **sqlcode** A long integer that specifies the error code when the database detects an error on a request. Definitions for the error codes can be found in the header file *sqlerr.h*. The error code is 0 (zero) for a successful operation, positive for a warning, and negative for an error.

For a full listing of error codes, see "Error Messages".

- **sqlerrml** The length of the information in the sqlerrmc field.
- **sqlerrmc** Zero or more character strings to be inserted into an error message. Some error messages contain one or more placeholder strings (*%1*, *%2*, ...) that are replaced with the strings in this field.

  For example, if a `Table Not Found` error is generated, sqlerrmc contains the table name, which is inserted into the error message at the appropriate place.

  For a full listing of error messages, see "Error Messages".
- **sqlerrp** Reserved.
- **sqlerrd** A utility array of long integers.
- **sqlwarn** Reserved.
- **sqlstate** The SQLSTATE status value. The ANSI SQL standard defines this type of return value from a SQL statement in addition to the SQLCODE value. The SQLSTATE value is always a five-character null-terminated string, divided into a two-character class (the first two characters) and a three-character subclass. Each character can be a digit from 0 through 9 or an uppercase alphabetic character A through Z.

  Any class or subclass that begins with 0 through 4 or A through H is defined by the SQL standard; other classes and subclasses are implementation defined. The SQLSTATE value '00000' means that there has been no error or warning.

  For more SQLSTATE values, see "SQL Anywhere error messages sorted by SQLSTATE" [*Error Messages*].

sqlerror array

The sqlerror field array has the following elements.

- **sqlerrd[1] (SQLIOCOUNT)** The actual number of input/output operations that were required to complete a statement.

  The database server does not set this number to zero for each statement. Your program can set this variable to zero before executing a sequence of statements. After the last statement, this number is the total number of input/output operations for the entire statement sequence.
- **sqlerrd[2] (SQLCOUNT)** The value of this field depends on which statement is being executed.
  - **INSERT, UPDATE, PUT, and DELETE statements** The number of rows that were affected by the statement.
  - **OPEN and RESUME statements** On a cursor OPEN or RESUME, this field is filled in with either the actual number of rows in the cursor (a value greater than *or equal to* 0) or an estimate thereof (a negative number whose absolute value is the estimate). It is the actual number of rows if

the database server can compute it without counting the rows. The database can also be configured to always return the actual number of rows using the row_counts option.

- **FETCH cursor statement** The SQLCOUNT field is filled if a SQLE_NOTFOUND warning is returned. It contains the number of rows by which a FETCH RELATIVE or FETCH ABSOLUTE statement goes outside the range of possible cursor positions (a cursor can be on a row, before the first row, or after the last row). For a wide fetch, SQLCOUNT is the number of rows actually fetched, and is less than or equal to the number of rows requested. During a wide fetch, SQLE_NOTFOUND is only set if no rows are returned.

  For more information about wide fetches, see "Fetching more than one row at a time" on page 473.

  The value is 0 if the row was not found, but the position is valid, for example, executing FETCH RELATIVE 1 when positioned on the last row of a cursor. The value is positive if the attempted fetch was beyond the end of the cursor, and negative if the attempted fetch was before the beginning of the cursor.

- **GET DATA statement** The SQLCOUNT field holds the actual length of the value.

- **DESCRIBE statement** In the WITH VARIABLE RESULT clause used to describe procedures that may have more than one result set, SQLCOUNT is set to one of the following values:

  - **0** The result set may change: the procedure call should be described again following each OPEN statement.

  - **1** The result set is fixed. No re-describing is required.

  For the SQLE_SYNTAX_ERROR syntax error, the field contains the approximate character position within the statement where the error was detected.

- **sqlerrd[3] (SQLIOESTIMATE)** The estimated number of input/output operations that are required to complete the statement. This field is given a value on an OPEN or EXPLAIN statement.

SQLCA management for multithreaded or reentrant code

You can use embedded SQL statements in multithreaded or reentrant code. However, if you use a single connection, you are restricted to one active request per connection. In a multithreaded application, you should not use the same connection to the database on each thread unless you use a semaphore to control access.

There are no restrictions on using separate connections on each thread that wants to use the database. The SQLCA is used by the runtime library to distinguish between the different thread contexts. So, each thread wanting to use the database concurrently must have its own SQLCA.

Any given database connection is accessible only from one SQLCA, with the exception of the cancel instruction, which must be issued from a separate thread.

For information about canceling requests, see "Implementing request management" on page 483.

The following is an example of multithreaded embedded SQL reentrant code.

```
#include <stdio.h>
#include <string.h>
#include <malloc.h>
#include <ctype.h>
#include <stdlib.h>
#include <process.h>
#include <windows.h>
EXEC SQL INCLUDE SQLCA;
EXEC SQL INCLUDE SQLDA;

#define TRUE 1
#define FALSE 0

// multithreading support

typedef struct a_thread_data {
    SQLCA sqlca;
    int num_iters;
    int thread;
    int done;
} a_thread_data;

// each thread's ESQL test

EXEC SQL SET SQLCA "&thread_data->sqlca";

static void PrintSQLError( a_thread_data * thread_data )
/******************************************************/
{
  char                buffer[200];

  printf( "%d: SQL error %d -- %s ... aborting\n",
      thread_data->thread,
      SQLCODE,
      sqlerror_message( &thread_data->sqlca,
                buffer, sizeof( buffer ) ) );
    exit( 1 );
}

EXEC SQL WHENEVER SQLERROR { PrintSQLError( thread_data ); };

static void do_one_iter( void * data )
{
  a_thread_data *  thread_data = (a_thread_data *)data;
  int    i;
  EXEC SQL BEGIN DECLARE SECTION;
  char    user[ 20 ];
  EXEC SQL END DECLARE SECTION;

  if( db_init( &thread_data->sqlca ) != 0 ) {
    for( i = 0; i < thread_data->num_iters; i++ ) {
     EXEC SQL CONNECT "dba" IDENTIFIED BY "sql";
     EXEC SQL SELECT USER INTO :user;
     EXEC SQL DISCONNECT;
    }
    printf( "Thread %d did %d iters successfully\n",
        thread_data->thread, thread_data->num_iters );
    db_fini( &thread_data->sqlca );
  }
  thread_data->done = TRUE;
```



```
}

int main()
{
  int num_threads = 4;
  int thread;
  int num_iters = 300;
  int num_done = 0;
  a_thread_data *thread_data;
  thread_data = (a_thread_data *)malloc( sizeof(a_thread_data) *
num_threads );
  for( thread = 0; thread < num_threads; thread++ ) {
    thread_data[ thread ].num_iters = num_iters;
    thread_data[ thread ].thread = thread;
    thread_data[ thread ].done = FALSE;
    if( _beginthread( do_one_iter,
      8096,
      (void *)&thread_data[thread] ) <= 0 ) {
      printf( "FAILED creating thread.\n" );
      return( 1 );
    }
  }
    while( num_done != num_threads ) {
    Sleep( 1000 );
    num_done = 0;
    for( thread = 0; thread < num_threads; thread++ ) {
      if( thread_data[ thread ].done == TRUE ) {
        num_done++;
      }
    }
  }
  return( 0 );
}
```

Using multiple SQLCAs

To manage multiple SQLCAs in your application

1. You must not use the option on the SQL preprocessor that generates non-reentrant code (-r-). The reentrant code is a little larger and a little slower because statically initialized global variables cannot be used. However, these effects are minimal.

2. Each SQLCA used in your program must be initialized with a call to db_init and cleaned up at the end with a call to db_fini.

3. The embedded SQL statement SET SQLCA is used to tell the SQL preprocessor to use a different SQLCA for database requests. Usually, a statement such as `EXEC SQL SET SQLCA 'task_data->sqlca';` is used at the top of your program or in a header file to set the SQLCA reference to point at task specific data. Performance is unaffected because this statement does not generate any code. It changes the state within the preprocessor so that any reference to the SQLCA uses the given string.

For information about creating SQLCAs, see "SET SQLCA statement [ESQL]" [*SQL Anywhere Server - SQL Reference*].

When to use multiple SQLCAs

You can use the multiple SQLCA support in any of the supported embedded SQL environments, but it is only required in reentrant code.

The following list details the environments where multiple SQLCAs must be used:

- **Multithreaded applications** Each thread must have its own SQLCA. This can also happen when you have a DLL that uses embedded SQL and is called by more than one thread in your application.
- **Dynamic link libraries and shared libraries** A DLL has only one data segment. While the database server is processing a request from one application, it may yield to another application that makes a request to the database server. If your DLL uses the global SQLCA, both applications are using it at the same time. Each Windows application must have its own SQLCA.
- **A DLL with one data segment** A DLL can be created with only one data segment or one data segment for each application. If your DLL has only one data segment, you cannot use the global SQLCA for the same reason that a DLL cannot use the global SQLCA. Each application must have its own SQLCA.

Connection management with multiple SQLCAs

You do not need to use multiple SQLCAs to connect to more than one database or have more than one connection to a single database.

Each SQLCA can have one unnamed connection. Each SQLCA has an active or current connection See "SET CONNECTION statement [Interactive SQL] [ESQL]" [*SQL Anywhere Server - SQL Reference*].

All operations on a given database connection must use the same SQLCA that was used when the connection was established.

Record locking
Operations on different connections are subject to the normal record locking mechanisms and may cause each other to block and possibly to deadlock. For information about locking, see "Using procedures, triggers, and batches" [*SQL Anywhere Server - SQL Usage*].

Static and dynamic SQL

There are two ways to embed SQL statements into a C program:

- Static statements
- Dynamic statements

Until now, static SQL has been discussed. This section compares static and dynamic SQL.

Static SQL statements

All standard SQL data manipulation and data definition statements can be embedded in a C program by prefixing them with EXEC SQL and suffixing the statement with a semicolon (;). These statements are referred to as **static** statements.

Static statements can contain references to host variables. All examples to this point have used static embedded SQL statements. See "Using host variables" on page 442.

Host variables can only be used in place of string or numeric constants. They cannot be used to substitute column names or table names; dynamic statements are required to perform those operations.

Dynamic SQL statements

In the C language, strings are stored in arrays of characters. Dynamic statements are constructed in C language strings. These statements can then be executed using the PREPARE and EXECUTE statements. These SQL statements cannot reference host variables in the same manner as static statements since the C language variables are not accessible by name when the C program is executing.

To pass information between the statements and the C language variables, a data structure called the **SQL Descriptor Area** (**SQLDA**) is used. This structure is set up for you by the SQL preprocessor if you specify a list of host variables on the EXECUTE statement in the USING clause. These variables correspond by position to place holders in the appropriate positions of the prepared statement.

For information about the SQLDA, see "The SQL descriptor area (SQLDA)" on page 460.

A **place holder** is put in the statement to indicate where host variables are to be accessed. A place holder is either a question mark (?) or a host variable reference as in static statements (a host variable name preceded by a colon). In the latter case, the host variable name used in the actual text of the statement serves only as a place holder indicating a reference to the SQL descriptor area.

A host variable used to pass information to the database is called a **bind variable**.

Example

For example:

```
EXEC SQL BEGIN DECLARE SECTION;
char      comm[200];
char      street[30];
char      city[20];
a_sql_len cityind;
long      empnum;
EXEC SQL END DECLARE SECTION;

...
sprintf( comm,
    "UPDATE %s SET Street = :?, City = :?"
    "WHERE EmployeeID = :?",
    tablename );
EXEC SQL PREPARE S1 FROM :comm FOR UPDATE;
EXEC SQL EXECUTE S1 USING :street, :city:cityind, :empnum;
```

This method requires you to know how many host variables there are in the statement. Usually, this is not the case. So, you can set up your own SQLDA structure and specify this SQLDA in the USING clause on the EXECUTE statement.

The DESCRIBE BIND VARIABLES statement returns the host variable names of the bind variables that are found in a prepared statement. This makes it easier for a C program to manage the host variables. The general method is as follows:

```
EXEC SQL BEGIN DECLARE SECTION;
char comm[200];
EXEC SQL END DECLARE SECTION;
...
sprintf( comm,
    "UPDATE %s SET Street = :street, City = :city"
   " WHERE EmployeeID = :empnum",
   tablename );
EXEC SQL PREPARE S1 FROM :comm FOR UPDATE;
/* Assume that there are no more than 10 host variables.
 * See next example if you cannot put a limit on it. */
sqlda = alloc_sqlda( 10 );
EXEC SQL DESCRIBE BIND VARIABLES FOR S1 INTO sqlda;
/* sqlda->sqld will tell you how many
   host variables there were. */
/* Fill in SQLDA_VARIABLE fields with
   values based on name fields in sqlda. */
...
EXEC SQL EXECUTE S1 USING DESCRIPTOR sqlda;
free_sqlda( sqlda );
```

SQLDA contents

The SQLDA consists of an array of variable descriptors. Each descriptor describes the attributes of the corresponding C program variable or the location that the database stores data into or retrieves data from:

- data type
- length if *type* is a string type
- memory address
- indicator variable

For a complete description of the SQLDA structure, see "The SQL descriptor area (SQLDA)" on page 460.

Indicator variables and NULL

The indicator variable is used to pass a NULL value to the database or retrieve a NULL value from the database. The database server also uses the indicator variable to indicate truncation conditions encountered during a database operation. The indicator variable is set to a positive value when not enough space was provided to receive a database value.

For more information, see "Indicator variables" on page 448.

See also

- "EXECUTE statement [ESQL]" [*SQL Anywhere Server - SQL Reference*]

Dynamic SELECT statement

A SELECT statement that returns only a single row can be prepared dynamically, followed by an EXECUTE with an INTO clause to retrieve the one-row result. SELECT statements that return multiple rows, however, are managed using dynamic cursors.

With dynamic cursors, results are put into a host variable list or a SQLDA that is specified on the FETCH statement (FETCH INTO and FETCH USING DESCRIPTOR). Since the number of select list items is usually unknown, the SQLDA route is the most common. The DESCRIBE SELECT LIST statement sets up a SQLDA with the types of the select list items. Space is then allocated for the values using the fill_sqlda or fill_s_sqlda functions, and the information is retrieved by the FETCH USING DESCRIPTOR statement.

The typical scenario is as follows:

```
EXEC SQL BEGIN DECLARE SECTION;
char comm[200];
EXEC SQL END DECLARE SECTION;
int actual_size;
SQLDA * sqlda;
...
sprintf( comm, "SELECT * FROM %s", table_name );
EXEC SQL PREPARE S1 FROM :comm;
/* Initial guess of 10 columns in result.
   If it is wrong, it is corrected right
   after the first DESCRIBE by reallocating
   sqlda and doing DESCRIBE again. */
sqlda = alloc_sqlda( 10 );
EXEC SQL DESCRIBE SELECT LIST FOR S1
  INTO sqlda;
if( sqlda->sqld > sqlda->sqln )
{
  actual_size = sqlda->sqld;
  free_sqlda( sqlda );
  sqlda = alloc_sqlda( actual_size );
  EXEC SQL DESCRIBE SELECT LIST FOR S1
    INTO sqlda;
}
fill_sqlda( sqlda );
EXEC SQL DECLARE C1 CURSOR FOR S1;
EXEC SQL OPEN C1;
EXEC SQL WHENEVER NOTFOUND {break};
for( ;; )
{
  EXEC SQL FETCH C1 USING DESCRIPTOR sqlda;
  /* do something with data */
}
EXEC SQL CLOSE C1;
EXEC SQL DROP STATEMENT S1;
```

Drop statements after use
To avoid consuming unnecessary resources, ensure that statements are dropped after use.

For a complete example using cursors for a dynamic select statement, see "Dynamic cursor sample" on page 438.

For more information about the functions mentioned above, see "Library function reference" on page 488.

See also

- "PREPARE statement [ESQL]" [*SQL Anywhere Server - SQL Reference*]
- "DESCRIBE statement [ESQL]" [*SQL Anywhere Server - SQL Reference*]

The SQL descriptor area (SQLDA)

The SQLDA (SQL Descriptor Area) is an interface structure that is used for dynamic SQL statements. The structure passes information regarding host variables and SELECT statement results to and from the database. The SQLDA is defined in the header file *sqlda.h*.

There are functions in the database interface library or DLL that you can use to manage SQLDAs. For descriptions, see "Library function reference" on page 488.

When host variables are used with static SQL statements, the preprocessor constructs a SQLDA for those host variables. It is this SQLDA that is actually passed to and from the database server.

The SQLDA header file

The contents of *sqlda.h* are as follows:

```
#ifndef _SQLDA_H_INCLUDED
#define _SQLDA_H_INCLUDED
#define II_SQLDA

#include "sqlca.h"

#if defined( _SQL_PACK_STRUCTURES )
#include "pshpk1.h"
#endif

#define SQL_MAX_NAME_LEN  30

#define _sqldafar
typedef short int   a_sql_type;
struct sqlname
{
  short int length; /* length of char data */
  char  data[ SQL_MAX_NAME_LEN ]; /* data */
};
struct sqlvar
{   /* array of variable descriptors */
  short int  sqltype; /* type of host variable */
  a_sql_len  sqllen;  /* length of host variable */
  void      *sqldata; /* address of variable */
  a_sql_len *sqlind;  /* indicator variable pointer */
  struct sqlname  sqlname;
};
struct sqlda
{
  unsigned char sqldaid[8]; /* eye catcher "SQLDA" */
  a_sql_int32   sqldabc; /* length of sqlda structure */
  short int     sqln;    /* descriptor size in number of entries */
  short int     sqld;    /* number of variables found by DESCRIBE */
  struct sqlvar sqlvar[1]; /* array of variable descriptors */
```



```
};

typedef struct sqlda    SQLDA;
typedef struct sqlvar   SQLVAR, SQLDA_VARIABLE;
typedef struct sqlname  SQLNAME, SQLDA_NAME;
#ifndef SQLDASIZE
#define SQLDASIZE(n)    ( sizeof( struct sqlda ) +  \
                          (n-1) * sizeof( struct sqlvar) )
#endif
#if defined( _SQL_PACK_STRUCTURES )
#include "poppk.h"
#endif
#endif
```

SQLDA fields

The SQLDA fields have the following meanings:

Field	Description
sqldaid	An 8-byte character field that contains the string **SQLDA** as an identification of the SQLDA structure. This field helps in debugging when you are looking at memory contents.
sqldabc	A long integer containing the length of the SQLDA structure.
sqln	The number of variable descriptors allocated in the sqlvar array.
sqld	The number of variable descriptors that are valid (contain information describing a host variable). This field is set by the DESCRIBE statement. As well, you can set it when supplying data to the database server.
sqlvar	An array of descriptors of type struct sqlvar, each describing a host variable.

SQLDA host variable descriptions

Each sqlvar structure in the SQLDA describes a host variable. The fields of the sqlvar structure have the following meanings:

- **sqltype** The type of the variable that is described by this descriptor. See "Embedded SQL data types" on page 439.

  The low order bit indicates whether NULL values are allowed. Valid types and constant definitions can be found in the *sqldef.h* header file.

  This field is filled by the DESCRIBE statement. You can set this field to any type when supplying data to the database server or retrieving data from the database server. Any necessary type conversion is done automatically.

- **sqllen** The length of the variable. A sqllen value has type a_sql_len. What the length actually means depends on the type information and how the SQLDA is being used.

  For LONG VARCHAR, LONG NVARCHAR, and LONG BINARY data types, the array_len field of the DT_LONGVARCHAR, DT_LONGNVARCHAR, or DT_LONGBINARY data type structure is used instead of the sqllen field.

  For more information about the length field, see "SQLDA sqllen field values" on page 463.

- **sqldata** A pointer to the memory occupied by this variable. This memory must correspond to the sqltype and sqllen fields.

  For storage formats, see "Embedded SQL data types" on page 439.

  For UPDATE and INSERT statements, this variable is not involved in the operation if the sqldata pointer is a null pointer. For a FETCH, no data is returned if the sqldata pointer is a null pointer. In other words, the column returned by the sqldata pointer is an **unbound column**.

  If the DESCRIBE statement uses LONG NAMES, this field holds the long name of the result set column. If, in addition, the DESCRIBE statement is a DESCRIBE USER TYPES statement, then this field holds the long name of the user-defined data type, instead of the column. If the type is a base type, the field is empty.

- **sqlind** A pointer to the indicator value. An indicator value has type a_sql_len. A negative indicator value indicates a NULL value. A positive indicator value indicates that this variable has been truncated by a FETCH statement, and the indicator value contains the length of the data before truncation. A value of -2 indicates a conversion error if the conversion_error database option is set to Off. See "conversion_error option" [*SQL Anywhere Server - Database Administration*].

  For more information, see "Indicator variables" on page 448.

  If the sqlind pointer is the null pointer, no indicator variable pertains to this host variable.

  The sqlind field is also used by the DESCRIBE statement to indicate parameter types. If the type is a user-defined data type, this field is set to DT_HAS_USERTYPE_INFO. In this case, you may want to perform a DESCRIBE USER TYPES to obtain information on the user-defined data types.

- **sqlname** A VARCHAR-like structure, as follows:

  ```
  struct sqlname {
     short int  length;
     char  data[ SQL_MAX_NAME_LEN ];
  };
  ```

  It is filled by a DESCRIBE statement and is not otherwise used. This field has a different meaning for the two formats of the DESCRIBE statement:

  - **SELECT LIST** The name data buffer is filled with the column heading of the corresponding item in the select list.

- **BIND VARIABLES** The name data buffer is filled with the name of the host variable that was used as a bind variable, or "?" if an unnamed parameter marker is used.

On a DESCRIBE SELECT LIST statement, any indicator variables present are filled with a flag indicating whether the select list item is updatable or not. More information about this flag can be found in the *sqldef.h* header file.

If the DESCRIBE statement is a DESCRIBE USER TYPES statement, then this field holds the long name of the user-defined data type instead of the column. If the type is a base type, the field is empty.

SQLDA sqllen field values

The sqllen field length of the sqlvar structure in a SQLDA is used in the following kinds of interactions with the database server:

- **describing values** The DESCRIBE statement gets information about the host variables required to store data retrieved from the database, or host variables required to pass data to the database. See "Describing values" on page 463.
- **retrieving values** Retrieving values from the database. See "Retrieving values" on page 468.
- **sending values** Sending information to the database. See "Sending values" on page 466.

These interactions are described in this section.

The following tables detail each of these interactions. These tables list the interface constant types (the **DT_** types) found in the *sqldef.h* header file. These constants would be placed in the SQLDA sqltype field.

For information about sqltype field values, see "Embedded SQL data types" on page 439.

In static SQL, a SQLDA is still used, but it is generated and completely filled in by the SQL preprocessor. In this static case, the tables give the correspondence between the static C language host variable types and the interface constants.

Describing values

The following table indicates the values of the sqllen and sqltype structure members returned by the DESCRIBE statement for the various database types (both SELECT LIST and BIND VARIABLE DESCRIBE statements). For a user-defined database data type, the base type is described.

Your program can use the types and lengths returned from a DESCRIBE, or you may use another type. The database server performs type conversions between any two types. The memory pointed to by the sqldata field must correspond to the sqltype and sqllen fields. The embedded SQL type is obtained by a bitwise AND of sqltype with DT_TYPES (sqltype & DT_TYPES).

For information about embedded SQL data types, see "Embedded SQL data types" on page 439.

Database field type	Embedded SQL type returned	Length (in bytes) returned on describe
BIGINT	DT_BIGINT	8
BINARY(n)	DT_BINARY	n
BIT	DT_BIT	1
CHAR(n)	DT_FIXCHAR[2]	n times maximum data expansion when converting from database character set to the client's CHAR character set. If this length would be more than 32767 bytes, then the embedded SQL type returned is DT_LONGVARCHAR with a length of 32767 bytes.
CHAR(n CHAR)	DT_FIXCHAR[2]	n times maximum character length in the client's CHAR character set. If this length would be more than 32767 bytes, then the embedded SQL type returned is DT_LONGVARCHAR with a length of 32767 bytes.
DATE	DT_DATE	length of longest formatted string
DECIMAL(p,s)	DT_DECIMAL	high byte of length field in SQLDA set to p, and low byte set to s
DOUBLE	DT_DOUBLE	8
FLOAT	DT_FLOAT	4
INT	DT_INT	4
LONG BINARY	DT_LONGBINARY	32767
LONG NVARCHAR	DT_LONGNVARCHAR[1]	32767
LONG VARCHAR	DT_LONGVARCHAR	32767

Database field type	Embedded SQL type returned	Length (in bytes) returned on describe
NCHAR(n)	DT_NFIXCHAR[1]	n times maximum character length in the client's NCHAR character set. If this length would be more than 32767 bytes, then the embedded SQL type returned is DT_LONG-NVARCHAR with a length of 32767 bytes.
NVARCHAR(n)	DT_NVARCHAR[1]	n times maximum character length in the client's NCHAR character set. If this length would be more than 32767 bytes, then the embedded SQL type returned is DT_LONG-NVARCHAR with a length of 32767 bytes.
REAL	DT_FLOAT	4
SMALLINT	DT_SMALLINT	2
TIME	DT_TIME	length of longest formatted string
TIMESTAMP	DT_TIMESTAMP	length of longest formatted string
TINYINT	DT_TINYINT	1
UNSIGNED BIGINT	DT_UNSBIGINT	8
UNSIGNED INT	DT_UNSINT	4
UNSIGNED SMALLINT	DT_UNSSMALLINT	2
VARCHAR(n)	DT_VARCHAR[2]	n times maximum data expansion when converting from database character set to the client's CHAR character set. If this length would be more than 32767 bytes, then the embedded SQL type returned is DT_LONGVARCHAR with a length of 32767 bytes.

Database field type	Embedded SQL type returned	Length (in bytes) returned on describe
VARCHAR(n CHAR)	DT_VARCHAR(2)	n times maximum character length in the client's CHAR character set. If this length would be more than 32767, then the embedded SQL type returned is DT_LONGVARCHAR with length 32767.

[1] The type returned for NCHAR and NVARCHAR may be DT_LONGNVARCHAR if the maximum byte length in the client's NCHAR character set is greater than 32767 bytes. For examples of the results returned when a DESCRIBE is performed, see "NCHAR data type" [*SQL Anywhere Server - SQL Reference*] and "NVARCHAR data type" [*SQL Anywhere Server - SQL Reference*].

In embedded SQL, NCHAR, NVARCHAR, and LONG NVARCHAR are described by default as either DT_FIXCHAR, DT_VARCHAR, or DT_LONGVARCHAR, respectively. If the db_change_nchar_charset function has been called, the types are described as DT_NFIXCHAR, DT_NVARCHAR, and DT_LONGNVARCHAR, respectively. See "db_change_nchar_charset function" on page 494.

[2] The type returned may be DT_LONGVARCHAR if the maximum byte length in the client's CHAR character set is greater than 32767 bytes. For examples of the results returned when a DESCRIBE is performed, see "CHAR data type" [*SQL Anywhere Server - SQL Reference*] and "VARCHAR data type" [*SQL Anywhere Server - SQL Reference*].

Sending values

The following table indicates how you specify lengths of values when you supply data to the database server in the SQLDA.

Only the data types displayed in the table are allowed in this case. The DT_DATE, DT_TIME, and DT_TIMESTAMP types are treated the same as DT_STRING when supplying information to the database; the value must be a null-terminated character string in an appropriate date format.

Embedded SQL data type	Program action to set the length
DT_BIGINT	No action required.
DT_BINARY(n)	Length taken from field in BINARY structure.
DT_BIT	No action required.
DT_DATE	Length determined by terminating \0.

Embedded SQL data type	Program action to set the length
DT_DOUBLE	No action required.
DT_FIXCHAR(n)	Length field in SQLDA determines length of string.
DT_FLOAT	No action required.
DT_INT	No action required.
DT_LONGBINARY	Length field ignored. See "Sending LONG data" on page 480.
DT_LONGNVARCHAR	Length field ignored. See "Sending LONG data" on page 480.
DT_LONGVARCHAR	Length field ignored. See "Sending LONG data" on page 480.
DT_NFIXCHAR(n)	Length field in SQLDA determines length of string.
DT_NSTRING	Length determined by terminating \0. If the ansi_blanks option is On and the database is blank-padded, then the length field in the SQLDA must be set to the length of the buffer containing the value (at least the length of the value plus space for the terminating null character).
DT_NVARCHAR	Length taken from field in NVARCHAR structure.
DT_SMALLINT	No action required.
DT_STRING	Length determined by terminating \0. If the ansi_blanks option is On and the database is blank-padded, then the length field in the SQLDA must be set to the length of the buffer containing the value (at least the length of the value plus space for the terminating null character).
DT_TIME	Length determined by terminating \0.
DT_TIMESTAMP	Length determined by terminating \0.
DT_TIMESTAMP_STRUCT	No action required.
DT_UNSBIGINT	No action required.
DT_UNSINT	No action required.
DT_UNSSMALLINT	No action required.

Embedded SQL data type	Program action to set the length
DT_VARCHAR(n)	Length taken from field in VARCHAR structure.
DT_VARIABLE	Length determined by terminating \0.

Retrieving values

The following table indicates the values of the length field when you retrieve data from the database using a SQLDA. The sqllen field is never modified when you retrieve data.

Only the interface data types displayed in the table are allowed in this case. The DT_DATE, DT_TIME, and DT_TIMESTAMP data types are treated the same as DT_STRING when you retrieve information from the database. The value is formatted as a character string in the current date format.

Embedded SQL data type	What the program must set length field to when receiving	How the database returns length information after fetching a value
DT_BIGINT	No action required.	No action required.
DT_BINARY(n)	Maximum length of BINARY structure (n+2). The maximum value for n is 32765.	len field of BINARY structure set to actual length in bytes.
DT_BIT	No action required.	No action required.
DT_DATE	Length of buffer.	\0 at end of string.
DT_DOUBLE	No action required.	No action required.
DT_FIXCHAR(n)	Length of buffer, in bytes. The maximum value for n is 32767.	Padded with blanks to length of buffer.
DT_FLOAT	No action required.	No action required.
DT_INT	No action required.	No action required.
DT_LONGBINARY	Length field ignored. See “Retrieving LONG data” on page 478.	Length field ignored. See “Retrieving LONG data” on page 478.
DT_LONGNVARCHAR	Length field ignored. See “Retrieving LONG data” on page 478.	Length field ignored. See “Retrieving LONG data” on page 478.

Embedded SQL data type	What the program must set length field to when receiving	How the database returns length information after fetching a value
DT_LONGVARCHAR	Length field ignored. See "Retrieving LONG data" on page 478.	Length field ignored. See "Retrieving LONG data" on page 478.
DT_NFIXCHAR(n)	Length of buffer, in bytes. The maximum value for n is 32767.	Padded with blanks to length of buffer.
DT_NSTRING	Length of buffer.	\0 at end of string.
DT_NVARCHAR(n)	Maximum length of NVARCHAR structure (n+2). The maximum value for n is 32765.	len field of NVARCHAR structure set to actual length in bytes of string.
DT_SMALLINT	No action required.	No action required.
DT_STRING	Length of buffer.	\0 at end of string.
DT_TIME	Length of buffer.	\0 at end of string.
DT_TIMESTAMP	Length of buffer.	\0 at end of string.
DT_TIMESTAMP_ STRUCT	No action required.	No action required.
DT_UNSBIGINT	No action required.	No action required.
DT_UNSINT	No action required.	No action required.
DT_UNSSMALLINT	No action required.	No action required.
DT_VARCHAR(n)	Maximum length of VARCHAR structure (n+2). The maximum value for n is 32765.	len field of VARCHAR structure set to actual length in bytes of string.

Fetching data

Fetching data in embedded SQL is done using the SELECT statement. There are two cases:

- **The SELECT statement returns at most one row** Use an INTO clause to assign the returned values directly to host variables. See "SELECT statements that return at most one row" on page 470.
- **The SELECT statement may return multiple rows** Use cursors to manage the rows of the result set. See "Using cursors in embedded SQL" on page 471.

See also

- "FETCH statement [ESQL] [SP]" [*SQL Anywhere Server - SQL Reference*]

SELECT statements that return at most one row

A single row query retrieves at most one row from the database. A single-row query SELECT statement has an INTO clause following the select list and before the FROM clause. The INTO clause contains a list of host variables to receive the value for each select list item. There must be the same number of host variables as there are select list items. The host variables may be accompanied by indicator variables to indicate NULL results.

When the SELECT statement is executed, the database server retrieves the results and places them in the host variables. If the query results contain more than one row, the database server returns an error.

If the query results in no rows being selected, a `Row Not Found` warning is returned. Errors and warnings are returned in the SQLCA structure. See "The SQL Communication Area (SQLCA)" on page 451.

Example

The following code fragment returns 1 if a row from the Employees table is fetched successfully, 0 if the row doesn't exist, and -1 if an error occurs.

```
EXEC SQL BEGIN DECLARE SECTION;
long      id;
char      name[41];
char      sex;
char      birthdate[15];
a_sql_len ind_birthdate;
EXEC SQL END DECLARE SECTION;
...
int find_employee( long Employees )
{
  id = Employees;
  EXEC SQL SELECT GivenName ||
    ' ' || Surname, Sex, BirthDate
    INTO :name, :sex,
      :birthdate:ind_birthdate
    FROM Employees
    WHERE EmployeeID = :id;
  if( SQLCODE == SQLE_NOTFOUND )
  {
    return( 0 ); /* Employees not found */
  }
  else if( SQLCODE < 0 )
  {
    return( -1 ); /* error */
  }
  else
  {
    return( 1 ); /* found */
  }
}
```


Using cursors in embedded SQL

A cursor is used to retrieve rows from a query that has multiple rows in its result set. A **cursor** is a handle or an identifier for the SQL query and a position within the result set.

For an introduction to cursors, see "Working with cursors" on page 8.

To manage a cursor in embedded SQL

1. Declare a cursor for a particular SELECT statement, using the DECLARE statement.
2. Open the cursor using the OPEN statement.
3. Retrieve results one row at a time from the cursor using the FETCH statement.
4. Fetch rows until the `Row Not Found` warning is returned.

   Errors and warnings are returned in the SQLCA structure. See "The SQL Communication Area (SQLCA)" on page 451.
5. Close the cursor, using the CLOSE statement.

By default, cursors are automatically closed at the end of a transaction (on COMMIT or ROLLBACK). Cursors that are opened with a WITH HOLD clause are kept open for subsequent transactions until they are explicitly closed.

The following is a simple example of cursor usage:

```
void print_employees( void )
{
  EXEC SQL BEGIN DECLARE SECTION;
  char      name[50];
  char      sex;
  char      birthdate[15];
  a_sql_len ind_birthdate;
  EXEC SQL END DECLARE SECTION;
  EXEC SQL DECLARE C1 CURSOR FOR
    SELECT GivenName || ' ' || Surname,
      Sex, BirthDate
    FROM Employees;
  EXEC SQL OPEN C1;
  for( ;; )
  {
    EXEC SQL FETCH C1 INTO :name, :sex,
        :birthdate:ind_birthdate;
    if( SQLCODE == SQLE_NOTFOUND )
    {
      break;
    }
    else if( SQLCODE < 0 )
    {
      break;
    }

    if( ind_birthdate < 0 )
    {
```

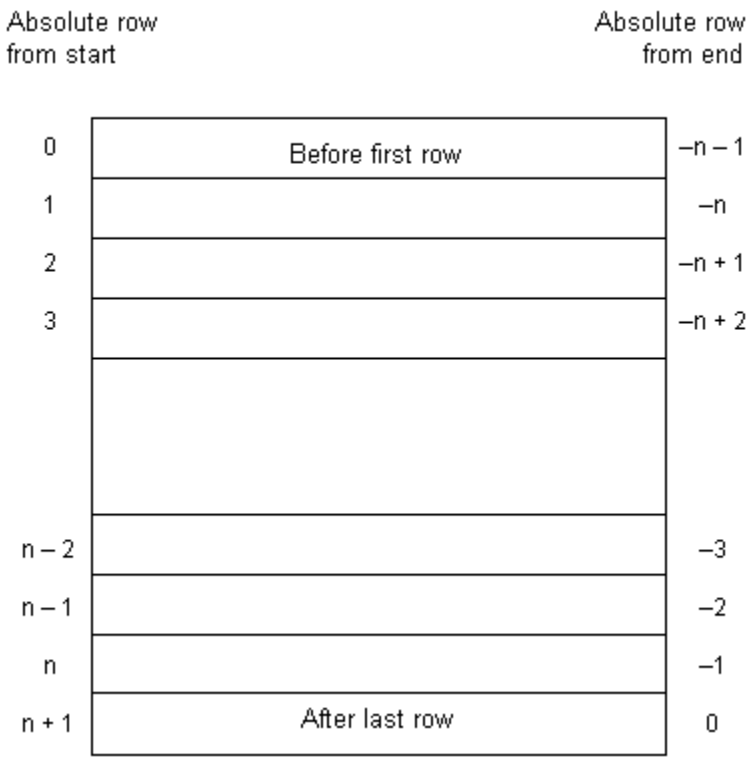
```
        strcpy( birthdate, "UNKNOWN" );
      }
      printf( "Name: %s Sex: %c Birthdate:
          %s.n",name, sex, birthdate );
    }
    EXEC SQL CLOSE C1;
}
```

For complete examples using cursors, see "Static cursor sample" on page 437 and "Dynamic cursor sample" on page 438.

Cursor positioning

A cursor is positioned in one of three places:

- On a row
- Before the first row
- After the last row



When a cursor is opened, it is positioned before the first row. The cursor position can be moved using the FETCH statement. It can be positioned to an absolute position either from the start or from the end of the query results. It can also be moved relative to the current cursor position. See "FETCH statement [ESQL] [SP]" [*SQL Anywhere Server - SQL Reference*].

There are special **positioned** versions of the UPDATE and DELETE statements that can be used to update or delete the row at the current position of the cursor. If the cursor is positioned before the first row or after the last row, an error is returned indicating that there is no corresponding row in the cursor.

The PUT statement can be used to insert a row into a cursor. See "PUT statement [ESQL]" [*SQL Anywhere Server - SQL Reference*].

Cursor positioning problems

Inserts and some updates to DYNAMIC SCROLL cursors can cause problems with cursor positioning. The database server does not put inserted rows at a predictable position within a cursor unless there is an ORDER BY clause on the SELECT statement. Sometimes the inserted row does not appear until the cursor is closed and opened again.

With SQL Anywhere, this occurs if a temporary table had to be created to open the cursor.

For a description, see "Use work tables in query processing (use All-rows optimization goal)" [*SQL Anywhere Server - SQL Usage*].

The UPDATE statement can cause a row to move in the cursor. This happens if the cursor has an ORDER BY clause that uses an existing index (a temporary table is not created).

Fetching more than one row at a time

The FETCH statement can be modified to fetch more than one row at a time, which may improve performance. This is called a **wide fetch** or an **array fetch**.

SQL Anywhere also supports wide puts and inserts. See "PUT statement [ESQL]" [*SQL Anywhere Server - SQL Reference*] and "EXECUTE statement [ESQL]" [*SQL Anywhere Server - SQL Reference*].

To use wide fetches in embedded SQL, include the fetch statement in your code as follows:

```
EXEC SQL FETCH ... ARRAY nnn
```

where ARRAY *nnn* is the last item of the FETCH statement. The fetch count *nnn* can be a host variable. The number of variables in the SQLDA must be the product of *nnn* and the number of columns per row. The first row is placed in SQLDA variables 0 to (columns per row) - 1, and so on.

Each column must be of the same type in each row of the SQLDA, or a SQLDA_INCONSISTENT error is returned.

The server returns in SQLCOUNT the number of records that were fetched, which is always greater than zero unless there is an error or warning. On a wide fetch, a SQLCOUNT of one with no error condition indicates that one valid row has been fetched.

Example

The following example code illustrates the use of wide fetches. You can also find this code in *samples-dir\SQLAnywhere\esqlwidefetch\widefetch.sqc*.

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include "sqldef.h"
EXEC SQL INCLUDE SQLCA;

EXEC SQL WHENEVER SQLERROR { PrintSQLError();
        goto err; };

static void PrintSQLError()
{
  char buffer[200];

  printf( "SQL error %d -- %s\n",
     SQLCODE,
     sqlerror_message( &sqlca,
              buffer,
              sizeof( buffer ) ) );
}
static SQLDA * PrepareSQLDA(
  a_sql_statement_number stat0,
  unsigned  width,
  unsigned  *cols_per_row )

/* Allocate a SQLDA to be used for fetching from
   the statement identified by "stat0". "width"
   rows are retrieved on each FETCH request.
   The number of columns per row is assigned to
   "cols_per_row". */
{
  int           num_cols;
  unsigned      row, col, offset;
  SQLDA *       sqlda;
  EXEC SQL BEGIN DECLARE SECTION;
  a_sql_statement_number  stat;
  EXEC SQL END DECLARE SECTION;
  stat = stat0;
  sqlda = alloc_sqlda( 100 );
  if( sqlda == NULL ) return( NULL );
  EXEC SQL DESCRIBE :stat INTO sqlda;
  *cols_per_row = num_cols = sqlda->sqld;
  if( num_cols * width > sqlda->sqln )
  {
    free_sqlda( sqlda );
    sqlda = alloc_sqlda( num_cols * width );
    if( sqlda == NULL ) return( NULL );
    EXEC SQL DESCRIBE :stat INTO sqlda;
  }
  // copy first row in SQLDA setup by describe
  // to following (wide) rows
  sqlda->sqld = num_cols * width;
  offset = num_cols;
  for( row = 1; row < width; row++ )
  {
    for( col = 0;
      col < num_cols;
      col++, offset++ )
    {
      sqlda->sqlvar[offset].sqltype =
          sqlda->sqlvar[col].sqltype;
      sqlda->sqlvar[offset].sqllen =
          sqlda->sqlvar[col].sqllen;
      // optional: copy described column name
      memcpy( &sqlda->sqlvar[offset].sqlname,
```



```
              &sqlda->sqlvar[col].sqlname,
              sizeof( sqlda->sqlvar[0].sqlname ) );
    }
  }
  fill_s_sqlda( sqlda, 40 );
  return( sqlda );
err:
  return( NULL );
}
static void PrintFetchedRows(
  SQLDA * sqlda,
  unsigned cols_per_row )
{
  /* Print rows already wide fetched in the SQLDA */
  long      rows_fetched;
  int       row, col, offset;

  if( SQLCOUNT == 0 )
  {
    rows_fetched = 1;
  }
  else
  {
    rows_fetched = SQLCOUNT;
  }
  printf( "Fetched %d Rows:\n", rows_fetched );
  for( row = 0; row < rows_fetched; row++ )
  {
    for( col = 0; col < cols_per_row; col++ )
    {
      offset = row * cols_per_row + col;
      printf( " \"%s\"",
        (char *)sqlda->sqlvar[offset].sqldata );
     }
     printf( "\n" );
  }
}
static int DoQuery(
  char * query_str0,
  unsigned fetch_width0 )
{
  /* Wide Fetch "query_str0" select statement
   * using a width of "fetch_width0" rows" */
  SQLDA *                 sqlda;
  unsigned                cols_per_row;
  EXEC SQL BEGIN DECLARE SECTION;
  a_sql_statement_number  stat;
  char *                  query_str;
  unsigned                fetch_width;
  EXEC SQL END DECLARE SECTION;

  query_str = query_str0;
  fetch_width = fetch_width0;

  EXEC SQL PREPARE :stat FROM :query_str;
  EXEC SQL DECLARE QCURSOR CURSOR FOR :stat
       FOR READ ONLY;
  EXEC SQL OPEN QCURSOR;
  sqlda = PrepareSQLDA( stat,
    fetch_width,
    &cols_per_row );
  if( sqlda == NULL )
  {
    printf( "Error allocating SQLDA\n" );
```

```
    return( SQLE_NO_MEMORY );
  }
  for( ;; )
  {
    EXEC SQL FETCH QCURSOR INTO DESCRIPTOR sqlda
      ARRAY :fetch_width;
    if( SQLCODE != SQLE_NOERROR ) break;
    PrintFetchedRows( sqlda, cols_per_row );
  }
  EXEC SQL CLOSE QCURSOR;
  EXEC SQL DROP STATEMENT :stat;
  free_filled_sqlda( sqlda );
err:
  return( SQLCODE );
}
void main( int argc, char *argv[] )
{
  /* Optional first argument is a select statement,
   * optional second argument is the fetch width */
  char *query_str =
    "SELECT GivenName, Surname FROM Employees";
  unsigned fetch_width = 10;

  if( argc > 1 )
  {
    query_str = argv[1];
    if( argc > 2 )
    {
      fetch_width = atoi( argv[2] );
      if( fetch_width < 2 )
      {
        fetch_width = 2;
      }
    }
  }
  db_init( &sqlca );
  EXEC SQL CONNECT "DBA" IDENTIFIED BY "sql";

  DoQuery( query_str, fetch_width );

  EXEC SQL DISCONNECT;
err:
  db_fini( &sqlca );
}
```

Notes on using wide fetches

- In the function PrepareSQLDA, the SQLDA memory is allocated using the alloc_sqlda function. This allows space for indicator variables, rather than using the alloc_sqlda_noind function.
- If the number of rows fetched is fewer than the number requested, but is not zero (at the end of the cursor for example), the SQLDA items corresponding to the rows that were not fetched are returned as NULL by setting the indicator value. If no indicator variables are present, an error is generated (SQLE_NO_INDICATOR: no indicator variable for NULL result).
- If a row being fetched has been updated, generating a SQLE_ROW_UPDATED_WARNING warning, the fetch stops on the row that caused the warning. The values for all rows processed to that point (including the row that caused the warning) are returned. SQLCOUNT contains the number of rows that were fetched, including the row that caused the warning. All remaining SQLDA items are marked as NULL.

- If a row being fetched has been deleted or is locked, generating a SQLE_NO_CURRENT_ROW or SQLE_LOCKED error, SQLCOUNT contains the number of rows that were read before the error. This does not include the row that caused the error. The SQLDA does not contain values for any of the rows since SQLDA values are not returned on errors. The SQLCOUNT value can be used to reposition the cursor, if necessary, to read the rows.

Sending and retrieving long values

The method for sending and retrieving LONG VARCHAR, LONG NVARCHAR, and LONG BINARY values in embedded SQL applications is different from that for other data types. The standard SQLDA fields are limited to 32767 bytes of data as the fields holding the length information (sqldata, sqllen, sqlind) are 16-bit values. Changing these values to 32-bit values would break existing applications.

The method of describing LONG VARCHAR, LONG NVARCHAR, and LONG BINARY values is the same as for other data types.

For information about how to retrieve and send values, see "Retrieving LONG data" on page 478, and "Sending LONG data" on page 480.

Static SQL structures

Separate fields are used to hold the allocated, stored, and untruncated lengths of LONG BINARY, LONG VARCHAR, and LONG NVARCHAR data types. The static SQL data types are defined in *sqlca.h* as follows:

```
#define DECL_LONGVARCHAR( size )         \
  struct { a_sql_uint32    array_len;    \
           a_sql_uint32    stored_len;   \
           a_sql_uint32    untrunc_len;  \
           char            array[size+1];\
         }
#define DECL_LONGNVARCHAR( size )        \
  struct { a_sql_uint32    array_len;    \
           a_sql_uint32    stored_len;   \
           a_sql_uint32    untrunc_len;  \
           char            array[size+1];\
         }
#define DECL_LONGBINARY( size )          \
  struct { a_sql_uint32    array_len;    \
           a_sql_uint32    stored_len;   \
           a_sql_uint32    untrunc_len;  \
           char            array[size];  \
         }
```

Dynamic SQL structures

For dynamic SQL, set the sqltype field to DT_LONGVARCHAR, DT_LONGNVARCHAR, or DT_LONGBINARY as appropriate. The associated LONGVARCHAR, LONGNVARCHAR, and LONGBINARY structures are as follows:

```
typedef struct LONGVARCHAR {
    a_sql_uint32    array_len;
    a_sql_uint32    stored_len;
    a_sql_uint32    untrunc_len;
```

```
    char            array[1];
} LONGVARCHAR, LONGNVARCHAR, LONGBINARY;
```

Structure member definitions

For both static and dynamic SQL structures, the structure members are defined as follows:

- **array_len** (Sending and retrieving.) The number of bytes allocated for the array part of the structure.
- **stored_len** (Sending and retrieving.) The number of bytes stored in the array. Always less than or equal to array_len and untrunc_len.
- **untrunc_len** (Retrieving only.) The number of bytes that would be stored in the array if the value was not truncated. Always greater than or equal to stored_len. If truncation occurs, this value is larger than array_len.

Retrieving LONG data

This section describes how to retrieve LONG values from the database. For background information, see "Sending and retrieving long values" on page 477.

The procedures are different depending on whether you are using static or dynamic SQL.

To receive a LONG VARCHAR, LONG NVARCHAR, or LONG BINARY value (static SQL)

1. Declare a host variable of type DECL_LONGVARCHAR, DECL_LONGNVARCHAR, or DECL_LONGBINARY, as appropriate. The array_len member is filled in automatically.
2. Retrieve the data using FETCH, GET DATA, or EXECUTE INTO. SQL Anywhere sets the following information:
   - **indicator variable** Negative if the value is NULL, 0 if there is no truncation, otherwise the positive untruncated length in bytes up to a maximum of 32767.

     For more information, see "Indicator variables" on page 448.
   - **stored_len** The number of bytes stored in the array. Always less than or equal to array_len and untrunc_len.
   - **untrunc_len** The number of bytes that would be stored in the array if the value was not truncated. Always greater than or equal to stored_len. If truncation occurs, this value is larger than array_len.

To receive a value into a LONGVARCHAR, LONGNVARCHAR, or LONGBINARY structure (dynamic SQL)

1. Set the sqltype field to DT_LONGVARCHAR, DT_LONGNVARCHAR, or DT_LONGBINARY as appropriate.
2. Set the sqldata field to point to the LONGVARCHAR, LONGNVARCHAR, or LONGBINARY host variable structure.

You can use the LONGVARCHARSIZE(*n*), LONGNVARCHARSIZE(*n*), or LONGBINARYSIZE(*n*) macro to determine the total number of bytes to allocate to hold *n* bytes of data in the array field.

3. Set the array_len field of the host variable structure to the number of bytes allocated for the array field.

4. Retrieve the data using FETCH, GET DATA, or EXECUTE INTO. SQL Anywhere sets the following information:

   - *** sqlind** This sqlda field is negative if the value is NULL, 0 if there is no truncation, and is the positive untruncated length in bytes up to a maximum of 32767.
   - **stored_len** The number of bytes stored in the array. Always less than or equal to array_len and untrunc_len.
   - **untrunc_len** The number of bytes that would be stored in the array if the value was not truncated. Always greater than or equal to stored_len. If truncation occurs, this value is larger than array_len.

The following code fragment illustrates the mechanics of retrieving LONG VARCHAR data using dynamic embedded SQL. It is not intended to be a practical application:

```
#define DATA_LEN 128000
void get_test_var()
{
  LONGVARCHAR *longptr;
  SQLDA       *sqlda;
  SQLVAR      *sqlvar;

  sqlda = alloc_sqlda( 1 );
  longptr = (LONGVARCHAR *)malloc(
              LONGVARCHARSIZE( DATA_LEN ) );
  if( sqlda == NULL || longptr == NULL )
  {
    fatal_error( "Allocation failed" );
  }

  // init longptr for receiving data
  longptr->array_len = DATA_LEN;

  // init sqlda for receiving data
  // (sqllen is unused with DT_LONG types)
  sqlda->sqld = 1; // using 1 sqlvar
  sqlvar = &sqlda->sqlvar[0];
  sqlvar->sqltype = DT_LONGVARCHAR;
  sqlvar->sqldata = longptr;
  printf( "fetching test_var\n" );
  EXEC SQL PREPARE select_stmt FROM 'SELECT test_var';
  EXEC SQL EXECUTE select_stmt INTO DESCRIPTOR sqlda;
  EXEC SQL DROP STATEMENT select_stmt;
  printf( "stored_len: %d, untrunc_len: %d, "
          "1st char: %c, last char: %c\n",
        longptr->stored_len,
        longptr->untrunc_len,
        longptr->array[0],
        longptr->array[DATA_LEN-1] );
  free_sqlda( sqlda );
  free( longptr );
}
```

Sending LONG data

This section describes how to send LONG values to the database from embedded SQL applications. For background information, see "Sending and retrieving long values" on page 477.

The procedures are different depending on whether you are using static or dynamic SQL.

To send a LONG value (static SQL)

1. Declare a host variable of type DECL_LONGVARCHAR, DECL_LONGNVARCHAR, or DECL_LONGBINARY, as appropriate.
2. If you are sending NULL, set the indicator variable to a negative value.

   For more information, see "Indicator variables" on page 448.
3. Set the stored_len field of the host variable structure to the number of bytes of data in the array field.
4. Send the data by opening the cursor or executing the statement.

The following code fragment illustrates the mechanics of sending a LONG VARCHAR using static embedded SQL. It is not intended to be a practical application.

```
#define DATA_LEN 12800
EXEC SQL BEGIN DECLARE SECTION;
// SQLPP initializes longdata.array_len
DECL_LONGVARCHAR(128000) longdata;
EXEC SQL END DECLARE SECTION;

void set_test_var()
{
  // init longdata for sending data
  memset( longdata.array, 'a', DATA_LEN );
  longdata.stored_len = DATA_LEN;

  printf( "Setting test_var to %d a's\n", DATA_LEN );
  EXEC SQL SET test_var = :longdata;
}
```

To send a LONG value (dynamic SQL)

1. Set the sqltype field to DT_LONGVARCHAR, DT_LONGNVARCHAR, or DT_LONGBINARY, as appropriate.
2. If you are sending NULL, set *** sqlind** to a negative value.
3. If you are not sending NULL, set the sqldata field to point to the LONGVARCHAR, LONGNVARCHAR, or LONGBINARY host variable structure.

   You can use the LONGVARCHARSIZE(*n*), LONGNVARCHARSIZE(*n*), or LONGBINARYSIZE(*n*) macros to determine the total number of bytes to allocate to hold *n* bytes of data in the array field.

4. Set the array_len field of the host variable structure to the number of bytes allocated for the array field.

5. Set the stored_len field of the host variable structure to the number of bytes of data in the array field. This must not be more than array_len.

6. Send the data by opening the cursor or executing the statement.

Using simple stored procedures

You can create and call stored procedures in embedded SQL.

You can embed a CREATE PROCEDURE just like any other data definition statement, such as CREATE TABLE. You can also embed a CALL statement to execute a stored procedure. The following code fragment illustrates both creating and executing a stored procedure in embedded SQL:

```
EXEC SQL CREATE PROCEDURE pettycash(
 IN Amount DECIMAL(10,2) )
BEGIN
 UPDATE account
 SET balance = balance - Amount
 WHERE name = 'bank';

 UPDATE account
 SET balance = balance + Amount
 WHERE name = 'pettycash expense';
END;
EXEC SQL CALL pettycash( 10.72 );
```

If you want to pass host variable values to a stored procedure or to retrieve the output variables, you prepare and execute a CALL statement. The following code fragment illustrates the use of host variables. Both the USING and INTO clauses are used on the EXECUTE statement.

```
EXEC SQL BEGIN DECLARE SECTION;
double  hv_expense;
double  hv_balance;
EXEC SQL END DECLARE SECTION;

// Code here
EXEC SQL CREATE PROCEDURE pettycash(
   IN expense  DECIMAL(10,2),
   OUT endbalance DECIMAL(10,2) )
BEGIN
  UPDATE account
  SET balance = balance - expense
  WHERE name = 'bank';
  UPDATE account
  SET balance = balance + expense
  WHERE name = 'pettycash expense';

  SET endbalance = ( SELECT balance FROM account
         WHERE name = 'bank' );
END;

EXEC SQL PREPARE S1 FROM 'CALL pettycash( ?, ? )';
EXEC SQL EXECUTE S1 USING :hv_expense INTO :hv_balance;
```

For more information, see "EXECUTE statement [ESQL]" [*SQL Anywhere Server - SQL Reference*], and "PREPARE statement [ESQL]" [*SQL Anywhere Server - SQL Reference*].

Stored procedures with result sets

Database procedures can also contain SELECT statements. The procedure is declared using a RESULT clause to specify the number, name, and types of the columns in the result set. Result set columns are different from output parameters. For procedures with result sets, the CALL statement can be used in place of a SELECT statement in the cursor declaration:

```
EXEC SQL BEGIN DECLARE SECTION;
 char hv_name[100];
EXEC SQL END DECLARE SECTION;

EXEC SQL CREATE PROCEDURE female_employees()
  RESULT( name char(50) )
BEGIN
  SELECT GivenName || Surname FROM Employees
  WHERE Sex = 'f';
END;

EXEC SQL PREPARE S1 FROM 'CALL female_employees()';

EXEC SQL DECLARE C1 CURSOR FOR S1;
EXEC SQL OPEN C1;
for(;;)
{
  EXEC SQL FETCH C1 INTO :hv_name;
  if( SQLCODE != SQLE_NOERROR ) break;
  printf( "%s\\n", hv_name );
}
EXEC SQL CLOSE C1;
```

In this example, the procedure has been invoked with an OPEN statement rather than an EXECUTE statement. The OPEN statement causes the procedure to execute until it reaches a SELECT statement. At this point, C1 is a cursor for the SELECT statement within the database procedure. You can use all forms of the FETCH statement (backward and forward scrolling) until you are finished with it. The CLOSE statement stops execution of the procedure.

If there had been another statement following the SELECT in the procedure, it would not have been executed. To execute statements following a SELECT, use the RESUME cursor-name statement. The RESUME statement either returns the warning SQLE_PROCEDURE_COMPLETE or it returns SQLE_NOERROR indicating that there is another cursor. The example illustrates a two-select procedure:

```
EXEC SQL CREATE PROCEDURE people()
  RESULT( name char(50) )
BEGIN
 SELECT GivenName || Surname
 FROM Employees;

 SELECT GivenName || Surname
 FROM Customers;
END;

EXEC SQL PREPARE S1 FROM 'CALL people()';
EXEC SQL DECLARE C1 CURSOR FOR S1;
```



```
EXEC SQL OPEN C1;
while( SQLCODE == SQLE_NOERROR )
{
  for(;;)
  {
    EXEC SQL FETCH C1 INTO :hv_name;
    if( SQLCODE != SQLE_NOERROR ) break;
    printf( "%s\\n", hv_name );
  }
  EXEC SQL RESUME C1;
}
EXEC SQL CLOSE C1;
```

Dynamic cursors for CALL statements

These examples have used static cursors. Full dynamic cursors can also be used for the CALL statement.

For a description of dynamic cursors, see "Dynamic SELECT statement" on page 459.

The DESCRIBE statement works fully for procedure calls. A DESCRIBE OUTPUT produces a SQLDA that has a description for each of the result set columns.

If the procedure does not have a result set, the SQLDA has a description for each INOUT or OUT parameter for the procedure. A DESCRIBE INPUT statement produces a SQLDA having a description for each IN or INOUT parameter for the procedure.

DESCRIBE ALL

DESCRIBE ALL describes IN, INOUT, OUT, and RESULT set parameters. DESCRIBE ALL uses the indicator variables in the SQLDA to provide additional information.

The DT_PROCEDURE_IN and DT_PROCEDURE_OUT bits are set in the indicator variable when a CALL statement is described. DT_PROCEDURE_IN indicates an IN or INOUT parameter and DT_PROCEDURE_OUT indicates an INOUT or OUT parameter. Procedure RESULT columns have both bits clear.

After a describe OUTPUT, these bits can be used to distinguish between statements that have result sets (need to use OPEN, FETCH, RESUME, CLOSE) and statements that do not (need to use EXECUTE).

For a complete description, see "DESCRIBE statement [ESQL]" [*SQL Anywhere Server - SQL Reference*].

Multiple result sets

If you have a procedure that returns multiple result sets, you must re-describe after each RESUME statement if the result sets change shapes.

You need to describe the cursor, not the statement, to re-describe the current position of the cursor.

Embedded SQL programming techniques

This section contains a set of tips for developing embedded SQL programs.

Implementing request management

The default behavior of the interface DLL is for applications to wait for completion of each database request before carrying out other functions. This behavior can be changed using request management functions. For example, when using Interactive SQL, the operating system is still active while Interactive SQL is waiting for a response from the database and Interactive SQL carries out some tasks in that time.

You can achieve application activity while a database request is in progress by providing a callback function. In this callback function, you must not do another database request except db_cancel_request. You can use the db_is_working function in your message handlers to determine if you have a database request in progress.

The db_register_a_callback function is used to register your application callback functions.

See also

- "db_register_a_callback function" on page 500
- "db_cancel_request function" on page 493
- "db_is_working function" on page 497

Backup functions

The db_backup function provides support for online backup in embedded SQL applications. The backup utility makes use of this function. You should only need to write a program to use this function if your backup requirements are not satisfied by the SQL Anywhere backup utility.

BACKUP statement is recommended
Although this function provides one way to add backup features to an application, the recommended way to do this task is to use the BACKUP statement. See "BACKUP statement" [*SQL Anywhere Server - SQL Reference*].

You can also access the backup utility directly using the Database Tools DBBackup function. See "DBBackup function" on page 870.

See also

- "db_backup function" on page 489

SQL preprocessor

Processes a C or C++ program containing embedded SQL before the compiler is run.

Syntax

sqlpp [*options*] *input-file* [*output-file*]

Option	Description
-d	Generate code that reduces data space size. Data structures are reused and initialized at execution time before use. This increases code size.

Option	Description
-e *level*	Flag as an error any static embedded SQL that is not part of a specified standard. The *level* value indicates the standard to use. For example, `sqlpp -e c03 ...` flags any syntax that is not part of the core SQL/2008 standard. The supported *level* values are: • **c08** Flag syntax that is not core SQL/2008 syntax • **p08** Flag syntax that is not full SQL/2008 syntax • **c03** Flag syntax that is not core SQL/2003 syntax • **p03** Flag syntax that is not full SQL/2003 syntax • **c99** Flag syntax that is not core SQL/1999 syntax • **p99** Flag syntax that is not full SQL/1999 syntax • **e92** Flag syntax that is not entry-level SQL/1992 syntax • **i92** Flag syntax that is not intermediate-level SQL/1992 syntax • **f92** Flag syntax that is not full-SQL/1992 syntax • **t** Flag non-standard host variable types • **u** Flag syntax that is not supported by UltraLite For compatibility with previous SQL Anywhere versions, you can also specify e, i, and f, which correspond to e92, i92, and f92, respectively.
-h *width*	Limit the maximum length of lines output by sqlpp to *width*. The continuation character is a backslash (\) and the minimum value of *width* is 10.
-k	Notify the preprocessor that the program to be compiled includes a user declaration of SQLCODE. The definition must be of type LONG, but does not need to be in a declaration section.
-m *mode*	Specify the cursor updatability mode if it is not specified explicitly in the embedded SQL application. The *mode* can be one of: • **HISTORICAL** In previous versions, embedded SQL cursors defaulted to either FOR UPDATE or READ ONLY (depending on the query and the ansi_update_contraits option value). Explicit cursor updatability was specified on DECLARE CURSOR. Use this option to preserve this behavior. • **READONLY** Embedded SQL cursors default to READ ONLY. Explicit cursor updatability is specified on PREPARE. This is the default behavior. READ ONLY cursors can result in improved performance.

Option	Description
-n	Generate line number information in the C file. This consists of *#line* directives in the appropriate places in the generated C code. If the compiler that you are using supports the *#line* directive, this option makes the compiler report errors on line numbers in the SQC file (the one with the embedded SQL) as opposed to reporting errors on line numbers in the C file generated by the SQL preprocessor. Also, the *#line* directives are used indirectly by the source level debugger so that you can debug while viewing the SQC source file.
-o *operating-system*	Specify the target operating system. The supported operating systems are: • **WINDOWS** Microsoft Windows, including Windows Mobile. • **UNIX** Use this option if you are creating a 32-bit Unix application. • **UNIX64** Use this option if you are creating a 64-bit Unix application.
-q	Quiet mode—do not print messages.
-r-	Generate non-reentrant code. For more information about reentrant code, see "SQLCA management for multithreaded or reentrant code" on page 453.
-s *len*	Set the maximum size string that the preprocessor puts into the C file. Strings longer than this value are initialized using a list of characters (*'a','b','c'*, and so on). Most C compilers have a limit on the size of string literal they can handle. This option is used to set that upper limit. The default value is 500.
-u	Generate code for UltraLite. For more information, see "UltraLite Embedded SQL API reference" [*UltraLite - C and C++ Programming*].

Option	Description
-w *level*	Flag as a warning any static embedded SQL that is not part of a specified standard. The *level* value indicates the standard to use. For example, `sqlpp -w c08 ...` flags any SQL syntax that is not part of the core SQL/2008 syntax. The supported *level* values are: • **c08** Flag syntax that is not core SQL/2008 syntax • **p08** Flag syntax that is not full SQL/2008 syntax • **c03** Flag syntax that is not core SQL/2003 syntax • **p03** Flag syntax that is not full SQL/2003 syntax • **c99** Flag syntax that is not core SQL/1999 syntax • **p99** Flag syntax that is not full SQL/1999 syntax • **e92** Flag syntax that is not entry-level SQL/1992 syntax • **i92** Flag syntax that is not intermediate-level SQL/1992 syntax • **f92** Flag syntax that is not full-SQL/1992 syntax • **t** Flag non-standard host variable types • **u** Flag syntax that is not supported by UltraLite For compatibility with previous SQL Anywhere versions, you can also specify e, i, and f, which correspond to e92, i92, and f92, respectively.
-x	Change multibyte strings to escape sequences so that they can pass through compilers.
-z *cs*	Specify the collation sequence. For a list of recommended collation sequences, run `dbinit -l` at a command prompt. The collation sequence is used to help the preprocessor understand the characters used in the source code of the program, for example, in identifying alphabetic characters suitable for use in identifiers. If -z is not specified, the preprocessor attempts to determine a reasonable collation to use based on the operating system and the SALANG and SACHARSET environment variables. See "SACHARSET environment variable" [*SQL Anywhere Server - Database Administration*], and "SALANG environment variable" [*SQL Anywhere Server - Database Administration*].
input-file	A C or C++ program containing embedded SQL to be processed.
output-file	The C language source file created by the SQL preprocessor.

Description

The SQL preprocessor translates the SQL statements in the *input-file* into C language source that is put into the *output-file*. The normal extension for source programs with embedded SQL is *.sqc*. The default output file name is the *input-file* with an extension of *.c*. If *input-file* has a *.c* extension, the default output file name extension is *.cc*.

See also

- "Embedded SQL" on page 429
- "sql_flagger_error_level option" [*SQL Anywhere Server - Database Administration*]
- "sql_flagger_warning_level option" [*SQL Anywhere Server - Database Administration*]
- "SQLFLAGGER function [Miscellaneous]" [*SQL Anywhere Server - SQL Reference*]
- "sa_ansi_standard_packages system procedure" [*SQL Anywhere Server - SQL Reference*]
- "SQL preprocessor error messages" [*Error Messages*]

Library function reference

The SQL preprocessor generates calls to functions in the interface library or DLL. In addition to the calls generated by the SQL preprocessor, a set of library functions is provided to make database operations easier to perform. Prototypes for these functions are included by the EXEC SQL INCLUDE SQLCA statement.

This section contains a reference description of these various functions.

DLL entry points

The DLL entry points are the same except that the prototypes have a modifier appropriate for DLLs.

You can declare the entry points in a portable manner using **_esqlentry_**, which is defined in *sqlca.h*. It resolves to the value __stdcall.

alloc_sqlda function

Prototype

struct sqlda * **alloc_sqlda(** unsigned *numvar* **);**

Description

Allocates a SQLDA with descriptors for *numvar* variables. The sqln field of the SQLDA is initialized to *numvar*. Space is allocated for the indicator variables, the indicator pointers are set to point to this space, and the indicator value is initialized to zero. A null pointer is returned if memory cannot be allocated. It is recommended that you use this function instead of the alloc_sqlda_noind function.

alloc_sqlda_noind function

Prototype

struct sqlda * **alloc_sqlda_noind(** unsigned *numvar* **);**

Description

Allocates a SQLDA with descriptors for *numvar* variables. The sqln field of the SQLDA is initialized to *numvar*. Space is not allocated for indicator variables; the indicator pointers are set to the null pointer. A null pointer is returned if memory cannot be allocated.

db_backup function

Prototype

void **db_backup(**
SQLCA * *sqlca***,**
int *op***,**
*int file_num***,**
unsigned long *page_num***,**
struct sqlda * *sqlda***);**

Authorization

Must be connected as a user with DBA authority, REMOTE DBA authority (SQL Remote), or BACKUP authority.

Description

BACKUP statement is recommended
Although this function provides one way to add backup features to an application, the recommended way to do this task is to use the BACKUP statement. See "BACKUP statement" [*SQL Anywhere Server - SQL Reference*].

The action performed depends on the value of the *op* parameter:

- **DB_BACKUP_START** Must be called before a backup can start. Only one backup can be running per database at one time against any given database server. Database checkpoints are disabled until the backup is complete (db_backup is called with an *op* value of DB_BACKUP_END). If the backup cannot start, the SQLCODE is SQLE_BACKUP_NOT_STARTED. Otherwise, the SQLCOUNT field of the *sqlca* is set to the database page size. Backups are processed one page at a time.

  The *file_num*, *page_num*, and *sqlda* parameters are ignored.

- **DB_BACKUP_OPEN_FILE** Open the database file specified by *file_num*, which allows pages of the specified file to be backed up using DB_BACKUP_READ_PAGE. Valid file numbers are 0 through DB_BACKUP_MAX_FILE for the root database files, and 0 through DB_BACKUP_TRANS_LOG_FILE for the transaction log file. If the specified file does not exist, the SQLCODE is SQLE_NOTFOUND. Otherwise, SQLCOUNT contains the number of pages in the file, SQLIOESTIMATE contains a 32-bit value (POSIX time_t) that identifies the time that the database file was created, and the operating system file name is in the *sqlerrmc* field of the SQLCA.

The *page_num* and *sqlda* parameters are ignored.

- **DB_BACKUP_READ_PAGE** Read one page of the database file specified by *file_num*. The *page_num* should be a value from 0 to one less than the number of pages returned in SQLCOUNT by a successful call to db_backup with the DB_BACKUP_OPEN_FILE operation. Otherwise, SQLCODE is set to SQLE_NOTFOUND. The *sqlda* descriptor should be set up with one variable of type DT_BINARY or DT_LONG_BINARY pointing to a buffer. The buffer should be large enough to hold binary data of the size returned in the SQLCOUNT field on the call to db_backup with the DB_BACKUP_START operation.

  DT_BINARY data contains a two-byte length followed by the actual binary data, so the buffer must be two bytes longer than the page size.

  Application must save buffer
  This call makes a copy of the specified database page into the buffer, but it is up to the application to save the buffer on some backup media.

- **DB_BACKUP_READ_RENAME_LOG** This action is the same as DB_BACKUP_READ_PAGE, except that after the last page of the transaction log has been returned, the database server renames the transaction log and starts a new one.

  If the database server is unable to rename the log at the current time (for example in version 7.0.x or earlier databases there may be incomplete transactions), the SQLE_BACKUP_CANNOT_RENAME_LOG_YET error is set. In this case, do not use the page returned, but instead reissue the request until you receive SQLE_NOERROR and then write the page. Continue reading the pages until you receive the SQLE_NOTFOUND condition.

  The SQLE_BACKUP_CANNOT_RENAME_LOG_YET error may be returned multiple times and on multiple pages. In your retry loop, you should add a delay so as not to slow the server down with too many requests.

  When you receive the SQLE_NOTFOUND condition, the transaction log has been backed up successfully and the file has been renamed. The name for the old transaction file is returned in the *sqlerrmc* field of the SQLCA.

  You should check the sqlda->sqlvar[0].sqlind value after a db_backup call. If this value is greater than zero, the last log page has been written and the log file has been renamed. The new name is still in sqlca.sqlerrmc, but the SQLCODE value is SQLE_NOERROR.

  You should not call db_backup again after this, except to close files and finish the backup. If you do, you get a second copy of your backed up log file and you receive SQLE_NOTFOUND.

- **DB_BACKUP_CLOSE_FILE** Must be called when processing of one file is complete to close the database file specified by *file_num*.

  The *page_num* and *sqlda* parameters are ignored.

- **DB_BACKUP_END** Must be called at the end of the backup. No other backup can start until this backup has ended. Checkpoints are enabled again.

The *file_num*, *page_num* and *sqlda* parameters are ignored.

- **DB_BACKUP_PARALLEL_START** Starts a parallel backup. Like DB_BACKUP_START, only one backup can be running against a database at one time on any given database server. Database checkpoints are disabled until the backup is complete (until db_backup is called with an *op* value of DB_BACKUP_END). If the backup cannot start, you receive SQLE_BACKUP_NOT_STARTED. Otherwise, the SQLCOUNT field of the sqlca is set to the database page size.

  The *file_num* parameter instructs the database server to rename the transaction log and start a new one after the last page of the transaction log has been returned. If the value is non-zero then the transaction log is renamed or restarted. Otherwise, it is not renamed and restarted. This parameter eliminates the need for the DB_BACKUP_READ_RENAME_LOG operation, which is not allowed during a parallel backup operation.

  The *page_num* parameter informs the database server of the maximum size of the client's buffer, in database pages. On the server side, the parallel backup readers try to read sequential blocks of pages—this value lets the server know how large to allocate these blocks: passing a value of *nnn* lets the server know that the client is willing to accept at most *nnnn* database pages at a time from the server. The server may return blocks of pages of less than size *nnn* if it is unable to allocate enough memory for blocks of *nnn* pages. If the client does not know the size of database pages until after the call to DB_BACKUP_PARALLEL_START, this value can be provided to the server with the DB_BACKUP_INFO operation. This value must be provided before the first call to retrieve backup pages (DB_BACKUP_PARALLEL_READ).

  Note
  If you are using db_backup to start a parallel backup, db_backup does not create writer threads. The caller of db_backup must receive the data and act as the writer.

- **DB_BACKUP_INFO** This parameter provides additional information to the database server about the parallel backup. The *file_num* parameter indicates the type of information being provided, and the *page_num* parameter provides the value. You can specify the following additional information with DB_BACKUP_INFO:

  - **DB_BACKUP_INFO_PAGES_IN_BLOCK** The *page_num* argument contains the maximum number of pages that should be sent back in one block.

  - **DB_BACKUP_INFO_CHKPT_LOG** This is the client-side equivalent to the WITH CHECKPOINT LOG option of the BACKUP statement. A *page_num* value of DB_BACKUP_CHKPT_COPY indicates COPY, while the value DB_BACKUP_CHKPT_NOCOPY indicates NO COPY. If this value is not provided it defaults to COPY.

- **DB_BACKUP_PARALLEL_READ** This operation reads a block of pages from the database server. Before invoking this operation, use the DB_BACKUP_OPEN_FILE operation to open all the files that you want to back up. DB_BACKUP_PARALLEL_READ ignores the *file_num* and *page_num* arguments.

  The sqlda descriptor should be set up with one variable of type DT_LONGBINARY pointing to a buffer. The buffer should be large enough to hold binary data of the size *nnn* pages (specified in the

DB_BACKUP_START_PARALLEL operation, or in a DB_BACKUP_INFO operation). For more information about this data type, see DT_LONGBINARY in "Embedded SQL data types" on page 439.

The server returns a sequential block of database pages for a particular database file. The page number of the first page in the block is returned in the SQLCOUNT field. The file number that the pages belong to is returned in the SQLIOESTIMATE field, and this value matches one of the file numbers used in the DB_BACKUP_OPEN_FILE calls. The size of the data returned is available in the *stored_len* field of the DT_LONGBINARY variable, and is always a multiple of the database page size. While the data returned by this call contains a block of sequential pages for a given file, it is not safe to assume that separate blocks of data are returned in sequential order, or that all of one database file's pages are returned before another database file's pages. The caller should be prepared to receive portions of another individual file out of sequential order, or of any opened database file on any given call.

An application should make repeated calls to this operation until the size of the read data is 0, or the value of sqlda->sqlvar[0].sqlind is greater than 0. If the backup is started with transaction log renaming/restarting, SQLERROR could be set to SQLE_BACKUP_CANNOT_RENAME_LOG_YET. In this case, do not use the pages returned, but instead reissue the request until you receive SQLE_NOERROR, and then write the data. The SQLE_BACKUP_CANNOT_RENAME_LOG_YET error may be returned multiple times and on multiple pages. In your retry loop, you should add a delay so the database server is not slowed down by too many requests. Continue reading the pages until either of the first two conditions are met.

The dbbackup utility uses the following algorithm. Note that this is *not* C code, and does not include error checking.

```
sqlda->sqld = 1;
sqlda->sqlvar[0].sqltype = DT_LONGBINARY

/* Allocate LONGBINARY value for page buffer. It MUST have */
/* enough room to hold the requested number (128) of database pages */
sqlda->sqlvar[0].sqldata = allocated buffer

/* Open the server files needing backup */
for file_num = 0 to DB_BACKUP_MAX_FILE
  db_backup( ... DB_BACKUP_OPEN_FILE, file_num ... )
  if SQLCODE == SQLE_NO_ERROR
    /* The file exists */
    num_pages = SQLCOUNT
    file_time = SQLE_IO_ESTIMATE
    open backup file with name from sqlca.sqlerrmc
end for

/* read pages from the server, write them locally */
while TRUE
  /* file_no and page_no are ignored */
  db_backup( &sqlca, DB_BACKUP_PARALLEL_READ, 0, 0, &sqlda );

  if SQLCODE != SQLE_NO_ERROR
     break;

  if buffer->stored_len == 0 || sqlda->sqlvar[0].sqlind > 0
     break;

  /* SQLCOUNT contains the starting page number of the block    */
```



```
  /* SQLIOESTIMATE contains the file number the pages belong to */
  write block of pages to appropriate backup file
end while

/* close the server backup files */
for file_num = 0 to DB_BACKUP_MAX_FILE
    /* close backup file */
    db_backup( ... DB_BACKUP_CLOSE_FILE, file_num ... )
end for

/* shut down the backup */
db_backup( ... DB_BACKUP_END ... )

/* cleanup */
free page buffer
```

db_cancel_request function

Prototype

int **db_cancel_request(** SQLCA * *sqlca* **);**

Description

Cancels the currently active database server request. This function checks to make sure a database server request is active before sending the cancel request. If the function returns 1, then the cancel request was sent; if it returns 0, then no request was sent.

A non-zero return value does not mean that the request was canceled. There are a few critical timing cases where the cancel request and the response from the database or server cross. In these cases, the cancel simply has no effect, even though the function still returns TRUE.

The db_cancel_request function can be called asynchronously. This function and db_is_working are the only functions in the database interface library that can be called asynchronously using a SQLCA that might be in use by another request.

If you cancel a request that is carrying out a cursor operation, the position of the cursor is indeterminate. You must locate the cursor by its absolute position or close it, following the cancel.

db_change_char_charset function

Prototype

unsigned int **db_change_char_charset(**
SQLCA * *sqlca*,
char * charset **);**

Description

Changes the application's CHAR character set for this connection. Data sent and fetched using FIXCHAR, VARCHAR, LONGVARCHAR, and STRING types are in the CHAR character set.

Returns 1 if the change is successful, 0 otherwise.

For a list of recommended character sets, see "Recommended character sets and collations" [*SQL Anywhere Server - Database Administration*].

db_change_nchar_charset function

Prototype

unsigned int **db_change_nchar_charset(**
SQLCA * *sqlca*,
char * charset **);**

Description

Changes the application's NCHAR character set for this connection. Data sent and fetched using DT_NFIXCHAR, DT_NVARCHAR, DT_LONGNVARCHAR, and DT_NSTRING host variable types are in the NCHAR character set.

If the db_change_nchar_charset function is not called, all data is sent and fetched using the CHAR character set. Typically, an application that wants to send and fetch Unicode data should set the NCHAR character set to UTF-8.

If this function is called, the charset parameter is usually "UTF-8". The NCHAR character set cannot be set to UTF-16.

Returns 1 if the change is successful, 0 otherwise.

In embedded SQL, NCHAR, NVARCHAR and LONG NVARCHAR are described as DT_FIXCHAR, DT_VARCHAR, and DT_LONGVARCHAR, respectively, by default. If the db_change_nchar_charset function has been called, these types are described as DT_NFIXCHAR, DT_NVARCHAR, and DT_LONGNVARCHAR, respectively.

For a list of recommended character sets, see "Recommended character sets and collations" [*SQL Anywhere Server - Database Administration*].

db_delete_file function

Prototype

void **db_delete_file(**
SQLCA * *sqlca*,
char * *filename* **);**

Authorization

Must be connected to a user ID with DBA authority or REMOTE DBA authority (SQL Remote).

Description

The db_delete_file function requests the database server to delete *filename*. This can be used after backing up and renaming the transaction log to delete the old transaction log. See DB_BACKUP_READ_RENAME_LOG in "db_backup function" on page 489.

You must be connected to a user ID with DBA authority.

db_find_engine function

Prototype

unsigned short **db_find_engine(**
SQLCA * *sqlca***,**
char * *name* **);**

Description

Returns an unsigned short value, which indicates status information about the local database server whose name is *name*. If no server can be found over shared memory with the specified name, the return value is 0. A non-zero value indicates that the local server is currently running.

If a null pointer is specified for *name*, information is returned about the default database server.

Each bit in the return value conveys some information. Constants that represent the bits for the various pieces of information are defined in the *sqldef.h* header file. Their meaning is described below.

- **DB_ENGINE** This flag is always set.
- **DB_CLIENT** This flag is always set.
- **DB_CAN_MULTI_DB_NAME** This flag is obsolete.
- **DB_DATABASE_SPECIFIED** This flag is always set.
- **DB_ACTIVE_CONNECTION** This flag is always set.
- **DB_CONNECTION_DIRTY** This flag is obsolete.
- **DB_CAN_MULTI_CONNECT** This flag is obsolete.
- **DB_NO_DATABASES** This flag is set if the server has no databases started.

db_fini function

Prototype

int **db_fini(** SQLCA * *sqlca* **);**

Description

This function frees resources used by the database interface or DLL. You must not make any other library calls or execute any embedded SQL statements after db_fini is called. If an error occurs during processing, the error code is set in SQLCA and the function returns 0. If there are no errors, a non-zero value is returned.

You need to call db_fini once for each SQLCA being used.

Note that db_fini must not be called directly or indirectly from the Windows DllMain function. The calls that can be made from DllMain are limited, and in particular attempting to communicate with other threads (which db_fini may do) can cause the application to hang.

For information about using db_init in UltraLite applications, see "db_fini method" [*UltraLite - C and C++ Programming*].

db_get_property function

Prototype

unsigned int **db_get_property(**
SQLCA * *sqlca*,
a_db_property *property*,
char * *value_buffer*,
int *value_buffer_size* **);**

Description

This function is used to obtain information about the database interface or the server to which you are connected.

The arguments are as follows:

- **a_db_property** The property requested, either DB_PROP_CLIENT_CHARSET, DB_PROP_SERVER_ADDRESS, or DB_PROP_DBLIB_VERSION.
- **value_buffer** This argument is filled with the property value as a null-terminated string.
- **value_buffer_size** The maximum length of the string value_buffer, including the terminating null character.

The following properties are supported:

- **DB_PROP_CLIENT_CHARSET** This property value gets the client character set (for example, "windows-1252").
- **DB_PROP_SERVER_ADDRESS** This property value gets the current connection's server network address as a printable string. The shared memory protocol always returns the empty string for the address. The TCP/IP protocol returns non-empty string addresses.

- **DB_PROP_DBLIB_VERSION** This property value gets the database interface library's version (for example, "12.0.0.1297").

Returns 1 if successful, 0 otherwise.

db_init function

Prototype

int **db_init(** SQLCA * *sqlca* **);**

Description

This function initializes the database interface library. This function must be called before any other library call is made and before any embedded SQL statement is executed. The resources the interface library required for your program are allocated and initialized on this call.

Returns 1 if successful, 0 otherwise.

Use db_fini to free the resources at the end of your program. If there are any errors during processing, they are returned in the SQLCA and 0 is returned. If there are no errors, a non-zero value is returned and you can begin using embedded SQL statements and functions.

Usually, this function should be called only once (passing the address of the global sqlca variable defined in the *sqlca.h* header file). If you are writing a DLL or an application that has multiple threads using embedded SQL, call db_init once for each SQLCA that is being used.

For more information, see "SQLCA management for multithreaded or reentrant code" on page 453.

For information about using db_init in UltraLite applications, see "db_init method" [*UltraLite - C and C++ Programming*].

db_is_working function

Prototype

unsigned short **db_is_working(** SQLCA * *sqlca* **);**

Description

Returns 1 if your application has a database request in progress that uses the given sqlca and 0 if there is no request in progress that uses the given sqlca.

This function can be called asynchronously. This function and db_cancel_request are the only functions in the database interface library that can be called asynchronously using a SQLCA that might be in use by another request.

db_locate_servers function

Prototype

unsigned int **db_locate_servers(**
SQLCA * *sqlca*,
SQL_CALLBACK_PARM *callback_address*,
void * *callback_user_data* **);**

Description

Provides programmatic access to the information displayed by the dblocate utility, listing all the SQL Anywhere database servers on the local network that are listening on TCP/IP.

The callback function must have the following prototype:

int (*)(SQLCA * *sqlca*,
a_server_address * *server_addr*,
void * *callback_user_data*);

The callback function is called for each server found. If the callback function returns 0, db_locate_servers stops iterating through servers.

The sqlca and callback_user_data passed to the callback function are those passed into db_locate_servers. The second parameter is a pointer to an a_server_address structure. a_server_address is defined in *sqlca.h*, with the following definition:

```
typedef struct a_server_address {
    a_sql_uint32 port_type;
    a_sql_uint32 port_num;
    char         *name;
    char         *address;
} a_server_address;
```

- **port_type** Is always PORT_TYPE_TCP at this time (defined to be 6 in *sqlca.h*).
- **port_num** Is the TCP port number on which this server is listening.
- **name** Points to a buffer containing the server name.
- **address** Points to a buffer containing the IP address of the server.

Returns 1 if successful, 0 otherwise.

See also

- "Server Enumeration utility (dblocate)" [*SQL Anywhere Server - Database Administration*]

db_locate_servers_ex function

Prototype

unsigned int **db_locate_servers_ex(**
SQLCA * *sqlca*,

SQL_CALLBACK_PARM *callback_address*,
void * *callback_user_data*,
unsigned int *bitmask*);

Description

Provides programmatic access to the information displayed by the dblocate utility, listing all the SQL Anywhere database servers on the local network that are listening on TCP/IP, and provides a mask parameter used to select addresses passed to the callback function.

The callback function must have the following prototype:

int (*)(SQLCA * *sqlca*,
a_server_address * *server_addr*,
void * *callback_user_data*);

The callback function is called for each server found. If the callback function returns 0, db_locate_servers_ex stops iterating through servers.

The sqlca and callback_user_data passed to the callback function are those passed into db_locate_servers. The second parameter is a pointer to an a_server_address structure. a_server_address is defined in *sqlca.h*, with the following definition:

```
typedef struct a_server_address {
    a_sql_uint32   port_type;
    a_sql_uint32   port_num;
    char           *name;
    char           *address;
    char           *dbname;
} a_server_address;
```

- **port_type** Is always PORT_TYPE_TCP at this time (defined to be 6 in *sqlca.h*).
- **port_num** Is the TCP port number on which this server is listening.
- **name** Points to a buffer containing the server name.
- **address** Points to a buffer containing the IP address of the server.
- **dbname** Points to a buffer containing the database name.

Three bitmask flags are supported:

- DB_LOOKUP_FLAG_NUMERIC
- DB_LOOKUP_FLAG_ADDRESS_INCLUDES_PORT
- DB_LOOKUP_FLAG_DATABASES

These flags are defined in *sqlca.h* and can be ORed together.

DB_LOOKUP_FLAG_NUMERIC ensures that addresses passed to the callback function are IP addresses, instead of host names.

DB_LOOKUP_FLAG_ADDRESS_INCLUDES_PORT specifies that the address includes the TCP/IP port number in the a_server_address structure passed to the callback function.

DB_LOOKUP_FLAG_DATABASES specifies that the callback function is called once for each database found, or once for each database server found if the database server doesn't support sending database information (version 9.0.2 and earlier database servers).

Returns 1 if successful, 0 otherwise.

For more information, see "Server Enumeration utility (dblocate)" [*SQL Anywhere Server - Database Administration*].

db_register_a_callback function

Prototype

void **db_register_a_callback(**
SQLCA * *sqlca***,**
a_db_callback_index *index***,**
(SQL_CALLBACK_PARM) *callback* **);**

Description

This function registers callback functions.

If you do not register a DB_CALLBACK_WAIT callback, the default action is to do nothing. Your application blocks, waiting for the database response. You must register a callback for the MESSAGE TO CLIENT statement. See "MESSAGE statement" [*SQL Anywhere Server - SQL Reference*].

To remove a callback, pass a null pointer as the *callback* function.

The following values are allowed for the *index* parameter:

- **DB_CALLBACK_DEBUG_MESSAGE** The supplied function is called once for each debug message and is passed a null-terminated string containing the text of the debug message. A debug message is a message that is logged to the LogFile file. In order for a debug message to be passed to this callback, the LogFile connection parameter must be used. The string normally has a newline character (\n) immediately before the terminating null character. The prototype of the callback function is as follows:

  void SQL_CALLBACK *debug_message_callback***(**
  SQLCA * *sqlca*,
  char * *message_string* **);**

  For more information, see "LogFile (LOG) connection parameter" [*SQL Anywhere Server - Database Administration*].

- **DB_CALLBACK_START** The prototype is as follows:

  void SQL_CALLBACK *start_callback***(** SQLCA * *sqlca* **);**

  This function is called just before a database request is sent to the server. DB_CALLBACK_START is used only on Windows.

- **DB_CALLBACK_FINISH** The prototype is as follows:

  void SQL_CALLBACK *finish_callback*(SQLCA * *sqlca*);

  This function is called after the response to a database request has been received by the interface DLL. DB_CALLBACK_FINISH is used only on Windows operating systems.

- **DB_CALLBACK_CONN_DROPPED** The prototype is as follows:

  void SQL_CALLBACK *conn_dropped_callback* (
  SQLCA * *sqlca*,
  char * *conn_name*);

  This function is called when the database server is about to drop a connection because of a liveness timeout, through a DROP CONNECTION statement, or because the database server is being shut down. The connection name *conn_name* is passed in to allow you to distinguish between connections. If the connection was not named, it has a value of NULL.

- **DB_CALLBACK_WAIT** The prototype is as follows:

  void SQL_CALLBACK *wait_callback*(SQLCA * *sqlca*);

  This function is called repeatedly by the interface library while the database server or client library is busy processing your database request.

  You would register this callback as follows:

  ```
  db_register_a_callback( &sqlca,
     DB_CALLBACK_WAIT,
     (SQL_CALLBACK_PARM)&db_wait_request );
  ```

- **DB_CALLBACK_MESSAGE** This is used to enable the application to handle messages received from the server during the processing of a request. Messages can be sent to the client application from the database server using the SQL MESSAGE statement. Messages can also be generated by long running database server statements. For more information, see "MESSAGE statement" [*SQL Anywhere Server - SQL Reference*].

  The callback prototype is as follows:

  void SQL_CALLBACK *message_callback*(
  SQLCA * *sqlca*,
  unsigned char *msg_type*,
  an_sql_code *code*,
  unsigned short *length*,
  char * *msg*
  );

  The *msg_type* parameter states how important the message is. You may want to handle different message types in different ways. The following possible values for *msg_type* are defined in *sqldef.h*.

  - **MESSAGE_TYPE_INFO** The message type was INFO.
  - **MESSAGE_TYPE_WARNING** The message type was WARNING.

- **MESSAGE_TYPE_ACTION** The message type was ACTION.
- **MESSAGE_TYPE_STATUS** The message type was STATUS.
- **MESSAGE_TYPE_PROGRESS** The message type was PROGRESS. This type of message is generated by long running database server statements such as BACKUP DATABASE and LOAD TABLE. See "progress_messages option" [*SQL Anywhere Server - Database Administration*].

The *code* field may provide a SQLCODE associated with the message, otherwise the value is 0. The *length* field tells you how long the message is. The message is *not* null-terminated. SQL Anywhere DBLIB and ODBC clients can use the DB_CALLBACK_MESSAGE parameter to receive progress messages.

For example, the Interactive SQL callback displays STATUS and INFO message on the Messages tab, while messages of type ACTION and WARNING go to a window. If an application does not register this callback, there is a default callback, which causes all messages to be written to the server logfile (if debugging is on and a logfile is specified). In addition, messages of type MESSAGE_TYPE_WARNING and MESSAGE_TYPE_ACTION are more prominently displayed, in an operating system-dependent manner.

When a message callback is not registered by the application, messages sent to the client are saved to the log file when the LogFile connection parameter is specified. Also, ACTION or STATUS messages sent to the client appear in a window on Windows operating systems and are logged to stderr on Unix operating systems.

- **DB_CALLBACK_VALIDATE_FILE_TRANSFER** This is used to register a file transfer validation callback function. Before allowing any transfer to take place, the client library will invoke the validation callback, if it exists. If the client data transfer is being requested during the execution of indirect statements such as from within a stored procedure, the client library will not allow a transfer unless the client application has registered a validation callback. The conditions under which a validation call is made are described more fully below.

  The callback prototype is as follows:

  ```
  int SQL_CALLBACK file_transfer_callback(
  SQLCA * sqlca,
  char * file_name,
  int is_write
  );
  ```

  The *file_name* parameter is the name of the file to be read or written. The *is_write* parameter is 0 if a read is requested (transfer from the client to the server), and non-zero for a write. The callback function should return 0 if the file transfer is not allowed, non-zero otherwise.

  For data security, the server tracks the origin of statements requesting a file transfer. The server determines if the statement was received directly from the client application. When initiating the transfer of data from the client, the server sends the information about the origin of the statement to the client software. On its part, the embedded SQL client library allows unconditional transfer of data only if the data transfer is being requested due to the execution of a statement sent directly by the client application. Otherwise, the application must have registered the validation callback described

above, in the absence of which the transfer is denied and the statement fails with an error. Note that if the client statement invokes a stored procedure already existing in the database, then the execution of the stored procedure itself is considered not to have been for a client initiated statement. However, if the client application explicitly creates a temporary stored procedure then the execution of the stored procedure results in the server treating the procedure as having been client initiated. Similarly, if the client application executes a batch statement, then the execution of the batch statement is considered as being done directly by the client application.

db_start_database function

Prototype

unsigned int **db_start_database(** SQLCA * *sqlca*, char * *parms* **);**

Arguments

- **sqlca** A pointer to a SQLCA structure. For information, see "The SQL Communication Area (SQLCA)" on page 451.
- **parms** A null-terminated string containing a semicolon-delimited list of parameter settings, each of the form KEYWORD=*value*. For example:

  ```
  "UID=DBA;PWD=sql;DBF=c:\\db\\mydatabase.db"
  ```

  For a list of connection parameters, see "Connection parameters" [*SQL Anywhere Server - Database Administration*].

Description

The database is started on an existing server, if possible. Otherwise, a new server is started. The steps carried out to start a database are described in "Locating a database server" [*SQL Anywhere Server - Database Administration*].

If the database was already running or was successfully started, the return value is true (non-zero) and SQLCODE is set to 0. Error information is returned in the SQLCA.

If a user ID and password are supplied in the parameters, they are ignored.

The permission required to start and stop a database is set on the server command line. For information, see "-gd dbeng12/dbsrv12 server option" [*SQL Anywhere Server - Database Administration*].

db_start_engine function

Prototype

unsigned int **db_start_engine(** SQLCA * *sqlca*, char * *parms* **);**

Arguments

- **sqlca** A pointer to a SQLCA structure. For information, see "The SQL Communication Area (SQLCA)" on page 451.

- **parms** A null-terminated string containing a semicolon-delimited list of parameter settings, each of the form KEYWORD=*value*. For example,

  ```
  "UID=DBA;PWD=sql;DBF=c:\\db\\mydatabase.db"
  ```

  For a list of connection parameters, see "Connection parameters" [*SQL Anywhere Server - Database Administration*].

Description

Starts the database server if it is not running.

For a description of the steps carried out by this function when ForceStart is not specified, see "Locating a database server" [*SQL Anywhere Server - Database Administration*].

If the database server was already running or was successfully started, the return value is TRUE (non-zero) and SQLCODE is set to 0. Error information is returned in the SQLCA.

The following call to db_start_engine starts the database server and names it demo, but does not load the database, despite the DBF connection parameter:

```
db_start_engine( &sqlca,
    "DBF=samples-dir\\demo.db;START=dbeng12" );
```

If you want to start a database and the server, include the database file in the StartLine (START) connection parameter:

```
db_start_engine( &sqlca,
   "SERVER=eng_name;START=dbeng12 samples-dir\\demo.db" );
```

This call starts the server, names it eng_name, and starts the SQL Anywhere sample database on that server.

The db_start_engine function attempts to connect to a server before starting one, to avoid attempting to start a server that is already running.

The ForceStart (FORCE) connection parameter is used only by the db_start_engine function. When set to YES, there is no attempt to connect to a server before trying to start one. This enables the following pair of commands to work as expected:

1. Start a database server named server_1:

   ```
   start dbeng12 -n server_1 demo.db
   ```

2. Force a new server to start and connect to it:

   ```
   db_start_engine( &sqlda,
     "START=dbeng12 -n server_2 mydb.db;ForceStart=YES" )
   ```


If ForceStart (FORCE) was not used, and without a ServerName (Server) parameter, the second command would have attempted to connect to server_1. The db_start_engine function does not pick up the server name from the -n option of the StartLine (START) parameter.

db_stop_database function

Prototype

unsigned int **db_stop_database(** SQLCA * *sqlca*, char * *parms* **);**

Arguments

- **sqlca** A pointer to a SQLCA structure. For information, see "The SQL Communication Area (SQLCA)" on page 451.
- **parms** A null-terminated string containing a semicolon-delimited list of parameter settings, each of the form KEYWORD=*value*. For example:

  ```
  "UID=DBA;PWD=sql;DBF=c:\\db\\mydatabase.db"
  ```

  For a list of connection parameters, see "Connection parameters" [*SQL Anywhere Server - Database Administration*].

Description

Stop the database identified by DatabaseName (DBN) on the server identified by ServerName (Server). If ServerName is not specified, the default server is used.

By default, this function does not stop a database that has existing connections. If Unconditional is yes, the database is stopped regardless of existing connections.

A return value of TRUE indicates that there were no errors.

The permission required to start and stop a database is set on the server command line. For information, see "-gd dbeng12/dbsrv12 server option" [*SQL Anywhere Server - Database Administration*].

db_stop_engine function

Prototype

unsigned int **db_stop_engine(** SQLCA * *sqlca*, char * *parms* **);**

Arguments

- **sqlca** A pointer to a SQLCA structure. For information, see "The SQL Communication Area (SQLCA)" on page 451.
- **parms** A null-terminated string containing a semicolon-delimited list of parameter settings, each of the form KEYWORD=*value*. For example,

  ```
  "UID=DBA;PWD=sql;DBF=c:\\db\\mydatabase.db"
  ```

For a list of connection parameters, see "Connection parameters" [*SQL Anywhere Server - Database Administration*].

Description

Stops execution of the database server. The steps carried out by this function are:

- Look for a local database server that has a name that matches the ServerName (Server) parameter. If no ServerName is specified, look for the default local database server.
- If no matching server is found, this function returns with success.
- Send a request to the server to tell it to checkpoint and shut down all databases.
- Unload the database server.

By default, this function does not stop a database server that has existing connections. If Unconditional is yes, the database server is stopped regardless of existing connections.

A C program can use this function instead of spawning dbstop. A return value of TRUE indicates that there were no errors.

The use of db_stop_engine is subject to the permissions set with the -gk server option. See "-gk dbeng12/dbsrv12 server option" [*SQL Anywhere Server - Database Administration*].

db_string_connect function

Prototype

unsigned int **db_string_connect(** SQLCA * *sqlca*, char * *parms* **);**

Arguments

- **sqlca** A pointer to a SQLCA structure. For information, see "The SQL Communication Area (SQLCA)" on page 451.
- **parms** A null-terminated string containing a semicolon-delimited list of parameter settings, each of the form KEYWORD=*value*. For example:

  ```
  "UID=DBA;PWD=sql;DBF=c:\\db\\mydatabase.db"
  ```

  For a list of connection parameters, see "Connection parameters" [*SQL Anywhere Server - Database Administration*].

Description

Provides extra functionality beyond the embedded SQL CONNECT statement.

For a description of the algorithm used by this function, see "Troubleshooting connections" [*SQL Anywhere Server - Database Administration*].

The return value is TRUE (non-zero) if a connection was successfully established and FALSE (zero) otherwise. Error information for starting the server, starting the database, or connecting is returned in the SQLCA.

db_string_disconnect function

Prototype

unsigned int **db_string_disconnect(**
SQLCA * *sqlca*,
char * *parms* **);**

Arguments

- **sqlca** A pointer to a SQLCA structure. For information, see "The SQL Communication Area (SQLCA)" on page 451.

- **parms** A null-terminated string containing a semicolon-delimited list of parameter settings, each of the form KEYWORD=*value*. For example:

  ```
  "UID=DBA;PWD=sql;DBF=c:\\db\\mydatabase.db"
  ```

  For a list of connection parameters, see "Connection parameters" [*SQL Anywhere Server - Database Administration*].

Description

This function disconnects the connection identified by the ConnectionName parameter. All other parameters are ignored.

If no ConnectionName parameter is specified in the string, the unnamed connection is disconnected. This is equivalent to the embedded SQL DISCONNECT statement. The return value is TRUE if a connection was successfully ended. Error information is returned in the SQLCA.

This function shuts down the database if it was started with the AutoStop=yes parameter and there are no other connections to the database. It also stops the server if it was started with the AutoStop=yes parameter and there are no other databases running.

db_string_ping_server function

Prototype

unsigned int **db_string_ping_server(**
SQLCA * *sqlca*,
char * *connect_string*,
unsigned int *connect_to_db* **);**

Description

- **connect_string** The *connect_string* is a normal connect string that may or may not contain server and database information.

- **connect_to_db** If *connect_to_db* is non-zero (TRUE), then the function attempts to connect to a database on a server. It returns TRUE only if the connect string is sufficient to connect to the named database on the named server.

- **connect_to_db** If *connect_to_db* is zero, then the function only attempts to locate a server. It returns TRUE only if the connect string is sufficient to locate a server. It makes no attempt to connect to the database.

db_time_change function

Prototype

unsigned int **db_time_change(**
SQLCA * *sqlca***);**

Description

sqlca A pointer to a SQLCA structure. For information, see "The SQL Communication Area (SQLCA)" on page 451.

This function permits clients to notify the server that the time has changed on the client. This function recalculates the time zone adjustment and sends it to the server. On Windows platforms, it is recommended that applications call this function when they receive the WM_TIMECHANGE message. This will make sure that UTC timestamps are consistent over time changes, time zone changes, or daylight savings time changeovers.

Returns TRUE if successful, and FALSE otherwise.

fill_s_sqlda function

Prototype

struct sqlda * **fill_s_sqlda(**
struct sqlda * *sqlda***,**
unsigned int *maxlen* **);**

Description

The same as fill_sqlda, except that it changes all the data types in *sqlda* to type DT_STRING. Enough space is allocated to hold the string representation of the type originally specified by the SQLDA, up to a maximum of *maxlen* bytes. The length fields in the SQLDA (sqllen) are modified appropriately. Returns *sqlda* if successful and returns the null pointer if there is not enough memory available.

The SQLDA should be freed using the free_filled_sqlda function.

fill_sqlda function

Prototype

struct sqlda * **fill_sqlda(** struct sqlda * *sqlda* **);**

Description

Allocates space for each variable described in each descriptor of *sqlda*, and assigns the address of this memory to the sqldata field of the corresponding descriptor. Enough space is allocated for the database type and length indicated in the descriptor. Returns *sqlda* if successful and returns the null pointer if there is not enough memory available.

The SQLDA should be freed using the free_filled_sqlda function.

See also

- "fill_sqlda_ex function" on page 509

fill_sqlda_ex function

Prototype

struct sqlda * **fill_sqlda_ex(** struct sqlda * *sqlda* , unsigned int flags**);**

Description

Allocates space for each variable described in each descriptor of *sqlda*, and assigns the address of this memory to the sqldata field of the corresponding descriptor. Enough space is allocated for the database type and length indicated in the descriptor. Returns *sqlda* if successful and returns the null pointer if there is not enough memory available.

The SQLDA should be freed using the free_filled_sqlda function.

One flag bit is supported: FILL_SQLDA_FLAG_RETURN_DT_LONG. This flag is defined in sqlca.h.

FILL_SQLDA_FLAG_RETURN_DT_LONG preserves DT_LONGVARCHAR, DT_LONGNVARCHAR and DT_LONGBINARY types in the filled descriptor. If this flag bit is not specified, fill_sqlda_ex converts DT_LONGVARCHAR, DT_LONGNVARCHAR and DT_LONGBINARY types to DT_VARCHAR, DT_NVARCHAR and DT_BINARY respectively. Using DT_LONG*xyz* types makes it possible to fetch 32767 bytes, not the 32765 bytes that DT_VARCHAR, DT_NVARCHAR and DT_BINARY are limited to.

fill_sqlda(sqlda) is equivalent to fill_sqlda_ex(sqlda, 0).

See also

- "fill_sqlda function" on page 509
- "free_filled_sqlda function" on page 510

free_filled_sqlda function

Prototype

void **free_filled_sqlda(** struct sqlda * *sqlda* **);**

Description

Free the memory allocated to each sqldata pointer and the space allocated for the SQLDA itself. Any null pointer is not freed.

This should only be called if fill_sqlda or fill_s_sqlda was used to allocate the sqldata fields of the SQLDA.

Calling this function causes free_sqlda to be called automatically, and so any descriptors allocated by alloc_sqlda are freed.

free_sqlda function

Prototype

void **free_sqlda(** struct sqlda * *sqlda* **);**

Description

Free space allocated to this *sqlda* and free the indicator variable space, as allocated in fill_sqlda. Do not free the memory referenced by each sqldata pointer.

free_sqlda_noind function

Prototype

void **free_sqlda_noind(** struct sqlda * *sqlda* **);**

Description

Free space allocated to this *sqlda*. Do not free the memory referenced by each sqldata pointer. The indicator variable pointers are ignored.

sql_needs_quotes function

Prototype

unsigned int **sql_needs_quotes(** SQLCA **sqlca*, char * *str* **);**

Description

Returns a TRUE or FALSE value that indicates whether the string requires double quotes around it when it is used as a SQL identifier. This function formulates a request to the database server to determine if quotes are needed. Relevant information is stored in the sqlcode field.

There are three cases of return value/code combinations:

- **return = FALSE, sqlcode = 0** The string does not need quotes.
- **return = TRUE** The sqlcode is always SQLE_WARNING, and the string requires quotes.
- **return = FALSE** If sqlcode is something other than SQLE_WARNING, the test is inconclusive.

sqlda_storage function

Prototype

unsigned int **sqlda_storage(** struct sqlda * *sqlda***,** int *varno* **);**

Description

Returns an unsigned 32-bit integer value representing the amount of storage required to store any value for the variable described in sqlda->sqlvar[varno].

sqlda_string_length function

Prototype

unsigned int **sqlda_string_length(** struct sqlda * *sqlda***,** int *varno* **);**

Description

Returns an unsigned 32-bit integer value representing the length of the C string (type DT_STRING) that would be required to hold the variable sqlda->sqlvar[varno] (no matter what its type is).

sqlerror_message function

Prototype

char * **sqlerror_message(** SQLCA * *sqlca***,** char * *buffer***,** int *max* **);**

Description

Return a pointer to a string that contains an error message. The error message contains text for the error code in the SQLCA. If no error was indicated, a null pointer is returned. The error message is placed in the buffer supplied, truncated to length *max* if necessary.

Embedded SQL statement summary

EXEC SQL
ALL embedded SQL statements must be preceded with EXEC SQL and end with a semicolon (;).

There are two groups of embedded SQL statements. Standard SQL statements are used by simply placing them in a C program enclosed with EXEC SQL and a semicolon (;). CONNECT, DELETE, SELECT, SET, and UPDATE have additional formats only available in embedded SQL. The additional formats fall into the second category of embedded SQL specific statements.

For descriptions of the standard SQL statements, see "SQL statements" [*SQL Anywhere Server - SQL Reference*].

Several SQL statements are specific to embedded SQL and can only be used in a C program. See "SQL language elements" [*SQL Anywhere Server - SQL Reference*].

Standard data manipulation and data definition statements can be used from embedded SQL applications. In addition the following statements are specifically for embedded SQL programming:

- **ALLOCATE DESCRIPTOR** allocate memory for a descriptor. See "ALLOCATE DESCRIPTOR statement [ESQL]" [*SQL Anywhere Server - SQL Reference*].
- **CLOSE** close a cursor. See "CLOSE statement [ESQL] [SP]" [*SQL Anywhere Server - SQL Reference*].
- **CONNECT** connect to the database. See "CONNECT statement [ESQL] [Interactive SQL]" [*SQL Anywhere Server - SQL Reference*].
- **DEALLOCATE DESCRIPTOR** reclaim memory for a descriptor. See "DEALLOCATE DESCRIPTOR statement [ESQL]" [*SQL Anywhere Server - SQL Reference*].
- **Declaration section** declare host variables for database communication. See "Declaration section [ESQL]" [*SQL Anywhere Server - SQL Reference*].
- **DECLARE CURSOR** declare a cursor. See "DECLARE CURSOR statement [ESQL] [SP]" [*SQL Anywhere Server - SQL Reference*].
- **DELETE (positioned)** delete the row at the current position in a cursor. See "DELETE (positioned) statement [ESQL] [SP]" [*SQL Anywhere Server - SQL Reference*].
- **DESCRIBE** describe the host variables for a particular SQL statement. See "DESCRIBE statement [ESQL]" [*SQL Anywhere Server - SQL Reference*].
- **DISCONNECT** disconnect from database server. See "DISCONNECT statement [ESQL] [Interactive SQL]" [*SQL Anywhere Server - SQL Reference*].
- **DROP STATEMENT** free resources used by a prepared statement. See "DROP STATEMENT statement [ESQL]" [*SQL Anywhere Server - SQL Reference*].

- **EXECUTE** execute a particular SQL statement. See "EXECUTE statement [ESQL]" [*SQL Anywhere Server - SQL Reference*].
- **EXPLAIN** explain the optimization strategy for a particular cursor. See "EXPLAIN statement [ESQL]" [*SQL Anywhere Server - SQL Reference*].
- **FETCH** fetch a row from a cursor. See "FETCH statement [ESQL] [SP]" [*SQL Anywhere Server - SQL Reference*].
- **GET DATA** fetch long values from a cursor. See "GET DATA statement [ESQL]" [*SQL Anywhere Server - SQL Reference*].
- **GET DESCRIPTOR** retrieve information about a variable in a SQLDA. See "GET DESCRIPTOR statement [ESQL]" [*SQL Anywhere Server - SQL Reference*].
- **GET OPTION** get the setting for a particular database option. See "GET OPTION statement [ESQL]" [*SQL Anywhere Server - SQL Reference*].
- **INCLUDE** include a file for SQL preprocessing. See "INCLUDE statement [ESQL]" [*SQL Anywhere Server - SQL Reference*].
- **OPEN** open a cursor. See "OPEN statement [ESQL] [SP]" [*SQL Anywhere Server - SQL Reference*].
- **PREPARE** prepare a particular SQL statement. See "PREPARE statement [ESQL]" [*SQL Anywhere Server - SQL Reference*].
- **PUT** insert a row into a cursor. See "PUT statement [ESQL]" [*SQL Anywhere Server - SQL Reference*].
- **SET CONNECTION** change active connection. See "SET CONNECTION statement [Interactive SQL] [ESQL]" [*SQL Anywhere Server - SQL Reference*].
- **SET DESCRIPTOR** describe the variables in a SQLDA and place data into the SQLDA. See "SET DESCRIPTOR statement [ESQL]" [*SQL Anywhere Server - SQL Reference*].
- **SET SQLCA** use a SQLCA other than the default global one. See "SET SQLCA statement [ESQL]" [*SQL Anywhere Server - SQL Reference*].
- **UPDATE (positioned)** update the row at the current location of a cursor. See "UPDATE (positioned) statement [ESQL] [SP]" [*SQL Anywhere Server - SQL Reference*].
- **WHENEVER** specify actions to occur on errors in SQL statements. See "WHENEVER statement [ESQL]" [*SQL Anywhere Server - SQL Reference*].

SQL Anywhere database API for C/C++

The SQL Anywhere C application programming interface (API) is a data access API for the C / C++ languages. The C API specification defines a set of functions, variables and conventions that provide a consistent database interface independent of the actual database being used. Using the SQL Anywhere C API, your C / C++ applications have direct access to SQL Anywhere database servers.

SQL Anywhere C API support

The SQL Anywhere C application programming interface (API) is a data access API for the C / C++ languages. The C API specification defines a set of functions, variables and conventions that provide a consistent database interface independent of the actual database being used. Using the SQL Anywhere C API, your C / C++ applications have direct access to SQL Anywhere database servers.

The SQL Anywhere C API simplifies the creation of C and C++ wrapper drivers for several interpreted programming languages including PHP, Perl, Python, and Ruby. The SQL Anywhere C API is layered on top of the DBLIB package and it was implemented with Embedded SQL.

Although it is not a replacement for DBLIB, the SQL Anywhere C API simplifies the creation of applications using C and C++. You do not need an advanced knowledge of embedded SQL to use the SQL Anywhere C API. For more information about implementation, see *sqlany_imp.sqc*.

API distribution

The API is built as a dynamic link library (DLL) (*dbcapi.dll*) on Microsoft Windows systems and as a shared object (*libdbcapi.so*) on Unix systems. The DLL is statically linked to the DBLIB package of the SQL Anywhere version on which it is built. When the *dbcapi.dll* file is loaded, the corresponding *dblibX.dll* file is loaded by the operating system. Applications using *dbcapi.dll* can either link directly to it or load it dynamically.

Descriptions of the SQL Anywhere C API data types and entry points are provided in the main header file (*sacapi.h*).

Threading support

The SQL Anywhere C API library is thread-unaware; the library does not perform any tasks that require mutual exclusion. To allow the library to work in threaded applications, only one request is allowed on a single connection. With this rule, the application is responsible for doing mutual exclusion when accessing any connection-specific resource. This includes connection handles, prepared statements, and result set objects.

Loading the interface library dynamically

The code to dynamically load the DLL is contained in the header file *sacapidll.h*. Applications must include the *sacapidll.h* header file and compile in *sacapidll.c*. You can use sqlany_initialize_interface to dynamically load the DLL and look up the entry points.

SQL Anywhere C API examples

connecting.cpp

This is an example of how to create a connection object and connect with it to SQL Anywhere.

```
// *************************************************************************
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// of any kind.
//
// You may use, reproduce, modify and distribute this sample code
// without limitation, on the condition that you retain the foregoing
// copyright notice and disclaimer as to the original iAnywhere code.
//
// *************************************************************************
#include <stdlib.h>
#include <stdio.h>
#include <string.h>
#include "sacapidll.h"

int main( int argc, char * argv[] )
{
    SQLAnywhereInterface  api;
    a_sqlany_connection   *conn;
    unsigned int          max_api_ver;

    if( !sqlany_initialize_interface( &api, NULL ) ) {
        printf( "Could not initialize the interface!\n" );
        exit( 0 );
    }

    if( !api.sqlany_init( "MyApp", SQLANY_CURRENT_API_VERSION,
&max_api_ver )) {
        printf( "Failed to initialize the interface! Supported version = %d
\n", max_api_ver );
        sqlany_finalize_interface( &api );
        return -1;
    }

    /* A connection object needs to be created first */
    conn = api.sqlany_new_connection();

    if( !api.sqlany_connect( conn, "uid=dba;pwd=sql" ) ) {
        /* failed to connect */
        char buffer[SACAPI_ERROR_SIZE];
        int  rc;
        rc = api.sqlany_error( conn, buffer, sizeof(buffer) );
        printf( "Failed to connect: error code=%d error message=%s\n",
            rc, buffer );
    } else {
        printf( "Connected successfully!\n" );
        api.sqlany_disconnect( conn );
    }

    /* Must free the connection object or there will be a memory leak */
    api.sqlany_free_connection( conn );

    api.sqlany_fini();
```



```
    sqlany_finalize_interface( &api );

    return 0;
}
```

dbcapi_isql.cpp

This example shows how to write an ISQL application using dbcapi.

```
// *************************************************************************
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// of any kind.
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// without limitation, on the condition that you retain the foregoing
// copyright notice and disclaimer as to the original iAnywhere code.
//
// *************************************************************************
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <ctype.h>
#include <assert.h>

#include "sacapidll.h"

#define max( x, y) ( x >= y ? x : y )

SQLAnywhereInterface api;
a_sqlany_connection *conn;


void print_blob( char * buffer, size_t length )
/*********************************************/
{
    size_t I;

    if( length == 0 ) {
        return;
    }
    printf( "0x" );
    I = 0;
    while( I < length ) {
        printf( "%.2X", (unsigned char)buffer[i] );
        I++;
    }
}


void execute( char * query )
/**************************/
{
    a_sqlany_stmt * stmt;
    int             err_code;
    char            err_mesg[SACAPI_ERROR_SIZE];
    int             I;
    int             num_rows;
    int             length;
```

```
    stmt = api.sqlany_execute_direct( conn, query );
    if( stmt == NULL ) {
        err_code = api.sqlany_error( conn, err_mesg, sizeof(err_mesg) );
        printf( "Failed: [%d] '%s'\n", err_code, err_mesg );
        return;
    }
    if( api.sqlany_error( conn, NULL, 0 ) > 0 ) {
        err_code = api.sqlany_error( conn, err_mesg, sizeof(err_mesg) );
        printf( "Warning: [%d] '%s'\n", err_code, err_mesg );
    }
    if( api.sqlany_num_cols( stmt ) == 0 ) {
        printf( "Executed successfully.\n" );
        if( api.sqlany_affected_rows( stmt ) > 0 ) {
            printf( "%d affected rows.\n",
api.sqlany_affected_rows( stmt ) );
        }
        api.sqlany_free_stmt( stmt );
        return;
    }

    // first output column header
    length = 0;
    for( I = 0; I < api.sqlany_num_cols( stmt ); I++ ) {
        a_sqlany_column_info    column_info;

        if( I > 0 ) {
            printf( "," );
            length += 1;
        }
        api.sqlany_get_column_info( stmt, I, &column_info );
        printf( "%s", column_info.name );
        length += (int)strlen( column_info.name );
    }
    printf( "\n" );
    for( I = 0; I < length; I++ ) {
        printf( "-" );
    }
    printf( "\n" );
    num_rows = 0;
    while( api.sqlany_fetch_next( stmt ) ) {
        num_rows++;
        for( I = 0; I < api.sqlany_num_cols( stmt ); I++ ) {
            a_sqlany_data_value dvalue;

            api.sqlany_get_column( stmt, I, &dvalue );
            if( I > 0 ) {
                printf( "," );
            }
            if( *(dvalue.is_null) ) {
                printf( "(NULL)" );
                continue;
            }
            switch( dvalue.type ) {
                case A_BINARY:
                    print_blob( dvalue.buffer, *(dvalue.length) );
                    break;
                case A_STRING:
                  printf( "'%.*s'", *(dvalue.length), (char *)dvalue.buffer,
*(dvalue.length) );
                    break;
                case A_VAL64:
                    printf( "%lld", *(long long*)dvalue.buffer);
                    break;
                case A_UVAL64:
```



```
                    printf( "%lld", *(unsigned long long*)dvalue.buffer);
                    break;
                case A_VAL32:
                    printf( "%d", *(int*)dvalue.buffer );
                    break;
                case A_UVAL32:
                    printf( "%u", *(unsigned int*)dvalue.buffer );
                    break;
                case A_VAL16:
                    printf( "%d", *(short*)dvalue.buffer );
                    break;
                case A_UVAL16:
                    printf( "%u", *(unsigned short*)dvalue.buffer );
                    break;
                case A_VAL8:
                    printf( "%d", *(char*)dvalue.buffer );
                    break;
                case A_UVAL8:
                    printf( "%d", *(char*)dvalue.buffer );
                    break;
                case A_DOUBLE:
                    printf( "%f", *(double*)dvalue.buffer );
                    break;
            }
        }
        printf( "\n" );
    }
    for( I = 0; I < length; I++ ) {
        printf( "-" );
    }
    printf( "\n" );

    printf( "%d rows returned\n", num_rows );
    if( api.sqlany_error( conn, NULL, 0 ) != 100 ) {
        char buffer[256];
        int  code = api.sqlany_error( conn, buffer, sizeof(buffer) );
        printf( "Failed: [%d] '%s'\n", code, buffer );
    }
    printf( "\n" );

    fflush( stdout );
    api.sqlany_free_stmt( stmt );
}


int main( int argc, char * argv[] )
/*********************************/
{
    unsigned int  max_api_ver;
    char          buffer[256];
    int           len;
    int           ch;

    if( argc < 1 ) {
        printf( "Usage: %s -c <connection_string>\n", argv[0] );
        exit( 0 );
    }
    if( !sqlany_initialize_interface( &api, NULL ) ) {
        printf( "Failed to initialize the interface!\n" );
        exit( 0 );
    }
   if( !api.sqlany_init( "isql", SQLANY_CURRENT_API_VERSION, &max_api_ver ))
{
        printf( "Failed to initialize the interface! Supported version = %d
```

```
\n", max_api_ver );
        sqlany_finalize_interface( &api );
        return -1;
    }
    conn = api.sqlany_new_connection();

    if( !api.sqlany_connect( conn, argv[1] ) ) {
        int code = api.sqlany_error( conn, buffer, sizeof(buffer) );
        printf( "Could not connect: [%d] %s\n", code, buffer );
        goto done;
    }

    printf( "Connected successfully!\n" );
    while( 1 ) {
        printf( "\n%s> ", argv[0] );
        fflush( stdout );

        len = 0;
        while( len < (sizeof(buffer) - 1) ) {
            ch = fgetc( stdin );
            if( ch == '\0' || ch == '\n' || ch == '\r' || ch == -1 ) {
                break;
            }
            buffer[len] = (char)tolower( ch );
            len++;
        }
        buffer[len] = '\0';
        if(buffer[0] == '\0' ) {
            break;
        }
        if( strcmp( buffer, "quit" ) == 0 ) {
            break;
        }
        execute( buffer );
    }

    api.sqlany_disconnect( conn );

done:
    api.sqlany_free_connection( conn );
    api.sqlany_fini();
    sqlany_finalize_interface( &api );
}
```

fetching_a_result_set.cpp

This example shows how to fetch data from a result set.

```
// *****************************************************************
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// of any kind.
//
// You may use, reproduce, modify and distribute this sample code
// without limitation, on the condition that you retain the foregoing
// copyright notice and disclaimer as to the original iAnywhere code.
//
// *****************************************************************
#include <stdlib.h>
#include <stdio.h>
#include <string.h>
```

```
#include "sacapidll.h"

int main( )
{
    SQLAnywhereInterface  api;
    a_sqlany_connection * conn;
    a_sqlany_stmt       * stmt;
    unsigned int          max_api_ver;

    if( !sqlany_initialize_interface( &api, NULL ) ) {
        printf( "Could not initialize the interface!\n" );
        exit( 0 );
    }

    if( !api.sqlany_init( "MyApp", SQLANY_CURRENT_API_VERSION,
&max_api_ver ) ) {
        printf( "Failed to initialize the interface! Supported version=%d\n",
max_api_ver );
        sqlany_finalize_interface( &api );
        return -1;
    }

    /* A connection object needs to be created first */
    conn = api.sqlany_new_connection();

    if( !api.sqlany_connect( conn, "uid=dba;pwd=sql" ) ) {
        api.sqlany_free_connection( conn );
        api.sqlany_fini();
        sqlany_finalize_interface( &api );
        exit( -1 );
    }

    printf( "Connected successfully!\n" );


    if( (stmt = api.sqlany_execute_direct( conn, "select * from systable" )) !
= NULL ) {
        int                     num_rows = 0;
        a_sqlany_data_value     value;

        while( api.sqlany_fetch_next( stmt ) ) {

            num_rows++;
            printf( "\nRow [%d] data .......\n", num_rows );
            for( int I = 0; I < api.sqlany_num_cols( stmt ); I++ ) {
                int rc = api.sqlany_get_column( stmt, I, &value );

                if( rc < 0 ) {
                    printf( "Truncation of column %d\n", I );
                }
                if( *(value.is_null) ) {
                    printf( "Received a NULL value\n" );
                    continue;
                }

                switch( value.type ) {
                    case A_BINARY:
                        printf( "Binary value of length %d.\n",
*(value.length) );
                        break;
                    case A_STRING:
                        printf( "String value [%.*s] of length %d.\n",
                                *(value.length), (char *)value.buffer,
*(value.length) );
```

```
                        break;
                    case A_VAL64:
                        printf( "A_VAL64 value [%lld].\n", *(long long
*)value.buffer );
                        break;
                    case A_UVAL64:
                        printf( "A_UVAL64 value [%lld].\n", *(unsigned long
long *)value.buffer );
                        break;
                    case A_VAL32:
                        printf( "A_VAL32 value [%d].\n",
*(int*)value.buffer );
                        break;
                    case A_UVAL32:
                        printf( "A_UVAL32 value [%d].\n", *(unsigned
int*)value.buffer );
                        break;
                    case A_VAL16:
                        printf( "A_VAL16 value [%d].\n",
*(short*)value.buffer );
                        break;
                    case A_UVAL16:
                        printf( "A_UVAL16 value [%d].\n", *(unsigned
short*)value.buffer );
                        break;
                    case A_VAL8:
                        printf( "A_VAL8 value [%d].\n", *(char
*)value.buffer );
                        break;
                    case A_UVAL8:
                        printf( "A_UVAL8 value [%d].\n", *(unsigned char
*)value.buffer );
                        break;
                }
                /* do some processing with the data ... */
            }
        }

        /* Must free the result set object when done with it */
        api.sqlany_free_stmt( stmt );
    }
    api.sqlany_disconnect( conn );

    /* Must free the connection object or there will be a memory leak */
    api.sqlany_free_connection( conn );

    api.sqlany_fini();

    sqlany_finalize_interface( &api );

    return 0;
}
```

fetching_multiple_from_sp.cpp

This example shows how to fetch multiple result sets from a stored procedure.

```
// *************************************************************
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// This sample code is provided AS IS, without warranty or liability
// of any kind.
```

```
//
// You may use, reproduce, modify and distribute this sample code
// without limitation, on the condition that you retain the foregoing
// copyright notice and disclaimer as to the original iAnywhere code.
//
// *********************************************************************
#include <stdlib.h>
#include <stdio.h>
#include <string.h>
#include "sacapidll.h"

int main( )
{
    SQLAnywhereInterface  api;
    a_sqlany_connection * conn;
    a_sqlany_stmt       * stmt;
    unsigned int          max_api_ver;

    if( !sqlany_initialize_interface( &api, NULL ) ) {
        printf( "Could not initialize the interface!\n" );
        exit( 0 );
    }

    if( !api.sqlany_init( "MyApp", SQLANY_CURRENT_API_VERSION,
&max_api_ver )) {
        printf( "Failed to initialize the interface! Supported version=%d\n",
max_api_ver );
        sqlany_finalize_interface( &api );
        return -1;
    }

    /* A connection object needs to be created first */
    conn = api.sqlany_new_connection();

    if( !api.sqlany_connect( conn, "uid=dba;pwd=sql" ) ) {
        api.sqlany_free_connection( conn );
        api.sqlany_fini();
        sqlany_finalize_interface( &api );
        exit( -1 );
    }

    printf( "Connected successfully!\n" );

    api.sqlany_execute_immediate( conn, "drop procedure myproc" );
    api.sqlany_execute_immediate( conn,
            "create procedure myproc( ) \n"
            "begin              \n"
            "    select 1, 2;   \n"
            "    select 3, 4, 5;\n"
            "end                \n" );


   if( (stmt = api.sqlany_execute_direct( conn, "call myproc()" )) != NULL )
{
        do {
            /* fetch one row at a time */
            while( api.sqlany_fetch_next( stmt ) ) {

               /* sqlany_num_cols() will be updated every time the result set
shape changes */
                for( int I = 0; I < api.sqlany_num_cols( stmt ); I++ ) {
                    /* process data here ... */
                }
            }
```

```
            /* Check to see if there are other result sets */
        } while( api.sqlany_get_next_result( stmt ) );

        /* Must free the result set object when done with it */
        api.sqlany_free_stmt( stmt );
    }
    api.sqlany_disconnect( conn );

    /* Must free the connection object or there will be a memory leak */
    api.sqlany_free_connection( conn );

    api.sqlany_fini();

    sqlany_finalize_interface( &api );

    return 0;
}
```

preparing_statements.cpp

This example shows how to prepare and execute a statement.

```
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// copyright notice and disclaimer as to the original iAnywhere code.
//
// *************************************************************************
#include <stdlib.h>
#include <stdio.h>
#include <string.h>
#include "sacapidll.h"
#include <assert.h>

int main( )
{
    SQLAnywhereInterface  api;
    a_sqlany_connection * conn;
    a_sqlany_stmt       * stmt;
    unsigned int          max_api_ver;

    if( !sqlany_initialize_interface( &api, NULL ) ) {
        printf( "Could not initialize the interface!\n" );
        exit( 0 );
    }

    if( !api.sqlany_init( "MyApp", SQLANY_CURRENT_API_VERSION,
&max_api_ver )) {
        printf( "Failed to initialize the interface! Supported version=%d\n",
max_api_ver );
        sqlany_finalize_interface( &api );
        return -1;
    }

    /* A connection object needs to be created first */
    conn = api.sqlany_new_connection();
```

```
    if( !api.sqlany_connect( conn, "pktdump=c:\\temp\
\pktdump;uid=dba;pwd=sql" ) ) {
        api.sqlany_free_connection( conn );
        api.sqlany_fini();
        sqlany_finalize_interface( &api );
        exit( -1 );
    }

    printf( "Connected successfully!\n" );

    api.sqlany_execute_immediate( conn, "drop procedure myproc" );
    api.sqlany_execute_immediate( conn,
            "create procedure myproc ( IN prefix char(10),       \n"
            "                          INOUT buffer varchar(256),\n"
            "                          OUT str_len int,          \n"
            "                          IN suffix char(10) ) \n"
            "begin                                               \n"
            "    set buffer = prefix || buffer || suffix;\n"
            "    select length( buffer ) into str_len;   \n"
            "end                                                 \n" );
    stmt = api.sqlany_prepare( conn, "call myproc( ?, ?, ?, ? )" );

    if( stmt ) {

        a_sqlany_bind_param     param;
        char                    buffer[256] = "-some_string-";
        int                     str_len;
        size_t                  buffer_size = strlen(buffer);
        size_t                  prefix_length = 6;
        size_t                  suffix_length = 6;

        assert( api.sqlany_describe_bind_param( stmt, 0, &param ) );
        param.value.buffer = "PREFIX";
        param.value.length = &prefix_length;
        assert( api.sqlany_bind_param( stmt, 0, &param ) );

        assert( api.sqlany_describe_bind_param( stmt, 1, &param ) );
        param.value.buffer = buffer;
        param.value.length = &buffer_size;
        //params[1].value.type      = A_STRING;           // already set by
sqlany_describe_bind_param()
        //params[1].direction       = INPUT_OUTPUT;       // already set by
sqlany_describe_bind_param()
        param.value.buffer_size = sizeof(buffer);         // IMPORTANT: this
field must be set for
                                                          // OUTPUT and
INPUT_OUTPUT parameters so that
                                                         // the library knows
how much data can be written
                                                          // into the buffer
        assert( api.sqlany_bind_param( stmt, 1, &param ) );

        assert( api.sqlany_describe_bind_param( stmt, 2, &param ) );
        param.value.buffer      = (char *)&str_len;
        param.value.is_null     = NULL;                   // use NULL if not
interested in nullability
        //param.value.type          = A_VAL32;            // already set by
sqlany_describe_bind_param()
        //param.direction           = OUTPUT_ONLY;        // already set by
sqlany_describe_bind_param()
        //param.value.buffer_size = sizeof(str_len);      // for non string
or binary buffers, buffer_size is not needed
        assert( api.sqlany_bind_param( stmt, 2, &param ) );
```

```
        assert( api.sqlany_describe_bind_param( stmt, 3, &param ) );
        param.value.buffer      = "SUFFIX";
        param.value.length      = &suffix_length;
        //params.value.type     = A_STRING;              // already set by
sqlany_describe_bind_param()
        assert( api.sqlany_bind_param( stmt, 3, &param ) );

        /* A result set is not expected so the result set parameter could be
NULL */
        if( api.sqlany_execute( stmt ) ) {
            printf( "Complete string is %s and is %d chars long \n", buffer,
str_len );
            assert( str_len == (6+13+6) );

            buffer_size = str_len;
            api.sqlany_execute( stmt );
            printf( "Complete string is %s and is %d chars long \n", buffer,
str_len );
            assert( str_len == 6+(6+13+6)+6 );
        } else {
            char buffer[SACAPI_ERROR_SIZE];
            int  rc;
            rc = api.sqlany_error( conn, buffer, sizeof(buffer));
            printf( "Failed to execute! [%d] %s\n", rc, buffer );
        }

        /* Free the statement object or there will be a memory leak */
        api.sqlany_free_stmt( stmt );
    }

    api.sqlany_disconnect( conn );

    /* Must free the connection object or there will be a memory leak */
    api.sqlany_free_connection( conn );

    api.sqlany_fini();

    sqlany_finalize_interface( &api );

    return 0;
}
```

send_retrieve_full_blob.cpp

This example shows how to insert and retrieve a blob in one chunk.

```
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//
// *************************************************************
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <assert.h>
#include "sacapidll.h"
```

```
int main( )
{
    SQLAnywhereInterface api;
    a_sqlany_connection *conn;
    a_sqlany_stmt       *stmt;
    unsigned int         I;
    unsigned char       *data;
    size_t               size = 1024*1024; // 1MB blob
    int                  code;
    a_sqlany_data_value  value;
    int                  num_cols;
    unsigned int         max_api_ver;
    a_sqlany_bind_param  param;

    if( !sqlany_initialize_interface( &api, NULL ) ) {
        printf( "Could not initialize the interface!\n" );
        exit( 0 );
    }

    assert( api.sqlany_init( "my_php_app", SQLANY_CURRENT_API_VERSION,
&max_api_ver ) );
    conn = api.sqlany_new_connection();

    if( !api.sqlany_connect( conn, "uid=dba;pwd=sql" ) ) {
        char buffer[SACAPI_ERROR_SIZE];
        code = api.sqlany_error( conn, buffer, sizeof(buffer) );
        printf( "Could not connection[%d]:%s\n", code, buffer );
        goto clean;
    }

    printf( "Connected successfully!\n" );

    api.sqlany_execute_immediate( conn, "drop table my_blob_table" );
    assert( api.sqlany_execute_immediate( conn, "create table my_blob_table
(size integer, data long binary)" ) != 0);

    stmt = api.sqlany_prepare( conn, "insert into my_blob_table( size, data )
values( ?, ?)" );
    assert( stmt != NULL );

    data = (unsigned char *)malloc( size );
    // initialize the buffer
    for( I = 0; I < size; I++ ) {
        data[i] = I % 256;
    }


    // initialize the parameters
    api.sqlany_describe_bind_param( stmt, 0, &param );
    param.value.buffer = (char *)&size;
    param.value.type   = A_VAL32;              // This needs to be set as the
server does not
    // know what data will be inserting.
    api.sqlany_bind_param( stmt, 0, &param );

    api.sqlany_describe_bind_param( stmt, 1, &param );
    param.value.buffer = (char *)data;
    param.value.length = &size;
    param.value.type   = A_BINARY;              // This needs to be set for
the same reason as above.
    api.sqlany_bind_param( stmt, 1, &param );

    assert( api.sqlany_execute( stmt ) );
```

```
    api.sqlany_free_stmt( stmt );

    api.sqlany_commit( conn );

    stmt = api.sqlany_execute_direct( conn, "select * from my_blob_table" );
    assert( stmt != NULL );

    assert( api.sqlany_fetch_next( stmt ) == 1 );

    num_cols = api.sqlany_num_cols( stmt );

    assert( num_cols == 2 );

    api.sqlany_get_column( stmt, 0, &value );

    assert( *((int*)value.buffer) == size );
    assert( value.type == A_VAL32 );

    api.sqlany_get_column( stmt, 1, &value );

    assert( value.type == A_BINARY );
    assert( *(value.length) == size );

    for( I = 0; I < (*value.length); I++ ) {
        assert( (unsigned char)(value.buffer[i]) == data[i]);
    }

    assert( api.sqlany_fetch_next( stmt ) == 0 );
    api.sqlany_free_stmt( stmt );

    api.sqlany_disconnect( conn );

clean:
    api.sqlany_free_connection( conn );

    api.sqlany_fini();

    sqlany_finalize_interface( &api );
    printf( "Success!\n" );
}
```

send_retrieve_part_blob.cpp

This example shows how to insert a blob in chunks and retrieve it in chunks too.

```
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//
// *************************************************************
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <assert.h>
#include "sacapidll.h"
```

```
int main( )
{
    SQLAnywhereInterface api;
    a_sqlany_connection *conn;
    a_sqlany_stmt       *stmt;
    unsigned int         I;
    unsigned char       *data;
    unsigned int         size = 1024*1024; // 1MB blob
    int                  code;
    a_sqlany_data_value  value;
    int                  num_cols;
    unsigned char        retrieve_buffer[4096];
    a_sqlany_data_info   dinfo;
    int                  bytes_read;
    size_t               total_bytes_read;
    unsigned int         max_api_ver;

    if( !sqlany_initialize_interface( &api, NULL ) ) {
        printf( "Could not initialize the interface!\n" );
        exit( 0 );
    }

    assert( api.sqlany_init( "my_php_app", SQLANY_CURRENT_API_VERSION,
&max_api_ver ) );
    conn = api.sqlany_new_connection();

    if( !api.sqlany_connect( conn, "uid=dba;pwd=sql" ) ) {
        char buffer[SACAPI_ERROR_SIZE];
        code = api.sqlany_error( conn, buffer, sizeof(buffer) );
        printf( "Could not connection[%d]:%s\n", code, buffer );
        goto clean;
    }

    printf( "Connected successfully!\n" );

    api.sqlany_execute_immediate( conn, "drop table my_blob_table" );
    assert( api.sqlany_execute_immediate( conn, "create table my_blob_table
(size integer, data long binary)" ) != 0);

    // 1. Starting to insert blob operation
    stmt = api.sqlany_prepare( conn, "insert into my_blob_table( size, data)
values( ?, ? )" );
    assert( stmt != NULL );


    // 1.1 You must first bind the parameters
    a_sqlany_bind_param param;

    api.sqlany_describe_bind_param( stmt, 0, &param );
    param.value.buffer = (char *)&size;
    param.value.type   = A_VAL32;
    param.value.is_null= NULL;
    param.direction    = DD_INPUT;
    api.sqlany_bind_param( stmt, 0, &param );

    api.sqlany_describe_bind_param( stmt, 1, &param );
    param.value.buffer = NULL;
    param.value.type   = A_BINARY;
    param.value.is_null= NULL;
    param.direction    = DD_INPUT;
    api.sqlany_bind_param( stmt, 1, &param );

    data = (unsigned char *)malloc( size );
```

```
        for( I = 0; I < size; I++ ) {
            data[i] = I % 256;
        }

        // 1.2 upload the blob data to the server in chunks
        for( I = 0; I < size; I += 4096 ) {
            if( !api.sqlany_send_param_data( stmt, 1, (char *)&data[i], 4096 )) {
                char buffer[SACAPI_ERROR_SIZE];
                code = api.sqlany_error( conn, buffer, sizeof(buffer) );
                printf( "Could not send param[%d]:%s\n", code, buffer );
            }
        }

        // 1.3 actually do the row insert operation
        assert( api.sqlany_execute( stmt ) == 1 );

        api.sqlany_commit( conn );

        api.sqlany_free_stmt( stmt );


        // 2. Now let's retrieve the blob
        stmt = api.sqlany_execute_direct( conn, "select * from my_blob_table" );
        assert( stmt != NULL );

        assert( api.sqlany_fetch_next( stmt ) == 1 );

        num_cols = api.sqlany_num_cols( stmt );

        assert( num_cols == 2 );

        api.sqlany_get_column( stmt, 0, &value );

        assert( I == size );
        assert( value.type == A_VAL32 );

        api.sqlany_get_data_info( stmt, 1, &dinfo );

        assert( dinfo.type == A_BINARY );
        assert( dinfo.data_size == size );
        assert( dinfo.is_null == 0 );

        // 2.1 Retrieve data in 4096 byte chunks
        total_bytes_read = 0;
        while( 1 ) {
            bytes_read = api.sqlany_get_data( stmt, 1, total_bytes_read,
    retrieve_buffer, sizeof(retrieve_buffer) );
            if( bytes_read <= 0 ) {
                break;
            }
            // verify the buffer contents
            for( I = 0; I < (unsigned int)bytes_read; I++ ) {
                assert( retrieve_buffer[i] == data[total_bytes_read+I] );
            }
            total_bytes_read += bytes_read;
        }
        assert( total_bytes_read == size );

        free(data );

        assert( api.sqlany_fetch_next( stmt ) == 0 );

        api.sqlany_free_stmt( stmt );
```



```
    api.sqlany_disconnect( conn );

clean:
    api.sqlany_free_connection( conn );

    api.sqlany_fini();

    sqlany_finalize_interface( &api );

    printf( "Success!\n" );
}
```

SQL Anywhere C API reference

Header files

- `sacapi.h`
- `sacapidll.h`

Remarks

The *sacapi.h* header file defines the SQL Anywhere C API entry points.

The *sacapidll.h* header file defines the C API library initialization and finalization functions. You must include *sacapidll.h* in your source files and include the source code from *sacapidll.c*.

sqlany_affected_rows method

Returns the number of rows affected by execution of the prepared statement.

Syntax

```
public sacapi_i32 sqlany_affected_rows(a_sqlany_stmt * sqlany_stmt)
```

Parameters

- **sqlany_stmt** A statement that was prepared and executed successfully with no result set returned. For example, an INSERT, UPDATE or DELETE statement was executed.

Returns

The number of rows affected or -1 on failure.

See also

- “sqlany_execute method” on page 537
- “sqlany_execute_direct method” on page 538

sqlany_bind_param method

Bind a user-supplied buffer as a parameter to the prepared statement.

Syntax

```
public sacapi_bool sqlany_bind_param(
    a_sqlany_stmt * sqlany_stmt,
    sacapi_u32 index,
    a_sqlany_bind_param * param
)
```

Parameters

- **sqlany_stmt** A statement prepared successfully using sqlany_prepare().
- **index** The index of the parameter. This number must be between 0 and sqlany_num_params() - 1.
- **param** A a_sqlany_bind_param structure description of the parameter to be bound.

Returns

1 on success or 0 on unsuccessful.

See also

- "sqlany_describe_bind_param method" on page 535

sqlany_cancel method

Cancel an outstanding request on a connection This function can be used to cancel an outstanding request on a specific connection.

Syntax

```
public void sqlany_cancel(a_sqlany_connection * sqlany_conn)
```

Parameters

- **sqlany_conn** A connection object with a connection established using sqlany_connect().

sqlany_clear_error method

Clears the last stored error code.

Syntax

```
public void sqlany_clear_error(a_sqlany_connection * sqlany_conn)
```

Parameters

- **sqlany_conn** A connection object returned from sqlany_new_connection().

See also

- "sqlany_new_connection method" on page 550

sqlany_client_version method

Returns the current client version.

Syntax

```
public sacapi_bool sqlany_client_version(char * buffer, size_t len)
```

Parameters

- **buffer** The buffer to be filled with the client version string.
- **len** The length of the buffer supplied.

Returns

1 when successful or 0 when unsuccessful.

Remarks

This method fills the buffer passed with the major, minor, patch, and build number of the client library. The buffer will be null-terminated.

sqlany_client_version_ex method

Returns the current client version.

Syntax

```
public sacapi_bool sqlany_client_version_ex(
    a_sqlany_interface_context * context,
    char * buffer,
    size_t len
)
```

Parameters

- **context** object that was create with sqlany_init_ex()
- **buffer** The buffer to be filled with the client version string.
- **len** The length of the buffer supplied.

Returns

1 when successful or 0 when unsuccessful.

Remarks

This method fills the buffer passed with the major, minor, patch, and build number of the client library. The buffer will be null-terminated.

See also

- "sqlany_init_ex method" on page 547

sqlany_commit method

Commits the current transaction.

Syntax

```
public sacapi_bool sqlany_commit(a_sqlany_connection * sqlany_conn)
```

Parameters

- **sqlany_conn** The connection object on which the commit operation is performed.

Returns

1 when successful or 0 when unsuccessful.

See also

- "sqlany_rollback method" on page 553

sqlany_connect method

Creates a connection to a SQL Anywhere database server using the supplied connection object and connection string.

Syntax

```
public sacapi_bool sqlany_connect(
    a_sqlany_connection * sqlany_conn,
    const char * str
)
```

Parameters

- **sqlany_conn** A connection object created by sqlany_new_connection().
- **str** A SQL Anywhere connection string.

Returns

1 if the connection is established successfully or 0 when the connection fails. Use sqlany_error() to retrieve the error code and message.

Remarks

The supplied connection object must first be allocated using sqlany_new_connection().

The following example demonstrates how to retrieve the error code of a failed connection attempt:

```
a_sqlany_connection * sqlany_conn;
sqlany_conn = sqlany_new_connection();
if( !sqlany_connect( sqlany_conn, "uid=dba;pwd=sql" ) ) {
    char reason[SACAPI_ERROR_SIZE];
    sacapi_i32 code;
    code = sqlany_error( sqlany_conn, reason, sizeof(reason) );
    printf( "Connection failed. Code: %d Reason: %s\n", code, reason );
} else {
    printf( "Connected successfully!\n" );
    sqlany_disconnect( sqlany_conn );
}
sqlany_free_connection( sqlany_conn );
```

For more information on connecting to a SQL Anywhere database server, see "Connection parameters" [*SQL Anywhere Server - Database Administration*] and "SQL Anywhere database connections" [*SQL Anywhere Server - Database Administration*] .

See also

- "sqlany_new_connection method" on page 550
- "sqlany_error method" on page 536

sqlany_describe_bind_param method

Describes the bind parameters of a prepared statement.

Syntax

```
public sacapi_bool sqlany_describe_bind_param(
    a_sqlany_stmt * sqlany_stmt,
    sacapi_u32 index,
    a_sqlany_bind_param * param
)
```

Parameters

- **sqlany_stmt** A statement prepared successfully using sqlany_prepare().
- **index** The index of the parameter. This number must be between 0 and sqlany_num_params() - 1.
- **param** A a_sqlany_bind_param structure that is populated with information.

Returns

1 when successful or 0 when unsuccessful.

Remarks

This function allows the caller to determine information about prepared statement parameters. The type of prepared statement, stored procedured or a DML, determines the amount of information provided. The direction of the parameters (input, output, or input-output) are always provided.

See also

- "sqlany_bind_param method" on page 531
- "sqlany_prepare method" on page 552

sqlany_disconnect method

Disconnects an already established SQL Anywhere connection.

Syntax

```
public sacapi_bool sqlany_disconnect(a_sqlany_connection * sqlany_conn)
```

Parameters

- **sqlany_conn** A connection object with a connection established using sqlany_connect().

Returns

1 when successful or 0 when unsuccessful.

Remarks

All uncommitted transactions are rolled back.

See also

- "sqlany_connect method" on page 534
- "sqlany_new_connection method" on page 550

sqlany_error method

Retrieves the last error code and message stored in the connection object.

Syntax

```
public sacapi_i32 sqlany_error(
    a_sqlany_connection * sqlany_conn,
    char * buffer,
    size_t size
)
```

Parameters

- **sqlany_conn** A connection object returned from sqlany_new_connection().

- **buffer** A buffer to be filled with the error message.
- **size** The size of the supplied buffer.

Returns

The last error code. Positive values are warnings, negative values are errors, and 0 indicates success.

Remarks

For more information on SQLCODE error messages, see "SQL Anywhere error messages sorted by SQLCODE" [*Error Messages*] .

See also

- "sqlany_connect method" on page 534

sqlany_execute method

Executes a prepared statement.

Syntax

```
public sacapi_bool sqlany_execute(a_sqlany_stmt * sqlany_stmt)
```

Parameters

- **sqlany_stmt** A statement prepared successfully using sqlany_prepare().

Returns

1 if the statement is executed successfully or 0 on failure.

Remarks

You can use sqlany_num_cols() to verify if the executed statement returned a result set.

The following example shows how to execute a statement that does not return a result set:

```
a_sqlany_stmt *      stmt;
int                  i;
a_sqlany_bind_param   param;

stmt = sqlany_prepare( sqlany_conn, "insert into moe(id,value)
values( ?,? )" );
if( stmt ) {
    sqlany_describe_bind_param( stmt, 0, &param );
    param.value.buffer = (char *)&i;
    param.value.type   = A_VAL32;
    sqlany_bind_param( stmt, 0, &param );

    sqlany_describe_bind_param( stmt, 1, &param );
    param.value.buffer = (char *)&i;
    param.value.type   = A_VAL32;
    sqlany_bind_param( stmt, 1, &param );

    for( i = 0; i < 10; i++ ) {
```

```
            if( !sqlany_execute( stmt ) ) {
                    // call sqlany_error()
                }
        }
        sqlany_free_stmt( stmt );
    }
```

See also

- "sqlany_prepare method" on page 552

sqlany_execute_direct method

Executes the SQL statement specified by the string argument and possibly returns a result set.

Syntax

```
public a_sqlany_stmt * sqlany_execute_direct(
    a_sqlany_connection * sqlany_conn,
    const char * sql_str
)
```

Parameters

- **sqlany_conn** A connection object with a connection established using sqlany_connect().
- **sql_str** A SQL string. The SQL string should not have parameters such as ?.

Returns

A statement handle if the function executes successfully, NULL when the function executes unsuccessfully.

Remarks

Use this method if you want to prepare and execute a statement, or instead of calling sqlany_prepare() followed by sqlany_execute().

The following example shows how to execute a statement that returns a result set:

```
stmt = sqlany_execute_direct( sqlany_conn, "select * from employees" ) ) {
if( stmt && sqlany_num_cols( stmt ) > 0 ) {
    while( sqlany_fetch_next( stmt ) ) {
        int i;
           for( i = 0; i < sqlany_num_cols( stmt ); i++ ) {
            // Get column i data
        }
    }
    sqlany_free_stmt( stmt  );
}
```

Note
This function can not be used for executing a SQL statement with parameters.

See also

- "sqlany_fetch_absolute method" on page 539
- "sqlany_fetch_next method" on page 540
- "sqlany_num_cols method" on page 551
- "sqlany_get_column method" on page 543

sqlany_execute_immediate method

Executes the supplied SQL statement immediately without returning a result set.

Syntax

```
public sacapi_bool sqlany_execute_immediate(
    a_sqlany_connection * sqlany_conn,
    const char * sql
)
```

Parameters

- **sqlany_conn** A connection object with a connection established using sqlany_connect().
- **sql** A string representing the SQL statement to be executed.

Returns

1 on success or 0 on failure.

Remarks

This function is useful for SQL statements that do not return a result set.

sqlany_fetch_absolute method

Moves the current row in the result set to the row number specified and then fetches the data at that row.

Syntax

```
public sacapi_bool sqlany_fetch_absolute(
    a_sqlany_stmt * sqlany_stmt,
    sacapi_i32 row_num
)
```

Parameters

- **sqlany_stmt** A statement object that was executed by sqlany_execute() or sqlany_execute_direct().
- **row_num** The row number to be fetched. The first row is 1, the last row is -1.

Returns

1 if the fetch was successfully, 0 when the fetch is unsuccessful.

See also

- “sqlany_execute_direct method” on page 538
- “sqlany_execute method” on page 537
- “sqlany_error method” on page 536
- “sqlany_fetch_next method” on page 540

sqlany_fetch_next method

Returns the next row from the result set.

Syntax

```
public sacapi_bool sqlany_fetch_next(a_sqlany_stmt * sqlany_stmt)
```

Parameters

- **sqlany_stmt** A statement object that was executed by sqlany_execute() or sqlany_execute_direct().

Returns

1 if the fetch was successfully, 0 when the fetch is unsuccessful.

Remarks

This function fetches the next row from the result set. When the result object is first created, the current row pointer is set to before the first row (i.e. row 0). This function first advances the row pointer and then fetches the data at the new row.

See also

- “sqlany_fetch_absolute method” on page 539
- “sqlany_execute_direct method” on page 538
- “sqlany_execute method” on page 537
- “sqlany_error method” on page 536

sqlany_finalize_interface method

Unloads the C API DLL library and resets the SQLAnywhereInterface structure.

Syntax

```
public void sqlany_finalize_interface(SQLAnywhereInterface * api)
```

Parameters

- **api** An initialized structure to finalize.

Remarks

Use the following statement to include the function prototype:


```
#include "sacapidll.h"
```

Use this method to finalize and free resources associated with the SQL Anywhere C API DLL.

To view examples of the sqlany_finalize_interface method in use, see the following topics:

- "connecting.cpp" on page 516
- "dbcapi_isql.cpp" on page 517
- "fetching_a_result_set.cpp" on page 520
- "fetching_multiple_from_sp.cpp" on page 522
- "preparing_statements.cpp" on page 524
- "send_retrieve_full_blob.cpp" on page 526
- "send_retrieve_part_blob.cpp" on page 528

sqlany_fini method

Finalizes the interface.

Syntax

```
public void sqlany_fini()
```

Remarks

Frees any resources allocated by the API.

See also

- "sqlany_init method" on page 546

sqlany_fini_ex method

Finalize the interface that was created using the specified context.

Syntax

```
public void sqlany_fini_ex(a_sqlany_interface_context * context)
```

Parameters

- **context** A context object that was returned from sqlany_init_ex()

See also

- "sqlany_init_ex method" on page 547

sqlany_free_connection method

Frees the resources associated with a connection object.

Syntax

```
public void sqlany_free_connection(a_sqlany_connection * sqlany_conn)
```

Parameters

- **sqlany_conn** A connection object created with sqlany_new_connection().

See also

- "sqlany_new_connection method" on page 550

sqlany_free_stmt method

Frees resources associated with a prepared statement object.

Syntax

```
public void sqlany_free_stmt(a_sqlany_stmt * sqlany_stmt)
```

Parameters

- **sqlany_stmt** A statement object returned by the successful execution of sqlany_prepare() or sqlany_execute_direct().

See also

- "sqlany_prepare method" on page 552
- "sqlany_execute_direct method" on page 538

sqlany_get_bind_param_info method

Retrieves information about the parameters that were bound using sqlany_bind_param().

Syntax

```
public sacapi_bool sqlany_get_bind_param_info(
    a_sqlany_stmt * sqlany_stmt,
    sacapi_u32 index,
    a_sqlany_bind_param_info * info
)
```

Parameters

- **sqlany_stmt** A statement prepared successfully using sqlany_prepare().
- **index** The index of the parameter. This number should be between 0 and sqlany_num_params() - 1.

- **info** A sqlany_bind_param_info buffer to be populated with the bound parameter's information.

Returns

1 on success or 0 on failure.

See also

- "sqlany_bind_param method" on page 531
- "sqlany_describe_bind_param method" on page 535
- "sqlany_prepare method" on page 552

sqlany_get_column method

Fills the supplied buffer with the value fetched for the specified column.

Syntax

```
public sacapi_bool sqlany_get_column(
    a_sqlany_stmt * sqlany_stmt,
    sacapi_u32 col_index,
    a_sqlany_data_value * buffer
)
```

Parameters

- **sqlany_stmt** A statement object executed by sqlany_execute() or sqlany_execute_direct().
- **col_index** The number of the column to be retrieved. A column number is between 0 and sqlany_num_cols() - 1.
- **buffer** A a_sqlany_data_value object to be filled with the data fetched for column col_index.

Returns

1 on success or 0 for failure. A failure can happen if any of the parameters are invalid or if there is not enough memory to retrieve the full value from the SQL Anywhere database server.

Remarks

For A_BINARY and A_STRING * data types, value->buffer points to an internal buffer associated with the result set. Do not rely upon or alter the content of the pointer buffer as it changes when a new row is fetched or when the result set object is feed. Users should copy the data out of those pointers into their own buffers.

The value->length field indicates the number of valid characters that value->buffer points to. The data returned in value->buffer is not null-terminated. This function fetches all the returned values from the SQL Anywhere database server. For example, if the column contains a 2GB blob, this function attempts to allocate enough memory to hold that value. If you do not want to allocate memory, use sqlany_get_data() instead.

See also

- “sqlany_execute_direct method” on page 538
- “sqlany_execute method” on page 537
- “sqlany_fetch_absolute method” on page 539
- “sqlany_fetch_next method” on page 540

sqlany_get_column_info method

Retrieves column metadata information and fills the a_sqlany_column_info structure with information about the column.

Syntax

```
public sacapi_bool sqlany_get_column_info(
    a_sqlany_stmt * sqlany_stmt,
    sacapi_u32 col_index,
    a_sqlany_column_info * buffer
)
```

Parameters

- **sqlany_stmt** A statement object created by sqlany_prepare() or sqlany_execute_direct().
- **col_index** The column number between 0 and sqlany_num_cols() - 1.
- **buffer** A column info structure to be filled with column information.

Returns

1 on success or 0 if the column index is out of range, or if the statement does not return a result set.

See also

- “sqlany_execute method” on page 537
- “sqlany_execute_direct method” on page 538
- “sqlany_prepare method” on page 552

sqlany_get_data method

Retrieves the data fetched for the specified column into the supplied buffer memory.

Syntax

```
public sacapi_i32 sqlany_get_data(
    a_sqlany_stmt * sqlany_stmt,
    sacapi_u32 col_index,
    size_t offset,
    void * buffer,
    size_t size
)
```


Parameters

- **sqlany_stmt** A statement object executed by sqlany_execute() or sqlany_execute_direct().
- **col_index** The number of the column to be retrieved. A column number is between 0 and sqlany_num_cols() - 1.
- **offset** The starting offset of the data to get.
- **buffer** A buffer to be filled with the contents of the column. The buffer pointer must be aligned correctly for the data type copied into it.
- **size** The size of the buffer in bytes. The function fails if you specify a size greater than 2GB.

Returns

The number of bytes successfully copied into the supplied buffer. This number must not exceed 2GB. 0 indicates that no data remains to be copied. -1 indicates a failure.

See also

- "sqlany_execute method" on page 537
- "sqlany_execute_direct method" on page 538
- "sqlany_fetch_absolute method" on page 539
- "sqlany_fetch_next method" on page 540

sqlany_get_data_info method

Retrieves information about the data that was fetched by the last fetch operation.

Syntax

```
public sacapi_bool sqlany_get_data_info(
    a_sqlany_stmt * sqlany_stmt,
    sacapi_u32 col_index,
    a_sqlany_data_info * buffer
)
```

Parameters

- **sqlany_stmt** A statement object executed by sqlany_execute() or sqlany_execute_direct().
- **col_index** The column number between 0 and sqlany_num_cols() - 1.
- **buffer** A data info buffer to be filled with the metadata about the data fetched.

Returns

1 on success, and 0 on failure. Failure is returned when any of the supplied parameters are invalid.

See also

- “sqlany_execute method” on page 537
- “sqlany_execute_direct method” on page 538
- “sqlany_fetch_absolute method” on page 539
- “sqlany_fetch_next method” on page 540

sqlany_get_next_result method

Advances to the next result set in a multiple result set query.

Syntax

```
public sacapi_bool sqlany_get_next_result(a_sqlany_stmt * sqlany_stmt)
```

Parameters

- **sqlany_stmt** A statement object executed by sqlany_execute() or sqlany_execute_direct().

Returns

1 if the statement successfully advances to the next result set, 0 otherwise.

Remarks

If a query (such as a call to a stored procedure) returns multiple result sets, then this function advances from the current result set to the next.

The following example demonstrates how to advance to the next result set in a multiple result set query:

```
stmt = sqlany_execute_direct( sqlany_conn, "call
my_multiple_results_procedure()" );
if( result ) {
    do {
        while( sqlany_fetch_next( stmt ) ) {
           // get column data
        }
    } while( sqlany_get_next_result( stmt ) );
    sqlany_free_stmt( stmt );
}
```

See also

- “sqlany_execute_direct method” on page 538
- “sqlany_execute method” on page 537

sqlany_init method

Initializes the interface.

Syntax

```
public sacapi_bool sqlany_init(
    const char * app_name,
    sacapi_u32 api_version,
    sacapi_u32 * version_available
)
```

Parameters

- **app_name** A string that names the application that is using the API. For example, "PHP", "PERL", or "RUBY".
- **api_version** The version of the compiled application.
- **version_available** An optional argument to return the maximum supported API version.

Returns

1 on success, 0 otherwise

Remarks

The following example demonstrates how to initialize the SQL Anywhere C API DLL:

```
sacapi_u32 api_version;
if( sqlany_init( "PHP", SQLANY_API_VERSION_1, &api_version ) ) {
    printf( "Interface initialized successfully!\n" );
} else {
    printf( "Failed to initialize the interface! Supported version=%d\n",
api_version );
}
```

See also

- "sqlany_fini method" on page 541

sqlany_init_ex method

Initializes the interface using a context.

Syntax

```
public a_sqlany_interface_context * sqlany_init_ex(
    const char * app_name,
    sacapi_u32 api_version,
    sacapi_u32 * version_available
)
```

Parameters

- **app_name** A string that names the API used, for example "PHP", "PERL", or "RUBY".
- **api_version** The current API version that the application is using. This should normally be one of the SQLANY_API_VERSION_* macros

- **version_available** An optional argument to return the maximum API version that is supported.

Returns

a context object on success and NULL on failure.

See also

- "sqlany_fini_ex method" on page 541

sqlany_initialize_interface method

Initializes the SQLAnywhereInterface object and loads the DLL dynamically.

Syntax

```
public int sqlany_initialize_interface(
    SQLAnywhereInterface * api,
    const char * optional_path_to_dll
)
```

Parameters

- **api** An API structure to initialize.
- **optional_path_to_dll** An optional argument that specifies a path to the SQL Anywhere C API DLL.

Returns

1 on successful initialization, and 0 on failure.

Remarks

Use the following statement to include the function prototype:

```
#include "sacapidll.h"
```

This function attempts to load the SQL Anywhere C API DLL dynamically and looks up all the entry points of the DLL. The fields in the SQLAnywhereInterface structure are populated to point to the corresponding functions in the DLL. If the optional path argument is NULL, the environment variable SQLANY_DLL_PATH is checked. If the variable is set, the library attempts to load the DLL specified by the environment variable. If that fails, the interface attempts to load the DLL directly (this relies on the environment being setup correctly).

To view examples of the sqlany_initialize_interface method in use, see the following topics:

- "connecting.cpp" on page 516
- "dbcapi_isql.cpp" on page 517
- "fetching_a_result_set.cpp" on page 520
- "fetching_multiple_from_sp.cpp" on page 522

- “preparing_statements.cpp” on page 524
- “send_retrieve_full_blob.cpp” on page 526
- “send_retrieve_part_blob.cpp” on page 528

sqlany_make_connection method

Creates a connection object based on a supplied DBLIB SQLCA pointer.

Syntax

```
public a_sqlany_connection * sqlany_make_connection(void * arg)
```

Parameters

- **arg** A void * pointer to a DBLIB SQLCA object.

Returns

A connection object.

See also

- “sqlany_new_connection method” on page 550
- “sqlany_execute method” on page 537
- “sqlany_execute_direct method” on page 538
- “sqlany_execute_immediate method” on page 539
- “sqlany_prepare method” on page 552

sqlany_make_connection_ex method

Creates a connection object based on a supplied DBLIB SQLCA pointer and context.

Syntax

```
public a_sqlany_connection * sqlany_make_connection_ex(
    a_sqlany_interface_context * context,
    void * arg
)
```

Parameters

- **context** A valid context object that was created by sqlany_init_ex()
- **arg** A void * pointer to a DBLIB SQLCA object.

Returns

A connection object.

See also

- “sqlany_init_ex method” on page 547
- “sqlany_execute method” on page 537
- “sqlany_execute_direct method” on page 538
- “sqlany_execute_immediate method” on page 539
- “sqlany_prepare method” on page 552

sqlany_new_connection method

Creates a connection object.

Syntax

```
public a_sqlany_connection * sqlany_new_connection(void )
```

Returns

A connection object

Remarks

You must create an API connection object before establishing a database connection. Errors can be retrieved from the connection object. Only one request can be processed on a connection at a time. In addition, not more than one thread is allowed to access a connection object at a time. Undefined behavior or a failure occurs when multiple threads attempt to access a connection object simultaneously.

See also

- “sqlany_connect method” on page 534
- “sqlany_disconnect method” on page 536

sqlany_new_connection_ex method

Creates a connection object using a context.

Syntax

```
public a_sqlany_connection * sqlany_new_connection_ex(
    a_sqlany_interface_context * context
)
```

Parameters

- **context** A context object that was returned from sqlany_init_ex()

Returns

A connection object

See also

- "sqlany_connect method" on page 534
- "sqlany_disconnect method" on page 536
- "sqlany_init_ex method" on page 547

sqlany_num_cols method

Returns number of columns in the result set.

Syntax

```
public sacapi_i32 sqlany_num_cols(a_sqlany_stmt * sqlany_stmt)
```

Parameters

- **sqlany_stmt** A statement object created by sqlany_prepare() or sqlany_execute_direct().

Returns

The number of columns in the result set or -1 on a failure.

See also

- "sqlany_execute method" on page 537
- "sqlany_execute_direct method" on page 538
- "sqlany_prepare method" on page 552

sqlany_num_params method

Returns the number of parameters expected for a prepared statement.

Syntax

```
public sacapi_i32 sqlany_num_params(a_sqlany_stmt * sqlany_stmt)
```

Parameters

- **sqlany_stmt** A statement object returned by the successful execution of sqlany_prepare().

Returns

The expected number of parameters, or -1 if the statement object is not valid.

See also

- "sqlany_prepare method" on page 552

sqlany_num_rows method

Returns the number of rows in the result set.

Syntax

```
public sacapi_i32 sqlany_num_rows(a_sqlany_stmt * sqlany_stmt)
```

Parameters

- **sqlany_stmt** A statement object that was executed by sqlany_execute() or sqlany_execute_direct().

Returns

The number rows in the result set. If the number of rows is an estimate, the number returned is negative and the estimate is the absolute value of the returned integer. The value returned is positive if the number of rows is exact.

Remarks

By default this function only returns an estimate. To return an exact count, set the row_counts option on the connection. For more information on the row_counts option, see "row_counts option" [*SQL Anywhere Server - Database Administration*] .

See also

- "sqlany_execute_direct method" on page 538
- "sqlany_execute method" on page 537

sqlany_prepare method

Prepares a supplied SQL string.

Syntax

```
public a_sqlany_stmt * sqlany_prepare(
    a_sqlany_connection * sqlany_conn,
    const char * sql_str
)
```

Parameters

- **sqlany_conn** A connection object with a connection established using sqlany_connect().
- **sql_str** The SQL statement to be prepared.

Returns

A handle to a SQL Anywhere statement object. The statement object can be used by sqlany_execute() to execute the statement.

Remarks

Execution does not happen until sqlany_execute() is called. The returned statement object should be freed using sqlany_free_stmt().

The following statement demonstrates how to prepare a SELECT SQL string:

```
char * str;
a_sqlany_stmt * stmt;

str = "select * from employees where salary >= ?";
stmt = sqlany_prepare( sqlany_conn, str );
if( stmt == NULL ) {
    // Failed to prepare statement, call sqlany_error() for more info
}
```

See also

- "sqlany_free_stmt method" on page 542
- "sqlany_connect method" on page 534
- "sqlany_execute method" on page 537
- "sqlany_num_params method" on page 551
- "sqlany_describe_bind_param method" on page 535
- "sqlany_bind_param method" on page 531

sqlany_reset method

Resets a statement to its prepared state condition.

Syntax

```
public sacapi_bool sqlany_reset(a_sqlany_stmt * sqlany_stmt)
```

Parameters

- **sqlany_stmt** A statement prepared successfully using sqlany_prepare().

Returns

1 on success, 0 on failure.

See also

- "sqlany_prepare method" on page 552

sqlany_rollback method

Rolls back the current transaction.

Syntax

```
public sacapi_bool sqlany_rollback(a_sqlany_connection * sqlany_conn)
```

Parameters

- **sqlany_conn** The connection object on which the rollback operation is to be performed.

Returns

1 on success, 0 otherwise.

See also

- "sqlany_commit method" on page 534

sqlany_send_param_data method

Sends data as part of a bound parameter.

Syntax

```
public sacapi_bool sqlany_send_param_data(
    a_sqlany_stmt * sqlany_stmt,
    sacapi_u32 index,
    char * buffer,
    size_t size
)
```

Parameters

- **sqlany_stmt** A statement prepared successfully using sqlany_prepare().
- **index** The index of the parameter. This should be a number between 0 and sqlany_num_params() - 1.
- **buffer** The data to be sent.
- **size** The number of bytes to send.

Returns

1 on success or 0 on failure.

Remarks

This method can be used to send a large amount of data for a bound parameter in chunks.

See also

- "sqlany_prepare method" on page 552

sqlany_sqlstate method

Retrieves the current SQLSTATE.

Syntax

```
public size_t sqlany_sqlstate(
    a_sqlany_connection * sqlany_conn,
    char * buffer,
```



```
    size_t size
)
```

Parameters

- **sqlany_conn** A connection object returned from sqlany_new_connection().
- **buffer** A buffer to be filled with the current 5-character SQLSTATE.
- **size** The buffer size.

Returns

The number of bytes copied into the buffer.

Remarks

For more information on SQLSTATE error messages, see "SQL Anywhere error messages sorted by SQLSTATE" [*Error Messages*] .

See also

- "sqlany_error method" on page 536

a_sqlany_data_direction enumeration

A data direction enumeration.

Syntax

```
public enum a_sqlany_data_direction
```

Members

Member name	Description	Value
DD_INVALID	Invalid data direction.	0x0
DD_INPUT	Input-only host variables.	0x1
DD_OUTPUT	Output-only host variables.	0x2
DD_INPUT_OUTPUT	Input and output host variables.	0x3

a_sqlany_data_type enumeration

Specifies the data type being passed in or retrieved.

Syntax

```
public enum a_sqlany_data_type
```

Members

Member name	Description
A_INVALID_TYPE	Invalid data type.
A_BINARY	Binary data. Binary data is treated as-is and no character set conversion is performed.
A_STRING	String data. The data where character set conversion is performed.
A_DOUBLE	Double data. Includes float values.
A_VAL64	64-bit integer.
A_UVAL64	64-bit unsigned integer.
A_VAL32	32-bit integer.
A_UVAL32	32-bit unsigned integer.
A_VAL16	16-bit integer.
A_UVAL16	16-bit unsigned integer.
A_VAL8	8-bit integer.
A_UVAL8	8-bit unsigned integer.

a_sqlany_native_type enumeration

An enumeration of the native types of values as described by the server.

Syntax

```
public enum a_sqlany_native_type
```

Members

Member name	Description
DT_NOTYPE	No data type.
DT_DATE	Null-terminated character string that is a valid date.
DT_TIME	Null-terminated character string that is a valid time.
DT_TIME-STAMP	Null-terminated character string that is a valid timestamp.

Member name	Description
DT_VARCHAR	Varying length character string, in the CHAR character set, with a two-byte length field. The maximum length is 32765 bytes . When sending data, you must set the length field. When fetching data, the database server sets the length field. The data is not null-terminated or blank-padded.
DT_FIXCHAR	Fixed-length blank-padded character string, in the CHAR character set. The maximum length, specified in bytes, is 32767. The data is not null-terminated.
DT_LONGVARCHAR	Long varying length character string, in the CHAR character set.
DT_STRING	Null-terminated character string, in the CHAR character set. The string is blank-padded if the database is initialized with blank-padded strings.
DT_DOUBLE	8-byte floating-point number.
DT_FLOAT	4-byte floating-point number.
DT_DECIMAL	Packed decimal number (proprietary format).
DT_INT	32-bit signed integer.
DT_SMALLINT	16-bit signed integer.
DT_BINARY	Varying length binary data with a two-byte length field. The maximum length is 32765 bytes. When supplying information to the database server, you must set the length field. When fetching information from the database server, the server sets the length field.
DT_LONGBINARY	Long binary data.
DT_TINYINT	8-bit signed integer.
DT_BIGINT	64-bit signed integer.
DT_UNSINT	32-bit unsigned integer.
DT_UNSSMALLINT	16-bit unsigned integer.
DT_UNSBIGINT	64-bit unsigned integer.
DT_BIT	8-bit signed integer.
DT_LONGNVARCHAR	Long varying length character string, in the NCHAR character set.

Remarks

The value types correspond to the embedded SQL data types. For more information on embedded SQL data types, see “Embedded SQL data types” on page 439 .

See also

- “sqlany_get_column_info method” on page 544
- “a_sqlany_column_info structure” on page 559

a_sqlany_bind_param structure

A bind parameter structure used to bind parameter and prepared statements.

Syntax

```
public struct a_sqlany_bind_param
```

Members

Member name	Type	Description
direction	a_sqlany_data_direction	The direction of the data. (input, output, input_output).
name	char *	Name of the bind parameter. This is only used by sqlany_describe_bind_param().
value	a_sqlany_data_value	The actual value of the data.

Remarks

To view examples of the a_sqlany_bind_param structure in use, see the following topics:

See also

- “sqlany_execute method” on page 537

a_sqlany_bind_param_info structure

Gets information about the currently bound parameters.

Syntax

```
public struct a_sqlany_bind_param_info
```


Members

Member name	Type	Description
direction	a_sqlany_data_direction	The direction of the parameter.
input_value	a_sqlany_data_value	Information about the bound input value.
name	char *	A pointer to the name of the parameter.
output_value	a_sqlany_data_value	Information about the bound output value.

Remarks

sqlany_get_bind_param_info() can be used to populate this structure.

To view examples of the a_sqlany_bind_param_info structure in use, see the following topics:

See also

- "sqlany_execute method" on page 537

a_sqlany_column_info structure

Returns column metadata information.

Syntax

```
public struct a_sqlany_column_info
```

Members

Member name	Type	Description
max_size	size_t	The maximum size a data value in this column can take.
name	char *	The name of the column (null-terminated). The string can be referenced as long as the result set object is not freed.
native_type	a_sqlany_native_type	The native type of the column in the database.
nullable	sacapi_bool	Indicates whether a value in the column can be null.
precision	unsigned short	The precision.
scale	unsigned short	The scale.

Member name	Type	Description
type	a_sqlany_data_type	The column data type.

Remarks

sqlany_get_column_info() can be used to populate this structure.

To view an example of the a_sqlany_column_info structure in use, see “dbcapi_isql.cpp” on page 517 .

a_sqlany_data_info structure

Returns metadata information about a column value in a result set.

Syntax

```
public struct a_sqlany_data_info
```

Members

Member name	Type	Description
data_size	size_t	The total number of bytes available to be fetched. This field is only valid after a successful fetch operation.
is_null	sacapi_bool	Indicates whether the last fetched data is NULL. This field is only valid after a successful fetch operation.
type	a_sqlany_data_type	The type of the data in the column.

Remarks

sqlany_get_data_info() can be used to populate this structure with information about what was last retrieved by a fetch operation.

See also

- “sqlany_get_data_info method” on page 545

a_sqlany_data_value structure

Returns a description of the attributes of a data value.

Syntax

```
public struct a_sqlany_data_value
```


Members

Member name	Type	Description
buffer	char *	A pointer to user supplied buffer of data.
buffer_size	size_t	The size of the buffer.
is_null	sacapi_bool *	A pointer to indicate whether the last fetched data is NULL.
length	size_t *	A pointer to the number of valid bytes in the buffer. This value must be less than buffer_size.
type	a_sqlany_data_type	The type of the data.

Remarks

To view examples of the a_sqlany_data_value structure in use, see the following topics:

- "dbcapi_isql.cpp" on page 517
- "fetching_a_result_set.cpp" on page 520
- "send_retrieve_full_blob.cpp" on page 526
- "preparing_statements.cpp" on page 524

SQLAnywhereInterface structure

The SQL Anywhere C API interface structure.

Syntax

```
public struct SQLAnywhereInterface
```

Members

Member name	Type	Description
dll_handle	void *	DLL handle.
function	method	Pointer to sqlany_init() function.
function	method	Pointer to sqlany_fini() function.
function	method	Pointer to sqlany_new_connection() function.
function	method	Pointer to sqlany_free_connection() function.

Member name	Type	Description
function	method	Pointer to sqlany_make_connection() function.
function	method	Pointer to sqlany_connect() function.
function	method	Pointer to sqlany_disconnect() function.
function	method	Pointer to sqlany_execute_immediate() function.
function	method	Pointer to sqlany_prepare() function.
function	method	Pointer to sqlany_free_stmt() function.
function	method	Pointer to sqlany_num_params() function.
function	method	Pointer to sqlany_describe_bind_param() function.
function	method	Pointer to sqlany_bind_param() function.
function	method	Pointer to sqlany_send_param_data() function.
function	method	Pointer to sqlany_reset() function.
function	method	Pointer to sqlany_get_bind_param_info() function.
function	method	Pointer to sqlany_execute() function.
function	method	Pointer to sqlany_execute_direct() function.
function	method	Pointer to sqlany_fetch_absolute() function.
function	method	Pointer to sqlany_fetch_next() function.
function	method	Pointer to sqlany_get_next_result() function.
function	method	Pointer to sqlany_affected_rows() function.
function	method	Pointer to sqlany_num_cols() function.
function	method	Pointer to sqlany_num_rows() function.
function	method	Pointer to sqlany_get_column() function.
function	method	Pointer to sqlany_get_data() function.
function	method	Pointer to sqlany_get_data_info() function.
function	method	Pointer to sqlany_get_column_info() function.

Member name	Type	Description
function	method	Pointer to sqlany_commit() function.
function	method	Pointer to sqlany_rollback() function.
function	method	Pointer to sqlany_client_version() function.
function	method	Pointer to sqlany_error() function.
function	method	Pointer to sqlany_sqlstate() function.
function	method	Pointer to sqlany_clear_error() function.
function	method	Pointer to sqlany_init_ex() function.
function	method	Pointer to sqlany_fini_ex() function.
function	method	Pointer to sqlany_new_connection_ex() function.
function	method	Pointer to sqlany_make_connection_ex() function.
function	method	Pointer to sqlany_client_version_ex() function.
function	method	Pointer to sqlany_cancel() function.
initialized	int	Flag to know if initialized or not.

See also

- "sqlany_initialize_interface method" on page 548

SACAPI_ERROR_SIZE variable

Returns the minimal error buffer size.

Syntax

```
#define SACAPI_ERROR_SIZE 256
```

SQLANY_API_VERSION_1 variable

Defines to indicate the API versions.

Syntax

```
#define SQLANY_API_VERSION_1 1
```

SQLANY_API_VERSION_2 variable

Version 2 introduced the "_ex" functions and the ability to cancel requests.

Syntax

```
#define SQLANY_API_VERSION_2 2
```


SQL Anywhere external call interface

You can call a function in an external library from a stored procedure or function. You can call functions in a DLL under Windows operating systems and in a shared object on Unix. You cannot call external functions on Windows Mobile.

This section describes how to use the external function call interface. Sample external stored procedures, plus the files required to build a DLL containing them, are located in the following folder: *samples-dir\SQLAnywhere\ExternalProcedures*. For information about the location of *samples-dir*, see "Samples directory" [*SQL Anywhere Server - Database Administration*].

Caution
External libraries called from procedures share the memory of the server. If you call an external library from a procedure and the external library contains memory-handling errors, you can crash the server or corrupt your database. Ensure that you thoroughly test your libraries before deploying them on production databases.

The interface described in this section replaces an older interface, which has been deprecated. Libraries written to the older interface, used in versions before version 7.0.x, are still supported, but in any new development, the new interface is recommended. Note that the new interface must be used for all Unix platforms and for all 64-bit platforms, including 64-bit Windows.

SQL Anywhere includes a set of system procedures that make use of this capability, for example to send MAPI email messages. See "MAPI and SMTP procedures" [*SQL Anywhere Server - SQL Reference*].

Creating procedures and functions with external calls

This section presents some examples of procedures and functions with external calls.

DBA authority required
You must have DBA authority to create procedures or functions that reference external libraries. This requirement is more strict than the RESOURCE authority required for creating other procedures or functions.

Syntax

You can create a SQL stored procedure that calls a C/C++ function in a library (a Dynamic Link Library (DLL) or shared object) as follows:

```
CREATE PROCEDURE coverProc( parameter-list )
  EXTERNAL NAME 'myFunction@myLibrary'
  LANGUAGE C_ESQL32;
```

When you define a stored procedure or function in this way, you are creating a bridge to the function in the external DLL. The stored procedure or function cannot perform any other tasks.

Similarly, you can create a SQL stored function that calls a C/C++ function in a library as follows:

```
CREATE FUNCTION coverFunc( parameter-list )
  RETURNS data-type
  EXTERNAL NAME 'myFunction@myLibrary'
  LANGUAGE C_ESQL32;
```

In these statements, the EXTERNAL NAME clause indicates the function name and library in which it resides. In the example, `myFunction` is the exported name of a function in the library, and `myLibrary` is the name of the library (for example, *myLibrary.dll* or *myLibrary.so*).

The LANGUAGE clause indicates that the function is to be called in an external environment. The LANGUAGE clause can specify one of C_ESQL32, C_ESQL64, C_ODBC32, or C_ODBC64. The **32** or **64** suffix indicates that the function is compiled as a 32-bit or 64-bit application. The **ODBC** designation indicates that the application uses the ODBC API. The **ESQL** designation indicates that the application could use the Embedded SQL API, the SQL Anywhere C API, any other non-ODBC API, or no API at all.

If the LANGUAGE clause is omitted, then the library containing the function is loaded into the address space of the database server. When called, the external function will execute as part of the server. In this case, if the function causes a fault, then the database server will be terminated. Because of this, loading and executing functions in an external environment is recommended. If a function causes a fault in an external environment, the database server will continue to run.

The arguments in *parameter-list* must correspond in type and order to the arguments expected by the library function. The library function accesses the procedure arguments using an interface described in "External function prototypes" on page 567.

Any value or result set returned by the external function can be returned by the stored procedure or function to the calling environment.

No other statements permitted

A stored procedure or function that references an external function can include no other statements: its sole purpose is to take arguments for a function, call the function, and return any value and returned arguments from the function to the calling environment. You can use IN, INOUT, or OUT parameters in the procedure call in the same way as for other procedures: the input values get passed to the external function, and any parameters modified by the function are returned to the calling environment in OUT or INOUT parameters or as the RETURNS result of the stored function.

System-dependent calls

You can specify operating-system dependent calls, so that a procedure calls one function when run on one operating system, and another function (presumably analogous) on another operating system. The syntax for such calls involves prefixing the function name with the operating system name. The operating system identifier must be Unix. An example follows.

```
CREATE FUNCTION func ( parameter-list )
  RETURNS data-type
  EXTERNAL NAME 'Unix:function-name@library.so;function-name@library.dll';
```

If the list of functions does not contain an entry for the operating system on which the server is running, but the list does contain an entry without an operating system specified, the database server calls the function in that entry.

See also

- "CREATE FUNCTION statement (external procedures)" [*SQL Anywhere Server - SQL Reference*]
- "CREATE FUNCTION statement (external procedures)" [*SQL Anywhere Server - SQL Reference*]
- "SQL Anywhere external environment support" on page 583

External function prototypes

This section describes the interface that you use for functions written in C or C++.

The interface is defined by a header file named *extfnapi.h*, in the *SDK\Include* subdirectory of your SQL Anywhere installation directory. This header file handles the platform-dependent features of external function prototypes.

Function prototypes

The name of the function must match that referenced in the CREATE PROCEDURE or CREATE FUNCTION statement. Suppose the following CREATE FUNCTION statement had been executed.

```
CREATE FUNCTION cover-name ( parameter-list )
  RETURNS data-type
  EXTERNAL NAME 'function-name@library.dll'
  LANGUAGE C_ESQL32;
```

The C/C++ function declaration must be as follows:

void *function-name***(an_extfn_api ***api*, **void ***argument-handle* **)**

The function must return void, and must take as arguments a pointer to a structure used to call a set of callback functions and a handle to the arguments provided by the SQL procedure.

extfn_use_new_api method

To notify the database server that the external library is written using the external function call interface, your external library must export the following function:

Syntax

extern "C" a_sql_uint32 SQL_CALLBACK extfn_use_new_api(void);

Returns

The function returns an unsigned 32-bit integer. The returned value must be the interface version number, EXTFN_API_VERSION, defined in *extfnapi.h*. A return value of 0 means that the old, deprecated interface is being used.

Remarks

If the function is not exported by the library, the database server assumes that the old interface is in use. The new interface must be used for all Unix platforms and for all 64-bit platforms, including 64-bit Windows.

A typical implementation of this function follows:

```
extern "C" a_sql_uint32 SQL_CALLBACK extfn_use_new_api( void )
{
    return( EXTFN_API_VERSION );
}
```

See also

- "an_extfn_api structure" on page 570

extfn_cancel method

To notify the database server that the external library supports cancel processing, your external library must export the following function:

Syntax

extern "C" void SQL_CALLBACK extfn_cancel(void *cancel_handle);

Parameters

- **cancel_handle** A pointer to a variable to manipulate.

Remarks

This function is called asynchronously by the database server whenever the currently executing SQL statement is canceled.

The function uses the cancel_handle to set a flag indicating to the external library functions that the SQL statement has been canceled.

If the function is not exported by the library, the database server assumes that cancel processing is not supported.

A typical implementation of this function follows:

```
extern "C" void SQL_CALLBACK extfn_cancel( void *cancel_handle )
{
    *(short *)cancel_handle = 1;
}
```

See also

- "an_extfn_api structure" on page 570

extfn_post_load_library method

If this function is implemented and exposed in the external library, it is executed by the database server after the external library has been loaded and the version check has been performed, and before any other function defined in the external library is called.

Syntax

extern "C" void SQL_CALLBACK extfn_post_load_library(void);

Remarks

This function is required only if there is a library-specific requirement to do library-wide setup before any function within the library is called.

This function is called asynchronously by the database server after the external library has been loaded and the version check has been performed, and before any other function defined in the external library is called.

Example

```
extern "C" __declspec( dllexport )
void SQL_CALLBACK extfn_post_load_library( void )
{
    MessageBox( NULL, "Library loaded",
          "SQL Anywhere",
          MB_OK | MB_TASKMODAL );
}
```

See also

- “an_extfn_api structure” on page 570

extfn_pre_unload_library method

If this function is implemented and exposed in the external library, it is executed by the database server immediately before unloading the external library.

Syntax

extern "C" void SQL_CALLBACK extfn_pre_unload_library(void);

Remarks

This function is required only if there is a library-specific requirement to do library-wide cleanup before the library is unloaded.

This function is called asynchronously by the database server immediately before unloading the external library.

Example

```
extern "C" __declspec( dllexport )
void SQL_CALLBACK extfn_pre_unload_library( void )
{
    MessageBox( NULL, "Library unloading",
          "SQL Anywhere",
```

```
            MB_OK | MB_TASKMODAL );
}
```

See also

- "an_extfn_api structure" on page 570

an_extfn_api structure

Used to communicate with the calling SQL environment.

Syntax

```
typedef struct an_extfn_api {
    short (SQL_CALLBACK *get_value)(
                void *          arg_handle,
                a_sql_uint32    arg_num,
                an_extfn_value *value
                );
    short (SQL_CALLBACK *get_piece)(
                void *          arg_handle,
                a_sql_uint32    arg_num,
                an_extfn_value *value,
                a_sql_uint32    offset
                );
    short (SQL_CALLBACK *set_value)(
                void *          arg_handle,
                a_sql_uint32    arg_num,
                an_extfn_value *value
                short           append
                );
    void (SQL_CALLBACK *set_cancel)(
                void *          arg_handle,
                void *          cancel_handle
                );
} an_extfn_api;
```

Properties

- **get_value** Use this callback function to get the specified parameter's value. The following example gets the value for parameter 1.

  ```
  result = extapi->get_value( arg_handle, 1, &arg )
  if( result == 0 || arg.data == NULL )
  {
      return; // no parameter or parameter is NULL
  }
  ```

- **get_piece** Use this callback function to get the next chunk of the specified parameter's value (if there are any). The following example gets the remaining pieces for parameter 1.

  ```
  cmd = (char *)malloc( arg.len.total_len + 1 );
  offset = 0;
  for( ; result != 0; )
  {
       if( arg.data == NULL ) break;
       memcpy( &cmd[offset], arg.data, arg.piece_len );
       offset += arg.piece_len;
       cmd[offset] = '\0';
  ```



```
        if( arg.piece_len == 0 ) break;
        result = extapi->get_piece( arg_handle, 1, &arg, offset );
    }
```

- **set_value** Use this callback function to set the specified parameter's value. The following example sets the return value (parameter 0) for a RETURNS clause of a FUNCTION.

```
an_extfn_value      retval;
int ret = -1;

// set up the return value struct
retval.type = DT_INT;
retval.data = (void*) &ret;
retval.piece_len = retval.len.total_len =
    (a_sql_uint32) sizeof( int );
extapi->set_value( arg_handle, 0, &retval, 0 );
```

- **set_cancel** Use this callback function to establish a pointer to a variable that can be set by the **extfn_cancel** method. The following is example.

```
short               canceled = 0;
extapi->set_cancel( arg_handle, &canceled );
```

Remarks

A pointer to the an_extfn_api structure is passed by the caller to your external function. Here is an example.

```
extern "C" __declspec( dllexport )
void my_external_proc( an_extfn_api *extapi, void *arg_handle )
{
    short               result;
    short               canceled;
    an_extfn_value      arg;

    canceled = 0;
    extapi->set_cancel( arg_handle, &canceled );

    result = extapi->get_value( arg_handle, 1, &arg );
    if( canceled || result == 0 || arg.data == NULL )
    {
        return; // no parameter or parameter is NULL
    }
.
.
.
}
```

Whenever you use any of the callback functions, you must pass back the argument handle that was passed to your external function as the second parameter.

See also

- “an_extfn_value structure” on page 571
- “extfn_cancel method” on page 568

an_extfn_value structure

Used to access parameter data from the calling SQL environment.

Syntax

```
typedef struct an_extfn_value {
    void *           data;
    a_sql_uint32     piece_len;
    union {
        a_sql_uint32 total_len;
        a_sql_uint32 remain_len;
    } len;
    a_sql_data_type  type;
} an_extfn_value;
```

Properties

- **data** A pointer to the data for this parameter.
- **piece_len** The length of this segment of the parameter. This is less than or equal to **total_len**.
- **total_len** The total length of the parameter. For strings, this represents the length of the string and does not include a null terminator. This property is set after a call to the **get_value** callback function. This property is no longer valid after a call to the **get_piece** callback function.
- **remain_len** When the parameter is obtained in segments, this is the length of the part that has not yet been obtained. This property is set after each call to the **get_piece** callback function.
- **type** Indicates the type of the parameter. This is one of the Embedded SQL data types such as **DT_INT**, **DT_FIXCHAR**, or **DT_BINARY**. See "Embedded SQL data types" on page 439.

Remarks

Suppose that your external function interface was described using the following SQL statement.

```
CREATE FUNCTION mystring( IN instr LONG VARCHAR )
RETURNS LONG VARCHAR
EXTERNAL NAME 'mystring@c:\\project\\mystring.dll';
```

The following code fragment shows how to access the properties for objects of type **an_extfn_value**. In the example, the input parameter 1 (`instr`) to this function (`mystring`) is expected to be a SQL LONGVARCHAR string.

```
an_extfn_value      arg;

result = extapi->get_value( arg_handle, 1, &arg );
if( result == 0 || arg.data == NULL )
{
    return; // no parameter or parameter is NULL
}

if( arg.type != DT_LONGVARCHAR )
{
    return; // unexpected type of parameter
}

cmd = (char *)malloc( arg.len.total_len + 1 );
offset = 0;
for( ; result != 0; )
{
```



```
        if( arg.data == NULL ) break;
        memcpy( &cmd[offset], arg.data, arg.piece_len );
        offset += arg.piece_len;
        cmd[offset] = '\0';
        if( arg.piece_len == 0 ) break;
        result = extapi->get_piece( arg_handle, 1, &arg, offset );
    }
```

See also

- "an_extfn_api structure" on page 570

an_extfn_result_set_info structure

Facilitates the return of result sets to the calling SQL environment.

Syntax

```
typedef struct an_extfn_result_set_info {
    a_sql_uint32                        number_of_columns;
    an_extfn_result_set_column_info     *column_infos;
    an_extfn_result_set_column_data     *column_data_values;
} an_extfn_result_set_info;
```

Properties

- **number_of_columns** The number of columns in the result set.
- **column_infos** Link to a description of the result set columns. See "an_extfn_result_set_column_info structure" on page 574.
- **column_data_values** Link to a description of the result set column data. See "an_extfn_result_set_column_data structure" on page 575.

Remarks

The following code fragment shows how to set the properties for objects of this type.

```
int columns = 2;
an_extfn_result_set_info    rs_info;

an_extfn_result_set_column_info *col_info =
    (an_extfn_result_set_column_info *)
    malloc( columns * sizeof(an_extfn_result_set_column_info) );

an_extfn_result_set_column_data *col_data =
    (an_extfn_result_set_column_data *)
    malloc( columns * sizeof(an_extfn_result_set_column_data) );

rs_info.number_of_columns   = columns;
rs_info.column_infos        = col_info;
rs_info.column_data_values  = col_data;
```

See also

- "an_extfn_result_set_column_info structure" on page 574
- "an_extfn_result_set_column_data structure" on page 575

an_extfn_result_set_column_info structure

Used to describe a result set.

Syntax

```
typedef struct an_extfn_result_set_column_info {
    char *                          column_name;
    a_sql_data_type                 column_type;
    a_sql_uint32                    column_width;
    a_sql_uint32                    column_index;
    short int                       column_can_be_null;
} an_extfn_result_set_column_info;
```

Properties

- **column_name** Points to the name of the column which is a null-terminated string.
- **column_type** Indicates the type of the column. This is one of the Embedded SQL data types such as **DT_INT**, **DT_FIXCHAR**, or **DT_BINARY**. See "Embedded SQL data types" on page 439.
- **column_width** Defines the maximum width for char(n), varchar(n) and binary(n) declarations and is set to 0 for all other types.
- **column_index** The ordinal position of the column which starts at 1.
- **column_can_be_null** Set to 1 if the column is nullable; otherwise it is set to 0.

Remarks

The following code fragment shows how to set the properties for objects of this type and how to describe the result set to the calling SQL environment.

```
// set up column descriptions
// DepartmentID          INTEGER NOT NULL
col_info[0].column_name  = "DepartmentID";
col_info[0].column_type  = DT_INT;
col_info[0].column_width = 0;
col_info[0].column_index = 1;
col_info[0].column_can_be_null = 0;

// DepartmentName        CHAR(40) NOT NULL
col_info[1].column_name  = "DepartmentName";
col_info[1].column_type  = DT_FIXCHAR;
col_info[1].column_width = 40;
col_info[1].column_index = 2;
col_info[1].column_can_be_null = 0;

extapi->set_value( arg_handle,
                EXTFN_RESULT_SET_ARG_NUM,
                (an_extfn_value *)&rs_info,
                EXTFN_RESULT_SET_DESCRIBE );
```

See also

- "an_extfn_result_set_info structure" on page 573
- "an_extfn_result_set_column_data structure" on page 575

an_extfn_result_set_column_data structure

Used to return the data values for columns.

Syntax

```
typedef struct an_extfn_result_set_column_data {
    a_sql_uint32                        column_index;
    void *                              column_data;
    a_sql_uint32                        data_length;
    short                               append;
} an_extfn_result_set_column_data;
```

Properties

- **column_index** The ordinal position of the column which starts at 1.
- **column_data** Pointer to a buffer containing the column data.
- **data_length** The actual length of the data.
- **append** Used to return the column value in chunks. Set to 1 when returning a partial column value; 0 otherwise.

Remarks

The following code fragment shows how to set the properties for objects of this type and how to return the result set row to the calling SQL environment.

```
int DeptNumber = 400;
char * DeptName = "Marketing";

col_data[0].column_index = 1;
col_data[0].column_data  = &DeptNumber;
col_data[0].data_length  = sizeof( DeptNumber );
col_data[0].append  = 0;

col_data[1].column_index = 2;
col_data[1].column_data  = DeptName;
col_data[1].data_length  = strlen(DeptName);
col_data[1].append  = 0;

extapi->set_value(  arg_handle,
                EXTFN_RESULT_SET_ARG_NUM,
                (an_extfn_value *)&rs_info,
                EXTFN_RESULT_SET_NEW_ROW_FLUSH );
```

See also

- “an_extfn_result_set_info structure” on page 573
- “an_extfn_result_set_column_info structure” on page 574

Using the external function call interface methods

get_value callback

```
short (SQL_CALLBACK *get_value)
(
    void *         arg_handle,
    a_sql_uint32   arg_num,
    an_extfn_value *value
);
```

The **get_value** callback function can be used to obtain the value of a parameter that was passed to the stored procedure or function that acts as the interface to the external function. It returns 0 if not successful; otherwise it returns a non-zero result. After calling get_value, the total_len field of the an_extfn_value structure contains the length of the entire value. The piece_len field contains the length of the portion that was obtained as a result of calling get_value. Note that piece_len will always be less than or equal to total_len. When it is less than, a second function **get_piece** can be called to obtain the remaining pieces. Note that the total_len field is only valid after the initial call to get_value. This field is overlaid by the remain_len field which is altered by calls to get_piece. It is important to preserve the value of the total_len field immediately after calling get_value if you plan to use it later on.

get_piece callback

```
short (SQL_CALLBACK *get_piece)
(
    void *         arg_handle,
    a_sql_uint32   arg_num,
    an_extfn_value *value,
    a_sql_uint32   offset
);
```

If the entire parameter value cannot be returned in one piece, then the **get_piece** function can be called iteratively to obtain the remaining pieces of the parameter value.

The sum of all the piece_len values returned by both calls to get_value and get_piece will add up to the initial value that was returned in the total_len field after calling get_value. After calling get_piece, the remain_len field, which overlays total_len, represents the amount not yet obtained.

Using get_value and get_piece callbacks

The following example shows the use of get_value and get_piece to obtain the value of a string parameter such as a long varchar parameter.

Suppose that the wrapper to an external function was declared as follows:

```
CREATE PROCEDURE mystring( IN instr LONG VARCHAR )
  EXTERNAL NAME 'mystring@mystring.dll';
```

To call the external function from SQL, use a statement like the following.

```
call mystring('Hello world!');
```

A sample implementation for the Windows operating system of the mystring function, written in C, follows:

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <windows.h>
```



```
#include "extfnapi.h"

BOOL APIENTRY DllMain( HMODULE hModule,
                       DWORD  ul_reason_for_call,
                       LPVOID lpReserved
      )
{
    return TRUE;
}

extern "C" __declspec( dllexport )
a_sql_uint32 extfn_use_new_api( void )
{
    return( EXTFN_API_VERSION );
}

extern "C" __declspec( dllexport )
void mystring( an_extfn_api *extapi, void *arg_handle )
{
    short               result;
    an_extfn_value      arg;
    unsigned            offset;
    char                *string;

    result = extapi->get_value( arg_handle, 1, &arg );
    if( result == 0 || arg.data == NULL )
    {
        return; // no parameter or parameter is NULL
    }
    string = (char *)malloc( arg.len.total_len + 1 );
    offset = 0;
    for( ; result != 0; ) {
         if( arg.data == NULL ) break;
         memcpy( &string[offset], arg.data, arg.piece_len );
         offset += arg.piece_len;
         string[offset] = '\0';
         if( arg.piece_len == 0 ) break;
         result = extapi->get_piece( arg_handle, 1, &arg, offset );
    }
    MessageBoxA( NULL, string,
          "SQL Anywhere",
          MB_OK | MB_TASKMODAL );
    free( string );
    return;
}
```

set_value callback

```
short (SQL_CALLBACK *set_value)
(
    void *         arg_handle,
    a_sql_uint32   arg_num,
    an_extfn_value *value
    short          append
);
```

The set_value callback function can be used to set the values of OUT parameters and the RETURNS result of a stored function. Use an arg_num value of 0 to set the RETURNS value. The following is an example.

```
an_extfn_value      retval;
```

```
retval.type = DT_LONGVARCHAR;
retval.data = result;
retval.piece_len = retval.len.total_len = (a_sql_uint32) strlen( result );
extapi->set_value( arg_handle, 0, &retval, 0 );
```

The append argument of set_value determines whether the supplied data replaces (false) or appends to (true) the existing data. You must call set_value with `append=FALSE` before calling it with `append=TRUE` for the same argument. The append argument is ignored for fixed length data types.

To return NULL, set the data field of the an_extfn_value structure to NULL.

set_cancel callback

```
void (SQL_CALLBACK *set_cancel)
(
    void *arg_handle,
    void *cancel_handle
);
```

External functions can get the values of IN or INOUT parameters and set the values of OUT parameters and the RETURNS result of a stored function. There is a case, however, where the parameter values obtained may no longer be valid or the setting of values is no longer necessary. This occurs when an executing SQL statement is canceled. This may occur as the result of an application abruptly disconnecting from the database server. To handle this situation, you can define a special entry point in the library called extfn_cancel. When this function is defined, the server will call it whenever a running SQL statement is canceled.

The extfn_cancel function is called with a handle that can be used in any way you consider suitable. A typical use of the handle is to indirectly set a flag to indicate that the calling SQL statement has been canceled.

The value of the handle that is passed can be set by functions in the external library using the set_cancel callback function. This is illustrated by the following code fragment.

```
extern "C" __declspec( dllexport )
void extfn_cancel( void *cancel_handle )
{
    *(short *)cancel_handle = 1;
}

extern "C" __declspec( dllexport )
void mystring( an_extfn_api *api, void *arg_handle )
{
.
.
.
    short  canceled = 0;

    extapi->set_cancel( arg_handle, &canceled );
.
.
.
    if( canceled )
```

Note that setting a static global "canceled" variable is inappropriate since that would be misinterpreted as all SQL statements on all connections being canceled which is usually not the case. This is why a set_cancel callback function is provided. Make sure to initialize the "canceled" variable before calling set_cancel.

It is important to check the setting of the "canceled" variable at strategic points in your external function. Strategic points would include before and after calling any of the external library call interface functions like get_value and set_value. When the variable is set (as a result of extfn_cancel having been called), then the external function can take appropriate termination action. A code fragment based on the earlier example follows:

```
if( canceled )
{
    free( string );
    return;
}
```

Notes

The get_piece function for any given argument can only be called immediately after the get_value function for the same argument.

Calling get_value on an OUT parameter returns the type field of the an_extfn_value structure set to the data type of the argument, and returns the data field of the an_extfn_value structure set to NULL.

The header file *extfnapi.h* in the SQL Anywhere installation *SDK\Include* folder contains some additional notes.

The following table shows the conditions under which the functions defined in an_extfn_api return false:

Function	Returns 0 when the following is true; else returns 1
get_value()	• arg_num is invalid; for example, arg_num is greater than the number of arguments for the external function.
get_piece()	• arg_num is invalid; for example, arg_num does not correspond to the argument number used with the previous call to get_value. • The offset is greater than the total length of the value for the arg_num argument. • It is called before get_value has been called.
set_value()	• arg_num is invalid; for example, arg_num is greater than the number of arguments for the external function. • Argument arg_num is input only. • The type of value supplied does not match that of argument arg_num.

Handling data types

Data types

The following SQL data types can be passed to an external library:

SQL data type	sqldef.h	C type
CHAR	DT_FIXCHAR	Character data, with a specified length
VARCHAR	DT_VARCHAR	Character data, with a specified length
LONG VARCHAR, TEXT	DT_LONG-VARCHAR	Character data, with a specified length
UNIQUEIDENTIFIERSTR	DT_FIXCHAR	Character data, with a specified length
XML	DT_LONG-VARCHAR	Character data, with a specified length
NCHAR	DT_NFIX-CHAR	UTF-8 character data, with a specified length
NVARCHAR	DT_NVARCH-AR	UTF-8 character data, with a specified length
LONG NVARCHAR, NTEXT	DT_LONG-NVARCHAR	UTF-8 character data, with a specified length
UNIQUEIDENTIFIER	DT_BINARY	Binary data, 16 bytes long
BINARY	DT_BINARY	Binary data, with a specified length
VARBINARY	DT_BINARY	Binary data, with a specified length
LONG BINARY	DT_LONGBI-NARY	Binary data, with a specified length
TINYINT	DT_TINYINT	1-byte integer
[UNSIGNED] SMALLINT	DT_SMALL-INT, DT_UN-SSMALLINT	[Unsigned] 2-byte integer
[UNSIGNED] INT	DT_INT, DT_UNSINT	[Unsigned] 4-byte integer
[UNSIGNED] BIGINT	DT_BIGINT, DT_UNSBI-GINT	[Unsigned] 8-byte integer
REAL, FLOAT(1-24)	DT_FLOAT	Single-precision floating-point number
DOUBLE, FLOAT(25-53)	DT_DOUBLE	Double-precision floating-point number

You cannot use any of the date or time data types, and you cannot use the DECIMAL or NUMERIC data types (including the money types).

To provide values for INOUT or OUT parameters, use the set_value function. To read IN and INOUT parameters, use the get_value function.

Determining data types of parameters

After a call to get_value, the type field of the an_extfn_value structure can be used to obtain data type information for the parameter. The following sample code fragment shows how to identify the type of the parameter.

```
an_extfn_value      arg;
a_sql_data_type     data_type;

extapi->get_value( arg_handle, 1, &arg );
data_type = arg.type & DT_TYPES;
switch( data_type )
{
case DT_FIXCHAR:
case DT_VARCHAR:
case DT_LONGVARCHAR:
    break;
default:
    return;
}
```

For more information on data types, see “Using host variables” on page 442.

UTF-8 types

The UTF-8 data types such as NCHAR, NVARCHAR, LONG NVARCHAR and NTEXT as passed as UTF-8 encoded strings. A function such as the Windows MultiByteToWideChar function can be used to convert a UTF-8 string to a wide-character (Unicode) string.

Passing NULL

You can pass NULL as a valid value for all arguments. Functions in external libraries can supply NULL as a return value for any data type.

Return values

To set a return value in an external function, call the set_value function with an arg_num parameter value of 0. If set_value is not called with arg_num set to 0, the function result is NULL.

It is also important to set the data type of a return value for a stored function call. The following code fragment shows how to set the return data type.

```
an_extfn_value      retval;

retval.type = DT_LONGVARCHAR;
retval.data = result;
retval.piece_len = retval.len.total_len = (a_sql_uint32) strlen( result );
extapi->set_value( arg_handle, 0, &retval, 0 );
```

Unloading external libraries

The system procedure, dbo.sa_external_library_unload, can be used to unload an external library when the library is not in use. The procedure takes one optional parameter, a long varchar. The parameter specifies the name of the library to be unloaded. If no parameter is specified, all external libraries not in use will be unloaded.

The following example unloads an external function library.

```
call sa_external_library_unload('library.dll')
```

This function is useful when developing a set of external functions because you do not have to shut down the database server to install a newer version of the library.

SQL Anywhere external environment support

SQL Anywhere includes support for six external runtime environments. These include embedded SQL and ODBC applications written in C/C++, and applications written in Java, Perl, PHP, or languages such as C# and Visual Basic that are based on the Microsoft .NET Framework Common Language Runtime (CLR).

SQL Anywhere has had the ability to call compiled native functions written in C or C++ for some time. However, when these procedures are run by the database server, the dynamic link library or shared object has always been loaded by the database server and the calls out to the native functions have always been made by the database server. The risk here is that if the native function causes a fault, then the database server crashes. Running compiled native functions outside the database server, in an external environment, eliminates these risks to the server.

The following is an overview of the external environment support in SQL Anywhere.

Catalog tables

A system catalog table stores the information needed to identify and launch each of the external environments. The definition for this table is:

```
SYS.SYSEXTERNENV (
  object_id            unsigned bigint not null,
  name                 varchar(128)    not null,
  scope                char(1)         not null,
  supports_result_sets char(1)         not null,
  location             long varchar    not null,
  options              long varchar    not null,
  user_id              unsigned int
)
```

- **object_id** A unique identifier that is generated by the database server.
- **name** The name column identifies the name of the external environment or language. It is one of **java**, **perl**, **php**, **clr**, **c_esql32**, **c_esql64**, **c_odbc32**, or **c_odbc64**.
- **scope** The scope column is either **C** for CONNECTION or **D** for DATABASE respectively. The scope column identifies if the external environment is launched as one-per-connection or one-per-database.

  For one-per-connection external environments (like PERL, PHP, C_ESQL32, C_ESQL64, C_ODBC32, and C_ODBC64), there is one instance of the external environment for each connection using the external environment. For a one-per-connection, the external environment terminates when the connection terminates.

  For one-per-database external environments (like JAVA and CLR), there is one instance of the external environment for each database using the external environment. Theone-per-database external environment terminates when the database is stopped.
- **supports_result_sets** The supports_result_sets column identifies those external environments that can return result sets. All external environments can return result sets except PERL and PHP.

- **location** The location column identifies the location on the database server computer where the executable/binary for the external environment can be found. It includes the executable/binary name. This path can either be fully qualified or relative. If the path is relative, then the executable/binary must be in a location where the database server can find it.

- **options** The options column identifies any options required on the command line to launch the executable associated with the external environment. You should not modify this column.

- **user_id** The user_id column identifies a user ID in the database that has DBA authority. When the external environment is initially launched, it must make a connection back to the database to set things up for the external environment's usage. By default, this connection is made using the DBA user ID, but if the database administrator prefers to have the external environment use a different user ID with DBA authority, then the user_id column in the SYS.SYSEXTERNENV table would indicate that different user ID instead. Typically, this column in SYS.SYSEXTERNENV is NULL and the database server, by default, uses the DBA user ID.

Another system catalog table stores the non-Java external objects. The table definition for this table is:

```
SYS.SYSEXTERNENVOBJECT (
  object_id    unsigned bigint not null,
  extenv_id    unsigned bigint not null,
  owner        unsigned int    not null,
  name         long varchar    not null,
  contents     long binary     not null,
  update_time  timestamp       not null
)
```

- **object_id** A unique identifier that is generated by the database server.

- **extenv_id** The extenv_id identifies the external environment type (as stored in SYS.SYSEXTERNENV).

- **owner** The owner column identifies the creator/owner of the external object.

- **name** The name column is the name of the external object as specified in the INSTALL EXTERNAL OBJECT statement.

- **contents** The contents column contains the contents of the external object.

- **update_time** The update_time column represents the last time the object was modified (or installed).

Deprecated options

With the introduction of the SYS.SYSEXTERNENV table, some Java-specific options have now been deprecated. These deprecated options are:

```
java_location
java_main_userid
```

Applications that have been using these options to identify which specific Java VM to use or which user ID to use for installing classes and other Java-related administrative tasks should use the ALTER

EXTERNAL ENVIRONMENT statement instead to set the location and user_id values in the SYS.SYSEXTERNENV table for Java.

SQL statements

The following SQL syntax allows you to set or modify the location of external environments in SYS.SYSEXTERNENV table.

```
ALTER EXTERNAL ENVIRONMENT environment-name
     [ LOCATION location-string ]
```

Once an external environment is set up to be used on the database server, you can then install objects into the database and create stored procedures and functions that make use of these objects within the external environment. Installation, creation, and usage of these objects, stored procedures, and stored functions is very similar to the current method of installing Java classes and creating and using Java stored procedures and functions.

To add a comment for an external environment, you can execute:

```
COMMENT ON EXTERNAL ENVIRONMENT environment-name
  IS comment-string
```

To install a Perl or PHP external object (for example, a Perl script) from a file or an expression into the database, you would need to execute an INSTALL EXTERNAL OBJECT statement similar to the following:

```
INSTALL EXTERNAL OBJECT object-name-string
  [ update-mode ]
  FROM { FILE file-path | VALUE expression }
  ENVIRONMENT environment-name
```

To add a comment for an installed Perl or PHP external object, you can execute:

```
COMMENT ON EXTERNAL [ENVIRONMENT] OBJECT object-name-string
  IS comment-string
```

To remove an installed Perl or PHP external object from the database, you would need to use a REMOVE EXTERNAL OBJECT statement:

```
REMOVE EXTERNAL OBJECT object-name-string
```

Once the external objects are installed in the database, they can be used within external stored procedure and function definitions (similar to the current mechanism for creating Java stored procedures and functions).

```
CREATE PROCEDURE procedure-name(...)
  EXTERNAL NAME '...'
  LANGUAGE environment-name

CREATE FUNCTION function-name(...)
  RETURNS ...
  EXTERNAL NAME '...'
  LANGUAGE environment-name
```

Once these stored procedures and functions are created, they can be used like any other stored procedure or function in the database. The database server, when encountering an external environment stored procedure or function, automatically launches the external environment (if it has not already been started),

and sends over whatever information is needed to get the external environment to fetch the external object from the database and execute it. Any result sets or return values resulting from the execution are returned as needed.

If you want to start or stop an external environment on demand, you can use the START EXTERNAL ENVIRONMENT and STOP EXTERNAL ENVIRONMENT statements (similar to the current START JAVA and STOP JAVA statements):

```
START EXTERNAL ENVIRONMENT environment-name
STOP EXTERNAL ENVIRONMENT environment-name
```

For more information, see:

- "ALTER EXTERNAL ENVIRONMENT statement" [*SQL Anywhere Server - SQL Reference*]
- "INSTALL EXTERNAL OBJECT statement" [*SQL Anywhere Server - SQL Reference*]
- "REMOVE EXTERNAL OBJECT statement" [*SQL Anywhere Server - SQL Reference*]
- "COMMENT statement" [*SQL Anywhere Server - SQL Reference*]
- "CREATE FUNCTION statement (external procedures)" [*SQL Anywhere Server - SQL Reference*]
- "CREATE PROCEDURE statement (external procedures)" [*SQL Anywhere Server - SQL Reference*]
- "START EXTERNAL ENVIRONMENT statement" [*SQL Anywhere Server - SQL Reference*]
- "STOP EXTERNAL ENVIRONMENT statement" [*SQL Anywhere Server - SQL Reference*]

The CLR external environment

SQL Anywhere includes support for CLR stored procedures and functions. A CLR stored procedure or function behaves the same as a SQL stored procedure or function except that the code for the procedure or function is written in a .NET language such as C# or Visual Basic, and the execution of the procedure or function takes place outside the database server (that is, within a separate .NET executable). There is only one instance of this .NET executable per database. All connections executing CLR functions and stored procedures use the same .NET executable instance, but the namespaces for each connection are separate. Statics persist for the duration of the connection, but are not shareable across connections. Only .NET version 2.0 is supported.

To call an external CLR function or procedure, you define a corresponding stored procedure or function with an EXTERNAL NAME string defining which DLL to load and which function within the assembly to call. You must also specify LANGUAGE CLR when defining the stored procedure or function. An example declaration follows:

```
CREATE PROCEDURE clr_stored_proc(
    IN p1 INT,
    IN p2 UNSIGNED SMALLINT,
    OUT p3 LONG VARCHAR)
EXTERNAL NAME 'MyCLRTest.dll::MyCLRTest.Run( int, ushort, out string )'
LANGUAGE CLR;
```

In this example, the stored procedure called `clr_stored_proc`, when executed, loads the DLL *MyCLRTest.dll* and calls the function MyCLRTest.Run. The clr_stored_proc procedure takes three SQL parameters, two IN parameters, one of type INT and one of type UNSIGNED SMALLINT, and one OUT parameter of type LONG VARCHAR. On the .NET side, these three parameters translate to input

arguments of type int and ushort and an output argument of type string. In addition to out arguments, the CLR function can also have ref arguments. A user must declared a ref CLR argument if the corresponding stored procedure has an INOUT parameter.

The following table lists the various CLR argument types and the corresponding suggested SQL data type:

CLR type	Recommended SQL data type
bool	bit
byte	tinyint
short	smallint
ushort	unsigned smallint
int	int
uint	unsigned int
long	bigint
ulong	unsigned bigint
decimal	numeric
float	real
double	double
DateTime	timestamp
string	long varchar
byte[]	long binary

The declaration of the DLL can be either a relative or absolute path. If the specified path is relative, then the external .NET executable searches the path, and other locations, for the DLL. The executable does not search the Global Assembly Cache (GAC) for the DLL.

Like the existing Java stored procedures and functions, CLR stored procedures and functions can make server-side requests back to the database, and they can return result sets. Also, like Java, any information output to Console.Out and Console.Error is automatically redirected to the database server messages window.

For more information about how to make server-side requests and how to return result sets from a CLR function or stored procedure, refer to the samples located in the *samples-dir\SQLAnywhere \ExternalEnvironments\CLR* directory.

To use CLR in the database, make sure the database server is able to locate and start the CLR executable. You can verify if the database server is able to locate and start the CLR executable by executing the following statement:

```
START EXTERNAL ENVIRONMENT CLR;
```

If the database server fails to start CLR, then the database server is likely not able to locate the CLR executable. The CLR executable is *dbextclr12.exe*. Make sure that this file is present in the *install-dir\Bin32* or *install-dir\Bin64* folder, depending on which version of the database server you are using.

Note that the START EXTERNAL ENVIRONMENT CLR statement is not necessary other than to verify that the database server can launch CLR executables. In general, making a CLR stored procedure or function call starts CLR automatically.

Similarly, the STOP EXTERNAL ENVIRONMENT CLR statement is not necessary to stop an instance of CLR since the instance automatically goes away when the connection terminates. However, if you are completely done with CLR and you want to free up some resources, then the STOP EXTERNAL ENVIRONMENT CLR statement releases the CLR instance for your connection.

Unlike the Perl, PHP, and Java external environments, the CLR environment does not require the installation of anything in the database. As a result, you do not need to execute any INSTALL statements before using the CLR external environment.

Here is an example of a function written in C# that can be run within an external environment.

```
public class StaticTest
{
    private static int val = 0;

    public static int GetValue() {
        val += 1;
        return val;
    }
}
```

When compiled into a dynamic link library, this function can be called from an external environment. An executable image called *dbextclr12.exe* is started by the database server and it loads the dynamic link library for you. Different versions of this executable are included with SQL Anywhere. For example, on Windows you may have both 32-bit and 64-bit executables. One is for use with the 32-bit version of the database server and the other for the 64-bit version of the database server.

To build this application into a dynamic link library using the Microsoft C# compiler, use a command like the following. The source code for the above example is assumed to reside in a file called *StaticTest.cs*.

```
csc /target:library /out:clrtest.dll StaticTest.cs
```

This command places the compiled code in a DLL called *clrtest.dll*. To call the compiled C# function, GetValue, a wrapper is defined as follows using Interactive SQL:

```
CREATE FUNCTION stc_get_value()
RETURNS INT
EXTERNAL NAME 'clrtest.dll::StaticTest.GetValue() int'
LANGUAGE CLR;
```


For CLR, the EXTERNAL NAME string is specified in a single line of SQL. You may be required to include the path to the DLL as part of the EXTERNAL NAME string so that it can be located. For dependent assemblies (for example, if *myLib.dll* has code that calls functions in, or in some way depends on, *myOtherLib.dll*) then it is up to the .NET Framework to load the dependencies. The CLR External Environment will take care of loading the specified assembly, but extra steps might be required to ensure that dependent assemblies are loaded. One solution is to register all dependencies in the Global Assembly Cache (**GAC**) by using the Microsoft **gacutil** utility installed with the .NET Framework. For custom-developed libraries, gacutil requires that these be signed with a strong name key before they can be registered in the **GAC**.

To execute the sample compiled C# function, execute the following statement.

```
SELECT stc_get_value();
```

Each time the C# function is called, a new integer result is produced. The sequence of values returned is 1, 2, 3, and so on.

For additional information and examples on using the CLR in the database support, refer to the examples located in the *samples-dir\SQLAnywhere\ExternalEnvironments\CLR* directory.

The ESQL and ODBC external environments

SQL Anywhere has had the ability to call compiled native functions written in C or C++ for some time. However, when these procedures are run by the database server, the dynamic link library or shared object has always been loaded by the database server and the calls out to the native functions have always been made by the database server. While having the database server make these native calls is most efficient, there can be serious consequences if the native function misbehaves. In particular, if the native function enters an infinite loop, then the database server can hang, and if the native function causes a fault, then the database server crashes. As a result, you now have the option of running compiled native functions outside the database server, in an external environment. There are some key benefits to running a compiled native function in an external environment:

1. The database server does not hang or crash if the compiled native function misbehaves.

2. The native function can be written to use ODBC, Embedded SQL (ESQL), or the SQL Anywhere C API and can make server-side calls back into the database server without having to make a connection.

3. The native function can return a result set to the database server.

4. In the external environment, a 32-bit database server can communicate with a 64-bit compiled native function and vice versa. Note that this is not possible when the compiled native functions are loaded directly into the address space of the database server. A 32-bit library can only be loaded by a 32-bit server and a 64-bit library can only be loaded by a 64-bit server.

Running a compiled native function in an external environment instead of within the database server results in a small performance penalty.

Also, the compiled native function must use the native function call interface to pass information to and return information from the native function. This interface is described in "SQL Anywhere external call interface" on page 565.

To run a compiled native C function in an external environment instead of within the database server, the stored procedure or function is defined with the EXTERNAL NAME clause followed by the LANGUAGE attribute specifying one of C_ESQL32, C_ESQL64, C_ODBC32, or C_ODBC64.

Unlike the Perl, PHP, and Java external environments, you do not install any source code or compiled objects in the database. As a result, you do not need to execute any INSTALL statements before using the ESQL and ODBC external environments.

Here is an example of a function written in C++ that can be run within the database server or in an external environment.

```
#include <windows.h>
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include "extfnapi.h"

BOOL APIENTRY DllMain( HMODULE hModule,
    DWORD  ul_reason_for_call,
    LPVOID lpReserved
    )
{
    return TRUE;
}

// Note: extfn_use_new_api used only for
// execution in the database server

extern "C" __declspec( dllexport )
a_sql_uint32 extfn_use_new_api( void )
{
    return( EXTFN_API_VERSION );
}

extern "C" __declspec( dllexport )
void SimpleCFunction(
    an_extfn_api *api,
    void *arg_handle )
{
    short               result;
    an_extfn_value      arg;
    an_extfn_value      retval;
    int *               intptr;
    int                 i, j, k;

    j = 1000;
    k = 0;
    for( i = 1; i <= 4; i++ )
    {
        result = api->get_value( arg_handle, i, &arg );
        if( result == 0 || arg.data == NULL ) break;
        if( arg.type & DT_TYPES != DT_INT ) break;
        intptr = (int *) arg.data;
        k += *intptr * j;
        j = j / 10;
    }
```



```
    retval.type = DT_INT;
    retval.data = (void*)&k;
    retval.piece_len = retval.len.total_len =
       (a_sql_uint32) sizeof( int );
    api->set_value( arg_handle, 0, &retval, 0 );
    return;
}
```

When compiled into a dynamic link library or shared object, this function can be called from an external environment. An executable image called *dbexternc12* is started by the database server and this executable image loads the dynamic link library or shared object for you. Different versions of this executable are included with SQL Anywhere. For example, on Windows you may have both 32-bit and 64-bit executables.

Note that 32-bit or 64-bit versions of the database server can be used and either version can start 32-bit or 64-bit versions of *dbexternc12*. This is one of the advantages of using the external environment. Note that once *dbexternc12* is started by the database server, it does not terminate until the connection has been terminated or a STOP EXTERNAL ENVIRONMENT statement (with the correct environment name) is executed. Each connection that does an external environment call will get its own copy of *dbexternc12*.

To call the compiled native function, SimpleCFunction, a wrapper is defined as follows:

```
CREATE FUNCTION SimpleCDemo(
  IN arg1 INT,
  IN arg2 INT,
  IN arg3 INT,
  IN arg4 INT )
RETURNS INT
EXTERNAL NAME 'SimpleCFunction@c:\\c\\extdemo.dll'
LANGUAGE C_ODBC32;
```

This is almost identical to the way a compiled native function is described when it is to be loaded into the database server's address space. The one difference is the use of the LANGUAGE C_ODBC32 clause. This clause indicates that SimpleCDemo is a function running in an external environment and that it is using 32-bit ODBC calls. The language specification of C_ESQL32, C_ESQL64, C_ODBC32, or C_ODBC64 tells the database server whether the external C function issues 32-bit or 64-bit ODBC, ESQL, or SQL Anywhere C API calls when making server-side requests.

When the native function uses none of the ODBC, ESQL, or SQL Anywhere C API calls to make server-side requests, then either C_ODBC32 or C_ESQL32 can be used for 32-bit applications and either C_ODBC64 or C_ESQL64 can be used for 64-bit applications. This is the case in the external C function shown above. It does not use any of these APIs.

To execute the sample compiled native function, execute the following statement.

```
SELECT SimpleCDemo(1,2,3,4);
```

To use server-side ODBC, the C/C++ code must use the default database connection. To get a handle to the database connection, call get_value with an EXTFN_CONNECTION_HANDLE_ARG_NUM argument. The argument tells the database server to return the current external environment connection rather than opening a new one.

```
#include <windows.h>
#include <stdio.h>
```

```
#include "odbc.h"
#include "extfnapi.h"

BOOL APIENTRY DllMain( HMODULE hModule,
    DWORD  ul_reason_for_call,
    LPVOID lpReserved
    )
{
    return TRUE;
}

extern "C" __declspec( dllexport )
void ServerSideFunction( an_extfn_api *api, void *arg_handle )
{
    short               result;
    an_extfn_value      arg;
    an_extfn_value      retval;
    SQLRETURN           ret;

    ret = -1;
    // set up the return value struct
    retval.type = DT_INT;
    retval.data = (void*) &ret;
    retval.piece_len = retval.len.total_len =
        (a_sql_uint32) sizeof( int );

    result = api->get_value( arg_handle,
                    EXTFN_CONNECTION_HANDLE_ARG_NUM,
                    &arg );
    if( result == 0 || arg.data == NULL )
    {
        api->set_value( arg_handle, 0, &retval, 0 );
        return;
    }

    HDBC dbc = (HDBC)arg.data;
    HSTMT stmt = SQL_NULL_HSTMT;
    ret = SQLAllocHandle( SQL_HANDLE_STMT, dbc, &stmt );
    if( ret != SQL_SUCCESS ) return;
    ret = SQLExecDirect( stmt,
            (SQLCHAR *) "INSERT INTO odbcTab "
                "SELECT table_id, table_name "
                "FROM SYS.SYSTAB", SQL_NTS );
    if( ret == SQL_SUCCESS )
    {
        SQLExecDirect( stmt,
            (SQLCHAR *) "COMMIT", SQL_NTS );
    }
    SQLFreeHandle( SQL_HANDLE_STMT, stmt );

    api->set_value( arg_handle, 0, &retval, 0 );
    return;
}
```

If the above ODBC code is stored in the file *extodbc.cpp*, it can be built for Windows using the following commands (assuming that the SQL Anywhere software is installed in the folder *c:\sa12* and that Microsoft Visual C++ is installed).

```
cl extodbc.cpp /LD /Ic:\sa12\sdk\include odbc32.lib
```

The following example creates a table, defines the stored procedure wrapper to call the compiled native function, and then calls the native function to populate the table.


```
CREATE TABLE odbcTab(c1 int, c2 char(128));

CREATE FUNCTION ServerSideODBC( )
RETURNS INT
EXTERNAL NAME 'ServerSideFunction@extodbc.dll'
LANGUAGE C_ODBC32;

SELECT ServerSideODBC();

// The following statement should return two identical rows
SELECT COUNT(*) FROM odbcTab
UNION ALL
SELECT COUNT(*) FROM SYS.SYSTAB;
```

Similarly, to use server-side ESQL, the C/C++ code must use the default database connection. To get a handle to the database connection, call get_value with an EXTFN_CONNECTION_HANDLE_ARG_NUM argument. The argument tells the database server to return the current external environment connection rather than opening a new one.

```
#include <windows.h>
#include <stdio.h>

#include "sqlca.h"
#include "sqlda.h"
#include "extfnapi.h"

BOOL APIENTRY DllMain( HMODULE hModule,
    DWORD  ul_reason_for_call,
    LPVOID lpReserved
    )
{
    return TRUE;
}

EXEC SQL INCLUDE SQLCA;
static SQLCA *_sqlc;
EXEC SQL SET SQLCA "_sqlc";
EXEC SQL WHENEVER SQLERROR { ret = _sqlc->sqlcode; };

extern "C" __declspec( dllexport )
void ServerSideFunction( an_extfn_api *api, void *arg_handle )
{
    short               result;
    an_extfn_value      arg;
    an_extfn_value      retval;

    EXEC SQL BEGIN DECLARE SECTION;
    char *stmt_text =
        "INSERT INTO esqlTab "
            "SELECT table_id, table_name "
            "FROM SYS.SYSTAB";
    char *stmt_commit =
        "COMMIT";
    EXEC SQL END DECLARE SECTION;

    int ret = -1;

    // set up the return value struct
    retval.type = DT_INT;
    retval.data = (void*) &ret;
    retval.piece_len = retval.len.total_len =
        (a_sql_uint32) sizeof( int );
```

```
    result = api->get_value( arg_handle,
                    EXTFN_CONNECTION_HANDLE_ARG_NUM,
                    &arg );
    if( result == 0 || arg.data == NULL )
    {
        api->set_value( arg_handle, 0, &retval, 0 );
        return;
    }
    ret = 0;
    _sqlc = (SQLCA *)arg.data;

    EXEC SQL EXECUTE IMMEDIATE :stmt_text;
    EXEC SQL EXECUTE IMMEDIATE :stmt_commit;

    api->set_value( arg_handle, 0, &retval, 0 );
}
```

If the above embedded SQL statements are stored in the file *extesql.sqc*, it can be built for Windows using the following commands (assuming that the SQL Anywhere software is installed in the folder *c:\sa12* and that Microsoft Visual C++ is installed).

```
sqlpp extesql.sqc extesql.cpp
cl extesql.cpp /LD /Ic:\sa12\sdk\include c:\sa12\sdk\lib\x86\dblibtm.lib
```

The following example creates a table, defines the stored procedure wrapper to call the compiled native function, and then calls the native function to populate the table.

```
CREATE TABLE esqlTab(c1 int, c2 char(128));

CREATE FUNCTION ServerSideESQL( )
RETURNS INT
EXTERNAL NAME 'ServerSideFunction@extesql.dll'
LANGUAGE C_ESQL32;

SELECT ServerSideESQL();

// The following statement should return two identical rows
SELECT COUNT(*) FROM esqlTab
UNION ALL
SELECT COUNT(*) FROM SYS.SYSTAB;
```

As in the previous examples, to use server-side SQL Anywhere C API calls, the C/C++ code must use the default database connection. To get a handle to the database connection, call get_value with an EXTFN_CONNECTION_HANDLE_ARG_NUM argument. The argument tells the database server to return the current external environment connection rather than opening a new one. The following example shows the framework for obtaining the connection handle, initializing the C API environment, and transforming the connection handle into a connection object (**a_sqlany_connection**) that can be used with the SQL Anywhere C API.

```
#include <windows.h>
#include "sacapidll.h"
#include "extfnapi.h"

BOOL APIENTRY DllMain( HMODULE hModule,
    DWORD  ul_reason_for_call,
    LPVOID lpReserved
    )
{
    return TRUE;
```



```
}

extern "C" __declspec( dllexport )
void ServerSideFunction( an_extfn_api *extapi, void *arg_handle )
{
    short               result;
    an_extfn_value      arg;
    an_extfn_value      retval;
    unsigned            offset;
    char                *cmd;

    SQLAnywhereInterface  capi;
    a_sqlany_connection * sqlany_conn;
    unsigned int          max_api_ver;

    result = extapi->get_value( arg_handle,
                    EXTFN_CONNECTION_HANDLE_ARG_NUM,
                    &arg );

    if( result == 0 || arg.data == NULL )
    {
        return;
    }
    if( !sqlany_initialize_interface( &capi, NULL ) )
    {
        return;
    }
    if( !capi.sqlany_init( "MyApp",
            SQLANY_CURRENT_API_VERSION,
            &max_api_ver ) )
    {
        sqlany_finalize_interface( &capi );
        return;
    }
    sqlany_conn = sqlany_make_connection( arg.data );

    // processing code goes here

    capi.sqlany_fini();

    sqlany_finalize_interface( &capi );
    return;
}
```

If the above C code is stored in the file *extcapi.c*, it can be built for Windows using the following commands (assuming that the SQL Anywhere software is installed in the folder *c:\sa12* and that Microsoft Visual C++ is installed).

```
cl /LD /Tp extcapi.c /Tp c:\sa12\SDK\C\sacapidll.c
      /Ic:\sa12\SDK\Include c:\sa12\SDK\Lib\X86\dbcapi.lib
```

The following example defines the stored procedure wrapper to call the compiled native function, and then calls the native function.

```
CREATE FUNCTION ServerSideC()
RETURNS INT
EXTERNAL NAME 'ServerSideFunction@extcapi.dll'
LANGUAGE C_ESQL32;

SELECT ServerSideC();
```

The LANGUAGE attribute in the above example specifies C_ESQL32. For 64-bit applications, you would use C_ESQL64. You must use the embedded SQL language attribute since the SQL Anywhere C API is built on the same layer (library) as ESQL.

As mentioned earlier, each connection that does an external environment call will start its own copy of *dbexternc12*. This executable application is loaded automatically by the server the first time an external environment call is made. However, you can use the START EXTERNAL ENVIRONMENT statement to preload *dbexternc12*. This is useful if you want to avoid the slight delay that is incurred when an external environment call is executed for the first time. Here is an example of the statement.

```
START EXTERNAL ENVIRONMENT C_ESQL32
```

Another case where preloading *dbexternc12* is useful is when you want to debug your external function. You can use the debugger to attach to the running *dbexternc12* process and set breakpoints in your external function.

The STOP EXTERNAL ENVIRONMENT statement is useful when updating a dynamic link library or shared object. It will terminate the native library loader, *dbexternc12*, for the current connection thereby releasing access to the dynamic link library or shared object. If multiple connections are using the same dynamic link library or shared object then each of their copies of *dbexternc12* must be terminated. The appropriate external environment name must be specified in the STOP EXTERNAL ENVIRONMENT statement. Here is an example of the statement.

```
STOP EXTERNAL ENVIRONMENT C_ESQL32
```

To return a result set from an external function, the compiled native function must use the native function call interface. This interface is fully described in "SQL Anywhere external call interface" on page 565. The following are some of the highlights for returning result sets.

The following code fragment shows how to set up a result set information structure. It contains a column count, a pointer to an array of column information structures, and a pointer to an array of column data value structures. The example also uses the SQL Anywhere C API.

```
an_extfn_result_set_info    rs_info;

int columns = capi.sqlany_num_cols( sqlany_stmt );

an_extfn_result_set_column_info *col_info =
    (an_extfn_result_set_column_info *)
    malloc( columns * sizeof(an_extfn_result_set_column_info) );

an_extfn_result_set_column_data *col_data =
    (an_extfn_result_set_column_data *)
    malloc( columns * sizeof(an_extfn_result_set_column_data) );

rs_info.number_of_columns   = columns;
rs_info.column_infos        = col_info;
rs_info.column_data_values  = col_data;
```

The following code fragment shows how to describe the result set. It uses the SQL Anywhere C API to obtain column information for a SQL query that was executed previously by the C API. The information that is obtained from the SQL Anywhere C API for each column is transformed into a column name, type, width, index, and null value indicator that will be used to describe the result set.


```
a_sqlany_column_info        info;
for( int i = 0; i < columns; i++ )
{
    if( sqlany_get_column_info( sqlany_stmt, i, &info ) )
    {
        // set up a column  description
        col_info[i].column_name  = info.name;
        col_info[i].column_type  = info.native_type;
        switch( info.native_type )
        {
            case DT_DATE:       // DATE is converted to string by C API
            case DT_TIME:       // TIME is converted to string by C API
            case DT_TIMESTAMP:  // TIMESTAMP is converted to string by C API
            case DT_DECIMAL:    // DECIMAL is converted to string by C API
                col_info[i].column_type  = DT_FIXCHAR;
                break;
            case DT_FLOAT:      // FLOAT is converted to double by C API
                col_info[i].column_type  = DT_DOUBLE;
                break;
            case DT_BIT:        // BIT is converted to tinyint by C API
                col_info[i].column_type  = DT_TINYINT;
                break;
        }
        col_info[i].column_width = info.max_size;
        col_info[i].column_index = i + 1; // column indices are origin 1
        col_info[i].column_can_be_null = info.nullable;
    }
}
// send the result set description
if( extapi->set_value( arg_handle,
                   EXTFN_RESULT_SET_ARG_NUM,
                   (an_extfn_value *)&rs_info,
                   EXTFN_RESULT_SET_DESCRIBE ) == 0 )
{
    // failed
    free( col_info );
    free( col_data );
    return;
}
```

Once the result set has been described, the result set rows can be returned. The following code fragment shows how to return the rows of the result set. It uses the SQL Anywhere C API to fetch the rows for a SQL query that was executed previously by the C API. The rows returned by the SQL Anywhere C API are sent back, one at a time, to the calling environment. The array of column data value structures must be filled in before returning each row. The column data value structure consists of a column index, a pointer to a data value, a data length, and an append flag.

```
a_sqlany_data_value *value = (a_sqlany_data_value *)
    malloc( columns * sizeof(a_sqlany_data_value) );

while( capi.sqlany_fetch_next( sqlany_stmt ) )
{
    for( int i = 0; i < columns; i++ )
    {
        if( capi.sqlany_get_column( sqlany_stmt, i, &value[i] ) )
        {
            col_data[i].column_index = i + 1;
            col_data[i].column_data  = value[i].buffer;
            col_data[i].data_length  = (a_sql_uint32)*(value[i].length);
            col_data[i].append  = 0;
            if( *(value[i].is_null) )
            {
```

```
                // Received a NULL value
                col_data[i].column_data = NULL;
            }
        }
    }
    if( extapi->set_value(  arg_handle,
                        EXTFN_RESULT_SET_ARG_NUM,
                        (an_extfn_value *)&rs_info,
                        EXTFN_RESULT_SET_NEW_ROW_FLUSH ) == 0 )
    {
        // failed
        free( value );
        free( col_data );
        free( col_data );
        extapi->set_value( arg_handle, 0, &retval, 0 );
        return;
    }
}
```

For additional information, see "SQL Anywhere external call interface" on page 565.

For more information on how to make server-side requests and how to return result sets from an external function, refer to the samples in *samples-dir\SQLAnywhere\ExternalEnvironments\ExternC*.

The Java external environment

SQL Anywhere includes support for Java stored procedures and functions. A Java stored procedure or function behaves the same as a SQL stored procedure or function except that the code for the procedure or function is written in Java and the execution of the procedure or function takes place outside the database server (that is, within a Java VM environment). It should be noted that there is one instance of the Java VM for each database rather than one instance per connection. Java stored procedures can return result sets.

There are a few prerequisites to using Java in the database support:

1. A copy of the Java Runtime Environment must be installed on the database server computer.

2. The SQL Anywhere database server must be able to locate the Java executable (the Java VM).

To use Java in the database, make sure that the database server is able to locate and start the Java executable. Verify that this can be done by executing:

```
START EXTERNAL ENVIRONMENT JAVA;
```

If the database server fails to start Java then the problem probably occurs because the database server is not able to locate the Java executable. In this case, you should execute an ALTER EXTERNAL ENVIRONMENT statement to explicitly set the location of the Java executable. Make sure to include the executable file name.

```
ALTER EXTERNAL ENVIRONMENT JAVA
  LOCATION 'java-path';
```

For example:


```
ALTER EXTERNAL ENVIRONMENT JAVA
  LOCATION 'c:\\jdk1.6.0\\jre\\bin\\java.exe';
```

You can query the location of the Java VM that the database server will use by executing the following SQL query:

```
SELECT db_property('JAVAVM');
```

Note that the START EXTERNAL ENVIRONMENT JAVA statement is not necessary other than to verify that the database server can start the Java VM. In general, making a Java stored procedure or function call starts the Java VM automatically.

Similarly, the STOP EXTERNAL ENVIRONMENT JAVA statement is not necessary to stop an instance of Java since the instance automatically goes away when the all connections to the database have terminated. However, if you are completely done with Java and you want to make it possible to free up some resources, then the STOP EXTERNAL ENVIRONMENT JAVA statement decrements the usage count for the Java VM.

Once you have verified that the database server can start the Java VM executable, the next thing to do is to install the necessary Java class code into the database. Do this by using the INSTALL JAVA statement. For example, you can execute the following statement to install a Java class from a file into the database.

```
INSTALL JAVA
NEW
FROM FILE 'java-class-file';
```

You can also install a Java JAR file into the database.

```
INSTALL JAVA
NEW
JAR 'jar-name'
FROM FILE 'jar-file';
```

Java classes can be installed from a variable, as follows:

```
CREATE VARIABLE JavaClass LONG VARCHAR;
SET JavaClass = xp_read_file('java-class-file')
INSTALL JAVA
NEW
FROM JavaClass;
```

Java JAR files can be installed from a variable, as follows:

```
CREATE VARIABLE JavaJar LONG VARCHAR;
SET JavaJar = xp_read_file('jar-file')
INSTALL JAVA
NEW
JAR 'jar-name'
FROM JavaJar;
```

To remove a Java class from the database, use the REMOVE JAVA statement, as follows:

```
REMOVE JAVA CLASS java-class
```

To remove a Java JAR from the database, use the REMOVE JAVA statement, as follows:

```
REMOVE JAVA JAR 'jar-name'
```

To modify existing Java classes, you can use the UPDATE clause of the INSTALL JAVA statement, as follows:

```
INSTALL JAVA
UPDATE
FROM FILE 'java-class-file'
```

You can also update existing Java JAR files in the database.

```
INSTALL JAVA
UPDATE
JAR 'jar-name'
FROM FILE 'jar-file';
```

Java classes can be updated from a variable, as follows:

```
CREATE VARIABLE JavaClass LONG VARCHAR;
SET JavaClass = xp_read_file('java-class-file')
INSTALL JAVA
UPDATE
FROM JavaClass;
```

Java JAR files can be updated from a variable, as follows:

```
CREATE VARIABLE JavaJar LONG VARCHAR;
SET JavaJar = xp_read_file('jar-file')
INSTALL JAVA
UPDATE
FROM JavaJar;
```

Once the Java class is installed in the database, you can then create stored procedures and functions to interface to the Java methods. The EXTERNAL NAME string contains the information needed to call the Java method and to return OUT parameters and return values. The LANGUAGE attribute of the EXTERNAL NAME clause must specify JAVA. The format of the EXTERNAL NAME clause is:

EXTERNAL NAME '*java-call*' LANGUAGE JAVA

java-call :
[*package-name*.]*class-name*.*method-name method-signature*

method-signature :
([*field-descriptor*, ...] **)** *return-descriptor*

field-descriptor and *return-descriptor* :
Z
| **B**
| **S**
| **I**
| **J**
| **F**
| **D**
| **C**
| **V**
| **[***descriptor*
| **L***class-name***;**

A Java method signature is a compact character representation of the types of the parameters and the type of the return value. If the number of parameters is less than the number indicated in the method-signature,

then the difference must equal the number specified in DYNAMIC RESULT SETS, and each parameter in the method signature that is more than those in the procedure parameter list must have a method signature of `[Ljava/SQL/ResultSet;`.

The *field-descriptor* and *return-descriptor* have the following meanings:

Field type	Java data type
B	byte
C	char
D	double
F	float
I	int
J	long
L *class-name*;	an instance of the class *class-name*. The class name must be fully qualified, and any dot in the name must be replaced by a /. For example, java/lang/String
S	short
V	void
Z	Boolean
[	use one for each dimension of an array

For example,

```
double some_method(
  boolean a,
  int b,
  java.math.BigDecimal c,
  byte [][] d,
  java.sql.ResultSet[] rs ) {
}
```

would have the following signature:

```
'(ZILjava/math/BigDecimal;[[B[Ljava/SQL/ResultSet;)D'
```

The following procedure creates an interface to a Java method. The Java method does not return any value (V).

```
CREATE PROCEDURE insertfix()
EXTERNAL NAME 'JDBCExample.InsertFixed()V'
LANGUAGE JAVA;
```

The following procedure creates an interface to a Java method that has a String ([Ljava/lang/String;) input argument. The Java method does not return any value (V).

```
CREATE PROCEDURE InvoiceMain( IN arg1 CHAR(50) )
EXTERNAL NAME 'Invoice.main([Ljava/lang/String;)V'
LANGUAGE JAVA;
```

The following procedure creates an interface to a Java method Invoice.init which takes a string argument (Ljava/lang/String;), a double (D), another string argument (Ljava/lang/String;), and another double (D), and returns no value (V).

```
CREATE PROCEDURE init( IN arg1 CHAR(50),
                      IN arg2 DOUBLE,
                      IN arg3 CHAR(50),
                      IN arg4 DOUBLE)
EXTERNAL NAME 'Invoice.init(Ljava/lang/String;DLjava/lang/String;D)V'
LANGUAGE JAVA
```

For more information about calling Java methods, see “Accessing methods in the Java class” on page 386.

For more information on returning result sets, see “Returning result sets from Java methods” on page 394.

The following Java example takes a string and writes it to the database server messages window:

```
import java.io.*;

public class Hello
{
    public static void main( String[] args )
    {
        System.out.print( "Hello" );
               for ( int i = 0; i  < args.length; i++ )
                   System.out.print( " " + args[i] );
        System.out.println();
    }
}
```

The Java code above is placed in the file *Hello.java* and compiled using the Java compiler. The class file that results is loaded into the database as follows.

```
INSTALL JAVA
NEW
FROM FILE 'Hello.class';
```

Using Interactive SQL, the stored procedure that will interface to the method `main` in the class `Hello` is created as follows:

```
CREATE PROCEDURE HelloDemo( IN name LONG VARCHAR )
EXTERNAL NAME 'Hello.main([Ljava/lang/String;)V'
LANGUAGE JAVA;
```

Note that the argument to `main` is described as an array of java.lang.String. Using Interactive SQL, test the interface by executing the following SQL statement.

```
CALL HelloDemo('SQL Anywhere');
```

If you check the database server messages window, you will find the message written there. All output to System.out is redirected to the server messages window.

In attempting to trouble shoot why a Java external environment did not start, that is, if the application gets a "main thread not found" error when a Java call is made, the DBA should check the following:

- If the Java VM is a different bitness than the database server, then ensure that the client libraries with the same bitness as the VM are installed on the database server machine.
- Ensure that the *sajdbc.jar* and *dbjdbc12/libdbjdbc12* shared objects are from the same software build.
- If more than one *sajdbc.jar* are on the database server machine, make sure they are all synchronized to the same software version.
- If the database server machine is very busy, then there is a chance the error is being reported due to a timeout.

For additional information and examples on using the Java in the database support, refer to "Java in the database" on page 379.

The PERL external environment

SQL Anywhere includes support for Perl stored procedures and functions. A Perl stored procedure or function behaves the same as a SQL stored procedure or function except that the code for the procedure or function is written in Perl and the execution of the procedure or function takes place outside the database server (that is, within a Perl executable instance). It should be noted that there is a separate instance of the Perl executable for each connection that uses Perl stored procedures and functions. This behavior is different from Java stored procedures and functions. For Java, there is one instance of the Java VM for each database rather than one instance per connection. The other major difference between Perl and Java is that Perl stored procedures do not return result sets, whereas Java stored procedures can return result sets.

There are a few prerequisites to using Perl in the database support:

1. Perl must be installed on the database server computer and the SQL Anywhere database server must be able to locate the Perl executable.
2. The DBD::SQLAnywhere driver must be installed on the database server computer.
3. On Windows, Microsoft Visual Studio must also be installed. This is a prerequisite since it is necessary for installing the DBD::SQLAnywhere driver.

For more information about installing the DBD::SQLAnywhere driver, see "Perl DBI support" on page 613.

In addition to the above prerequisites, the database administrator must also install the SQL Anywhere Perl External Environment module. To install the external environment module:

To install the external environment module (Windows)

- Run the following commands from the *SDK\PerlEnv* subdirectory of your SQL Anywhere installation:

```
perl Makefile.PL
nmake
nmake install
```

To install the external environment module (Unix)

- Run the following commands from the *sdk/perlenv* subdirectory of your SQL Anywhere installation:

```
perl Makefile.PL
make
make install
```

Once the Perl external environment module has been built and installed, the Perl in the database support can be used. Note that Perl in the database support is only available with SQL Anywhere version 11 or later databases. If a SQL Anywhere 10 database is loaded, then an error indicating that external environments are not supported is returned when you try to use the Perl in the database support.

To use Perl in the database, make sure that the database server is able to locate and start the Perl executable. Verify that this can be done by executing:

```
START EXTERNAL ENVIRONMENT PERL;
```

If the database server fails to start Perl, then the problem probably occurs because the database server is not able to locate the Perl executable. In this case, you should execute an ALTER EXTERNAL ENVIRONMENT statement to explicitly set the location of the Perl executable. Make sure to include the executable file name.

```
ALTER EXTERNAL ENVIRONMENT PERL
  LOCATION 'perl-path';
```

For example:

```
ALTER EXTERNAL ENVIRONMENT PERL
  LOCATION 'c:\\Perl\\bin\\perl.exe';
```

Note that the START EXTERNAL ENVIRONMENT PERL statement is not necessary other than to verify that the database server can start Perl. In general, making a Perl stored procedure or function call starts Perl automatically.

Similarly, the STOP EXTERNAL ENVIRONMENT PERL statement is not necessary to stop an instance of Perl since the instance automatically goes away when the connection terminates. However, if you are completely done with Perl and you want to free up some resources, then the STOP EXTERNAL ENVIRONMENT PERL statement releases the Perl instance for your connection.

Once you have verified that the database server can start the Perl executable, the next thing to do is to install the necessary Perl code into the database. Do this by using the INSTALL statement. For example, you can execute the following statement to install a Perl script from a file into the database.

```
INSTALL EXTERNAL OBJECT 'perl-script'
  NEW
  FROM FILE 'perl-file'
  ENVIRONMENT PERL;
```

Perl code also can be built and installed from an expression, as follows:

```
INSTALL EXTERNAL OBJECT 'perl-script'
  NEW
  FROM VALUE 'perl-statements'
  ENVIRONMENT PERL;
```


Perl code also can be built and installed from a variable, as follows:

```
CREATE VARIABLE PerlVariable LONG VARCHAR;
SET PerlVariable = 'perl-statements';
INSTALL EXTERNAL OBJECT 'perl-script'
  NEW
  FROM VALUE PerlVariable
  ENVIRONMENT PERL;
```

To remove Perl code from the database, use the REMOVE statement, as follows:

```
REMOVE EXTERNAL OBJECT 'perl-script'
```

To modify existing Perl code, you can use the UPDATE clause of the INSTALL EXTERNAL OBJECT statement, as follows:

```
INSTALL EXTERNAL OBJECT 'perl-script'
  UPDATE
  FROM FILE 'perl-file'
  ENVIRONMENT PERL

INSTALL EXTERNAL OBJECT 'perl-script'
  UPDATE
  FROM VALUE 'perl-statements'
  ENVIRONMENT PERL

SET PerlVariable = 'perl-statements';
INSTALL EXTERNAL OBJECT 'perl-script'
  UPDATE
  FROM VALUE PerlVariable
  ENVIRONMENT PERL
```

Once the Perl code is installed in the database, you can then create the necessary Perl stored procedures and functions. When creating Perl stored procedures and functions, the LANGUAGE is always PERL and the EXTERNAL NAME string contains the information needed to call the Perl subroutines and to return OUT parameters and return values. The following global variables are available to the Perl code on each call:

- **$sa_perl_return** This is used to set the return value for a function call.
- **$sa_perl_argN** where N is a positive integer [0 .. n]. This is used for passing the SQL arguments down to the Perl code. For example, `$sa_perl_arg0` refers to argument 0, `$sa_perl_arg1` refers to argument 1, and so on.
- **$sa_perl_default_connection** This is used for making server-side Perl calls.
- **$sa_output_handle** This is used for sending output from the Perl code to the database server messages window.

A Perl stored procedure can be created with any set of data types for input and output arguments, and for the return value. However, all non-binary data types are mapped to strings when making the Perl call while binary data is mapped to an array of numbers. A simple Perl example follows:

```
INSTALL EXTERNAL OBJECT 'SimplePerlExample'
  NEW
  FROM VALUE 'sub SimplePerlSub{
```

```
    return( ($_[0] * 1000) +
            ($_[1] * 100) +
            ($_[2] * 10) +
            $_[3] );
  }'
  ENVIRONMENT PERL;

CREATE FUNCTION SimplePerlDemo(
    IN thousands INT,
    IN hundreds INT,
    IN tens INT,
    IN ones INT)
  RETURNS INT
  EXTERNAL NAME '<file=SimplePerlExample>
    $sa_perl_return = SimplePerlSub(
      $sa_perl_arg0,
      $sa_perl_arg1,
      $sa_perl_arg2,
      $sa_perl_arg3)'
  LANGUAGE PERL;

// The number 1234 should appear
SELECT SimplePerlDemo(1,2,3,4);
```

The following Perl example takes a string and writes it to the database server messages window:

```
INSTALL EXTERNAL OBJECT 'PerlConsoleExample'
  NEW
  FROM VALUE 'sub WriteToServerConsole { print $sa_output_handle $_[0]; }'
  ENVIRONMENT PERL;

CREATE PROCEDURE PerlWriteToConsole( IN str LONG VARCHAR)
  EXTERNAL NAME '<file=PerlConsoleExample>
    WriteToServerConsole( $sa_perl_arg0 )'
  LANGUAGE PERL;

// 'Hello world' should appear in the database server messages window
CALL PerlWriteToConsole( 'Hello world' );
```

To use server-side Perl, the Perl code must use the $sa_perl_default_connection variable. The following example creates a table and then calls a Perl stored procedure to populate the table:

```
CREATE TABLE perlTab(c1 int, c2 char(128));

INSTALL EXTERNAL OBJECT 'ServerSidePerlExample'
  NEW
  FROM VALUE 'sub ServerSidePerlSub
    { $sa_perl_default_connection->do(
        "INSERT INTO perlTab SELECT table_id, table_name FROM SYS.SYSTAB" );
      $sa_perl_default_connection->do(
        "COMMIT" );
    }'
  ENVIRONMENT PERL;

CREATE PROCEDURE PerlPopulateTable()
  EXTERNAL NAME '<file=ServerSidePerlExample> ServerSidePerlSub()'
  LANGUAGE PERL;

CALL PerlPopulateTable();

// The following should return 2 identical rows
SELECT count(*) FROM perlTab
```



```
UNION ALL
SELECT count(*) FROM SYS.SYSTAB;
```

For additional information and examples on using the Perl in the database support, refer to the examples located in the *samples-dir\SQLAnywhere\ExternalEnvironments\Perl* directory.

The PHP external environment

SQL Anywhere includes support for PHP stored procedures and functions. A PHP stored procedure or function behaves the same as a SQL stored procedure or function except that the code for the procedure or function is written in PHP and the execution of the procedure or function takes place outside the database server (that is, within a PHP executable instance). There is a separate instance of the PHP executable for each connection that uses PHP stored procedures and functions. This behavior is quite different from Java stored procedures and functions. For Java, there is once instance of the Java VM for each database rather than one instance per connection. The other major difference between PHP and Java is that PHP stored procedures do not return result sets, whereas Java stored procedures can return result sets. PHP only returns an object of type LONG VARCHAR, which is the output of the PHP script.

There are two prerequisites to using PHP in the database support:

1. A copy of PHP must be installed on the database server computer and SQL Anywhere database server must be able to locate the PHP executable.

2. The SQL Anywhere PHP extension (shipped with SQL Anywhere) must be installed on the database server computer. See "Deploying PHP clients" on page 958.

In addition to the above two prerequisites, the database administrator must also install the SQL Anywhere PHP External Environment module. Prebuilt modules for several versions of PHP are included with the SQL Anywhere distribution. To install prebuilt modules, copy the appropriate driver module to your PHP extensions directory (which can be found in *php.ini*). On Unix, you can also use a symbolic link.

To install the external environment module (Windows)

1. Locate the *php.ini* file for your PHP installation, and open it in a text editor. Locate the line that specifies the location of the **extension_dir** directory. If **extension_dir** is not set to any specific directory, it is a good idea to set it to point to an isolated directory for better system security.

2. Copy the desired external environment PHP module from the SQL Anywhere installation directory to your PHP extensions directory. The following is a model to use:

   ```
   copy install-dir\Bin32\php-5.2.6_sqlanywhere_extenv12.dll
     php-dir\ext
   ```

3. Make sure that you have also installed the SQL Anywhere PHP driver from the SQL Anywhere installation directory into your PHP extensions directory. This file name follows the pattern *php-5.x.y_sqlanywhere.dll* where x and y are the version numbers. It should match the version numbers of the file that you copied in step 2.

To install the external environment module (Unix)

1. Locate the *php.ini* file for your PHP installation, and open it in a text editor. Locate the line that specifies the location of the **extension_dir** directory. If **extension_dir** is not set to any specific directory, it is a good idea to set it to point to an isolated directory for better system security.

2. Copy the desired external environment PHP module from the SQL Anywhere installation directory to your PHP installation directory. The following is a model to use:

   ```
   cp install-dir/bin32/php-5.2.6_sqlanywhere_extenv12.so
     php-dir/ext
   ```

3. Make sure that you have also installed the SQL Anywhere PHP driver from the SQL Anywhere installation directory into your PHP extensions directory. This file name follows the pattern *php-5.x.y_sqlanywhere.so* where x and y are the version numbers. It should match the version numbers of the file that you copied in step 2.

PHP in the database support is only available with SQL Anywhere version 11 or later databases. If a SQL Anywhere 10 database is loaded, then an error indicating that external environments are not supported is returned when you try to use the PHP in the database support.

To use PHP in the database, the database server must be able to locate and start the PHP executable. You can verify if the database server is able to locate and start the PHP executable by executing the following statement:

```
START EXTERNAL ENVIRONMENT PHP;
```

If you see a message that states that 'external executable' could not be found, then the problem is that the database server is not able to locate the PHP executable. In this case, you should execute an ALTER EXTERNAL ENVIRONMENT statement to explicitly set the location of the PHP executable including the executable name or you should ensure that the PATH environment variable includes the directory containing the PHP executable.

```
ALTER EXTERNAL ENVIRONMENT PHP
  LOCATION 'php-path';
```

For example:

```
ALTER EXTERNAL ENVIRONMENT PHP
  LOCATION 'c:\\php\\php-5.2.6-win32\\php.exe';
```

To restore the default setting, execute the following statement:

```
ALTER EXTERNAL ENVIRONMENT PHP
  LOCATION 'php';
```

If you see a message that states that 'main thread' could not be found, then check for the following:

- Make sure that both the *php-5.x.y_sqlanywhere* and *php-5.x.y_sqlanywhere_extenv12* modules are located in the directory indicated by **extension_dir**. Check the installation steps described above.
- Make sure that *phpenv.php* can be located. Check that the SQL Anywhere *bin32* folder is in your PATH.
- For Windows, make sure that the 32-bit DLLs (*dbcapi.dll*, *dblib12.dll*, *dbicu12.dll*, *dbicudt12.dll*, *dblgen12.dll*, and *dbextenv12.dll*) can be located. Check that the SQL Anywhere *bin32* folder is in your PATH.
- For Linux, Unix, and Mac OS X make sure that the 32-bit shared objects (*libdbcapi_r*, *libdblib12_r*, *libdbicu12_r*, *libdbicudt12*, *dblgen12.res*, and *libdbextenv12_r*) can be located. Check that the SQL Anywhere *bin32* folder is in your PATH.
- Make sure that the environment variable **PHPRC** is not set, or make sure that it points to the version of PHP that you intend to use.

The START EXTERNAL ENVIRONMENT PHP statement is not necessary other than to verify that the database server can start PHP. In general, making a PHP stored procedure or function call starts PHP automatically.

Similarly, the STOP EXTERNAL ENVIRONMENT PHP statement is not necessary to stop an instance of PHP since the instance automatically goes away when the connection terminates. However, if you are completely done with PHP and you want to free up some resources, then the STOP EXTERNAL ENVIRONMENT PHP statement releases the PHP instance for your connection.

Once you have verified that the database server can start the PHP executable, the next thing to do is to install the necessary PHP code into the database. Do this by using the INSTALL statement. For example, you can execute the following statement to install a particular PHP script into the database.

```
INSTALL EXTERNAL OBJECT 'php-script'
  NEW
  FROM FILE 'php-file'
  ENVIRONMENT PHP;
```

PHP code can also be built and installed from an expression as follows:

```
INSTALL EXTERNAL OBJECT 'php-script'
  NEW
  FROM VALUE 'php-statements'
  ENVIRONMENT PHP;
```

PHP code can also be built and installed from a variable as follows:

```
CREATE VARIABLE PHPVariable LONG VARCHAR;
SET PHPVariable = 'php-statements';
INSTALL EXTERNAL OBJECT 'php-script'
  NEW
  FROM VALUE PHPVariable
  ENVIRONMENT PHP;
```

To remove PHP code from the database, use the REMOVE statement as follows:

```
REMOVE EXTERNAL OBJECT 'php-script';
```

To modify existing PHP code, you can use the UPDATE clause of the INSTALL statement as follows:

```
INSTALL EXTERNAL OBJECT 'php-script'
  UPDATE
```

```
  FROM FILE 'php-file'
  ENVIRONMENT PHP;

INSTALL EXTERNAL OBJECT 'php-script'
  UPDATE
  FROM VALUE 'php-statements'
  ENVIRONMENT PHP;

SET PHPVariable = 'php-statements';
INSTALL EXTERNAL OBJECT 'php-script'
  UPDATE
  FROM VALUE PHPVariable
  ENVIRONMENT PHP;
```

Once the PHP code is installed in the database, you can then go ahead and create the necessary PHP stored procedures and functions. When creating PHP stored procedures and functions, the LANGUAGE is always PHP and the EXTERNAL NAME string contains the information needed to call the PHP subroutines and for returning OUT parameters.

The arguments are passed to the PHP script in the $argv array, similar to the way PHP would take arguments from the command line (that is, $argv[1] is the first argument). To set an output parameter, assign it to the appropriate $argv element. The return value is always the output from the script (as a LONG VARCHAR).

A PHP stored procedure can be created with any set of data types for input or output arguments. However, the parameters are converted to and from a boolean, integer, double, or string for use inside the PHP script. The return value is always an object of type LONG VARCHAR. A simple PHP example follows:

```
INSTALL EXTERNAL OBJECT 'SimplePHPExample'
  NEW
  FROM VALUE '<? function SimplePHPFunction(
    $arg1, $arg2, $arg3, $arg4 )
    { return ($arg1 * 1000) +
      ($arg2 * 100) +
      ($arg3 * 10) +
      $arg4;
    } ?>'
  ENVIRONMENT PHP;

CREATE FUNCTION SimplePHPDemo(
  IN thousands INT,
  IN hundreds INT,
  IN tens INT,
  IN ones INT)
RETURNS LONG VARCHAR
EXTERNAL NAME '<file=SimplePHPExample> print SimplePHPFunction(
    $argv[1], $argv[2], $argv[3], $argv[4]);'
LANGUAGE PHP;

// The number 1234 should appear
SELECT SimplePHPDemo(1,2,3,4);
```

For PHP, the EXTERNAL NAME string is specified in a single line of SQL.

To use server-side PHP, the PHP code can use the default database connection. To get a handle to the database connection, call sasql_pconnect with an empty string argument (" or ""). The empty string argument tells the SQL Anywhere PHP driver to return the current external environment connection rather than opening a new one. The following example creates a table and then calls a PHP stored procedure to populate the table:


```
CREATE TABLE phpTab(c1 int, c2 char(128));

INSTALL EXTERNAL OBJECT 'ServerSidePHPExample'
  NEW
  FROM VALUE '<? function ServerSidePHPSub() {
    $conn = sasql_pconnect( '''' );
    sasql_query( $conn,
    "INSERT INTO phpTab
       SELECT table_id, table_name FROM SYS.SYSTAB" );
    sasql_commit( $conn );
  } ?>'
  ENVIRONMENT PHP;

CREATE PROCEDURE PHPPopulateTable()
EXTERNAL NAME '<file=ServerSidePHPExample> ServerSidePHPSub()'
LANGUAGE PHP;

CALL PHPPopulateTable();

// The following should return 2 identical rows
SELECT count(*) FROM phpTab
UNION ALL
SELECT count(*) FROM SYS.SYSTAB;
```

For PHP, the EXTERNAL NAME string is specified in a single line of SQL. In the above example, note that the single quotes are doubled-up because of the way quotes are parsed in SQL. If the PHP source code was in a file, then the single quotes would not be doubled-up.

To return an error back to the database server, throw a PHP exception. The following example shows how to do this.

```
CREATE TABLE phpTab(c1 int, c2 char(128));

INSTALL EXTERNAL OBJECT 'ServerSidePHPExample'
  NEW
  FROM VALUE '<? function ServerSidePHPSub() {
    $conn = sasql_pconnect( '''' );
    if( !sasql_query( $conn,
      "INSERT INTO phpTabNoExist
         SELECT table_id, table_name FROM SYS.SYSTAB" )
    ) throw new Exception(
      sasql_error( $conn ),
      sasql_errorcode( $conn )
    );
    sasql_commit( $conn );
  } ?>'
  ENVIRONMENT PHP;

CREATE PROCEDURE PHPPopulateTable()
  EXTERNAL NAME
    '<file=ServerSidePHPExample> ServerSidePHPSub()'
  LANGUAGE PHP;

CALL PHPPopulateTable();
```

The above example should terminate with error SQLE_UNHANDLED_EXTENV_EXCEPTION indicating that the table `phpTabNoExist` could not be found.

For additional information and examples on using the PHP in the database support, refer to the examples located in the *samples-dir\SQLAnywhere\ExternalEnvironments\PHP* directory.

Perl DBI support

DBD::SQLAnywhere is the SQL Anywhere database driver for DBI, which is a data access API for the Perl language. The DBI API specification defines a set of functions, variables and conventions that provide a consistent database interface independent of the actual database being used. Using DBI and DBD::SQLAnywhere, your Perl scripts have direct access to SQL Anywhere database servers.

Introduction to DBD::SQLAnywhere

DBD::SQLAnywhere is a driver for the Database Independent Interface for Perl (DBI) module written by Tim Bunce. Once you have installed the DBI module and DBD::SQLAnywhere, you can access and change the information in SQL Anywhere databases from Perl.

The DBD::SQLAnywhere driver is thread-safe when using Perl with ithreads.

Requirements

The DBD::SQLAnywhere interface requires the following components.

- Perl 5.6.0 or later. On Windows, ActivePerl 5.6.0 build 616 or later is required.
- DBI 1.34 or later.
- A C compiler. On Windows, only the Microsoft Visual C++ compiler is supported.

Installing Perl/DBI support on Windows

To prepare your computer

1. Install ActivePerl 5.6.0 or later. You can use the ActivePerl installer to install Perl and configure your computer. You do not need to recompile Perl.
2. Install Microsoft Visual Studio and configure your environment.

   If you did not choose to configure your environment at install time, you must set your PATH, LIB, and INCLUDE environment variables correctly before proceeding. Microsoft provides a batch file for this purpose. For 32-bit builds, a batch file called *vcvars32.bat* is included in the *vc\bin* subdirectory of the Visual Studio 2005 or 2008 installation. For 64-bit builds, look for a 64-bit version of this batch file such as *vcvarsamd64.bat*. Open a new system command prompt and run this batch file before continuing.

   For more information on configuring a 64-bit Visual C++ build environment, see http://msdn.microsoft.com/en-us/library/x4d2c09s.aspx.

To install the DBI Perl module on Windows

1. At a command prompt, change to the *bin* subdirectory of your ActivePerl installation directory.

   The system command prompt is strongly recommended as the following steps may not work from alternative shells.

2. Using the Perl Module Manager, enter the following command.

   ```
   ppm query dbi
   ```

   If ppm fails to run, check that Perl is installed correctly.

   This command should generate two lines of text similar to those shown below. In this case, the information indicates that ActivePerl version 5.8.1 build 807 is running and that DBI version 1.38 is installed.

   ```
   Querying target 1 (ActivePerl 5.8.1.807)
     1. DBI [1.38] Database independent interface for Perl
   ```

   Later versions of Perl may show instead a table similar to the following. In this case, the information indicates that DBI version 1.58 is installed.

name	version	abstract	area
DBI	1.58	Database independent interface for Perl	perl

   If DBI is not installed, you must install it. To do so, enter the following command at the ppm prompt.

   ```
   ppm install dbi
   ```

To install DBD::SQLAnywhere on Windows

1. At a command prompt, change to the *SDK\Perl* subdirectory of your SQL Anywhere installation.

2. Enter the following commands to build and test DBD::SQLAnywhere.

   ```
   perl Makefile.PL
   ```

   ```
   nmake
   ```

   If for any reason you need to start over, you can run the command **nmake clean** to remove any partially built targets.

3. To test DBD::SQLAnywhere, copy the sample database file to your *SDK\Perl* directory and make the tests.

   ```
   copy "samples-dir\demo.db" .
   ```

   For information about the default location of *samples-dir*, see "Samples directory" [*SQL Anywhere Server - Database Administration*].

   ```
   dbeng12 demo
   ```



```
nmake test
```

If the tests do not run, ensure that the *bin32* or *bin64* subdirectory of the SQL Anywhere installation is in your path.

4. To complete the installation, execute the following command at the same prompt.

```
nmake install
```

The DBD::SQLAnywhere interface is now ready to use.

Installing Perl/DBI support on Unix and Mac OS X

The following procedure documents how to install the DBD::SQLAnywhere interface on the supported Unix platforms, including Mac OS X.

To prepare your computer

1. Install ActivePerl 5.6.0 build 616 or later.
2. Install a C compiler.

To install the DBI Perl module on Unix and Mac OS X

1. Download the DBI module source from http://www.cpan.org.
2. Extract the contents of this file into a new directory.
3. At a command prompt, change to the new directory and execute the following commands to build the DBI module.

```
perl Makefile.PL
```

```
make
```

If for any reason you need to start over, you can use the command **make clean** to remove any partially built targets.

4. Use the following command to test the DBI module.

```
make test
```

5. To complete the installation, execute the following command at the same prompt.

```
make install
```

6. Optionally, you can now delete the DBI source tree. It is no longer required.

To install DBD::SQLAnywhere on Unix and Mac OS X

1. Make sure the environment is set up for SQL Anywhere.

   Depending on which shell you are using, enter the appropriate command to source the SQL Anywhere configuration script from the SQL Anywhere installation directory:

In this shell ...	... use this command
sh, ksh, or bash	*. bin/sa_config.sh*
csh or tcsh	source *bin/sa_config.csh*

2. At a shell prompt, change to the *sdk/perl* subdirectory of your SQL Anywhere installation.

3. At a command prompt, run the following commands to build DBD::SQLAnywhere.

   ```
   perl Makefile.PL
   make
   ```

   If for any reason you need to start over, you can use the command **make clean** to remove any partially built targets.

4. To test DBD::SQLAnywhere, copy the sample database file to your *sdk/perl* directory and make the tests.

   ```
   cp samples-dir/demo.db .
   dbeng12 demo
   make test
   ```

   If the tests do not run, ensure that the *bin32* or *bin64* subdirectory of the SQL Anywhere installation is in your path.

5. To complete the installation, execute the following command at the same prompt.

   ```
   make install
   ```

The DBD::SQLAnywhere interface is now ready to use.

Writing Perl scripts that use DBD::SQLAnywhere

This section provides an overview of how to write Perl scripts that use the DBD::SQLAnywhere interface. DBD::SQLAnywhere is a driver for the DBI module. Complete documentation for the DBI module is available online at http://dbi.perl.org.

Loading the DBI module

To use the DBD::SQLAnywhere interface from a Perl script, you must first tell Perl that you plan to use the DBI module. To do so, include the following line at the top of the file.

```
use DBI;
```

In addition, it is highly recommended that you run Perl in strict mode. This statement, which for example makes explicit variable definitions mandatory, is likely to greatly reduce the chance that you will run into mysterious errors due to such common mistakes as typographical errors.

```
#!/usr/local/bin/perl -w
#
use DBI;
use strict;
```

The DBI module automatically loads the DBD drivers, including DBD::SQLAnywhere, as required.

Opening and closing a connection

Generally, you open a single connection to a database and then perform all the required operations through it by executing a sequence of SQL statements. To open a connection, you use the connect method. The return value is a handle to the database connection that you use to perform subsequent operations on that connection.

The parameters to the connect method are as follows:

1. "DBI:SQLAnywhere:" and additional connection parameters separated by semicolons.
2. A user name. Unless this string is blank, ";UID=*value*" is appended to the connection string.
3. A password value. Unless this string is blank, ";PWD=*value*" is appended to the connection string.
4. A pointer to a hash of default values. Settings such as AutoCommit, RaiseError, and PrintError may be set in this manner.

The following code sample opens and closes a connection to the SQL Anywhere sample database. You must start the database server and sample database before running this script.

```
#!/usr/local/bin/perl -w
#
use DBI;
use strict;
my $database = "demo";
my $data_src = "DBI:SQLAnywhere:SERVER=$database;DBN=$database";
my $uid      = "DBA";
my $pwd      = "sql";
my %defaults = (
     AutoCommit => 1, # Autocommit enabled.
     PrintError => 0  # Errors not automatically printed.
   );
my $dbh = DBI->connect($data_src, $uid, $pwd, \%defaults)
  or die "Cannot connect to $data_src: $DBI::errstr\n";
$dbh->disconnect;
```

```
exit(0);
__END__
```

Optionally, you can append the user name or password value to the data-source string instead of supplying them as separate parameters. If you do so, supply a blank string for the corresponding argument. For example, in the above script may be altered by replacing the statement that opens the connections with these statements:

```
$data_src .= ";UID=$uid";
$data_src .= ";PWD=$pwd";
my $dbh = DBI->connect($data_src, '', '', \%defaults)
  or die "Cannot connect to $data_src: $DBI::errstr\n";
```

Selecting data

Once you have obtained a handle to an open connection, you can access and modify data stored in the database. Perhaps the simplest operation is to retrieve some rows and print them out.

SQL statements that return row sets must be prepared before being executed. The prepare method returns a handle to the statement. You use the handle to execute the statement, then retrieve meta information about the result set and the rows of the result set.

```
#!/usr/local/bin/perl -w
#
use DBI;
use strict;
my $database = "demo";
my $data_src = "DBI:SQLAnywhere:SERVER=$database;DBN=$database";
my $uid      = "DBA";
my $pwd      = "sql";
my $sel_stmt = "SELECT ID, GivenName, Surname
                FROM Customers
                ORDER BY GivenName, Surname";
my %defaults = (
     AutoCommit => 0, # Require explicit commit or rollback.
     PrintError => 0
   );
my $dbh = DBI->connect($data_src, $uid, $pwd, \%defaults)
  or die "Cannot connect to $data_src: $DBI::errstr\n";
&db_query($sel_stmt, $dbh);
$dbh->rollback;
$dbh->disconnect;
exit(0);

sub db_query {
      my($sel, $dbh) = @_;
      my($row, $sth) = undef;
      $sth = $dbh->prepare($sel);
      $sth->execute;
      print "Fields:     $sth->{NUM_OF_FIELDS}\n";
      print "Params:     $sth->{NUM_OF_PARAMS}\n\n";
      print join("\t\t", @{$sth->{NAME}}), "\n\n";
      while($row = $sth->fetchrow_arrayref) {
         print join("\t\t", @$row), "\n";
      }
      $sth = undef;
}
__END__
```


Prepared statements are not dropped from the database server until the Perl statement handle is destroyed. To destroy a statement handle, reuse the variable or set it to undef. Calling the finish method does not drop the handle. In fact, the finish method should not be called, except when you have decided not to finish reading a result set.

To detect handle leaks, the SQL Anywhere database server limits the number of cursors and prepared statements permitted to a maximum of 50 per connection by default. The resource governor automatically generates an error if these limits are exceeded. If you get this error, check for undestroyed statement handles. Use prepare_cached sparingly, as the statement handles are not destroyed.

If necessary, you can alter these limits by setting the max_cursor_count and max_statement_count options. See “max_cursor_count option” [*SQL Anywhere Server - Database Administration*], and “max_statement_count option” [*SQL Anywhere Server - Database Administration*].

Inserting rows

Inserting rows requires a handle to an open connection. The simplest method is to use a parameterized INSERT statement, meaning that question marks are used as place holders for values. The statement is first prepared, and then executed once per new row. The new row values are supplied as parameters to the execute method.

The following sample program inserts two new customers. Although the row values appear as literal strings, you may want to read the values from a file.

```
#!/usr/local/bin/perl -w
#
use DBI;
use strict;
my $database = "demo";
my $data_src = "DBI:SQLAnywhere:SERVER=$database;DBN=$database";
my $uid      = "DBA";
my $pwd      = "sql";
my $ins_stmt = "INSERT INTO Customers (ID, GivenName, Surname,
                        Street, City, State, Country, PostalCode,
                        Phone, CompanyName)
                VALUES (?, ?, ?, ?, ?, ?, ?, ?, ?, ?)";
my %defaults = (
     AutoCommit => 0, # Require explicit commit or rollback.
     PrintError => 0
   );
my $dbh = DBI->connect($data_src, $uid, $pwd, \%defaults)
     or die "Can't connect to $data_src: $DBI::errstr\n";
&db_insert($ins_stmt, $dbh);
$dbh->commit;
$dbh->disconnect;
exit(0);

sub db_insert {
      my($ins, $dbh) = @_;
      my($sth) = undef;
      my @rows = (
        "801,Alex,Alt,5 Blue Ave,New York,NY,USA,10012,5185553434,BXM",
        "802,Zach,Zed,82 Fair St,New York,NY,USA,10033,5185552234,Zap"
       );
      $sth = $dbh->prepare($ins);
      my $row = undef;
```

```
        foreach $row ( @rows ) {
          my @values = split(/,/, $row);
          $sth->execute(@values);
        }
}
__END__
```


Python support

The SQL Anywhere Python database interface, sqlanydb, is a data access API for the Python language. This section describes how to use SQL Anywhere with Python.

Introduction to sqlanydb

The SQL Anywhere Python database interface, sqlanydb, is a data access API for the Python language. The Python Database API specification defines a set of methods that provides a consistent database interface independent of the actual database being used. Using the sqlanydb module, your Python scripts have direct access to SQL Anywhere database servers.

The sqlanydb module implements, with extensions, the Python Database API specification v2.0 written by Marc-André Lemburg. Once you have installed the sqlanydb module, you can access and change the information in SQL Anywhere databases from Python.

For information about the Python Database API specification v2.0, see http://www.python.org/dev/peps/pep-0249/.

The sqlanydb module is thread-safe when using Python with threads.

Requirements

The sqlanydb module requires the following components.

- Python is required. For a list of supported versions, see http://www.sybase.com/detail?id=1068981.
- The ctypes module is required. To test if the ctypes module is present, open a command prompt window and run Python.

  At the Python prompt, enter the following statement.

  ```
  import ctypes
  ```

  If you see an error message, then ctypes is not present. The following is an example.

  ```
  >>> import ctypes
  Traceback (most recent call last):
    File "<stdin>", line 1, in ?
  ImportError: No module named ctypes
  ```

  If ctypes is not included in your Python installation, install it. Installs can be found in the SourceForge.net files section at http://sourceforge.net/project/showfiles.php?group_id=71702.

  Peak EasyInstall also installs ctypes. To download Peak EasyInstall, go to http://peak.telecommunity.com/DevCenter/EasyInstall.

Installing Python support on Windows

To prepare your computer

1. Install Python. For a list of supported versions, see http://www.sybase.com/detail?id=1068981.
2. Install the ctypes module if missing.

To install the sqlanydb module on Windows

1. At a system command prompt, change to the *SDK\Python* subdirectory of your SQL Anywhere installation.
2. Run the following command to install sqlanydb.

   ```
   python setup.py install
   ```

3. To test sqlanydb, copy the sample database file to your *SDK\Python* directory and run a test.

   ```
   copy "samples-dir\demo.db" .
   dbeng12 demo
   python Scripts\test.py
   ```

   If the tests do not run, ensure that the *bin32* or *bin64* subdirectory of the SQL Anywhere installation is in your path.

The sqlanydb module is now ready to use.

Installing Python support on Unix and Mac OS X

The following procedure documents how to install the sqlanydb module on the supported Unix platforms, including Mac OS X.

To prepare your computer

1. Install Python. For a list of supported versions, see http://www.sybase.com/detail?id=1068981.
2. Install the ctypes module if missing.

To install the sqlanydb module on Unix and Mac OS X

1. Make sure the environment is set up for SQL Anywhere.

   Depending on which shell you are using, enter the appropriate command to source the SQL Anywhere configuration script from the SQL Anywhere installation directory (*bin64* may be used in place of *bin32*, if you have the 64-bit software installed):

In this shell ...	... use this command
sh, ksh, or bash	*. bin32/sa_config.sh*

In this shell ...	... use this command
csh or tcsh	source *bin32/sa_config.csh*

2. At a shell prompt, change to the *sdk/python* subdirectory of your SQL Anywhere installation.
3. Enter the following command to install sqlanydb.

   ```
   python setup.py install
   ```

4. To test sqlanydb, copy the sample database file to your *sdk/python* directory and run a test.

   ```
   cp samples-dir/demo.db .
   dbeng12 demo
   python scripts/test.py
   ```

   The test script makes a connection to the database server and executes a SQL query. If successful, the test displays the message `sqlanydb successfully installed.`

   If the test does not run, ensure that the *bin32* or *bin64* subdirectory of the SQL Anywhere installation is in your path.

The sqlanydb module is now ready to use.

Writing Python scripts that use sqlanydb

This section provides an overview of how to write Python scripts that use the sqlanydb interface. Complete documentation for the API is available online at http://www.python.org/dev/peps/pep-0249/.

Loading the sqlanydb module

To use the sqlanydb module from a Python script, you must first load it by including the following line at the top of the file.

```
import sqlanydb
```

Opening and closing a connection

Generally, you open a single connection to a database and then perform all the required operations through it by executing a sequence of SQL statements. To open a connection, you use the connect method. The return value is a handle to the database connection that you use to perform subsequent operations on that connection.

The parameters to the connect method are specified as a series of keyword=value pairs delimited by commas.

```
sqlanydb.connect( keyword=value, ...)
```

Some common connection parameters are as follows:

- **DataSourceName="*dsn*"** A short form for this connection parameter is **DSN**="*dsn*". An example is DataSourceName="SQL Anywhere 12 Demo".
- **UserID="*user-id*"** A short form for this connection parameter is **UID**="*user-id*". An example is UserID="DBA".
- **Password="*passwd*"** A short form for this connection parameter is **PWD**="*passwd*". An example is Password="sql".
- **DatabaseFile="*db-file*"** A short form for this connection parameter is **DBF**="*db-file*". An example is DatabaseFile="demo.db".

For the complete list of connection parameters, see "Connection parameters" [*SQL Anywhere Server - Database Administration*].

The following code sample opens and closes a connection to the SQL Anywhere sample database. You must start the database server and sample database before running this script.

```
import sqlanydb

# Create a connection object
con = sqlanydb.connect( userid="DBA",
                        password="sql" )
# Close the connection
con.close()
```

To avoid starting the database server manually, you could use a data source that is configured to start the server. This is shown in the following example.

```
import sqlanydb

# Create a connection object
con = sqlanydb.connect( DSN="SQL Anywhere 12 Demo" )

# Close the connection
con.close()
```

Selecting data

Once you have obtained a handle to an open connection, you can access and modify data stored in the database. Perhaps the simplest operation is to retrieve some rows and print them out.

The cursor method is used to create a cursor on the open connection. The execute method is used to create a result set. The fetchall method is used to obtain the rows in this result set.

```
import sqlanydb

# Create a connection object, then use it to create a cursor
con = sqlanydb.connect( userid="DBA",
                        password="sql" )
cursor = con.cursor()
```



```
# Execute a SQL string
sql = "SELECT * FROM Employees"
cursor.execute(sql)

# Get a cursor description which contains column names
desc = cursor.description
print len(desc)

# Fetch all results from the cursor into a sequence,
# display the values as column name=value pairs,
# and then close the connection
rowset = cursor.fetchall()
for row in rowset:
    for col in range(len(desc)):
        print "%s=%s" % (desc[col][0], row[col] )
    print
cursor.close()
con.close()
```

Inserting rows

The simplest way to insert rows into a table is to use a non-parameterized INSERT statement, meaning that values are specified as part of the SQL statement. A new statement is constructed and executed for each new row. As in the previous example, a cursor is required to execute SQL statements.

The following sample program inserts two new customers into the sample database. Before disconnecting, it commits the transactions to the database.

```
import sqlanydb

# Create a connection object, then use it to create a cursor
con = sqlanydb.connect( userid="DBA", pwd="sql" )
cursor = con.cursor()
cursor.execute("DELETE FROM Customers WHERE ID > 800")

rows = ((801,'Alex','Alt','5 Blue Ave','New York','NY',
        'USA','10012','5185553434','BXM'),
        (802,'Zach','Zed','82 Fair St','New York','NY',
        'USA','10033','5185552234','Zap'))

# Set up a SQL INSERT
parms = ("'%s'," * len(rows[0]))[:-1]
sql = "INSERT INTO Customers VALUES (%s)" % (parms)
print sql % rows[0]
cursor.execute(sql % rows[0])
print sql % rows[1]
cursor.execute(sql % rows[1])
cursor.close()
con.commit()
con.close()
```

An alternate technique is to use a parameterized INSERT statement, meaning that question marks are used as place holders for values. The executemany method is used to execute an INSERT statement for each member of the set of rows. The new row values are supplied as a single argument to the executemany method.

```
import sqlanydb
```

```
# Create a connection object, then use it to create a cursor
con = sqlanydb.connect( userid="DBA", pwd="sql" )
cursor = con.cursor()
cursor.execute("DELETE FROM Customers WHERE ID > 800")

rows = ((801,'Alex','Alt','5 Blue Ave','New York','NY',
        'USA','10012','5185553434','BXM'),
       (802,'Zach','Zed','82 Fair St','New York','NY',
        'USA','10033','5185552234','Zap'))

# Set up a parameterized SQL INSERT
parms = ("?," * len(rows[0]))[:-1]
sql = "INSERT INTO Customers VALUES (%s)" % (parms)
print sql
cursor.executemany(sql, rows)
cursor.close()
con.commit()
con.close()
```

Although both examples may appear to be equally suitable techniques for inserting row data into a table, the latter example is superior for a couple of reasons. If the data values are obtained by prompts for input, then the first example is susceptible to injection of rogue data including SQL statements. In the first example, the execute method is called for each row to be inserted into the table. In the second example, the executemany method is called only once to insert all the rows into the table.

Database type conversion

To control how database types are mapped into Python objects when results are fetched from the database server, conversion callbacks can be registered.

Callbacks are registered using the module level register_converter method. This method is called with the database type as the first parameter and the conversion function as the second parameter. For example, to request that sqlanydb create Decimal objects for data in any column described as having type DT_DECIMAL, you would use the following example:

```
import sqlanydb
import decimal

def convert_to_decimal(num):
    return decimal.Decimal(num)

sqlanydb.register_converter(sqlanydb.DT_DECIMAL, convert_to_decimal)
```

Converters may be registered for the following database types:

```
DT_DATE
DT_TIME
DT_TIMESTAMP
DT_VARCHAR
DT_FIXCHAR
DT_LONGVARCHAR
DT_DOUBLE
DT_FLOAT
DT_DECIMAL
DT_INT
```



```
DT_SMALLINT
DT_BINARY
DT_LONGBINARY
DT_TINYINT
DT_BIGINT
DT_UNSINT
DT_UNSSMALLINT
DT_UNSBIGINT
DT_BIT
```

The following example demonstrates how to convert decimal results to integer resulting in the truncation of any digits after the decimal point. Note that the salary amount displayed when the application is run is an integral value.

```
import sqlanydb

def convert_to_int(num):
    return int(float(num))

sqlanydb.register_converter(sqlanydb.DT_DECIMAL, convert_to_int)

# Create a connection object, then use it to create a cursor
con = sqlanydb.connect( userid="DBA",
                        password="sql" )
cursor = con.cursor()

# Execute a SQL string
sql = "SELECT * FROM Employees WHERE EmployeeID=105"
cursor.execute(sql)

# Get a cursor description which contains column names
desc = cursor.description
print len(desc)

# Fetch all results from the cursor into a sequence,
# display the values as column name=value pairs,
# and then close the connection
rowset = cursor.fetchall()
for row in rowset:
    for col in range(len(desc)):
        print "%s=%s" % (desc[col][0], row[col] )
    print
cursor.close()
con.close()
```

PHP support

SQL Anywhere PHP extension

PHP, which stands for **PHP: Hypertext Preprocessor**, is an open source scripting language. Although it can be used as a general-purpose scripting language, it was designed to be a convenient language in which to write scripts that could be embedded with HTML documents. Unlike scripts written in JavaScript, which are frequently executed by the client, PHP scripts are processed by the web server, and the resulting HTML output sent to the clients. The syntax of PHP is derived from that of other popular languages, such as Java and Perl.

To make it a convenient language in which to develop dynamic web pages, PHP provides the ability to retrieve information from many popular databases, such as SQL Anywhere. Included with SQL Anywhere is an extension that provides access to SQL Anywhere databases from PHP. You can use the SQL Anywhere PHP extension and the PHP language to write standalone scripts and create dynamic web pages that rely on information stored in SQL Anywhere databases.

The SQL Anywhere PHP extension provides a native means of accessing your databases from PHP. You might prefer it to other PHP data access techniques because it is simple, and it helps to avoid system resource leaks that can occur with other techniques.

Prebuilt versions of the PHP extension are provided for Windows, Linux, and Solaris and are installed in the binaries subdirectories of your SQL Anywhere installation. Source code for the SQL Anywhere PHP extension is installed in the *sdk\php* subdirectory of your SQL Anywhere installation.

For more information and the latest SQL Anywhere PHP drivers, see http://www.sybase.com/detail?id=1019698.

For information on installing the SQL Anywhere PHP extension, see "Deploying PHP clients" on page 958.

Testing the PHP extension

Once all of the required PHP components have been installed on your system, you can do a quick check to verify that the SQL Anywhere PHP extension is working correctly.

To test the PHP extension

1. Make sure that the *bin32* subdirectory of your SQL Anywhere installation is in your path. The SQL Anywhere PHP extension requires the *bin32* directory to be in your path.

2. At a command prompt, run the following command to start the SQL Anywhere sample database.

   ```
   dbeng12 samples-dir\demo.db
   ```

The command starts a database server using the sample database.

3. At a command prompt, change to the *SDK\PHP\Examples* subdirectory of your SQL Anywhere installation. Make sure that the **php** executable directory is included in your path. Enter the following command:

   ```
   php test.php
   ```

   Messages similar to the following should appear. If the PHP command is not recognized, verify that PHP is in your path.

   ```
   Installation successful
   Using php-5.2.11_sqlanywhere.dll
   Connected successfully
   ```

   If the SQL Anywhere PHP extension does not load, you can use the command "php -i" for helpful information about your PHP setup. Search for **extension_dir** and **sqlanywhere** in the output from this command.

4. When you are done, stop the SQL Anywhere database server by clicking Shut Down in the database server messages window.

For more information, see "Creating PHP test pages" on page 630.

Running PHP test scripts in your web pages

This section describes how to write PHP test scripts that query the sample database and display information about PHP.

Creating PHP test pages

The following instructions apply to all configurations.

To test whether PHP is set up properly, the following procedure describes how to create and run a web page that calls phpinfo. The PHP function, phpinfo, generates a page of system setup information. The output tells you whether PHP is working properly.

For information about installing PHP, see http://us2.php.net/install.

To create a PHP information test page

1. Create a file in your root web content directory named *info.php*.

   If you are not sure which directory to use, check your web server's configuration file. In Apache installations, the content directory is often called *htdocs*. If you are using Mac OS X, the web content directory name may depend on which account you are using:

   - If you are the System Administrator on a Mac OS X system, use */Library/WebServer/Documents*.

- If you are a Mac OS X user, place the file in */Users/your-user-name/Sites/*.

2. Insert the following code into this file:

```
<?php phpinfo(); ?>
```

   This confirms that your installation of PHP and your web server are working together properly.

3. At a command prompt, run the following command to start the SQL Anywhere sample database (if you have not already done so):

```
dbeng12 samples-dir\demo.db
```

4. To test that PHP and your web server are working correctly with SQL Anywhere:
   a. Copy the file *connect.php* from the *sdk\php\examples* directory to your root web content directory.
   b. From a web browser, access the *connect.php* page.

      The message `Connected successfully` should appear.

To create the query page that uses the SQL Anywhere PHP extension

- Create a file containing the following PHP code in your root web content directory named *sa_test.php*.

```
<?php
  $conn = sasql_connect( "UID=DBA;PWD=sql" );
  $result = sasql_query( $conn, "SELECT * FROM Employees" );
  sasql_result_all( $result );
  sasql_free_result( $result );
  sasql_disconnect( $conn );
?>
```

Accessing your test web pages

The following procedure describes how to view your test pages from a web browser, after installing and configuring PHP and the SQL Anywhere PHP extension.

To view your web pages

1. Restart your web server.

   For example, to start the Apache web server, run the following command from the *bin* subdirectory of your Apache installation:

```
apachectl start
```

2. On Linux or Mac OS X, set the SQL Anywhere environment variables using one of the supplied scripts.

   Depending on which shell you are using, enter the appropriate command to source the SQL Anywhere configuration script from your SQL Anywhere installation directory:

In this shell ...	... use this command
sh, ksh, or bash	`. /bin32/sa_config.sh`
csh or tcsh	`source /bin32/sa_config.csh`

3. Start the SQL Anywhere database server.

   For example, to access the test web pages described above, use the following command to start the SQL Anywhere sample database.

   ```
   dbeng12 samples-dir\demo.db
   ```

4. To access the test pages from a browser that is running on the same computer as the server, enter the following URLs:

For this test page ...	... use this URL
info.php	`http://localhost/info.php`
sa_test.php	`http://localhost/sa_test.php`

   If everything is configured correctly, the sa_test page displays the contents of the Employees table.

Writing PHP scripts

This section describes how to write PHP scripts that use the SQL Anywhere PHP extension to access SQL Anywhere databases.

The source code for these and other examples is located in the *SDK\PHP\Examples* subdirectory of your SQL Anywhere installation.

Connecting to a database

To make a connection to a database, pass a standard SQL Anywhere connection string to the database server as a parameter to the sasql_connect function. The <?php and ?> tags tell the web server that it should let PHP execute the code that lies between them and replace it with the PHP output.

The source code for this example is contained in your SQL Anywhere installation in a file called *connect.php*.

```
<?php
  # Connect using the default user ID and password
  $conn = sasql_connect( "UID=DBA;PWD=sql" );
  if( ! $conn ) {
      echo "Connection failed\n";
  } else {
      echo "Connected successfully\n";
```



```
    sasql_close( $conn );
}?>
```

This script attempts to make a connection to a database on a local server. For this code to succeed, the SQL Anywhere sample database or one with identical credentials must be started on a local server.

Retrieving data from a database

One use of PHP scripts in web pages is to retrieve and display information contained in a database. The following examples demonstrate some useful techniques.

Simple select query

The following PHP code demonstrates a convenient way to include the result set of a SELECT statement in a web page. This sample is designed to connect to the SQL Anywhere sample database and return a list of customers.

This code can be embedded in a web page, provided your web server is configured to execute PHP scripts.

The source code for this sample is contained in your SQL Anywhere installation in a file called *query.php*.

```
<?php
  # Connect using the default user ID and password
  $conn = sasql_connect( "UID=DBA;PWD=sql" );
  if( ! $conn ) {
      echo "sasql_connect failed\n";
  } else {
      echo "Connected successfully\n";
      # Execute a SELECT statement
      $result = sasql_query( $conn, "SELECT * FROM Customers" );
      if( ! $result ) {
          echo "sasql_query failed!";
      } else {
          echo "query completed successfully\n";
          # Generate HTML from the result set
          sasql_result_all( $result );
          sasql_free_result( $result );
      }
      sasql_close( $conn );
  }
?>
```

The sasql_result_all function fetches all the rows of the result set and generates an HTML output table to display them. The sasql_free_result function releases the resources used to store the result set.

Fetching by column name

In certain cases, you may not want to display all the data from a result set, or you may want to display the data in a different manner. The following sample illustrates how you can exercise greater control over the output format of the result set. PHP allows you to display as much information as you want in whatever manner you choose.

The source code for this sample is contained in your SQL Anywhere installation in a file called *fetch.php*.

```
<?php
  # Connect using the default user ID and password
```

```
    $conn = sasql_connect( "UID=DBA;PWD=sql" );
    if( ! $conn ) {
        die ("Connection failed");
    } else {
        # Connected successfully.
    }
    # Execute a SELECT statement
    $result = sasql_query( $conn, "SELECT * FROM Customers" );
    if( ! $result ) {
        echo "sasql_query failed!";
        return 0;
    } else {
        echo "query completed successfully\n";
    }
    # Retrieve meta information about the results
    $num_cols = sasql_num_fields( $result );
    $num_rows = sasql_num_rows( $result );
    echo "Num of rows = $num_rows\n";
    echo "Num of cols = $num_cols\n";
    while( ($field = sasql_fetch_field( $result )) ) {
        echo "Field # : $field->id \n";
        echo "\tname   : $field->name \n";
        echo "\tlength : $field->length \n";
        echo "\ttype   : $field->type \n";
    }
    # Fetch all the rows
    $curr_row = 0;
    while( ($row = sasql_fetch_row( $result )) ) {
        $curr_row++;
        $curr_col = 0;
        while( $curr_col < $num_cols ) {
            echo "$row[$curr_col]\t|";
            $curr_col++;
        }
        echo "\n";
    }
    # Clean up.
    sasql_free_result( $result );
    sasql_disconnect( $conn );
?>
```

The sasql_fetch_array function returns a single row from the table. The data can be retrieved by column names and column indexes.

The sasql_fetch_assoc function returns a single row from the table as an associative array. The data can be retrieved by using the column names as indexes. The following is an example.

```
<?php
  # Connect using the default user ID and password
  $conn = sasql_connect("UID=DBA;PWD=sql");

  /* check connection */
  if( sasql_errorcode() ) {
      printf("Connect failed: %s\n", sasql_error());
      exit();
  }

  $query = "SELECT Surname, Phone FROM Employees ORDER by EmployeeID";

  if( $result = sasql_query($conn, $query) ) {

      /* fetch associative array */
```



```
        while( $row = sasql_fetch_assoc($result) ) {
            printf ("%s (%s)\n", $row["Surname"], $row["Phone"]);
        }

        /* free result set */
        sasql_free_result($result);
    }

    /* close connection */
    sasql_close($conn);
?>
```

Two other similar methods are provided in the PHP interface: sasql_fetch_row returns a row that can be searched by column indexes only, while sasql_fetch_object returns a row that can be searched by column names only.

For an example of the sasql_fetch_object function, see the *fetch_object.php* example script.

Nested result sets

When a SELECT statement is sent to the database, a result set is returned. The sasql_fetch_row and sasql_fetch_array functions retrieve data from the individual rows of a result set, returning each row as an array of columns that can be queried further.

The source code for this sample is contained in your SQL Anywhere installation in a file called *nested.php*.

```
<?php
  # Connect using the default user ID and password
  $conn = sasql_connect( "UID=DBA;PWD=sql" );
  if( ! $conn ) {
      die ("Connection failed");
  } else {
      # Connected successfully.
  }
  # Retrieve the data and output HTML
  echo "<BR>\n";
  $query1 = "SELECT table_id, table_name FROM SYSTAB";
  $result = sasql_query( $conn, $query1 );
  if( $result ) {
    $num_rows = sasql_num_rows( $result );
    echo "Returned : $num_rows <BR>\n";
    $I = 1;
    while( ($row = sasql_fetch_array( $result ))) {
      echo "$I:  table_id:$row[table_id]" .
           " --- table_name:$row[table_name] <br>\n";
      $query2 = "SELECT table_id, column_name " .
      "FROM SYSTABCOL" .
      "WHERE table_id = '$row[table_id]'";
      echo " $query2 <br>\n";
      echo "  Columns: ";
      $result2 = sasql_query( $conn, $query2 );
      if( $result2 ) {
     while(($detailed = sasql_fetch_array($result2))) {
         echo " $detailed[column_name]";
     }
     sasql_free_result( $result2 );
      } else {
     echo "******FAILED********";
      }
      echo "<br>\n";
```

```
        $I++;
      }
    }
    echo "<BR>\n";
    sasql_disconnect( $conn );
  ?>
```

In the above sample, the SQL statement selects the table ID and name for each table from SYSTAB. The sasql_query function returns an array of rows. The script iterates through the rows using the sasql_fetch_array function to retrieve the rows from an array. An inner iteration goes through the columns of each row and prints their values.

Web forms

PHP can take user input from a web form, pass it to the database server as a SQL query, and display the result that is returned. The following example demonstrates a simple web form that gives the user the ability to query the sample database using SQL statements and display the results in an HTML table.

The source code for this sample is contained in your SQL Anywhere installation in a file called *webisql.php*.

```
<?php
  echo "<HTML>\n";
  $qname = $_POST["qname"];
  $qname = str_replace( "\\", "", $qname );
  echo "<form method=post action=webisql.php>\n";
  echo "<br>Query: <input type=text Size=80 name=qname value=\"$qname\">\n";
  echo "<input type=submit>\n";
  echo "</form>\n";
  echo "<HR><br>\n";
  if( ! $qname ) {
      echo "No Current Query\n";
      return;
  }
  # Connect to the database
  $con_str = "UID=DBA;PWD=sql;SERVER=demo;LINKS=tcpip";
  $conn = sasql_connect( $con_str );
  if( ! $conn ) {
      echo "sasql_connect failed\n";
      echo "</html>\n";
      return 0;
  }
  $qname = str_replace( "\\", "", $qname );
  $result = sasql_query( $conn, $qname );
  if( ! $result ) {
        echo "sasql_query failed!";
  } else {
        // echo "query completed successfully\n";
        sasql_result_all( $result, "border=1" );
      sasql_free_result( $result );
  }
  sasql_disconnect( $conn );
  echo "</html>\n";
?>
```

This design could be extended to handle complex web forms by formulating customized SQL queries based on the values entered by the user.

Working with BLOBs

SQL Anywhere databases can store any type of data as a binary large object (BLOB). If that data is of a type readable by a web browser, a PHP script can easily retrieve it from the database and display it on a dynamically generated page.

BLOB fields are often used for storing non-text data, such as images in GIF or JPG format. Numerous types of data can be passed to a web browser without any need for third-party software or data type conversion. The following sample illustrates the process of adding an image to the database and then retrieving it again to be displayed in a web browser.

This sample is similar to the sample code in the files *image_insert.php* and *image_retrieve.php* of your SQL Anywhere installation. These samples also illustrate the use of a BLOB column for storing images.

```
<?php
  $conn = sasql_connect( "UID=DBA;PWD=sql" )
        or die("Cannot connect to database");
  $create_table = "CREATE TABLE images (ID INTEGER PRIMARY KEY, img IMAGE)";
  sasql_query( $conn, $create_table);
  $insert = "INSERT INTO images VALUES (99,
xp_read_file('ianywhere_logo.gif'))";
  sasql_query( $conn, $insert );
  $query = "SELECT img FROM images WHERE ID = 99";
  $result = sasql_query($conn, $query);
  $data = sasql_fetch_row($result);
  $img = $data[0];
  header("Content-type: image/gif");
  echo $img;
  sasql_disconnect($conn);
?>
```

To be able to send the binary data from the database directly to a web browser, the script must set the data's MIME type using the header function. In this case, the browser is told to expect a GIF image so it can display it correctly.

Building the SQL Anywhere PHP extension on Unix and Mac OS X

To connect PHP to SQL Anywhere using the SQL Anywhere PHP extension on Unix and Mac OS X, you must add the SQL Anywhere PHP extension's files to PHP's source tree, and then re-compile PHP.

Requirements

The following is a list of software you need to have on your system to complete the steps detailed in this document:

- A SQL Anywhere installation, which can run on the same computer as the Apache web server, or on a different computer.
- The source code for the SQL Anywhere PHP extension, which can be downloaded from http://download.sybase.com/ianywhere/php/2.0.3/src/sasql_php.zip.

You also need **sqlpp** and *libdblib12.so* (Unix) or *libdblib12.dylib* (Mac OS X) installed (check your SQL Anywhere *lib32* directory).

- The PHP source code, which can be downloaded from http://www.php.net.

  Version 5.2.11 and 5.3.2 of PHP are recent stable releases. For a list of supported versions, see http://www.sybase.com/detail?id=1068981.

- The Apache web server source code, which can be downloaded from http://httpd.apache.org.

  If you are going to use a pre-built version of Apache, make sure that you have **apache** and **apache-devel** installed.

- If you plan to use the Unified ODBC PHP extension, you need to have *libdbodbc12.so* (Unix) or *libdbodbc12.dylib* (Mac OS X) installed (check your SQL Anywhere *lib32* directory).

The following binaries should be installed from your Unix installation disk if they are not already installed, and can be found as RPMs:

- make
- automake
- autoconf
- libtool (glibtool for Mac OS X)
- makeinfo
- bison
- gcc
- cpp
- glibc-devel
- kernel-headers
- flex

You must have the same access privileges as the person who installed PHP to perform certain steps of the installation. Most Unix-based systems offer a **sudo** command that allows users with insufficient permissions to execute certain commands as a user with the right to execute them.

Adding the SQL Anywhere PHP extension files to the PHP source tree

1. Download the SQL Anywhere PHP extension from http://download.sybase.com/ianywhere/php/2.0.3/src/sasql_php.zip.

2. From the directory where you saved the SQL Anywhere PHP extension, extract the files to the *ext* subdirectory of the PHP source tree (Mac OS X users should replace **tar** with **gnutar**):

   ```
   $ tar -xzf sasql_php.zip -C PHP-source-directory/ext/
   ```

   For example:

   ```
   $ tar -xzf sqlanywhere_php-1.0.8.tar.gz -C ~/php-5.2.11/ext
   ```

3. Make PHP aware of the extension:


```
$ cd PHP-source-directory/ext/sqlanywhere
$ touch *
$ cd ~/PHP-source-directory
$ ./buildconf
```

The following example is for PHP version 5.2.11. You must change php-5.2.11 below to the version of PHP you are using.

```
$ cd ~/php-5.2.11/ext/sqlanywhere
$ touch *
$ cd ~/php-5.2.11
$ ./buildconf
```

4. Verify that PHP is aware of the extension:

   ```
   $ ./configure -help | egrep sqlanywhere
   ```

   If you were successful in making PHP aware of the SQL Anywhere extension, you should see the following text:

   ```
   --with-sqlanywhere=[DIR]
   ```

   If you are unsuccessful, keep track of the output of this command and post it to the **sybase.public.sqlanywhere.linux** newsgroup for assistance.

Compiling Apache and PHP

PHP can be compiled as a shared module of a web server (such as Apache) or as a CGI executable. If you are using a web server that is not supported by PHP, or if you want to execute PHP scripts in your command shell rather than on a web page, you should compile PHP as a CGI executable. Otherwise, if you want to install PHP to operate in conjunction with Apache, compile it as an Apache module.

For information about compiling PHP as an Apache module, see "Compiling PHP as an Apache module" on page 639.

For information about compiling PHP as a CGI executable, see "Compiling PHP as a CGI executable" on page 642.

Compiling PHP as an Apache module

The first two steps in the following instructions configure Apache so that it recognizes shared modules. If you have a compiled version of Apache already installed on your system, proceed to step 3. Note that Mac OS X comes with a pre-installed Apache web server.

To compile PHP as an Apache module

1. Configure Apache to recognize shared modules.

   Execute the following command (entered all on one line) from the directory where your Apache files were extracted:

```
$ cd Apache-source-directory
$ ./configure --enabled-shared=max --enable-module=most --
prefix=/Apache-installation-directory
```

The following example is for Apache version 2.2.9. You must change **apache_2.2.9** to the version of Apache you are using.

```
$ cd ~/apache_2.2.9
$ ./configure --enabled-shared=max --enable-module=most --
prefix=/usr/local/web/apache
```

2. Recompile and install the relevant components:

```
$ make
$ make install
```

Now you are ready to compile PHP to operate as an Apache module.

3. Make sure the environment is set up for SQL Anywhere.

Depending on which shell you are using, enter the appropriate command from the directory where SQL Anywhere is installed (by default, this is */opt/sqlanywhere12*). On Mac OS X, the default directory is */Applications/SQLAnywhere12/System*.

If you are using this shell...	...use this command
sh, ksh, bash	`. ./bin32/sa_config.sh`
csh, tcsh	`source ./bin32/sa_config.csh`

4. Configure PHP as an Apache module to include the SQL Anywhere PHP extension.

Execute the following commands:

```
$ cd PHP-source-directory
$ ./configure --with-sqlanywhere --with- apxs=/Apache-installation-
directory/bin/apxs
```

The following example is for PHP version 5.2.11. You must change php-5.2.11 to the version of PHP you are using.

```
$ cd ~/php-5.2.11
$ ./configure --with-sqlanywhere --with- apxs=/usr/local/web/apache/bin/
apxs
```

The *configure* script will try to determine the version and location of your SQL Anywhere installation. In the output from the command, you should see lines similar to the following:

```
checking for SQL Anywhere support... yes
checking     SQL Anywhere install dir... /opt/sqlanywhere12
checking     SQL Anywhere version... 12
```

5. Recompile the relevant components:


```
$ make
```

6. Check that the libraries are properly linked.

   - Linux users (the following example assumes you are using PHP version 5):

     ```
     ldd ./.libs/libphp5.so
     ```

   - Mac OS X users:

     Refer to your *httpd.conf* configuration file to determine where *libphp5.so* is on your computer. Perform the check with the following command:

     ```
     otool -L $LIBPHP5_DIR/libphp5.so
     ```

     $LIBPHP5_DIR is the directory where *libphp5.so* is located, according to your server configuration.

     This command outputs a list of the libraries that *libphp5.so* uses. Verify that *libdblib12.so* is in the list.

7. Install the PHP binaries in Apache's *lib* directory:

   ```
   $ make install
   ```

8. Perform verification. PHP does this automatically. All you need is to make sure that your *httpd.conf* configuration file is verified so that Apache will recognize *.php* files as PHP scripts.

   httpd.conf is stored in the *conf* subdirectory of the *Apache* directory:

   ```
   $ cd Apache-installation-directory/conf
   ```

   For example:

   ```
   $ cd /usr/local/web/apache/conf
   ```

   Make a backup copy of *httpd.conf* before editing the file (you can replace **pico** with the text editor of your choice):

   ```
   $ cp httpd.conf httpd.conf.backup
   $ pico httpd.conf
   ```

   Add or uncomment the following lines in *httpd.conf* (they are not located together in the file):

   ```
   LoadModule php5_module   libexec/libphp5.so
   AddModule mod_php5.c
   AddType application/x-httpd-php .php
   AddType application/x-httpd-php-source .phps
   ```

   Note
   On Mac OS X, the last two lines should be added or uncommented in *httpd_macosxserver.conf*.

   The first two lines point Apache to the files that are used for interpreting PHP code, while the other two lines declare file types for files whose extension is *.php* or *.phps* so Apache can recognize and deal with them appropriately.

For information about testing and using your setup, see "Running PHP test scripts in your web pages" on page 630.

Compiling PHP as a CGI executable

To compile PHP as a CGI executable

1. Make sure the environment is set up for SQL Anywhere.

   For instructions on setting up the environment for SQL Anywhere, follow the instructions in step 4 of "Compiling PHP as an Apache module" on page 639.

2. Configure PHP as a CGI executable and with the SQL Anywhere PHP extension.

   Execute the following command from the directory where your PHP files were extracted:

   ```
   $ cd PHP-source-directory
   $ ./configure --with-sqlanywhere
   ```

   For example:

   ```
   $ cd ~/php-5.2.11
   $ ./configure --with-sqlanywhere
   ```

   The configuration script will try to determine the version and location of your SQL Anywhere installation. If you examine the output of this command, you should see lines similar to the following:

   ```
   checking for SQL Anywhere support... yes
   checking     SQL Anywhere install dir... /opt/sqlanywhere12
   checking     SQL Anywhere version... 12
   ```

3. Compile the executable:

   ```
   $ make
   ```

4. Install the components.

   ```
   $ make install
   ```

For information about testing and using PHP, see "Running PHP test scripts in your web pages" on page 630.

SQL Anywhere PHP API reference

The PHP API supports the following functions:

Connections

- "sasql_close" on page 645
- "sasql_connect" on page 645
- "sasql_disconnect" on page 647
- "sasql_error" on page 647
- "sasql_errorcode" on page 648
- "sasql_insert_id" on page 654
- "sasql_message" on page 654
- "sasql_pconnect" on page 656
- "sasql_set_option" on page 661

Queries

- "sasql_affected_rows" on page 644
- "sasql_next_result" on page 655
- "sasql_query" on page 658
- "sasql_real_query" on page 659
- "sasql_store_result" on page 672
- "sasql_use_result" on page 673

Result sets

- "sasql_data_seek" on page 646
- "sasql_fetch_array" on page 649
- "sasql_fetch_assoc" on page 649
- "sasql_fetch_field" on page 650
- "sasql_fetch_object" on page 651
- "sasql_fetch_row" on page 651
- "sasql_field_count" on page 652
- "sasql_free_result" on page 653
- "sasql_num_rows" on page 656
- "sasql_result_all" on page 660

Transactions

- "sasql_commit" on page 645
- "sasql_rollback" on page 661

Statements

Miscellaneous

sasql_affected_rows

Prototype

int **sasql_affected_rows(** sasql_conn *$conn* **)**

Description

Returns the number of rows affected by the last SQL statement. This function is typically used for INSERT, UPDATE, or DELETE statements. For SELECT statements, use the sasql_num_rows function.

Parameters

$conn The connection resource returned by a connect function.

Returns

The number of rows affected.

Related functions

sasql_commit

Prototype

bool **sasql_commit(** sasql_conn *$conn* **)**

Description

Ends a transaction on the SQL Anywhere database and makes any changes made during the transaction permanent. Useful only when the auto_commit option is Off.

Parameters

$conn The connection resource returned by a connect function.

Returns

TRUE on success or FALSE on failure.

Related functions

- "sasql_rollback" on page 661
- "sasql_set_option" on page 661
- "sasql_pconnect" on page 656
- "sasql_disconnect" on page 647

sasql_close

Prototype

bool **sasql_close(** sasql_conn *$conn* **)**

Description

Closes a previously opened database connection.

Parameters

$conn The connection resource returned by a connect function.

Returns

TRUE on success or FALSE on failure.

sasql_connect

Prototype

sasql_conn **sasql_connect(** string *$con_str* **)**

Description

Establishes a connection to a SQL Anywhere database.

Parameters

$con_str A connection string as recognized by SQL Anywhere.

Returns

A positive SQL Anywhere connection resource on success, or an error and 0 on failure.

Related functions

- "sasql_pconnect" on page 656
- "sasql_disconnect" on page 647

See also

- "Connection parameters" [*SQL Anywhere Server - Database Administration*]
- "SQL Anywhere database connections" [*SQL Anywhere Server - Database Administration*]

sasql_data_seek

Prototype

bool **sasql_data_seek(** sasql_result *$result***,** int *row_num* **)**

Description

Positions the cursor on row *row_num* on the *$result* that was opened using sasql_query.

Parameters

$result The result resource returned by the sasql_query function.

row_num An integer that represents the new position of the cursor within the result resource. For example, specify 0 to move the cursor to the first row of the result set or 5 to move it to the sixth row. Negative numbers represent rows relative to the end of the result set. For example, -1 moves the cursor to the last row in the result set and -2 moves it to the second-last row.

Returns

TRUE on success or FALSE on error.

Related functions

- "sasql_fetch_field" on page 650
- "sasql_fetch_array" on page 649
- "sasql_fetch_assoc" on page 649
- "sasql_fetch_row" on page 651
- "sasql_fetch_object" on page 651
- "sasql_query" on page 658

sasql_disconnect

Prototype

bool **sasql_disconnect(** sasql_conn *$conn* **)**

Description

Closes a connection that has been opened with sasql_connect or sasql_pconnect.

Parameters

$conn The connection resource returned by a connect function.

Returns

TRUE on success or FALSE on error.

Related functions

- "sasql_connect" on page 645
- "sasql_pconnect" on page 656

sasql_error

Prototype

string **sasql_error(** [sasql_conn *$conn*] **)**

Description

Returns the error text of the most recently executed SQL Anywhere PHP function. Error messages are stored per connection. If no *$conn* is specified, then sasql_error returns the last error message where no connection was available. For example, if you call sasql_connect and the connection fails, then call sasql_error with no parameter for *$conn* to get the error message. If you want to obtain the corresponding SQL Anywhere error code value, use the sasql_errorcode function.

Parameters

$conn The connection resource returned by a connect function.

Returns

A string describing the error. For a list of error messages, see "SQL Anywhere error messages" [*Error Messages*].

Related functions

- "sasql_errorcode" on page 648
- "sasql_sqlstate" on page 673
- "sasql_set_option" on page 661
- "sasql_stmt_errno" on page 665
- "sasql_stmt_error" on page 666

sasql_errorcode

Prototype

int **sasql_errorcode(** [sasql_conn *$conn*] **)**

Description

Returns the error code of the most-recently executed SQL Anywhere PHP function. Error codes are stored per connection. If no *$conn* is specified, then sasql_errorcode returns the last error code where no connection was available. For example, if you are calling sasql_connect and the connection fails, then call sasql_errorcode with no parameter for the *$conn* to get the error code. If you want to get the corresponding error message use the sasql_error function.

Parameters

$conn The connection resource returned by a connect function.

Returns

An integer representing a SQL Anywhere error code. An error code of 0 means success. A positive error code indicates success with warnings. A negative error code indicates failure. For a list of error codes, see "SQL Anywhere error messages sorted by SQLCODE" [*Error Messages*].

Related functions

- "sasql_connect" on page 645
- "sasql_pconnect" on page 656
- "sasql_error" on page 647
- "sasql_sqlstate" on page 673
- "sasql_set_option" on page 661
- "sasql_stmt_errno" on page 665
- "sasql_stmt_error" on page 666

sasql_escape_string

Prototype

string **sasql_escape_string(** sasql_conn *$conn*, string *$str* **)**

Description

Escapes all special characters in the supplied string. The special characters that are escaped are \r, \n, ', ", ;, \, and the NULL character. This function is an alias of sasql_real_escape_string.

Parameters

$conn The connection resource returned by a connect function.

$string The string to be escaped.

Returns

The escaped string.

Related functions

- "sasql_real_escape_string" on page 659
- "sasql_connect" on page 645

sasql_fetch_array

Prototype

array **sasql_fetch_array(** sasql_result *$result* [**,** int *$result_type*]**)**

Description

Fetches one row from the result set. This row is returned as an array that can be indexed by the column names or by the column indexes.

Parameters

$result The result resource returned by the sasql_query function.

$result_type This optional parameter is a constant indicating what type of array should be produced from the current row data. The possible values for this parameter are the constants SASQL_ASSOC, SASQL_NUM, or SASQL_BOTH. It defaults to SASQL_BOTH.

By using the SASQL_ASSOC constant this function will behave identically to the sasql_fetch_assoc function, while SASQL_NUM will behave identically to the sasql_fetch_row function. The final option SASQL_BOTH will create a single array with the attributes of both.

Returns

An array that represents a row from the result set, or FALSE when no rows are available.

Related functions

- "sasql_data_seek" on page 646
- "sasql_fetch_assoc" on page 649
- "sasql_fetch_field" on page 650
- "sasql_fetch_row" on page 651
- "sasql_fetch_object" on page 651

sasql_fetch_assoc

Prototype

array **sasql_fetch_assoc(** sasql_result *$result* **)**

Description

Fetches one row from the result set as an associative array.

Parameters

$result The result resource returned by the sasql_query function.

Returns

An associative array of strings representing the fetched row in the result set, where each key in the array represents the name of one of the result set's columns or FALSE if there are no more rows in resultset.

Related functions

- "sasql_data_seek" on page 646
- "sasql_fetch_field" on page 650
- "sasql_fetch_field" on page 650
- "sasql_fetch_row" on page 651
- "sasql_fetch_object" on page 651

sasql_fetch_field

Prototype

object **sasql_fetch_field(** sasql_result *$result* [**,** int *$field_offset*] **)**

Description

Returns an object that contains information about a specific column.

Parameters

$result The result resource returned by the sasql_query function.

$field_offset An integer representing the column/field on which you want to retrieve information. Columns are zero based; to get the first column, specify the value 0. If this parameter is omitted, then the next field object is returned.

Returns

An object that has the following properties:

- **id** contains the field's number.
- **name** contains the field's name.
- **numeric** indicates whether the field is a numeric value.
- **length** returns the field's native storage size.
- **type** returns the field's type.

- **native_type** returns the field's native type. These are values like DT_FIXCHAR, DT_DECIMAL or DT_DATE. See "Embedded SQL data types" on page 439.
- **precision** returns the field's numeric precision. This property is only set for fields with native_type equal to DT_DECIMAL.
- **scale** returns the field's numeric scale. This property is only set for fields with native_type equal to DT_DECIMAL.

Related functions

- "sasql_data_seek" on page 646
- "sasql_fetch_array" on page 649
- "sasql_fetch_assoc" on page 649
- "sasql_fetch_row" on page 651
- "sasql_fetch_object" on page 651

sasql_fetch_object

Prototype

object **sasql_fetch_object(** sasql_result *$result* **)**

Description

Fetches one row from the result set as an object.

Parameters

$result The result resource returned by the sasql_query function.

Returns

An object representing the fetched row in the result set where each property name matches one of the result set column names, or FALSE if there are no more rows in result set.

Related functions

- "sasql_data_seek" on page 646
- "sasql_fetch_field" on page 650
- "sasql_fetch_array" on page 649
- "sasql_fetch_assoc" on page 649
- "sasql_fetch_row" on page 651

sasql_fetch_row

Prototype

array **sasql_fetch_row(** sasql_result *$result* **)**

Description

Fetches one row from the result set. This row is returned as an array that can be indexed by the column indexes only.

Parameters

$result The result resource returned by the sasql_query function.

Returns

An array that represents a row from the result set, or FALSE when no rows are available.

Related functions

- "sasql_data_seek" on page 646
- "sasql_fetch_field" on page 650
- "sasql_fetch_array" on page 649
- "sasql_fetch_assoc" on page 649
- "sasql_fetch_object" on page 651

sasql_field_count

Prototype

int **sasql_field_count(** sasql_conn *$conn* **)**

Description

Returns the number of columns (fields) the last result contains.

Parameters

$conn The connection resource returned by a connect function.

Returns

A positive number of columns, or FALSE if *$conn* is not valid.

sasql_field_seek

Prototype

bool **sasql_field_seek(** sasql_result *$result*, int *$field_offset* **)**

Description

Sets the field cursor to the given offset. The next call to sasql_fetch_field will retrieve the field definition of the column associated with that offset.

Parameters

$result The result resource returned by the sasql_query function.

$field_offset An integer representing the column/field on which you want to retrieve information. Columns are zero based; to get the first column, specify the value 0. If this parameter is omitted, then the next field object is returned.

Returns

TRUE on success or FALSE on error.

sasql_free_result

Prototype

bool **sasql_free_result(** sasql_result *$result* **)**

Description

Frees database resources associated with a result resource returned from sasql_query.

Parameters

$result The result resource returned by the sasql_query function.

Returns

TRUE on success or FALSE on error.

Related functions

- "sasql_query" on page 658

sasql_get_client_info

Prototype

string **sasql_get_client_info( )**

Description

Returns the version information of the client.

Parameters

None

Returns

A string that represents the SQL Anywhere client software version. The returned string is of the form X.Y.Z.W where X is the major version number, Y is the minor version number, Z is the patch number, and W is the build number (for example, 10.0.1.3616).

sasql_insert_id

Prototype

int **sasql_insert_id(** sasql_conn *$conn* **)**

Description

Returns the last value inserted into an IDENTITY column or a DEFAULT AUTOINCREMENT column, or zero if the most recent insert was into a table that did not contain an IDENTITY or DEFAULT AUTOINCREMENT column.

The sasql_insert_id function is provided for compatibility with MySQL databases.

Parameters

$conn The connection resource returned by a connect function.

Returns

The ID generated for an AUTOINCREMENT column by a previous INSERT statement or zero if last insert did not affect an AUTOINCREMENT column. The function can return FALSE if the *$conn* is not valid.

sasql_message

Prototype

bool **sasql_message(** sasql_conn *$conn*, string *$message* **)**

Description

Writes a message to the server messages window.

Parameters

$conn The connection resource returned by a connect function.

$message A message to be written to the server messages window.

Returns

TRUE on success or FALSE on failure.

sasql_multi_query

Prototype

bool **sasql_multi_query(** sasql_conn *$conn*, string *$sql_str* **)**

Description

Prepares and executes one or more SQL queries specified by *$sql_str* using the supplied connection resource. Each query is separated from the other using semicolons.

The first query result can be retrieved or stored using sasql_use_result or sasql_store_result. sasql_field_count can be used to check if the query returns a result set or not.

All subsequent query results can be processed using sasql_next_result and sasql_use_result/ sasql_store_result.

Parameters

$conn The connection resource returned by a connect function.

$sql_str One or more SQL statements separated by semicolons.

For more information about SQL statements, see "SQL statements" [*SQL Anywhere Server - SQL Reference*].

Returns

TRUE on success or FALSE on failure.

Related functions

- "sasql_store_result" on page 672
- "sasql_use_result" on page 673
- "sasql_field_count" on page 652

sasql_next_result

Prototype

bool **sasql_next_result(** sasql_conn *$conn* **)**

Description

Prepares the next result set from the last query that executed on *$conn*.

Parameters

$conn The connection resource returned by a connect function.

Returns

FALSE if there is no other result set to be retrieved. TRUE if there is another result to be retrieved. Call sasql_use_result or sasql_store_result to retrieve the next result set.

Related functions

- "sasql_use_result" on page 673
- "sasql_store_result" on page 672

sasql_num_fields

Prototype

int **sasql_num_fields(** sasql_result *$result* **)**

Description

Returns the number of fields that a row in the *$result* contains.

Parameters

$result The result resource returned by the sasql_query function.

Returns

Returns the number of fields in the specified result set.

Related functions

- "sasql_num_rows" on page 656
- "sasql_query" on page 658

sasql_num_rows

Prototype

int **sasql_num_rows(** sasql_result *$result* **)**

Description

Returns the number of rows that the *$result* contains.

Parameters

$result The result resource returned by the sasql_query function.

Returns

A positive number if the number of rows is exact, or a negative number if it is an estimate. To get the exact number of rows, the database option row_counts must be set permanently on the database, or temporarily on the connection. See "sasql_set_option" on page 661.

Related functions

- "sasql_num_fields" on page 656
- "sasql_query" on page 658

sasql_pconnect

Prototype

sasql_conn **sasql_pconnect(** string *$con_str* **)**

Description

Establishes a persistent connection to a SQL Anywhere database. Because of the way Apache creates child processes, you may observe a performance gain when using sasql_pconnect instead of sasql_connect. Persistent connections may provide improved performance in a similar fashion to connection pooling. If your database server has a limited number of connections (for example, the personal database server is limited to 10 concurrent connections), caution should be exercised when using persistent connections. Persistent connections could be attached to each of the child processes, and if you have more child processes in Apache than there are available connections, you will receive connection errors.

Parameters

$con_str A connection string as recognized by SQL Anywhere.

Returns

A positive SQL Anywhere persistent connection resource on success, or an error and 0 on failure.

Related functions

- "sasql_connect" on page 645
- "sasql_disconnect" on page 647

See also

- "Connection parameters" [*SQL Anywhere Server - Database Administration*]
- "SQL Anywhere database connections" [*SQL Anywhere Server - Database Administration*]

sasql_prepare

Prototype

sasql_stmt **sasql_prepare(** sasql_conn *$conn*, string *$sql_str* **)**

Description

Prepares the supplied SQL string.

Parameters

$conn The connection resource returned by a connect function.

$sql_str The SQL statement to be prepared. The string can include parameter markers by embedding question marks at the appropriate positions.

For more information about SQL statements, see "SQL statements" [*SQL Anywhere Server - SQL Reference*].

Returns

A statement object or FALSE on failure.

Related functions

- "sasql_stmt_param_count" on page 670
- "sasql_stmt_bind_param" on page 663
- "sasql_stmt_bind_param_ex" on page 663
- "sasql_prepare" on page 657
- "sasql_stmt_execute" on page 666
- "sasql_connect" on page 645
- "sasql_pconnect" on page 656

sasql_query

Prototype

mixed **sasql_query(** sasql_conn *$conn*, string *$sql_str* [, int *$result_mode*] **)**

Description

Prepares and executes the SQL query *$sql_str* on the connection identified by *$conn* that has already been opened using sasql_connect or sasql_pconnect.

The sasql_query function is equivalent to calling two functions, sasql_real_query and one of sasql_store_result or sasql_use_result.

Parameters

$conn The connection resource returned by a connect function.

$sql_str A SQL statement supported by SQL Anywhere.

$result_mode Either SASQL_USE_RESULT, or SASQL_STORE_RESULT (the default).

For more information about SQL statements, see "SQL statements" [*SQL Anywhere Server - SQL Reference*].

Returns

FALSE on failure; TRUE on success for INSERT, UPDATE, DELETE, CREATE; sasql_result for SELECT.

Related functions

- "sasql_real_query" on page 659
- "sasql_free_result" on page 653
- "sasql_fetch_array" on page 649
- "sasql_fetch_field" on page 650
- "sasql_fetch_object" on page 651
- "sasql_fetch_row" on page 651

sasql_real_escape_string

Prototype

string **sasql_real_escape_string(** sasql_conn *$conn*, string *$str* **)**

Description

Escapes all special characters in the supplied string. The special characters that are escaped are \r, \n, ', ", ;, \, and the NULL character.

Parameters

$conn The connection resource returned by a connect function.

$string The string to be escaped.

Returns

The escaped string or FALSE on error.

Related functions

- "sasql_escape_string" on page 648
- "sasql_connect" on page 645

sasql_real_query

Prototype

bool **sasql_real_query(** sasql_conn *$conn*, string *$sql_str* **)**

Description

Executes a query against the database using the supplied connection resource. The query result can be retrieved or stored using sasql_store_result or sasql_use_result. The sasql_field_count function can be used to check if the query returns a result set or not.

Note that the sasql_query function is equivalent to calling this function and one of sasql_store_result or sasql_use_result.

Parameters

$conn The connection resource returned by a connect function.

$sql_str A SQL statement supported by SQL Anywhere.

Returns

TRUE on success or FALSE on failure.

Related functions

- “sasql_query” on page 658
- “sasql_store_result” on page 672
- “sasql_use_result” on page 673
- “sasql_field_count” on page 652

sasql_result_all

Prototype

bool **sasql_result_all(** resource *$result*
[**,** *$html_table_format_string*
[**,** *$html_table_header_format_string*
[**,** *$html_table_row_format_string*
[**,** *$html_table_cell_format_string*
]]]] **)**

Description

Fetches all results of the *$result* and generates an HTML output table with an optional formatting string.

Parameters

$result The result resource returned by the sasql_query function.

$html_table_format_string A format string that applies to HTML tables. For example, **"Border=1; Cellpadding=5"**. The special value none does not create an HTML table. This is useful if you want to customize your column names or scripts. If you do not want to specify an explicit value for this parameter, use NULL for the parameter value.

$html_table_header_format_string A format string that applies to column headings for HTML tables. For example, **"bgcolor=#FF9533"**. The special value none does not create an HTML table. This is useful if you want to customize your column names or scripts. If you do not want to specify an explicit value for this parameter, use NULL for the parameter value.

$html_table_row_format_string A format string that applies to rows within HTML tables. For example, **"onclick='alert('this')'"**. If you would like different formats that alternate, use the special token ><. The left side of the token indicates which format to use on odd rows and the right side of the token is used to format even rows. If you do not place this token in your format string, all rows have the same format. If you do not want to specify an explicit value for this parameter, use NULL for the parameter value.

$html_table_cell_format_string A format string that applies to cells within HTML table rows. For example, **"onclick='alert('this')'"**. If you do not want to specify an explicit value for this parameter, use NULL for the parameter value.

Returns

TRUE on success or FALSE on failure.

Related functions

- "sasql_query" on page 658

sasql_rollback

Prototype

bool **sasql_rollback(** sasql_conn *$conn* **)**

Description

Ends a transaction on the SQL Anywhere database and discards any changes made during the transaction. This function is only useful when the auto_commit option is Off.

Parameters

$conn The connection resource returned by a connect function.

Returns

TRUE on success or FALSE on failure.

Related functions

- "sasql_commit" on page 645
- "sasql_set_option" on page 661

sasql_set_option

Prototype

bool **sasql_set_option(** sasql_conn *$conn*, string *$option*, mixed *$value* **)**

Description

Sets the value of the specified option on the specified connection. You can set the value for the following options:

Name	Description	Default
auto_commit	When this option is set to on, the database server commits after executing each statement.	on
row_counts	When this option is set to FALSE, the sasql_num_rows function returns an estimate of the number of rows affected. If you want to obtain an exact count, set this option to TRUE.	FALSE

Name	Description	Default
verbose_errors	When this option is set to TRUE, the PHP driver returns verbose errors. When this option is set to FALSE, you must call the sasql_error or sasql_errorcode functions to get further error information.	TRUE

You can change the default value for an option by including the following line in the *php.ini* file. In this example, the default value is set for the auto_commit option.

```
sqlanywhere.auto_commit=0
```

Parameters

$conn The connection resource returned by a connect function.

$option The name of the option you want to set.

$value The new option value.

Returns

TRUE on success or FALSE on failure.

Related functions

- "sasql_commit" on page 645
- "sasql_error" on page 647
- "sasql_errorcode" on page 648
- "sasql_num_rows" on page 656
- "sasql_rollback" on page 661

sasql_stmt_affected_rows

Prototype

int **sasql_stmt_affected_rows(** sasql_stmt *$stmt* **)**

Description

Returns the number of rows affected by executing the statement.

Parameters

$stmt A statement resource that was executed by sasql_stmt_execute.

Returns

The number of rows affected or FALSE on failure.

Related functions

- "sasql_stmt_execute" on page 666

sasql_stmt_bind_param

Prototype

bool **sasql_stmt_bind_param(** sasql_stmt *$stmt*, string *$types*, mixed &*$var_1* [, mixed &*$var_2* ..] **)**

Description

Binds PHP variables to statement parameters.

Parameters

$stmt A prepared statement resource that was returned by the sasql_prepare function.

$types A string that contains one or more characters specifying the types of the corresponding bind. This can be any of: **s** for string, **i** for integer, **d** for double, **b** for blobs. The length of the $types string must match the number of parameters that follow the $types parameter ($var_1, $var_2, ...). The number of characters should also match the number of parameter markers (question marks) in the prepared statement.

$var_n The variable references.

Returns

TRUE if binding the variables was successful or FALSE otherwise.

Related functions

- "sasql_prepare" on page 657
- "sasql_stmt_param_count" on page 670
- "sasql_stmt_bind_param_ex" on page 663
- "sasql_stmt_execute" on page 666

sasql_stmt_bind_param_ex

Prototype

bool **sasql_stmt_bind_param_ex(** sasql_stmt *$stmt*, int *$param_number*, mixed &*$var*, string *$type* [, bool *$is_null* [, int *$direction*]] **)**

Description

Binds a PHP variable to a statement parameter.

Parameters

$stmt A prepared statement resource that was returned by the sasql_prepare function.

$param_number The parameter number. This should be a number between 0 and (sasql_stmt_param_count($stmt) - 1).

$var A PHP variable. Only references to PHP variables are allowed.

$type Type of the variable. This can be one of: **s** for string, **i** for integer, **d** for double, **b** for blobs.

$is_null Whether the value of the variable is NULL or not.

$direction Can be SASQL_D_INPUT, SASQL_D_OUTPUT, or SASQL_INPUT_OUTPUT.

Returns

TRUE if binding the variable was successful or FALSE otherwise.

Related functions

- "sasql_prepare" on page 657
- "sasql_stmt_param_count" on page 670
- "sasql_stmt_bind_param" on page 663
- "sasql_stmt_execute" on page 666

sasql_stmt_bind_result

Prototype

bool **sasql_stmt_bind_result(** sasql_stmt *$stmt***,** mixed **&***$var1* [**,** mixed **&***$var2* ..] **)**

Description

Binds one or more PHP variables to result columns of a statement that was executed, and returns a result set.

Parameters

$stmt A statement resource that was executed by sasql_stmt_execute.

$var1 References to PHP variables that will be bound to result set columns returned by the sasql_stmt_fetch.

Returns

TRUE on success or FALSE on failure.

Related functions

- "sasql_stmt_execute" on page 666
- "sasql_stmt_fetch" on page 667

sasql_stmt_close

Prototype

bool **sasql_stmt_close(** sasql_stmt *$stmt* **)**

Description

Closes the supplied statement resource and frees any resources associated with it. This function will also free any result objects that were returned by the sasql_stmt_result_metadata.

Parameters

$stmt A prepared statement resource that was returned by the sasql_prepare function.

Returns

TRUE for success or FALSE on failure.

Related functions

- "sasql_stmt_result_metadata" on page 671
- "sasql_prepare" on page 657

sasql_stmt_data_seek

Prototype

bool **sasql_stmt_data_seek(** sasql_stmt *$stmt*, int *$offset* **)**

Description

This function seeks to the specified offset in the result set.

Parameters

$stmt A statement resource.

$offset The offset in the result set. This is a number between 0 and (sasql_stmt_num_rows($stmt) - 1).

Returns

TRUE on success or FALSE failure.

Related functions

- "sasql_stmt_num_rows" on page 669

sasql_stmt_errno

Prototype

int **sasql_stmt_errno(** sasql_stmt *$stmt* **)**

Description

Returns the error code for the most recently executed statement function using the specified statement resource.

Parameters

$stmt A prepared statement resource that was returned by the sasql_prepare function.

Returns

An integer error code. For a list of error codes, see "SQL Anywhere error messages sorted by SQLCODE" [*Error Messages*].

Related functions

- "sasql_stmt_error" on page 666
- "sasql_error" on page 647
- "sasql_errorcode" on page 648
- "sasql_prepare" on page 657
- "sasql_stmt_result_metadata" on page 671

sasql_stmt_error

Prototype

string **sasql_stmt_error(** sasql_stmt *$stmt* **)**

Description

Returns the error text for the most recently executed statement function using the specified statement resource.

Parameters

$stmt A prepared statement resource that was returned by the sasql_prepare function.

Returns

A string describing the error. For a list of error messages, see "SQL Anywhere error messages" [*Error Messages*].

Related functions

- "sasql_stmt_errno" on page 665
- "sasql_error" on page 647
- "sasql_errorcode" on page 648
- "sasql_prepare" on page 657
- "sasql_stmt_result_metadata" on page 671

sasql_stmt_execute

Prototype

bool **sasql_stmt_execute(** sasql_stmt *$stmt* **)**

Description

Executes the prepared statement. The sasql_stmt_result_metadata can be used to check whether the statement returns a result set.

Parameters

$stmt A prepared statement resource that was returned by the sasql_prepare function. Variables should be bound before calling execute.

Returns

TRUE for success or FALSE on failure.

Related functions

- "sasql_prepare" on page 657
- "sasql_stmt_param_count" on page 670
- "sasql_stmt_bind_param" on page 663
- "sasql_stmt_bind_param_ex" on page 663
- "sasql_stmt_result_metadata" on page 671
- "sasql_stmt_bind_result" on page 664

sasql_stmt_fetch

Prototype

bool **sasql_stmt_fetch(** sasql_stmt *$stmt* **)**

Description

This function fetches one row out of the result for the statement and places the columns in the variables that were bound using sasql_stmt_bind_result.

Parameters

$stmt A statement resource.

Returns

TRUE on success or FALSE on failure.

Related functions

- "sasql_stmt_bind_result" on page 664

sasql_stmt_field_count

Prototype

int **sasql_stmt_field_count(** sasql_stmt *$stmt* **)**

Description

This function returns the number of columns in the result set of the statement.

Parameters

$stmt A statement resource.

Returns

The number of columns in the result of the statement. If the statement does not return a result, it returns 0.

Related functions

- "sasql_stmt_result_metadata" on page 671

sasql_stmt_free_result

Prototype

bool **sasql_stmt_free_result(** sasql_stmt *$stmt* **)**

Description

This function frees cached result set of the statement.

Parameters

$stmt A statement resource that was executed using sasql_stmt_execute.

Returns

TRUE on success or FALSE on failure.

Related functions

- "sasql_stmt_execute" on page 666
- "sasql_stmt_store_result" on page 672

sasql_stmt_insert_id

Prototype

int **sasql_stmt_insert_id(** sasql_stmt *$stmt* **)**

Description

Returns the last value inserted into an IDENTITY column or a DEFAULT AUTOINCREMENT column, or zero if the most recent insert was into a table that did not contain an IDENTITY or DEFAULT AUTOINCREMENT column.

Parameters

$stmt A statement resource that was executed by sasql_stmt_execute.

Returns

The ID generated for an IDENTITY column or a DEFAULT AUTOINCREMENT column by a previous INSERT statement, or zero if the last insert did not affect an IDENTITY or DEFAULT AUTOINCREMENT column. The function can return FALSE (0) if $stmt is not valid.

Related functions

- "sasql_stmt_execute" on page 666

sasql_stmt_next_result

Prototype

bool **sasql_stmt_next_result(** sasql_stmt *$stmt* **)**

Description

This function advances to the next result from the statement. If there is another result set, the currently cashed results are discarded and the associated result set object deleted (as returned by sasql_stmt_result_metadata).

Parameters

$stmt A statement resource.

Returns

TRUE on success or FALSE failure.

Related functions

- "sasql_stmt_result_metadata" on page 671

sasql_stmt_num_rows

Prototype

int **sasql_stmt_num_rows(** sasql_stmt *$stmt* **)**

Description

Returns the number of rows in the result set. The actual number of rows in the result set can only be determined after the sasql_stmt_store_result function is called to buffer the entire result set. If the sasql_stmt_store_result function has not been called, 0 is returned.

Parameters

$stmt A statement resource that was executed by sasql_stmt_execute and for which sasql_stmt_store_result was called.

Returns

The number of rows available in the result or 0 on failure.

Related functions

- "sasql_stmt_execute" on page 666
- "sasql_stmt_store_result" on page 672

sasql_stmt_param_count

Prototype

int **sasql_stmt_param_count(** sasql_stmt *$stmt* **)**

Description

Returns the number of parameters in the supplied prepared statement resource.

Parameters

$stmt A statement resource returned by the sasql_prepare function.

Returns

The number of parameters or FALSE on error.

Related functions

- "sasql_prepare" on page 657
- "sasql_stmt_bind_param" on page 663
- "sasql_stmt_bind_param_ex" on page 663

sasql_stmt_reset

Prototype

bool **sasql_stmt_reset(** sasql_stmt *$stmt* **)**

Description

This function resets the *$stmt* object to the state just after the describe. Any variables that were bound are unbound and any data sent using sasql_stmt_send_long_data are dropped.

Parameters

$stmt A statement resource.

Returns

TRUE on success or FALSE on failure.

Related functions

- "sasql_stmt_send_long_data" on page 671

sasql_stmt_result_metadata

Prototype

sasql_result **sasql_stmt_result_metadata(** sasql_stmt *$stmt* **)**

Description

Returns a result set object for the supplied statement.

Parameters

$stmt A statement resource that was prepared and executed.

Returns

sasql_result object or FALSE if the statement does not return any results.

sasql_stmt_send_long_data

Prototype

bool **sasql_stmt_send_long_data(** sasql_stmt *$stmt*, int *$param_number*, string *$data* **)**

Description

Allows the user to send parameter data in chunks. The user must first call sasql_stmt_bind_param or sasql_stmt_bind_param_ex before attempting to send any data. The bind parameter must be of type string or blob. Repeatedly calling this function appends on to what was previously sent.

Parameters

$stmt A statement resource that was prepared using sasql_prepare.

$param_number The parameter number. This must be a number between 0 and (sasql_stmt_param_count($stmt) - 1).

$data The data to be sent.

Returns

TRUE on success or FALSE on failure.

Related functions

- "sasql_stmt_bind_param" on page 663
- "sasql_stmt_bind_param_ex" on page 663
- "sasql_prepare" on page 657
- "sasql_stmt_param_count" on page 670

sasql_stmt_store_result

Prototype

bool **sasql_stmt_store_result(** sasql_stmt *$stmt* **)**

Description

This function allows the client to cache the whole result set of the statement. You can use the function sasql_stmt_free_result to free the cached result.

Parameters

$stmt A statement resource that was executed using sasql_stmt_execute.

Returns

TRUE on success or FALSE on failure.

Related functions

- "sasql_stmt_free_result" on page 668
- "sasql_stmt_execute" on page 666

sasql_store_result

Prototype

sasql_result **sasql_store_result(** sasql_conn *$conn* **)**

Description

Transfers the result set from the last query on the database connection *$conn* to be used with the sasql_data_seek function.

Parameters

$conn The connection resource returned by a connect function.

Returns

FALSE if the query does not return a result object, or a result set object, that contains all the rows of the result. The result is cached at the client.

Related functions

- "sasql_data_seek" on page 646
- "sasql_stmt_execute" on page 666

sasql_sqlstate

Prototype

string **sasql_sqlstate(** sasql_conn *$conn* **)**

Description

Returns the most recent SQLSTATE string. SQLSTATE indicates whether the most recently executed SQL statement resulted in a success, error, or warning condition. SQLSTATE codes consists of five characters with "00000" representing no error. The values are defined by the ISO/ANSI SQL standard.

Parameters

$conn The connection resource returned by a connect function.

Returns

Returns a string of five characters containing the current SQLSTATE code. Note that "00000" means no error. For a list of SQLSTATE codes, see "SQL Anywhere error messages sorted by SQLSTATE" [*Error Messages*].

Related functions

- "sasql_error" on page 647
- "sasql_errorcode" on page 648

sasql_use_result

Prototype

sasql_result **sasql_use_result(** sasql_conn *$conn* **)**

Description

Initiates a result set retrieval for the last query that executed on the connection.

Parameters

$conn The connection resource returned by a connect function.

Returns

FALSE if the query does not return a result object or a result set object. The result is not cached on the client.

Related functions

- "sasql_data_seek" on page 646
- "sasql_stmt_execute" on page 666

Deprecated PHP functions

The following PHP functions are supported but deprecated. Each of these functions has a newer equivalent with a name starting with sasql_ instead of sqlanywhere_.

sqlanywhere_commit (deprecated)

Prototype

bool **sqlanywhere_commit(** resource *link_identifier* **)**

Description

This function is deprecated. You should use the following PHP function instead: "sasql_commit" on page 645.

Ends a transaction on the SQL Anywhere database and makes any changes made during the transaction permanent. Useful only when the auto_commit option is Off.

Parameters

link_identifier The link identifier returned by the sqlanywhere_connect function.

Returns

TRUE on success or FALSE on failure.

Example

This example shows how sqlanywhere_commit can be used to cause a commit on a specific connection.

```
$result = sqlanywhere_commit( $conn );
```

Related functions

- "sasql_commit" on page 645
- "sasql_pconnect" on page 656
- "sasql_disconnect" on page 647
- "sqlanywhere_pconnect (deprecated)" on page 686
- "sqlanywhere_disconnect (deprecated)" on page 676

sqlanywhere_connect (deprecated)

Prototype

resource **sqlanywhere_connect(** string *con_str* **)**

Description

This function is deprecated. You should use the following PHP function instead:
"sasql_connect" on page 645.

Establishes a connection to a SQL Anywhere database.

Parameters

con_str A connection string as recognized by SQL Anywhere.

Returns

A positive SQL Anywhere link identifier on success, or an error and 0 on failure.

Example

This example passes the user ID and password for a SQL Anywhere database in the connection string.

```
$conn = sqlanywhere_connect( "UID=DBA;PWD=sql" );
```

Related functions

- "sasql_connect" on page 645
- "sasql_pconnect" on page 656
- "sasql_disconnect" on page 647
- "sqlanywhere_pconnect (deprecated)" on page 686
- "sqlanywhere_disconnect (deprecated)" on page 676

sqlanywhere_data_seek (deprecated)

Prototype

bool **sqlanywhere_data_seek(** resource *result_identifier*, int *row_num* **)**

Description

This function is deprecated. You should use the following PHP function instead:
"sasql_data_seek" on page 646.

Positions the cursor on row *row_num* on the *result_identifier* that was opened using sqlanywhere_query.

Parameters

result_identifier The result resource returned by the sqlanywhere_query function.

row_num An integer that represents the new position of the cursor within the result_identifier. For example, specify 0 to move the cursor to the first row of the result set or 5 to move it to the sixth row. Negative numbers represent rows relative to the end of the result set. For example, -1 moves the cursor to the last row in the result set and -2 moves it to the second-last row.

Returns

TRUE on success or FALSE on error.

Example

This example shows how to seek to the sixth record in the result set.

```
sqlanywhere_data_seek( $result, 5 );
```

Related functions

- "sasql_data_seek" on page 646
- "sasql_fetch_field" on page 650
- "sasql_fetch_array" on page 649
- "sasql_fetch_row" on page 651
- "sasql_fetch_object" on page 651
- "sasql_query" on page 658
- "sqlanywhere_fetch_field (deprecated)" on page 680
- "sqlanywhere_fetch_array (deprecated)" on page 679
- "sqlanywhere_fetch_row (deprecated)" on page 682
- "sqlanywhere_fetch_object (deprecated)" on page 681
- "sqlanywhere_query (deprecated)" on page 686

sqlanywhere_disconnect (deprecated)

Prototype

bool **sqlanywhere_disconnect(** resource *link_identifier* **)**

Description

This function is deprecated. You should use the following PHP function instead: "sasql_disconnect" on page 647.

Closes a connection that has already been opened with sqlanywhere_connect.

Parameters

link_identifier The link identifier returned by the sqlanywhere_connect function.

Returns

TRUE on success or FALSE on error.

Example

This example closes the connection to a database.

```
sqlanywhere_disconnect( $conn );
```


Related functions

- “sasql_disconnect” on page 647
- “sasql_connect” on page 645
- “sasql_pconnect” on page 656
- “sqlanywhere_connect (deprecated)” on page 674
- “sqlanywhere_pconnect (deprecated)” on page 686

sqlanywhere_error (deprecated)

Prototype

string **sqlanywhere_error(** [resource *link_identifier*] **)**

Description

This function is deprecated. You should use the following PHP function instead: “sasql_error” on page 647.

Returns the error text of the most recently executed SQL Anywhere PHP function. Error messages are stored per connection. If no *link_identifier* is specified, then sqlanywhere_error returns the last error message where no connection was available. For example, if you call sqlanywhere_connect and the connection fails, then call sqlanywhere_error with no parameter for *link_identifier* to get the error message. If you want to obtain the corresponding SQL Anywhere error code value, use the sqlanywhere_errorcode function.

Parameters

link_identifier A link identifier that was returned by sqlanywhere_connect or sqlanywhere_pconnect.

Returns

A string describing the error.

Example

This example attempts to select from a table that does not exist. The sqlanywhere_query function returns FALSE and the sqlanywhere_error function returns the error message.

```
$result = sqlanywhere_query( $conn, "SELECT * FROM
table_that_does_not_exist" );
if( ! $result ) {
      $error_msg = sqlanywhere_error( $conn );
      echo "Query failed. Reason: $error_msg";
}
```

Related functions

- “sasql_error” on page 647
- “sasql_errorcode” on page 648
- “sasql_set_option” on page 661
- “sqlanywhere_errorcode (deprecated)” on page 678
- “sqlanywhere_set_option (deprecated)” on page 689

sqlanywhere_errorcode (deprecated)

Prototype

bool **sqlanywhere_errorcode(** [resource *link_identifier*] **)**

Description

This function is deprecated. You should use the following PHP function instead:
"sasql_errorcode" on page 648.

Returns the error code of the most-recently executed SQL Anywhere PHP function. Error codes are stored per connection. If no *link_identifier* is specified, then sqlanywhere_errorcode returns the last error code where no connection was available. For example, if you are calling sqlanywhere_connect and the connection fails, then call sqlanywhere_errorcode with no parameter for the *link_identifier* to get the error code. If you want to get the corresponding error message use the sqlanywhere_error function.

Parameters

link_identifier A link identifier that was returned by sqlanywhere_connect or sqlanywhere_pconnect.

Returns

An integer representing a SQL Anywhere error code. An error code of 0 means success. A positive error code indicates success with warnings. A negative error code indicates failure.

Example

This example shows how you can retrieve the last error code from a failed SQL Anywhere PHP call.

```
$result = sqlanywhere_query( $conn, "SELECT * from
table_that_does_not_exist" );
   if( ! $result ) {
       $error_code = sqlanywhere_errorcode( $conn );
       echo "Query failed: Error code: $error_code";
   }
```

Related functions

- "sasql_error" on page 647
- "sasql_set_option" on page 661
- "sqlanywhere_error (deprecated)" on page 677
- "sqlanywhere_set_option (deprecated)" on page 689

sqlanywhere_execute (deprecated)

Prototype

bool **sqlanywhere_execute(** resource *link_identifier*, string *sql_str* **)**

Description

This function is deprecated.

Prepares and executes the SQL query *sql_str* on the connection identified by the *link_identifier* that has already been opened using sqlanywhere_connect or sqlanywhere_pconnect. This function returns TRUE or FALSE depending on the outcome of the query execution. This function is suitable for queries that do not return result sets. If you are expecting a result set, use the sqlanywhere_query function instead.

Parameters

link_identifier A link identifier returned by sqlanywhere_connect or sqlanywhere_pconnect.

sql_str A SQL statement supported by SQL Anywhere.

Returns

TRUE if the query executed successfully, otherwise, FALSE and an error message.

Example

This example shows how to execute a DDL statement using the sqlanywhere_execute function.

```
if( sqlanywhere_execute( $conn, "CREATE TABLE my_test_table( INT id )" ) ) {
   // handle success
} else {
   // handle failure
}
```

Related functions

- "sasql_query" on page 658
- "sqlanywhere_query (deprecated)" on page 686

sqlanywhere_fetch_array (deprecated)

Prototype

array **sqlanywhere_fetch_array(** resource *result_identifier* **)**

Description

This function is deprecated. You should use the following PHP function instead: "sasql_fetch_array" on page 649.

Fetches one row from the result set. This row is returned as an array that can be indexed by the column names or by the column indexes.

Parameters

result_identifier The result resource returned by the sqlanywhere_query function.

Returns

An array that represents a row from the result set, or FALSE when no rows are available.

Example

This example shows how to retrieve all the rows in a result set. Each row is returned as an array.

```
$result = sqlanywhere_query( $conn, "SELECT GivenName, Surname FROM
Employees" );
  While( ($row = sqlanywhere_fetch_array( $result )) ) {
 echo " GivenName = " . $row["GivenName"] . " \n" ;
        echo " Surname = $row[1] \n";
  }
```

Related functions

- "sasql_fetch_array" on page 649
- "sasql_data_seek" on page 646
- "sasql_fetch_field" on page 650
- "sasql_fetch_row" on page 651
- "sasql_fetch_object" on page 651
- "sasql_query" on page 658
- "sqlanywhere_data_seek (deprecated)" on page 675
- "sqlanywhere_fetch_field (deprecated)" on page 680
- "sqlanywhere_fetch_row (deprecated)" on page 682
- "sqlanywhere_fetch_object (deprecated)" on page 681
- "sqlanywhere_query (deprecated)" on page 686

sqlanywhere_fetch_field (deprecated)

Prototype

object **sqlanywhere_fetch_field(** resource *result_identifier* [, *field_offset*] **)**

Description

This function is deprecated. You should use the following PHP function instead: "sasql_fetch_field" on page 650.

Returns an object that contains information about a specific column.

Parameters

result_identifier The result resource returned by the sqlanywhere_query function.

field_offset An integer representing the column/field on which you want to retrieve information. Columns are zero based; to get the first column, specify the value 0. If this parameter is omitted, then the next field object is returned.

Returns

An object that has the following properties:

- **id** contains the field/column number.
- **name** contains the field/column name.
- **numeric** indicates whether the field is a numeric value.

- **length** returns field length.
- **type** returns field type.

Example

This example shows how to use sqlanywhere_fetch_field to retrieve all the column information for a result set.

```
$result = sqlanywhere_query($conn, "SELECT GivenName, Surname FROM
Employees");
while( ($field = sqlanywhere_fetch_field( $result )) ) {
        echo " Field ID = $field->id \n";
        echo " Field name = $field->name \n";
  }
```

Related functions

- “sasql_data_seek” on page 646
- “sasql_fetch_field” on page 650
- “sasql_fetch_array” on page 649
- “sasql_fetch_row” on page 651
- “sasql_fetch_object” on page 651
- “sasql_query” on page 658
- “sqlanywhere_data_seek (deprecated)” on page 675
- “sqlanywhere_fetch_array (deprecated)” on page 679
- “sqlanywhere_fetch_row (deprecated)” on page 682
- “sqlanywhere_fetch_object (deprecated)” on page 681
- “sqlanywhere_query (deprecated)” on page 686

sqlanywhere_fetch_object (deprecated)

Prototype

object **sqlanywhere_fetch_object(** resource *result_identifier* **)**

Description

This function is deprecated. You should use the following PHP function instead: “sasql_fetch_object” on page 651.

Fetches one row from the result set. This row is returned as an object that can be indexed by the column name only.

Parameters

result_identifier The result resource returned by the sqlanywhere_query function.

Returns

An object that represents a row from the result set, or FALSE when no rows are available.

Example

This example shows how to retrieve one row at a time from a result set as an object. Column names can be used as object members to access the column value.

```
$result = sqlanywhere_query( $conn, "SELECT GivenName, Surname FROM
Employees" );
  While( ($row = sqlanywhere_fetch_object( $result )) ) {
        echo "$row->GivenName \n";   # output the data in the first column
only.
  }
```

Related functions

- "sasql_data_seek" on page 646
- "sasql_fetch_field" on page 650
- "sasql_fetch_array" on page 649
- "sasql_fetch_row" on page 651
- "sasql_fetch_object" on page 651
- "sasql_query" on page 658
- "sqlanywhere_query (deprecated)" on page 686
- "sqlanywhere_data_seek (deprecated)" on page 675
- "sqlanywhere_fetch_field (deprecated)" on page 680
- "sqlanywhere_fetch_array (deprecated)" on page 679
- "sqlanywhere_fetch_row (deprecated)" on page 682

sqlanywhere_fetch_row (deprecated)

Prototype

array **sqlanywhere_fetch_row(** resource *result_identifier* **)**

Description

This function is deprecated. You should use the following PHP function instead: "sasql_fetch_row" on page 651.

Fetches one row from the result set. This row is returned as an array that can be indexed by the column indexes only.

Parameters

result_identifier The result resource returned by the sqlanywhere_query function.

Returns

An array that represents a row from the result set, or FALSE when no rows are available.

Example

This example shows how to retrieve one row at a time from a result set.

```
while( ($row = sqlanywhere_fetch_row( $result )) ) {
        echo "$row[0] \n";     # output the data in the first column only.
  }
```


Related functions

- "sasql_fetch_row" on page 651
- "sasql_data_seek" on page 646
- "sasql_fetch_field" on page 650
- "sasql_fetch_array" on page 649
- "sasql_fetch_object" on page 651
- "sasql_query" on page 658
- "sqlanywhere_data_seek (deprecated)" on page 675
- "sqlanywhere_fetch_field (deprecated)" on page 680
- "sqlanywhere_fetch_array (deprecated)" on page 679
- "sqlanywhere_fetch_object (deprecated)" on page 681
- "sqlanywhere_query (deprecated)" on page 686

sqlanywhere_free_result (deprecated)

Prototype

bool **sqlanywhere_free_result(** resource *result_identifier* **)**

Description

This function is deprecated. You should use the following PHP function instead: "sasql_free_result" on page 653.

Frees database resources associated with a result resource returned from sqlanywhere_query.

Parameters

result_identifier The result resource returned by the sqlanywhere_query function.

Returns

TRUE on success or FALSE on error.

Example

This example shows how to free a result identifier's resources.

```
sqlanywhere_free_result( $result );
```

Related functions

- "sasql_query" on page 658
- "sasql_free_result" on page 653
- "sqlanywhere_query (deprecated)" on page 686

sqlanywhere_identity (deprecated)

Prototype

int **sqlanywhere_identity(** resource *link_identifier* **)**

int **sqlanywhere_insert_id(** resource *link_identifier* **)**

Description

This function is deprecated. You should use the following PHP function instead: "sasql_insert_id" on page 654.

Returns the last value inserted into an IDENTITY column or a DEFAULT AUTOINCREMENT column, or zero if the most recent insert was into a table that did not contain an IDENTITY or DEFAULT AUTOINCREMENT column.

The sqlanywhere_insert_id function is provided for compatibility with MySQL databases.

Parameters

link_identifier A link identifier returned by sqlanywhere_connect or sqlanywhere_pconnect.

Returns

The ID generated for an AUTOINCREMENT column by a previous INSERT statement or zero if last insert did not affect an AUTOINCREMENT column. The function can return FALSE if the *link_identifier* is not valid.

Example

This example shows how the sqlanywhere_identity function can be used to retrieve the autoincrement value most recently inserted into a table by the specified connection.

```
if( sqlanywhere_execute( $conn, "INSERT INTO my_auto_increment_table VALUES
( 1 ) " ) ) {
      $insert_id = sqlanywhere_insert_id( $conn );
      echo "Last insert id = $insert_id";
}
```

Related functions

- "sasql_insert_id" on page 654
- "sqlanywhere_execute (deprecated)" on page 678

sqlanywhere_num_fields (deprecated)

Prototype

int **sqlanywhere_num_fields(** resource *result_identifier* **)**

Description

This function is deprecated. You should use the following PHP function instead: "sasql_field_count" on page 652.

Returns the number of columns (fields) the *result_identifier* contains.

Parameters

result_identifier The result resource returned by the sqlanywhere_query function.

Returns

A positive number of columns, or an error if *result_identifier* is not valid.

Example

This example returns a value indicating how many columns are in the result set.

```
$num_columns = sqlanywhere_num_fields( $result );
```

Related functions

- "sasql_field_count" on page 652
- "sasql_query" on page 658
- "sqlanywhere_query (deprecated)" on page 686

sqlanywhere_num_rows (deprecated)

Prototype

int **sqlanywhere_num_rows(** resource *result_identifier* **)**

Description

This function is deprecated. You should use the following PHP function instead: "sasql_num_rows" on page 656.

Returns the number of rows that the *result_identifier* contains.

Parameters

result_identifier The result resource returned by the sqlanywhere_query function.

Returns

A positive number if the number of rows is exact, or a negative number if it is an estimate. To get the exact number of rows, the database option row_counts must be set permanently on the database, or temporarily on the connection. See "sasql_set_option" on page 661.

Example

This example shows how to retrieve the estimated number of rows returned in a result set:

```
$num_rows = sqlanywhere_num_rows( $result );
   if( $num_rows < 0 ) {
       $num_rows = abs( $num_rows );    # take the absolute value as an
estimate
   }
```

Related functions

- "sasql_num_rows" on page 656
- "sasql_query" on page 658
- "sqlanywhere_query (deprecated)" on page 686

sqlanywhere_pconnect (deprecated)

Prototype

resource **sqlanywhere_pconnect(** string *con_str* **)**

Description

This function is deprecated. You should use the following PHP function instead:
"sasql_pconnect" on page 656.

Establishes a persistent connection to a SQL Anywhere database. Because of the way Apache creates child processes, you may observe a performance gain when using sqlanywhere_pconnect instead of sqlanywhere_connect. Persistent connections may provide improved performance in a similar fashion to connection pooling. If your database server has a limited number of connections (for example, the personal database server is limited to 10 concurrent connections), caution should be exercised when using persistent connections. Persistent connections could be attached to each of the child processes, and if you have more child processes in Apache than there are available connections, you will receive connection errors.

Parameters

con_str A connection string as recognized by SQL Anywhere.

Returns

A positive SQL Anywhere persistent link identifier on success, or an error and 0 on failure.

Example

This example shows how to retrieve all the rows in a result set. Each row is returned as an array.

```
$conn = sqlanywhere_pconnect( "UID=DBA;PWD=sql" );
```

Related functions

- "sasql_pconnect" on page 656
- "sasql_connect" on page 645
- "sasql_disconnect" on page 647
- "sqlanywhere_connect (deprecated)" on page 674
- "sqlanywhere_disconnect (deprecated)" on page 676

sqlanywhere_query (deprecated)

Prototype

resource **sqlanywhere_query(** resource *link_identifier*, string *sql_str* **)**

Description

This function is deprecated. You should use the following PHP function instead:
"sasql_query" on page 658.

Prepares and executes the SQL query *sql_str* on the connection identified by *link_identifier* that has already been opened using sqlanywhere_connect or sqlanywhere_pconnect. For queries that do not return result sets, you can use the sqlanywhere_execute function.

Parameters

link_identifier The link identifier returned by the sqlanywhere_connect function.

sql_str A SQL statement supported by SQL Anywhere.

For more information about SQL statements, see "SQL statements" [*SQL Anywhere Server - SQL Reference*].

Returns

A positive value representing the result resource on success, or 0 and an error message on failure.

Example

This example executes the query SELECT * FROM SYSTAB on the SQL Anywhere database.

```
$result = sqlanywhere_query( $conn, "SELECT * FROM SYSTAB" );
```

Related functions

- "sasql_query" on page 658
- "sasql_free_result" on page 653
- "sasql_fetch_array" on page 649
- "sasql_fetch_field" on page 650
- "sasql_fetch_object" on page 651
- "sasql_fetch_row" on page 651
- "sqlanywhere_execute (deprecated)" on page 678
- "sqlanywhere_free_result (deprecated)" on page 683
- "sqlanywhere_fetch_array (deprecated)" on page 679
- "sqlanywhere_fetch_field (deprecated)" on page 680
- "sqlanywhere_fetch_object (deprecated)" on page 681
- "sqlanywhere_fetch_row (deprecated)" on page 682

sqlanywhere_result_all (deprecated)

Prototype

bool **sqlanywhere_result_all(** resource *result_identifier* **[,** *html_table_format_string* **[,** *html_table_header_format_string* **[,** *html_table_row_format_string* **[,** *html_table_cell_format_string* **]** **]** **]** **]** **)**

Description

This function is deprecated.

Fetches all results of the *result_identifier* and generates an HTML output table with an optional formatting string.

Parameters

result_identifier The result resource returned by the sqlanywhere_query function.

html_table_format_string A format string that applies to HTML tables. For example, **"Border=1; Cellpadding=5"**. The special value none does not create an HTML table. This is useful if you want to customize your column names or scripts. If you do not want to specify an explicit value for this parameter, use NULL for the parameter value.

html_table_header_format_string A format string that applies to column headings for HTML tables. For example, **"bgcolor=#FF9533"**. The special value none does not create an HTML table. This is useful if you want to customize your column names or scripts. If you do not want to specify an explicit value for this parameter, use NULL for the parameter value.

html_table_row_format_string A format string that applies to rows within HTML tables. For example, **"onclick='alert('this')'"**. If you would like different formats that alternate, use the special token ><. The left side of the token indicates which format to use on odd rows and the right side of the token is used to format even rows. If you do not place this token in your format string, all rows have the same format. If you do not want to specify an explicit value for this parameter, use NULL for the parameter value.

html_table_cell_format_string A format string that applies to cells within HTML table rows. For example, **"onclick='alert('this')'"**. If you do not want to specify an explicit value for this parameter, use NULL for the parameter value.

Returns

TRUE on success or FALSE on failure.

Example

This example shows how to use sqlanywhere_result_all to generate an HTML table with all the rows from a result set.

```
$result = sqlanywhere_query( $conn, "SELECT GivenName, Surname FROM
Employees" );
  sqlanywhere_result_all( $result );
```

This example shows how to use different formatting on alternate rows using a style sheet.

```
$result = sqlanywhere_query( $conn, "SELECT GivenName, Surname FROM
Employees");
sqlanywhere_result_all( $result, "border=2", "bordercolor=#3F3986",
"bgcolor=#3F3986 style=\"color=#FF9533\"", 'class="even"><class="odd"');
```

Related functions

- “sasql_query” on page 658
- “sqlanywhere_query (deprecated)” on page 686

sqlanywhere_rollback (deprecated)

Prototype

bool **sqlanywhere_rollback(** resource *link_identifier* **)**

Description

This function is deprecated. You should use the following PHP function instead:
"sasql_rollback" on page 661.

Ends a transaction on the SQL Anywhere database and discards any changes made during the transaction. This function is only useful when the auto_commit option is Off.

Parameters

link_identifier The link identifier returned by the sqlanywhere_connect function.

Returns

TRUE on success or FALSE on failure.

Example

This example uses sqlanywhere_rollback to roll back a connection.

```
$result = sqlanywhere_rollback( $conn );
```

Related functions

- "sasql_rollback" on page 661
- "sasql_commit" on page 645
- "sasql_set_option" on page 661
- "sqlanywhere_commit (deprecated)" on page 674
- "sqlanywhere_set_option (deprecated)" on page 689

sqlanywhere_set_option (deprecated)

Prototype

bool **sqlanywhere_set_option(** resource *link_identifier*, string *option*, mixed *value* **)**

Description

This function is deprecated. You should use the following PHP function instead:
"sasql_set_option" on page 661.

Sets the value of the specified option on the specified connection. You can set the value for the following options:

Name	Description	Default
auto_commit	When this option is set to on, the database server commits after executing each statement.	on

Name	Description	Default
row_counts	When this option is set to FALSE, the sqlanywhere_num_rows function returns an estimate of the number of rows affected. If you want to obtain an exact count, set this option to TRUE.	FALSE
verbose_errors	When this option is set to TRUE, the PHP driver returns verbose errors. When this option is set to FALSE, you must call the sqlanywhere_error or sqlanywhere_errorcode functions to get further error information.	TRUE

You can change the default value for an option by including the following line in the *php.ini* file. In this example, the default value is set for the auto_commit option.

```
sqlanywhere.auto_commit=0
```

Parameters

link_identifier The link identifier returned by the sqlanywhere_connect function.

option The name of the option you want to set.

value The new option value.

Returns

TRUE on success or FALSE on failure.

Example

The following examples show the different ways you can set the value of the auto_commit option.

```
$result = sqlanywhere_set_option( $conn, "auto_commit", "Off" );

$result = sqlanywhere_set_option( $conn, "auto_commit", 0 );

$result = sqlanywhere_set_option( $conn, "auto_commit", False );
```

Related functions

- “sasql_set_option” on page 661
- “sasql_commit” on page 645
- “sasql_error” on page 647
- “sasql_errorcode” on page 648
- “sasql_num_rows” on page 656
- “sasql_rollback” on page 661
- “sqlanywhere_commit (deprecated)” on page 674
- “sqlanywhere_error (deprecated)” on page 677
- “sqlanywhere_errorcode (deprecated)” on page 678
- “sqlanywhere_num_rows (deprecated)” on page 685
- “sqlanywhere_rollback (deprecated)” on page 688

Ruby support

SQL Anywhere Ruby API support

There are three different Ruby APIs supported by SQL Anywhere. First, there is the SQL Anywhere Ruby API. This API provides a Ruby wrapping over the interface exposed by the SQL Anywhere C API. Second, there is support for ActiveRecord, an object-relational mapper popularized by being part of the Ruby on Rails web development framework. Third, there is support for Ruby DBI. SQL Anywhere provides a Ruby Database Driver (DBD) which can be used with DBI.

There are three separate packages available in the SQL Anywhere for Ruby project. The simplest way to install any of these packages is to use **RubyGems**. To obtain RubyGems, go to http://rubyforge.org/projects/rubygems/. It is recommended that you install version 1.3.1 or later.

The home for the SQL Anywhere Ruby project is http://sqlanywhere.rubyforge.org/.

SQL Anywhere Native Ruby Driver

sqlanywhere This package is a low-level driver that allows Ruby code to interface with SQL Anywhere databases. This package provides a Ruby wrapping over the interface exposed by the SQL Anywhere C API. This package is written in C and is available as source, or as pre-compiled gems, for Windows and Linux. If you have **RubyGems** installed, this package can be obtained by running the following command:

```
gem install sqlanywhere
```

Note that this package is a prerequisite for any of the other SQL Anywhere Ruby packages. For more information, see:

- "SQL Anywhere Ruby API reference" on page 698
- Download source: http://rubyforge.org/projects/sqlanywhere
- RDocs: http://sqlanywhere.rubyforge.org/sqlanywhere/
- Ruby Programming Language: http://www.ruby-lang.org
- RubyForge/Ruby Central: http://rubyforge.org/

SQL Anywhere ActiveRecord Adapter

activerecord-sqlanywhere-adapter This package is an adapter that allows ActiveRecord to communicate with SQL Anywhere. ActiveRecord is an object-relational mapper, popularized by being part of the Ruby on Rails web development framework. This package is written in pure Ruby, and available in source, or gem format. This adapter uses (and has a dependency on) the **sqlanywhere** gem. If you have **RubyGems** installed, this package and its dependencies can be installed by running the following command:

```
gem install activerecord-sqlanywhere-adapter
```

For more information, see:

- "Rails support in SQL Anywhere" on page 692
- Download source: http://rubyforge.org/projects/sqlanywhere
- RDocs: http://sqlanywhere.rubyforge.org/activerecord-sqlanywhere-adapter
- Ruby on Rails: http://www.rubyonrails.org/

SQL Anywhere Ruby/DBI Driver

dbi This package is a DBI driver for Ruby. If you have RubyGems installed, this package and its dependencies can be installed by running the following command:

```
gem install dbi
```

dbd-sqlanywhere This package is a driver that allows Ruby/DBI to communicate with SQL Anywhere. Ruby/DBI is a generic database interface modeled after Perl's popular DBI module. This package is written in pure Ruby, and available in source, or gem format. This driver uses (and has a dependency on) the sqlanywhere gem. If you have RubyGems installed, this package and its dependencies can be installed by running the following command:

```
gem install dbd-sqlanywhere
```

For more information, see:

- "Ruby-DBI Driver for SQL Anywhere" on page 694
- Download source: http://rubyforge.org/projects/sqlanywhere
- RDocs: http://sqlanywhere.rubyforge.org/dbd-sqlanywhere
- Ruby/DBI - Direct database access layer for Ruby: http://ruby-dbi.rubyforge.org/

For feedback on any of these packages, use the mailing list sqlanywhere-users@rubyforge.com.

For general questions about using SQL Anywhere in a web environment, use the SQL Anywhere Web Development at http://groups.google.com/group/sql-anywhere-web-development forum.

For general questions on SQL Anywhere and its usage, use the newsgroup sybase.public.sqlanywhere.general.

Rails support in SQL Anywhere

Rails is a web development framework written in the Ruby language. Its strength is in web application development. A familiarity with the Ruby programming language is highly recommended before you attempt Rails development. You might consider including the "SQL Anywhere Ruby API reference" on page 698 as part of your familiarization with Ruby.

If you are ready to jump into Rails development, there are a few things you need to do.

Prerequisites

- **RubyGems** You should install RubyGems. It simplifies the installation of Ruby packages. At the time of writing, version 1.3.1 was required for Rails development. The Ruby on Rails web site directs you to the correct version to install. See http://www.rubyonrails.org/.

- **Ruby** You must install the Ruby interpreter on your system. The Ruby on Rails web site recommends which version to install.

- **Rails** With RubyGems, you can install all of Rails and its dependencies with a single command line:

  ```
  gem install rails
  ```

- **activerecord-sqlanywhere-adapter** If you have not already done so, you must install the SQL Anywhere ActiveRecord support to do Rails development using SQL Anywhere. With RubyGems, you can install all of SQL Anywhere ActiveRecord support and its dependencies with a single command line:

  ```
  gem install activerecord-sqlanywhere-adapter
  ```

Before you begin

Once you have installed the requisite components, there are a few final steps that you must undertake before you can begin Rails development using SQL Anywhere. These steps are required to add SQL Anywhere to the set of database management systems supported by Rails.

1. You must create a *sqlanywhere.yml* file in the Rails *configs\databases* directory. If you have installed Ruby in the path *\Ruby* and you have installed version 2.2.2 of Rails, then the path to this file would be *\Ruby\lib\ruby\gems\1.8\gems\rails-2.2.2\configs\databases*. The contents of this file should be:

   ```
   #
   # SQL Anywhere database configuration
   #
   # This configuration file defines the patten used for
   # database filenames. If your application is called "blog",
   # then the database names will be blog_development,
   # blog_test, blog_production. The specified username and
   # password should permit DBA access to the database.
   #

   development:
     adapter: sqlanywhere
     database: <%= app_name %>_development
     username: DBA
     password: sql

   # Warning: The database defined as "test" will be erased and
   # re-generated from your development database when you run "rake".
   # Do not set this db to the same as development or production.
   test:
     adapter: sqlanywhere
     database: <%= app_name %>_test
     username: DBA
     password: sql

   production:
     adapter: sqlanywhere
     database: <%= app_name %>_production
   ```

```
    username: DBA
    password: sql
```

2. You must update the Rails *app_generator.rb* file. Using the same assumptions in step 1 above, this file is located in the path *\Ruby\lib\ruby\gems\1.8\gems\rails-2.2.2\lib\rails_generator\generators\applications\app*. Edit the *app_generator.rb* file and locate the following line:

   ```
   DATABASES = %w(mysql oracle postgresql sqlite2 sqlite3 frontbase ibm_db)
   ```

   Add **sqlanywhere** to the list as follows.

   ```
   DATABASES = %w(sqlanywhere mysql oracle postgresql sqlite2 sqlite3
   frontbase ibm_db)
   ```

   If you want, you can also change the **DEFAULT_DATABASE** setting (on the next line) to read as follows:

   ```
   DEFAULT_DATABASE = 'sqlanywhere'
   ```

   Now save the file and exit.

Learning Rails

It is recommended that you start with the tutorial on the Ruby on Rails website. See http://guides.rails.info/getting_started.html.

In the tutorial, you are shown the command to initialize the **blog** project. Here is the command to initialize the **blog** project for use with SQL Anywhere.

```
rails blog -d sqlanywhere
```

If you changed the **DEFAULT_DATABASE** setting, then the `-d sqlanywhere` option is not required.

Also, note that the **blog** tutorial requires that you set up three databases. After you have initialized the project, you can change to the root directory of the project and create three databases as follows.

```
dbinit blog_development
dbinit blog_test
dbinit blog_production
```

Before you continue, you must start the database server and the three databases as follows.

```
dbsrv12 blog_development.db blog_production.db blog_test.db
```

You are now ready to explore Ruby on Rails web development using the tutorial.

For more information about the Ruby on Rails web development framework, see http://www.rubyonrails.org/.

Ruby-DBI Driver for SQL Anywhere

This section provides an overview of how to write Ruby applications that use the SQL Anywhere DBI driver. Complete documentation for the DBI module is available online at http://ruby-dbi.rubyforge.org/.

Loading the DBI module

To use the DBI:SQLAnywhere interface from a Ruby application, you must first tell Ruby that you plan to use the Ruby DBI module. To do so, include the following line near the top of the Ruby source file.

```
require 'dbi'
```

The DBI module automatically loads the SQL Anywhere database driver (DBD) interface as required.

Opening and closing a connection

Generally, you open a single connection to a database and then perform all the required operations through it by executing a sequence of SQL statements. To open a connection, you use the connect function. The return value is a handle to the database connection that you use to perform subsequent operations on that connection.

The call to the connect function takes the general form:

```
dbh = DBI.connect('DBI:SQLAnywhere:server-name', user-id, password, options)
```

- ***server-name*** is the name of the database server that you want to connect to. Alternately, you can specify a connection string in the format "option1=value1;option2=value2;...".
- ***user-id*** is a valid user ID. Unless this string is empty, ";UID=value" is appended to the connection string.
- ***password*** is the corresponding password for the user ID. Unless this string is empty, ";PWD=value" is appended to the connection string.
- ***options*** is a hash of additional connection parameters such as DatabaseName, DatabaseFile, and ConnectionName. These are appended to the connection string in the format "option1=value1;option2=value2;...".

To demonstrate the connect function, start the database server and sample database before running the sample Ruby scripts.

```
dbeng12 samples-dir\demo.db
```

The following code sample opens and closes a connection to the SQL Anywhere sample database. The string "demo" in the example below is the server name.

```
require 'dbi'
DBI.connect('DBI:SQLAnywhere:demo', 'DBA', 'sql') do |dbh|
    if dbh.ping
       print "Successfully Connected\n"
       dbh.disconnect()
    end
end
```

Optionally, you can specify a connection string in place of the server name. For example, in the above script may be altered by replacing the first parameter to the connect function as follows:

```
require 'dbi'
DBI.connect('DBI:SQLAnywhere:SERVER=demo;DBN=demo', 'DBA', 'sql') do |dbh|
    if dbh.ping
       print "Successfully Connected\n"
```

```
        dbh.disconnect()
    end
end
```

The user ID and password cannot be specified in the connection string. Ruby DBI will automatically fill in the username and password with defaults if these arguments are omitted, so you should never include a UID or PWD connection parameter in your connection string. If you do, an exception will be thrown.

The following example shows how additional connection parameters can be passed to the connect function as a hash of key/value pairs.

```
require 'dbi'
DBI.connect('DBI:SQLAnywhere:demo', 'DBA', 'sql',
        { :ConnectionName => "RubyDemo",
          :DatabaseFile => "demo.db",
          :DatabaseName => "demo" }
         ) do |dbh|
    if dbh.ping
        print "Successfully Connected\n"
        dbh.disconnect()
    end
end
```

Selecting data

Once you have obtained a handle to an open connection, you can access and modify data stored in the database. Perhaps the simplest operation is to retrieve some rows and print them out.

A SQL statement must be executed first. If the statement returns a result set, you use the resulting statement handle to retrieve meta information about the result set and the rows of the result set. The following example obtains the column names from the metadata and displays the column names and values for each row fetched.

```
require 'dbi'

def db_query( dbh, sql )
    sth = dbh.execute(sql)
    print "# of Fields:  #{sth.column_names.size}\n"
    sth.fetch do |row|
        print "\n"
        sth.column_info.each_with_index do |info, i|
            unless info["type_name"] == "LONG VARBINARY"
                print "#{info["name"]}=#{row[i]}\n"
            end
        end
    end
    sth.finish
end

begin
    dbh = DBI.connect('DBI:SQLAnywhere:demo', 'DBA', 'sql')
    db_query(dbh, "SELECT * FROM Products")
rescue DBI::DatabaseError => e
    puts "An error occurred"
    puts "Error code: #{e.err}"
    puts "Error message: #{e.errstr}"
    puts "Error SQLSTATE: #{e.state}"
ensure
    dbh.disconnect if dbh
end
```


The first few lines of output that appear are reproduced below.

```
# of Fields:  8

ID=300
Name=Tee Shirt
Description=Tank Top
Size=Small
Color=White
Quantity=28
UnitPrice=9.00

ID=301
Name=Tee Shirt
Description=V-neck
Size=Medium
Color=Orange
Quantity=54
UnitPrice=14.00
```

It is important to call finish to release the statement handle when you are done. If you do not, then you may get an error like the following:

```
Resource governor for 'prepared statements' exceeded
```

To detect handle leaks, the SQL Anywhere database server limits the number of cursors and prepared statements permitted to a maximum of 50 per connection by default. The resource governor automatically generates an error if these limits are exceeded. If you get this error, check for undestroyed statement handles. Use prepare_cached sparingly, as the statement handles are not destroyed.

If necessary, you can alter these limits by setting the max_cursor_count and max_statement_count options. See “max_cursor_count option” [*SQL Anywhere Server - Database Administration*], and “max_statement_count option” [*SQL Anywhere Server - Database Administration*].

Inserting rows

Inserting rows requires a handle to an open connection. The simplest way to insert rows is to use a parameterized INSERT statement, meaning that question marks are used as place holders for values. The statement is first prepared, and then executed once per new row. The new row values are supplied as parameters to the execute method.

```
require 'dbi'

def db_query( dbh, sql )
    sth = dbh.execute(sql)
    print "# of Fields:  #{sth.column_names.size}\n"
    sth.fetch do |row|
        print "\n"
        sth.column_info.each_with_index do |info, i|
            unless info["type_name"] == "LONG VARBINARY"
                print "#{info["name"]}=#{row[i]}\n"
            end
        end
    end
    sth.finish
end

def db_insert( dbh, rows )
    sql = "INSERT INTO Customers (ID, GivenName, Surname,
```

```
                Street, City, State, Country, PostalCode,
                Phone, CompanyName)
            VALUES (?, ?, ?, ?, ?, ?, ?, ?, ?, ?)"
    sth = dbh.prepare(sql);
    rows.each do |row|
        sth.execute(row[0],row[1],row[2],row[3],row[4],
                    row[5],row[6],row[7],row[8],row[9])
    end
end

begin
    dbh = DBI.connect('DBI:SQLAnywhere:demo', 'DBA', 'sql')
    rows = [
        [801,'Alex','Alt','5 Blue Ave','New York','NY','USA',
            '10012','5185553434','BXM'],
        [802,'Zach','Zed','82 Fair St','New York','NY','USA',
            '10033','5185552234','Zap']
       ]
    db_insert(dbh, rows)
    dbh.commit
    db_query(dbh, "SELECT * FROM Customers WHERE ID > 800")
rescue DBI::DatabaseError => e
    puts "An error occurred"
    puts "Error code: #{e.err}"
    puts "Error message: #{e.errstr}"
    puts "Error SQLSTATE: #{e.state}"
ensure
    dbh.disconnect if dbh
end
```

SQL Anywhere Ruby API reference

SQL Anywhere provides a low-level interface to the SQL Anywhere C API. The API described in the following sections permits the rapid development of SQL applications. To demonstrate the power of Ruby application development, consider the following sample Ruby program. It loads the SQL Anywhere Ruby extension, connects to the sample database, lists column values from the Products table, disconnects, and terminates.

```
begin
    require 'rubygems'
    gem 'sqlanywhere'
    unless defined? SQLAnywhere
        require 'sqlanywhere'
    end
end
api = SQLAnywhere::SQLAnywhereInterface.new()
SQLAnywhere::API.sqlany_initialize_interface( api )
api.sqlany_init()
conn = api.sqlany_new_connection()
api.sqlany_connect( conn, "DSN=SQL Anywhere 12 Demo" )
stmt = api.sqlany_execute_direct( conn, "SELECT * FROM Products" )
num_rows = api.sqlany_num_rows( stmt )
num_rows.times {
    api.sqlany_fetch_next( stmt )
    num_cols = api.sqlany_num_cols( stmt )
    for col in 1..num_cols do
        info = api.sqlany_get_column_info( stmt, col - 1 )
        unless info[3]==1 # Don't do binary
            rc, value = api.sqlany_get_column( stmt, col - 1 )
```



```
            print "#{info[2]}=#{value}\n"
        end
    end
    print "\n"
}
api.sqlany_free_stmt( stmt )
api.sqlany_disconnect(conn)
api.sqlany_free_connection(conn)
api.sqlany_fini()
SQLAnywhere::API.sqlany_finalize_interface( api )
```

The first two rows of the result set output from this Ruby program are shown below:

```
ID=300
Name=Tee Shirt
Description=Tank Top
Size=Small
Color=White
Quantity=28
UnitPrice=9.00

ID=301
Name=Tee Shirt
Description=V-neck
Size=Medium
Color=Orange
Quantity=54
UnitPrice=14.00
```

The following sections describe each of the supported functions.

sqlany_affected_rows

Returns the number of rows affected by execution of the prepared statement.

Syntax

sqlany_affected_rows (*$stmt*)

Parameters

- **$stmt** A statement that was prepared and executed successfully in which no result set was returned. For example, an INSERT, UPDATE or DELETE statement was executed.

Returns

Returns a scalar value that is the number of rows affected, or -1 on failure.

See also

- "sqlany_execute function" on page 704

Example

```
affected = api.sqlany_affected( stmt )
```

sqlany_bind_param function

Binds a user-supplied buffer as a parameter to the prepared statement.

Syntax

```
sqlany_bind_param ( $stmt, $index, $param )
```

Parameters

- **$stmt** A statement object returned by the successful execution of sqlany_prepare.
- **$index** The index of the parameter. The number must be between 0 and sqlany_num_params() - 1.
- **$param** A filled bind object retrieved from sqlany_describe_bind_param.

Returns

Returns a scalar value that is 1 when successful or 0 when unsuccessful.

See also

- "sqlany_describe_bind_param function" on page 702

Example

```
stmt = api.sqlany_prepare(conn, "UPDATE Contacts
     SET Contacts.ID = Contacts.ID + 1000
     WHERE Contacts.ID >= ?" )
rc, param = api.sqlany_describe_bind_param( stmt, 0 )
print "Param name = ", param.get_name(), "\n"
print "Param dir = ", param.get_direction(), "\n"
param.set_value(50)
rc = api.sqlany_bind_param( stmt, 0, param )
```

sqlany_clear_error function

Clears the last stored error code.

Syntax

```
sqlany_clear_error ( $conn )
```

Parameters

- **$conn** A connection object returned from sqlany_new_connection.

Returns

Returns nil.

See also

- "sqlany_new_connection function" on page 712

Example

```
api.sqlany_clear_error( conn )
```

sqlany_client_version function

Returns the current client version.

Syntax

sqlany_client_version ( )

Returns

Returns a scalar value that is the client version string.

Example

```
buffer = api.sqlany_client_version()
```

sqlany_commit function

Commits the current transaction.

Syntax

sqlany_commit (*$conn*)

Parameters

- **$conn** The connection object on which the commit operation is to be performed.

Returns

Returns a scalar value that is 1 when successful or 0 when unsuccessful.

See also

- "sqlany_rollback function" on page 715

Example

```
rc = api.sqlany_commit( conn )
```

sqlany_connect function

Creates a connection to a SQL Anywhere database server using the specified connection object and connection string.

Syntax

sqlany_connect (*$conn*, *$str*)

Parameters

- **$conn** The connection object created by sqlany_new_connection.
- **$str** A SQL Anywhere connection string.

Returns

Returns a scalar value that is 1 if the connection is established successfully or 0 when the connection fails. Use sqlany_error to retrieve the error code and message.

See also

- "sqlany_new_connection function" on page 712
- "sqlany_error function" on page 703
- "Connection parameters" [*SQL Anywhere Server - Database Administration*]
- "SQL Anywhere database connections" [*SQL Anywhere Server - Database Administration*]

Example

```
# Create a connection
conn = api.sqlany_new_connection()

# Establish a connection
status = api.sqlany_connect( conn, "UID=DBA;PWD=sql" )
print "Connection status = #{status}\n"
```

sqlany_describe_bind_param function

Describes the bind parameters of a prepared statement.

Syntax

sqlany_describe_bind_param (*$stmt*, *$index*)

Parameters

- **$stmt** A statement prepared successfully using sqlany_prepare.
- **$index** The index of the parameter. The number must be between 0 and sqlany_num_params() - 1.

Returns

Returns a 2-element array that contains 1 on success or 0 on failure as the first element and a described parameter as the second element.

Remarks

This function allows the caller to determine information about prepared statement parameters. The type of prepared statement (stored procedure or a DML), determines the amount of information provided. The direction of the parameters (input, output, or input-output) are always provided.

See also

- "sqlany_bind_param function" on page 700
- "sqlany_prepare function" on page 715

Example

```
stmt = api.sqlany_prepare(conn, "UPDATE Contacts
     SET Contacts.ID = Contacts.ID + 1000
     WHERE Contacts.ID >= ?" )
rc, param = api.sqlany_describe_bind_param( stmt, 0 )
print "Param name = ", param.get_name(), "\n"
print "Param dir = ", param.get_direction(), "\n"
param.set_value(50)
rc = api.sqlany_bind_param( stmt, 0, param )
```

sqlany_disconnect function

Disconnects a SQL Anywhere connection. All uncommitted transactions are rolled back.

Syntax

sqlany_disconnect (*$conn*)

Parameters

- **$conn** A connection object with a connection established using sqlany_connect.

Returns

Returns a scalar value that is 1 on success or 0 on failure.

See also

- "sqlany_connect function" on page 701
- "sqlany_new_connection function" on page 712

Example

```
# Disconnect from the database
status = api.sqlany_disconnect( conn )
print "Disconnect status = #{status}\n"
```

sqlany_error function

Returns the last error code and message stored in the connection object.

Syntax

sqlany_error (*$conn*)

Parameters

- **$conn** A connection object returned from sqlany_new_connection.

Returns

Returns a 2-element array that contains the SQL error code as the first element and an error message string as the second element.

For the error code, positive values are warnings, negative values are errors, and 0 is success.

See also

- "sqlany_connect function" on page 701
- "SQL Anywhere error messages sorted by SQLCODE" [*Error Messages*]

Example

```
code, msg = api.sqlany_error( conn )
print "Code=#{code} Message=#{msg}\n"
```

sqlany_execute function

Executes a prepared statement.

Syntax

sqlany_execute (*$stmt*)

Parameters

- **$stmt** A statement prepared successfully using sqlany_prepare.

Returns

Returns a scalar value that is 1 on success or 0 on failure.

Remarks

You can use sqlany_num_cols to verify if the statement returned a result set.

See also

- "sqlany_prepare function" on page 715

Example

```
stmt = api.sqlany_prepare(conn, "UPDATE Contacts
     SET Contacts.ID = Contacts.ID + 1000
     WHERE Contacts.ID >= ?" )
rc, param = api.sqlany_describe_bind_param( stmt, 0 )
param.set_value(50)
rc = api.sqlany_bind_param( stmt, 0, param )
rc = api.sqlany_execute( stmt )
```

sqlany_execute_direct function

Executes the SQL statement specified by the string argument.

Syntax

```
sqlany_execute_direct ( $conn, $sql )
```

Parameters

- **$conn** A connection object with a connection established using sqlany_connect.
- **$sql** A SQL string. The SQL string should not have parameters such as **?**.

Returns

Returns a statement object or nil on failure.

Remarks

Use this function if you want to prepare and execute a statement in one step. Do not use this function to execute a SQL statement with parameters.

See also

- "sqlany_fetch_absolute function" on page 706
- "sqlany_fetch_next function" on page 706
- "sqlany_num_cols function" on page 713
- "sqlany_get_column function" on page 709

Example

```
stmt = api.sqlany_execute_direct( conn, "SELECT * FROM Employees" )
rc = api.sqlany_fetch_next( stmt )
rc, employeeID = api.sqlany_get_column( stmt, 0 )
rc, managerID  = api.sqlany_get_column( stmt, 1 )
rc, surname = api.sqlany_get_column( stmt, 2 )
rc, givenName = api.sqlany_get_column( stmt, 3 )
rc, departmentID = api.sqlany_get_column( stmt, 4 )
print employeeID, ",", managerID, ",",
     surname, ",", givenName, ",", departmentID, "\n"
```

sqlany_execute_immediate function

Executes the specified SQL statement immediately without returning a result set. It is useful for statements that do not return result sets.

Syntax

```
sqlany_execute_immediate ( $conn, $sql )
```

Parameters

- **$conn** A connection object with a connection established using sqlany_connect.
- **$sql** A SQL string. The SQL string should not have parameters such as **?**.

Returns

Returns a scalar value that is 1 on success or 0 on failure.

See also

- "sqlany_error function" on page 703

Example

```
rc = api.sqlany_execute_immediate(conn, "UPDATE Contacts
     SET Contacts.ID = Contacts.ID + 1000
     WHERE Contacts.ID >= 50" )
```

sqlany_fetch_absolute function

Moves the current row in the result set to the row number specified and then fetches the data at that row.

Syntax

sqlany_fetch_absolute (*$stmt*, *$row_num*)

Parameters

- **$stmt** A statement object that was executed by sqlany_execute or sqlany_execute_direct.
- **$row_num** The row number to be fetched. The first row is 1, the last row is -1.

Returns

Returns a scalar value that is 1 on success or 0 on failure.

See also

- "sqlany_error function" on page 703
- "sqlany_execute function" on page 704
- "sqlany_execute_direct function" on page 704
- "sqlany_fetch_next function" on page 706

Example

```
stmt = api.sqlany_execute_direct( conn, "SELECT * FROM Employees" )
# Fetch the second row
rc = api.sqlany_fetch_absolute( stmt, 2 )
rc, employeeID = api.sqlany_get_column( stmt, 0 )
rc, managerID  = api.sqlany_get_column( stmt, 1 )
rc, surname = api.sqlany_get_column( stmt, 2 )
rc, givenName = api.sqlany_get_column( stmt, 3 )
rc, departmentID = api.sqlany_get_column( stmt, 4 )
print employeeID, ",", managerID, ",",
     surname, ",", givenName, ",", departmentID, "\n"
```

sqlany_fetch_next function

Returns the next row from the result set. This function first advances the row pointer and then fetches the data at the new row.

Syntax

sqlany_fetch_next (*$stmt*)

Parameters

- **$stmt** A statement object that was executed by sqlany_execute or sqlany_execute_direct.

Returns

Returns a scalar value that is 1 on success or 0 on failure.

See also

- "sqlany_error function" on page 703
- "sqlany_execute function" on page 704
- "sqlany_execute_direct function" on page 704
- "sqlany_fetch_absolute function" on page 706

Example

```
stmt = api.sqlany_execute_direct( conn, "SELECT * FROM Employees" )
# Fetch the second row
rc = api.sqlany_fetch_next( stmt )
rc, employeeID = api.sqlany_get_column( stmt, 0 )
rc, managerID  = api.sqlany_get_column( stmt, 1 )
rc, surname = api.sqlany_get_column( stmt, 2 )
rc, givenName = api.sqlany_get_column( stmt, 3 )
rc, departmentID = api.sqlany_get_column( stmt, 4 )
print employeeID, ",", managerID, ",",
     surname, ",", givenName, ",", departmentID, "\n"
```

sqlany_fini function

Frees resources allocated by the API.

Syntax

sqlany_fini ( )

Returns

Returns nil.

See also

- "sqlany_init function" on page 712

Example

```
# Disconnect from the database
api.sqlany_disconnect( conn )

# Free the connection resources
api.sqlany_free_connection( conn )

# Free resources the api object uses
api.sqlany_fini()
```

```
# Close the interface
SQLAnywhere::API.sqlany_finalize_interface( api )
```

sqlany_free_connection function

Frees the resources associated with a connection object.

Syntax

sqlany_free_connection (*$conn*)

Parameters

- **$conn** A connection object created by sqlany_new_connection.

Returns

Returns nil.

See also

- "sqlany_new_connection function" on page 712

Example

```
# Disconnect from the database
api.sqlany_disconnect( conn )

# Free the connection resources
api.sqlany_free_connection( conn )

# Free resources the api object uses
api.sqlany_fini()

# Close the interface
SQLAnywhere::API.sqlany_finalize_interface( api )
```

sqlany_free_stmt function

Frees resources associated with a statement object.

Syntax

sqlany_free_stmt (*$stmt*)

Parameters

- **$stmt** A statement object returned by the successful execution of sqlany_prepare or sqlany_execute_direct.

Returns

Returns nil.

See also

- "sqlany_prepare function" on page 715
- "sqlany_execute_direct function" on page 704

Example

```
stmt = api.sqlany_prepare(conn, "UPDATE Contacts
     SET Contacts.ID = Contacts.ID + 1000
     WHERE Contacts.ID >= ?" )
rc, param = api.sqlany_describe_bind_param( stmt, 0 )
param.set_value(50)
rc = api.sqlany_bind_param( stmt, 0, param )
rc = api.sqlany_execute( stmt )
rc = api.sqlany_free_stmt( stmt )
```

sqlany_get_bind_param_info function

Retrieves information about the parameters that were bound using sqlany_bind_param.

Syntax

sqlany_get_bind_param_info (*$stmt*, *$index*)

Parameters

- **$stmt** A statement successfully prepared using sqlany_prepare.
- **$index** The index of the parameter. The number must be between 0 and sqlany_num_params() - 1.

Returns

Returns a 2-element array that contains 1 on success or 0 on failure as the first element and a described parameter as the second element.

See also

- "sqlany_bind_param function" on page 700
- "sqlany_describe_bind_param function" on page 702
- "sqlany_prepare function" on page 715

Example

```
# Get information on first parameter (0)
rc, param_info = api.sqlany_get_bind_param_info( stmt, 0 )
print "Param_info direction = ", param_info.get_direction(), "\n"
print "Param_info output = ", param_info.get_output(), "\n"
```

sqlany_get_column function

Returns the value fetched for the specified column.

Syntax

sqlany_get_column (*$stmt*, *$col_index*)

Parameters

- **$stmt** A statement object that was executed by sqlany_execute or sqlany_execute_direct.
- **$col_index** The number of the column to be retrieved. A column number is between 0 and sqlany_num_cols() - 1.

Returns

Returns a 2-element array that contains 1 on success or 0 on failure as the first element and the column value as the second element.

See also

- "sqlany_execute function" on page 704
- "sqlany_execute_direct function" on page 704
- "sqlany_fetch_absolute function" on page 706
- "sqlany_fetch_next function" on page 706

Example

```
stmt = api.sqlany_execute_direct( conn, "SELECT * FROM Employees" )
# Fetch the second row
rc = api.sqlany_fetch_next( stmt )
rc, employeeID = api.sqlany_get_column( stmt, 0 )
rc, managerID  = api.sqlany_get_column( stmt, 1 )
rc, surname = api.sqlany_get_column( stmt, 2 )
rc, givenName = api.sqlany_get_column( stmt, 3 )
rc, departmentID = api.sqlany_get_column( stmt, 4 )
print employeeID, ",", managerID, ",",
     surname, ",", givenName, ",", departmentID, "\n"
```

sqlany_get_column_info function

Gets column information for the specified result set column.

Syntax

sqlany_get_column_info (*$stmt*, *$col_index*)

Parameters

- **$stmt** A statement object that was executed by sqlany_execute or sqlany_execute_direct.
- **$col_index** The column number between 0 and sqlany_num_cols() - 1.

Returns

Returns a 9-element array of information describing a column in a result set. The first element contains 1 on success or 0 on failure. The array elements are described in the following table.

Element number	Type	Description
0	Integer	1 on success or 0 on failure.
1	Integer	Column index (0 to sqlany_num_cols() - 1).
2	String	Column name.
3	Integer	Column type. See “Column types” on page 716.
4	Integer	Column native type. See “Native column types” on page 717.
5	Integer	Column precision (for numeric types).
6	Integer	Column scale (for numeric types).
7	Integer	Column size.
8	Integer	Column nullable (1=nullable, 0=not nullable).

See also

- “sqlany_execute function” on page 704
- “sqlany_execute_direct function” on page 704
- “sqlany_prepare function” on page 715

Example

```
# Get column info for first column (0)
rc, col_num, col_name, col_type, col_native_type, col_precision, col_scale,
    col_size, col_nullable = api.sqlany_get_column_info( stmt, 0 )
```

sqlany_get_next_result function

Advances to the next result set in a multiple result set query.

Syntax

sqlany_get_next_result (*$stmt*)

Parameters

- **$stmt** A statement object executed by sqlany_execute or sqlany_execute_direct.

Returns

Returns a scalar value that is 1 on success or 0 on failure.

See also

- “sqlany_execute function” on page 704
- “sqlany_execute_direct function” on page 704

Example

```
stmt = api.sqlany_prepare(conn, "call two_results()" )
rc = api.sqlany_execute( stmt )
# Fetch from first result set
rc = api.sqlany_fetch_absolute( stmt, 3 )
# Go to next result set
rc = api.sqlany_get_next_result( stmt )
# Fetch from second result set
rc = api.sqlany_fetch_absolute( stmt, 2 )
```

sqlany_init function

Initializes the interface.

Syntax

```
sqlany_init ( )
```

Returns

Returns a 2-element array that contains 1 on success or 0 on failure as the first element and the Ruby interface version as the second element.

See also

- "sqlany_fini function" on page 707

Example

```
# Load the SQLAnywhere gem
begin
    require 'rubygems'
    gem 'sqlanywhere'
    unless defined? SQLAnywhere
        require 'sqlanywhere'
    end
end
# Create an interface
api = SQLAnywhere::SQLAnywhereInterface.new()
# Initialize the interface (loads the DLL/SO)
SQLAnywhere::API.sqlany_initialize_interface( api )
# Initialize our api object
api.sqlany_init()
```

sqlany_new_connection function

Creates a connection object.

Syntax

```
sqlany_new_connection ()
```

Returns

Returns a scalar value that is a connection object.

Remarks

A connection object must be created before a database connection is established. Errors can be retrieved from the connection object. Only one request can be processed on a connection at a time.

See also

- "sqlany_connect function" on page 701
- "sqlany_disconnect function" on page 703

Example

```
# Create a connection
conn = api.sqlany_new_connection()

# Establish a connection
status = api.sqlany_connect( conn, "UID=DBA;PWD=sql" )
print "Status=#{status}\n"
```

sqlany_num_cols function

Returns number of columns in the result set.

Syntax

sqlany_num_cols (*$stmt*)

Parameters

- **$stmt** A statement object executed by sqlany_execute or sqlany_execute_direct.

Returns

Returns a scalar value that is the number of columns in the result set, or -1 on a failure.

See also

- "sqlany_execute function" on page 704
- "sqlany_execute_direct function" on page 704
- "sqlany_prepare function" on page 715

Example

```
stmt = api.sqlany_execute_direct( conn, "SELECT * FROM Employees" )
# Get number of result set columns
num_cols = api.sqlany_num_cols( stmt )
```

sqlany_num_params function

Returns the number of parameters that are expected for a prepared statement.

Syntax

sqlany_num_params (*$stmt*)

Parameters

- **$stmt** A statement object returned by the successful execution of sqlany_prepare.

Returns

Returns a scalar value that is the number of parameters in a prepared statement, or -1 on a failure.

See also

- "sqlany_prepare function" on page 715

Example

```
stmt = api.sqlany_prepare(conn, "UPDATE Contacts
      SET Contacts.ID = Contacts.ID + 1000
      WHERE Contacts.ID >= ?" )
num_params = api.sqlany_num_params( stmt )
```

sqlany_num_rows function

Returns the number of rows in the result set.

Syntax

sqlany_num_rows (*$stmt*)

Parameters

- **$stmt** A statement object executed by sqlany_execute or sqlany_execute_direct.

Returns

Returns a scalar value that is the number of rows in the result set. If the number of rows is an estimate, the number returned is negative and the estimate is the absolute value of the returned integer. The value returned is positive if the number of rows is exact.

Remarks

By default, this function only returns an estimate. To return an exact count, set the ROW_COUNTS option on the connection. For more information, see "row_counts option" [*SQL Anywhere Server - Database Administration*].

A count of the number of rows in a result set can be returned only for the first result set in a statement that returns multiple result sets. If sqlany_get_next_result is used to move to the next result set, sqlany_num_rows will still return the number of rows in the first result set.

See also

- "sqlany_execute function" on page 704
- "sqlany_execute_direct function" on page 704

Example

```
stmt = api.sqlany_execute_direct( conn, "SELECT * FROM Employees" )
# Get number of rows in result set
num_rows = api.sqlany_num_rows( stmt )
```

sqlany_prepare function

Prepares the supplied SQL string.

Syntax

```
sqlany_prepare ( $conn, $sql )
```

Parameters

- **$conn** A connection object with a connection established using sqlany_connect.
- **$sql** The SQL statement to be prepared.

Returns

Returns a scalar value that is the statement object, or nil on failure.

Remarks

The statement associated with the statement object is executed by sqlany_execute. You can use sqlany_free_stmt to free the resources associated with the statement object.

See also

- "sqlany_execute function" on page 704
- "sqlany_free_stmt function" on page 708
- "sqlany_num_params function" on page 713
- "sqlany_describe_bind_param function" on page 702
- "sqlany_bind_param function" on page 700

Example

```
stmt = api.sqlany_prepare(conn, "UPDATE Contacts
     SET Contacts.ID = Contacts.ID + 1000
     WHERE Contacts.ID >= ?" )
rc, param = api.sqlany_describe_bind_param( stmt, 0 )
param.set_value(50)
rc = api.sqlany_bind_param( stmt, 0, param )
rc = api.sqlany_execute( stmt )
```

sqlany_rollback function

Rolls back the current transaction.

Syntax

```
sqlany_rollback ( $conn )
```

Parameters

- **$conn** The connection object on which the rollback operation is to be performed.

Returns

Returns a scalar value that is 1 on success, 0 on failure.

See also

- "sqlany_commit function" on page 701

Example

```
rc = api.sqlany_rollback( conn )
```

sqlany_sqlstate function

Retrieves the current SQLSTATE.

Syntax

sqlany_sqlstate (*$conn*)

Parameters

- **$conn** A connection object returned from sqlany_new_connection.

Returns

Returns a scalar value that is the current 5-character SQLSTATE.

See also

- "sqlany_error function" on page 703
- "SQL Anywhere error messages sorted by SQLSTATE" [*Error Messages*]

Example

```
sql_state = api.sqlany_sqlstate( conn )
```

Column types

The following Ruby class defines the column types returned by some SQL Anywhere Ruby functions.

```
class Types
    A_INVALID_TYPE = 0
    A_BINARY       = 1
    A_STRING       = 2
    A_DOUBLE       = 3
    A_VAL64        = 4
    A_UVAL64       = 5
    A_VAL32        = 6
    A_UVAL32       = 7
    A_VAL16        = 8
    A_UVAL16       = 9
```



```
    A_VAL8          = 10
    A_UVAL8         = 11
end
```

Native column types

The following table defines the native column types returned by some SQL Anywhere functions.

Native Type Value	Native Type
384	DT_DATE
388	DT_TIME
390	DT_TIMESTAMP_STRUCT
392	DT_TIMESTAMP
448	DT_VARCHAR
452	DT_FIXCHAR
456	DT_LONGVARCHAR
460	DT_STRING
480	DT_DOUBLE
482	DT_FLOAT
484	DT_DECIMAL
496	DT_INT
500	DT_SMALLINT
524	DT_BINARY
528	DT_LONGBINARY
600	DT_VARIABLE
604	DT_TINYINT
608	DT_BIGINT
612	DT_UNSINT
616	DT_UNSSMALLINT

Native Type Value	Native Type
620	DT_UNSBIGINT
624	DT_BIT
628	DT_NSTRING
632	DT_NFIXCHAR
636	DT_NVARCHAR
640	DT_LONGNVARCHAR

Sybase Open Client support

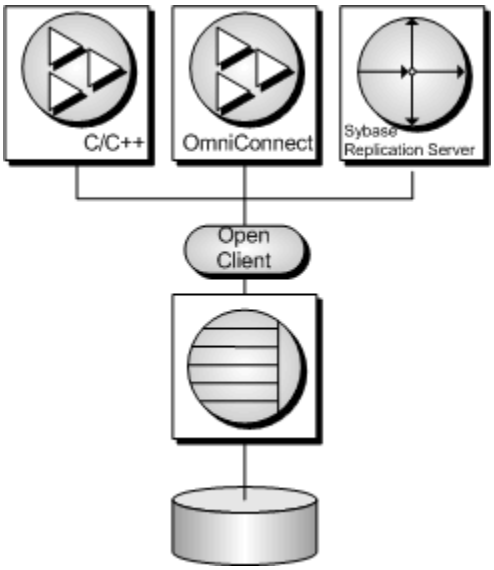
Sybase Open Client provides customer applications, third-party products, and other Sybase products with the interfaces needed to communicate with SQL Anywhere and other Open Servers.

When to use Open Client

You should consider using the Open Client interface if you are concerned with Adaptive Server Enterprise compatibility or if you are using other Sybase products that support the Open Client interface.

Open Client applications

You can develop applications in C or C++, and then connect those applications to SQL Anywhere using the Open Client API. Other Sybase applications, such as OmniConnect, use Open Client. The Open Client API is also supported by Sybase Adaptive Server Enterprise.



See also

- "Using SQL Anywhere as an Open Server" [*SQL Anywhere Server - Database Administration*]

Open Client architecture

Note
This section describes the Sybase Open Client programming interface for SQL Anywhere. The primary documentation for Sybase Open Client application development is the Open Client documentation, available from Sybase. This section describes features specific to SQL Anywhere, but it is not an exhaustive guide to Sybase Open Client application programming.

Sybase Open Client has two components: programming interfaces and network services.

DB-Library and Client Library

Sybase Open Client provides two core programming interfaces for writing client applications: DB-Library and Client-Library.

Open Client DB-Library provides support for older Open Client applications, and is a completely separate programming interface from Client-Library. DB-Library is documented in the *Open Client DB-Library/C Reference Manual*, provided with the Sybase Open Client product.

Client-Library programs also depend on CS-Library, which provides routines that are used in both Client-Library and Server-Library applications. Client-Library applications can also use routines from Bulk-Library to help high-speed data transfer.

Both CS-Library and Bulk-Library are included in the Sybase Open Client, which is available separately.

Network services

Open Client network services include Sybase Net-Library, which provides support for specific network protocols such as TCP/IP and DECnet. The Net-Library interface is invisible to application developers. However, on some platforms, an application may need a different Net-Library driver for different system network configurations. Depending on your host platform, the Net-Library driver is specified either by the system's Sybase configuration or when you compile and link your programs.

Instructions for driver configuration can be found in the *Open Client/Server Configuration Guide*.

Instructions for building Client-Library programs can be found in the *Open Client/Server Programmer's Supplement*.

What you need to build Open Client applications

To run Open Client applications, you must install and configure Sybase Open Client components on the computer where the application is running. You may have these components present as part of your installation of other Sybase products or you can optionally install these libraries with SQL Anywhere, subject to the terms of your license agreement.

Open Client applications do not need any Open Client components on the computer where the database server is running.

To build Open Client applications, you need the development version of Open Client, available from Sybase.

By default, SQL Anywhere databases are created as case-insensitive, while Adaptive Server Enterprise databases are case sensitive.

For more information about running Open Client applications with SQL Anywhere, see "Using SQL Anywhere as an Open Server" [*SQL Anywhere Server - Database Administration*].

Data type mappings

Sybase Open Client has its own internal data types, which differ in some details from those available in SQL Anywhere. For this reason, SQL Anywhere internally maps some data types between those used by Open Client applications and those available in SQL Anywhere.

To build Open Client applications, you need the development version of Open Client. To use Open Client applications, the Open Client run-times must be installed and configured on the computer where the application runs.

The SQL Anywhere server does not require any external communications runtime to support Open Client applications.

Each Open Client data type is mapped onto the equivalent SQL Anywhere data type. All Open Client data types are supported.

SQL Anywhere data types with no direct counterpart in Open Client

The following table lists the mappings of data types supported in SQL Anywhere that have no direct counterpart in Open Client.

SQL Anywhere data type	Open Client data type
unsigned short	int
unsigned int	bigint
unsigned bigint	numeric(20,0)
string	varchar
timestamp	datetime

Range limitations in data type mapping

Some data types have different ranges in SQL Anywhere than in Open Client. In such cases, overflow errors can occur during retrieval or insertion of data.

The following table lists Open Client application data types that can be mapped to SQL Anywhere data types, but with some restriction in the range of possible values.

The Open Client data type is usually mapped to a SQL Anywhere data type with a greater range of possible values. As a result, it is possible to pass a value to SQL Anywhere that will be accepted and stored in a database, but that is too large to be fetched by an Open Client application.

Data type	Open Client lower range	Open Client upper range	SQL Anywhere lower range	SQL Anywhere upper range
MONEY	-922 377 203 685 477.5808	922 377 203 685 477.5807	-999 999 999 999 999.9999	999 999 999 999 999.9999
SMALLMONEY	-214 748.3648	214 748.3647	-999 999.9999	-999 999.9999
DATETIME [1]	January 1, 1753	December 31, 9999	January 1, 0001	December 31, 9999
SMALLDATETIME	January 1, 1900	June 6, 2079	January 1, 0001	December 31, 9999

[1] For versions earlier than OpenClient 15.5; otherwise, the full range of dates from 0001-01-01 to 9999-12-31 is supported.

Example

For example, the Open Client MONEY and SMALLMONEY data types do not span the entire numeric range of their underlying SQL Anywhere implementations. Therefore, it is possible to have a value in a SQL Anywhere column which exceeds the boundaries of the Open Client data type MONEY. When the client fetches any such offending values via SQL Anywhere, an error is generated.

Timestamps

Timestamp values inserted into or retrieved from SQL Anywhere will have the date portion restricted to January 1, 1753 or later and the time version restricted to 1/300th of a second precision if the client is using Open Client 15.1 or earlier. If, however, the client is using Open Client 15.5 or later, then no restriction will apply to the timestamp values.

Using SQL in Open Client applications

This section provides a very brief introduction to using SQL in Open Client applications, with a particular focus on SQL Anywhere-specific issues.

For an introduction to the concepts, see “Using SQL in applications” on page 1.

Executing SQL statements

You send SQL statements to a database server by including them in Client Library function calls. For example, the following pair of calls executes a DELETE statement:

```
ret = ct_command(cmd, CS_LANG_CMD,
                 "DELETE FROM Employees
                  WHERE EmployeeID=105"
```



```
                    CS_NULLTERM,
                    CS_UNUSED);
    ret = ct_send(cmd);
```

Using prepared statements

The ct_dynamic function is used to manage prepared statements. This function takes a *type* parameter that describes the action you are taking.

To use a prepared statement in Open Client

1. Prepare the statement using the ct_dynamic function, with a CS_PREPARE *type* parameter.
2. Set statement parameters using ct_param.
3. Execute the statement using ct_dynamic with a CS_EXECUTE *type* parameter.
4. Free the resources associated with the statement using ct_dynamic with a CS_DEALLOC *type* parameter.

For more information about using prepared statements in Open Client, see your Open Client documentation.

Using cursors

The ct_cursor function is used to manage cursors. This function takes a *type* parameter that describes the action you are taking.

Supported cursor types

Not all the types of cursor that SQL Anywhere supports are available through the Open Client interface. You cannot use scroll cursors, dynamic scroll cursors, or insensitive cursors through Open Client.

Uniqueness and updatability are two properties of cursors. Cursors can be unique (each row carries primary key or uniqueness information, regardless of whether it is used by the application) or not. Cursors can be read-only or updatable. If a cursor is updatable and not unique, performance may suffer, as no prefetching of rows is done in this case, regardless of the CS_CURSOR_ROWS setting.

The steps in using cursors

In contrast to some other interfaces, such as embedded SQL, Open Client associates a cursor with a SQL statement expressed as a string. Embedded SQL first prepares a statement and then the cursor is declared using the statement handle.

To use cursors in Open Client

1. To declare a cursor in Open Client, use ct_cursor with CS_CURSOR_DECLARE as the *type* parameter.
2. After declaring a cursor, you can control how many rows are prefetched to the client side each time a row is fetched from the server by using ct_cursor with CS_CURSOR_ROWS as the *type* parameter.

Storing prefetched rows at the client side reduces the number of calls to the server and this improves overall throughput and turnaround time. Prefetched rows are not immediately passed on to the application; they are stored in a buffer at the client side ready for use.

The setting of the prefetch database option controls prefetching of rows for other interfaces. It is ignored by Open Client connections. The CS_CURSOR_ROWS setting is ignored for non-unique, updatable cursors.

3. To open a cursor in Open Client, use ct_cursor with CS_CURSOR_OPEN as the *type* parameter.
4. To fetch each row in to the application, use ct_fetch.
5. To close a cursor, you use ct_cursor with CS_CURSOR_CLOSE.
6. In Open Client, you also need to deallocate the resources associated with a cursor. You do this by using ct_cursor with CS_CURSOR_DEALLOC. You can also use CS_CURSOR_CLOSE with the additional parameter CS_DEALLOC to perform these operations in a single step.

Modifying rows through a cursor

With Open Client, you can delete or update rows in a cursor, as long as the cursor is for a single table. The user must have permissions to update the table and the cursor must be marked for update.

To modify rows through a cursor

- Instead of carrying out a fetch, you can delete or update the current row of the cursor using ct_cursor with CS_CURSOR_DELETE or CS_CURSOR_UPDATE, respectively.

You cannot insert rows through a cursor in Open Client applications.

Describing query results in Open Client

Open Client handles result sets in a different way than some other SQL Anywhere interfaces.

In embedded SQL and ODBC, you **describe** a query or stored procedure to set up the proper number and types of variables to receive the results. The description is done on the statement itself.

In Open Client, you do not need to describe a statement. Instead, each row returned from the server can carry a description of its contents. If you use ct_command and ct_send to execute statements, you can use the ct_results function to handle all aspects of rows returned in queries.

If you do not want to use this row-by-row method of handling result sets, you can use ct_dynamic to prepare a SQL statement and use ct_describe to describe its result set. This corresponds more closely to the describing of SQL statements in other interfaces.

Known Open Client limitations of SQL Anywhere

Using the Open Client interface, you can use a SQL Anywhere database in much the same way as you would an Adaptive Server Enterprise database. There are some limitations, including the following:

- SQL Anywhere does not support the Adaptive Server Enterprise Commit Service.
- A client/server connection's **capabilities** determine the types of client requests and server responses permitted for that connection. The following capabilities are not supported:
  - CS_CSR_ABS
  - CS_CSR_FIRST
  - CS_CSR_LAST
  - CS_CSR_PREV
  - CS_CSR_REL
  - CS_DATA_BOUNDARY
  - CS_DATA_SENSITIVITY
  - CS_OPT_FORMATONLY
  - CS_PROTO_DYNPROC
  - CS_REG_NOTIF
  - CS_REQ_BCP
- Security options, such as SSL, are not supported. However, password encryption is supported.
- Open Client applications can connect to SQL Anywhere using TCP/IP.

  For more information about capabilities, see the *Open Server Server-Library C Reference Manual*.
- When the CS_DATAFMT is used with the CS_DESCRIBE_INPUT, it does not return the data type of a column when a parameterized variable is sent to SQL Anywhere as input.

HTTP web services

Using SQL Anywhere as an HTTP web server

SQL Anywhere contains a built-in HTTP web server that allows you to create online web services in SQL Anywhere databases. SQL Anywhere web servers support HTTP and SOAP over HTTP requests sent by web browsers and client applications. The web server performance is optimized because web services are embedded in the database.

SQL Anywhere web services provide client applications with an alternative to traditional interfaces, such as JDBC and ODBC. They are easily deployed because additional components are not needed, and can be accessed from multi-platform client applications written in a variety of languages, including scripting languages — such as Perl and Python.

In addition to providing web services over an HTTP web server, SQL Anywhere can function as a SOAP or HTTP client application to access standard web services available over the Internet and other SQL Anywhere HTTP web servers. For more information about accessing web services using web clients, see "Accessing web services using web clients" on page 773.

Quick start guide to using SQL Anywhere as an HTTP web server

This quick start guide illustrates how to start a SQL Anywhere HTTP web server, create a web service, and access it from a web browser. It does not illustrate SQL Anywhere web service features, such as SOAP over HTTP support and application development, to a full extent. Many SQL Anywhere web service features are available that are beyond the scope of this guide.

The following tasks are performed:

- Start a SQL Anywhere HTTP web server database
- Create a general HTTP web service
- View the web service in a web browser

To create a SQL Anywhere HTTP web server and a general HTTP web service

1. Start the SQL Anywhere HTTP web server while loading a SQL Anywhere database.

   Run the following command at the command prompt:

   ```
   dbeng12 -xs http(port=8082) samples-dir\demo.db
   ```

> **Note**
> Use the dbeng12 command to start a personal database server that can only be accessed by the local host. Use the dbsrv12 command to start a network database server instead.

Replace *samples-dir* with the location of your samples directory. The -xs http(port=8082) option instructs the server to listen for HTTP requests on port 8082. Use a different port number if a web server is already running on port 8082.

For more information about starting an HTTP web server, see "Starting an HTTP web server" on page 729.

2. Use the CREATE SERVICE statement to create a web service that responds to incoming web browser requests.

   a. Connect to the *demo.db* database using Interactive SQL.

      Run the following command from the *samples-dir* directory:

      ```
      dbisql -c "dbf=samples-dir\demo.db;uid=DBA;pwd=sql"
      ```

   b. Create a new web service in the database.

      Run the following SQL script in Interactive SQL:

      ```
      CREATE SERVICE SampleWebService
          TYPE 'web-service-type-clause'
          AUTHORIZATION OFF
          USER DBA
          AS SELECT 'Hello world!';
      ```

      Replace *web-service-type-clause* with the desired web service type. The **HTML** type clause is recommended for web browser compatibility. Other general HTTP web service type clauses include **XML**, **RAW**, and **JSON**. You can use the **SOAP** and **DISH** type clauses for creating a SOAP over HTTP web service but these types are not compatible with the above statement. For more information about supported web service types, see "Choosing a web service type" on page 732.

      The CREATE SERVICE statement creates the **SampleWebService** web service, which returns the result set of the SELECT SQL statement. In this example, the script returns "Hello world!"

      The AUTHORIZATION OFF clause indicates that authorization is not required to access the web service.

      The USER DBA statement indicates that the service statement should be run under the DBA login name.

      The AS SELECT clause allows the service to select from a table or function, or view data directly. Use AS CALL as an alternative clause to call a stored procedure.

      For more information about the CREATE SERVICE statement and these clauses, see "CREATE SERVICE statement" on page 740.

3. View the web service in a web browser.

   On the computer running the SQL Anywhere HTTP web server, open a web browser, such as Internet Explorer or Firefox, and go to the following URL:


```
http://localhost:8082/demo/SampleWebService
```

This URL directs your web browser to the HTTP web server on port 8082. **SampleWebService** prints "Hello world". The result set output is displayed in the format specified by the *web-service-type-clause* from step 2. For more information about how result sets are displayed in web browsers, see "Choosing a web service type" on page 732.

Other sample resources

Samples are included in the *samples-dir\SQLAnywhere\http* directory.

Other examples might be available on CodeXchange at http://www.sybase.com/developer/codexchange.

Starting an HTTP web server

The SQL Anywhere HTTP web server starts automatically when you launch the database server with the -xs dbeng12/dbsrv12 server option at the command line. This server option allows you to perform the following tasks:

- Enable a web service protocol to listen for web service requests.
- Configure network protocol options, such as server port, logging, time-out criteria, and the maximum request size.

See also

- "Managing web services in an HTTP web server" on page 732
- "-xs dbeng12/dbsrv12 server option" [*SQL Anywhere Server - Database Administration*]

Enabling a web service protocol

Web service protocols are enabled by launching your database server with the -xs dbeng12/dbsrv12 server option.

For example, the following command starts a database server and enables a web service protocol for the *your-database-name.db* database:

```
dbsrv12 -xs protocol-type your-database-name.db
```

Replace the *protocol-type* argument with one of the following supported protocols:

- **HTTP** Use this protocol to listen for HTTP connections.
- **HTTPS** Use this protocol to listen for HTTPS connections. SSL version 3.0 and TLS version 1.0 are supported.

Note
Network protocol options are available for each supported protocol. These options allow you to control protocol behavior and can be configured at the command line when you launch your database server. See "Configuring network protocol options" on page 730.

See also

- "-xs dbeng12/dbsrv12 server option" [*SQL Anywhere Server - Database Administration*]

Configuring network protocol options

Network protocol options are optional settings that provide control over a specified web service protocol. These settings are configured at the command line when you launch your database server with the -xs dbeng12/dbsrv12 server option. See "-xs dbeng12/dbsrv12 server option" [*SQL Anywhere Server - Database Administration*].

For example, the following command line configures an HTTPS listener with the PORT, FIPS, Identity, and Identity_Password network protocol options specified:

```
dbsrv12 -xs https(PORT=544;FIPS=YES;
    Identity=certificate.id;Identity_Password=password) your-database-name.db
```

This command starts a database server that enables the HTTPS web service protocol for the *your-database-name.db* database. The network protocol options indicate that the web server should perform the following tasks:

- Listen on port 544 instead of the default HTTPS port.
- Enable FIPS-approved security algorithms to encrypt communications.
- Locate the specified identity file, *certificate.id*, which contains a public certificate and its private key.
- Validate the private key against the specified identity password, **password**.

The following list identifies the network protocol options that are commonly used for web service protocols:

Network protocol option	Available web service protocols	Description
"DatabaseName (DBN) protocol option" [*SQL Anywhere Server - Database Administration*]	HTTP, HTTPS	Specifies the name of a database to use when processing web requests, or uses the REQUIRED or AUTO keyword to specify whether database names are required as part of the URL.
"FIPS protocol option" [*SQL Anywhere Server - Database Administration*]	HTTPS	Enables FIPS-approved security algorithms to encrypt database files, communications for database client/server communication, and web services.
"Identity protocol option" [*SQL Anywhere Server - Database Administration*]	HTTPS	Specifies the name of an identity file to use for secure HTTPS connections.

Network protocol option	Available web service protocols	Description
"Identity_Password protocol option" [*SQL Anywhere Server - Database Administration*]	HTTPS	Specifies the password for the encryption certificate.
"LocalOnly (LOCAL) protocol option" [*SQL Anywhere Server - Database Administration*]	HTTP, HTTPS	Allows a client to choose to connect only to a server on the local computer, if one exists.
"LogFile (LOG) protocol option" [*SQL Anywhere Server - Database Administration*]	HTTP, HTTPS	Specifies the name of the file where the database server writes information about web requests.
"LogFormat protocol (LF) option" [*SQL Anywhere Server - Database Administration*]	HTTP, HTTPS	Controls the format of messages written to the log file where the database server writes information about web requests, and specifies which fields appear in the messages.
"LogOptions (LOPT) protocol option" [*SQL Anywhere Server - Database Administration*]	HTTP, HTTPS	Specifies the types of messages that are recorded in the log where the database server writes information about web requests.
"ServerPort (PORT) protocol option" [*SQL Anywhere Server - Database Administration*]	HTTP, HTTPS	Specifies the port the database server is running on.

For a complete list of network protocol options, see "Network protocol options" [*SQL Anywhere Server - Database Administration*].

Starting multiple HTTP web servers

A multiple HTTP web server configuration allows you to create web services across databases and have them appear as part of a single web site. You can start multiple HTTP web servers by using multiple instances of the -xs dbeng12/dbsrv12 server option. This task is performed by specifying a unique port number for each HTTP web server.

Example

In this example, the following command line starts two HTTP web services — one for *your-first-database.db* and one for *your-second-database.db*:

```
dbsrv12 -xs
    http(port=80;dbn=your-first-database)
    http(port=8800;dbn=your-second-database)
    your-first-database.db your-second-database.db
```

See also

- "DatabaseName (DBN) protocol option" [*SQL Anywhere Server - Database Administration*]
- "-xs dbeng12/dbsrv12 server option" [*SQL Anywhere Server - Database Administration*]

Managing web services in an HTTP web server

Web services refer to software that assists inter-computer data transfer and interoperability. They make segments of business logic available over the Internet. URLs become available to clients when managing web services in an HTTP web server. The conventions used when specifying a URL determine how the server should communicate with web clients.

Web service management involves the following tasks:

- Choosing the types of web services that you want to manage.
- Creating and maintaining those web services

Web services can be created and stored in a SQL Anywhere database.

Choosing a web service type

When a web browser or client application makes a web service request to a SQL Anywhere web service, the request is processed and a result set is returned in the response. SQL Anywhere supports several web service types that provide control over the result set format and how result sets are returned. You specify the web server type with the TYPE clause of the CREATE SERVICE or ALTER SERVICE statement after choosing an appropriate web service type.

The following web service types are supported:

- **HTML** The result set of a statement, function, or procedure is formatted into an HTML document that contains a table. Web browsers display the body of the HTML document.

- **XML** The result set of a statement, function, or procedure is returned as an XML document. Non-XML formatted result sets are automatically formatted into XML. Web browsers display the raw XML code, including tags and attributes.

  The XML formatting is the equivalent of using the FOR XML RAW clause in a SELECT statement, such as in the following SQL statement example:


```
SELECT * FROM table-name FOR XML RAW
```

- **RAW** The result set of a statement, function, or procedure is returned without automatic formatting.

  This service type provides the most control over the result set. However, you must generate the response by writing the necessary markup (HTML, XML) explicitly within your stored procedure. You can use the SA_SET_HTTP_HEADER system procedure to set the HTTP Content-Type header to specify the MIME type, allowing web browsers to correctly display the result set. For a complete list of web service system procedures, see "Web services system procedures" [*SQL Anywhere Server - SQL Reference*].

  For an example of a stored procedure that works in conjunction with the RAW web service type, see "Customizing web pages" on page 752.

- **JSON** The result set of a statement, function, or procedure is returned in JSON (JavaScript Object Notation). JSON is more compact than XML format and has a similar structure. For more information about JSON, see http://www.json.org/.

  This service is used by AJAX to make HTTP calls to web applications. For an example of the JSON type, see *samples-dir\SQLAnywhere\HTTP\json_sample.sql*.

- **SOAP** The result set of a statement, function, or procedure is returned as a SOAP response. SOAP services provide a common data interchange standard to provide data access to disparate client applications that support SOAP. SOAP request and response envelopes are transported as an XML payload using HTTP (SOAP over HTTP). A request to a SOAP service must be a valid SOAP request, not a general HTTP request. The output of SOAP services can be adjusted using the FORMAT and DATATYPE attributes of the CREATE or ALTER SERVICE statement.

  For more information about SOAP services, see "Creating SOAP over HTTP services" on page 735.

- **DISH** A DISH service (Determine SOAP Handler) is a SQL Anywhere SOAP endpoint. The DISH service exposes the WSDL (Web Services Description Language) document that describes all SOAP Operations (SQL Anywhere SOAP services) accessible through it. A SOAP client toolkit builds the client application with interfaces based on the WSDL. The SOAP client application directs all SOAP requests to the SOAP endpoint (the SQL Anywhere DISH service).

  For more information about DISH services, see "Creating DISH services" on page 736.

Example

The following example illustrates the creation of a general HTTP web service that uses the **RAW** service type:

```
CREATE OR REPLACE PROCEDURE sp_echotext( str long varchar )
BEGIN
    CALL sa_set_http_header('Content-Type', 'text/plain');
    SELECT str;
END;

CREATE SERVICE SampleWebService
    TYPE 'RAW'
    AUTHORIZATION OFF
    USER DBA
    AS CALL sp_echotext ( :str );
```

See also

- "Creating or altering a web service" on page 734
- "HTTP and SOAP request structures" on page 821
- "CREATE SERVICE statement" on page 740

Maintaining web services

Web service maintenance involves the following tasks:

- **Creating or altering web services** Create or alter web services to provide web applications supporting a web browser interface and provide data interchange over the web using REST and SOAP methodologies. For an example of general HTTP web service creation, see "Quick start guide to using SQL Anywhere as an HTTP web server" on page 727.
- **Dropping web services** Dropping a web service causes the subsequent requests made for that service to return a `404 Not Found` HTTP status message. All unresolved requests, intended or unintended, are processed if a **root** web service exists.
- **Commenting on web services** Commenting is optional and allows you to provide documentation for your web services.
- **Creating and customizing a root web service** You can create a **root** web service to handle HTTP requests that do not match any other web service requests.
- **Enabling and disabling web services** A disabled web service returns a `404 Not Found` HTTP status message. The METHOD clause specifies the HTTP methods that can be called for a particular web service. See "CREATE SERVICE statement" on page 740.

Creating or altering a web service

Creating or altering a web service requires use of the CREATE SERVICE or ALTER SERVICE statement, respectively. This section illustrates how to run these statements with Interactive SQL to create different kinds of web services. The examples in this section assume that you have connected to a SQL Anywhere database, *your-sql-anywhere-database.db*, through Interactive SQL using the following command:

```
dbisql -c "dbf=your-sql-anywhere-database.db;uid=your-userid;pwd=your-
password"
```

Creating general HTTP web services

General HTTP web services are classified as HTML, XML or RAW. All general HTTP web services can be created or altered using the same CREATE SERVICE and ALTER SERVICE statement syntax.

Example

Run the following statement in Interactive SQL to create a sample general HTTP web service in the HTTP web server:


```
CREATE SERVICE SampleWebService
    TYPE 'web-service-type-clause'
    URL OFF
    USER DBA
    AUTHORIZATION OFF
    AS sql-statement;
```

The CREATE SERVICE statement creates a new web service named **SampleWebService** and returns the result set of *sql-statement*. You can replace *sql-statement* with either a SELECT statement to select data from a table or view directly, or a CALL statement to call a stored procedure in the database. For more information about creating stored functions and procedures for your web services, see "Developing web service applications in an HTTP web server" on page 752.

Replace *web-service-type-clause* with the desired web service type. Valid clauses for general HTTP web services include **HTML**, **XML**, **RAW** and **JSON**. For more information about supported web service types, see "Choosing a web service type" on page 732.

You can view the generated result set for the **SampleWebService** service by accessing the service in a web browser. See "Browsing an HTTP web server" on page 770.

See also

- "Choosing a web service type" on page 732
- "CREATE SERVICE statement" on page 740
- "ALTER SERVICE statement" on page 749

Creating SOAP over HTTP services

SOAP is a data interchange standard supported by many development environments. A SOAP payload consists of an XML document, known as a SOAP envelope. A SOAP request envelope contains the SOAP operation (a SOAP service) and specifies all appropriate parameters. The SOAP service parses the request envelope to obtain the parameters and calls or selects a stored procedure or function just as any other service does. The presentation layer of the SOAP service streams the result set back to the client within a SOAP envelope in a predefined format as specified by the DISH service's WSDL. For more information about SOAP standards, see http://www.w3.org/TR/2000/NOTE-SOAP-20000508/.

By default, SOAP service parameters and result data are typed as STRING parameters. DATATYPE ON specifies that input parameters and response data should use TRUE types. Specifying DATATYPE changes the WSDL specification accordingly, so that client SOAP toolkits generate interfaces with the appropriate type of parameters and response objects. For more information about how data types are formatted for client applications, see "Accessing variables in result sets" on page 806.

The FORMAT clause is used to target specific SOAP toolkits with varying capabilities. DNET provides Microsoft .NET client applications to consume a SOAP service response as a System.Data.DataSet object. CONCRETE exposes a more general structure that allows an object-oriented application, such as .NET or Java, to generate response objects that package rows and columns. XML returns the entire response as an XML document, exposing it as a string. Clients can further process the data using an XML parser. The FORMAT clause of the CREATE SERVICE statement supports multiple client application types. For examples of other formats supported by SOAP services, see "HTTP web service examples" on page 826.

Note
The DATATYPE clause only pertains to SOAP services (there is no data typing in HTML) The FORMAT clause can be specified for either a SOAP or DISH service. A SOAP service FORMAT specification overrides that of the DISH service. For more information about DISH services, see "Creating DISH services" on page 736.

Example

Run the following statement in Interactive SQL to create a SOAP over HTTP service:

```
CREATE SERVICE SampleSOAPService
    TYPE 'SOAP'
    DATATYPE ON
    FORMAT 'CONCRETE'
    USER DBA
    AUTHORIZATION OFF
    AS sql-statement;
```

See also

- "Choosing a web service type" on page 732
- "CREATE SERVICE statement" on page 740
- "ALTER SERVICE statement" on page 749

Creating DISH services

SQL Anywhere allows you to create DISH services that act as SOAP endpoints for groups of SOAP services. DISH services also automatically construct WSDL (Web Services Description Language) documents that allow SOAP client toolkits to generate the interfaces necessary to interchange data with the SOAP services described by the WSDL. SOAP services can be added and removed without requiring maintenance to the DISH services because the current working set of SOAP over HTTP services are always exposed.

Example

Run the following SQL script in Interactive SQL to create sample SOAP and DISH services in the HTTP web server:

```
CREATE SERVICE "Samples/TestSoapOp"
    TYPE 'SOAP'
    DATATYPE ON
    USER DBA
    AUTHORIZATION OFF
    AS CALL sp_echo(:i, :f, :s);

CREATE OR ALTER PROCEDURE sp_echo(i INTEGER, f REAL, s LONG VARCHAR )
RESULT( ret_i INTEGER, ret_f REAL, ret_s LONG VARCHAR )
BEGIN
    SELECT i, f, s;
END;

CREATE SERVICE "dnet_endpoint"
    TYPE 'DISH'
    GROUP "Samples"
    FORMAT 'DNET';
```


The first CREATE SERVICE statement creates a new SOAP service named **Samples/TestSoapOp**. For more information about creating SOAP services, see "Creating SOAP over HTTP services" on page 735.

The second CREATE SERVICE statement creates a new DISH service named **dnet_endpoint**. The **Samples** portion of the GROUP clause identifies the group of SOAP services to expose. You can view the WSDL document generated by the DISH service. When running your SQL Anywhere web server on a machine, you can access the service using the `http://localhost:`*`port-number`*`/samples/dnet_endpoint` URL, where *port-number* is the port number that the server is running on. See "Browsing an HTTP web server" on page 770.

In this example, the SOAP service does not contain a FORMAT clause to indicate a SOAP response format. Therefore, the SOAP response format is dictated by the DISH service, which does not override the FORMAT clause of the SOAP service. This feature allows you to create homogeneous DISH services where each DISH endpoint can serve SOAP clients with varying capabilities.

Creating homogeneous DISH services

When SOAP service definitions defer the specification of the FORMAT clause to the DISH service, a set of SOAP services can be grouped together within a DISH service that defines the format. Multiple DISH services can then expose the same group of SOAP services with a different FORMAT specifications. If you expand on the **TestSoapOp** example, you can create another DISH service named **java_endpoint** using the following SQL script:

```
CREATE SERVICE "java_endpoint"
    TYPE 'DISH'
    GROUP "Samples"
    FORMAT 'CONCRETE';
```

In this example, the SOAP client receives a response object named **TestSoapOp_Dataset** when it makes a web service request for the **TestSoapOp** operation through the **java_endpoint** DISH service. The WSDL can be inspected to compare the differences between **dnet_endpoint** and **java_endpoint**. Using this technique, a SOAP endpoint can quickly be constructed to meet the needs of a particular SOAP client toolkit.

See also

- "Choosing a web service type" on page 732
- "HTTP web service examples" on page 826
- "CREATE SERVICE statement" on page 740
- "ALTER SERVICE statement" on page 749

Dropping a web service

Dropping a web service causes the subsequent requests made for that service to return a `404 Not Found` HTTP status message. All unresolved requests, intended or unintended, are processed if a **root** web service exists.

Example

Run the following SQL script to drop a web service named **SampleWebService**:

```
DROP SERVICE SampleWebService;
```

See also

- "DROP SERVICE statement" on page 750
- "Creating and customizing a root web service" on page 738

Commenting on a web service

Providing documentation for a web service requires use of the COMMENT ON SERVICE statement. A comment can be removed by setting the *statement* clause to null.

Example

For example, run the following statement to create a new comment on a web service named **SampleWebService**:

```
COMMENT ON SERVICE SampleWebService
    IS "This is a comment on my web service.";
```

See also

- "COMMENT statement" [*SQL Anywhere Server - SQL Reference*]

Creating and customizing a root web service

An HTTP client request that does not match any web service request is processed by the **root** web service if a **root** web service is defined.

The **root** web service provides you with an easy and flexible method to handle arbitrary HTTP requests whose URLs are not necessarily known at the time when you build your application, and to handle unrecognized requests.

Example

This example illustrates how to use a **root** web service, which is stored in a table within the database, to provide content to web browsers and other HTTP clients. It assumes that you have started a local HTTP web server on a single database and listening on port 80. All scripts are run on the web server.

Connect to the database server through Interactive SQL and run the following SQL script to create a **root** web service that passes the url host variable, which is supplied by the client, to a procedure named **PageContent**:

```
CREATE SERVICE root
    TYPE 'RAW'
    AUTHORIZATION OFF
    SECURE OFF
    URL ON
    USER DBA
    AS CALL PageContent(:url);
```


The URL ON portion specifies that the full path component is made accessible by an HTTP variable named URL. For more information about the CREATE SERVICE statement syntax, see "CREATE SERVICE statement" on page 740.

Run the following SQL script to create a table for storing page content. In this example, the page content is defined by its URL, MIME-type, and the content itself.

```
CREATE TABLE Page_Content (
    url          VARCHAR(1024) NOT NULL PRIMARY KEY,
    content_type VARCHAR(128)  NOT NULL,
    image        LONG VARCHAR  NOT NULL
);
```

Run the following SQL script to populate the table. In this example, the intent is to define the content to be provided to the HTTP client when the index.html page is requested.

```
INSERT INTO Page_Content
VALUES(
    'index.html',
    'text/html',
    '<html><body><h1>Hello World</h1></body></html>'
);
COMMIT;
```

Run the following SQL script to implement the **PageContent** procedure, which accepts the url host variable that is passed through to the **root** web service:

```
CREATE PROCEDURE PageContent( IN @url LONG VARCHAR )
RESULT ( html_doc LONG VARCHAR )
BEGIN
    DECLARE @status char(3);
    DECLARE @type varchar(128);
    DECLARE @image long varchar;

    SELECT content_type, image INTO @type, @image
        FROM Page_Content
        WHERE url = @url;

    IF @image is NULL THEN
        SET @status = '404';
        SET @type = 'text/html';
        SET @image =  '<html><body><h1>404 - Page Not Found</h1>There is no
content located at the URL "' || html_encode( @url ) || '" on this server.</
body></html>';
    ELSE
        SET @status = '200';
    END IF;
    CALL dbo.sa_set_http_header( '@HttpStatus', @status );
    CALL dbo.sa_set_http_header( 'Content-Type', @type );
    SELECT @image;
END;
```

The **root** web service calls the **PageContent** procedure when a request to the HTTP server does not match any other defined web service URL. The procedure checks if the client-supplied URL matches a url in the **Page_Content** table. The SELECT statement sends a response to the client. If the client-supplied URL was not found in the table, a generic `404 - Page Not Found` html page is built and sent to the client.

In the error message, the HTML_ENCODE function is used to encode the special characters in the client-supplied URL. For more information, see "HTML_ENCODE function [Miscellaneous]" [*SQL Anywhere Server - SQL Reference*].

The @HttpStatus header is used to set the status code returned with the request. A 404 status indicates a Not Found error, and a 200 status indicates OK. The 'Content-Type' header is used to set the content type returned with the request. In this example, the content (MIME) type of the index.html page is text/html. For more information, see "sa_set_http_header system procedure" [*SQL Anywhere Server - SQL Reference*].

See also

- "Customizing web pages" on page 752
- "Browsing an HTTP web server" on page 770

Web service SQL statements

The following SQL statements are available to assist with web service maintenance:

Web server related SQL statements	Description
"CREATE SERVICE statement" on page 740	Creates a new web service.
"ALTER SERVICE statement" on page 749	Alters an existing web service.

"COMMENT statement" [*SQL Anywhere Server - SQL Reference*]	Stores a comment for a web service in the system tables.
	
	Use the following syntax to comment on a web service:
	
	`COMMENT ON SERVICE 'web-service-name'`
	`    IS 'your comments'`

"DROP SERVICE statement" on page 750	Drops a web service.

CREATE SERVICE statement

Creates a new web service.

Syntax 1: General HTTP web services

CREATE SERVICE *service-name*
TYPE { **'RAW'** | **'HTML'** | **'JSON'** | **'XML'** }
[**URL** [**PATH**] { **ON** | **OFF** | **ELEMENTS** }]
[*common-attributes*]
[**AS** { *statement* | **NULL** }]

common-attributes:
[**AUTHORIZATION** { **ON** | **OFF** }]
[**ENABLE** | **DISABLE**]
[**METHODS** '*method*,...']
[**SECURE** { **ON** | **OFF** }]
[**USER** { *user-name* | **NULL** }]

method:
DEFAULT
| **POST**
| **GET**
| **HEAD**
| **PUT**
| **DELETE**
| **NONE**
| *****

Syntax 2: SOAP over HTTP

CREATE SERVICE *service-name*
TYPE 'SOAP'
[**DATATYPE** { **ON** | **OFF** | **IN** | **OUT** }]
[**FORMAT** { **'DNET'** | **'CONCRETE'** [**EXPLICIT** { **ON** | **OFF** }] | **'XML'** | **NULL** }]
[*common-attributes*]
AS *statement*

Syntax 3: DISH services

CREATE SERVICE *service-name*
TYPE 'DISH'
[**GROUP** { *group-name* | **NULL** }]
[**FORMAT** { **'DNET'** | **'CONCRETE'** [**EXPLICIT** { **ON** | **OFF** }] | **'XML'** | **NULL** }]
[*common-attributes*]

Parameters

service-name Web service names can be any sequence of alphanumeric characters or slash (/), hyphen (-), underscore (_), period (.), exclamation mark (!), tilde (~), asterisk (*), apostrophe ('), left parenthesis ((), or right parenthesis ()), except that the service name must not begin or end with a slash (/) or contain two or more consecutive slashes (for example, //).

Unlike other services, you cannot use a slash (/) anywhere in a DISH service name.

You can name your service **root**, but this name has a special function. For more information, see "Creating and customizing a root web service" on page 738.

TYPE clause Identifies the type of the service where each service defines a specific response format. The type must be one of the listed service types. There is no default value.

- **'SOAP'** The result set is returned as an XML payload known as a SOAP envelope. The format of the data may be further refined using by the FORMAT clause. A request to a SOAP service must be a valid SOAP request, not just a general HTTP request. For more information about the SOAP standards, see http://www.w3.org/TR/2000/NOTE-SOAP-20000508/.

- **'DISH'** A DISH service (Determine SOAP Handler) is a SOAP endpoint that references any SOAP service within its GROUP context. It also exposes the interfaces to its SOAP services by generating a WSDL (Web Services Description Language) for consumption by SOAP client toolkits.

- **'RAW'** The result set is sent to the client without any formatting. Utilization of this service requires that all content markup is explicitly provided. Complex dynamic content containing current content with markup, JavaScript and images can be generated on demand. The media type may be specified by setting the Content-Type response header using the sa_set_http_header procedure. Setting the Content-Type header to 'text/html' is good practice when generating HTML markup to ensure that all browsers display the markup as HTML and not text/plain. See "Developing web service applications in an HTTP web server" on page 752, and "sa_set_http_header system procedure" [*SQL Anywhere Server - SQL Reference*].

- **'HTML'** The result set is returned as an HTML representation of a table or view.

- **'JSON'** The result set is returned in JavaScript Object Notation (JSON). For more information about JSON, see http://www.json.org/.

- **'XML'** The result set is returned as XML. If the result set is already XML, no additional formatting is applied. Otherwise, it is automatically formatted as XML. As an alternative approach, a RAW service could return a select using the FOR XML RAW clause having set a valid Content-Type such as text/xml using sa_set_http_header procedure. See "sa_set_http_header system procedure" [*SQL Anywhere Server - SQL Reference*].

GROUP clause A DISH service without a GROUP clause exposes all SOAP services defined within the database. By convention, the SOAP service name can be composed of a GROUP and a NAME element. The name is delimited from the group by the last slash character. For example, a SOAP service name defined as **'aaa/bbb/ccc'** is **'ccc'**, and the group is **'aaa/bbb'**. Delimiting a DISH service using this convention is invalid. Instead, a GROUP clause is applied to specify the group of SOAP services for which it is to be the SOAP endpoint.

Note
Slashes are converted to underscores within the WSDL to produce valid XML. Use caution when using a DISH service that does not specify a GROUP clause such that it exposes all SOAP services that may contain slashes. Use caution when using groups in conjunction with SOAP service names that contain underscores to avoid ambiguity.

DATATYPE clause Applies to SOAP services only. When DATATYPE OFF is specified, SOAP input parameters and response data are defined as XMLSchema string types. In most cases, true data types are preferred because it negates the need for the SOAP client to cast the data prior to computation. Parameter data types are exposed in the schema section of the WSDL generated by the DISH service. Output data types are represented as XML schema type attributes for each column of data.

The following values are permitted for the DATATYPE clause:

- **ON** Generates data typing of input parameters and result set responses.

- **OFF** All input parameters and response data are typed as XMLSchema string. (default)

- **IN** Generates true data types for input parameters only. Response data types are XMLSchema string.
- **OUT** Generates true data types for responses only. Input parameters are typed as XMLSchema string.

For more information about SOAP services, see "Tutorial: Using SQL Anywhere to access a SOAP/DISH service" on page 830.

For more information about mapping **XMLSchema** types to SQL data types, see "Working with data types (SOAP only)" on page 809.

URL clause Determines whether URL paths are accepted and, if so, how they are processed. Applies to XML, HTML, JSON, and RAW service types. PATH is optional in the syntax and is ignored.

- **OFF** Indicates that the service name in a URL request must not be followed by a path. OFF is the default setting. For example, the following form will be disallowed due to the path elements `/aaa/bbb/ccc`.

  ```
  http://<host-name>/<service-name>/aaa/bbb/ccc
  ```

  Suppose that `CREATE SERVICE echo URL PATH OFF` was specified when creating the web service. A URL similar to `http://localhost/echo?id=1` produces the following values:

  ```
  HTTP_VARIABLE('id') == 1,
  HTTP_HEADER('@HTTPQUERYSTRING') == id=1
  ```

- **ON** Indicates that the service name in a URL request can be followed by a path. The path is value is returned by querying a dedicated HTTP variable named **URL**. A service can be defined to explicitly provide the URL parameter or it may be retrieved using the HTTP_VARIABLE function. For example, the following form is allowed:

  ```
  http://<host-name>/<service-name>/aaa/bbb/ccc
  ```

  Suppose that `CREATE SERVICE echo URL PATH ON` was specified when creating the web service. A URL similar to `http://localhost/echo/one/two?id=1` produces the following values:

  ```
  HTTP_VARIABLE('id') == 1,
  HTTP_VARIABLE('URL') == one/two,
  HTTP_HEADER('@HTTPQUERYSTRING') == id=1
  ```

- **ELEMENTS** Indicates that the service name in a URL request may be followed by a path. The path is obtained in segments by specifying a single parameter keyword **URL1**, **URL2**, and so on. Each parameter may be retrieved using the HTTP_VARIABLE or NEXT_HTTP_VARIABLE functions. These iterator functions can be used in applications where a variable number of path elements can be provided. For example, the following form is allowed:

  ```
  http://<host-name>/<service-name>/aaa/bbb/ccc
  ```

  Suppose that `CREATE SERVICE echo URL PATH ELEMENTS` was specified when creating the web service. A URL similar to `http://localhost/echo/one/two?id=1` produces the following values:

  ```
  HTTP_VARIABLE('id') == 1,
  HTTP_VARIABLE('URL1') == one,
  ```

```
HTTP_VARIABLE('URL2') == two,
HTTP_HEADER('@HTTPQUERYSTRING') == id=1
```

Up to 10 elements can be obtained. A NULL value is returned if the corresponding element is not supplied. In the above example, `HTTP_VARIABLE('URL3')` returns NULL because no corresponding element was supplied.

For more information about URLs, see "Browsing an HTTP web server" on page 770, and "Accessing client-supplied HTTP variables and headers" on page 753.

FORMAT clause Applies to DISH and SOAP services only. This clause specifies the output format when sending responses to SOAP client applications.

The SOAP service format is dictated by the associated DISH service format specification when it is not specified by the SOAP service. The default format is **DNET**.

SOAP requests should be directed to the DISH service (the SQL Anywhere SOAP endpoint) to leverage common formatting rules for a group of SOAP services (SOAP operations). A SOAP service FORMAT specification overrides that of a DISH service. The format specification of the DISH service is used when a SOAP service does not define a FORMAT clause. If no FORMAT is provided by either service then the default is '**DNET**'.

The following formats are supported for DISH and SOAP services:

- **'DNET'** The output is in a System.Data.DataSet compatible format for consumption by .NET client applications. (default)
- **'CONCRETE'** This output format is used to support client SOAP toolkits that are capable of generating interfaces representing arrays of row and column objects but are not able to consume the DNET format. Java and .NET clients can easily consume this output format.

  The specific output format is exposed within the WSDL of a DISH service. For CONCRETE OFF or as a last resort, a CONCRETE format for one or more SOAP services is represented as a **SimpleDataset**. Examining the WSDL, a **SimpleDataset** is composed of an array of rows composed of an array of any number of columns. This is not an ideal representation because the specific column names and data types are not specified. It is recommended that SOAP services define a call to a stored procedure that, in turn, defines a RESULT clause. A DISH service exposing SOAP services defined in this way can fully describe the result set when generating the WSDL.

  By default, **EXPLICIT ON** is assumed and the WSDL contains a specific Dataset entry for each SOAP service if the result set for a SOAP service can be described. Each entry name is prefixed by the SOAP service name and an underscore. For example, a SOAP service named **test** produces a **test_Dataset** object specification containing the XMLSchema definitions for each of its column elements.

  When **EXPLICIT ON** is specified (default), the WSDL describes an explicit **DataSet** element when the following criteria are met:

  - The CREATE SERVICE statement calls a stored procedure

- A RESULT clause describing the columns and data types is specified in the stored procedure

  When **EXPLICIT OFF** is specified, the WSDL describes the **SimpleDataset** element. This description does not provide the number of columns, column names or data types.

- **'XML'** The output is generated in an XMLSchema string format. The response is an XML document that requires further processing by the SOAP client to extract column data. This format is suitable for SOAP clients that cannot generate intermediate interface objects that represent arrays of rows and columns.

- **NULL** A NULL type causes the SOAP or DISH service to use the default behavior. The format type of an existing service is overwritten when using the NULL type in an ALTER SERVICE statement.

AUTHORIZATION clause Determines whether users must specify a user name and password through basic HTTP authorization when connecting to the service. The default value is ON. If authorization is OFF, the AS clause is required for all services with the exception of DISH, and a user must be specified with the USER clause. All requests are run using that user's account and permissions. If AUTHORIZATION is ON, all users must provide a user name and password. Optionally, you can limit the users that are permitted to use the service by providing a user or group name with the USER clause. If the user name is NULL, all known users can access the service. The AUTHORIZATION clause allows your web services to use database authorization and permissions to control access to the data in your database.

When the authorization value is ON, an HTTP client connecting to a web service uses basic authentication (RFC 2617) which obfuscates the user and password information using base-64 encoding. It is recommended that you use the HTTPS protocol for increased security.

ENABLE and DISABLE clauses Determines whether the service is available for use. By default, when a service is created, it is enabled. When creating or altering a service, you may include an ENABLE or DISABLE clause. Disabling a service effectively takes the service off line. Later, it can be enabled using ALTER SERVICE with the ENABLE clause. An HTTP request made to a disabled service typically returns a `404 Not Found` HTTP status.

METHODS clause Specifies the HTTP methods that are supported by the service. Valid values are DEFAULT, POST, GET, HEAD, PUT, DELETE, and NONE. An asterisk (*****) may be used as a short form to represent the POST, GET, and HEAD methods which are default request types for the RAW, HTML and XML service types. The default method types for SOAP services are POST and HEAD. The default method types for DISH services are GET, POST, and HEAD. Not all HTTP methods are valid for all the service types. The following table summarizes the valid HTTP methods that can be applied to each service type:

Request type	Applies to service	Description
DEFAULT	all	Use DEFAULT to reset the set of request types to the default set for the given service type. It cannot be included in a list with other request types.

Request type	Applies to service	Description
POST	SOAP, DISH, RAW, HTML, XML	Enabled by default for SOAP, RAW, HTML and XML.
GET	DISH, RAW, HTML, XML	Enabled by default for DISH, RAW, HTML and XML.
HEAD	SOAP, DISH, RAW, HTML, XML	Enabled by default for SOAP, DISH, RAW, HTML and XML.
PUT	RAW, HTML, XML	Not enabled by default.
DELETE	RAW, HTML, XML	Not enabled by default.
NONE	all	Use NONE to disable access to a service. When applied to a SOAP service, the service cannot be directly accessed by a SOAP request. This enforce exclusive access to a SOAP operation through a DISH service SOAP endpoint. It is recommended that you specify METHOD **NONE** for each SOAP service.
*****	DISH, RAW, HTML, XML	Same as specifying **'POST,GET,HEAD'**.

For example, you can use either of the following clauses to specify that a service supports all HTTP method types:

```
METHODS '*,PUT,DELETE'
METHODS 'POST,GET,HEAD,PUT,DELETE'
```

To reset the list of request types for any service type to its default, you can use the following clause:

```
METHODS 'DEFAULT'
```


SECURE clause Specifies whether the service should be accessible on a secure or non-secure listener. ON indicates that only HTTPS connections are accepted, and that connections received on the HTTP port are automatically redirected to the HTTPS port. OFF indicates that both HTTP and HTTPS connections are accepted, provided that the necessary ports are specified when starting the web server. The default value is OFF.

USER clause Specifies a database user, or group of users, with permissions to execute the web service request. A USER clause must be specified when the service is configured with AUTHORIZATION OFF and should be specified with AUTHORIZATION ON. (the default) An HTTP request made to a service requiring authorization results in a `401 Authorization Required` HTTP response status. Based on this response, the web browser prompts for a user ID and password.

Caution
It is strongly recommended that you specify a USER clause when authorization is enabled (default). Otherwise, authorization is granted to all users.

The USER clause controls which database user accounts can be used to process service requests. Database access permissions are restricted to the privileges assigned to the user of the service.

statement Specifies a command, such as a stored procedure call, to invoke when the service is accessed.

A DISH service is the only service that must either define a null statement, or not define a statement. A SOAP service must define a statement. Any other SERVICE can have a NULL statement, but only if configured with AUTHORIZATION ON.

An HTTP request to a non-DISH service with no *statement* specifies the SQL expression to execute within its URL. Although authorization is required, this capability should not be used in production systems because it makes the server vulnerable to SQL injections. When a statement is defined within the service, the specified SQL statement is the only statement that can be executed through the service.

In a typical web service application, you use *statement* to call a function or procedure. You can pass host variables as parameters to access client-supplied HTTP variables.

The following *statement* demonstrates a procedure call that passes two host variables to a procedure named **AuthenticateUser**. This call presumes that a web client supplies the **user_name** and **user_password** variables:

```
CALL AuthenticateUser ( :user_name, :user_password );
```

For more information about passing host variables to a function or procedure, see "Accessing client-supplied HTTP variables and headers" on page 753.

Remarks

Service definitions are stored within the ISYSWEBSERVICE table and can be examined from the SYSWEBSERVICE view.

Permissions

DBA authority.

Side effects

None.

See also

- "ALTER SERVICE statement" [*SQL Anywhere Server - SQL Reference*]
- "DROP SERVICE statement" [*SQL Anywhere Server - SQL Reference*]
- "ISYSWEBSERVICE system table" [*SQL Anywhere Server - SQL Reference*]
- "Using SQL Anywhere as an HTTP web server" on page 727

Standards and compatibility

- **SQL/2008** Vendor extension.
- **Transact-SQL** CREATE SERVICE is supported by Adaptive Server Enterprise, for types XML, RAW, and SOAP only.

Examples

The following example demonstrates how to create a JSON service.

Start a database server with the -xs (http or https) option and then execute the following SQL script to set up the service:

```
CREATE PROCEDURE ListEmployees()
RESULT (
 EmployeeID            integer,
 Surname               person_name_t,
 GivenName             person_name_t,
 StartDate             date,
 TerminationDate       date )
BEGIN
    SELECT EmployeeID, Surname, GivenName, StartDate, TerminationDate
    FROM Employees
END;

CREATE SERVICE "jsonEmployeeList"
    TYPE 'JSON'
    AUTHORIZATION OFF
    SECURE OFF
    USER DBA
    AS CALL ListEmployees();
```

The JSON service provides data for easy consumption by an AJAX call back.

Run the following SQL script to create an HTML service that provides the service in a readable form:

```
CREATE SERVICE "EmployeeList"
    TYPE 'HTML'
    AUTHORIZATION OFF
    SECURE OFF
    USER DBA
    AS CALL ListEmployees();
```

Use a web browser to access the service using an URL similar to `http://localhost/EmplyeeList`.

ALTER SERVICE statement

Alters an existing web service.

Syntax 1 - Simple web service

ALTER SERVICE *service-name*
[**TYPE** { **'RAW'** | **'HTML'** | **'JSON'** | **'XML'** }]
[**URL** [**PATH**] { **ON** | **OFF** | **ELEMENTS** }]
[*common-attributes*]
[**AS** { *statement* | **NULL** }]

common-attributes:
[**AUTHORIZATION** { **ON** | **OFF** }]
[**ENABLE** | **DISABLE**]
[**METHODS** '*method*,...']
[**SECURE** { **ON** | **OFF** }]
[**USER** { *user-name* | **NULL** }]

method:
DEFAULT
| **POST**
| **GET**
| **HEAD**
| **PUT**
| **DELETE**
| **NONE**
| *****

Syntax 2 - SOAP service

ALTER SERVICE *service-name*
[**TYPE 'SOAP'**]
[**DATATYPE** { **ON** | **OFF** | **IN** | **OUT** }]
[**FORMAT** { **'DNET'** | **'CONCRETE'** [**EXPLICIT** { **ON** | **OFF** }] | **'XML'** | **NULL** }]
[*common-attributes*]
[**AS** *statement*]

Syntax 3 - DISH service

ALTER SERVICE *service-name*
[**TYPE 'DISH'**]
[**GROUP** { *group-name* | **NULL** }]
[**FORMAT** { **'DNET'** | **'CONCRETE'** [**EXPLICIT** { **ON** | **OFF** }]| **'XML'** | **NULL** }]
[*common-attributes*]

Parameters

The descriptions of the ALTER SERVICE clauses are identical to those of the CREATE SERVICE statement. See "CREATE SERVICE statement" [*SQL Anywhere Server - SQL Reference*].

Remarks

The ALTER SERVICE statement modifies the attributes of a web service.

Permissions

DBA authority

Side effects

None.

See also

- "CREATE SERVICE statement" [*SQL Anywhere Server - SQL Reference*]
- "DROP SERVICE statement" [*SQL Anywhere Server - SQL Reference*]
- "Tutorial: Using SQL Anywhere to access a SOAP/DISH service" on page 830
- "SYSWEBSERVICE system view" [*SQL Anywhere Server - SQL Reference*]
- "-xs dbeng12/dbsrv12 server option" [*SQL Anywhere Server - Database Administration*]
- "Using SQL Anywhere as an HTTP web server" on page 727

Standards and compatibility

- **SQL/2008** Vendor extension.

Example

The following example demonstrates how to disable an existing web service using the ALTER SERVICE statement:

```
CREATE SERVICE WebServiceTable
   AUTHORIZATION OFF
   USER DBA
   AS SELECT *
      FROM SYS.SYSTAB;

ALTER SERVICE WebServiceTable DISABLE;
```

DROP SERVICE statement

Drops a web service.

Syntax

DROP SERVICE *service-name*

Remarks

This statement deletes a web service listed in the ISYSWEBSERVICE system table.

Permissions

DBA authority

Side effects

None.

See also

- "ALTER SERVICE statement" [*SQL Anywhere Server - SQL Reference*]
- "CREATE SERVICE statement" [*SQL Anywhere Server - SQL Reference*]
- "ISYSWEBSERVICE system table" [*SQL Anywhere Server - SQL Reference*]

Standards and compatibility

- **SQL/2008** Vendor extension.

Example

The following SQL script illustrates how to drop a web service named **WebServiceTable**:

```
DROP SERVICE WebServiceTable;
```

Connection pooling for web services

Each database that exposes web services has access to a pool of database connections. The pool is grouped by user name such that all services defined under a given USER clause share the same connection pool group.

A service request executing a query for the first time must go through an optimization phase to establish an execution plan. If the plan can be cached and reused, then the optimization phase can be skipped for subsequent executions. HTTP connection pooling leverages the plan caching in database connections by reusing them whenever possible. Each service maintains its own list of connections to optimize reuse. However, during peak loads, a service can steal least utilized connections from within the same user group of connections.

Over time, a given connection may acquire cached plans that can optimize performance for the execution of a number of services. For more information about cached plan settings, see "max_plans_cached option" [*SQL Anywhere Server - Database Administration*].

In a connection pool, an HTTP request for a given service tries to acquire a database connection from a pool. Unlike HTTP sessions, pooled connections are sanitized by resetting the connection scope environment, such as connection scope variables and temporary tables.

Database connections that are pooled within the HTTP connection pool are not counted as connections in use for the purposes of licensing. Connections are counted as licensed connections when they are acquired from the pool. A `503 Service Temporarily Unavailable` status is returned when an HTTP request exceeds the licensing restrictions while acquiring a connection from the pool.

Web services can only utilize a connection pool when they are defined with AUTHORIZATION OFF. For more information, see "CREATE SERVICE statement" on page 740.

A database connection within a pool is not updated when changes occur to database and connection options.

See also

- "http_connection_pool_basesize connection property" [*SQL Anywhere Server - Database Administration*]
- "http_connection_pool_timeout connection property" [*SQL Anywhere Server - Database Administration*]
- "Web services connection properties" on page 768

Developing web service applications in an HTTP web server

This section provides an overview of web page creation and customization. It explains how to develop stored procedures for your HTTP web server. It assumes that you have knowledge of starting SQL Anywhere HTTP web servers and creating web services that call stored procedures.

For detailed examples of web service applications, see the *samples-dir\SQLAnywhere\HTTP* directory.

See also

- "Starting an HTTP web server" on page 729
- "Managing web services in an HTTP web server" on page 732

Customizing web pages

You must first evaluate the format of the web service invoked by the HTTP web server to customize your web pages. For example, web pages are formatted in HTML when the web service specifies the **HTML** type. For more information on supported web service types, see "Choosing a web service type" on page 732.

The **RAW** web service type provides the most customization because it requires that web service procedures and functions explicitly require coding to provide the required markup such as HTML or XML. The following tasks must be performed to customize web pages when using the **RAW** type:

- Set the HTTP Content-Type header field to the appropriate MIME type, such as text/html, in the called stored procedure.
- Apply appropriate markup for the MIME type when generating web page output from the called stored procedure.

Example

The following example illustrates how to create a new web service with the **RAW** type specified:

```
CREATE SERVICE WebServiceName
    TYPE 'RAW'
    AUTHORIZATION OFF
    URL ON
    USER DBA
    AS CALL HomePage( :url );
```

In this example, the web service calls the **HomePage** stored procedure, which is required to define a single URL parameter that receives the PATH component of the URL.

Setting the Content-Type header field

Use the sa_set_http_header system procedure to define the HTTP Content-Type header to ensure that web browsers correctly render the content.

The following example illustrates how to format web page output in HTML using the text/html MIME-type with the sa_set_http_header system procedure:


```
CREATE PROCEDURE HomePage ( IN url LONG VARCHAR )
    RESULT (html_doc XML)
    BEGIN
        CALL dbo.sa_set_http_header ( 'Content-Type', 'text/html' );
        -- Your SQL code goes here.
        ...
    END
```

Applying tagging conventions of the MIME-type

You must apply the tagging conventions of the MIME-type specified by the Content-Type header in your stored procedure. SQL Anywhere provides several functions that allow you to create tags. For more information, see "Functions" [*SQL Anywhere Server - SQL Reference*].

The following example illustrates how to use the XMLCONCAT, and XMLELEMENT functions to generate HTML content, assuming that the sa_set_http_header system procedure is used to set the Content-Type header to the text/html MIME-type:

```
XMLCONCAT(
    '<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01//EN">',
   XMLELEMENT(
        'HTML',
        XMLELEMENT(
            'HEAD',
            XMLELEMENT('TITLE', 'My Home Page')
        ),
        XMLELEMENT(
            'BODY',
            XMLELEMENT('H1', 'My home on the web'),
            XMLELEMENT('P', 'Thank you for visiting my web site!')
        )
    )
)
```

For an extensive example of a **RAW** web service that generates a custom web page, see "Creating and customizing a root web service" on page 738.

See also

- "sa_set_http_header system procedure" [*SQL Anywhere Server - SQL Reference*]
- "Web services functions" on page 768
- "XMLCONCAT function [String]" [*SQL Anywhere Server - SQL Reference*]
- "XMLELEMENT function [String]" [*SQL Anywhere Server - SQL Reference*]
- "Browsing an HTTP web server" on page 770

Accessing client-supplied HTTP variables and headers

Variables and headers in an HTTP client request can be accessed using one of the following approaches:

- The web service statement declaration to pass them as host parameters of a stored function and procedure call.
- Calling the HTTP_VARIABLE, NEXT_HTTP_VARIABLE, HTTP_HEADER, HTTP_NEXT_HEADER functions in a stored function or procedure.

For more information about supplying HTTP variables and headers to a web service, see "Supplying variables to a web service" on page 802.

Accessing HTTP variables using host parameters

You can reference client-supplied variables when you pass them as host parameters of a function or procedure call.

Example

The following example illustrates how to access the host parameters used in a web service named **ShowTable**:

```
CREATE SERVICE ShowTable
    TYPE 'RAW'
    AUTHORIZATION ON
    AS CALL ShowTable( :user_name, :table_name );

CREATE PROCEDURE ShowTable( IN user VARCHAR, IN tblname LONG VARCHAR )
BEGIN
    -- write SQL code utilizing the user and tblname variables here.
END;
```

Service host parameters are mapped in the declaration order of procedure parameters. In the above example, the **user_name** and **table_name** host parameters map to the **user** and **tblname** parameters, respectively.

For more information about passing the URL as a host parameter, see "Browsing an HTTP web server" on page 770.

Accessing HTTP variables and headers using web service functions

The HTTP_VARIABLE, NEXT_HTTP_VARIABLE, HTTP_HEADER, HTTP_NEXT_HEADER functions can be used to iterate through the variables and headers supplied by the client.

Accessing variables using HTTP_VARIABLE and HTTP_NEXT_VARIABLE

You can iterate through all client-supplied variables using NEXT_HTTP_VARIABLE and HTTP_VARIABLE functions within your stored procedures.

The HTTP_VARIABLE function allows you to get the value of a variable name.

The NEXT_HTTP_VARIABLE function allows you to iterate through all variables sent by the client. Pass the NULL value when calling it for the first time to get the first variable name. Use the returned variable name as a parameter to an HTTP_VARIABLE function call to get its value. Passing the previous variable name to the next_http_variable call gets the next variable name. Null is returned when the last variable name is passed.

Iterating through the variable names guarantees that each variable name is returned exactly once but the variable name order may not be the same as the order they appear in the client request.

The following example illustrates how to use the HTTP_VARIABLE function to retrieve values from parameters supplied in a client request that accesses the **ShowDetail** service:

```
CREATE SERVICE ShowDetail
    TYPE 'HTML'
    URL PATH OFF
    AUTHORIZATION OFF
    USER DBA
    AS CALL ShowDetail();

CREATE PROCEDURE ShowDetail()
BEGIN
    DECLARE v_customer_id LONG VARCHAR;
    DECLARE v_product_id LONG VARCHAR;
    SET v_customer_id = HTTP_VARIABLE( 'customer_id' );
    SET v_product_id = HTTP_VARIABLE( 'product_id' );
    CALL ShowSalesOrderDetail( v_customer_id, v_product_id );
END;
```

The following example illustrates how to retrieve three attributes from header-field values associated with the **image** variable:

```
SET v_name = HTTP_VARIABLE( 'image', NULL, 'Content-Disposition' );
SET v_type = HTTP_VARIABLE( 'image', NULL, 'Content-Type' );
SET v_image = HTTP_VARIABLE( 'image', NULL, '@BINARY' );
```

Supplying an integer as the second parameter allows you to retrieve additional values. The third parameter allows you to retrieve header-field values from multi-part requests. Supply the name of a header field to retrieve its value.

Accessing headers using HTTP_HEADER and NEXT_HTTP_HEADER

HTTP request headers can be obtained from a request using the NEXT_HTTP_HEADER and HTTP_HEADER functions.

The HTTP_HEADER function returns the value of the named HTTP header field.

The NEXT_HTTP_HEADER function iterates through the HTTP headers and returns the next HTTP header name. Calling this function with NULL causes it to return the name of the first header. Subsequent headers are retrieved by passing the name of the previous header to the function. NULL is returned when the last header name is called.

The following table lists common HTTP request headers and their default values:

Header Name	Header Value
Accept	image/gif, image/x-xbitmap, image/jpeg, image/pjpeg, application/x-shockwave-flash, application/vnd.ms-excel, application/vnd.ms-powerpoint, application/msword, */*
Accept-Language	en-us
Accept-Charset	utf-8, iso-8859-5;q=0.8

Header Name	Header Value
Accept-Encoding	gzip, deflate
User-Agent	Mozilla/4.0 (compatible; MSIE 7.0; Windows NT 5.2; WOW64; SV1; .NET CLR 2.0.50727)
Host	localhost
Connection	Keep-Alive

The following table lists special headers and their default values:

Header Name	Header Value
@HttpMethod	GET
@HttpURI	/demo/ShowHTTPHeaders
@HttpVersion	HTTP/1.1
@HttpQueryString	&id=-123&version=109&lang=en

You can use the @HttpStatus special header to set the status code of the request being processed.

The following example illustrates how to format header names and values into an HTML table.

Create the **ShowHTTPHeaders** web service:

```
CREATE SERVICE ShowHTTPHeaders
    TYPE 'RAW'
    AUTHORIZATION OFF
    USER DBA
    AS CALL HTTPHeaderExample();
```

Create a **HTTPHeaderExample** procedure that uses the NEXT_HTTP_HEADER function to get the name of the header, then uses the HTTP_HEADER function to retreive its value:

```
CREATE PROCEDURE HTTPHeaderExample()
RESULT ( html_string LONG VARCHAR )
BEGIN
    declare header_name long varchar;
    declare header_value long varchar;
    declare header_query long varchar;
    declare table_rows XML;
    set header_name  = NULL;
    set table_rows = NULL;
header_loop:
    LOOP
        SET header_name = NEXT_HTTP_HEADER( header_name );
        IF header_name IS NULL THEN
            LEAVE header_loop
        END IF;
        SET header_value = HTTP_HEADER( header_name );
```



```
            SET header_query = HTTP_HEADER( '@HttpQueryString' );
            -- Format header name and value into an HTML table row
            SET table_rows = table_rows ||
                XMLELEMENT( name "tr",
                    XMLATTRIBUTES( 'left' AS "align",
                                   'top' AS "valign" ),
                    XMLELEMENT( name "td", header_name ),
                    XMLELEMENT( name "td", header_value ),
                    XMLELEMENT( name "td", header_query ) );

        END LOOP;
        SELECT XMLELEMENT( name "table",
                    XMLATTRIBUTES( '' AS "BORDER",
                                  '10' AS "CELLPADDING",
                                   '0' AS "CELLSPACING" ),
                    XMLELEMENT( name "th",
                        XMLATTRIBUTES( 'left' AS "align",
                                       'top'  AS "valign" ),
                                       'Header Name' ),
                    XMLELEMENT( name "th",
                        XMLATTRIBUTES( 'left' AS "align",
                                       'top'  AS "valign" ),
                                       'Header Value' ),
                    XMLELEMENT( name "th",
                        XMLATTRIBUTES( 'left' AS "align",
                                       'top'  AS "valign" ),
                                       'HTTP Query String' ),
                    table_rows );
    END;
```

Access the **ShowHTTPHeaders** in a web browser to see the request headers arranged in an HTML table.

See also

- "Supplying variables to a web service" on page 802
- "HTTP_VARIABLE function [HTTP]" [*SQL Anywhere Server - SQL Reference*]
- "NEXT_HTTP_VARIABLE function [HTTP]" [*SQL Anywhere Server - SQL Reference*]
- "HTTP_HEADER function [HTTP]" [*SQL Anywhere Server - SQL Reference*]
- "NEXT_HTTP_HEADER function [HTTP]" [*SQL Anywhere Server - SQL Reference*]

Accessing client-supplied SOAP request headers

Headers in SOAP requests can be obtained using a combination of the NEXT_SOAP_HEADER and SOAP_HEADER functions. The NEXT_SOAP_HEADER function iterates through the SOAP headers included within a SOAP request envelope and returns the next SOAP header name. Calling it with NULL causes it to return the name of the first header. Subsequent headers are retrieved by passing the name of the previous header to the NEXT_SOAP_HEADER function. This function returns NULL when called with the name of the last header.

The following example illustrates the SOAP header retrieval:

```
SET hd_key = NEXT_SOAP_HEADER( hd_key );
    IF hd_key IS NULL THEN
      -- no more header entries
      LEAVE header_loop;
    END IF;
```

Calling this function repeatedly returns all the header fields exactly once, but not necessarily in the order they appear in the SOAP request.

The SOAP_HEADER function returns the value of the named SOAP header field, or NULL if not called from an SOAP service. It is used when processing an SOAP request via a web service. If a header for the given field-name does not exist, the return value is NULL.

The example searches for a SOAP header named Authentication. When it finds this header, it extracts the value for entire SOAP header and the values of the **@namespace** and **mustUnderstand** attributes. The SOAP header value might look something like this XML string:

```
<Authentication xmlns="CustomerOrderURN" mustUnderstand="1">
  <userName pwd="none">
    <first>John</first>
    <last>Smith</last>
  </userName>
</Authentication>
```

For this header, the **@namespace** attribute value would be **CustomerOrderURN**

Also, the **mustUnderstand** attribute value would be 1

The interior of this XML string is parsed with the OPENXML function using an XPath string set to **/*:Authentication/*:userName**.

```
SELECT * FROM OPENXML( hd_entry, xpath )
    WITH ( pwd LONG VARCHAR '@*:pwd',
        first_name LONG VARCHAR '*:first/text()',
        last_name LONG VARCHAR '*:last/text()' );
```

Using the sample SOAP header value shown above, the SELECT statement would create a result set as follows:

pwd	first_name	last_name
none	John	Smith

A cursor is declared on this result set and the three column values are fetched into three variables. At this point, you have all the information of interest that was passed to the web service.

Example

The following example illustrates how a web server can process SOAP requests containing parameters, and SOAP headers. The example implements an **addItem** SOAP operation that takes two parameters: **amount** of type int and **item** of type string. The **sp_addItems** procedure processes an Authentication SOAP header extracting the first and last name of the user. The values are used to populate a SOAP response Validation header via the sa_set_soap_header system procedure. The response is a result of three columns: **quantity**, **item** and **status** with types INT, LONG VARCHAR and LONG VARCHAR respectively.

```
// create the SOAP service
call sa_make_object( 'service', 'addItems' );
alter SERVICE "addItems"
    TYPE 'SOAP'
```



```
    format 'concrete'
    AUTHORIZATION OFF
    USER dba
    AS call sp_addItems( :amount, :item );

// create SOAP endpoint for related services
call sa_make_object( 'service', 'store' );
alter SERVICE "store"
    TYPE 'DISH'
    AUTHORIZATION OFF
    USER dba;

// create the procedure that will process the SOAP requests for the addItems
service
create or replace procedure sp_addItems( "count" int, item long varchar )
result( quantity int, item long varchar, status long varchar )
begin
    declare "hd_key" long varchar;
    declare "hd_entry" long varchar;
    declare "pwd" long varchar;
    declare "first" long varchar;
    declare "last" long varchar;
    declare "xpath" long varchar;
    declare "authinfo" long varchar;
    declare "namespace" long varchar;
    declare "mustUnderstand" long varchar;

  header_loop:
    loop
        set hd_key = next_soap_header( hd_key );
        if hd_key is NULL then
      // no more header entries.
            leave header_loop;
        end if;
        if hd_key = 'Authentication' then
            set hd_entry = soap_header( hd_key );
            set xpath = '/*:' || hd_key || '/*:userName';
            set "namespace" = soap_header( hd_key, 1, '@namespace' );
            set mustUnderstand = soap_header( hd_key, 1, 'mustUnderstand' );
            begin
        // parse for the pieces that we are interested in
                declare crsr cursor for select * from
                    openxml( hd_entry, xpath )
                        with ( pwd long varchar '@*:pwd',
                               "first" long varchar '*:first/text()',
                               "last" long varchar '*:last/text()');
                open crsr;
                fetch crsr into pwd, "first", "last";
                close crsr;
            end;
      // build a response header, based on the pieces from the request header
            set authinfo = XMLELEMENT( 'Validation',
            XMLATTRIBUTES(
                    "namespace" as xmlns,
                    "mustUnderstand" as mustUnderstand ),
                    XMLELEMENT( 'first', "first" ),
                    XMLELEMENT( 'last', "last" ) );

            call sa_set_soap_header( 'authinfo', authinfo);
        end if;
    end loop header_loop;
    //  code to validate user/session and check item goes here...
    select count, item, 'available';
end;
```

For the client-side implementation of this example, see "SOAP request header management" on page 783 or "Sample: Handling SOAP headers, parameters, and responses" on page 850.

Managing HTTP sessions on an HTTP server

A web application can support sessions in various ways. Hidden fields within HTML forms can be used to preserve client/server data across multiple requests. Alternatively, Web 2.0 techniques, such as an AJAX enabled client-side JavaScript, can make asynchronous HTTP requests based on client state. SQL Anywhere offers the additional capability of preserving a database connection for exclusive use of sessioned HTTP requests.

Any connection scope variables and temporary tables created and altered within the HTTP session are accessible to subsequent HTTP requests that specify the given SessionID. The SessionID can be specified by a GET or POST HTTP request method or specified within an HTTP cookie header. When an HTTP request is received with a SessionID variable, the server checks its session repository for a matching context. If it finds a session, the server utilizes its database connection for processing the request. If the session is in use, it queues the HTTP request and activates it when the session is freed.

The sa_set_http_option can be used to create, delete and change session ids.

HTTP sessions require special handling for management of the session criteria. Only one database connection exists for use by a given SessionID, so consecutive client requests for that SessionID are serialized by the server. Up to 16 requests can be queued for a given SessionID. Subsequent requests for the given SessionID are rejected with a `503 Service Unavailable` status when the session queue is full.

When creating a SessionID for the first time, the SessionID is immediately registered by the system. Subsequent requests that modify or delete the SessionID are only applied when the given HTTP request terminates. This approach promotes consistent behavior if the request processing results in a roll-back or if the application deletes and resets the SessionID.

The current session is deleted and replaced with the pending session when an HTTP request changes the SessionID. The database connection cached by the session is effectively moved to the new session context, and all state data is preserved, such as temporary tables and created variables.

For a complete example of HTTP session usage, see *samples-dir\SQLAnywhere\HTTP\session.sql*.

Licensing note
Stale sessions should be deleted an appropriate time out should be set to minimize the number of outstanding connections because each client application connection holds a license seat. Connections associated with HTTP sessions maintain their hold on the server database for the duration of the connection.

For more information about licensing in SQL Anywhere, see http://www.sybase.com/detail?id=1056242.

See also

- "sa_set_http_option system procedure" [*SQL Anywhere Server - SQL Reference*]
- "sa_set_http_header system procedure" [*SQL Anywhere Server - SQL Reference*]
- "CONNECTION_PROPERTY function [System]" [*SQL Anywhere Server - SQL Reference*]
- "Connection properties" [*SQL Anywhere Server - Database Administration*]

Creating an HTTP session

Sessions can be created using the SessionID option in the sa_set_http_option system procedure. The session ID can be defined by any non-null string.

Session state management is supported by URLs and cookies. HTTP sessions can be accessed using HTTP cookies, or through the URL of a GET request or from within the body of a POST (x-www-form-urlencoded) request. For example, the following URL utilizes the **XYZ** database connection when it executes:

```
http://localhost/sa_svc?SESSIONID=XYZ
```

The request is processed as a standard session-less request if an **XYZ** database connection does not exist.

Example

The following code illustrates how to create a **RAW** web service that creates and deletes sessions. A connection scope variable named **request_count** is increment each time an HTTP request is made while specifying a valid SessionID.

```
create service "session"
    type 'raw'
    authorization off
    user DBA
    as call sp_session();

create or replace procedure sp_session()
begin
    declare body long varchar;
    declare sesid long varchar;
    declare newsesid long varchar;
    declare createtm timestamp;
    declare lastaccesstm timestamp;

    select connection_property('sessionid') into sesid;
    if HTTP_VARIABLE('delete') is not null then
        call sa_set_http_option('SessionID', null );
        set body = '<html><body>Deleted ' || sesid
            || '</BR><a href="http://localhost/session">Start Again</a>';
        select body;
    end if;
    if sesid = '' then
        set newsesid = set_session();
        create variable request_count int;
        set request_count = 0;

        set body = '<html><body> Created sessionid ' || newsesid
          || '</BR><a href="http://localhost/session?SessionID=' || newsesid
|| '"> Enter into Session</a>';
    else
```

```
            select connection_property('sessionid') into sesid;

            set request_count = request_count +1;
            select connection_property('sessioncreatetime') into createtm;
            select connection_property('sessionlasttime') into  lastaccesstm;

            set body = '<html><body>Session ' || sesid || '</BR>'
                || 'created ' || createtm || '</BR>'
                || 'last access ' || lastaccesstm || '</BR>'
                || '<H3>REQUEST COUNT is '|| request_count || '</H3><HR></BR>'
               || '<a href="http://localhost/session?SessionID=' || sesid || '">
Enter into Session</a></BR>'
                || '<a href="http://localhost/session?SessionID=' || sesid ||
'&delete"> Delete Session</a>';
        end if;

        select body;
end;
```

For more information about the set_session function implementation, see "Using the URL to manage a session" on page 762.

Using the URL to manage a session

In a URL session state management system, the client application or web browser provides the session ID in a URL.

Example

The following example illustrates unique session ID creation within an HTTP web server SQL function where session IDs can be provided by a URL only:

```
CREATE OR REPLACE FUNCTION set_session()
RETURNS LONG VARCHAR
BEGIN
    DECLARE session_id LONG VARCHAR;
    DECLARE tm TIMESTAMP;
    SET tm=now(*);
    SET session_id = 'session_' ||
    CONVERT( VARCHAR, SECONDS(tm)*1000+DATEPART(millisecond,tm));
    CALL sa_set_http_option('SessionID', session_id);
    SELECT CONNECTION_PROPERTY( 'SessionID' ) INTO session_id;
    RETURN( session_id );
END;
```

The SessionID is represented as an empty string if the session_id is not defined for the connection, making a sessionless connection.

The sa_set_http_option system procedure returns an error if the session_id is owned by another HTTP request. For more information about error codes, see "Web service error code reference" on page 824.

See also

- "sa_set_http_option system procedure" [*SQL Anywhere Server - SQL Reference*]
- "sa_set_http_header system procedure" [*SQL Anywhere Server - SQL Reference*]
- "CONNECTION_PROPERTY function [System]" [*SQL Anywhere Server - SQL Reference*]
- "Connection properties" [*SQL Anywhere Server - Database Administration*]
- "Detecting an inactive HTTP session" on page 763
- "Deleting an HTTP session or changing the session ID" on page 764

Using cookies to manage a session

In a cookie session state management system, the client application or web browser provides the session ID in an HTTP cookie header instead of a URL. Cookie session management is supported with the 'Set-Cookie' HTTP response header of the sa_set_http_header system procedure.

Note
You can not rely on cookie state management when cookies can be disabled in the client application or web browser. Support for both URL and cookie state management is recommended. The URL-supplied session ID is used when session IDs are provided by both the URL and a cookie.

Example

The following example illustrates unique session ID creation within an HTTP web server SQL function where session IDs can be provided by a URL or a cookie:

```
CREATE OR REPLACE FUNCTION set_session_cookie()
RETURNS LONG VARCHAR
BEGIN
    DECLARE session_id LONG VARCHAR;
    DECLARE tm TIMESTAMP;
    SET tm=now(*);
    SET session_id = 'session_' ||
    CONVERT( VARCHAR, SECONDS(tm)*1000+DATEPART(millisecond,tm));
    CALL sa_set_http_option('SessionID', session_id);
    CALL sa_set_http_header( 'Set-Cookie',
        'sessionid=' || session_id || ';' ||
        'max-age=60;' ||
        'path=/session;' );
    SELECT CONNECTION_PROPERTY( 'SessionID' ) INTO session_id;
    RETURN( session_id );
END;
```

See also

- "sa_set_http_option system procedure" [*SQL Anywhere Server - SQL Reference*]
- "sa_set_http_header system procedure" [*SQL Anywhere Server - SQL Reference*]
- "CONNECTION_PROPERTY function [System]" [*SQL Anywhere Server - SQL Reference*]
- "Connection properties" [*SQL Anywhere Server - Database Administration*]
- "Detecting an inactive HTTP session" on page 763
- "Deleting an HTTP session or changing the session ID" on page 764

Detecting an inactive HTTP session

The SessionCreateTime and SessionLastTime connection properties can be used to determine if the current connection is within a session context. The HTTP request is not running within a session context when either connection property query returns an empty string.

The SessionCreateTime connection property provides a metric of when a given session was created. It is initially defined when the sa_set_http_option system procedure is called to establish the SessionID.

The SessionLastTime connection property provides the time when the last processed session request released the database connection upon termination of the previous request. It is returned as an empty string when the session is first created until the creator request releases the connection.

Note
You can adjust the session timeout duration using the http_session_timeout option. For more information, see "http_session_timeout option" [*SQL Anywhere Server - Database Administration*].

Example

The following example illustrates session detection using the SessionCreateTime and SessionLastTime connection properties:

```
SELECT CONNECTION_PROPERTY( 'sessioncreatetime' ) INTO ses_create;
SELECT CONNECTION_PROPERTY( 'sessionlasttime' ) INTO ses_last;
```

See also

- "CONNECTION_PROPERTY function [System]" [*SQL Anywhere Server - SQL Reference*]
- "Connection properties" [*SQL Anywhere Server - Database Administration*]
- "Creating an HTTP session" on page 761
- "Deleting an HTTP session or changing the session ID" on page 764

Deleting an HTTP session or changing the session ID

Explicitly dropping a database connection that is cached within a session context causes the session to be deleted. Session deletion in this manner is a cancel operation; any requests released from the session queue are in a canceled state. This action ensures that any outstanding requests waiting on the session are terminated. Similarly, a server or database shutdown cancels all database connections.

A Session can be deleted by setting the SessionID option in the sa_set_http_option system procedure to null or an empty string.

The following code can be used for session deletion:

```
CALL sa_set_http_option( 'SessionID', null );
```

When an HTTP session is deleted or the SessionID is changed, any pending HTTP requests that are waiting on the session queue are released and allowed to run outside of a session context. The pending requests do not reuse the same database connection.

A session ID cannot be set to an existing session ID. Pending requests referring to the old SessionID are released to run as session-less requests when a SessionID has changed. Subsequent requests referring to the new SessionID reuse the same database connection instantiated by the old SessionID.

The following conditions are applied when deleting or changing an HTTP session:

- The behavior differs depending on whether the current request had inherited a session whereby a database connection belonging to a session was acquired, or whether a session-less request had instantiated a new session. If the request began as session-less, then the act of creating or deleting a session occurs immediately. If the request has inherited a session, then a change in the session state, such as deleting the session or changing the SessionID, only occurs after the request terminates and its changes have been committed. The difference in behavior addresses processing anomalies that may occur if a client makes simultaneous requests using the same SessionID.
- Changing a session to a SessionID of the current session (has no pending session) is not an error and has no substantial effect.
- Changing a session to a SessionID in use by another HTTP request is an error.
- Changing a session when a change is already pending results in the pending session being deleted and new pending session being created. The pending session is only activated once the request successfully terminates.
- Changing a session with a pending session back to its original SessionID results in the pending session being deleted without any change to the current session.

See also

- "CONNECTION_PROPERTY function [System]" [*SQL Anywhere Server - SQL Reference*]
- "Connection properties" [*SQL Anywhere Server - Database Administration*]
- "sa_set_http_option system procedure" [*SQL Anywhere Server - SQL Reference*]
- "Detecting an inactive HTTP session" on page 763

HTTP session administration

A session created by an HTTP request is immediately instantiated so that any subsequent HTTP requests requiring that session context is queued by the session.

In this example, a local host client can access the session with the specified session ID, session_63315422814117, running within the database, *dbname*, running the service session_service with the following URL once the session is created on the server with the sa_set_http_option procedure. For more information about the sa_set_http_option procedure, see "sa_set_http_option system procedure" [*SQL Anywhere Server - SQL Reference*].

```
http://localhost/dbname/session_service?sessionid=session_63315422814117
```

A web application can require a means to track active session usage within the HTTP web server. Session data can be found using the NEXT_CONNECTION function call to iterate through the active database connections and checking for session related properties such as SessionID. For more information about

the NEXT_CONNECTION function, see "NEXT_CONNECTION function [System]" [*SQL Anywhere Server - SQL Reference*].

The following SQL script illustrates how to track an active session:

```
CREATE VARIABLE conn_id LONG VARCHAR;
CREATE VARIABLE the_sessionID LONG VARCHAR;
SELECT NEXT_CONNECTION( NULL, NULL ) INTO conn_id;
conn_loop:
    LOOP
        IF conn_id IS NULL THEN
            LEAVE conn_loop;
        END IF;
        SELECT CONNECTION_PROPERTY( 'SessionID', conn_id )
            INTO the_sessionID;
        IF the_sessionID != '' THEN
            PRINT 'conn_id = %1!, SessionID = %2!', conn_id, the_sessionID;
        ELSE
            PRINT 'conn_id = %1!', conn_id;
        END IF;
        SELECT NEXT_CONNECTION( conn_id, NULL ) INTO conn_id;
    END LOOP conn_loop;
    PRINT '\n';
```

If you examine the database server messages window, you see data that is similar to the following output:

```
conn_id = 30
conn_id = 29, SessionID = session_63315442223323
conn_id = 28, SessionID = session_63315442220088
conn_id = 25, SessionID = session_63315441867629
```

Explicitly dropping a connection that belongs to a session causes the connection to be closed and the session to be deleted. If the connection being dropped is currently active in servicing an HTTP request, the request is marked for deletion and the connection is sent a cancel signal to terminate the request. When the request terminates, the session is deleted and the connection closed. Deleting the session causes any pending requests on that session's queue to be re-queued. For more information, see "Deleting an HTTP session or changing the session ID" on page 764.

In the event the connection is currently inactive, the session is marked for deletion and re-queued to the beginning of the session timeout queue. The session and the connection are deleted in the next timeout cycle (normally within 5 seconds). Any session marked for deletion cannot be used by a new HTTP request.

All sessions are lost when the database is stopped.

For more information about sessions in a database context, see the description of session key in "Creating an HTTP session" on page 761.

HTTP session error codes

The `503 Service Unavailable` error occurs when a new request tries to access a session where more than 16 requests are pending on that session, or an error occurred while queuing the session.

The `403 Forbidden` error occurs when the client IP address or host name does not match that of the creator of the session.

A request stipulating a session that does not exist does not implicitly generate an error. It is up to the web application to detect this condition (by checking SessionID, SessionCreateTime, or SessionLastTime connection properties) and do the appropriate action.

See also

- "Web service error code reference" on page 824

Character set conversion considerations

Character-set conversion is performed automatically on outgoing result sets of text types by default. Result sets of other types, such as binary objects, are not affected. The character set of the request is converted to the HTTP web server character set, and the result set is converted to the client application character set. The server uses the first suitable character set listed in the request when multiple sets are listed.

Character-set conversion can be enabled or disabled by setting the HTTP option 'CharsetConversion' option of the sa_set_http_option system procedure.

The following example illustrates how to turn off automatic character-set conversion:

```
CALL sa_set_http_option('CharsetConversion', 'OFF');
```

You can use the 'AcceptCharset' option of the sa_set_http_option system procedure to specify the character-set encoding preference when character-set conversion is enabled.

The following example illustrates how to specify the web service character set encoding preference to ISO-8859-5, if supported; otherwise, set it to UTF-8:

```
CALL sa_set_http_option('AcceptCharset', 'iso-8859-5, utf-8');
```

Character sets are prioritized by server preference but the selection also considers the client's Accept-Charset criteria. The most favored character set according to the client that is also specified by this option is used.

See also

- "sa_set_http_option system procedure" [*SQL Anywhere Server - SQL Reference*]

Web services system procedures

The following system procedures are for use with web services:

- "sa_http_header_info system procedure" [*SQL Anywhere Server - SQL Reference*]
- "sa_http_php_page system procedure" [*SQL Anywhere Server - SQL Reference*]
- "sa_http_php_page_interpreted system procedure" [*SQL Anywhere Server - SQL Reference*]
- "sa_http_variable_info system procedure" [*SQL Anywhere Server - SQL Reference*]
- "sa_set_http_header system procedure" [*SQL Anywhere Server - SQL Reference*]
- "sa_set_http_option system procedure" [*SQL Anywhere Server - SQL Reference*]
- "sa_set_soap_header system procedure" [*SQL Anywhere Server - SQL Reference*]

There are also many functions available for web services. See "Web services functions" [*SQL Anywhere Server - SQL Reference*].

See also

- "Using SQL Anywhere as an HTTP web server" on page 727
- "-xs dbeng12/dbsrv12 server option" [*SQL Anywhere Server - Database Administration*]

Web services functions

Web service functions assist the handling of HTTP and SOAP requests within web services.

The following functions are available:

- "HTML_DECODE function [Miscellaneous]" [*SQL Anywhere Server - SQL Reference*]
- "HTML_ENCODE function [Miscellaneous]" [*SQL Anywhere Server - SQL Reference*]
- "HTTP_BODY function [HTTP]" [*SQL Anywhere Server - SQL Reference*]
- "HTTP_DECODE function [HTTP]" [*SQL Anywhere Server - SQL Reference*]
- "HTTP_ENCODE function [HTTP]" [*SQL Anywhere Server - SQL Reference*]
- "HTTP_HEADER function [HTTP]" [*SQL Anywhere Server - SQL Reference*]
- "HTTP_RESPONSE_HEADER function [HTTP]" [*SQL Anywhere Server - SQL Reference*]
- "HTTP_VARIABLE function [HTTP]" [*SQL Anywhere Server - SQL Reference*]
- "NEXT_HTTP_HEADER function [HTTP]" [*SQL Anywhere Server - SQL Reference*]
- "NEXT_HTTP_RESPONSE_HEADER function [HTTP]" [*SQL Anywhere Server - SQL Reference*]
- "NEXT_HTTP_VARIABLE function [HTTP]" [*SQL Anywhere Server - SQL Reference*]
- "NEXT_SOAP_HEADER function [SOAP]" [*SQL Anywhere Server - SQL Reference*]
- "SOAP_HEADER function [SOAP]" [*SQL Anywhere Server - SQL Reference*]

There are also many system procedures available for web services. See "Web services system procedures" [*SQL Anywhere Server - SQL Reference*].

See also

- "Using SQL Anywhere as an HTTP web server" on page 727
- "-xs dbeng12/dbsrv12 server option" [*SQL Anywhere Server - Database Administration*]

Web services connection properties

Web service connection properties can be database properties that are accessible using the CONNECTION_PROPERTY function.

Use the following syntax to store a connection property value from the HTTP server to a local variable in a SQL function or procedure:

```
SELECT CONNECTION_PROPERTY('connection-property-name') INTO variable_name;
```

The following is a list of useful runtime HTTP request connection properties that are commonly used for web service applications:

- **HttpServiceName** Returns the service name origin for a web application. See "HttpServiceName connection property" [*SQL Anywhere Server - Database Administration*].
- **AuthType** Returns the type of authentication used when connecting. See "AuthType connection property" [*SQL Anywhere Server - Database Administration*].
- **ServerPort** Returns the database server's TCP/IP port number or 0. See "ServerPort connection property" [*SQL Anywhere Server - Database Administration*]
- **ClientNodeAddress** Returns the node for the client in a client/server connection. See "ClientNodeAddress connection property" [*SQL Anywhere Server - Database Administration*]
- **ServerNodeAddress** Returns the node for the server in a client/server connection. See "ServerNodeAddress connection property" [*SQL Anywhere Server - Database Administration*]
- **BytesReceived** Returns the number of bytes received during client/server communications. See "BytesReceived connection property" [*SQL Anywhere Server - Database Administration*]

For a complete list of SQL Anywhere connection properties, see "Connection properties" [*SQL Anywhere Server - Database Administration*].

Web services options

Web service options control various aspects of HTTP server behavior.

Use the following syntax to set a public option in an HTTP server:

```
SET TEMPORARY OPTION PUBLIC.http_session_timeout=100;
```

The following is a list of options that are commonly used in HTTP servers for application configuration:

- **http_connection_pool_basesize** Specifies the nominal threshold size of database connections. See "http_connection_pool_basesize option" [*SQL Anywhere Server - Database Administration*].
- **http_connection_pool_timeout** Specifies the maximum duration that an unused connection can be retained in the connection pool. See "http_connection_pool_timeout option" [*SQL Anywhere Server - Database Administration*].

- **http_session_timeout** Specifies the default timeout duration, in minutes, that the HTTP session persists during inactivity. See "http_session_timeout option" [*SQL Anywhere Server - Database Administration*].

- **request_timeout** Controls the maximum time a single request can run. See "request_timeout option" [*SQL Anywhere Server - Database Administration*].

- **webservice_namespace_host** Specifies the hostname to be used as the XML namespace within specification for DISH services. See "webservice_namespace_host option" [*SQL Anywhere Server - Database Administration*].

For more information about SQL Anywhere database options, see "Database options" [*SQL Anywhere Server - Database Administration*].

Browsing an HTTP web server

Available URL names are defined by how your web services are named and designed. Each web service provides its own set of web content. This content is typically generated by custom functions and procedures in your database, but content can also be generated with a URL that specifies a SQL statement. Alternatively, or in conjunction, you can define the **root** web service, which processes all HTTP requests that are not processed by a dedicated service. The **root** web service would typically inspect the request URL and headers to determine how to process the request. For more information about the **root** web service, see "Creating and customizing a root web service" on page 738.

URLs uniquely specify resources such as html content available through HTTP or secured HTTPS requests. This section explains how to format the URL syntax in your web browser so that you can access the web services defined on your SQL Anywhere HTTP web server.

Note
The information in this section applies to HTTP web servers that use general HTTP web service types, such as RAW, XML, and HTML, and DISH services. You cannot use a browser to issue SOAP requests. JSON services return result sets for consumption by web service applications using AJAX.

Syntax

```
{http|https}://host-name[:port-number][/dbn]/service-name[/path-name|?url-query]
```

Parameters

- **host-name and port-number** Specifies the location of the web server and, optionally, the port number if it is not defined as the default HTTP or HTTPS port numbers. The *host-name* can be the IP address of the computer running the web server. The *port-number* must match the port number used when you started the web server.

  See "-xs dbeng12/dbsrv12 server option" [*SQL Anywhere Server - Database Administration*] and "ServerPort (PORT) protocol option" [*SQL Anywhere Server - Database Administration*].

- **dbn** Specifies the name of a database. This database must be running on the web server and contain web services.

  You do not need to specify *dbn* if the web server is running only one database or if the database name was specified for the given HTTP/HTTPS listener of the protocol option.

  See "-xs dbeng12/dbsrv12 server option" [*SQL Anywhere Server - Database Administration*] and "DatabaseName (DBN) protocol option" [*SQL Anywhere Server - Database Administration*].

- **service-name** Specifies the name of the web service to access. This web service must exist in the database specified by *dbn*. Slash characters (/) are permitted when you create or alter a web service, so you can use them as part of the *service-name*. SQL Anywhere matches the remainder of the URL with the defined services.

  The client request is processed if a *service-name* is not specified and the **root** web service is defined. A `404 Not Found` error is returned if the server cannot identify an applicable service to process the request. As a side-effect, if the **root** web service does exist and cannot process the request based on the URL criteria, then it is responsible for generating the`404 Not Found` error.

  For more information about the **root** web service, see "Creating and customizing a root web service" on page 738.

- **path-name** After resolving the service name, the remaining slash delimited path can be accessed by a web service procedure. If the service was created with URL ON, then the whole path is accessible using a designated **URL** http variable. If the service was created with URL ELEMENTS, then each path element can be accessed using designated http variables **URL1** to **URL10**.

  Path element variables can be defined as host variables within the parameter declaration of the service statement definition. Alternatively, or additionally, HTTP variables can be accessed from within a stored procedure using the HTTP_VARIABLE function call. For more information, see "HTTP_VARIABLE function [HTTP]" [*SQL Anywhere Server - SQL Reference*].

  The following example illustrates the SQL script used to create a web service where the URL clause is set to ELEMENTS:

  ```
  CREATE SERVICE TestWebService
      TYPE 'HTML'
      URL ELEMENTS
      AUTHORIZATION OFF
      USER DBA
      AS CALL TestProcedure ( :url1, :url2 );
  ```

  This **TestWebService** web service calls a procedure that explicitly defines the **url1** and **url2** host variables.

  You can access this web service using the following URL, assuming that **TestWebService** is running on the **demo** database from **localhost** through the default port:

  ```
  http://localhost/demo/TestWebService/Assignment1/Assignment2/Assignment3
  ```

  This URL accesses **TestWebService**, which runs **TestProcedure** and assigns the **Assignment1** value to **url1**, and the **Assignment2** value to **url2**. Optionally, **TestProcedure** can access other path

elements using the HTTP_VARIABLE function. For example, a HTTP_VARIABLE('url3') function call returns **Assignment3**.

For more information about URL ELEMENTS and URL-based variables, see "CREATE SERVICE statement" on page 740.

- **url-query** An HTTP GET request may follow a path with a query component that specifies HTTP variables. Similarly, the body of a POST request using a standard application/x-www-form-urlencoded Content-Type can pass HTTP variables within the request body. In either case, HTTP variables are passed as name/value pairs where the variable name is delimited from its value with an equals signs. Variables are delimited with an ampersand.

  HTTP variables can be explicitly declared as host variables within the parameter list of the service-statement, or accessed using the HTTP_VARIABLE function from within the stored procedure of the service statement.

  For example, the following SQL script creates a web service that requires two host variables. Host variables are identified with a colon (:) prefix.

```
CREATE SERVICE ShowSalesOrderDetail
    TYPE 'HTML'
    URL OFF
    AUTHORIZATION OFF
    USER DBA
    AS CALL ShowSalesOrderDetail( :customer_id, :product_id );
```

  Assuming that **ShowSalesOrderDetail** is running on the **demo** database from **localhost** through the default port, you can access the web service using the following URL:

```
http://localhost/demo/ShowSalesOrderDetail?customer_id=101&product_id=300
```

  This URL accesses **ShowSalesOrderDetail** and assigns a value of 101 to **customer_id**, and a value of 300 to **product_id**. The resultant output is displayed in your web browser in HTML format.

Remarks

The web browser prompts for user name and password when required to connect to the server. The browser base64 then encodes the user input within an Authorization request header and resends the request.

If your web service URL clause is set to ON or ELEMENTS, the URL syntax properties of *path-name* and *url-query* can be used simultaneously so that the web service is accessible using one of several different formatting options. When using these syntax properties simultaneously, the *path-name* format must be used first followed by the *url-query* format.

In the following example, this SQL script creates a web service where the URL clause is set to ON, which defines the **url** variable:

```
CREATE SERVICE ShowSalesOrderDetail
    TYPE 'HTML'
    URL ON
    AUTHORIZATION OFF
    USER DBA
    AS CALL ShowSalesOrderDetail( :product_id, :url );
```


The following is a sample list of acceptable URLs that assign a **url** value of 101 and a **product_id** value of 300:

- `http://localhost:80/demo/ShowSalesOrderDetail2/101?product_id=300`
- `http://localhost:80/demo/ShowSalesOrderDetail2?url=101&product_id=300`
- `http://localhost:80/demo/ShowSalesOrderDetail2?product_id=300&url=101`

When a host variable name is assigned more than once in the context of *path-name* and *url-query*, the last assignment always takes precedence. For example, the following sample URLs assign a **url** value of 101 and a **product_id** value of 300:

- `http://localhost:80/demo/ShowSalesOrderDetail2/302?url=101&product_id=300`
- `http://localhost:80/demo/ShowSalesOrderDetail2/String?product_id=300&url=101`

See also

- "CREATE SERVICE statement" on page 740
- "Accessing client-supplied HTTP variables and headers" on page 753

Example

The following URL syntax is used to access a web service named **gallery_image** that is running in a database named **demo** on a local HTTP server through the default port, assuming that the **gallery_image** service is defined with **URL ON**:

```
http://localhost/demo/gallery_image/sunset.jpg
```

The URL appears to request a graphic file in a directory from a traditional web server, but it accesses the **gallery_image** service with **sunset.jpg** specified as an input parameter for an HTTP web server.

The following SQL script illustrates how the gallery service could be defined on the HTTP server to accomplish this behavior:

```
CREATE SERVICE gallery_image
    TYPE 'RAW'
    URL ON
    AUTHORIZATION OFF
    USER DBA
    AS CALL gallery_image ( :url );
```

The **gallery_image** service calls a procedure with the same name, passing the client-supplied URL. For a sample implementation of a **gallery_image** procedure that can be accessed by this web service definitions, see *samples-dir\SQLAnywhere\HTTP\gallery.sql*.

Accessing web services using web clients

SQL Anywhere can be used as a web client to access web services hosted by a SQL Anywhere web server or third party web servers such as Apache or IIS.

In addition to using SQL Anywhere as a web client, SQL Anywhere web services provide client applications with an alternative to traditional interfaces, such as JDBC and ODBC. They are easily deployed because additional components are not needed, and can be accessed from multi-platform client applications written in a variety of languages, including scripting languages — such as Perl and Python.

For more information about SQL Anywhere as an HTTP web server, see "Using SQL Anywhere as an HTTP web server" on page 727.

Quick start guide to using SQL Anywhere as a web client

This quick start guide illustrates how to use SQL Anywhere as a web client application to connect to a SQL Anywhere HTTP server and access a general HTTP web service. It does not illustrate SQL Anywhere web client capabilities to a full extent. Many SQL Anywhere web client features are available that are beyond the scope of this guide.

The following tasks are performed:

- Create and start a SQL Anywhere web client.
- Create a procedure that connects to a web service on an HTTP server.
- Perform operations on the result set sent by the HTTP server.

You can develop SQL Anywhere web client applications that connect to any type of online web server, but this guide assumes that you have started a local SQL Anywhere HTTP server on port 8082 and want to connect to a web service named **SampleWebService**, created with the following SQL script:

```
CREATE SERVICE SampleWebService
    TYPE 'HTML'
    USER DBA
    AUTHORIZATION OFF
    AS CALL sp_echo(:i, :f, :s);

CREATE PROCEDURE sp_echo(i INTEGER, f REAL, s LONG VARCHAR )
RESULT( ret_i INTEGER, ret_f REAL, ret_s LONG VARCHAR )
BEGIN
    SELECT i, f, s;
END;
```

For more information about setting up a quick HTTP server, see "Quick start guide to using SQL Anywhere as an HTTP web server" on page 727.

To create a SQL Anywhere web client application

1. Run the following command to create a SQL Anywhere client database if one does not already exist:

   ```
   dbinit client-database-name
   ```


Replace *client-database-name* with a new name for your client database.

2. Run the following command to start the client database:

```
dbsrv12 client-database-name.db
```

3. Run the following command to connect to the client database through Interactive SQL:

```
dbisql -c "UID=DBA;PWD=sql;SERVER=client-database-name"
```

4. Create a new client procedure that connects to the **SampleWebService** web service using the following SQL script:

```
CREATE PROCEDURE client_echo( f REAL, i INTEGER, s VARCHAR(16), x
VARCHAR(16) )
    URL 'http://localhost:8082/SampleWebService'
    TYPE 'HTTP:POST'
    HEADER 'User-Agent:SATest';
```

5. Run the following SQL script to call the client procedure and send an HTTP request to the web server:

```
CALL client_echo(3.14, 9, 's varchar', 'x varchar');
```

The output displayed in Interactive SQL should be similar to the following output:

Attribute	Value
Status	HTTP/1.1 200 OK
Body	<html> <head> <title>/SampleWebService</title></head> <body> /SampleWebService <table border=1> <tr class="header"><th>ret_i</th> <th>ret_f</th> <th>ret_s</th> </tr> <tr><td>9</td><td>3.1400001049041748</td><td>s varchar</td>
Date	Wed, 09 Jun 2010 21:55:01 GMT
Connection	close
Expires	Wed, 09 Jun 2010 21:55:01 GMT
Content-Type	text/html; charset=windows-1252
Server	SQLAnywhere/12.0.0

See also

- “Developing web service applications in an HTTP web server” on page 752
- “CREATE PROCEDURE statement (web clients)” on page 795
- “CREATE FUNCTION statement (web clients)” on page 789

Quick start guide to accessing a SQL Anywhere HTTP web server

This quick start guide illustrates how to access a SQL Anywhere HTTP web server using two different types of client application - Python and C#. It does not illustrate SQL Anywhere web service application capabilities to a full extent. Many SQL Anywhere web service features are available that are beyond the scope of this guide.

The following tasks are performed:

- Create a procedure that connects to a web service on an HTTP server.
- Perform operations on the result set sent by the HTTP server.

You can develop SQL Anywhere web client applications that connect to any type of online web server, but this guide assumes that you have started a local SQL Anywhere HTTP server on port 8082 and want to connect to a web service named **SampleWebService**, created with the following SQL script:

```
CREATE SERVICE SampleWebService
    TYPE 'XML'
    USER DBA
    AUTHORIZATION OFF
    AS CALL sp_echo(:i, :f, :s);

CREATE PROCEDURE sp_echo(i INTEGER, f NUMERIC(6,2), s LONG VARCHAR )
RESULT( ret_i INTEGER, ret_f NUMERIC(6,2), ret_s LONG VARCHAR )
BEGIN
    SELECT i, f, s;
END;
```

For more information about setting up a quick HTTP server, see “Quick start guide to using SQL Anywhere as an HTTP web server” on page 727.

To access an XML web service using C# or Python

1. Write code that accesses the **SampleWebService** web service.
   - For C#, use the following code:

```
using System;
using System.Xml;

public class WebClient {
    static void Main(string[] args) {
       XmlTextReader reader = new XmlTextReader( "http://localhost:8082/
demo/SampleWebService?i=5&f=3.14&s=hello" );
```



```
            while( reader.Read() ) {
                switch( reader.NodeType ) {
                    case XmlNodeType.Element:
                        if( reader.Name == "row" ) {
                            Console.Write(reader.GetAttribute("ret_i") +
" ");
                            Console.Write(reader.GetAttribute("ret_s") +
" ");

Console.WriteLine(reader.GetAttribute("ret_f"));
                        }
                        break;
                }
            }
            reader.Close();
        }
    }
```

Save the code to a file named *DocHandler.cs*.

To compile the program, run the following command at the command prompt:

```
csc /out:DocHandler.exe DocHandler.cs
```

- For Python, use the following code:

```
import xml.sax

class DocHandler( xml.sax.ContentHandler ):
    def startElement( self, name, attrs ):
        if name == 'row':
            table_int = attrs.getValue( 'ret_i' )
            table_string = attrs.getValue( 'ret_s' )
            table_float = attrs.getValue( 'ret_f' )
            print '%s %s %s' % ( table_int, table_string, table_float )

parser = xml.sax.make_parser()
parser.setContentHandler( DocHandler() )
parser.parse( 'http://localhost:8082/demo/SampleWebService?
i=5&f=3.14&s=hello' )
```

Save the code to a file named *DocHandler.py*.

2. Run the application.
   - For C#, run the following command:

     ```
     DocHandler
     ```

   - For Python, run the following command:

     ```
     python DocHandler.py
     ```

The application displays the following output:

```
5 hello 3.14
```

See also

- "Developing web service applications in an HTTP web server" on page 752

Developing web client applications

SQL Anywhere databases can act as web client applications to access SQL Anywhere hosted web services or web services hosted on third party web servers. SQL Anywhere web client applications are created by writing stored procedures and functions using configuration clauses, such as the URL clause that specifies the web service target endpoint. Web client procedures do not have a body, but in every other way are used as any other stored procedure. When called, a web client procedure makes an outbound HTTP or SOAP request. A web client procedure is restricted from making an outbound HTTP request to itself; it cannot call a localhost SQL Anywhere web service running on the same database.

For detailed examples of web service applications, see the *samples-dir\SQLAnywhere\HTTP* directory.

See also

- "Web client SQL statements" on page 788

Web client function and procedure requirements and recommendations

Web service client procedures and functions require the definition of an URL clause to identify the web service endpoint. A web service client procedure or function has specialized clauses for configuration but is used like any other stored procedure or function in every other respect.

You can use the CREATE PROCEDURE and CREATE FUNCTION statements to create web client functions and procedures to send SOAP or HTTP requests to a web server.

The following list outlines the requirements and recommendations for creating or altering web client functions and procedures. You can specify the following information when creating or altering a web client function or procedure:

- The URL clause, which requires an absolute URL specifying the web service endpoint. (Required)
- The TYPE clause to specify whether the request is HTTP or SOAP over HTTP. (Recommended)
- Ports that are accessible to the client application. (Optional)
- The HEADER clause to specify HTTP request headers. (Optional)
- The SOAPHEADER clause to specify SOAP header criteria within the SOAP request envelope. (Optional. For SOAP requests only)
- The namespace URI. (For SOAP requests only)

Web client URL clause

You must specify the location of the web service endpoint to make it accessible to your web client function or procedure. The URL clause of the CREATE PROCEDURE and CREATE FUNCTION

statements provides the web service URL that you want to access. For more information, see "Web client SQL statements" on page 788.

Specifying an HTTP service URL

Specifying an HTTP scheme within the URL clause configures the procedure or function for non-secure communication using an HTTP protocol.

The following statement illustrates how to create a procedure that sends requests to a web service named **SampleWebService** that resides in a database named **dbname** hosted by an HTTP web server located at **localhost** on the default port:

```
CREATE PROCEDURE MyOperation ()
    URL 'HTTP://localhost/dbname/SampleWebService'
```

The database name is only required if the HTTP server hosts more than one database. You can substitute **localhost** with host name or the IP address of the HTTP server.

For more information about starting an HTTP server with these sample specifications, see "Starting an HTTP web server" on page 729.

Specifying an HTTPS service URL

Specifying an HTTPS scheme within the URL clause configures the procedure or function for secure communication over Secure Socket Layer. (SSL)

Your web client application must have access to the server certificate or the certificate that signs the server certificate to issue a secure HTTPS request. The certificate is required for the client procedure in order to authenticate the server to prevent man-in-the-middle exploits.

Use the CERTIFICATE clause of the CREATE PROCEDURE and CREATE FUNCTION statements to authenticate the server and establish a secure data channel. You can either place the certificate in a file and provide the file name, or provide the entire certificate as a string value; you cannot do both.

The following statement demonstrates how to create a procedure that sends requests to a web service named **SampleWebService** that resides in a database named **dbname** in an HTTPS server located at **localhost** on the default port:

```
CREATE PROCEDURE MyOperation ()
    URL 'HTTPS://localhost/dbname/SampleWebService'
    CERTIFICATE 'file=C:\srv_cert.id;co=Sybase;unit=SA;name=JohnSmith';
```

The CERTIFICATE clause in this example indicates that the server certificate is located in the *C:\srv_cert.id* file.

Note
Specifying HTTPS_FIPS forces the system to use the FIPS libraries. If HTTPS_FIPS is specified, but no FIPS libraries are present, non-FIPS libraries are used instead.

For more information about starting an HTTP web server with these sample specifications, see "Starting an HTTP web server" on page 729.

Specifying a proxy server URL

Some requests need to be sent through a proxy server. Use the PROXY clause of the CREATE PROCEDURE and CREATE FUNCTION statements to specify the proxy server URL and redirect requests to that URL. The proxy server forwards the request to the final destination, obtains the response, and forwards the response back to SQL Anywhere.

Web service request types

You can specify the type of client requests to send to the web server when creating a web client function or procedure. The TYPE clause of the CREATE PROCEDURE and CREATE FUNCTION statements formats requests before sending them to a URL. For more information, see "Web client SQL statements" on page 788.

Specifying an HTTP request format

Web client functions and procedures send HTTP requests when the specified format in the TYPE clause begins with an **HTTP** suffix.

For example, run the following SQL script in the web client database to create an HTTP procedure named **MyOperation** that sends HTTP requests to the specified URL:

```
CREATE PROCEDURE MyOperation ( a INTEGER, b CHAR(128) )
    URL 'HTTP://localhost:8020/dbname/SampleWebService'
    TYPE 'HTTP:POST';
```

In this example, requests are formatted as a HTTP:POST request.

Specifying a SOAP request format

Web client functions and procedures send HTTP requests when the specified format in the TYPE clause begins with a **SOAP** suffix.

For example, run the following statement in the web client database to create a SOAP procedure named **MyOperation** that sends SOAP requests to the specified URL:

```
CREATE PROCEDURE MyOperation ( intvariable INTEGER, charvariable CHAR(128) )
    URL 'HTTP://localhost/dbname/SampleWebService'
    TYPE 'SOAP:DOC';
```

In this example, a SOAP:DOC request is sent to the URL when you call this procedure, which would produce output similar to the following SOAP request:

```
<SOAP-ENV:Envelope
  xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:m="HTTP://localhost/dbname/SampleWebService">
  <SOAP-ENV:Body>
    <m:MyOperation>
      <m:intvariable>input-integer</m:intvariable>
      <m:charvariable>input-character</m:charvariable>
    </m:MyOperation>
  </SOAP-ENV:Body>
 </SOAP-ENV:Envelope>
```


The procedure name appears in the <m:**MyOperation**> tag within the body. The two parameters to the procedure, **intvariable** and **charvariable**, become <m:**intvariable**> and <m:**charvariable**>, respectively.

By default, the stored procedure name is used as the SOAP operation name when building a SOAP request. Parameter names appear in SOAP envelope tagnames. You must reference these names correctly when defining a SOAP stored procedure since the server expects these names in the SOAP request. The SET clause can be used to specify an alternate SOAP operation name for the given procedure. WSDLC can be used to read a WSDL from a file or URL specification and generate SQL stub functions or procedures. For all but the simplest cases (ie: a SOAP RPC call returns a single string value) it is recommended that function definitions are used rather than procedures. A SOAP function returns the full SOAP response envelope which can be parsed using OPENXML.

See also

- "openxml system procedure" [*SQL Anywhere Server - SQL Reference*]
- "Supplying variables to a web service" on page 802
- "HTTP and SOAP request structures" on page 821

Web client ports

It is sometimes necessary to indicate which ports to use when opening a server connection through a firewall. You can use the CLIENTPORT clause of the CREATE PROCEDURE and CREATE FUNCTION statements to designate port numbers on which the client application communicates using TCP/IP. It is recommended that you not use this feature unless your firewall restricts access to a particular range of ports. For more information, see "Web client SQL statements" on page 788.

For example, run the following statement in the web client database to create an procedure named **MyOperation** that sends requests to the specified URL using one of the ports in the range 5050-5060, or port 5070:

```
CREATE PROCEDURE MyOperation ()
    URL 'HTTP://localhost:8020/dbname/SampleWebService'
    CLIENTPORT '5050-5060,5070';
```

It is recommended that you specify a range of port numbers when required. Only one connection is maintained at a time when you specify a single port number; the client application attempts to access all specified port numbers until it finds one to bind to. After closing the connection, a timeout period of several minutes is initiated so that no new connection can be made to the same server and port.

This feature is similar to setting the ClientPort network protocol option. See "ClientPort (CPORT) protocol option" [*SQL Anywhere Server - Database Administration*].

HTTP request header management

HTTP request headers can be added, changed, or removed with the HEADER clause of the CREATE PROCEDURE and CREATE FUNCTION statements. You suppress an HTTP request header by referencing the name. You add or change an HTTP request header value by placing a colon after the

header name following by the value. Header value specifications are optional. For more information, see "Web client SQL statements" on page 788.

For example, run the following statement in the web client database to create an procedure named **MyOperation** that sends requests to the specified URL that puts restrictions on HTTP request headers:

```
CREATE PROCEDURE MyOperation ()
    URL 'HTTP://localhost:8020/dbname/SampleWebService'
    TYPE 'HTTP:GET'
    HEADER 'SOAPAction\nDate\nFrom:\nCustomAlias:John Doe';
```

In this example, the **Date** header, which is automatically generated by SQL Anywhere, is suppressed. The **From** header is included but is not assigned a value. A new header named **CustomAlias** is included in the HTTP request and is assigned the value of **John Doe**.

Folding of long header values is supported, provided that one or more white spaces immediately follow the **\n**.

The following example illustrates long header value support:

```
CREATE PROCEDURE MyOperation ()
    URL 'HTTP://localhost:8020/dbname/SampleWebService'
    TYPE 'HTTP:POST'
    HEADER 'heading1: This long value\n is really long for a header.\n
    heading2:shortvalue'
```

Note
You must set the **SOAPAction** HTTP request header to the given SOAP service URI as specified in the WSDL when creating a SOAP function or procedure.

Automatically generated HTTP request headers

Modifying automatically generated headers can have unexpected results. The following HTTP request headers should not be modified without precaution:

HTTP header	Description
Accept-Charset	Always automatically generated. Changing or deleting this header may result in unexpected data conversion errors.
ASA-Id	Always automatically generated. This header ensures that the client application does not connect to itself to prevent deadlock.
Authorization	Automatically generated when URL contains credentials. Changing or deleting this header may result in failure of the request. Only BASIC authorization is supported. User and password information should only be included when connecting via HTTPS.
Connection	Connection: close, is always automatically generated. Client applications do not support persistent connections. The connection could hang if changed.

HTTP header	Description
Host	Always automatically generated. HTTP/1.1 servers are required to respond with 400 Bad Request if an HTTP/1.1 client does not provide a Host header.
Transfer-Encoding	Automatically generated when posting a request in chunk mode. Removing this header or deleting the chunked value will result in failure when the client is using CHUNK mode.
Content-Length	Automatically generated when posting a request and not in chunk mode. This header is required to tell the server the content length of the body. If the content length is wrong the connection may hang or data loss could occur.

SOAP request header management

A SOAP request header is an XML fragment within a SOAP envelope. While the SOAP operation and its parameters can be thought of as an RPC (Remote Procedure Call), a SOAP request header can be used to transfer meta information within a specific request or response. SOAP request headers transport application meta data such as authorization or session criteria.

The value of a SOAPHEADER clause must be a valid XML fragment that conforms to a SOAP request header entry. Multiple SOAP request header entries can be specified. The stored procedure or function automatically injects the SOAP request header entries within a SOAP header element. SOAPHEADER values specify SOAP headers that can be declared as a static constant, or dynamically set using the parameter substitution mechanism.

Processing SOAP response headers (returned by the SOAP call) differs for functions and procedures. When using a function, which is the most flexible and recommended approach, the entire SOAP response envelope is received. The response envelope can then be processed using openxml to extract SOAP header and SOAP body data. When using a procedure, SOAP response headers can only be extracted through the use of a substitution parameter that maps to an IN or INOUT variable. A SOAP procedure allows for a maximum of one IN or INOUT parameter.

A web service function must parse the response SOAP envelope to obtain the header entries.

Example

The following examples illustrate how to create SOAP procedures and functions that send parameters and SOAP headers. Wrapper procedures are used to populate the web service procedure calls and process the responses. The **soapAddItemProc** procedure illustrates the use of a SOAP web service procedure, the **soapAddItemFunction** function illustrates the use of a SOAP web service function, and the **httpAddItemFunction** function illustrates how a SOAP payload may be passed to an HTTP web service procedure.

```
/* -- SOAP client procedure --
    uses substitution parameters to send SOAP headers
         a single inout parameter is used to receive SOAP headers
*/
create or replace procedure soapAddItemProc("amount" int, item long varchar,
```

```
inout inoutheader long varchar, in inheader long varchar )
    url 'http://localhost/store'
    set 'SOAP( OP=addItems )'
    type 'SOAP:DOC'
    soapheader '!inoutheader!inheader';

/* Wrapper that calls soapAddItemProc
    demonstrates:
        how to send and receive soap headers
        how to send parameters
 */
create or replace procedure addItemProcWrapper( amount int, item long
varchar, "first" long varchar, "last" long varchar )
    begin
        declare io_header long varchar;    // inout (write/read) soap header
        declare resxml long varchar;
        declare soap_header_sent long varchar;
        declare i_header long varchar;    // in (write) only soap header
        declare err int;
       declare crsr cursor for call soapAddItemProc( amount, item, io_header,
i_header );

        set io_header = XMLELEMENT( 'Authentication',
                    XMLATTRIBUTES('CustomerOrderURN' as xmlns),
                XMLELEMENT('userName', XMLATTRIBUTES(
                        'none' as pwd,
                        '1' as mustUnderstand ),
                        XMLELEMENT( 'first', "first" ),
                        XMLELEMENT( 'last', "last" ) ) );
        set i_header = '<Session xmlns="SomeSession">123456789</Session>';
        set soap_header_sent = io_header || i_header;
        open crsr;
        fetch crsr into resxml, err;
        close crsr;

        select resxml, err, soap_header_sent, io_header as
soap_header_received;
    end;

/* example call to addItemProcWrapper */
call addItemProcWrapper( 5, 'shirt', 'John', 'Smith' );


/* -- SOAP client function --
    uses substitution parameters to send SOAP headers
    Entire SOAP response envelope is returned.  SOAP headers can be parsed
using openxml
*/
create or replace function soapAddItemFunction("amount" int, item long
varchar, in inheader1 long varchar, in inheader2 long varchar )
returns XML
    url 'http://localhost/store'
    set 'SOAP( OP=addItems )'
    type 'SOAP:DOC'
    soapheader '!inheader1!inheader2';

/* Wrapper that calls soapAddItemFunction
    demonstrates the use of SOAP function:
        how to send and receive soap headers
        how to send parameters and process response
 */
create or replace procedure addItemFunctionWrapper( amount int, item long
varchar, "first" long varchar, "last" long varchar )
    begin
```



```
        declare i_header1 long varchar;
        declare i_header2 long varchar;
        declare res long varchar;
        declare ns long varchar;
        declare xpath long varchar;
        declare header_entry long varchar;
        declare localname long varchar;
        declare namespaceuri long varchar;
        declare r_quantity int;
        declare r_item long varchar;
        declare r_status long varchar;


        set i_header1 = XMLELEMENT( 'Authentication',
                      XMLATTRIBUTES('CustomerOrderURN' as xmlns),
                    XMLELEMENT('userName', XMLATTRIBUTES(
                            'none' as pwd,
                            '1' as mustUnderstand ),
                            XMLELEMENT( 'first', "first" ),
                            XMLELEMENT( 'last', "last" ) ) );
        set i_header2 = '<Session xmlns="SessionURN">123456789</Session>';

        set res = soapAddItemFunction( amount, item, i_header1, i_header2 );

         set ns = '<ns xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/
envelope/"'
        || ' xmlns:mp="urn:ianywhere-com:sa-xpath-metaprop"'
        || ' xmlns:customer="CustomerOrderURN"'
        || ' xmlns:session="SessionURN"'
        || ' xmlns:tns="http://localhost"></ns>';

        // Process headers...
        set xpath = '//SOAP-ENV:Header/*';
        begin
         declare crsr cursor for select * from
             openxml( res, xpath, 1, ns )
                          with (  "header_entry" long varchar '@mp:xmltext',
                        "localname" long varchar '@mp:localname',
                        "namespaceuri" long varchar '@mp:namespaceuri' );
            open crsr;
            fetch crsr into "header_entry", "localname", "namespaceuri";
            close crsr;
        end;

        // Process body...
        set xpath = '//tns:row';
        begin
         declare crsr1 cursor for select * from
             openxml( res, xpath, 1, ns )
                          with (  "r_quantity" int 'tns:quantity/text()',
                        "r_item" long varchar 'tns:item/text()',
                        "r_status" long varchar 'tns:status/text()' );
            open crsr1;
            fetch crsr1 into "r_quantity", "r_item", "r_status";
            close crsr1;
        end;

    select r_item, r_quantity, r_status, header_entry, localname,
namespaceuri;
    end;

/* example call to addItemFunctionWrapper */
call addItemFunctionWrapper( 5, 'shirt', 'John', 'Smith' );
```

```
/*
 Demonstrate how a HTTP:POST can be used as a transport for a SOAP payload
 Rather than creating a webservice client SOAP procedure, this approach
 creates a webservice HTTP procedure that transports a SOAP payload
*/
create or replace function httpAddItemFunction("soapPayload" xml )
returns XML
    url 'http://localhost/store'
    type 'HTTP:POST:text/xml'
    header 'SOAPAction: "http://localhost/addItems"';


/* Wrapper that calls soapAddItemFunction
    demonstrates the use of SOAP function:
        how to send and receive soap headers
        how to send parameters and process response
 */

create or replace procedure addItemHttpWrapper( amount int, item long
varchar )
result(response xml)
begin
    declare payload xml;
    declare response xml;

    set payload =
'<?xml version="1.0"?>
<SOAP-ENV:Envelope
  xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:m="http://localhost">
  <SOAP-ENV:Body>
    <m:addItems>
      <m:amount>' || amount || '</m:amount>
      <m:item>' || item || '</m:item>
    </m:addItems>
  </SOAP-ENV:Body>
</SOAP-ENV:Envelope>';
    set response = httpAddItemFunction( payload );
    /* process response as demonstrated in addItemFunctionWrapper */
    select response;
end
go

/* example call to addItemHttpWrapper */
call addItemHttpWrapper( 5, 'shirt' );
```

For the server-side implementation of this example, see "Accessing client-supplied SOAP request headers" on page 757 or "Sample: Handling SOAP headers, parameters, and responses" on page 850.

Limitations

- Server side SOAP services cannot currently define input and output SOAP header requirements. Therefore SOAP header metadata is not available in the WSDL output of a DISH service. This means that a SOAP client toolkit cannot automatically generate SOAP header interfaces for a SQL Anywhere SOAP service endpoint.
- Soap header faults are not supported.

SOAP namespace URI requirement

The namespace URI specifies the XML namespace used to compose the SOAP request envelope for the given SOAP operation. The domain component from URL clause is used when the namespace URI is not defined.

The server-side SOAP processor uses this URI to understand the names of the various entities in the message body of the request. The NAMESPACE clause of the CREATE PROCEDURE and CREATE FUNCTION statements specifies the namespace URI. For more information, see "Web client SQL statements" on page 788.

You may be required to specify a namespace URI before procedure calls succeed. This information is usually explained the public web server documentation, but you can obtain the required namespace URI from the WSDL available from the web server. You can generate a WSDL by accessing the DISH service if you are trying to communicate with a SQL Anywhere web server.

Generally, the NAMESPACE can be copied from the **targetNamespace** attribute specified at the beginning of the WSDL document within the **wsdl:definition** element. Be careful when including any trailing '/', as they are significant. Secondly, check for a **soapAction** attribute for the given SOAP operation. It should correspond to the **SOAPAction** HTTP header that would be generated as explained in the following paragraphs.

The NAMESPACE clause fulfills two functions. It specifies the namespace for the body of the SOAP envelope, and, if the procedure has TYPE 'SOAP:DOC' specified, it is used as the domain component of the **SOAPAction** HTTP header.

The following example illustrates the use of the NAMESPACE clause:

```
CREATE function an_operation( a_parameter long varchar )
    RETURNS long varchar
    URL 'http://wsdl.domain.com/fictitious.asmx'
    TYPE 'SOAP:DOC'
    NAMESPACE 'http://wsdl.domain.com/'
```

Run the following SQL script in Interactive SQL:

```
SELECT an_operation('a_value');
```

The script generates a SOAP request similar to the following output:

```
POST /fictitious.asmx HTTP/1.0
SOAPAction: "http://wsdl.domain.com/an_operation"
Host: wsdl.domain.com
Content-Type: text/xml
Content-Length: 387
Connection: close

<?xml version="1.0"?>
<SOAP-ENV:Envelope
 xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
 xmlns:xs="http://www.w3.org/2001/XMLSchema"
 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
 xmlns:m="http://wsdl.domain.com/">
  <SOAP-ENV:Body>
   <m:an_operation>
```

```
      <m:a_parameter>a_value</m:a_parameter>
    </m:an_operation>
  </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

The namespace for the prefix 'm' is set to **http://wsdl.domain.com/** and the **SOAPAction** HTTP header specifies a fully qualified URL for the SOAP operation.

The trailing slash is not a requirement for correct operation of SQL Anywhere but it can cause a response failure that is difficult to diagnose. The **SOAPAction** HTTP header is correctly generated regardless of the trailing slash.

When a NAMESPACE is not specified, the domain component from the URL clause is used as the namespace for the SOAP body, and if the procedure is of TYPE 'SOAP:DOC', it is used to generate the HTTP **SOAPAction** HTTP header. If in the above example the NAMESPACE clause is omitted, then **http://wsdl.domain.com** is used as the namespace. The subtle difference is that a trailing slash '/' is not present. Every other aspect of the SOAP request, including the **SOAPAction** HTTP header would be identical to the above example.

The NAMESPACE clause is used to specify the namespace for the SOAP body as described for the SOAP:DOC case above. However, the **SOAPAction** HTTP header is generated with an empty value: SOAPAction: ""

When using the SOAP:DOC request type, the namespace is also used to compose the **SOAPAction** HTTP header.

See also

- "Web service request types" on page 780
- "Creating DISH services" on page 736

Web client SQL statements

The following SQL statements are available to assist with web client development:

Web client related SQL statements	Description
"CREATE FUNCTION statement (web clients)" on page 789	Creates a web client function that makes an HTTP or SOAP over HTTP request.
"ALTER FUNCTION statement" [*SQL Anywhere Server - SQL Reference*]	Modifies a function.
"CREATE PROCEDURE statement (web clients)" on page 795	Creates a web client procedure that makes an HTTP or SOAP over HTTP request.

Web client related SQL statements	Description
"ALTER PROCEDURE statement" [*SQL Anywhere Server - SQL Reference*]	Modifies a procedure.

CREATE FUNCTION statement (web clients)

Creates a web client function that makes an HTTP or SOAP over HTTP request. To create a user-defined SQL function, see "CREATE FUNCTION statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

CREATE [**OR REPLACE**] **FUNCTION** [*owner*.]*function-name* **(** [*parameter*, ...] **)**
RETURNS *data-type*
URL *url-string*
[**HEADER** *header-string*]
[**SOAPHEADER** *soap-header-string*]
[**TYPE** {
  'HTTP[**:**{ **GET** | **POST**[**:***MIME-type*] | **PUT**[**:***MIME-type*] | **DELETE** | **HEAD** }]**'** |
  'SOAP[**:**{ **RPC** | **DOC** }]**'** }]
[**NAMESPACE** *namespace-string*]
[**CERTIFICATE** *certificate-string*]
[**CLIENTPORT** *clientport-string*]
[**PROXY** *proxy-string*]
[**SET** *protocol-option-string*]

url-string :
' { **HTTP** | **HTTPS** | **HTTPS_FIPS** }**://**[*user***:***password*@]*hostname*[**:***port*][**/***path*]**'**

parameter :
  [**IN**] *parameter-name data-type* [**DEFAULT** *expression*]

Parameters

CREATE FUNCTION Parameter names must conform to the rules for database identifiers. They must have a valid SQL data type, and must be prefixed by the keyword IN, signifying that the argument is an expression that provides a value to the function.

When functions are executed, not all parameters need to be specified. If a default value is provided in the CREATE FUNCTION statement, missing parameters are assigned the default values. If an argument is not provided by the caller and no default is set, an error is given.

Specifying OR REPLACE (CREATE OR REPLACE FUNCTION) creates a new function, or replaces an existing function with the same name. This clause changes the definition of the function, but preserves existing permissions. You cannot use the OR REPLACE clause with temporary functions.

RETURNS clause Specify one of the following to define the return type for the SOAP or HTTP function:

- CHAR
- VARCHAR
- LONG VARCHAR
- TEXT
- NCHAR
- NVARCHAR
- LONG NVARCHAR
- NTEXT
- XML
- BINARY
- VARBINARY
- LONG BINARY

The value returned is the body of the HTTP response. No HTTP header information is included. If more information is required, such as status information, use a procedure instead of a function.

The data type does not affect how the HTTP response is processed.

URL clause For use only when defining an HTTP or SOAP web services client function. Specifies the URL of the web service. The optional user name and password parameters provide a means of supplying the credentials needed for HTTP basic authentication. HTTP basic authentication base-64 encodes the user and password information and passes it in the Authentication header of the HTTP request.

Specifying HTTPS_FIPS forces the system to use the FIPS libraries. If HTTPS_FIPS is specified, but no FIPS libraries are present, non-FIPS libraries are used instead.

HEADER clause When creating HTTP web service client functions, use this clause to add or modify HTTP request header entries. Only printable ASCII characters can be specified for HTTP headers, and they are case-insensitive. For more information about how to use this clause, see the HEADER clause of the "CREATE PROCEDURE statement (web clients)" [*SQL Anywhere Server - SQL Reference*].

For more information about using HTTP headers, see "HTTP request header management" on page 781.

SOAPHEADER clause When declaring a SOAP web service as a function, use this clause to specify one or more SOAP request header entries. A SOAP header can be declared as a static constant, or can be dynamically set using the parameter substitution mechanism (declaring IN, OUT, or INOUT parameters for hd1, hd2, and so on). A web service function can define one or more IN mode substitution parameters, but can not define an INOUT or OUT substitution parameter. For more information about how to use this clause, see the SOAPHEADER clause of the "CREATE PROCEDURE statement (web clients)" [*SQL Anywhere Server - SQL Reference*].

For more information about using SOAP headers, see "Tutorial: Using SQL Anywhere to access a SOAP/DISH service" on page 830.

For more information about substitution parameters, see "HTTP and SOAP request structures" on page 821.

TYPE clause Specifies the format used when making the web service request. SOAP:RPC is used when SOAP is specified or no type clause is included. HTTP:POST is used when HTTP is specified. See "Developing web client applications" on page 778.

The TYPE clause allows the specification of a MIME-type for HTTP:GET, HTTP:POST, and HTTP:PUT types. The *MIME-type* specification is used to set the Content-Type request header and set the mode of operation to allow only a single call parameter to populate the body of the request. Only zero or one parameter may remain when making a web service stored function call after parameter substitutions have been processed. Calling a web service function with a null or no parameter (after substitutions) results in a request with no body and a content-length of zero. The behavior has not changed if a MIME type is not specified. Parameter names and values (multiple parameters are permitted) are URL encoded within the body of the HTTP request.

Some typical MIME-types include:

- text/plain
- text/html
- text/xml

The keywords for the TYPE clause have the following meanings:

- **HTTP:GET** By default, this type uses the application/x-www-form-urlencoded MIME-type for encoding parameters specified in the URL.

  For example, the following request is produced when a client submits a request from the URL, `http://localhost/WebServiceName?arg1=param1&arg2=param2`:

  ```
  GET /WebServiceName?arg1=param1&arg2=param2 HTTP/1.1
  // <End of Request - NO BODY>
  ```

- **HTTP:POST** By default, this type uses the application/x-www-form-urlencoded MIME-type for encoding parameters specified in the body of a POST request. URL parameters are stored in the body.

  For example, the following request is produced when a client submits a request the URL, `http://localhost/WebServiceName?arg1=param1&arg2=param2`:

  ```
  POST /WebServiceName HTTP/1.1
  Content-Type: application/x-www-form-urlencoded
  Content-Length: 19

  arg1=param1&arg2=param2
  // <End of Request>
  ```

- **HTTP:PUT** HTTP:PUT is similar to HTTP:POST, but the HTTP request method is emitted. An HTTP:PUT type does not have a default media type.

  The following example demonstrates how to configure a general purpose client procedure that uploads data to a SQL Anywhere server running the *put_data.sql* sample:

  ```
  ALTER PROCEDURE CPUT("data" LONG VARCHAR, resnm LONG VARCHAR, mediatype
  LONG VARCHAR)
      URL 'http://localhost/resource/!resnm'
      TYPE 'HTTP:PUT:!mediatype';
  ```

```
CALL CPUT('hello world', 'hello', 'text/plain' );
```

- **HTTP:DELETE** A web service client procedure can be configured to delete a resource located on a server. Specifying the media type is optional.

  The following example demonstrates how to configure a general purpose client procedure that deletes a resource from a SQL Anywhere server running the *put_data.sql* sample:

  ```
  ALTER PROCEDURE CDEL(resnm LONG VARCHAR, mediatype LONG VARCHAR)
      URL 'http://localhost/resource/!resnm'
      TYPE 'HTTP:DELETE:!mediatype';

  CALL CDEL('hello', 'text/plain' );
  ```

- **HTTP:HEAD** The head method is identical to a GET method but the server does not return a body. A media type can be specified.

  ```
  ALTER PROCEDURE CHEAD(resnm LONG VARCHAR)
      URL 'http://localhost/resource/!resnm'
      TYPE 'HTTP:HEAD';

  CALL CHEAD( 'hello' );
  ```

- **SOAP:RPC** This type sets the Content-Type to 'text/xml'. SOAP operations and parameters are encapsulated in SOAP envelope XML documents.

- **SOAP:DOC** This type sets the Content-Type to 'text/xml'. It is similar to the SOAP:RPC type but allows you to send richer data types. SOAP operations and parameters are encapsulated in SOAP envelope XML documents.

Specifying a MIME-type for the TYPE clause automatically sets the Content-Type header to that MIME-type. For an example of MIME-type usage, see "Supplying variables to a web service" on page 802 and "Tutorial: Working with MIME types in a RAW service" on page 826.

NAMESPACE clause Applies to SOAP client functions only. This clause identifies the method namespace usually required for both SOAP:RPC and SOAP:DOC requests. The SOAP server handling the request uses this namespace to interpret the names of the entities in the SOAP request message body. The namespace can be obtained from the WSDL (Web Services Description Language) of the SOAP service available from the web service server. The default value is the function's URL, up to but not including, the optional path component.

CERTIFICATE clause To make a secure (HTTPS) request, a client must have access to the certificate used by the HTTPS server. The necessary information is specified in a string of semicolon-separated key/value pairs. You can use the file key to specify the file name of the certificate, or you can use the certificate key to specify the server certificate in a string. You cannot specify a file and certificate key together. The following keys are available:

Key	Abbreviation	Description
file		The file name of the certificate.

Key	Abbreviation	Description
certificate	cert	The certificate itself.
company	co	The company specified in the certificate.
unit		The company unit specified in the certificate.
name		The common name specified in the certificate.

Certificates are required only for requests that are directed to an HTTPS server, or for requests that can be redirected from a non-secure to a secure server. Only PEM formatted certificates are supported.

CLIENTPORT clause Identifies the port number on which the HTTP client function communicates using TCP/IP. It is provided for and recommended only for connections across firewalls, as firewalls filter according to the TCP/UDP port. You can specify a single port number, ranges of port numbers, or a combination of both; for example, CLIENTPORT '85,90-97'. See "ClientPort (CPORT) protocol option" [*SQL Anywhere Server - Database Administration*].

PROXY clause Specifies the URI of a proxy server. For use when the client must access the network through a proxy. This clause indicates that the function is to connect to the proxy server and send the request to the web service through it.

SET clause Specifies protocol-specific behavior options for HTTP and SOAP. The following list describes the supported SET options. CHUNK and VERSION apply to the HTTP protocol, and OPERATION applies to the SOAP protocol. Parameter substitution is supported for this clause.

- **'HTTP(CH[UNK]=option)'** (HTTP or SOAP) This option allows you to specify whether to use chunking. Chunking allows HTTP messages to be broken up into several parts. Possible values are ON (always chunk), OFF (never chunk), and AUTO (chunk only if the contents, excluding auto-generated markup, exceeds 8196 bytes). For example, the following SET clause enables chunking:

  ```
  SET 'HTTP(CHUNK=ON)'
  ```

  If the CHUNK option is not specified, the default behavior is AUTO. If a chunked request fails in AUTO mode with a status of 505 **HTTP Version Not Supported**, or with 501 **Not Implemented**, or with 411 **Length Required**, the client retries the request without chunked transfer-coding.

  Set the CHUNK option to OFF (never chunk) if the HTTP server does not support chunked transfer-coded requests.

  Since CHUNK mode is a transfer encoding supported starting in HTTP version 1.1, setting CHUNK to ON requires that the version (VER) be set to 1.1, or not be set at all, in which case 1.1 is used as the default version.

- **' HTTP(VER[SION]=ver)'** (HTTP or SOAP) This option allows you to specify the version of HTTP protocol that is used for the format of the HTTP message. For example, the following SET clause sets the HTTP version to 1.1:

```
SET 'HTTP(VERSION=1.1)'
```

Possible values are 1.0 and 1.1. If VERSION is not specified:

- if CHUNK is set to ON, 1.1 is used as the HTTP version
- if CHUNK is set to OFF, 1.0 is used as the HTTP version
- if CHUNK is set to AUTO, either 1.0 or 1.1 is used, depending on whether the client is sending in CHUNK mode

- **'SOAP(OP[ERATION]=soap-operation-name)'** (SOAP only) This option allows you to specify the name of the SOAP operation, if it is different from the name of the procedure you are creating. The value of OPERATION is analogous to the name of a remote procedure call. For example, if you wanted to create a procedure called accounts_login that calls a SOAP operation called login, you would specify something like the following:

  ```
  CREATE FUNCTION accounts_login(
        name LONG VARCHAR,
        pwd LONG VARCHAR )
     SET 'SOAP(OPERATION=login)';
  ```

  If the OPERATION option is not specified, the name of the SOAP operation must match the name of the procedure you are creating.

The following statement shows how several *protocol-option* settings are combined in the same SET clause:

```
CREATE FUNCTION accounts_login(
      name LONG VARCHAR,
      pwd LONG VARCHAR )
   SET 'HTTP ( CHUNK=ON; VERSION=1.1 ), SOAP( OPERATION=login )'
   ...
```

Remarks

The CREATE FUNCTION statement creates a web services function in the database. A function can be created for another user by specifying an owner name.

Parameter values are passed as part of the request. The syntax used depends on the type of request. For HTTP:GET, the parameters are passed as part of the URL; for HTTP:POST requests, the values are placed in the body of the request. Parameters to SOAP requests are always bundled in the request body.

Permissions

RESOURCE authority.

DBA authority for external functions, including Java functions.

Side effects

Automatic commit.

See also

- "ALTER FUNCTION statement" [*SQL Anywhere Server - SQL Reference*]
- "CREATE FUNCTION statement" [*SQL Anywhere Server - SQL Reference*]
- "CREATE FUNCTION statement (external procedures)" [*SQL Anywhere Server - SQL Reference*]
- "CREATE PROCEDURE statement" [*SQL Anywhere Server - SQL Reference*]
- "CREATE PROCEDURE statement (web clients)" [*SQL Anywhere Server - SQL Reference*]
- "DROP FUNCTION statement" [*SQL Anywhere Server - SQL Reference*]
- "RETURN statement" [*SQL Anywhere Server - SQL Reference*]
- "Using SQL Anywhere as an HTTP web server" on page 727
- "Developing web client applications" on page 778
- "remote_idle_timeout option" [*SQL Anywhere Server - Database Administration*]

Standards and compatibility

- **SQL/2008** Vendor extension.
- **Transact-SQL** Not supported by Adaptive Server Enterprise.

Examples

The following statement creates a function named **cli_test1** that returns images from the **get_picture** service running on localhost:

```
CREATE FUNCTION cli_test1( image LONG VARCHAR )
RETURNS LONG BINARY
URL 'http://localhost/get_picture'
TYPE 'HTTP:GET';
```

The following statement issues an HTTP request with the URL *http://localhost/get_picture?image=widget*:

```
SELECT cli_test1( 'widget' );
```

The following statement uses a substitution parameter to allow the request URL to be passed as an input parameter. The SET clause is used to turn off CHUNK mode transfer-encoding.

```
CREATE FUNCTION cli_test2( image LONG VARCHAR, myurl LONG VARCHAR )
RETURNS LONG BINARY
URL '!myurl'
TYPE 'HTTP:GET'
SET 'HTTP(CH=OFF)'
HEADER 'ASA-ID';
```

The following statement issues an HTTP request with the URL *http://localhost/get_picture?image=widget*:

```
CREATE VARIABLE a_binary LONG BINARY
a_binary = cli_test2('widget', 'http://localhost/get_picture');
SELECT a_binary;
```

CREATE PROCEDURE statement (web clients)

Creates a web client procedure that makes an HTTP or SOAP over HTTP request. To create a user-defined SQL procedure, see "CREATE PROCEDURE statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

CREATE [**OR REPLACE**] **PROCEDURE** [*owner*.]*procedure-name* **(** [*parameter*, ...] **)**
URL *url-string*
[**TYPE** { *http-type-spec-string* | *soap-type-spec-string* }]
[**HEADER** *header-string*]
[**CERTIFICATE** *certificate-string*]
[**CLIENTPORT** *clientport-string*]
[**PROXY** *proxy-string*]
[**SET** *protocol-option-string*]
[**SOAPHEADER** *soap-header-string*]
[**NAMESPACE** *namespace-string*]

http-type-spec-string :
HTTP[**:** { **GET**
| **POST**[**:***MIME-type*]
| **PUT**[**:***MIME-type*]
| **DELETE**
| **HEAD** }]

soap-type-spec-string :
SOAP[**:**{ **RPC** | **DOC** }

parameter :
parameter-mode parameter-name data-type [**DEFAULT** *expression*]

parameter-mode :
IN
| **OUT**
| **INOUT**

url-string :
{ **HTTP** | **HTTPS** | **HTTPS_FIPS** }**:***//*[*user***:***password*@]*hostname*[**:***port*][***/path***]

protocol-option-string
[*http-option-list*]
[**,** *soap-option-list*]

http-option-list :
HTTP(
[**CH**[**UNK**]**=**{ **ON** | **OFF** | **AUTO** }]
[**; VER**[**SION**]**=**{ **1.0** | **1.1** }]
)

soap-option-list:
SOAP(OP[**ERATION**]**=***soap-operation-name***)**

Parameters

CREATE PROCEDURE You can create or replace a web services client procedure. You can use PROC as a synonym for PROCEDURE.

For SOAP requests, the procedure name is used as the SOAP operation name by default. See the SET clause below for more information.

Parameter names must conform to the rules for other database identifiers such as column names. They must be a valid SQL data type. For a list of valid data types, see "SQL data types" [*SQL Anywhere Server - SQL Reference*].

Only SOAP requests support the transmission of typed data such as FLOAT, INT, and so on. HTTP requests support the transmission of strings only, so you are limited to CHAR types. For more information about supported SOAP types, see "Working with data types (SOAP only)" on page 809 and "Working with structured data types (SOAP only)" on page 815.

Parameters can be prefixed with one of the keywords IN, OUT, or INOUT. If you do not specify one of these values, parameters are INOUT by default. The keywords have the following meanings:

- **IN** The parameter is an expression that provides a value to the procedure.
- **OUT** The parameter is a variable that could be given a value by the procedure.
- **INOUT** The parameter is a variable that provides a value to the procedure, and could be given a new value by the procedure.

When procedures are executed using the CALL statement, not all parameters need to be specified. If a default value is provided in the CREATE PROCEDURE statement, missing parameters are assigned the default values. If an argument is not provided in the CALL statement, and no default is set, an error is given.

Specifying OR REPLACE (CREATE OR REPLACE PROCEDURE) creates a new procedure, or replaces an existing procedure with the same name. This clause changes the definition of the procedure, but preserves existing permissions. An error is returned if you attempt to replace a procedure that is already in use.

You cannot create TEMPORARY web services procedures.

URL clause Specifies the URI of the web service. The optional user name and password parameters provide a means of supplying the credentials needed for HTTP basic authentication. HTTP basic authentication base-64 encodes the user and password information and passes it in the Authentication header of the HTTP request. When specified in this way, the user name and password are passed unencrypted, as part of the URL.

TYPE clause Specifies the format used when making the web service request. SOAP:RPC is used when SOAP is specified or no type clause is included. HTTP:POST is used when HTTP is specified. See "Developing web client applications" on page 778.

The TYPE clause allows the specification of a MIME-type for HTTP:GET, HTTP:POST, and HTTP:PUT types. The *MIME-type* specification is used to set the Content-Type request header and set the mode of operation to allow only a single call parameter to populate the body of the request. Only zero or one parameter may remain when making a web service stored procedure call after parameter substitutions have been processed. Calling a web service procedure with a null or no parameter (after substitutions) results in a request with no body and a content-length of zero. The behavior has not changed if a MIME type is not specified. Parameter names and values (multiple parameters are permitted) are URL encoded within the body of the HTTP request.

Some typical MIME-types include:

- text/plain
- text/html
- text/xml

The keywords for the TYPE clause have the following meanings:

- **'HTTP:GET'** By default, this type uses the application/x-www-form-urlencoded MIME-type for encoding parameters specified in the URL.

  For example, the following request is produced when a client submits a request from the URL, `http://localhost/WebServiceName?arg1=param1&arg2=param2`:

  ```
  GET /WebServiceName?arg1=param1&arg2=param2 HTTP/1.1
  // <End of Request - NO BODY>
  ```

- **'HTTP:POST'** By default, this type uses the application/x-www-form-urlencoded MIME-type for encoding parameters specified in the body of a POST request. URL parameters are stored in the body of the request.

  For example, the following request is produced when a client submits a request the URL, `http://localhost/WebServiceName?arg1=param1&arg2=param2`:

  ```
  POST /WebServiceName HTTP/1.1
  Content-Type: application/x-www-form-urlencoded
  Content-Length: 19
  arg1=param1&arg2=param2
  // <End of Request>
  ```

- **HTTP:PUT** HTTP:PUT is similar to HTTP:POST, but the HTTP request method is emitted. An HTTP:PUT type does not have a default media type.

  The following example demonstrates how to configure a general purpose client procedure that uploads data to a SQL Anywhere server running the *samples-dir\SQLAnywhere\HTTP\put_data.sql* sample:

  ```
  ALTER PROCEDURE CPUT("data" LONG VARCHAR, resnm LONG VARCHAR, mediatype
  LONG VARCHAR)
      URL 'http://localhost/resource/!resnm'
      TYPE 'HTTP:PUT:!mediatype';

  CALL CPUT('hello world', 'hello', 'text/plain' );
  ```

- **HTTP:DELETE** A web service client procedure can be configured to delete a resource located on a server. Specifying the media type is optional.

  The following example demonstrates how to configure a general purpose client procedure that deletes a resource from a SQL Anywhere server running the *put_data.sql* sample:

  ```
  ALTER PROCEDURE CDEL(resnm LONG VARCHAR, mediatype LONG VARCHAR)
      URL 'http://localhost/resource/!resnm'
      TYPE 'HTTP:DELETE:!mediatype';

  CALL CDEL('hello', 'text/plain' );
  ```


- **HTTP:HEAD** The head method is identical to a GET method but the server does not return a body. A media type can be specified.

```
ALTER PROCEDURE CHEAD(resnm LONG VARCHAR)
    URL 'http://localhost/resource/!resnm'
    TYPE 'HTTP:HEAD';

CALL CHEAD( 'hello' );
```

- **'SOAP:RPC'** This type sets the Content-Type header to 'text/xml'. SOAP operations and parameters are encapsulated in SOAP envelope XML documents.

- **'SOAP:DOC'** This type sets the Content-Type header to 'text/xml'. It is similar to the SOAP:RPC type but allows you to send richer data types. SOAP operations and parameters are encapsulated in SOAP envelope XML documents.

Specifying a MIME-type for the TYPE clause automatically sets the Content-Type header to that MIME-type. For an example of MIME-type usage, see "Supplying variables to a web service" on page 802 and "Tutorial: Working with MIME types in a RAW service" on page 826.

HEADER clause When creating HTTP web service client procedures, use this clause to add, modify, or delete HTTP request header entries. The specification of headers closely resembles the format specified in RFC2616 Hypertext Transfer Protocol — HTTP/1.1, and RFC822 Standard for ARPA Internet Text Messages, including the fact that only printable ASCII characters can be specified for HTTP headers, and they are case-insensitive.

Headers can be defined as *header-name*:*value-name* pairs. Each header must be delimited from its value with a colon (**:**) and therefore cannot contain a colon. You can define multiple headers by delimiting each pair with **\n**, **\x0d\n**, **<LF>** (line feed), or **<CR><LF>**. (carriage return followed by a line feed)

Multiple contiguous white spaces within the header are converted to a single white space.

For more information about using HTTP headers, see "HTTP request header management" on page 781.

CERTIFICATE clause To make a secure (HTTPS) request, a client must have access to the certificate used by the HTTPS server. The necessary information is specified in a string of semicolon-separated key/value pairs. You can use the file key to specify the file name of the certificate, or you can use the certificate key to specify the server certificate in a string. You cannot specify a file and certificate key together. The following keys are available:

Key	Abbreviation	Description
file		The file name of the certificate.
certificate	cert	The certificate itself.
company	co	The company specified in the certificate.
unit		The company unit specified in the certificate.

Key	Abbreviation	Description
name		The common name specified in the certificate.

Certificates are required only for requests that are either directed to an HTTPS server, or can be redirected from a non-secure to a secure server. Only PEM formatted certificates are supported.

CLIENTPORT clause Identifies the port number on which the HTTP client procedure communicates using TCP/IP. It is provided for and recommended only for connections through firewalls that filter "outgoing" TCP/IP connections. You can specify a single port number, ranges of port numbers, or a combination of both; for example, CLIENTPORT '85,90-97'. See "ClientPort (CPORT) protocol option" [*SQL Anywhere Server - Database Administration*].

PROXY clause Specifies the URI of a proxy server. For use when the client must access the network through a proxy. Indicates that the procedure is to connect to the proxy server and send the request to the web service through it.

SET clause Specifies protocol-specific behavior options for HTTP and SOAP. The following list describes the supported SET options. CHUNK and VERSION apply to the HTTP protocol, and OPERATION applies to the SOAP protocol. Parameter substitution is supported for this clause.

- **'HTTP(CH[UNK]=option)'** (HTTP or SOAP) This option allows you to specify whether to use chunking. Chunking allows HTTP messages to be broken up into several parts. Possible values are ON (always chunk), OFF (never chunk), and AUTO (chunk only if the contents, excluding auto-generated markup, exceeds 8196 bytes). For example, the following SET clause enables chunking:

  ```
  SET 'HTTP(CHUNK=ON)'
  ```

  If the CHUNK option is not specified, the default behavior is AUTO. If a chunked request fails in AUTO mode with a status of 505 **HTTP Version Not Supported**, or with 501 **Not Implemented**, or with 411 **Length Required**, the client retries the request without chunked transfer-coding.

  Set the CHUNK option to OFF (never chunk) if the HTTP server does not support chunked transfer-coded requests.

  Since CHUNK mode is a transfer encoding supported starting in HTTP version 1.1, setting CHUNK to ON requires that the version (VER) be set to 1.1, or not be set at all, in which case 1.1 is used as the default version.

- **' HTTP(VER[SION]=ver)'** (HTTP or SOAP) This option allows you to specify the version of HTTP protocol that is used for the format of the HTTP message. For example, the following SET clause sets the HTTP version to 1.1:

  ```
  SET 'HTTP(VERSION=1.1)'
  ```

  Possible values are 1.0 and 1.1. If VERSION is not specified:

  - if CHUNK is set to ON, 1.1 is used as the HTTP version
  - if CHUNK is set to OFF, 1.0 is used as the HTTP version

- if CHUNK is set to AUTO, either 1.0 or 1.1 is used, depending on whether the client is sending in CHUNK mode

- **' SOAP(OP[ERATION]=soap-operation-name)** (SOAP only) This option allows you to specify the name of the SOAP operation, if it is different from the name of the procedure you are creating. The value of OPERATION is analogous to the name of a remote procedure call. For example, if you wanted to create a procedure called accounts_login that calls a SOAP operation called login, you would specify something like the following:

  ```
  CREATE PROCEDURE accounts_login(
        name LONG VARCHAR,
        pwd LONG VARCHAR )
     SET 'SOAP(OPERATION=login)'
  ```

  If the OPERATION option is not specified, the name of the SOAP operation must match the name of the procedure you are creating.

The following statement shows how several *protocol-option* settings are combined in the same SET clause:

```
CREATE PROCEDURE accounts_login(
      name LONG VARCHAR,
      pwd LONG VARCHAR )
   SET 'HTTP ( CHUNK=ON; VERSION=1.1 ), SOAP( OPERATION=login )'
   ...
```

SOAPHEADER clause (SOAP format only) When declaring a SOAP web service as a procedure, use this clause to specify one or more SOAP request header entries. A SOAP header can be declared as a static constant, or can be dynamically set using the parameter substitution mechanism (declaring IN, OUT, or INOUT parameters for hd1, hd2, and so on). A web service procedure can define one or more IN mode substitution parameters, and a single INOUT or OUT substitution parameter.

The following example illustrates how a client can specify the sending of several header entries with parameters and receiving the response SOAP header data:

```
CREATE PROCEDURE soap_client
  (INOUT hd1 LONG VARCHAR, IN hd2 LONG VARCHAR, IN hd3 LONG VARCHAR)
  URL 'localhost/some_endpoint'
  SOAPHEADER '!hd1!hd2!hd3';
```

For more information about using SOAP headers, see “Tutorial: Using SQL Anywhere to access a SOAP/DISH service” on page 830.

For more information about substitution parameters, see “HTTP and SOAP request structures” on page 821.

NAMESPACE clause (SOAP format only) This clause identifies the method namespace usually required for both SOAP:RPC and SOAP:DOC requests. The SOAP server handling the request uses this namespace to interpret the names of the entities in the SOAP request message body. The namespace can be obtained from the WSDL (Web Services Description Language) of the SOAP service available from the web service server. The default value is the procedure's URL, up to but not including the optional path component. For more information about using SOAP namespaces, see “Working with structured data types (SOAP only)” on page 815.

For more information about creating web services, including examples, see "Using SQL Anywhere as an HTTP web server" on page 727.

Remarks

Parameter values are passed as part of the request. The syntax used depends on the type of request. For HTTP:GET, the parameters are passed as part of the URL; for HTTP:POST requests, the values are placed in the body of the request. Parameters to SOAP requests are always bundled in the request body.

Permissions

Must have RESOURCE authority.

Must have DBA authority to create a procedure for another user.

Side effects

Automatic commit.

See also

- "ALTER PROCEDURE statement" [*SQL Anywhere Server - SQL Reference*]
- "CALL statement" [*SQL Anywhere Server - SQL Reference*]
- "CREATE FUNCTION statement" [*SQL Anywhere Server - SQL Reference*]
- "CREATE FUNCTION statement (web clients)" [*SQL Anywhere Server - SQL Reference*]
- "CREATE PROCEDURE statement" [*SQL Anywhere Server - SQL Reference*]
- "DROP PROCEDURE statement" [*SQL Anywhere Server - SQL Reference*]
- "GRANT statement" [*SQL Anywhere Server - SQL Reference*]
- "Using SQL Anywhere as an HTTP web server" on page 727
- "Developing web client applications" on page 778
- "remote_idle_timeout option" [*SQL Anywhere Server - Database Administration*]

Standards and compatibility

- **SQL/2008** Vendor extension.
- **Transact-SQL** Not supported by Adaptive Server Enterprise.

Example

The following example creates a web services client procedure named FtoC.

```
CREATE PROCEDURE FtoC( IN temperature FLOAT,
    INOUT inoutheader LONG VARCHAR,
    IN inheader LONG VARCHAR )
  URL 'http://localhost:8082/FtoCService'
  TYPE 'SOAP:DOC'
  SOAPHEADER '!inoutheader!inheader';
```

Supplying variables to a web service

Variables can be supplied to a web service in various ways depending on the web service type.

Web client applications can supply variables to general HTTP web services using any of the following approaches:

- The suffix of the URL
- The body of an HTTP request

Variables can be supplied to the **SOAP** service type by including them as part of a standard SOAP envelope.

For more information on supported web service types, see "Choosing a web service type" on page 732.

Supplying variables in the URL to a web service

The HTTP web server can manage variables supplied in the URL by web browsers. These variables can be expressed in any of the following conventions:

- Appending them to the end of the URL while dividing each parameter value with a slash (/), such as in the following example:

  `http://localhost/database-name/param1/param2/param3`

- Defining them explicitly in a URL parameter list, such as in the following example:

  `http://localhost/database-name/?arg1=param1&arg2=param2&arg3=param3`

- A combination of appending them to the URL and defining them in a parameter list, such as in the following example:

  `http://localhost/database-name/param4/param5?arg1=param1&arg2=param2&arg3=param3`

The web server interpretation of the URL depends on how the web service URL clause is specified. For more information on how to specify the URL clause and the server interprets URL parameters, see "Browsing an HTTP web server" on page 770.

See also

- "CREATE SERVICE statement" on page 740
- "Accessing client-supplied HTTP variables and headers" on page 753
- "Creating and customizing a root web service" on page 738

Supplying variables in the body of an HTTP request

You can supply variables in the body of an HTTP request by specifying HTTP:POST in the TYPE clause in a web client function or procedure.

By default TYPE HTTP:POST uses application/x-www-form-urlencoded mime type. All parameters are urlencoded and passed within the body of the request. Optionally, if a media type is provided, the request Content-Type header is automatically adjusted to the provided media type and a single parameter value is uploaded within the body of the request.

Example

The following example assumes that a web service named **XMLService** exists on a **localhost** web server. Set up a SQL Anywhere client database, connect to it through Interactive SQL, and run the following SQL script:

```
CREATE PROCEDURE SendXMLContent( xmlcode LONG VARCHAR)
    URL 'http://localhost/XMLService'
    TYPE 'HTTP:POST:text/xml';
```

The script creates a procedure that allows you to send a variable in the body of an HTTP request in text/xml format.

Run the following SQL script in Interactive SQL to send an HTTP request to the **XMLService** web service:

```
CALL SendXMLContent('<title>Hello World!</title>');
```

The procedure call assigns a value to the **xmlcode** parameter and sends it to web service.

See also

- "Accessing client-supplied HTTP variables and headers" on page 753
- "CREATE PROCEDURE statement (web clients)" on page 795
- "CREATE FUNCTION statement (web clients)" on page 789

Supplying variables in a SOAP envelope

You can supply variables in a SOAP envelope using the SET SOAP option of a web client function or procedure to set a SOAP operation.

The following code illustrates how to set a SOAP operation in a web client function:

```
CREATE OR REPLACE FUNCTION soapAddItemFunction("amount" int, item long
varchar)
RETURNS XML
    URL 'http://localhost/store'
    SET 'SOAP(OP=addItems)'
    TYPE 'SOAP:DOC';
```

In this example, the **addItems** is the SOAP operation that contains the **amount** and **item** values, which are passed as parameters to the **soapAddItemFunction** function.

You can send a request by running the following sample script:

```
SELECT soapAddItemFunction(5, 'shirt');
```

A call to the **soapAddItemFunction** function call generates a SOAP envelope that looks similar to the following:

```
'<?xml version="1.0"?>
<SOAP-ENV:Envelope
  xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:m="http://localhost">
```



```
  <SOAP-ENV:Body>
    <m:addItems>
      <m:amount>5</m:amount>
      <m:item>shirt</m:item>
    </m:addItems>
  </SOAP-ENV:Body>
</SOAP-ENV:Envelope>'
```

As an alternative to the previous approach, you can create your own SOAP payload and send it to the server in an HTTP wrapper.

Variables to SOAP services must be included as part of a standard SOAP request. Values supplied using other methods are ignored.

The following code illustrates how to create an HTTP wrapper procedure that builds a customized SOAP envelope:

```
create or replace procedure addItemHttpWrapper( amount int, item long
varchar )
result(response xml)
begin
    declare payload xml;
    declare response xml;

    set payload =
'<?xml version="1.0"?>
<SOAP-ENV:Envelope
  xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:m="http://localhost">
  <SOAP-ENV:Body>
    <m:addItems>
      <m:amount>' || amount || '</m:amount>
      <m:item>' || item || '</m:item>
    </m:addItems>
  </SOAP-ENV:Body>
</SOAP-ENV:Envelope>';
    set response = httpAddItemFunction( payload );
    /* process response as demonstrated in addItemFunctionWrapper */
    select response;
end
```

The following code illustrates the web client function used to send the request:

```
create or replace function httpAddItemFunction("soapPayload" xml )
returns XML
    url 'http://localhost/store'
    type 'HTTP:POST:text/xml'
    header 'SOAPAction: "http://localhost/addItems"';
```

You can send a request by running the following sample script:

```
call addItemHttpWrapper( 5, 'shirt' );
```

Retrieving result sets from a web service

The SELECT statement can be used to retrieve values from results sets. Once retrieved, these values can be stored in tables or used to set variables.

Example

In this example, you assume that the web server returns at least two values in the result set.

Run the following SQL script to create a table with the intent of storing the values of the result set:

```
CREATE TABLE StoredResults(
     Attribute LONG VARCHAR,
     Value     LONG VARCHAR
);
```

It is assumed that the keywords, **Attribute** and **Value**, are defined in the HTTP response header fields. A **Body** attribute contains the body of the message, which is an HTML document.

Run the following SQL script to create a web client procedure:

```
CREATE PROCEDURE test( IN parm CHAR(128) )
    URL 'HTTP://localhost/test'
    TYPE 'HTTP';
```

The procedure type is HTTP, so this procedure requests a table as a result set.

Result sets can be inserted into the **StoredResults** table as follows:

```
INSERT INTO StoredResults SELECT * FROM test('Storing into a table')
    WITH (Attribute LONG VARCHAR, Value LONG VARCHAR);
```

You can add clauses according to the usual syntax of the SELECT statement. For example, if you want only a specific row of the result set you can add a WHERE clause to limit the results of the select to only one row:

```
SELECT Value
    FROM test('Calling test for the Status Code')
    WITH (Attribute LONG VARCHAR, Value LONG VARCHAR)
    WHERE Attribute = 'Status';
```

This statement selects only the status information from the result set. It can be used to verify that the call was successful.

See also

- "Web client SQL statements" on page 788
- "Accessing variables in result sets" on page 806

Accessing variables in result sets

Web service client calls can be made with stored functions or procedures. If made from a function, the return type must be of a character data type, such as CHAR, VARCHAR, or LONG VARCHAR. The body of the HTTP response is the returned value. No header information is included. Additional information about the request, including the HTTP status information, is returned by procedures. So, procedures are preferred when access to additional information is desired.

SOAP procedures

The response from a SOAP function is an XML document that contains the SOAP response.

SOAP responses are structured XML documents, so SQL Anywhere, by default, attempts to exploit this information and construct a more useful result set. Each of the top-level tags within the returned response document is extracted and used as a column name. The contents below each of these tags in the subtree is used as the row value for that column.

For example, SQL Anywhere would construct the shown data set given the following SOAP response:

```
<SOAP-ENV:Envelope
  xmlns:SOAPSDK1="http://www.w3.org/2001/XMLSchema"
  xmlns:SOAPSDK2="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:SOAPSDK3="http://schemas.xmlsoap.org/soap/encoding/"
  xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
  <SOAP-ENV:Body>
     <ElizaResponse xmlns:SOAPSDK4="SoapInterop">
        <Eliza>Hi, I'm Eliza. Nice to meet you.</Eliza>
     <ElizaResponse>
  </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Eliza
Hi, I'm Eliza. Nice to meet you.

In this example, the response document is delimited by the **ElizaResponse** tags that appear within the **SOAP-ENV:Body** tags.

Result sets have as many columns as there are top-level tags. This result set only has one column because there is only one top-level tag in the SOAP response. This single top-level tag, Eliza, becomes the name of the column.

XML processing facilities

Information within XML result sets, including SOAP responses, can be accessed using the OPENXML procedure. For more information, see “openxml system procedure” [*SQL Anywhere Server - SQL Reference*].

The following example uses the OPENXML procedure to extract portions of a SOAP response. This example uses a web service to expose the contents of the SYSWEBSERVICE table as a SOAP service:

```
CREATE SERVICE get_webservices
    TYPE 'SOAP'
    AUTHORIZATION OFF
    USER DBA
    AS SELECT * FROM SYSWEBSERVICE;
```

The following web client function, which must be created in a second SQL Anywhere database, issues a call to this web service. The return value of this function is the entire SOAP response document. The response is in the .NET **DataSet** format because **DNET** is the default SOAP service format.

```
CREATE FUNCTION get_webservices()
    RETURNS LONG VARCHAR
```

```
URL 'HTTP://localhost/get_webservices'
TYPE 'SOAP:DOC';
```

The following statement illustrates how you can use the OPENXML procedure to extract two columns of the result set. The **service_name** and **secure_required** columns indicate which SOAP services are secure and where HTTPS is required.

```
SELECT *
FROM openxml( get_webservices(), '//row' )
WITH ("Name"    char(128) 'service_name',
      "Secure?" char(1)   'secure_required' );
```

This statement works by selecting the decedents of the **row** node. The WITH clause constructs the result set based on the two elements of interest. Assuming only the **get_webservices** web service exists, this function returns the following result set:

Name	Secure?
get_webservices	N

For more information about the XML processing facilities available in SQL Anywhere, see "Using XML in the database" [*SQL Anywhere Server - SQL Usage*].

Other types of procedures

Procedures of other types return all the information about a response in a two-column result set. This result set includes the response status, header information and body. The first column, is named **Attribute** and the second is named **Value**. Both are of data type LONG VARCHAR.

The result set has one row for each of the response header fields, and a row for the HTTP status line (Status attribute) and a row for the response body (Body attribute).

The following example represents a typical response:

Attribute	Value
Status	HTTP /1.0 200 OK
Body	<!DOCTYPE HTML ... ><HTML> ... </HTML>
Content-Type	text/html
Server	GWS/2.1
Content-Length	2234
Date	Mon, 18 Oct 2004, 16:00:00 GMT

For more information, see "Accessing variables in result sets" on page 806.

Working with data types (SOAP only)

By default, the XML encoding of parameter input is string and the result set output for SOAP service formats contains no information that specifically describes the data type of the columns in the result set. For all formats, parameter data types are string. For the DNET format, within the schema section of the response, all columns are typed as string. CONCRETE and XML formats contain no data type information in the response. This default behavior can be manipulated using the DATATYPE clause.

SQL Anywhere enables data typing using the DATATYPE clause. Data type information can be included in the XML encoding of parameter input and result set output or responses for all SOAP service formats. This simplifies parameter passing from SOAP toolkits by not requiring client code to explicitly convert parameters to Strings. For example, an integer can be passed as an int. XML encoded data types enable a SOAP toolkit to parse and cast the data to the appropriate type.

When using string data types exclusively, the application needs to implicitly know the data type for every column within the result set. This is not necessary when data typing is requested of the web server. To control whether data type information is included, the DATATYPE clause can be used when the web service is defined.

Here is an example of a web service definition that enlists data typing for the result set response.

```
CREATE SERVICE "SASoapTest/EmployeeList"
    TYPE 'SOAP'
    AUTHORIZATION OFF
    SECURE OFF
    USER DBA
    DATATYPE OUT
    AS SELECT * FROM Employees;
```

In this example, data type information is requested for result set responses only since this service does not have parameters.

Data typing is applicable to all SQL Anywhere web services defined as type 'SOAP'.

Data typing of input parameters

Data typing of input parameters is supported by simply exposing the parameter data types as their true data types in the WSDL generated by the DISH service.

A typical string parameter definition (or a non-typed parameter) would look like the following:

```
<s:element minOccurs="0" maxOccurs="1" name="a_varchar" nillable="true"
type="s:string" />
```

The String parameter may be nillable, that is, it may or may not occur.

For a typed parameter such as an integer, the parameter must occur and is not nillable. The following is an example.

```
<s:element minOccurs="1" maxOccurs="1" name="an_int" nillable="false"
type="s:int" />
```

Data typing of output parameters

All SQL Anywhere web services of type 'SOAP' may expose data type information within the response data. The data types are exposed as attributes within the rowset column element.

The following is an example of a typed SimpleDataSet response from a SOAP FORMAT 'CONCRETE' web service.

```
<SOAP-ENV:Body>
  <tns:test_types_concrete_onResponse>
   <tns:test_types_concrete_onResult xsi:type='tns:SimpleDataset'>
    <tns:rowset>
      <tns:row>
       <tns:lvc xsi:type="xsd:string">Hello World</tns:lvc>
       <tns:i xsi:type="xsd:int">99</tns:i>
       <tns:ii xsi:type="xsd:long">99999999</tns:ii>
       <tns:f xsi:type="xsd:float">3.25</tns:f>
       <tns:d xsi:type="xsd:double">.555555555555555582</tns:d>
       <tns:bin xsi:type="xsd:base64Binary">AAAAZg==</tns:bin>
       <tns:date xsi:type="xsd:date">2006-05-29-04:00</tns:date>
      </tns:row>
     </tns:rowset>
   </tns:test_types_concrete_onResult>
  <tns:sqlcode>0</tns:sqlcode>
  </tns:test_types_concrete_onResponse>
</SOAP-ENV:Body>
```

The following is an example of a response from a SOAP FORMAT 'XML' web service returning the XML data as a string. The interior rowset consists of encoded XML and is presented here in its decoded form for legibility.

```
<SOAP-ENV:Body>
 <tns:test_types_XML_onResponse>
  <tns:test_types_XML_onResult xsi:type='xsd:string'>
   <tns:rowset
     xmlns:tns="http://localhost/satest/dish"
     xmlns:xsd="http://www.w3.org/2001/XMLSchema">
     xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
    <tns:row>
     <tns:lvc xsi:type="xsd:string">Hello World</tns:lvc>
     <tns:i xsi:type="xsd:int">99</tns:i>
     <tns:ii xsi:type="xsd:long">99999999</tns:ii>
     <tns:f xsi:type="xsd:float">3.25</tns:f>
     <tns:d xsi:type="xsd:double">.555555555555555582</tns:d>
     <tns:bin xsi:type="xsd:base64Binary">AAAAZg==</tns:bin>
     <tns:date xsi:type="xsd:date">2006-05-29-04:00</tns:date>
    </tns:row>
   </tns:rowset>
  </tns:test_types_XML_onResult>
  <tns:sqlcode>0</tns:sqlcode>
 </tns:test_types_XML_onResponse>
</SOAP-ENV:Body>
```

Note that, in addition to the data type information, the namespace for the elements and the XML schema provides all the information necessary for post processing by an XML parser. When no data type information exists in the result set (DATATYPE OFF or IN) then the xsi:type and the XML schema namespace declarations are omitted.

An example of a SOAP FORMAT 'DNET' web service returning a typed SimpleDataSet follows:


```
<SOAP-ENV:Body>
  <tns:test_types_dnet_outResponse>
   <tns:test_types_dnet_outResult xsi:type='sqlresultstream:SqlRowSet'>
    <xsd:schema id='Schema2'
       xmlns:xsd='http://www.w3.org/2001/XMLSchema'
       xmlns:msdata='urn:schemas-microsoft.com:xml-msdata'>
     <xsd:element name='rowset' msdata:IsDataSet='true'>
      <xsd:complexType>
       <xsd:sequence>
        <xsd:element name='row' minOccurs='0' maxOccurs='unbounded'>
         <xsd:complexType>
          <xsd:sequence>
           <xsd:element name='lvc' minOccurs='0' type='xsd:string' />
           <xsd:element name='ub' minOccurs='0' type='xsd:unsignedByte' />
           <xsd:element name='s' minOccurs='0' type='xsd:short' />
           <xsd:element name='us' minOccurs='0' type='xsd:unsignedShort' />
           <xsd:element name='i' minOccurs='0' type='xsd:int' />
           <xsd:element name='ui' minOccurs='0' type='xsd:unsignedInt' />
           <xsd:element name='l' minOccurs='0' type='xsd:long' />
           <xsd:element name='ul' minOccurs='0' type='xsd:unsignedLong' />
           <xsd:element name='f' minOccurs='0' type='xsd:float' />
           <xsd:element name='d' minOccurs='0' type='xsd:double' />
           <xsd:element name='bin' minOccurs='0' type='xsd:base64Binary' />
           <xsd:element name='bool' minOccurs='0' type='xsd:boolean' />
           <xsd:element name='num' minOccurs='0' type='xsd:decimal' />
           <xsd:element name='dc' minOccurs='0' type='xsd:decimal' />
           <xsd:element name='date' minOccurs='0' type='xsd:date' />
          </xsd:sequence>
         </xsd:complexType>
        </xsd:element>
       </xsd:sequence>
      </xsd:complexType>
     </xsd:element>
    </xsd:schema>
    <diffgr:diffgram xmlns:msdata='urn:schemas-microsoft-com:xml-msdata'
xmlns:diffgr='urn:schemas-microsoft-com:xml-diffgram-v1'>
     <rowset>
      <row>
       <lvc>Hello World</lvc>
       <ub>128</ub>
       <s>-99</s>
       <us>33000</us>
       <i>-2147483640</i>
       <ui>4294967295</ui>
       <l>-9223372036854775807</l>
       <ul>18446744073709551615</ul>
       <f>3.25</f>
       <d>.55555555555555582</d>
       <bin>QUJD</bin>
       <bool>1</bool>
       <num>123456.123457</num>
       <dc>-1.756000</dc>
       <date>2006-05-29-04:00</date>
      </row>
     </rowset>
    </diffgr:diffgram>
   </tns:test_types_dnet_outResult>
  <tns:sqlcode>0</tns:sqlcode>
  </tns:test_types_dnet_outResponse>
</SOAP-ENV:Body>
```

Mapping SQL Anywhere types to XML Schema types

SQL Anywhere type	XML Schema type	XML Example
CHAR	string	Hello World
VARCHAR	string	Hello World
LONG VARCHAR	string	Hello World
TEXT	string	Hello World
NCHAR	string	Hello World
NVARCHAR	string	Hello World
LONG NVARCHAR	string	Hello World
NTEXT	string	Hello World
UNIQUEIDENTIFIER	string	12345678-1234-5678-9012-123456789012
UNIQUEIDENTIFIERSTR	string	12345678-1234-5678-9012-123456789012
XML	This is user defined. A parameter is assumed to be valid XML representing a complex type (for example, base64Binary, SOAP array, struct).	<inputHexBinary xsi:type="xsd:hexBinary"> 414243 </inputHexBinary> (interpreted as 'ABC')
BIGINT	long	-9223372036854775807
UNSIGNED BIGINT	unsignedLong	18446744073709551615
BIT	boolean	1
VARBIT	string	11111111
LONG VARBIT	string	00000000000000001000000000000000
DECIMAL	decimal	-1.756000
DOUBLE	double	.555555555555555582
FLOAT	float	12.3456792831420898
INTEGER	int	-2147483640

SQL Anywhere type	XML Schema type	XML Example
UNSIGNED INTEGER	unsignedInt	4294967295
NUMERIC	decimal	123456.123457
REAL	float	3.25
SMALLINT	short	-99
UNSIGNED SMALLINT	unsignedShort	33000
TINYINT	unsignedByte	128
MONEY	decimal	12345678.9900
SMALLMONEY	decimal	12.3400
DATE	date	2006-11-21-05:00
DATETIME	dateTime	2006-05-21T09:00:00.000-08:00
SMALLDATETIME	dateTime	2007-01-15T09:00:00.000-08:00
TIME	time	14:14:48.980-05:00
TIMESTAMP	dateTime	2007-01-12T21:02:14.420-06:00
TIMESTAMP WITH TIME ZONE	dateTime	2007-01-12T21:02:14.420-06:00
BINARY	base64Binary	AAAAZg==
IMAGE	base64Binary	AAAAZg==
LONG BINARY	base64Binary	AAAAZg==
VARBINARY	base64Binary	AAAAZg==

When one or more parameters are of type NCHAR, NVARCHAR, LONG NVARCHAR, or NTEXT then the response output is in UTF8. If the client database uses the UTF-8 character encoding, there is no change in behavior (since NCHAR and CHAR data types are the same). However, if the database does not use the UTF-8 character encoding, then all parameters that are not an NCHAR data type are converted to UTF8. The value of the XML declaration encoding and Content-Type HTTP header will correspond to the character encoding used.

Mapping XML Schema types to Java types

XML Schema Type	Java Data Type
xsd:string	java.lang.String
xsd:integer	java.math.BigInteger
xsd:int	int
xsd:long	long
xsd:short	short
xsd:decimal	java.math.BigDecimal
xsd:float	float
xsd:double	double
xsd:boolean	boolean
xsd:byte	byte
xsd:QName	javax.xml.namespace.QName
xsd:dateTime	javax.xml.datatype.XMLGregorianCalendar
xsd:base64Binary	byte[]
xsd:hexBinary	byte[]
xsd:unsignedInt	long
xsd:unsignedShort	int
xsd:unsignedByte	short
xsd:time	javax.xml.datatype.XMLGregorianCalendar
xsd:date	javax.xml.datatype.XMLGregorianCalendar
xsd:g	javax.xml.datatype.XMLGregorianCalendar
xsd:anySimpleType	java.lang.Object
xsd:anySimpleType	java.lang.String
xsd:duration	javax.xml.datatype.Duration

XML Schema Type	Java Data Type
xsd:NOTATION	javax.xml.namespace.QName

Working with structured data types (SOAP only)

XML return values

The SQL Anywhere server as a web service client may interface to a web service using a function or a procedure.

A string representation within a result set may suffice for simple return data types. The use of a stored procedure may be warranted in this case.

The use of web service functions are a better choice when returning complex data such as arrays or structures. For function declarations, the RETURN clause can specify an XML data type. The returned XML can be parsed using OPENXML to extract the elements of interest.

Note that a return of XML data such as dateTime will be rendered within the result set verbatim. For example, if a TIMESTAMP column was included within a result set, it would be formatted as an XML dateTime string (2006-12-25T12:00:00.000-05:00) not as a string (2006-12-25 12:00:00.000).

XML parameter values

The SQL Anywhere XML data type is supported for use as a parameter within web service functions and procedures. For simple types, the parameter element is automatically constructed when generating the SOAP request body. However, for XML parameter types, this cannot be done since the XML representation of the element may require attributes that provide additional data. Therefore, when generating the XML for a parameter whose data type is XML, the root element name must correspond to the parameter name.

```
<inputHexBinary xsi:type="xsd:hexBinary">414243</inputHexBinary>
```

The XML type demonstrates how to send a parameter as a hexBinary XML type. The SOAP endpoint expects that the parameter name (or in XML terms, the root element name) is "inputHexBinary".

Cookbook constants

Knowledge of how SQL Anywhere references namespaces is required to construct complex structures and arrays. The prefixes listed here correspond to the namespace declarations generated for a SQL Anywhere SOAP request envelope.

SQL Anywhere XML Prefix	Namespace
xsd	http://www.w3.org/2001/XMLSchema
xsi	http://www.w3.org/2001/XMLSchema-instance
SOAP-ENC	http://schemas.xmlsoap.org/soap/encoding/

SQL Anywhere XML Prefix	Namespace
m	namespace as defined in the NAMESPACE clause

Complex data type examples

The following three examples demonstrate how to create web service client functions taking parameters that represent an array, a structure, and an array of structures. The web service functions will communicate to SOAP operations (or RPC function names) named echoFloatArray, echoStruct, and echoStructArray respectively. The common namespace used for Interoperability testing is http://soapinterop.org/, allowing a given function to test against alternative Interoperability servers simply by changing the URL clause to the chosen SOAP endpoint.

The examples are designed to issue requests to the Microsoft SOAP ToolKit 3.0 Round 2 Interoperability test server at http://mssoapinterop.org/stkV3.

All the examples use a table to generate the XML data. The following shows how to set up that table.

```
CREATE LOCAL TEMPORARY TABLE SoapData
(
    seqno INT DEFAULT AUTOINCREMENT,
    i INT,
    f FLOAT,
    s LONG VARCHAR
) ON COMMIT PRESERVE ROWS;

INSERT INTO SoapData (i,f,s)
VALUES (99,99.999,'Ninety-Nine');

INSERT INTO SoapData (i,f,s)
VALUES (199,199.999,'Hundred and Ninety-Nine');
```

The following three functions send SOAP requests to the Interoperability server. Note that this sample issues requests to the Microsoft Interop server:

```
CALL sa_make_object('function', 'echoFloatArray');
ALTER FUNCTION echoFloatArray( inputFloatArray XML )
RETURNS XML
URL 'http://mssoapinterop.org/stkV3/Interop.wsdl'
HEADER 'SOAPAction:"http://soapinterop.org/"'
NAMESPACE 'http://soapinterop.org/';

CALL sa_make_object('function', 'echoStruct');
ALTER FUNCTION echoStruct( inputStruct XML )
RETURNS XML
URL 'http://mssoapinterop.org/stkV3/Interop.wsdl'
HEADER 'SOAPAction:"http://soapinterop.org/"'
NAMESPACE 'http://soapinterop.org/';

CALL sa_make_object('function', 'echoStructArray');
ALTER FUNCTION echoStructArray( inputStructArray XML )
RETURNS XML
URL 'http://mssoapinterop.org/stkV3/Interop.wsdl'
HEADER 'SOAPAction:"http://soapinterop.org/"'
NAMESPACE 'http://soapinterop.org/';
```

Finally, the three example statements along with the XML representation of their parameters are presented:

1. The parameters in the following example represent an array.

```
SELECT echoFloatArray(
    XMLELEMENT( 'inputFloatArray',
       XMLATTRIBUTES( 'xsd:float[]' as "SOAP-ENC:arrayType" ),
        (
        SELECT XMLAGG( XMLELEMENT( 'number', f ) ORDER BY seqno )
        FROM SoapData
        )
    )
);
```

   The stored procedure echoFloatArray will send the following XML to the Interoperability server.

```
<inputFloatArray SOAP-ENC:arrayType="xsd:float[2]">
<number>99.9990005493164</number>
<number>199.998992919922</number>
</inputFloatArray>
```

   The response from the Interoperability server is shown below.

```
'<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<SOAP-ENV:Envelope
  xmlns:SOAPSDK1="http://www.w3.org/2001/XMLSchema"
  xmlns:SOAPSDK2="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:SOAPSDK3="http://schemas.xmlsoap.org/soap/encoding/"
  xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
  <SOAP-ENV:Body
    SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/">
    <SOAPSDK4:echoFloatArrayResponse
      xmlns:SOAPSDK4="http://soapinterop.org/">
      <Result SOAPSDK3:arrayType="SOAPSDK1:float[2]"
        SOAPSDK3:offset="[0]"
        SOAPSDK2:type="SOAPSDK3:Array">
        <SOAPSDK3:float>99.9990005493164</SOAPSDK3:float>
        <SOAPSDK3:float>199.998992919922</SOAPSDK3:float>
      </Result>
    </SOAPSDK4:echoFloatArrayResponse>
  </SOAP-ENV:Body>
</SOAP-ENV:Envelope>'
```

   If the response was stored in a variable, then it can be parsed using OPENXML.

```
SELECT * FROM openxml( resp,'//*:Result/*' )
WITH ( varFloat FLOAT 'text()' );
```

varFloat
99.9990005493
199.9989929199

2. The parameters in the following example represent a structure.

```
SELECT echoStruct(
    XMLELEMENT('inputStruct',
        (
        SELECT XMLFOREST( s as varString,
                          i as varInt,
                          f as varFloat )
```

```
        FROM SoapData
        WHERE seqno=1
        )
    )
);
```

The stored procedure echoStruct will send the following XML to the Interoperability server.

```
<inputStruct>
  <varString>Ninety-Nine</varString>
  <varInt>99</varInt>
  <varFloat>99.9990005493164</varFloat>
</inputStruct>
```

The response from the Interoperability server is shown below.

```
'<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<SOAP-ENV:Envelope
  xmlns:SOAPSDK1="http://www.w3.org/2001/XMLSchema"
  xmlns:SOAPSDK2="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:SOAPSDK3="http://schemas.xmlsoap.org/soap/encoding/"
  xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
  <SOAP-ENV:Body
    SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/">
    <SOAPSDK4:echoStructResponse
      xmlns:SOAPSDK4="http://soapinterop.org/">
      <Result href="#id1"/>
    </SOAPSDK4:echoStructResponse>
    <SOAPSDK5:SOAPStruct
      xmlns:SOAPSDK5="http://soapinterop.org/xsd"
      id="id1"
      SOAPSDK3:root="0"
      SOAPSDK2:type="SOAPSDK5:SOAPStruct">
      <varString>Ninety-Nine</varString>
      <varInt>99</varInt>
      <varFloat>99.9990005493164</varFloat>
    </SOAPSDK5:SOAPStruct>
  </SOAP-ENV:Body>
</SOAP-ENV:Envelope>'
```

If the response was stored in a variable, then it can be parsed using OPENXML.

```
SELECT * FROM openxml( resp,'//*:Body/*:SOAPStruct' )
WITH (
varString LONG VARCHAR 'varString',
varInt INT 'varInt',
varFloat FLOAT 'varFloat' );
```

varString	varInt	varFloat
Ninety-Nine	99	99.9990005493

3. The parameters in the following example represent an array of structures.

```
SELECT echoStructArray(
    XMLELEMENT( 'inputStructArray',
        XMLATTRIBUTES( 'http://soapinterop.org/xsd' AS "xmlns:q2",
                       'q2:SOAPStruct[2]' AS "SOAP-ENC:arrayType" ),
            (
            SELECT XMLAGG(
```



```
                XMLElement('q2:SOAPStruct',
                XMLFOREST( s as varString,
                           i as varInt,
                           f as varFloat )
                )
            ORDER BY seqno
            )
        FROM SoapData
        )
    )
);
```

The stored procedure echoFloatArray will send the following XML to the Interoperability server.

```
<inputStructArray xmlns:q2="http://soapinterop.org/xsd"
  SOAP-ENC:arrayType="q2:SOAPStruct[2]">
  <q2:SOAPStruct>
    <varString>Ninety-Nine</varString>
    <varInt>99</varInt>
    <varFloat>99.9990005493164</varFloat>
  </q2:SOAPStruct>
  <q2:SOAPStruct>
    <varString>Hundred and Ninety-Nine</varString>
    <varInt>199</varInt>
    <varFloat>199.998992919922</varFloat>
  </q2:SOAPStruct>
</inputStructArray>
```

The response from the Interoperability server is shown below.

```
'<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<SOAP-ENV:Envelope
  xmlns:SOAPSDK1="http://www.w3.org/2001/XMLSchema"
  xmlns:SOAPSDK2="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:SOAPSDK3="http://schemas.xmlsoap.org/soap/encoding/"
  xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
  <SOAP-ENV:Body
    SOAP-ENV:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/">
    <SOAPSDK4:echoStructArrayResponse
      xmlns:SOAPSDK4="http://soapinterop.org/">
      <Result xmlns:SOAPSDK5="http://soapinterop.org/xsd"
        SOAPSDK3:arrayType="SOAPSDK5:SOAPStruct[2]"
        SOAPSDK3:offset="[0]" SOAPSDK2:type="SOAPSDK3:Array">
        <SOAPSDK5:SOAPStruct href="#id1"/>
        <SOAPSDK5:SOAPStruct href="#id2"/>
      </Result>
    </SOAPSDK4:echoStructArrayResponse>
    <SOAPSDK6:SOAPStruct
      xmlns:SOAPSDK6="http://soapinterop.org/xsd"
      id="id1"
      SOAPSDK3:root="0"
      SOAPSDK2:type="SOAPSDK6:SOAPStruct">
      <varString>Ninety-Nine</varString>
      <varInt>99</varInt>
      <varFloat>99.9990005493164</varFloat>
    </SOAPSDK6:SOAPStruct>
    <SOAPSDK7:SOAPStruct
      xmlns:SOAPSDK7="http://soapinterop.org/xsd"
      id="id2"
      SOAPSDK3:root="0"
      SOAPSDK2:type="SOAPSDK7:SOAPStruct">
      <varString>Hundred and Ninety-Nine</varString>
      <varInt>199</varInt>
```

```
      <varFloat>199.998992919922</varFloat>
    </SOAPSDK7:SOAPStruct>
  </SOAP-ENV:Body>
</SOAP-ENV:Envelope>'
```

If the response was stored in a variable, then it can be parsed using OPENXML.

```
SELECT * FROM openxml( resp,'//*:Body/*:SOAPStruct' )
WITH (
varString LONG VARCHAR 'varString',
varInt INT 'varInt',
varFloat FLOAT 'varFloat' );
```

varString	varInt	varFloat
Ninety-Nine	99	99.9990005493
Hundred and Ninety-Nine	199	199.9989929199

Using substitution parameters for clause values

Declared parameters to a stored procedure or function are automatically substituted for place holders within a clause definition each time the stored procedure or function is run. Substitution parameters allow the creation of general web service procedures that dynamically configure clauses at run time. Any substrings that contain an exclamation mark '!' followed by the name of one of the declared parameters is replaced by that parameter's value. In this way one or more parameter values may be substituted to derive one or more clause values at runtime.

Parameter substitution requires adherence to the following rules:

- All parameters used for substitution must be alphanumeric. Underscores are not allowed.
- A substitution parameter must be followed immediately by a non-alphanumeric character or termination. For example, **!sizeXL** is not substituted with the value of a parameter named size because X is alphanumeric.
- A substitution parameter that is not matched to a parameter name is ignored.
- An exclamation mark (!) can be escaped with another exclamation mark.

For example, the following procedure illustrates the use of parameter substitution. URL and HTTP header definitions must be passed as parameters.

```
CREATE PROCEDURE test( uid CHAR(128), pwd CHAR(128), headers LONG VARCHAR )
    URL 'HTTP://!uid:!pwd@localhost/myservice';
    HEADER '!headers';
```

You can then use the following statement to call the **test** procedure and initiate an HTTP request:

```
CALL test('dba', 'sql', 'NewHeader1:value1\nNewHeader2:value2');
```

Different values can be used each time this procedure is called.

Encryption certificate example

You can use parameter substitution to pass encryption certificates from a file and pass them to a stored procedure or stored function.

The following example illustrates how to pass a certificate as a substitution string:

```
CREATE PROCEDURE secure( cert LONG VARCHAR )
URL 'https://localhost/secure'
TYPE 'HTTP:GET'
CERTIFICATE 'cert=!cert;company=test;unit=test;name=RSA Server';
```

The certificate is read from a file in the following call.

```
CALL secure( xp_read_file('install-dir\bin32\rsaserver.id') );
```

This example is for illustration only. The certificate can be read directly from a file using the **file=** keyword for the CERTIFICATE clause.

No matching parameter name example

Placeholders with no matching parameter name are automatically deleted.

For example, the parameter size would not be substituted for the placeholder in the following procedure:

```
CREATE PROCEDURE orderitem ( size CHAR(18) )
    URL 'HTTP://localhost/salesserver/order?size=!sizeXL'
    TYPE 'SOAP:RPC';
```

In this example, **!sizeXL** is always deleted because it is a placeholder for which there is no matching parameter.

Parameters can be used to replace placeholders within the body of the stored function or stored procedure at the time the function or procedure is called. If placeholders for a particular variable do not exist, the parameter and its value are passed as part of the request. Parameters and values used for substitution in this manner are not passed as part of the request.

HTTP and SOAP request structures

All parameters to a function or procedure, unless used during parameter substitution, are passed as part of the web service request. The format in which they are passed depends on the type of the web service request. For more information about substitution parameters, see “Using substitution parameters for clause values” on page 820.

Parameter values that are not of character or binary data types are converted to a string representation before being added to the request. This process is equivalent to casting the value to a character type. The conversion is done in accordance with the data type formatting option settings at the time the function or procedure is invoked. In particular, the conversion can be affected by such options as precision, scale, and timestamp_format.

HTTP request structures

Parameters for type HTTP:GET are URL encoded and placed within the URL. Parameter names are used verbatim as the name for HTTP variables. For example, the following procedure declares two parameters:

```
CREATE PROCEDURE test ( a INTEGER, b CHAR(128) )
    URL 'HTTP://localhost/myservice'
    TYPE 'HTTP:GET';
```

If this procedure is invoked with the two values 123 and 'xyz', then the URL used for the request is equivalent to that shown below:

```
HTTP://localhost/myservice?a=123&b=xyz
```

If the type is HTTP:POST, the parameters and their values are URL encoded and placed within the body of the request. After the headers, the following text appears in the body of the HTTP request for the two parameter and values:

```
a=123&b=xyz
```

SOAP request structures

Parameters passed to SOAP requests are bundled as part of the request body, as required by the SOAP specification:

```
<SOAP-ENV:Envelope
  xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:m="http://localhost">
  <SOAP-ENV:Body>
    <m:test>
      <m:a>123</m:a>
      <m:b>abc</m:b>
    </m:test>
  </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Logging web client information to the web server

Web service client information, including HTTP requests and transport data, can be logged to the web service client log file, and can be enabled by starting the web server with the -zoc server option or by setting the WebClientLogging server property using the sa_server_option system procedure.

See also

- "-zoc dbeng12/dbsrv12 server option" [*SQL Anywhere Server - Database Administration*]
- "sa_server_option system procedure" [*SQL Anywhere Server - SQL Reference*]

Web services references

This section provides information on web service references.

iAnywhere WSDL compiler utility (wsdlc)

The iAnywhere WSDL compiler generates a set of Java proxy classes, C# proxy classes, or SQL SOAP client procedures for SQL Anywhere that you include in your application when given a WSDL source that describes a web service.

Syntax

wsdlc [*options*] *wsdl-uri*

wsdl-uri

This is the specification for the WSDL (Web Services Description Language) source (a URL or file).

Options

- **-h** Display help text.
- **-v** Display verbose information.
- **-o *output-directory*** Specify an output directory for generated files.
- **-l *language*** Specify a language for the generated files. This is one of **java**, **cs** (for C#), or **sql**. These options must be specified in lowercase letters.
- **-d** Display debug information that may be helpful when contacting iAnywhere customer support.

Java-specific options

- **-p *package*** Specify a package name. This permits you to override the default package name.

C#-specific options

- **-n *namespace*** Specify a namespace. This permits you to wrap the generated classes in a namespace of your choosing.

SQL-specific options

- **-f *filename*** (Required) Specify the name of the output SQL file to which the SQL statements are written. This operation overwrites any existing file of the same name.
- **-p=*prefix*** Specify a prefix for the generated function or procedure names. The default prefix is the service name followed by a period (for example, "WSDish.").
- **-x** Generate procedure definitions rather than function definitions.

WSDLC does not expand complex parameters representing structures or arrays. Such parameters are commented out to allow the database server to automatically create the given procedure or function without modification. However, in order for the SOAP operation to work, such parameters must be analyzed and manually composed. The process may require using the SQL Anywhere XMLELEMENT function with the XMLATTRIBUTES parameter to generate complex XML representations of structures.

Remarks

The Java or C# classes generated by the WSDL compiler are intended for use with QAnywhere. These classes expose web service operations such as method calls. The classes that are generated are:

- The main service binding class (this class inherits from ianywhere.qanywhere.ws.WSBase in the mobile web services runtime).
- A proxy class for each complex type specified in the WSDL file.

For information about the generated proxy classes, see:

The WSDL compiler supports WSDL 1.1 and SOAP 1.1 over HTTP and HTTPS.

See also

- "Using the XMLELEMENT function" [*SQL Anywhere Server - SQL Usage*]
- "QAnywhere .NET API reference for web services" [*QAnywhere*]
- "QAnywhere Java API reference for web services" [*QAnywhere*]

Web service error code reference

The HTTP server generates standard web service errors when requests fail. These errors are assigned numbers consistent with protocol standards.

The following are some typical errors that you may encounter:

Number	Name	SOAP fault	Description
301	Moved permanently	Server	The requested page has been permanently moved. The server automatically redirects the request to the new location.
304	Not Modified	Server	The server has decided, based on information in the request, that the requested data has not been modified since the last request and so it does not need to be sent again.
307	Temporary Redirect	Server	The requested page has been moved, but this change may not be permanent. The server automatically redirects the request to the new location.
400	Bad Request	Client.BadRequest	The HTTP request is incomplete or malformed.
401	Authorization Required	Client.Authorization	Authorization is required to use the service, but a valid user name and password were not supplied.

Number	Name	SOAP fault	Description
403	Forbidden	Client.Forbidden	You do not have permission to access the database.
404	Not Found	Client.NotFound	The named database is not running on the server, or the named web service does not exist.
408	Request Timeout	Server.RequestTimeout	The maximum connection idle time was exceeded while receiving the request.
411	HTTP Length Required	Client.LengthRequired	The server requires that the client include a Content-Length specification in the request. This typically occurs when uploading data to the server.
413	Entity Too Large	Server	The request exceeds the maximum permitted size.
414	URI Too Large	Server	The length of the URI exceeds the maximum allowed length.
500	Internal Server Error	Server	An internal error occurred. The request could not be processed.
501	Not Implemented	Server	The HTTP request method is not GET, HEAD, or POST.
502	Bad Gateway	Server	The document requested resides on a third-party server and the server received an error from the third-party server.
503	Service Unavailable	Server	The number of connections exceeds the allowed maximum.

Faults are returned to the client as SOAP faults as defined by the following the SOAP version 1.1 standards when a SOAP service fails:

- When an error in the application handling the request generates a SQLCODE, a SOAP Fault is returned with a faultcode of Client, possibly with a sub-category, such as Procedure. The faultstring element within the SOAP Fault is set to a detailed explanation of the error and a detail element contains the numeric SQLCODE value.
- In the event of a transport protocol error, the faultcode is set to either Client or Server, depending on the error, faultstring is set to the HTTP transport message, such as `404 Not Found`, and the detail element contains the numeric HTTP error value.

- SOAP Fault messages generated due to application errors that return a SQLCODE value are returned with an HTTP status of `200 OK`.

The appropriate HTTP error is returned in a generated HTML document if the client cannot be identified as a SOAP client.

HTTP web service examples

Several sample implementations of web services are located in the *samples-dir\SQLAnywhere\HTTP* directory. For more information about the samples, see *samples-dir\SQLAnywhere\HTTP\readme.txt*.

Tutorial: Working with MIME types in a RAW service

This tutorial illustrates how to create a web server that tests the MIME-type setting specified by a web client application.

Required software

- SQL Anywhere 12

Competencies and experience

- Familiarity with XML
- Familiarity with MIME types
- Basic knowledge of SQL Anywhere web services

Goals

- Create and start a new SQL Anywhere web server database.
- Create a RAW web service.
- Set up a procedure that returns the information contained in HTTP requests.
- Create and start a new SQL Anywhere web client database.
- Send an HTTP:POST request of the xml/text MIME-type from the web client to the database server.
- Send an HTTP response in XML format from the database server to the web client.

Suggested background reading

- "CREATE PROCEDURE statement (web clients)" [*SQL Anywhere Server - SQL Reference*]
- "CREATE FUNCTION statement (web clients)" [*SQL Anywhere Server - SQL Reference*]
- "Using SQL Anywhere as an HTTP web server" on page 727

Lesson 1: Set up a web server database to receive RAW requests and send RAW responses

In this lesson, you set up a SQL Anywhere web service server running a web service that tests the MIME-type setting of a web client.

To set up a database server for receiving RAW requests and sending RAW responses

1. Run the following command to create a SQL Anywhere database:

   ```
   dbinit echo
   ```

2. Start the network database server using the following command:

   ```
   dbsrv12 -xs http(port=8082) -n echo echo.db
   ```

   This command indicates that the HTTP web server should listen on port 8082 for requests. Use a different port number if 8082 is disallowed on your network.

3. Connect to the database server in Interactive SQL using the following command:

   ```
   dbisql -c "UID=DBA;PWD=sql;SERVER=echo"
   ```

4. Create a new SOAP service to accept incoming requests.

   Run the following SQL script in Interactive SQL:

   ```
   CREATE SERVICE EchoService
   TYPE 'RAW'
   USER DBA
   AUTHORIZATION OFF
   SECURE OFF
   AS CALL Echo(:valueAsXML);
   ```

   This script creates a new SOAP service named **EchoService** that generates a RAW type as output. It calls a stored procedure named **Echo** when a web client sends a request to the service. You create the **Echo** procedure in the next step.

5. Create the **Echo** procedure to handle incoming requests. This procedure returns the body of the request.

   Run the following SQL script in Interactive SQL:

   ```
   CREATE PROCEDURE Echo( text LONG VARCHAR )
   BEGIN
       DECLARE body LONG VARCHAR;
       SET body = isnull( http_variable('text'), http_variable('body') );
       IF body IS NULL THEN
           SELECT 'failed';
       ELSE
           SELECT body;
       END IF;
   END;
   ```

See also

- "CREATE SERVICE statement" [*SQL Anywhere Server - SQL Reference*]
- "CREATE PROCEDURE statement (web clients)" [*SQL Anywhere Server - SQL Reference*]

Lesson 2: Set up a web client database to send RAW requests and receive RAW responses

In this lesson, you set up a MIME-type on a new web client. This lesson assumes that you have set up a web server database as instructed in the previous lesson. For more information about setting up a database server to receive the requests from the web client described in this lesson, see "Lesson 1: Set up a web server database to receive RAW requests and send RAW responses" on page 827.

To set up a database client for sending RAW requests and receiving RAW responses

1. Run the following command to create a SQL Anywhere database:

   ```
   dbinit echo_client
   ```

2. Start the personal database client using the following command:

   ```
   dbsrv12 echo_client.db
   ```

3. Connect to the database in Interactive SQL using the following command:

   ```
   dbisql -c "UID=DBA;PWD=sql;SERVER=echo_client"
   ```

4. Create a new stored procedure to send requests to a web service.

   Run the following SQL script in Interactive SQL:

   ```
   CREATE PROCEDURE setMIME(
       value LONG VARCHAR,
       mimeType LONG VARCHAR,
       urlSpec LONG VARCHAR
   )
   URL '!urlSpec'
   TYPE 'HTTP:POST:!mimeType';
   ```

   In the next lesson, the web client passes the necessary variables to the **setMIME** procedure, which requires three parameters. The **urlSpec** parameter indicates which URL to use to connect to the web service, the **mimeType** indicates which MIME-type to use for the HTTP:POST type, and the **value** parameter represents the body of the request that should be returned by the web service.

Note
The server sets the default TYPE to SOAP:RPC when the clause is not specified, which does not support custom MIME-types. For more information about the TYPE clause, see "CREATE PROCEDURE statement (web clients)" [*SQL Anywhere Server - SQL Reference*].

Lesson 3: Send a RAW request and receive a RAW response

In this lesson, you call the wrapper procedure created in the previous lesson, which sends a request to the web server database you created in lesson one. For more information about setting up a web client

database to send the requests described in this lesson, see "Lesson 2: Set up a web client database to send RAW requests and receive RAW responses" on page 828.

Note
This lesson contains several references to **localhost**. Use the IP address of the server database from lesson 1 instead of **localhost** if you are not running the web client on the same computer as the server database.

To send a request

1. Connect to the client database in Interactive SQL if it is not already open from lesson two.

   ```
   dbisql -c "UID=DBA;PWD=sql;SERVER=echo_client"
   ```

2. Call the wrapper procedure to send the request and obtain the response.

   Run the following SQL script in Interactive SQL:

   ```
   CALL setMIME('<hello>this is xml</hello>',
       'text/xml',
       'http://localhost:8082/EchoService'
   );
   ```

   The **http://localhost:8082/EchoService** variable indicates that the database server runs on **localhost** and listens on port 8082. The desired SOAP web service is named **EchoService**.

The following result set is displayed in Interactive SQL:

Attribute	Value
Status	HTTP/1.1 200 OK
Body	<hello>this is xml</hello>
Date	Thu, 04 Feb 2010 13:37:23 GMT
Connection	close
Expires	Thu, 04 Feb 2010 13:37:23 GMT
Content-Type	text/plain; charset=windows-1252
Server	SQLAnywhere/12.0.0.1234

The following is representative of the HTTP packet that is sent to the web server:

```
POST /EchoService HTTP/1.0
Date: Thu, 04 Feb 2010 13:37:23 GMT
Host: localhost
Accept-Charset: windows-1252, UTF-8, *
User-Agent: SQLAnywhere/12.0.0.1234
Content-Type: text/xml; charset=windows-1252
Content-Length: 49
ASA-Id: 1055532613:echo_client:echo:968000
```

```
Connection: close

valueAsXML=<hello>this is xml</hello>
```

The following is the response from the web server:

```
HTTP/1.1 200 OK
Server: SQLAnywhere/12.0.0.1234
Date: Thu, 04 Feb 2010 13:37:23 GMT
Expires: Thu, 04 Feb 2010 13:37:23 GMT
Content-Type: text/plain; charset=windows-1252
Connection: close

<hello>this is xml</hello>
```

Tutorial: Using SQL Anywhere to access a SOAP/DISH service

This tutorial illustrates how to create a SOAP server that converts a web client-supplied Fahrenheit value to Celsius.

Required software

- SQL Anywhere 12

Competencies and experience

- Familiarity with SOAP
- Basic knowledge of SQL Anywhere web services

Goals

- Create and start a new SQL Anywhere web server database.
- Create a SOAP web service.
- Set up a procedure that converts a client-supplied Fahrenheit value to a Celsius value.
- Create and start a new SQL Anywhere web client database.
- Send a SOAP request from the web client to the database server.
- Send a SOAP response from the database server to the web client.

Suggested background reading

- "CREATE PROCEDURE statement (web clients)" [*SQL Anywhere Server - SQL Reference*]
- "CREATE FUNCTION statement (web clients)" [*SQL Anywhere Server - SQL Reference*]
- "Using SQL Anywhere as an HTTP web server" on page 727

Lesson 1: Set up a web server database to receive SOAP requests and send SOAP responses

In this lesson, you set up a new database server and create a SOAP service to handle incoming SOAP requests. The server anticipates SOAP requests that provide a Fahrenheit value that needs to be converted to Celsius.

To set up a database server for receiving SOAP requests and sending SOAP responses

1. Run the following command to create a SQL Anywhere database:

   ```
   dbinit ftc
   ```

2. Start the network database server using the following command:

   ```
   dbsrv12 -xs http(port=8082) -n ftc ftc.db
   ```

   This command indicates that the HTTP web server should listen on port 8082 for requests. Use a different port number if 8082 is disallowed on your network.

3. Connect to the database server in Interactive SQL using the following command:

   ```
   dbisql -c "UID=DBA;PWD=sql;SERVER=ftc"
   ```

4. Create a new SOAP service to accept incoming requests.

   Run the following SQL script in Interactive SQL:

   ```
   CREATE SERVICE FtoCService
       TYPE 'SOAP'
       FORMAT 'XML'
       AUTHORIZATION OFF
       USER DBA
       AS CALL FToCConvertor( :temperature );
   ```

   This script creates a new SOAP service named **FtoCService** that generates XML-formatted strings as output. It calls a stored procedure named **FToCConvertor** when a web client sends a SOAP request to the service. You create the **FToCConvertor** procedure in the next step.

5. Create the **FToCConvertor** procedure to handle incoming SOAP requests. This procedure performs the necessary calculations to convert a client-supplied Fahrenheit value to a Celsius value.

   Run the following SQL script in Interactive SQL:

   ```
   CREATE PROCEDURE FToCConvertor( temperature FLOAT )
   BEGIN
       DECLARE hd_key LONG VARCHAR;
       DECLARE hd_entry LONG VARCHAR;
       DECLARE alias LONG VARCHAR;
       DECLARE first_name LONG VARCHAR;
       DECLARE last_name LONG VARCHAR;
       DECLARE xpath LONG VARCHAR;
       DECLARE authinfo LONG VARCHAR;
       DECLARE namespace LONG VARCHAR;
       DECLARE mustUnderstand LONG VARCHAR;
   header_loop:
   ```

```
        LOOP
            SET hd_key = NEXT_SOAP_HEADER( hd_key );
            IF hd_key IS NULL THEN
                -- no more header entries
                LEAVE header_loop;
            END IF;
            IF hd_key = 'Authentication' THEN
                SET hd_entry = SOAP_HEADER( hd_key );
                SET xpath = '/*:' || hd_key || '/*:userName';
                SET namespace = SOAP_HEADER( hd_key, 1, '@namespace' );
                SET mustUnderstand = SOAP_HEADER( hd_key, 1,
    'mustUnderstand' );
                BEGIN
                    -- parse the XML returned in the SOAP header
                    DECLARE crsr CURSOR FOR
                        SELECT * FROM OPENXML( hd_entry, xpath )
                            WITH ( alias LONG VARCHAR '@*:alias',
                                first_name LONG VARCHAR '*:first/text()',
                                last_name LONG VARCHAR '*:last/text()' );
                    OPEN crsr;
                    FETCH crsr INTO alias, first_name, last_name;
                    CLOSE crsr;
                END;

                -- build a response header
                -- based on the pieces from the request header
                SET authinfo =
                    XMLELEMENT( 'Authentication',
                        XMLATTRIBUTES(
                            namespace as xmlns,
                            alias,
                            mustUnderstand ),
                            XMLELEMENT( 'first', first_name ),
                            XMLELEMENT( 'last', last_name ) );
                CALL SA_SET_SOAP_HEADER( 'authinfo', authinfo );
            END IF;
        END LOOP header_loop;
        SELECT ROUND((temperature - 32.0) * 5.0 / 9.0, 5) AS answer;
    END;
```

The NEXT_SOAP_HEADER function is used in a LOOP structure to iterate through all the header names in a SOAP request, and exits the loop when the NEXT_SOAP_HEADER function returns NULL.

Note
This function does not necessarily iterate through the headers in the order that they appear in the SOAP request.

The SOAP_HEADER function returns the header value or NULL when the header name does not exist. The **FToCConvertor** procedure searches for a header named **Authentication** and extracts the header structure, including the **@namespace** and **mustUnderstand** attributes.

The following is an XML string representation of a possible **Authentication** header structure, where the **@namespace** attribute has a value of "**SecretAgent**", and **mustUnderstand** has a value of 1:

```
<Authentication xmlns="SecretAgent" mustUnderstand="1">
    <userName alias="99">
        <first>Susan</first>
        <last>Hilton</last>
    </userName>
</Authentication>
```


The OPENXML system procedure in the SELECT statement is used to extract information from the XML string, where the **xpath** string is set to "**/*:Authentication/*:userName**", and then stores the result set in the **crsr** variable. For more information about the OPENXML system procedure, see "openxml system procedure" [*SQL Anywhere Server - SQL Reference*].

The SET statement is used to build a SOAP response in XML format to send to the client. The following is an XML string representation of a possible SOAP response. It is based on the above **Authentication** header structure example.

```
<Authentication xmlns="SecretAgent" alias="99"
                              mustUnderstand="1">
  <first>Susan</first>
  <last>Hilton</last>
</Authentication>
```

The SA_SET_SOAP_HEADER system procedure is used to send the SOAP response to the client.

The final SELECT statement is used to convert the supplied Fahrenheit value to a Celsius value. This information is relayed back to the client.

See also

- "CREATE SERVICE statement" [*SQL Anywhere Server - SQL Reference*]
- "CREATE PROCEDURE statement (web clients)" [*SQL Anywhere Server - SQL Reference*]
- "SOAP_HEADER function [SOAP]" [*SQL Anywhere Server - SQL Reference*]
- "NEXT_SOAP_HEADER function [SOAP]" [*SQL Anywhere Server - SQL Reference*]
- "SOAP namespace URI requirement" on page 787

Lesson 2: Set up a web client database to send SOAP requests and receive SOAP responses

In this lesson, you set up a web client that sends SOAP requests and receives SOAP responses. This lesson assumes that you have set up a web server database as instructed in the previous lesson. For more information about setting up a database server to receive the SOAP requests from the client described in this lesson, see "Lesson 1: Set up a web server database to receive SOAP requests and send SOAP responses" on page 831.

Note
This lesson contains several references to **localhost**. Use the IP address of the server database from lesson 1 instead of **localhost** if you are not running the web client on the same computer as the server database.

To set up a database client for sending SOAP requests and receiving SOAP responses

1. Run the following command to create a SQL Anywhere database:

   ```
   dbinit ftc_client
   ```

2. Start the personal database client using the following command:

   ```
   dbsrv12 ftc_client.db
   ```

3. Connect to the database in Interactive SQL using the following command:

```
dbisql -c "UID=DBA;PWD=sql;SERVER=ftc_client"
```

4. Create a new stored procedure to send SOAP requests to a DISH service.

   Run the following SQL script in Interactive SQL:

```
CREATE SERVICE soap_endpoint
    TYPE 'DISH'
    AUTHORIZATION OFF
    SECURE OFF
    USER DBA;

CREATE PROCEDURE FtoC( temperature FLOAT )
    URL 'http://localhost:8082/soap_endpoint'
    SET 'SOAP(OP=FtoCService)'
    TYPE 'SOAP:DOC';
```

   The **http://localhost:8082/soap_endpoint** string in the URL clause indicates that the database server runs on **localhost** and listens on port 8082. The desired DISH web service is named **soap_endpoint**, which servers as a SOAP endpoint.

5. Create a wrapper procedure that builds a SOAP header, passes it to the **FtoC** procedure, and processes server responses.

   Run the following SQL script in Interactive SQL:

```
CREATE PROCEDURE FahrenheitToCelsius( temperature FLOAT )
BEGIN
  DECLARE io_header LONG VARCHAR;
  DECLARE in_header LONG VARCHAR;
  DECLARE result LONG VARCHAR;
  DECLARE err INTEGER;
  DECLARE crsr CURSOR FOR
    CALL FtoC( temperature, io_header, in_header );
  SET io_header =
    '<Authentication xmlns="SecretAgent" ' ||
    'mustUnderstand="1">' ||
    '<userName alias="99">' ||
    '<first>Susan</first><last>Hilton</last>' ||
    '</userName>' ||
    '</Authentication>';
  SET in_header =
    '<Session xmlns="SomeSession">' ||
    '123456789' ||
    '</Session>';

  MESSAGE 'send, soapheader=' || io_header || in_header;
  OPEN crsr;
  FETCH crsr INTO result, err;
  CLOSE crsr;
  MESSAGE 'receive, soapheader=' || io_header;
  SELECT temperature, Celsius
      FROM OPENXML(result, '//tns:answer', 1, result)
      WITH ("Celsius" FLOAT 'text()');
END;
```

   The first SET statement specifies the following XML representation of a SOAP header to inform the web server of user credentials:


```
<Authentication xmlns="SecretAgent" mustUnderstand="1">
    <userName alias="99">
      <first>Susan</first>
      <last>Hilton</last>
    </userName></Authentication>
```

The second SET statement sets the following XML representation of a SOAP header to track the client session ID:

```
<Session xmlns="SomeSession">123456789</Session>
```

The OPEN statement passes the following XML representation of a SOAP request to the web service procedure:

```
<Authentication xmlns="SecretAgent" alias="99"
    mustUnderstand="1">
    <first>Susan</first>
    <last>Hilton</last>
</Authentication>
```

See also

- "CREATE PROCEDURE statement (web clients)" [*SQL Anywhere Server - SQL Reference*]

Lesson 3: Send a SOAP request and receive a SOAP response

In this lesson, you call the wrapper procedure created in the previous lesson, which sends a SOAP request to the web server database you created in lesson one. For more information about setting up a web client database to send the SOAP requests described in this lesson, see "Lesson 2: Set up a web client database to send SOAP requests and receive SOAP responses" on page 833.

To send a SOAP request

1. Connect to the client database in Interactive SQL if it is not already open from lesson two.

   ```
   dbisql -c "UID=DBA;PWD=sql;SERVER=ftc_client"
   ```

2. Call the wrapper procedure to send a SOAP request and receive a SOAP response.

   Run the following SQL script in Interactive SQL:

   ```
   CALL FahrenheitToCelsius(212);
   ```

   This call passes a Fahrenheit value of 212 to the **FahrenheitToCelsius** procedure, which passes the value along with two customized SOAP headers to the **FToC** procedure. Both client-side procedures are created in lesson two.

   The **FToC** sends the Fahrenheit value and the SOAP headers to the **FToCService**, which returns a result set based on the Fahrenheit value.

The following SOAP response is returned in XML format by the **FToCService** web service when a Fahrenheit value of 212 is passed to the web server:

```
<tns:rowset xmlns:tns="http://localhost/ftc/FtoCService">
 <tns:row>
```

```
    <tns:answer>100</tns:answer>
   </tns:row>
  </tns:rowset>
```

The SELECT statement in the **FahrenheitToCelsius** procedure of the web client database uses the OPENXML function to parse the XML representation of the SOAP response, extracting the Celsius value defined by the **tns:answer** structure.

The following response is generated in Interactive SQL:

temperature	Celsius
212.0	100.0

Tutorial: Using JAX-WS to access a SOAP/DISH web service

This tutorial illustrates how to create a Java API for XML Web Services (JAX-WS) client application to access SOAP/DISH services on a SQL Anywhere web server.

Required software

- SQL Anywhere 12
- Java SE 6
- JAX-WS 2.2 (or a later version) for Windows (installation instructions are provided in the tutorial)

Competencies and experience

- Familiarity with SOAP
- Familiarity with Java or JAX-WS
- Basic knowledge of SQL Anywhere web services

Goals

- Create and start a new SQL Anywhere web server database.
- Create a SOAP web service.
- Set up a procedure that returns the information contained in a SOAP request.
- Create a DISH web service that provides WSDL documents and acts as a proxy.
- Set up JAX-WS on the client computer and import a WSDL document from the web server.
- Create a Java client application to retrieve information from the SOAP service using the WSDL document information.

Suggested background reading

- "CREATE PROCEDURE statement (web clients)" [*SQL Anywhere Server - SQL Reference*]
- "CREATE FUNCTION statement (web clients)" [*SQL Anywhere Server - SQL Reference*]
- "Using SQL Anywhere as an HTTP web server" on page 727

Lesson 1: Set up a web server database to receive SOAP requests and send SOAP responses

In this lesson, you set up a SQL Anywhere web server running SOAP and DISH web services that handles JAX-WS client application requests.

To set up a database server for receiving RAW requests and sending RAW responses

1. Start the SQL Anywhere **demo** database using the following command:

   ```
   dbsrv12 -xs http(port=8082) samples-dir\demo.db
   ```

   This command indicates that the HTTP web server should listen on port 8082 for requests. Use a different port number if 8082 is disallowed on your network.

2. Connect to the database server with Interactive SQL using the following command:

   ```
   dbisql -c "UID=DBA;PWD=sql;SERVER=demo"
   ```

3. Create a stored procedure that lists **Employees** table columns.

   Run the following SQL script in Interactive SQL:

   ```
   CREATE PROCEDURE ListEmployees()
   RESULT (
       EmployeeID            INTEGER,
       Surname               CHAR(20),
       GivenName             CHAR(20),
       StartDate             DATE,
       TerminationDate       DATE )
   BEGIN
       SELECT EmployeeID, Surname, GivenName, StartDate, TerminationDate
       FROM Employees;
   END;
   ```

   This script creates a new procedure named **ListEmployees** that defines the structure of the result set output, and selects certain columns from the Employees table.

4. Create a new SOAP service to accept incoming requests.

   Run the following SQL script in Interactive SQL:

   ```
   CREATE SERVICE "WS/EmployeeList"
       TYPE 'SOAP'
       FORMAT 'CONCRETE' EXPLICIT ON
       DATATYPE ON
       AUTHORIZATION OFF
   ```

```
    SECURE OFF
    USER DBA
    AS CALL ListEmployees();
```

This script creates a new SOAP web service named **WS/EmployeeList** that generates a SOAP type as output. It calls the **ListEmployees** procedure when a web client sends a request to the service.

SOAP web services accessed from JAX-WS should be declared with the FORMAT 'CONCRETE' clause. The EXPLICIT ON clause indicates that the corresponding DISH service should generate XML Schema that describes an explicit dataset object based on the result set of the **ListEmployees** procedure. The EXPLICIT clause only affects the generated WSDL document. For more information about the EXPLICIT clause, see "CREATE PROCEDURE statement (web clients)" [*SQL Anywhere Server - SQL Reference*].

DATATYPE ON indicates that explicit data type information is generated in the XML result set response and the input parameters. This option does not affect the WSDL document that is generated. For more information about the DATATYPE clause, see "CREATE PROCEDURE statement (web clients)" [*SQL Anywhere Server - SQL Reference*].

5. Create a new DISH service to act as a proxy for the SOAP service and to generate the WSDL document.

   Run the following SQL script in Interactive SQL:

   ```
   CREATE SERVICE "WSDish"
       TYPE 'DISH'
       FORMAT 'CONCRETE'
       GROUP "WS"
       AUTHORIZATION OFF
       SECURE OFF
       USER DBA;
   ```

   DISH web services accessed from JAX-WS should be declared with the FORMAT 'CONCRETE' clause. The GROUP clause identifies the SOAP services that should be handled by the DISH service. The EmployeeList service created in the previous step is part of the GROUP **WS** because it is declared as **WS/EmployeeList**.

6. Verify that the DISH web service is functional by accessing it through a web browser.

   Open your web browser and go to http://localhost:8082/demo/WSDish.

   The DISH service automatically generates a WSDL document that appears in the browser window. Examine the **EmployeeListDataset** object, which looks similar to the following output:

   ```
   <s:complexType name="EmployeeListDataset">
   <s:sequence>
   <s:element name="rowset">
     <s:complexType>
     <s:sequence>
     <s:element name="row" minOccurs="0" maxOccurs="unbounded">
       <s:complexType>
       <s:sequence>
       <s:element minOccurs="0" maxOccurs="1" name="EmployeeID"
           nillable="true" type="s:int" />
       <s:element minOccurs="0" maxOccurs="1" name="Surname"
           nillable="true" type="s:string" />
       <s:element minOccurs="0" maxOccurs="1" name="GivenName"
   ```



```
            nillable="true" type="s:string" />
          <s:element minOccurs="0" maxOccurs="1" name="StartDate"
            nillable="true" type="s:date" />
          <s:element minOccurs="0" maxOccurs="1" name="TerminationDate"
            nillable="true" type="s:date" />
          </s:sequence>
          </s:complexType>
        </s:element>
        </s:sequence>
        </s:complexType>
      </s:element>
      </s:sequence>
      </s:complexType>
```

EmployeeListDataset is the explicit object generated by the FORMAT 'CONCRETE' and EXPLICIT ON clauses in the **EmployeeList** SOAP service. In a later lesson, the wsimport application uses this information to generate a SOAP 1.1 client interface for this service.

7. (optional) Restore the sample database (*demo.db*) to its original state by following the steps found here: "Recreate the sample database (demo.db)" [*SQL Anywhere 12 - Introduction*].

See also

- "CREATE SERVICE statement" [*SQL Anywhere Server - SQL Reference*]
- "CREATE PROCEDURE statement (web clients)" [*SQL Anywhere Server - SQL Reference*]

Lesson 2: Set up JAX-WS on the web client

In this lesson, you set up JAX-WS on the web client to gather database information from the web server. It assumes that you have already set up the Java SE 6 JDK in the *C:\Program Files\Java\JDK1.6.0* directory. Note that, at the time of writing, recent versions of the JDK include JAX-WS 2.1.6. To determine if JAX-WS is present, check for a **wsimport** command in the *C:\Program Files\Java\JDK1.6.0\bin* directory. If you wish to install a more recent version such as JAX-WS 2.2, then use the following procedure.

To set up the latest version of JAX-WS on a web client

1. Download the latest version of JAX-WS. Go to https://jax-ws.dev.java.net/ to download the latest version.

2. Install JAX-WS.

   Follow the online instructions to install JAX-WS. This tutorial assumes that all files are extracted to the *C:\Program Files\Java* directory.

3. Add the *C:\Program Files\Java\jaxws-ri\bin* and *C:\Program Files\Java\JDK1.6.0\bin* directories to your **PATH** environment variable in the order listed.

   The code used in this tutorial relies on the JDK and JAX-WS binaries. You can write and compile the code from any directory by adding paths to these locations to your **PATH** environment variable.

4. Set your **CLASSPATH** environment variable using the following command:

   ```
   SET classpath=.;C:\Program Files\Java\jaxws-ri\lib\jaxb-api.jar;
   C:\Program Files\Java\jaxws-ri\lib\jaxws-rt.jar
   ```

5. Set the **JAXWS_HOME** environment variable using the following command:

   ```
   SET JAXWS_HOME=C:\Program Files\Java\jaxws-ri
   ```

6. Override endorsed standards provided by the Java Runtime Environment (JRE). To override the standard run-time environment, create an *endorsed* directory under the Java Runtime Environment (JRE) *lib* directory. This is usually *C:\Program Files\Java\JDK1.6.0\jre\lib*. Do not place the *endorsed* directory under the JDK *lib* directory.

   Copy the *jaxws-ri\lib\jaxws-api.jar* and *jaxws-ri\lib\jaxb-api.jar* files to the *C:\Program Files\Java\JDK1.6.0\jre\lib\endorsed* directory.

   Note
   JAX-WS 2.2 provides additional functionality to packaged objects that are not provided in current versions of the JDK. You must override the endorsed standards to make use of this functionality and prevent runtime errors. For more information about the Java Endorsed Standards Override Mechanism, see java.sun.com/javase/6/docs/technotes/guides/standards/index.html.

Lesson 3: Create a Java application to communicate with the web server database

In this lesson, you import the WSDL document generated from the DISH service and create a Java application to access table data based on the schema defined in the WSDL document.

To import a WSDL document from the database server

1. At a command prompt, create a new working directory for your Java code and generated files. Change to this new directory.

2. Generate the interface that calls the DISH web service and imports the WSDL document using the following command:

   ```
   wsimport -keep -Xendorsed "http://localhost:8082/demo/WSDish"
   ```

   The wsimport application retrieves the WSDL document from the given URL. It generates *.java* files to create an interface for it, then compiles them into *.class* files.

   The **keep** option indicates that the *.java* files should not be deleted after generating the class files. These files allow you to understand the generated source code.

   The **Xendorsed** option enables use of the endorsed standards overloaded in a previous lesson.

The wsimport application creates a new subdirectory structure named *localhost_8082\demo\ws* in your current working directory. The following is a list of directory contents:

- *EmployeeList.class*
- *EmployeeList.java*
- *EmployeeListDataset$Rowset$Row.class*
- *EmployeeListDataset$Rowset.class*
- *EmployeeListDataset.class*
- *EmployeeListDataset.java*
- *EmployeeListResponse.class*
- *EmployeeListResponse.java*
- *FaultMessage.class*
- *FaultMessage.java*
- *ObjectFactory.class*
- *ObjectFactory.java*
- *package-info.class*
- *package-info.java*
- *WSDish.class*
- *WSDish.java*
- *WSDishSoapPort.class*
- *WSDishSoapPort.java*

To access database information from the server

1. Write a Java application that accesses table data from the database server based on the dataset object schema defined in the generated API.

   Save the following Java source code as *SASoapDemo.java* in the current working directory. Note that your current working directory must be the directory containing the *localhost* subdirectory.

   ```
   // SASoapDemo.java illustrates a web service client that
   // calls the WSDish service and prints out the data.

   import java.util.*;
   import javax.xml.ws.*;
   import org.w3c.dom.Element;
   import org.w3c.dom.Node;
   import javax.xml.datatype.*;
   import localhost._8082.demo.ws.*;
   ```

```
public class SASoapDemo
{
  public static void main( String[] args )
  {
    try {
      WSDish service = new WSDish();

      Holder<EmployeeListDataset> response =
          new Holder<EmployeeListDataset>();
      Holder<Integer> sqlcode = new Holder<Integer>();

      WSDishSoapPort port = service.getWSDishSoap();

      // This is the SOAP service call to EmployeeList
      port.employeeList( response, sqlcode );

      EmployeeListDataset result = response.value;
      EmployeeListDataset.Rowset rowset = result.getRowset();

      List<EmployeeListDataset.Rowset.Row> rows = rowset.getRow();

      String fieldType;
      String fieldName;
      String fieldValue;
      Integer fieldInt;
      XMLGregorianCalendar fieldDate;

      for ( int i = 0; i < rows.size(); i++ ) {
        EmployeeListDataset.Rowset.Row row = rows.get( i );

        fieldType = row.getEmployeeID().getDeclaredType().getSimpleName();
        fieldName = row.getEmployeeID().getName().getLocalPart();
        fieldInt = row.getEmployeeID().getValue();
        System.out.println( "(" + fieldType + ")" + fieldName +
                            "=" + fieldInt );

        fieldType = row.getSurname().getDeclaredType().getSimpleName();
        fieldName = row.getSurname().getName().getLocalPart();
        fieldValue = row.getSurname().getValue();
        System.out.println( "(" + fieldType + ")" + fieldName +
                            "=" + fieldValue );

        fieldType = row.getGivenName().getDeclaredType().getSimpleName();
        fieldName = row.getGivenName().getName().getLocalPart();
        fieldValue = row.getGivenName().getValue();
        System.out.println( "(" + fieldType + ")" + fieldName +
                             "=" + fieldValue );

        fieldType = row.getStartDate().getDeclaredType().getSimpleName();
        fieldName = row.getStartDate().getName().getLocalPart();
        fieldDate = row.getStartDate().getValue();
        System.out.println( "(" + fieldType + ")" + fieldName +
                            "=" + fieldDate );

        if ( row.getTerminationDate() == null ) {
          fieldType = "unknown";
          fieldName = "TerminationDate";
          fieldDate = null;
        } else {
          fieldType =
            row.getTerminationDate().getDeclaredType().getSimpleName();
          fieldName = row.getTerminationDate().getName().getLocalPart();
          fieldDate = row.getTerminationDate().getValue();
        }
```



```
            System.out.println( "(" + fieldType + ")" + fieldName +
                                "=" + fieldDate );
            System.out.println();
          }
        }
        catch (Exception x) {
          x.printStackTrace();
        }
      }
    }
```

This application prints all server-provided column data to the standard system output.

Note
This application assumes that your SQL Anywhere web server is listening on port 8082, as instructed in lesson one. Replace the **8082** portion of the **import localhost._8082.demo.ws.*** code line with the port number you specified when you started the SQL Anywhere web server.

For more information about the Java methods used in this application, see the javax.xml.bind.JAXBElement class documentation at http://java.sun.com/javaee/5/docs/api/.

2. Compile your Java application using the following command:

   ```
   javac SASoapDemo.java
   ```

3. Execute the application using the following command:

   ```
   java SASoapDemo
   ```

4. The application sends its request to the web server. It receives an XML result set response that consists of an **EmployeeListResult** with a rowset containing several row entries. The SQLCODE result from executing the query is included in the response.

The following is an example of the generated output:

```
(Integer)EmployeeID=102
(String)Surname=Whitney
(String)GivenName=Fran
(XMLGregorianCalendar)StartDate=1984-08-28
(unknown)TerminationDate=null

(Integer)EmployeeID=105
(String)Surname=Cobb
(String)GivenName=Matthew
(XMLGregorianCalendar)StartDate=1985-01-01
(unknown)TerminationDate=null
.
.
.
(Integer)EmployeeID=1740
(String)Surname=Nielsen
(String)GivenName=Robert
(XMLGregorianCalendar)StartDate=1994-06-24
(unknown)TerminationDate=null

(Integer)EmployeeID=1751
(String)Surname=Ahmed
(String)GivenName=Alex
```

```
(XMLGregorianCalendar)StartDate=1994-07-12
(XMLGregorianCalendar)TerminationDate=2008-04-18
```

The **TerminationDate** column is only sent when its value is not NULL. The Java application is designed to detect when the **TerminationDate** column is not present. For this example, the last row in the Employees table was altered such that a non-NULL termination date was set.

The following is an example of a SOAP response from the web server:

```
<tns:EmployeeListResponse>
 <tns:EmployeeListResult xsi:type='tns:EmployeeListDataset'>
  <tns:rowset>
    <tns:row> ... </tns:row>
    .
    .
    .
    <tns:row>
      <tns:EmployeeID xsi:type="xsd:int">1751</tns:EmployeeID>
      <tns:Surname xsi:type="xsd:string">Ahmed</tns:Surname>
      <tns:GivenName xsi:type="xsd:string">Alex</tns:GivenName>
      <tns:StartDate xsi:type="xsd:dateTime">1994-07-12</tns:StartDate>
      <tns:TerminationDate xsi:type="xsd:dateTime">2010-03-22</
tns:TerminationDate>
    </tns:row>
  </tns:rowset>
 </tns:EmployeeListResult>
 <tns:sqlcode>0</tns:sqlcode>
</tns:EmployeeListResponse>
```

Column names and data types are included in each rowset.

Note
You can observe the response shown above through the use of proxy software that logs the XML message traffic. The proxy inserts itself between your client application and the web server.

Tutorial: Using Visual C# to access a SOAP/DISH web service

This tutorial illustrates how to create a Visual C# client application to access SOAP/DISH services on a SQL Anywhere web server.

Required software

- SQL Anywhere 12
- Visual Studio

Competencies and experience

- Familiarity with SOAP
- Familiarity with .NET framework

- Basic knowledge of SQL Anywhere web services

Goals

- Create and start a new SQL Anywhere web server database.
- Create a SOAP web service.
- Set up a procedure that returns the information contained in a SOAP request.
- Create a DISH web service that provides WSDL documents and acts as a proxy.
- Set up Visual C# on the client computer and import a WSDL document from the web server.
- Create a Java client application to retrieve information from the SOAP service using the WSDL document information.

Suggested background reading

- "CREATE PROCEDURE statement (web clients)" [*SQL Anywhere Server - SQL Reference*]
- "CREATE FUNCTION statement (web clients)" [*SQL Anywhere Server - SQL Reference*]
- "Using SQL Anywhere as an HTTP web server" on page 727

Lesson 1: Set up a web server database to receive SOAP requests and send SOAP responses

In this lesson, you set up a SQL Anywhere web server running SOAP and DISH web services that handles Visual C# client application requests.

To set up a database server for receiving RAW requests and sending RAW responses

1. Start the SQL Anywhere **demo** database using the following command:

   ```
   dbsrv12 -xs http(port=8082) samples-dir\demo.db
   ```

   This command indicates that the HTTP web server should listen on port 8082 for requests. Use a different port number if 8082 is disallowed on your network.

2. Connect to the database server in Interactive SQL using the following command:

   ```
   dbisql -c "UID=DBA;PWD=sql;SERVER=demo"
   ```

3. Create a new SOAP service to accept incoming requests.

   Run the following SQL script in Interactive SQL:

   ```
   CREATE SERVICE "SASoapTest/EmployeeList"
   TYPE 'SOAP'
   DATATYPE ON
   AUTHORIZATION OFF
   SECURE OFF
   ```

```
USER DBA
AS SELECT * FROM Employees;
```

This script creates a new SOAP web service named **SASoapTest/EmployeeList** that generates a SOAP type as output. It selects all columns from the **Employees** table and returns the result set to the client.

DATATYPE ON indicates that explicit data type information is generated in the XML result set response and the input parameters. This option does not affect the WSDL document that is generated. For more information about the DATATYPE clause, see "CREATE PROCEDURE statement (web clients)" [*SQL Anywhere Server - SQL Reference*].

4. Create a new DISH service to act as a proxy for the SOAP service and to generate the WSDL document.

   Run the following SQL script in Interactive SQL:

   ```
   CREATE SERVICE "SASoapTest_DNET"
   TYPE 'DISH'
   GROUP "SASoapTest"
   FORMAT 'DNET'
   AUTHORIZATION OFF
   SECURE OFF
   USER DBA;
   ```

   DISH web services accessed from .NET should be declared with the FORMAT 'DNET' clause. The GROUP clause identifies the SOAP services that should be handled by the DISH service. The **EmployeeList** service created in the previous step is part of the GROUP 'SASoapTest' because it is declared as **SASoapTest/EmployeeList**.

5. Verify that the DISH web service is functional by accessing it through a web browser.

   Open your web browser and go to http://localhost:8082/demo/SASoapTest_DNET.

See also

- "CREATE SERVICE statement" [*SQL Anywhere Server - SQL Reference*]
- "Creating DISH services" on page 736

Lesson 2: Create a Visual C# application to communicate with the web server database

Note that this example uses functions from the .NET Framework 2.0.

To create SOAP and DISH services

1. Start Visual Studio.
2. Create a new Visual C# Windows form application project.

   An empty form appears.

3. Add a web reference to the project.

a. From the **Project** menu, choose **Add Service Reference**.

b. In the Add Service Reference window, choose **Advanced**.

c. In the Service Reference Settings window, choose **Add Web Reference**.

d. In the Add Web Reference window, type **http://localhost:8082/demo/SASoapTest_DNET** in the **URL** field.

e. Click **Go**.

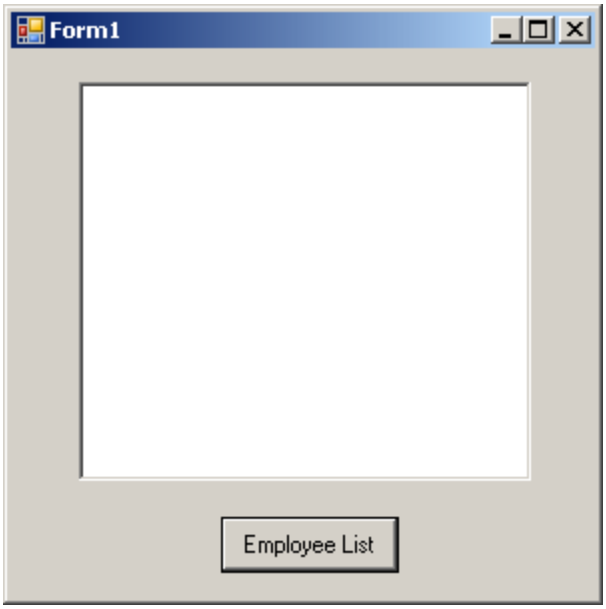
Visual Studio lists the EmployeeList method available from the SASoapTest_DNET service.

f. Click **Add Reference**.

Visual Studio adds the **localhost** web reference to the project. You can select it from the **Solution Explorer** pane.

4. Populate the empty form with the desired objects for web client application.

From the **Toolbox** pane, drag ListBox and Button objects onto the form and update the text attributes so that the form looks similar to the following diagram:



5. Write a procedure that accesses the web reference and uses the available methods.

Double-click **Employee List** and add the following code for the button click event:

```
int sqlCode;

listBox1.Items.Clear();

localhost.SASoapTest_DNET proxy = new localhost.SASoapTest_DNET();

DataSet results = proxy.EmployeeList(out sqlCode);
DataTableReader dr = results.CreateDataReader();
```

```
while (dr.Read())
{
  for (int i = 0; i < dr.FieldCount; i++)
  {
    string columnName = "(" + dr.GetDataTypeName(i)
                      + ")"
                      + dr.GetName(i);
    if (dr.IsDBNull(i))
    {
      listBox1.Items.Add(columnName + "=(null)");
    }
    else {
      System.TypeCode typeCode =
          System.Type.GetTypeCode(dr.GetFieldType(i));
      switch (typeCode)
      {
        case System.TypeCode.Int32:
          Int32 intValue = dr.GetInt32(i);
          listBox1.Items.Add(columnName + "="
              + intValue);
          break;
        case System.TypeCode.Decimal:
          Decimal decValue = dr.GetDecimal(i);
          listBox1.Items.Add(columnName + "="
              + decValue.ToString("c"));
          break;
        case System.TypeCode.String:
          string stringValue = dr.GetString(i);
          listBox1.Items.Add(columnName + "="
              + stringValue);
          break;
        case System.TypeCode.DateTime:
          DateTime dateValue = dr.GetDateTime(i);
          listBox1.Items.Add(columnName + "="
              + dateValue);
          break;
        case System.TypeCode.Boolean:
          Boolean boolValue = dr.GetBoolean(i);
          listBox1.Items.Add(columnName + "="
              + boolValue);
          break;
        case System.TypeCode.DBNull:
          listBox1.Items.Add(columnName
              + "=(null)");
          break;
        default:
          listBox1.Items.Add(columnName
              + "=(unsupported)");
          break;
      }
    }
  }
  listBox1.Items.Add("");
}
dr.Close();
```

6. Run the application.

   From the **Debug** menu, choose **Start Debugging**.

7. Communicate with the web database server.

   Click **Employee List**.

The **ListBox** object displays the **EmployeeList** result set as (type)name=value pairs. The following output illustrates how an entry appears in the **ListBox** object:

```
(Int32)EmployeeID=102
(Int32)ManagerID=501
(String)Surname=Whitney
(String)GivenName=Fran
(Int32)DepartmentID=100
(String)Street=9 East Washington Street
(String)City=Cornwall
(String)State=New York
(String)Country=USA
(String)PostalCode=02192
(String)Phone=6175553985
(String)Status=A
(String)SocialSecurityNumber=017349033
(String)Salary=$45,700.00
(DateTime)StartDate=28/08/1984 0:00:00 AM
(DateTime)TerminationDate=(null)
(DateTime)BirthDate=05/06/1958 0:00:00 AM
(Boolean)BenefitHealthInsurance=True
(Boolean)BenefitLifeInsurance=True
(Boolean)BenefitDayCare=False
(String)Sex=F
```

The Salary amount is converted to the client's currency format.

Values that contain null are returned as DBNull. Values that contain a date with no time are assigned a time of 00:00:00 or midnight.

The XML response from the web server includes a formatted result set. All column data is converted to a string representation of the data. The following result set illustrates how result sets are formatted when they are sent to the client:

```
<row>
 <EmployeeID>102</EmployeeID>
 <ManagerID>501</ManagerID>
 <Surname>Whitney</Surname>
 <GivenName>Fran</GivenName>
 <DepartmentID>100</DepartmentID>
 <Street>9 East Washington Street</Street>
 <City>Cornwall</City>
 <State>NY</State>
 <Country>USA</Country>
 <PostalCode>02192</PostalCode>
 <Phone>6175553985</Phone>
 <Status>A</Status>
 <SocialSecurityNumber>017349033</SocialSecurityNumber>
 <Salary>45700.000</Salary>
 <StartDate>1984-08-28-05:00</StartDate>
 <TerminationDate xsi:nil="true" />
 <BirthDate>1958-06-05-05:00</BirthDate>
 <BenefitHealthInsurance>1</BenefitHealthInsurance>
 <BenefitLifeInsurance>1</BenefitLifeInsurance>
 <BenefitDayCare>0</BenefitDayCare>
 <Sex>F</Sex>
 </row>
```

Columns containing date or time information include the offset from UTC of the web server. In the above result set, the offset is -05:00 which is 5 hours to the west of UTC (North American Eastern Standard Time).

Columns containing only the date are formatted as `yyyy-mm-dd-HH:MM` or `yyyy-mm-dd+HH:MM`. A zone offset (-HH:MM or +HH:MM) is suffixed to the string.

Columns containing only the time are formatted as `hh:mm:ss.nnn-HH:MM` or `hh:mm:ss.nnn +HH:MM`. A zone offset (-HH:MM or +HH:MM) is suffixed to the string.

Columns containing both date and time are formatted as `yyyy-mm-ddThh:mm:ss.nnn-HH:MM` or `yyyy-mm-ddThh:mm:ss.nnn+HH:MM`. Note that the date is separated from the time using the letter 'T'. A zone offset (-HH:MM or +HH:MM) is suffixed to the string.

The DATATYPE ON clause is specified to generate data type information in the XML result set response. A fragment of the response from the web server is shown below. Note that the type information matches the data type of the database columns.

```
<xsd:element name='EmployeeID' minOccurs='0' type='xsd:int' />
<xsd:element name='ManagerID' minOccurs='0' type='xsd:int' />
<xsd:element name='Surname' minOccurs='0' type='xsd:string' />
<xsd:element name='GivenName' minOccurs='0' type='xsd:string' />
<xsd:element name='DepartmentID' minOccurs='0' type='xsd:int' />
<xsd:element name='Street' minOccurs='0' type='xsd:string' />
<xsd:element name='City' minOccurs='0' type='xsd:string' />
<xsd:element name='State' minOccurs='0' type='xsd:string' />
<xsd:element name='Country' minOccurs='0' type='xsd:string' />
<xsd:element name='PostalCode' minOccurs='0' type='xsd:string' />
<xsd:element name='Phone' minOccurs='0' type='xsd:string' />
<xsd:element name='Status' minOccurs='0' type='xsd:string' />
<xsd:element name='SocialSecurityNumber' minOccurs='0' type='xsd:string' />
<xsd:element name='Salary' minOccurs='0' type='xsd:decimal' />
<xsd:element name='StartDate' minOccurs='0' type='xsd:date' />
<xsd:element name='TerminationDate' minOccurs='0' type='xsd:date' />
<xsd:element name='BirthDate' minOccurs='0' type='xsd:date' />
<xsd:element name='BenefitHealthInsurance' minOccurs='0' type='xsd:boolean' /
>
<xsd:element name='BenefitLifeInsurance' minOccurs='0' type='xsd:boolean' />
<xsd:element name='BenefitDayCare' minOccurs='0' type='xsd:boolean' />
<xsd:element name='Sex' minOccurs='0' type='xsd:string' />
```

Sample: Handling SOAP headers, parameters, and responses

This sample illustrates different ways of exchanging SOAP requests between a web server and a SOAP client.

The following server-side code illustrates how a web server can process SOAP requests containing parameters, and SOAP headers. The example implements an **addItem** SOAP operation that takes two parameters: **amount** of type int and **item** of type string. The **sp_addItems** procedure also processes an Authentication SOAP header extracting the first and last name of the user. The values are used to populate a SOAP response Validation header via the sa_set_soap_header system procedure. The response is a result of three columns: **quantity**, **item** and **status** with types INT, LONG VARCHAR and LONG VARCHAR respectively.

```
// create the SOAP service
call sa_make_object( 'service', 'addItems' );
alter SERVICE "addItems"
```



```
    TYPE 'SOAP'
    format 'concrete'
    AUTHORIZATION OFF
    USER dba
    AS call sp_addItems( :amount, :item );

// create SOAP endpoint for related services
call sa_make_object( 'service', 'store' );
alter SERVICE "store"
    TYPE 'DISH'
    AUTHORIZATION OFF
    USER dba;

// create the procedure that will process the SOAP requests for the addItems
service
create or replace procedure sp_addItems( "count" int, item long varchar )
result( quantity int, item long varchar, status long varchar )
begin
    declare "hd_key" long varchar;
    declare "hd_entry" long varchar;
    declare "pwd" long varchar;
    declare "first" long varchar;
    declare "last" long varchar;
    declare "xpath" long varchar;
    declare "authinfo" long varchar;
    declare "namespace" long varchar;
    declare "mustUnderstand" long varchar;

  header_loop:
    loop
        set hd_key = next_soap_header( hd_key );
        if hd_key is NULL then
      // no more header entries.
            leave header_loop;
        end if;
        if hd_key = 'Authentication' then
            set hd_entry = soap_header( hd_key );
            set xpath = '/*:' || hd_key || '/*:userName';
            set "namespace" = soap_header( hd_key, 1, '@namespace' );
            set mustUnderstand = soap_header( hd_key, 1, 'mustUnderstand' );
            begin
        // parse for the pieces that we are interested in
                declare crsr cursor for select * from
                    openxml( hd_entry, xpath )
                        with ( pwd long varchar '@*:pwd',
                               "first" long varchar '*:first/text()',
                               "last" long varchar '*:last/text()');
                open crsr;
                fetch crsr into pwd, "first", "last";
                close crsr;
            end;
      // build a response header, based on the pieces from the request header
            set authinfo = XMLELEMENT( 'Validation',
            XMLATTRIBUTES(
                    "namespace" as xmlns,
                    "mustUnderstand" as mustUnderstand ),
                    XMLELEMENT( 'first', "first" ),
                    XMLELEMENT( 'last', "last" ) );

            call sa_set_soap_header( 'authinfo', authinfo);
        end if;
    end loop header_loop;
    //  code to validate user/session and check item goes here...
```

```
    select count, item, 'available';
end;
```

The following client-side code illustrates how to create SOAP procedures and functions that send parameters and SOAP headers. Wrapper procedures are used to populate the web service procedure calls and process the responses. The **soapAddItemProc** procedure illustrates the use of a SOAP web service procedure, the **soapAddItemFunction** function illustrates the use of a SOAP web service function, and the **httpAddItemFunction** function illustrates how a SOAP payload may be passed to an HTTP web service procedure.

```
/* -- SOAP client procedure --
    uses substitution parameters to send SOAP headers
         a single inout parameter is used to receive SOAP headers
*/
create or replace procedure soapAddItemProc("amount" int, item long varchar,
inout inoutheader long varchar, in inheader long varchar )
    url 'http://localhost/store'
    set 'SOAP( OP=addItems )'
    type 'SOAP:DOC'
    soapheader '!inoutheader!inheader';

/* Wrapper that calls soapAddItemProc
    demonstrates:
        how to send and receive soap headers
        how to send parameters
 */
create or replace procedure addItemProcWrapper( amount int, item long
varchar, "first" long varchar, "last" long varchar )
    begin
        declare io_header long varchar;    // inout (write/read) soap header
        declare resxml long varchar;
        declare soap_header_sent long varchar;
        declare i_header long varchar;    // in (write) only soap header
        declare err int;
       declare crsr cursor for call soapAddItemProc( amount, item, io_header,
i_header );

        set io_header = XMLELEMENT( 'Authentication',
                      XMLATTRIBUTES('CustomerOrderURN' as xmlns),
                    XMLELEMENT('userName', XMLATTRIBUTES(
                            'none' as pwd,
                            '1' as mustUnderstand ),
                            XMLELEMENT( 'first', "first" ),
                            XMLELEMENT( 'last', "last" ) ) );
        set i_header = '<Session xmlns="SomeSession">123456789</Session>';
        set soap_header_sent = io_header || i_header;
        open crsr;
        fetch crsr into resxml, err;
        close crsr;

        select resxml, err, soap_header_sent, io_header as
soap_header_received;
    end;
/* example call to addItemProcWrapper */
call addItemProcWrapper( 5, 'shirt', 'John', 'Smith' );


/* -- SOAP client function --
    uses substitution parameters to send SOAP headers
    Entire SOAP response envelope is returned.  SOAP headers can be parsed
using openxml
```



```
*/
create or replace function soapAddItemFunction("amount" int, item long
varchar, in inheader1 long varchar, in inheader2 long varchar )
returns XML
    url 'http://localhost/store'
    set 'SOAP( OP=addItems )'
    type 'SOAP:DOC'
    soapheader '!inheader1!inheader2';

/* Wrapper that calls soapAddItemFunction
    demonstrates the use of SOAP function:
        how to send and receive soap headers
        how to send parameters and process response
 */
create or replace procedure addItemFunctionWrapper( amount int, item long
varchar, "first" long varchar, "last" long varchar )
    begin
        declare i_header1 long varchar;
        declare i_header2 long varchar;
        declare res long varchar;
        declare ns long varchar;
        declare xpath long varchar;
        declare header_entry long varchar;
        declare localname long varchar;
        declare namespaceuri long varchar;
        declare r_quantity int;
        declare r_item long varchar;
        declare r_status long varchar;


        set i_header1 = XMLELEMENT( 'Authentication',
                        XMLATTRIBUTES('CustomerOrderURN' as xmlns),
                    XMLELEMENT('userName', XMLATTRIBUTES(
                            'none' as pwd,
                            '1' as mustUnderstand ),
                            XMLELEMENT( 'first', "first" ),
                            XMLELEMENT( 'last', "last" ) ) );
        set i_header2 = '<Session xmlns="SessionURN">123456789</Session>';

        set res = soapAddItemFunction( amount, item, i_header1, i_header2 );

         set ns = '<ns xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/
envelope/"'
        || ' xmlns:mp="urn:ianywhere-com:sa-xpath-metaprop"'
        || ' xmlns:customer="CustomerOrderURN"'
        || ' xmlns:session="SessionURN"'
        || ' xmlns:tns="http://localhost"></ns>';

        // Process headers...
        set xpath = '//SOAP-ENV:Header/*';
        begin
         declare crsr cursor for select * from
             openxml( res, xpath, 1, ns )
                         with (  "header_entry" long varchar '@mp:xmltext',
                       "localname" long varchar '@mp:localname',
                       "namespaceuri" long varchar '@mp:namespaceuri' );
            open crsr;
            fetch crsr into "header_entry", "localname", "namespaceuri";
            close crsr;
        end;

        // Process body...
        set xpath = '//tns:row';
        begin
```

```
          declare crsr1 cursor for select * from
              openxml( res, xpath, 1, ns )
                          with (  "r_quantity" int 'tns:quantity/text()',
                        "r_item" long varchar 'tns:item/text()',
                        "r_status" long varchar 'tns:status/text()' );
             open crsr1;
             fetch crsr1 into "r_quantity", "r_item", "r_status";
             close crsr1;
         end;

    select r_item, r_quantity, r_status, header_entry, localname,
namespaceuri;
    end;

/* example call to addItemFunctionWrapper */
call addItemFunctionWrapper( 5, 'shirt', 'John', 'Smith' );

/*
 Demonstrate how a HTTP:POST can be used as a transport for a SOAP payload
 Rather than creating a webservice client SOAP procedure, this approach
 creates a webservice HTTP procedure that transports a SOAP payload
*/
create or replace function httpAddItemFunction("soapPayload" xml )
returns XML
    url 'http://localhost/store'
    type 'HTTP:POST:text/xml'
    header 'SOAPAction: "http://localhost/addItems"';


/* Wrapper that calls soapAddItemFunction
    demonstrates the use of SOAP function:
        how to send and receive soap headers
        how to send parameters and process response
 */

create or replace procedure addItemHttpWrapper( amount int, item long
varchar )
result(response xml)
begin
    declare payload xml;
    declare response xml;

    set payload =
'<?xml version="1.0"?>
<SOAP-ENV:Envelope
  xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:m="http://localhost">
  <SOAP-ENV:Body>
    <m:addItems>
      <m:amount>' || amount || '</m:amount>
      <m:item>' || item || '</m:item>
    </m:addItems>
  </SOAP-ENV:Body>
</SOAP-ENV:Envelope>';
    set response = httpAddItemFunction( payload );
    /* process response as demonstrated in addItemFunctionWrapper */
    select response;
end
go

/* example call to addItemHttpWrapper */
call addItemHttpWrapper( 5, 'shirt' );
```


See also

- “SOAP request header management” on page 783
- “Accessing client-supplied SOAP request headers” on page 757

Three-tier computing and distributed transactions

You can use SQL Anywhere as a database server or **resource manager**, participating in distributed transactions coordinated by a transaction server.

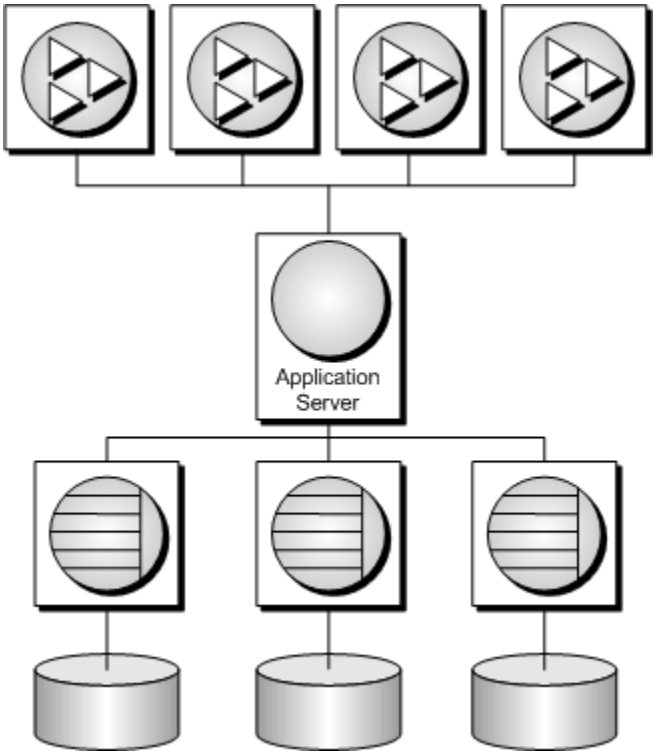
A three-tier environment, where an application server sits between client applications and a set of resource managers, is a common distributed-transaction environment. Sybase EAServer and some other application servers are also transaction servers.

Sybase EAServer and Microsoft Transaction Server both use the Microsoft Distributed Transaction Coordinator (DTC) to coordinate transactions. SQL Anywhere provides support for distributed transactions controlled by the DTC service, so you can use SQL Anywhere with either of these application servers, or any other product based on the DTC model.

When integrating SQL Anywhere into a three-tier environment, most of the work needs to be done from the application server. This section provides an introduction to the concepts and architecture of three-tier computing, and an overview of relevant SQL Anywhere features. It does not describe how to configure your application server to work with SQL Anywhere. For more information, see your application server documentation.

Three-tier computing architecture

In three-tier computing, application logic is held in an application server, such as Sybase EAServer, which sits between the resource manager and the client applications. In many situations, a single application server may access multiple resource managers. In the Internet case, client applications are browser-based, and the application server is generally a web server extension.



Sybase EAServer stores application logic in the form of components, and makes these components available to client applications. The components may be PowerBuilder components, JavaBeans, or COM components.

For more information, see your Sybase EAServer documentation.

Distributed transactions in three-tier computing

When client applications or application servers work with a single transaction processing database, such as SQL Anywhere, there is no need for transaction logic outside the database itself, but when working with multiple resource managers, transaction control must span the resources involved in the transaction. Application servers provide transaction logic to their client applications—guaranteeing that sets of operations are executed atomically.

Many transaction servers, including Sybase EAServer, use the Microsoft Distributed Transaction Coordinator (DTC) to provide transaction services to their client applications. DTC uses **OLE transactions**, which in turn use the **two-phase commit** protocol to coordinate transactions involving multiple resource managers. You must have DTC installed to use the features described in this section.

SQL Anywhere in distributed transactions

SQL Anywhere can take part in transactions coordinated by DTC, which means that you can use SQL Anywhere databases in distributed transactions using a transaction server such as Sybase EAServer or

Microsoft Transaction Server. You can also use DTC directly in your applications to coordinate transactions across multiple resource managers.

The vocabulary of distributed transactions

This section assumes some familiarity with distributed transactions. For information, see your transaction server documentation. This section describes some commonly used terms.

- **Resource managers** are those services that manage the data involved in the transaction.

  The SQL Anywhere database server can act as a resource manager in a distributed transaction when accessed through ADO.NET, OLE DB, or ODBC. The SQL Anywhere .NET Data Provider, OLE DB provider, and ODBC driver act as resource manager proxies on the client computer. The SQL Anywhere .NET Data Provider supports distributed transactions using DbProviderFactory and TransactionScope.

- Instead of communicating directly with the resource manager, application components can communicate with **resource dispensers**, which in turn manage connections or pools of connections to the resource managers.

  SQL Anywhere supports two resource dispensers: the ODBC driver manager and OLE DB.

- When a transactional component requests a database connection (using a resource manager), the application server **enlists** each database connection that takes part in the transaction. DTC and the resource dispenser perform the enlistment process.

Two-phase commit

Distributed transactions are managed using two-phase commit. When the work of the transaction is complete, the transaction manager (DTC) asks all the resource managers enlisted in the transaction whether they are ready to commit the transaction. This phase is called **preparing** to commit.

If all the resource managers respond that they are prepared to commit, DTC sends a commit request to each resource manager, and responds to its client that the transaction is completed. If one or more resource manager does not respond, or responds that it cannot commit the transaction, all the work of the transaction is rolled back across all resource managers.

How application servers use DTC

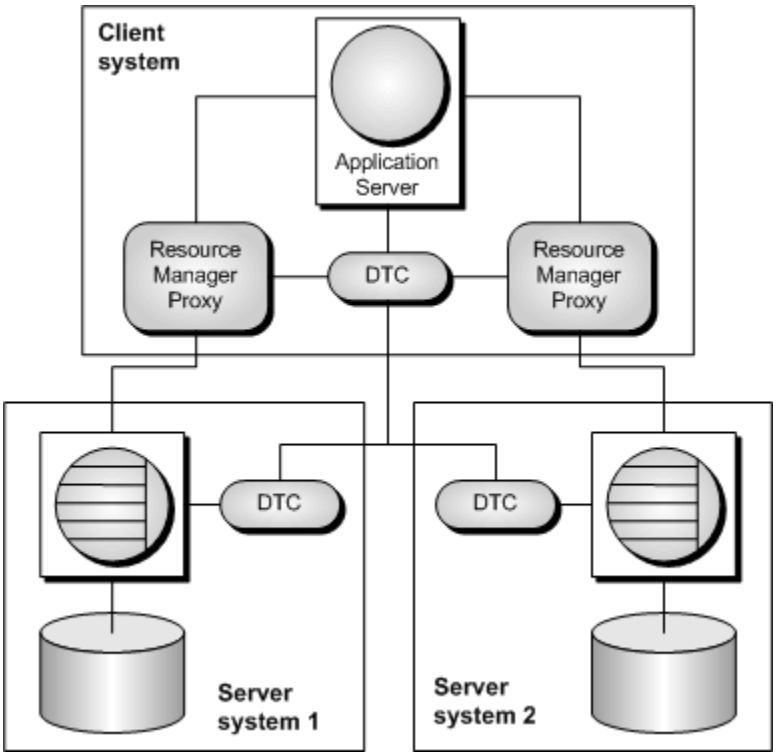
Sybase EAServer and Microsoft Transaction Server are both component servers. The application logic is held in the form of components, and made available to client applications.

Each component has a transaction attribute that indicates how the component participates in transactions. When building the component, you must program the work of the transaction into the component—the resource manager connections, the operations on the data for which each resource manager is responsible. However, you do not need to add transaction management logic to the component. Once the transaction

attribute is set, to indicate that the component needs transaction management, EAServer uses DTC to enlist the transaction and manage the two-phase commit process.

Distributed transaction architecture

The following diagram illustrates the architecture of distributed transactions. In this case, the resource manager proxy is either ADO.NET, OLE DB, or ODBC.



In this case, a single resource dispenser is used. The application server asks DTC to prepare a transaction. DTC and the resource dispenser enlist each connection in the transaction. Each resource manager must be in contact with both the DTC and the database, so the work can be performed and the DTC can be notified of its transaction status when required.

A DTC service must be running on each computer to operate distributed transactions. You can control DTC services from the Services icon in the Windows Control Panel; the DTC service is named **MSDTC**.

For more information, see your DTC or EAServer documentation.

Using distributed transactions

While SQL Anywhere is enlisted in a distributed transaction, it hands transaction control over to the transaction server, and SQL Anywhere ensures that it does not perform any implicit transaction management. The following conditions are imposed automatically by SQL Anywhere when it participates in distributed transactions:

- Autocommit is automatically turned off, if it is in use.
- Data definition statements (which commit as a side effect) are disallowed during distributed transactions.
- An explicit COMMIT or ROLLBACK issued by the application directly to SQL Anywhere, instead of through the transaction coordinator, generates an error. The transaction is not aborted, however.
- A connection can participate in only a single distributed transaction at a time.
- There must be no uncommitted operations at the time the connection is enlisted in a distributed transaction.

DTC isolation levels

DTC has a set of isolation levels, which the application server specifies. These isolation levels map to SQL Anywhere isolation levels as follows:

DTC isolation level	SQL Anywhere isolation level
ISOLATIONLEVEL_UNSPECIFIED	0
ISOLATIONLEVEL_CHAOS	0
ISOLATIONLEVEL_READUNCOMMITTED	0
ISOLATIONLEVEL_BROWSE	0
ISOLATIONLEVEL_CURSORSTABILITY	1
ISOLATIONLEVEL_READCOMMITTED	1
ISOLATIONLEVEL_REPEATABLEREAD	2
ISOLATIONLEVEL_SERIALIZABLE	3
ISOLATIONLEVEL_ISOLATED	3

Recovery from distributed transactions

If the database server faults while uncommitted operations are pending, it must either rollback or commit those operations on startup to preserve the atomic nature of the transaction.

If uncommitted operations from a distributed transaction are found during recovery, the database server attempts to connect to DTC and requests that it be re-enlisted in the pending or in-doubt transactions. Once the re-enlistment is complete, DTC instructs the database server to roll back or commit the outstanding operations.

If the reenlistment process fails, SQL Anywhere has no way of knowing whether the in-doubt operations should be committed or rolled back, and recovery fails. If you want the database in such a state to recover, regardless of the uncertain state of the data, you can force recovery using the following database server options:

- **-tmf** If DTC cannot be located, the outstanding operations are rolled back and recovery continues. See "-tmf dbeng12/dbsrv12 server option" [*SQL Anywhere Server - Database Administration*].
- **-tmt** If re-enlistment is not achieved before the specified time, the outstanding operations are rolled back and recovery continues. See "-tmt dbeng12/dbsrv12 server option" [*SQL Anywhere Server - Database Administration*].

Database tools interface (DBTools)

SQL Anywhere includes Sybase Central and a set of utilities for managing databases. These database management utilities perform tasks such as backing up databases, creating databases, translating transaction logs to SQL, and so on.

Supported platforms

All the database management utilities use a shared library called the **database tools library**. It is supplied for Windows operating systems and for Linux, Unix, and Mac OS X. For Windows, the name of this library is *dbtool12.dll*. For Linux and Unix, the name of this library is *libdbtool12_r.so*. For Mac OS X, the name of this library is *libdbtool12_r.dylib*.

You can develop your own database management utilities or incorporate database management features into your applications by calling the database tools library. This section describes the interface to the database tools library. This section assumes you are familiar with how to call library routines from the development environment you are using.

The database tools library has functions, or entry points, for each of the database management utilities. In addition, functions must be called before use of other database tools functions and when you have finished using other database tools functions.

Windows Mobile

The *dbtool12.dll* library is supplied for Windows Mobile, but includes only entry points for DBToolsInit, DBToolsFini, DBRemoteSQL, and DBSynchronizeLog. Other entry points are not provided for Windows Mobile.

The dbtools.h header file

The dbtools header file included with SQL Anywhere lists the entry points to the DBTools library and also the structures used to pass information to and from the library. The *dbtools.h* file is installed into the *SDK\Include* subdirectory under your SQL Anywhere installation directory. You should consult the *dbtools.h* file for the latest information about the entry points and structure members.

The *dbtools.h* header file includes other files such as:

- **sqlca.h** This is included for resolution of various macros, not for the SQLCA itself.
- **dllapi.h** Defines preprocessor macros for operating-system dependent and language-dependent macros.
- **dbtlvers.h** Defines the DB_TOOLS_VERSION_NUMBER preprocessor macro and other version specific macros.

The sqldef.h header file

The *sqldef.h* header file includes error return values.

The dbrmt.h header file

The *dbrmt.h* header file included with SQL Anywhere describes the DBRemoteSQL entry point in the DBTools library and also the structure used to pass information to and from the DBRemoteSQL entry point. The *dbrmt.h* file is installed into the *SDK\Include* subdirectory under your SQL Anywhere installation directory. You should consult the *dbrmt.h* file for the latest information about the DBRemoteSQL entry point and structure members.

Using the database tools interface

This section provides an overview of how to develop applications that use the DBTools interface for managing databases.

Using the import libraries

To use the DBTools functions, you must link your application against a DBTools **import library** that contains the required function definitions.

For Unix systems, no import library is required. Link directly against *libdbtool12.so* (non-threaded) or *libdbtool12_r.so* (threaded).

Import libraries

Import libraries for the DBTools interface are provided with SQL Anywhere for Windows and Windows Mobile. For Windows, they can be found in the *SDK\Lib\x86* and *SDK\Lib\x64* subdirectories under your SQL Anywhere installation directory. For Windows Mobile, the import library can be found in the *SDK\Lib\CE\Arm.50* subdirectory under your SQL Anywhere installation directory. The provided DBTools import libraries are as follows:

Compiler	Library
Microsoft Windows	*dbtlstm.lib*
Microsoft Windows Mobile	*dbtool12.lib*

Starting and finishing the DBTools library

Before using any other DBTools functions, you must call DBToolsInit. When you are finished using the DBTools library, you must call DBToolsFini.

The primary purpose of the DBToolsInit and DBToolsFini functions is to allow the DBTools library to load the SQL Anywhere message library. The messages library contains localized versions of all error messages and prompts that DBTools uses internally. If DBToolsFini is not called, the reference count of the messages library is not decremented and it will not be unloaded, so be careful to ensure there is a matched pair of DBToolsInit/DBToolsFini calls.

The following code fragment illustrates how to initialize and clean up DBTools:

```
// Declarations
a_dbtools_info  info;
short           ret;

//Initialize the a_dbtools_info structure
memset( &info, 0, sizeof( a_dbtools_info) );
info.errorrtn = (MSG_CALLBACK)MyErrorRtn;

// initialize the DBTools library
ret = DBToolsInit( &info );
if( ret != EXIT_OKAY ) {
    // library initialization failed
    ...
}
// call some DBTools routines ...
...
// finalize the DBTools library
DBToolsFini( &info );
```

Calling the DBTools functions

All the tools are run by first filling out a structure, and then calling a function (or **entry point**) in the DBTools library. Each entry point takes a pointer to a single structure as argument.

The following example shows how to use the DBBackup function on a Windows operating system.

```
// Initialize the structure
a_backup_db backup_info;
memset( &backup_info, 0, sizeof( backup_info ) );

// Fill out the structure
backup_info.version = DB_TOOLS_VERSION_NUMBER;
backup_info.output_dir = "c:\\backup";
backup_info.connectparms ="UID=DBA;PWD=sql;DBF=demo.db";

backup_info.confirmrtn = (MSG_CALLBACK) ConfirmRtn ;
backup_info.errorrtn = (MSG_CALLBACK) ErrorRtn ;
backup_info.msgrtn = (MSG_CALLBACK) MessageRtn ;
backup_info.statusrtn = (MSG_CALLBACK) StatusRtn ;
backup_info.backup_database = TRUE;

// start the backup
DBBackup( &backup_info );
```

For information about the members of the DBTools structures, see “DBTools structures” on page 879.

Using callback functions

Several elements in DBTools structures are of type MSG_CALLBACK. These are pointers to callback functions.

Uses of callback functions

Callback functions allow DBTools functions to return control of operation to the user's calling application. The DBTools library uses callback functions to handle messages sent to the user by the DBTools functions for four purposes:

- **Confirmation** Called when an action needs to be confirmed by the user. For example, if the backup directory does not exist, the tools library asks if it needs to be created.
- **Error message** Called to handle a message when an error occurs, such as when an operation is out of disk space.
- **Information message** Called for the tools to display some message to the user (such as the name of the current table being unloaded).
- **Status information** Called for the tools to display the status of an operation (such as the percentage done when unloading a table).

Assigning a callback function to a structure

You can directly assign a callback routine to the structure. The following statement is an example using a backup structure:

```
backup_info.errorrtn = (MSG_CALLBACK) MyFunction
```

MSG_CALLBACK is defined in the *dllapi.h* header file supplied with SQL Anywhere. Tools routines can call back to the calling application with messages that should appear in the appropriate user interface, whether that be a windowing environment, standard output on a character-based system, or other user interface.

Confirmation callback function example

The following example confirmation routine asks the user to answer YES or NO to a prompt and returns the user's selection:

```
extern short _callback ConfirmRtn(
        char * question )
{
    int ret = IDNO;
    if( question != NULL ) {
        ret = MessageBox( HwndParent, question,
        "Confirm", MB_ICONEXCLAMATION|MB_YESNO );
    }
    return( ret == IDYES );
}
```

Error callback function example

The following is an example of an error message handling routine, which displays the error message in a window.

```
extern short _callback ErrorRtn(
        char * errorstr )
{
    if( errorstr != NULL ) {
        MessageBox( HwndParent, errorstr, "Backup Error", MB_ICONSTOP|
MB_OK );
```



```
    }
    return( 0 );
}
```

Message callback function example

A common implementation of a message callback function outputs the message to the screen:

```
extern short _callback MessageRtn(
        char * messagestr )
{
    if( messagestr != NULL ) {
                    OutputMessageToWindow( messagestr );
    }
    return( 0 );
}
```

Status callback function example

A status callback routine is called when a tool needs to display the status of an operation (like the percentage done unloading a table). A common implementation would just output the message to the screen:

```
extern short _callback StatusRtn(
        char * statusstr )
{
    if( statusstr != NULL ) {
        OutputMessageToWindow( statusstr );
    return( 0 );
}
```

Version numbers and compatibility

Each structure has a member that indicates the version number. You should use this version member to hold the version of the DBTools library that your application was developed against. The current version of the DBTools library is defined when you include the *dbtools.h* header file.

To assign the current version number to a structure

- Assign the version constant to the version member of the structure before calling the DBTools function. The following line assigns the current version to a backup structure:

  ```
  backup_info.version = DB_TOOLS_VERSION_NUMBER;
  ```

Compatibility

The version number allows your application to continue working against newer versions of the DBTools library. The DBTools functions use the version number supplied by your application to allow the application to work, even if new members have been added to the DBTools structure.

When any of the DBTools structures are updated, or when a newer version of the software is released, the version number is augmented. If you use DB_TOOLS_VERSION_NUMBER and you rebuild your application with a new version of the DBTools header file, then you must deploy a new version of the DBTools library. If the functionality of your application doesn't change, then you may want to use one of the version-specific macros defined in *dbtlsvers.h*, so that a library version mismatch does not occur.

Using bit fields

Many of the DBTools structures use bit fields to hold Boolean information in a compact manner. For example, the backup structure includes the following bit fields:

```
a_bit_field     backup_database : 1;
a_bit_field     backup_logfile  : 1;
a_bit_field     no_confirm      : 1;
a_bit_field     quiet           : 1;
a_bit_field     rename_log      : 1;
a_bit_field     truncate_log    : 1;
a_bit_field     rename_local_log: 1;
a_bit_field     server_backup   : 1;
```

Each bit field is one bit long, indicated by the 1 to the right of the colon in the structure declaration. The specific data type used depends on the value assigned to a_bit_field, which is set at the top of *dbtools.h*, and is operating system-dependent.

You assign a value of 0 or 1 to a bit field to pass Boolean information in the structure.

A DBTools example

You can find this sample and instructions for compiling it in the *samples-dir\SQLAnywhere\DBTools* directory. The sample program itself is in *main.cpp*. The sample illustrates how to use the DBTools library to perform a backup of a database.

```
#define WIN32

#include <stdio.h>
#include <string.h>
#include "windows.h"
#include "sqldef.h"
#include "dbtools.h"
extern short _callback ConfirmCallBack( char * str )
{
    if( MessageBox( NULL, str, "Backup",
         MB_YESNO|MB_ICONQUESTION ) == IDYES )
    {
        return 1;
    }
    return 0;
}
extern short _callback MessageCallBack( char * str )
{
    if( str != NULL )
    {
        fprintf( stdout, "%s\n", str );
    }
    return 0;
}
extern short _callback StatusCallBack( char * str )
{
    if( str != NULL )
    {
        fprintf( stdout, "%s\n", str );
    }
```



```
    return 0;
}
extern short _callback ErrorCallBack( char * str )
{
    if( str != NULL )
    {
        fprintf( stdout, "%s\n", str );
    }
    return 0;
}
typedef void (CALLBACK *DBTOOLSPROC)( void * );
typedef short (CALLBACK *DBTOOLSFUNC)( void * );

// Main entry point into the program.
int main( int argc, char * argv[] )
{
    a_dbtools_info  dbt_info;
    a_backup_db     backup_info;
    char            dir_name[ _MAX_PATH + 1];
    char            connect[ 256 ];
    HINSTANCE       hinst;
    DBTOOLSFUNC     dbbackup;
    DBTOOLSFUNC     dbtoolsinit;
    DBTOOLSPROC     dbtoolsfini;
    short           ret_code;

    // Always initialize to 0 so new versions
    // of the structure will be compatible.
    memset( &dbt_info, 0, sizeof( a_dbtools_info ) );
    dbt_info.errorrtn = (MSG_CALLBACK)MessageCallBack;;

    memset( &backup_info, 0, sizeof( a_backup_db ) );
    backup_info.version = DB_TOOLS_VERSION_NUMBER;
    backup_info.quiet = 0;
    backup_info.no_confirm = 0;
    backup_info.confirmrtn = (MSG_CALLBACK)ConfirmCallBack;
    backup_info.errorrtn = (MSG_CALLBACK)ErrorCallBack;
    backup_info.msgrtn = (MSG_CALLBACK)MessageCallBack;
    backup_info.statusrtn = (MSG_CALLBACK)StatusCallBack;
    if( argc > 1 )
    {
        strncpy( dir_name, argv[1], _MAX_PATH );
    }
    else
    {
        // DBTools does not expect (or like) a trailing slash
        strcpy( dir_name, "c:\\temp" );
    }
    backup_info.output_dir = dir_name;
    if( argc > 2 )
    {
        strncpy( connect, argv[2], 255 );
    }
    else
    {
        strcpy( connect, "DSN=SQL Anywhere 12 Demo" );
    }
    backup_info.connectparms = connect;
    backup_info.quiet = 0;
    backup_info.no_confirm = 0;
    backup_info.backup_database = 1;
    backup_info.backup_logfile = 1;
    backup_info.rename_log = 0;
    backup_info.truncate_log = 0;
```

```
        hinst = LoadLibrary( "dbtool12.dll" );
        if( hinst == NULL )
        {
            // Failed
            return EXIT_FAIL;
        }
        dbbackup = (DBTOOLSFUNC) GetProcAddress( (HMODULE)hinst,
            "_DBBackup@4" );
        dbtoolsinit = (DBTOOLSFUNC) GetProcAddress( (HMODULE)hinst,
            "_DBToolsInit@4" );
        dbtoolsfini = (DBTOOLSPROC) GetProcAddress( (HMODULE)hinst,
            "_DBToolsFini@4" );
        ret_code = (*dbtoolsinit)( &dbt_info );
        if( ret_code != EXIT_OKAY ) {
            return ret_code;
        }
        ret_code = (*dbbackup)( &backup_info );
        (*dbtoolsfini)( &dbt_info );
        FreeLibrary( hinst );
        return ret_code;
    }
```

DBTools functions

DBBackup function

Backs up a database. This function is used by the dbbackup utility.

Prototype

short **DBBackup (** const a_backup_db * **);**

Parameters

A pointer to a structure. See “a_backup_db structure” on page 880.

Return value

A return code, as listed in “Software component exit codes” on page 925.

Remarks

The DBBackup function manages all client-side database backup tasks.

For a description of these tasks, see “Backup utility (dbbackup)” [*SQL Anywhere Server - Database Administration*].

To perform a server-side backup, use the BACKUP DATABASE statement. See “BACKUP statement” [*SQL Anywhere Server - SQL Reference*].

DBChangeLogName function

Changes the name of the transaction log file. This function is used by the dblog utility.

Prototype

short **DBChangeLogName (** const a_change_log * **);**

Parameters

A pointer to a structure. See "a_change_log structure" on page 881.

Return value

A return code, as listed in "Software component exit codes" on page 925.

Remarks

The -t option of the Transaction Log utility (dblog) changes the name of the transaction log. DBChangeLogName provides a programmatic interface to this function.

For a description of the dblog utility, see "Transaction Log utility (dblog)" [*SQL Anywhere Server - Database Administration*].

See also

- "ALTER DATABASE statement" [*SQL Anywhere Server - SQL Reference*]

DBCreate function

Creates a database. This function is used by the dbinit utility.

Prototype

short **DBCreate (** const a_create_db * **);**

Parameters

A pointer to a structure. See "a_create_db structure" on page 883.

Return value

A return code, as listed in "Software component exit codes" on page 925.

Remarks

For information about the dbinit utility, see "Initialization utility (dbinit)" [*SQL Anywhere Server - Database Administration*].

See also

- "CREATE DATABASE statement" [*SQL Anywhere Server - SQL Reference*]

DBCreatedVersion function

Determines the version of SQL Anywhere that was used to create a database file, without attempting to start the database. Currently, this function only differentiates between databases built with version 9 or earlier and those built with version 10 or later.

Prototype

short **DBCreatedVersion (** a_db_version_info * **);**

Parameters

A pointer to a structure. See "a_db_version_info structure" on page 888.

Return value

A return code, as listed in "Software component exit codes" on page 925.

Remarks

If the return code indicates success, then the created_version field of the a_db_version_info structure contains a value of type a_db_version indicating which version of SQL Anywhere created the database. For the definition of the possible values, see "a_db_version enumeration" on page 921.

Version information is not set if a failing code is returned.

See also

- "CREATE DATABASE statement" [*SQL Anywhere Server - SQL Reference*]
- "a_db_version_info structure" on page 888
- "a_db_version enumeration" on page 921

DBErase function

Erases a database file and/or transaction log file. This function is used by the dberase utility.

Prototype

short **DBErase (** const an_erase_db * **);**

Parameters

A pointer to a structure. See "an_erase_db structure" on page 890.

Return value

A return code, as listed in "Software component exit codes" on page 925.

Remarks

For information about the Erase utility and its features, see "Erase utility (dberase)" [*SQL Anywhere Server - Database Administration*].

DBInfo function

Returns information about a database file. This function is used by the dbinfo utility.

Prototype

short **DBInfo (** const a_db_info * **);**

Parameters

A pointer to a structure. See "a_db_info structure" on page 886.

Return value

A return code, as listed in "Software component exit codes" on page 925.

Remarks

For information about the Information utility and its features, see "Information utility (dbinfo)" [*SQL Anywhere Server - Database Administration*].

See also

- "DBInfoDump function" on page 873
- "DBInfoFree function" on page 874
- "DB_PROPERTY function [System]" [*SQL Anywhere Server - SQL Reference*]

DBInfoDump function

Returns information about a database file. This function is used by the dbinfo utility when the -u option is used.

Prototype

short **DBInfoDump (** const a_db_info * **);**

Parameters

A pointer to a structure. See "a_db_info structure" on page 886.

Return value

A return code, as listed in "Software component exit codes" on page 925.

Remarks

For information about the Information utility and its features, see "Information utility (dbinfo)" [*SQL Anywhere Server - Database Administration*].

See also

- "DBInfo function" on page 873
- "DBInfoFree function" on page 874
- "sa_table_page_usage system procedure" [*SQL Anywhere Server - SQL Reference*]

DBInfoFree function

Frees resources after the DBInfoDump function is called.

Prototype

short **DBInfoFree (** const a_db_info * **);**

Parameters

A pointer to a structure. See "a_db_info structure" on page 886.

Return value

A return code, as listed in "Software component exit codes" on page 925.

Remarks

For information about the Information utility and its features, see "Information utility (dbinfo)" [*SQL Anywhere Server - Database Administration*].

See also

- "DBInfo function" on page 873
- "DBInfoDump function" on page 873

DBLicense function

Modifies or reports the licensing information of the database server.

Prototype

short **DBLicense (** const a_dblic_info * **);**

Parameters

A pointer to a structure. See "a_dblic_info structure" on page 889.

Return value

A return code, as listed in "Software component exit codes" on page 925.

Remarks

For information about the Server Licensing utility and its features, see "Server Licensing utility (dblic)" [*SQL Anywhere Server - Database Administration*].

DBRemoteSQL function

Accesses the SQL Remote Message Agent.

Prototype

short **DBRemoteSQL(** const a _remote_sql * **);**

Parameters

A pointer to a structure. See "a_remote_sql structure" on page 892.

Return value

A return code, as listed in "Software component exit codes" on page 925.

Remarks

For information about the features you can access, see "SQL Remote Message Agent utility (dbremote)" [*SQL Remote*].

See also

- "Introducing SQL Remote" [*SQL Remote*]

DBSynchronizeLog function

Synchronize a database with a MobiLink server.

Prototype

short **DBSynchronizeLog(** const a _sync_db * **);**

Parameters

A pointer to a structure. See "a_sync_db structure" on page 897.

Return value

A return code, as listed in "Software component exit codes" on page 925.

Remarks

For information about the features you can access, see "Initiating synchronization" [*MobiLink - Client Administration*].

See also

- "DBTools interface for dbmlsync" [*MobiLink - Client Administration*]

DBToolsFini function

Decrements the counter and frees resources when an application is finished with the DBTools library.

Prototype

short **DBToolsFini (** const a_dbtools_info * **);**

Parameters

A pointer to a structure. See "a_dbtools_info structure" on page 890.

Return value

A return code, as listed in "Software component exit codes" on page 925.

Remarks

The DBToolsFini function must be called at the end of any application that uses the DBTools interface. Failure to do so can lead to lost memory resources.

See also

- "DBToolsInit function" on page 876

DBToolsInit function

Prepares the DBTools library for use.

Prototype

short **DBToolsInit(** const a_dbtools_info * **);**

Parameters

A pointer to a structure. See "a_dbtools_info structure" on page 890.

Return value

A return code, as listed in "Software component exit codes" on page 925.

Remarks

The primary purpose of the DBToolsInit function is to load the SQL Anywhere messages library. The messages library contains localized versions of error messages and prompts that DBTools uses internally.

The DBToolsInit function must be called at the start of any application that uses the DBTools interface, before any other DBTools functions. For an example, see "A DBTools example" on page 868.

See also

- "DBToolsFini function" on page 875

DBToolsVersion function

Returns the version number of the DBTools library.

Prototype

short **DBToolsVersion (** void **);**

Return value

A short integer indicating the version number of the DBTools library.

Remarks

Use the DBToolsVersion function to check that the DBTools library is not older than one against which your application is developed. While applications can run against newer versions of DBTools, they cannot run against older versions.

See also

- "Version numbers and compatibility" on page 867

DBTranslateLog function

Translates a transaction log file to SQL. This function is used by the dbtran utility.

Prototype

short **DBTranslateLog (** const a_translate_log * **);**

Parameters

A pointer to a structure. See "a_translate_log structure" on page 907.

Return value

A return code, as listed in "Software component exit codes" on page 925.

Remarks

For information about the Log Translation utility, see "Log Translation utility (dbtran)" [*SQL Anywhere Server - Database Administration*].

DBTruncateLog function

Truncates a transaction log file. This function is used by the dbbackup utility.

Prototype

short **DBTruncateLog (** const a_truncate_log * **);**

Parameters

A pointer to a structure. See "a_truncate_log structure" on page 911.

Return value

A return code, as listed in "Software component exit codes" on page 925.

Remarks

For information about the Backup utility, see "Backup utility (dbbackup)" [*SQL Anywhere Server - Database Administration*].

See also

- "BACKUP statement" [*SQL Anywhere Server - SQL Reference*]

DBUnload function

Unloads a database. This function is used by the dbunload and dbxtract utilities.

Prototype

short **DBUnload (** const an_unload_db * **);**

Parameters

A pointer to a structure. See "an_unload_db structure" on page 912.

Return value

A return code, as listed in "Software component exit codes" on page 925.

Remarks

For information about the Unload utility, see "Unload utility (dbunload)" [*SQL Anywhere Server - Database Administration*].

For information about the Extraction utility, see "Extraction utility (dbxtract)" [*SQL Remote*].

DBUpgrade function

Upgrades a database file. This function is used by the dbupgrad utility.

Prototype

short **DBUpgrade (** const an_upgrade_db * **);**

Parameters

A pointer to a structure. See "an_upgrade_db structure" on page 917.

Return value

A return code, as listed in "Software component exit codes" on page 925.

Remarks

For information about the Upgrade utility, see "Upgrade utility (dbupgrad)" [*SQL Anywhere Server - Database Administration*].

See also

- "ALTER DATABASE statement" [*SQL Anywhere Server - SQL Reference*]

DBValidate function

Validates all or part of a database. This function is used by the dbvalid utility.

Prototype

short **DBValidate (** const a_validate_db * **);**

Parameters

A pointer to a structure. See "a_validate_db structure" on page 918.

Return value

A return code, as listed in "Software component exit codes" on page 925.

Remarks

For information about the Validation utility, see "Validation utility (dbvalid)" [*SQL Anywhere Server - Database Administration*].

Caution
Validating a table or an entire database should be performed while no connections are making changes to the database; otherwise, spurious errors may be reported indicating some form of database corruption even though no corruption actually exists.

See also

- "VALIDATE statement" [*SQL Anywhere Server - SQL Reference*]
- "sa_validate system procedure" [*SQL Anywhere Server - SQL Reference*]

DBTools structures

This section lists the structures that are used to exchange information with the DBTools library. The structures are listed alphabetically. With the exception of the a_remote_sql structure, all of these structures are defined in *dbtools.h*. The a_remote_sql structure is defined in *dbrmt.h*.

Many of the structure elements correspond to command line options on the corresponding utility. For example, several structures have a member named quiet, which can take on values of 0 or 1. This member corresponds to the quiet operation (-q) option used by many of the utilities.

a_backup_db structure

Holds the information needed to perform backup tasks using the DBTools library.

Syntax

```
typedef struct a_backup_db {
    unsigned short      version;
    const char *        output_dir;
    const char *        connectparms;
    MSG_CALLBACK        confirmrtn;
    MSG_CALLBACK        errorrtn;
    MSG_CALLBACK        msgrtn;
    MSG_CALLBACK        statusrtn;
    a_bit_field         backup_database : 1;
    a_bit_field         backup_logfile  : 1;
    a_bit_field         no_confirm      : 1;
    a_bit_field         quiet           : 1;
    a_bit_field         rename_log      : 1;
    a_bit_field         truncate_log    : 1;
    a_bit_field         rename_local_log: 1;
    a_bit_field         server_backup   : 1;
    const char *        hotlog_filename;
    char                backup_interrupted;
    a_chkpt_log_type    chkpt_log_type;
    a_sql_uint32        page_blocksize;
} a_backup_db;
```

Members

Member	Description
Version	DBTools version number.
output_dir	Path to the output directory. For example: `"c:\backup"`

connectparms	Parameters needed to connect to the database. They take the form of connection strings, such as the following:
	`"UID=DBA;PWD=sql;DBF=samples-dir\demo.db"`
	The database server would be started by the connection string START parameter. For example:
	`"START=c:\SQLAny12\bin32\dbeng12.exe"`
	A full example connection string including the START parameter:
	`"UID=DBA;PWD=sql;DBF=samples-dir\demo.db;START=c:\SQLAny12\bin32\dbeng12.exe"`
	For a list of connection parameters, see "Connection parameters" [*SQL Anywhere Server - Database Administration*].

Member	Description
confirmrtn	Callback routine for confirming an action.
errorrtn	Callback routine for handling an error message.
msgrtn	Callback routine for handling an information message.
statusrtn	Callback routine for handling a status message.
backup_database	Back up the database file (1) or not (0).
backup_logfile	Back up the transaction log file (1) or not (0).
no_confirm	Operate with (0) or without (1) confirmation.
quiet	Operate without printing messages (1), or print messages (0).
rename_log	Rename the transaction log.
truncate_log	Delete the transaction log.
rename_local_log	Rename the local backup of the transaction log.
server_backup	When set to 1, indicates backup on server using BACKUP DATABASE. Equivalent to dbbackup -s option.
hotlog_filename	File name for the live backup file.
backup_interrupted	Indicates that the operation was interrupted.
chkpt_log_type	Control copying of checkpoint log. Must be one of BACKUP_CHKPT_LOG_COPY, BACKUP_CHKPT_LOG_NOCOPY, BACKUP_CHKPT_LOG_RECOVER,BACKUP_CHKPT_LOG_AUTO, or BACKUP_CHKPT_LOG_DEFAULT.
page_blocksize	Number of pages in data blocks. Equivalent to dbbackup -b option. If set to 0, then the default is 128.

See also

- “DBBackup function” on page 870
- “a_db_version enumeration” on page 921
- “Using callback functions” on page 865

a_change_log structure

Holds the information needed to perform dblog tasks using the DBTools library.

Syntax

```
typedef struct a_change_log {
    unsigned short      version;
    const char *        dbname;
    const char *        logname;
    MSG_CALLBACK        errorrtn;
    MSG_CALLBACK        msgrtn;
    a_bit_field         query_only              : 1;
    a_bit_field         quiet                   : 1;
    a_bit_field         change_mirrorname       : 1;
    a_bit_field         change_logname          : 1;
    a_bit_field         ignore_ltm_trunc        : 1;
    a_bit_field         ignore_remote_trunc     : 1;
    a_bit_field         set_generation_number   : 1;
    a_bit_field         ignore_dbsync_trunc     : 1;
    const char *        mirrorname;
    unsigned short      generation_number;
    char *              zap_current_offset;
    char *              zap_starting_offset;
    char *              encryption_key;
} a_change_log;
```

Members

Member	Description
version	DBTools version number.
dbname	Database file name.
logname	The name of the transaction log. If set to NULL, there is no log.
errorrtn	Callback routine for handling an error message.
msgrtn	Callback routine for handling an information message.
query_only	If 1, just display the name of the transaction log. If 0, permit changing of the log name.
quiet	Operate without printing messages (1), or print messages (0).
change_mirrorname	If 1, permit changing of the log mirror name.
change_logname	If 1, permit changing of the transaction log name.
ignore_ltm_trunc	Reserved. Use FALSE.
ignore_remote_trunc	For SQL Remote. Resets the offset kept for the delete_old_logs option, allowing transaction logs to be deleted when they are no longer needed.
set_generation_number	Reserved. Use FALSE.

Member	Description
ignore_dbsync_trunc	When using dbmlsync, resets the offset kept for the delete_old_logs option, allowing transaction logs to be deleted when they are no longer needed.
mirrorname	The new name of the transaction log mirror file.
generation_number	The new generation number. Used together with set_generation_number.
zap_current_offset	Change the current offset to the specified value. This is for use only in resetting a transaction log after an unload and reload to match dbremote or dbmlsync settings.
zap_starting_offset	Change the starting offset to the specified value. This is for use only in resetting a transaction log after an unload and reload to match dbremote or dbmlsync settings.
encryption_key	The encryption key for the database file.

See also

- "DBChangeLogName function" on page 870
- "Using callback functions" on page 865

a_create_db structure

Holds the information needed to create a database using the DBTools library.

Syntax

```
typedef struct a_create_db {
    unsigned short      version;
    const char          *dbname;
    const char          *logname;
    const char          *startline;
    unsigned short      page_size;
    const char          *default_collation;
    const char          *nchar_collation;
    const char          *encoding;
    MSG_CALLBACK        errorrtn;
    MSG_CALLBACK        msgrtn;

    a_bit_field         blank_pad               : 2;
    a_bit_field         respect_case            : 1;
    a_bit_field         encrypt                 : 1;
    a_bit_field         avoid_view_collisions   : 1;
    a_bit_field         jconnect                : 1;
    a_bit_field         checksum                : 1;
    a_bit_field         encrypted_tables        : 1;
    a_bit_field         case_sensitivity_use_default : 1;
    char                verbose;
```

```
    char                accent_sensitivity;
    const char          *mirrorname;
    const char          *data_store_type;
    const char          *encryption_key;
    const char          *encryption_algorithm;
    char                *dba_uid;
    char                *dba_pwd;
    unsigned int        db_size;
    int                 db_size_unit;
    void                *iq_params;
} a_create_db;
```

Members

Member	Description
version	DBTools version number.
dbname	Database file name.
logname	New transaction log name.

startline	The command line used to start the database server. For example:
	`"c:\SQLAny12\bin32\dbeng12.exe"`
	The default start line is used if this member is NULL.
	The following is the default START parameter:
	`"dbeng12 -gp page_size -c 10M"`

page_size	The page size of the database.
default_collation	The collation for the database.
nchar_collation	If not NULL, use to generate the NCHAR COLLATION clause with specified string.
errorrtn	Callback routine for handling an error message.
msgrtn	Callback routine for handling an information message.
blank_pad	Must be one of NO_BLANK_PADDING or BLANK_PADDING. Treat blanks as significant in string comparisons and hold index information to reflect this. See “Blank padding enumeration” on page 920.
respect_case	Make string comparisons case sensitive and hold index information to reflect this.
encrypt	When set, generates the ENCRYPTED ON or, when encrypted_tables is also set, the ENCRYPTED TABLES ON clause.

Member	Description
avoid_view_collisions	Omit the generation of Watcom SQL compatibility views SYS.SYSCOLUMNS and SYS.SYSINDEXES.
jconnect	Include system procedures needed for jConnect.
checksum	Set to 1 for ON or 0 for OFF. Generates one of CHECKSUM ON or CHECKSUM OFF clauses. See "Using checksums to detect corruption" [*SQL Anywhere Server - Database Administration*].
encrypted_tables	Set to 1 for encrypted tables. Used with encrypt, generates the ENCRYPTED TABLE ON clause instead of the ENCRYPTED ON clause.
case_sensitivity_use_default	If set, use the default case sensitivity for the locale. This only affects UCA. When set, do not add the CASE RESPECT clause to the CREATE DATABASE statement.
verbose	See "Verbosity enumeration" on page 924.
accent_sensitivity	One of y, n, or f (yes, no, french). Generates one of the ACCENT RESPECT, ACCENT IGNORE or ACCENT FRENCH clauses.
mirrorname	Transaction log mirror name.
data_store_type	Reserved. Use NULL.
encryption_key	The encryption key for the database file. Used with encrypt, it generates the KEY clause.
encryption_algorithm	The encryption algorithm (AES, AES256, AES_FIPS, or AES256_FIPS). Used with encrypt and encryption_key, it generates the ALGORITHM clause.
dba_uid	When not NULL, generates the DBA USER xxx clause.
dba_pwd	When not NULL, generates the DBA PASSWORD xxx clause.
db_size	When not 0, generates the DATABASE SIZE clause.
db_size_unit	Used with db_size, must be one of DBSP_UNIT_NONE, DBSP_UNIT_PAGES, DBSP_UNIT_BYTES, DBSP_UNIT_KILOBYTES, DBSP_UNIT_MEGABYTES, DBSP_UNIT_GIGABYTES, DBSP_UNIT_TERABYTES. When not DBSP_UNIT_NONE, it generates the corresponding keyword (for example, DATABASE SIZE 10 MB is generated when db_size is 10 and db_size_unit is DBSP_UNIT_MEGABYTES). See "Database size unit enumeration" on page 921.

Member	Description
iq_params	Reserved. Use NULL.

See also

- "DBCreate function" on page 871
- "Using callback functions" on page 865

a_db_info structure

Holds the information needed to return dbinfo information using the DBTools library.

Syntax

```
typedef struct a_db_info {
    unsigned short      version;
    MSG_CALLBACK        errorrtn;
    MSG_CALLBACK        msgrtn;
    MSG_CALLBACK        statusrtn;
    unsigned short      dbbufsize;
    char *              dbnamebuffer;
    unsigned short      logbufsize;
    char *              lognamebuffer;
    unsigned short      mirrorbufsize;
    char *              mirrornamebuffer;
    unsigned short      collationnamebufsize;
    char *              collationnamebuffer;
    const char *        connectparms;
    a_bit_field         quiet    : 1;
    a_bit_field         page_usage : 1;
    a_sysinfo           sysinfo;
    a_table_info *      totals;
    a_sql_uint32        file_size;
    a_sql_uint32        free_pages;
    a_sql_uint32        bit_map_pages;
    a_sql_uint32        other_pages;
    a_bit_field         checksum : 1;
    a_bit_field         encrypted_tables : 1;
} a_db_info;
```

Members

Member	Description
version	DBTools version number.
errorrtn	Callback routine for handling an error message.
msgrtn	Callback routine for handling an information message.
statusrtn	Callback routine for handling a status message.

Member	Description
dbbufsize	Set the length of the database file name buffer (for example, _MAX_PATH).
dbnamebuffer	Set the pointer to database file name buffer.
logbufsize	Set the length of the transaction log file name buffer (for example, _MAX_PATH).
lognamebuffer	Set the pointer to the transaction log file name buffer.
mirrorbufsize	Set the length of the mirror file name buffer (for example, _MAX_PATH).
mirrornamebuffer	Set the pointer to the mirror file name buffer.
collationnamebufsize	Set the length of the database collation name and label buffer (the maximum size is 129 including space for the null character).
collationnamebuffer	Set the pointer to the database collation name and label buffer.

connectparms	Parameters needed to connect to the database. They take the form of connection strings, such as the following:
	`"UID=DBA;PWD=sql;DBF=samples-dir\demo.db"`
	The database server would be started by the connection string START parameter. For example:
	`"START=c:\SQLAny12\bin32\dbeng12.exe"`
	A full example connection string including the START parameter:
	`"UID=DBA;PWD=sql;DBF=samples-dir\demo.db;START=c:\SQLAny12\bin32\dbeng12.exe"`
	For a list of connection parameters, see "Connection parameters" [*SQL Anywhere Server - Database Administration*].

quiet	Operate without confirming messages.
page_usage	1 to report page usage statistics, otherwise 0.
sysinfo	a_sysinfo structure. See "a_sysinfo structure" on page 906.
totals	Pointer to a_table_info structure. See "a_table_info structure" on page 907.
file_size	Size of database file.
free_pages	Number of free pages.

Member	Description
bit_map_pages	Number of bitmap pages in the database.
other_pages	Number of pages that are not table pages, index pages, free pages, or bitmap pages.
checksum	Global checksums enabled (a checksum on every database page) if 1, disabled if 0. See "Using checksums to detect corruption" [*SQL Anywhere Server - Database Administration*].
encrypted_tables	Encrypted tables are supported if 1, disabled if 0.

See also

- "DBInfo function" on page 873
- "Using callback functions" on page 865

a_db_version_info structure

Holds information regarding which version of SQL Anywhere was used to create the database.

Syntax

```
typedef struct a_db_version_info {
        unsigned short  version;
        const char      *filename;
        a_db_version    created_version;
        MSG_CALLBACK      errorrtn;
        MSG_CALLBACK      msgrtn;
   } a_db_version_info;
```

Members

Member	Description
version	DBTools version number.
filename	Name of the database file to check.
created_version	Set to a value of type a_db_version indicating the server version that create the database file. See "a_db_version enumeration" on page 921.
errorrtn	Callback routine for handling an error message.
msgrtn	Callback routine for handling an information message.

See also

- “DBCreatedVersion function” on page 871
- “a_db_version enumeration” on page 921
- “Using callback functions” on page 865

a_dblic_info structure

Holds information containing licensing information. You must use this information only in a manner consistent with your license agreement.

Syntax

```
typedef struct a_dblic_info {
    unsigned short      version;
    char                *exename;
    char                *username;
    char                *compname;
    a_sql_int32         nodecount;
    a_sql_int32         conncount;
    a_license_type      type;
    MSG_CALLBACK        errorrtn;
    MSG_CALLBACK        msgrtn;
    a_bit_field         quiet           : 1;
    a_bit_field         query_only      : 1;
    char                *installkey;
} a_dblic_info;
```

Members

Member	Description
version	DBTools version number.
exename	Name of the server executable or license file.
username	User name for licensing.
compname	Company name for licensing.
nodecount	Number of nodes licensed.
conncount	Must be 1000000L.
type	See *lictype.h* for values.
errorrtn	Callback routine for handling an error message.
msgrtn	Callback routine for handling an information message.
quiet	Operate without printing messages (1), or print messages (0).

Member	Description
query_only	If 1, just display the license information. If 0, permit changing the information.
installkey	Internal use only. Set to NULL.

a_dbtools_info structure

Holds the information needed to start and finish working with the DBTools library.

Syntax

```
typedef struct a_dbtools_info {
    MSG_CALLBACK        errorrtn;
} a_dbtools_info;
```

Members

Member	Description
errorrtn	Callback routine for handling an error message.

See also

- "DBToolsFini function" on page 875
- "DBToolsInit function" on page 876
- "Using callback functions" on page 865

an_erase_db structure

Holds information needed to erase a database using the DBTools library.

Syntax

```
typedef struct an_erase_db {
    unsigned short      version;
    const char *        dbname;
    MSG_CALLBACK        confirmrtn;
    MSG_CALLBACK        errorrtn;
    MSG_CALLBACK        msgrtn;
    a_bit_field         quiet : 1;
    a_bit_field         erase : 1;
    const char *        encryption_key;
} an_erase_db;
```


Members

Member	Description
version	DBTools version number.
dbname	Database file name to erase.
confirmrtn	Callback routine for confirming an action.
errorrtn	Callback routine for handling an error message.
msgrtn	Callback routine for handling an information message.
quiet	Operate without printing messages (1), or print messages (0).
erase	Erase without confirmation (1) or with confirmation (0).
encryption_key	The encryption key for the database file.

See also

- “DBErase function” on page 872
- “Using callback functions” on page 865

a_name structure

Holds a linked list of names. This is used by other structures requiring lists of names.

Syntax

```
typedef struct a_name {
    struct a_name *next;
    char          name[1];
} a_name, * p_name;
```

Members

Member	Description
next	Pointer to the next a_name structure in the list.
name	The name.

See also

- “a_translate_log structure” on page 907
- “a_validate_db structure” on page 918
- “an_unload_db structure” on page 912

a_remote_sql structure

Holds information needed for the dbremote utility using the DBTools library.

Syntax

```
typedef struct a_remote_sql {
    short               version;
    MSG_CALLBACK        confirmrtn;
    MSG_CALLBACK        errorrtn;
    MSG_CALLBACK        msgrtn;
    MSG_QUEUE_CALLBACK  msgqueuertn;
    char *              connectparms;
    char *              transaction_logs;
    a_bit_field         receive : 1;
    a_bit_field         send : 1;
    a_bit_field         verbose : 1;
    a_bit_field         deleted : 1;
    a_bit_field         apply : 1;
    a_bit_field         batch : 1;
    a_bit_field         more : 1;
    a_bit_field         triggers : 1;
    a_bit_field         debug : 1;
    a_bit_field         rename_log : 1;
    a_bit_field         latest_backup : 1;
    a_bit_field         scan_log : 1;
    a_bit_field         link_debug : 1;
    a_bit_field         full_q_scan : 1;
    a_bit_field         no_user_interaction : 1;
    a_bit_field         _unused1 : 1;
    a_sql_uint32        max_length;
    a_sql_uint32        memory;
    a_sql_uint32        frequency;
    a_sql_uint32        threads;
    a_sql_uint32        operations;
    char *              queueparms;
    char *              locale;
    a_sql_uint32        receive_delay;
    a_sql_uint32        patience_retry;
    MSG_CALLBACK        logrtn;
    a_bit_field         use_hex_offsets : 1;
    a_bit_field         use_relative_offsets : 1;
    a_bit_field         debug_page_offsets : 1;
    a_sql_uint32        debug_dump_size;
    a_sql_uint32        send_delay;
    a_sql_uint32        resend_urgency;
    char *              include_scan_range;
    SET_WINDOW_TITLE_CALLBACK set_window_title_rtn;
    char *              default_window_title;
    MSG_CALLBACK        progress_msg_rtn;
    SET_PROGRESS_CALLBACK progress_index_rtn;
    char **             argv;
    a_sql_uint32        log_size;
    char *              encryption_key;
    const char *        log_file_name;
    a_bit_field         truncate_remote_output_file:1;
    char *              remote_output_file_name;
    MSG_CALLBACK        warningrtn;
    char *              mirror_logs;
} a_remote_sql;
```

Members

Member	Description
version	DBTools version number.
confirmrtn	Pointer to a function that prints the given message and accepts a yes or no response returning TRUE if yes and FALSE if no.
errorrtn	Pointer to a function that prints the given error message.
msgrtn	Pointer to a function that prints the given informational (non-error) message.
msgqueuertn	Pointer to a function that should sleep for the number of milliseconds passed to it. This function is called with 0 when DBRemoteSQL is busy, but wants to allow the upper layer to process messages. This routine should return MSGQ_SLEEP_THROUGH normally, or MSGQ_SHUTDOWN_REQUESTED to stop SQL Remote processing.

connectparms	Parameters needed to connect to the database. Corresponds to the dbremote -c option. They take the form of connection strings, such as the following:
	`"UID=DBA;PWD=sql;DBF=samples-dir\demo.db"`
	The database server would be started by the connection string START parameter. For example:
	`"START=c:\SQLAny12\bin32\dbeng12.exe"`
	A full example connection string including the START parameter:
	`"UID=DBA;PWD=sql;DBF=samples-dir\demo.db;START=c:\SQLAny12\bin32\dbeng12.exe"`
	For a list of connection parameters, see “Connection parameters” [*SQL Anywhere Server - Database Administration*].

transaction_logs	Pointer to a string naming the directory with offline transaction logs. Corresponds to the transaction_logs_directory argument of dbremote.
receive	If receive is true, messages are received. Corresponds to the dbremote -r option. If receive and send are both false then both are assumed true. It is recommended that you set both to false.

Member	Description
send	If send is true, messages are sent. Corresponds to the dbremote -s option. If receive and send are both false then both are assumed true. It is recommended that you set both to false.
verbose	When true, extra information is printed. Corresponds to the dbremote -v option.
deleted	Should be set to true. If false, messages are not deleted after they are applied. Corresponds to dbremote -p option.
apply	Should be set to true. If false, messages are scanned, but not applied. Corresponds to dbremote -a option.
batch	If true, force exit after applying messages and scanning log. Same as at least one user having 'always' send time. If false, allow run mode to be determined by remote users' send times.
more	Should be set to true.
triggers	Should be set to false usually; otherwise, true means DBRemoteSQL replicates trigger actions. Corresponds to the dbremote -t option.
debug	Include debugging output if set true.
rename_log	If set to true, logs are renamed and restarted.
latest_backup	If set to true, only process logs that are backed up. Don't send operations from a live log. Corresponds to the dbremote -u option.
scan_log	Reserved; set to false.
link_debug	If set to true, debugging is turned on for links.
full_q_scan	Reserved; set to false.
no_user_interaction	If set to true, no user interaction is requested.
max_length	Set to the maximum length (in bytes) a message can have. This affects sending and receiving. The recommended value is 50000. Corresponds to the dbremote -l option.
memory	Set to the maximum size (in bytes) of memory buffers to use while building messages to send. The recommended value is at least 2 * 1024 * 1024. Corresponds to the dbremote -m option.

Member	Description
frequency	Set the polling frequency for incoming messages. This value should be set to the max(1, receive_delay/60). See receive_delay below.
threads	Set the number of worker threads that should be used to apply messages. This value must not exceed 50. Corresponds to the dbremote -w option.
operations	This value is used when applying messages. Commits are ignored until DBRemoteSQL has at least this number of operations(inserts, deletes, updates) that are uncommitted. Corresponds to the dbremote -g option.
queueparms	Reserved; set to NULL.
locale	Reserved; set to NULL.
receive_delay	Set this to the time (in seconds) to wait between polls for new incoming messages. The recommended value is 60. Corresponds to the dbremote -rd option.
patience_retry	Set this to the number of polls for incoming messages that DBRemoteSQL should wait before assuming that a message it is expecting is lost. For example, if patience_retry is 3 then DBRemoteSQL tries up to three times to receive the missing message. Afterward, it sends a resend request. The recommended value is 1. Corresponds to the dbremote -rp option.
logrtn	Pointer to a function that prints the given message to a log file. These messages do not need to be seen by the user.
use_hex_offsets	Set to true if you want log offsets to be shown in hexadecimal notation; otherwise decimal notation will be used.
use_relative_offsets	Set to true if you want log offsets to be displayed as relative to the start of the current log file. Set to false if you want log offsets from the beginning of time to be displayed.
debug_page_offsets	Reserved; set to false.
debug_dump_size	Reserved; set to 0.
send_delay	Set the time (in seconds) between scans of the log file for new operations to send. Set to zero to allow DBRemoteSQL to choose a good value based on user send times. Corresponds to the dbremote -sd option.

Member	Description
resend_urgency	Set the time (in seconds) that DBRemoteSQL waits after seeing that a user needs a rescan before performing a full scan of the log. Set to zero to allow DBRemoteSQL to choose a good value based on user send times and other information it has collected. Corresponds to the dbremote -ru option.
include_scan_range	Reserved; set to NULL.
set_window_title_rtn	Pointer to a function that resets the title of the window (Windows only). The title could be "*database_name* (receiving, scanning, or sending) - *default_window_title*".
default_window_title	A pointer to the default window title string.
progress_msg_rtn	Pointer to a function that displays a progress message.
progress_index_rtn	Pointer to a function that updates the state of the progress bar. This function takes two unsigned integer arguments *index* and *max*. On the first call, the values are the minimum and maximum values (for example, 0, 100). On subsequent calls, the first argument is the current index value (for example, between 0 and 100) and the second argument is always 0.
argv	Pointer to a parsed command line (a vector of pointers to strings). If not NULL, then DBRemoteSQL will call a message routine to display each command line argument except those prefixed with -c, -cq, or -ek.
log_size	DBRemoteSQL renames and restarts the online transaction log when the size of the online transaction log is greater than this value. Corresponds to the dbremote -x option.
encryption_key	Pointer to an encryption key. Corresponds to the dbremote -ek option.
log_file_name	Pointer to the name of the DBRemoteSQL output log to which the message callbacks print their output. If *send* is true, the error log is sent to the consolidated (unless this pointer is NULL).
truncate_remote_output_file	Set to true to cause the remote output file to be truncated rather than appended to. See below. Corresponds to the dbremote -rt option.
remote_output_file_name	Pointer to the name of the DBRemoteSQL remote output file. Corresponds to the dbremote -ro or -rt option.

Member	Description
warningrtn	Pointer to a function that prints the given warning message. If NULL, the *errorrtn* function is called instead.
mirror_logs	Pointer to the name of the directory containing offline mirror transaction logs. Corresponds to the dbremote -ml option.

The dbremote tool sets the following defaults before processing any command-line options:

- version = DB_TOOLS_VERSION_NUMBER
- argv = (argument vector passed to application)
- deleted = TRUE
- apply = TRUE
- more = TRUE
- link_debug = FALSE
- max_length = 50000
- memory = 2 * 1024 * 1024
- frequency = 1
- threads = 0
- receive_delay = 60
- send_delay = 0
- log_size = 0
- patience_retry = 1
- resend_urgency = 0
- log_file_name = (set from command line)
- truncate_remote_output_file = FALSE
- remote_output_file_name = NULL
- no_user_interaction = TRUE (if user interface is not available)
- errorrtn = (address of an appropriate routine)
- msgrtn = (address of an appropriate routine)
- confirmrtn = (address of an appropriate routine)
- msgqueuertn = (address of an appropriate routine)
- logrtn = (address of an appropriate routine)
- warningrtn = (address of an appropriate routine)
- set_window_title_rtn = (address of an appropriate routine)
- progress_msg_rtn = (address of an appropriate routine)
- progress_index_rtn = (address of an appropriate routine)

See also

- "DBRemoteSQL function" on page 875
- "DBTools interface for dbmlsync" [*MobiLink - Client Administration*]

a_sync_db structure

Holds information needed for the dbmlsync utility using the DBTools library.

Syntax

```
typedef struct a_sync_db {
    unsigned short      version;
    char *              connectparms;
    char *              publication;
    const char *        offline_dir;
    char *              extended_options;
    char *              script_full_path;
    const char *        include_scan_range;
    const char *        raw_file;
    MSG_CALLBACK        confirmrtn;
    MSG_CALLBACK        errorrtn;
    MSG_CALLBACK        msgrtn;
    MSG_CALLBACK        logrtn;
    a_sql_uint32        debug_dump_size;
    a_sql_uint32        dl_insert_width;
    a_bit_field         verbose                 : 1;
    a_bit_field         debug                   : 1;
    a_bit_field         debug_dump_hex          : 1;
    a_bit_field         debug_dump_char         : 1;
    a_bit_field         debug_page_offsets      : 1;
    a_bit_field         use_hex_offsets         : 1;
    a_bit_field         use_relative_offsets    : 1;
    a_bit_field         output_to_file          : 1;
    a_bit_field         output_to_mobile_link   : 1;
    a_bit_field         dl_use_put              : 1;
    a_bit_field         kill_other_connections  : 1;
    a_bit_field         retry_remote_behind     : 1;
    a_bit_field         ignore_debug_interrupt  : 1;
    SET_WINDOW_TITLE_CALLBACK set_window_title_rtn;
    char *              default_window_title;
    MSG_QUEUE_CALLBACK  msgqueuertn;
    MSG_CALLBACK        progress_msg_rtn;
    SET_PROGRESS_CALLBACK progress_index_rtn;
    char **             argv;
    char **             ce_argv;
    a_bit_field         connectparms_allocated  : 1;
    a_bit_field         entered_dialog          : 1;
    a_bit_field         used_dialog_allocation  : 1;
    a_bit_field         ignore_scheduling       : 1;
    a_bit_field         ignore_hook_errors      : 1;
    a_bit_field         changing_pwd            : 1;
    a_bit_field         prompt_again            : 1;
    a_bit_field         retry_remote_ahead      : 1;
    a_bit_field         rename_log              : 1;
    a_bit_field         hide_conn_str           : 1;
    a_bit_field         hide_ml_pwd             : 1;
    a_sql_uint32        dlg_launch_focus;
    char *              mlpassword;
    char *              new_mlpassword;
    char *              verify_mlpassword;
    USAGE_CALLBACK      usage_rtn;
    a_sql_uint32        log_size;
    a_sql_uint32        hovering_frequency;
    a_bit_short         ignore_hovering         : 1;
    a_bit_short         verbose_upload          : 1;
    a_bit_short         verbose_upload_data     : 1;
    a_bit_short         verbose_download        : 1;
    a_bit_short         verbose_download_data   : 1;
    a_bit_short         autoclose               : 1;
    a_bit_short         ping                    : 1;
    a_bit_short         _unused                 : 9;
    char *              encryption_key;
```



```
    a_syncpub *         upload_defs;
    const char *        log_file_name;
    char *              user_name;
    a_bit_short         verbose_minimum         : 1;
    a_bit_short         verbose_hook            : 1;
    a_bit_short         verbose_row_data        : 1;
    a_bit_short         verbose_row_cnts        : 1;
    a_bit_short         verbose_option_info     : 1;
    a_bit_short         strictly_ignore_trigger_ops : 1;
    a_bit_short         _unused2                : 10;
    a_sql_uint32        est_upld_row_cnt;
    STATUS_CALLBACK     status_rtn;
    MSG_CALLBACK        warningrtn;
    char **             ce_reproc_argv;
    a_bit_short         upload_only             : 1;
    a_bit_short         download_only           : 1;
    a_bit_short         allow_schema_change     : 1;
    a_bit_short         dnld_gen_num            : 1;
    a_bit_short         _unused3                :12;
    const char *        apply_dnld_file;
    const char *        create_dnld_file;
    char *              sync_params;
    const char *        dnld_file_extra;
    a_bit_short         trans_upload            : 1;
    a_bit_short         continue_download       : 1;
    a_bit_short         lite_blob_handling      : 1;
    a_sql_uint32        dnld_read_size;
    a_sql_uint32        dnld_fail_len;
    a_sql_uint32        upld_fail_len;
    a_bit_short         persist_connection      :1;
    a_bit_short         verbose_protocol        :1;
    a_bit_short         no_stream_compress      :1;
    a_bit_short         _unused4                :13;
    const char *        encrypted_stream_opts;
    a_sql_uint32        no_offline_logscan;
    a_bit_short         server_mode :1;
    a_bit_short         allow_outside_connect :1;
    a_bit_short         prompt_for_encrypt_key:1;
    a_bit_short         verbose_server:1;
    a_bit_short         _unused5 :11;
    a_sql_uint32        server_port;
    char *              preload_dlls;
    char *              sync_profile;
    char *              sync_opt;
    a_syncpub *         last_upload_def;
    a_sql_uint32        min_cache;
    char                min_cache_suffix;
    a_sql_uint32        max_cache;
    char                max_cache_suffix;
    a_sql_uint32        init_cache;
    char                init_cache_suffix;
    a_sql_int32         background_retry;
    a_bit_short         use_fixed_cache:1;
    a_bit_short         no_schema_cache:1;
    a_bit_short         cache_verbosity:1;
    a_bit_short         background_sync:1;
    a_bit_short         _unused6 :13;
} a_sync_db;
```

Members

Member	Description
version	DBTools version number.

connectparms	Parameters needed to connect to the database. They take the form of connection strings, such as the following:
	`"UID=DBA;PWD=sql;DBF=samples-dir\demo.db"`
	The database server would be started by the connection string START parameter. For example:
	`"START=c:\SQLAny12\bin32\dbeng12.exe"`
	A full example connection string including the START parameter:
	`"UID=DBA;PWD=sql;DBF=samples-dir\demo.db;START=c:\SQLAny12\bin32\dbeng12.exe"`
	For a list of connection parameters, see "Connection parameters" [*SQL Anywhere Server - Database Administration*].

offline_dir	Log directory, as specified on the command line after the options.
extended_options	Extended options, as specified with -e.
script_full_path	Deprecated; use NULL.
include_scan_range	Reserved; use NULL.
raw_file	Reserved; use NULL.
confirmrtn	Reserved; use NULL.
errorrtn	Function to display error messages.
msgrtn	Function to write messages to the user interface and, optionally, to the log file.
logrtn	Function to write messages only to the log file.
debug_dump_size	Reserved; use 0.
dl_insert_width	Reserved; use 0.
verbose	Deprecated; use 0.
debug	Reserved; use 0.
debug_dump_hex	Reserved; use 0.

Member	Description
debug_dump_char	Reserved; use 0.
debug_page_offsets	Reserved; use 0.
use_hex_offsets	Reserved; use 0.
use_relative_offsets	Reserved; use 0.
output_to_file	Reserved; use 0.
output_to_mobile_link	Reserved; use 1.
dl_use_put	Reserved; use 0.
kill_other_connections	TRUE if -d option is specified.
retry_remote_behind	TRUE if -r or -rb is specified.
ignore_debug_interrupt	Reserved; use 0.
set_window_title_rtn	Function to call to change the title of the dbmlsync window (Windows only).
default_window_title	Name of the program to display in the window caption (for example, DBMLSync).
msgqueuertn	Function called by DBMLSync when it wants to sleep. The parameter specifies the sleep period in milliseconds. The function should return the following, as defined in *dllapi.h*. • MSGQ_SLEEP_THROUGH indicates that the routine slept for the requested number of milliseconds. This is usually the value you should return. • MSGQ_SHUTDOWN_REQUESTED indicates that you would like the synchronization to terminate as soon as possible. • MSGQ_SYNC_REQUESTED indicates that the routine slept for less than the requested number of milliseconds and that the next synchronization should begin immediately if a synchronization is not currently in progress.
progress_msg_rtn	Function to change the text in the status window, above the progress bar.
progress_index_rtn	Function to update the state of the progress bar.

Member	Description
argv	argv array for this run; the last element of the array must be NULL.
ce_argv	Reserved; use NULL.
connectparms_allocated	Reserved; use 0.
entered_dialog	Reserved; use 0.
used_dialog_allocation	Reserved; use 0.
ignore_scheduling	TRUE if -is was specified.
ignore_hook_errors	TRUE if -eh was specified.
changing_pwd	TRUE if -mn was specified.
prompt_again	Reserved—use 0.
retry_remote_ahead	TRUE if -ra was specified.
rename_log	TRUE if -x was specified, in which case the log file is renamed and restarted.
hide_conn_str	TRUE unless -vc was specified.
hide_ml_pwd	TRUE unless -vp was specified.
dlg_launch_focus	Reserved; use 0.
mlpassword	MobiLink password specified with -mp; NULL otherwise.
new_mlpassword	New MobiLink password specified with -mn; NULL otherwise.
verify_mlpassword	Reserved; use NULL.
usage_rtn	Reserved; use NULL.
log_size	Log size in bytes, as specified with -x; otherwise 0.
hovering_frequency	Hovering frequency in seconds; as set with -pp.
ignore_hovering	True if -p was specified.
verbose_upload	True if -vu was specified.
verbose_upload_data	Reserved; use 0.
verbose_download	Reserved; use 0.

Member	Description
verbose_download_data	Reserved; use 0.
autoclose	TRUE if -k was specified.
ping	TRUE if -pi was specified.
encryption_key	Database key, as specified with -ek.
upload_defs	Linked list of publications to be uploaded together—see a_syncpub.
log_file_name	Database server message log file name specified with -o or -ot.
user_name	MobiLink user name, specified with -u.
verbose_minimum	TRUE if -v was specified.
verbose_hook	TRUE if -vs was specified.
verbose_row_data	TRUE if -vr was specified.
verbose_row_cnts	TRUE if -vn was specified.
verbose_option_info	TRUE if -vo was specified.
strictly_ignore_trigger_ops	Reserved; use 0.
est_upld_row_cnt	Estimated number of rows to upload, specified with -urc.
status_rtn	Reserved; use NULL.
warningrtn	Function to display warning messages.
ce_reproc_argv	Reserved, use NULL.
upload_only	True if -uo was specified.
download_only	TRUE if -ds was specified.
allow_schema_change	TRUE if -sc was specified.
dnld_gen_num	TRUE if -bg was specified.
apply_dnld_file	File specified with -ba; otherwise NULL.
create_dnld_file	File specified with -bc; otherwise NULL.
sync_params	User authentication parameters—specified with -ap.

Member	Description
dnld_file_extra	String specified with -be.
trans_upload	TRUE if -tu was specified.
continue_download	TRUE if -dc is specified.
dnld_read_size	Value specified by -drs option.
dnld_fail_len	Reserved; use 0.
upld_fail_len	Reserved; use 0.
persist_connection	TRUE if -pp is specified on command line.
verbose_protocol	Reserved; use 0.
no_stream_compress	Reserved; use 0.
encrypted_stream_opts	Reserved; use NULL.
no_offline_logscan	TRUE if -do is specified
server_mode	TRUE if -sm specified
allow_outside_connect	Reserved; use 0.
prompt_for_encrypt_key	Reserved; use 0.
verbose_server	Reserved; use 0.
server_port	Value from -sp option.
preload_dlls	Reserved; use NULL.
sync_profile	Value specified with -sp option.
sync_opt	Reserved; use NULL.
last_upload_def	Reserved; use NULL.
min_cache	
min_cache_suffix	
max_cache	
max_cache_suffix	

Member	Description
init_cache	
init_cache_suffix	
background_retry	
short use_fixed_cache	
no_schema_cache	
cache_verbosity	
background_sync	
a_bit_short _unused6	Reserved; use 0

Some members correspond to features accessible from the dbmlsync command line utility. Unused members should be assigned the value 0, FALSE, or NULL, depending on data type.

See the *dbtools.h* header file for additional comments.

For more information, see "dbmlsync syntax" [*MobiLink - Client Administration*].

See also

- "DBTools interface for dbmlsync" [*MobiLink - Client Administration*]
- "DBSynchronizeLog function" on page 875

a_syncpub structure

Holds information needed for the dbmlsync utility.

Syntax

```
typedef struct a_syncpub {
    struct a_syncpub *  next;
    char *              pub_name;
    char *              subscription;
    char *              ext_opt;
    a_bit_field         alloced_by_dbsync: 1;
} a_syncpub;
```

Members

Member	Description
a_syncpub	Pointer to the next node in the list, NULL for the last node.

Member	Description
pub_name	Publication name(s) specified for this -n option. This is the exact string following -n on the command line.
subscription	Subscription name(s) specified for the -s switch.
ext_opt	Extended options specified using the -eu option.
alloced_by_dbsync	Reserved; use FALSE.

See also

- "DBTools interface for dbmlsync" [*MobiLink - Client Administration*]

a_sysinfo structure

Holds information needed for dbinfo and dbunload utilities using the DBTools library.

```
typedef struct a_sysinfo {
    a_bit_field     valid_data          : 1;
    a_bit_field     blank_padding       : 1;
    a_bit_field     case_sensitivity    : 1;
    a_bit_field     encryption          : 1;
    char            default_collation[11];
    unsigned short  page_size;
} a_sysinfo;
```

Members

Member	Description
valid_date	Bit-field indicating whether the following values are set.
blank_padding	1 if blank padding is used in this database, 0 otherwise.
case_sensitivity	1 if the database is case sensitive, 0 otherwise.
encryption	1 if the database is encrypted, 0 otherwise.
default_collation	The collation sequence for the database.
page_size	The page size for the database.

See also

- "a_db_info structure" on page 886

a_table_info structure

Holds information about a table needed as part of the a_db_info structure.

Syntax

```
typedef struct a_table_info {
    struct a_table_info *next;
    a_sql_uint32        table_id;
    a_sql_uint32        table_pages;
    a_sql_uint32        index_pages;
    a_sql_uint32        table_used;
    a_sql_uint32        index_used;
    char *              table_name;
    a_sql_uint32        table_used_pct;
    a_sql_uint32        index_used_pct;
} a_table_info;
```

Members

Member	Description
next	Next table in the list.
table_id	ID number for this table.
table_pages	Number of table pages.
index_pages	Number of index pages.
table_used	Number of bytes used in table pages.
index_used	Number of bytes used in index pages.
table_name	Name of the table.
table_used_pct	Table space utilization as a percentage.
index_used_pct	Index space utilization as a percentage.

See also

- "a_db_info structure" on page 886

a_translate_log structure

Holds information needed for transaction log translation using the DBTools library.

Syntax

```
typedef struct a_translate_log {
    unsigned short      version;
```

```
    const char *        connectparms;
    const char *        logname;
    const char *        sqlname;
    const char *        encryption_key;
    const char *        logs_dir;
    p_name              userlist;
    a_sql_uint32        since_time;
    MSG_CALLBACK        confirmrtn;
    MSG_CALLBACK        errorrtn;
    MSG_CALLBACK        msgrtn;
    MSG_CALLBACK        logrtn;
    MSG_CALLBACK        statusrtn;
    char                userlisttype;
    a_bit_field         quiet                   : 1;
    a_bit_field         remove_rollback         : 1;
    a_bit_field         ansi_sql                : 1;
    a_bit_field         since_checkpoint        : 1;
    a_bit_field         replace                 : 1;
    a_bit_field         include_trigger_trans   : 1;
    a_bit_field         comment_trigger_trans   : 1;
    a_bit_field         debug                   : 1;
    a_bit_field         debug_sql_remote        : 1;
    a_bit_field         debug_dump_hex          : 1;
    a_bit_field         debug_dump_char         : 1;
    a_bit_field         debug_page_offsets      : 1;
    a_bit_field         omit_comments           : 1;
    a_bit_field         use_hex_offsets         : 1;
    a_bit_field         use_relative_offsets    : 1;
    a_bit_field         include_audit           : 1;
    a_bit_field         chronological_order     : 1;
    a_bit_field         force_recovery          : 1;
    a_bit_field         include_subsets         : 1;
    a_bit_field         force_chaining          : 1;
    a_bit_field         generate_reciprocals    : 1;
    a_bit_field         match_mode              : 1;
    a_bit_field         show_undo               : 1;
    a_bit_field         extra_audit             : 1;
    a_sql_uint32        debug_dump_size;
    a_sql_uint32        recovery_ops;
    a_sql_uint32        recovery_bytes;
    const char *        include_source_sets;
    const char *        include_destination_sets;
    const char *        include_scan_range;
    const char *        repserver_users;
    const char *        include_tables;
    const char *        include_publications;
    const char *        queueparms;
    const char *        match_pos;
    a_bit_field         leave_output_on_error   : 1;
} a_translate_log;
```

Members

Member	Description
version	DBTools version number.

Member	Description

connectparms	Parameters needed to connect to the database. They take the form of connection strings, such as the following:
	`"UID=DBA;PWD=sql;DBF=samples-dir\demo.db"`
	The database server would be started by the connection string START parameter. For example:
	`"START=c:\SQLAny12\bin32\dbeng12.exe"`
	A full example connection string including the START parameter:
	`"UID=DBA;PWD=sql;DBF=samples-dir\demo.db;START=c:\SQLAny12\bin32\dbeng12.exe"`
	For a list of connection parameters, see "Connection parameters" [*SQL Anywhere Server - Database Administration*].

logname	Name of the transaction log file. If NULL, there is no log.
sqlname	Name of the SQL output file. If NULL, then name is based on transaction log file name (-n sets this string).
encryption_key	Specify database encryption key (-ek sets string).
logs_dir	Transaction logs directory (-m *dir* sets string); sqlname must be set and connect_parms must be NULL.
userlist	A linked list of user names. Equivalent to -u user1,... or -x user1,... Select or omit transactions for listed users.
since_time	Output from most recent checkpoint before time (-j <time> sets this). The number of minutes since January 1, 0001.
confirmrtn	Callback routine for confirming an action.
errorrtn	Callback routine for handling an error message.
msgrtn	Callback routine for handling an information message.
logrtn	Callback routine to write messages only to the log file.
statusrtn	Callback routine for handling a status message.
userlisttype	Set to DBTRAN_INCLUDE_ALL unless you want to include or exclude a list of users. DBTRAN_INCLUDE_SOME for -u, or DBTRAN_EXCLUDE_SOME for -x.
quiet	Set to TRUE to operate without printing messages (-y).

Member	Description
remove_rollback	Normally set to TRUE; Set to FALSE if you want to include rollback transactions in output (equivalent to -a).
ansi_sql	Set to TRUE if you want to produce ANSI standard SQL transactions (equivalent to -s).
since_checkpoint	Set to TRUE if you want output from most recent checkpoint (equivalent to -f).
replace	Replace existing SQL file without confirmation (equivalent to -y).
include_trigger_trans	Set TRUE to include trigger-generated transactions (equivalent to -g, -sr or -t).
comment_trigger_trans	Set TRUE to include trigger-generated transactions as comments (equivalent to -z).
debug	Reserved; set to FALSE.
debug_sql_remote	Reserved, use FALSE.
debug_dump_hex	Reserved, use FALSE.
debug_dump_char	Reserved, use FALSE.
debug_page_offsets	Reserved, use FALSE.
use_hex_offsets	Reserved, use FALSE.
use_relative_offsets	Reserved, use FALSE.
include_audit	Reserved, use FALSE.
chronological_order	Reserved, use FALSE.
force_recovery	Reserved, use FALSE.
include_subsets	Reserved, use FALSE.
force_chaining	Reserved, use FALSE.
generate_reciprocals	Reserved, use FALSE.
match_mode	Reserved, use FALSE.
show_undo	Reserved, use FALSE.

Member	Description
debug_dump_size	Reserved, use 0.
recovery_ops	Reserved, use 0.
recovery_bytes	Reserved, use 0.
include_source_sets	Reserved, use NULL.
include_destination_sets	Reserved, use NULL.
include_scan_range	Reserved, use NULL.
repserver_users	Reserved, use NULL.
include_tables	Reserved, use NULL.
include_publications	Reserved, use NULL.
queueparms	Reserved, use NULL.
match_pos	Reserved, use NULL.
leave_output_on_error	Set to TRUE if you want to leave the generated .SQL file if corruption detected (equivalent to -k)

The members correspond to features accessible from the dbtran utility.

See the *dbtools.h* header file for additional comments.

See also

- "DBTranslateLog function" on page 877
- "a_name structure" on page 891
- "dbtran_userlist_type enumeration" on page 922
- "Using callback functions" on page 865

a_truncate_log structure

Holds information needed for transaction log truncation using the DBTools library.

Syntax

```
typedef struct a_truncate_log {
    unsigned short      version;
    const char *        connectparms;
    MSG_CALLBACK        errorrtn;
    MSG_CALLBACK        msgrtn;
    a_bit_field         quiet           : 1;
```

```
    a_bit_field         server_backup   : 1;
    char                truncate_interrupted;
} a_truncate_log;
```

Members

Member	Description
version	DBTools version number.

connectparms	Parameters needed to connect to the database. They take the form of connection strings, such as the following:
	`"UID=DBA;PWD=sql;DBF=samples-dir\demo.db"`
	The database server would be started by the connection string START parameter. For example:
	`"START=c:\SQLAny12\bin32\dbeng12.exe"`
	A full example connection string including the START parameter:
	`"UID=DBA;PWD=sql;DBF=samples-dir\demo.db;START=c:\SQLAny12\bin32\dbeng12.exe"`
	For a list of connection parameters, see "Connection parameters" [*SQL Anywhere Server - Database Administration*].

errorrtn	Callback routine for handling an error message.
msgrtn	Callback routine for handling an information message.
quiet	Operate without printing messages (1), or print messages (0).
server_backup	When set to 1, indicates backup on server using BACKUP DATABASE. Equivalent to dbbackup -s option.
truncate_interrupted	Indicates that the operation was interrupted.

See also

- "DBTruncateLog function" on page 877
- "Using callback functions" on page 865

an_unload_db structure

Holds information needed to unload a database using the DBTools library or extract a remote database for SQL Remote. Those fields used by the dbxtract SQL Remote Extraction utility are indicated.

Syntax

```
typedef struct an_unload_db {
    unsigned short      version;
    const char *        connectparms;
    const char *        temp_dir;
    const char *        reload_filename;
    char *              reload_connectparms;
    char *              reload_db_filename;
    MSG_CALLBACK        errorrtn;
    MSG_CALLBACK        msgrtn;
    MSG_CALLBACK        statusrtn;
    MSG_CALLBACK        confirmrtn;
    char                unload_type;
    char                verbose;
    char                escape_char;
    char                unload_interrupted;
    a_bit_field         unordered               : 1;
    a_bit_field         no_confirm              : 1;
    a_bit_field         use_internal_unload     : 1;
    a_bit_field         refresh_mat_view        : 1;
    a_bit_field         table_list_provided     : 1;
    a_bit_field         exclude_tables          : 1;
    a_bit_field         preserve_ids            : 1;
    a_bit_field         replace_db              : 1;
    a_bit_short         escape_char_present     : 1;
    a_bit_short         use_internal_reload     : 1;
    a_bit_field         recompute               : 1;
    a_bit_field         make_auxiliary          : 1;
    a_bit_field         profiling_uses_single_dbspace : 1;
    a_bit_field         encrypted_tables        : 1;
    a_bit_field         remove_encrypted_tables : 1;
    a_bit_field         extract                 : 1;
    a_bit_field         start_subscriptions     : 1;
    a_bit_field         exclude_foreign_keys    : 1;
    a_bit_field         exclude_procedures      : 1;
    a_bit_field         exclude_triggers        : 1;
    a_bit_field         exclude_views           : 1;
    a_bit_field         isolation_set           : 1;
    a_bit_field         include_where_subscribe : 1;
    a_bit_field         exclude_hooks           : 1;
    a_bit_field         startline_name          : 1;
    a_bit_field         debug                   : 1;
    a_bit_field         compress_output         : 1;
    a_bit_field         schema_reload           : 1;
    a_bit_field         genscript               : 1;
    a_bit_field         runscript               : 1;
    a_bit_field         display_create          : 1;
    a_bit_field         display_create_dbinit   : 1;
    a_bit_field         preserve_identity_values: 1;
    a_bit_field         no_reload_status        : 1;
    const char *        ms_filename;
    int                 ms_reserve;
    int                 ms_size;
    long                notemp_size;
    p_name              table_list;
    a_sysinfo           sysinfo;
    const char *        remote_dir;
    const char *        subscriber_username;
    unsigned short      isolation_level;
    const char *        site_name;
    const char *        template_name;
    char *              reload_db_logname;
    const char *        encryption_key;
```

```
    const char *        encryption_algorithm;
    unsigned short      reload_page_size;
    const char *        locale;
    const char *        startline;
    const char *        startline_old;
} an_unload_db;
```

Members

Members	Description
version	DBTools version number.

connectparms	Parameters needed to connect to the database. They take the form of connection strings, such as the following:
	`"UID=DBA;PWD=sql;DBF=samples-dir\demo.db"`
	The database server would be started by the connection string START parameter. For example:
	`"START=c:\SQLAny12\bin32\dbeng12.exe"`
	A full example connection string including the START parameter:
	`"UID=DBA;PWD=sql;DBF=samples-dir\demo.db;START=c:\SQLAny12\bin32\dbeng12.exe"`
	For a list of connection parameters, see “Connection parameters” [*SQL Anywhere Server - Database Administration*].

temp_dir	Directory for unloading data files.
reload_filename	The dbunload -r option, something like *reload.sql*.
reload_connectparms	User ID, password, database for reload database.
reload_db_filename	The file name of reload database to create.
errorrtn	Callback routine for handling an error message.
msgrtn	Callback routine for handling an information message.
statusrtn	Callback routine for handling a status message.
confirmrtn	Callback routine for confirming an action.
unload_type	See “dbunload type enumeration” on page 923.
verbose	See “Verbosity enumeration” on page 924.
escape_char	Used when escape_char_present is TRUE.

Members	Description
unload_interrupted	Set if unload interrupted.
unordered	dbunload -u sets TRUE.
no_confirm	dbunload -y sets TRUE.
use_internal_unload	dbunload -ii/-ix sets TRUE. dbunload -xi/-xx sets FALSE.
refresh_mat_view	dbunload -g sets TRUE.
table_list_provided	dbunload -e *list* or -i sets TRUE.
exclude_tables	dbunload -e sets TRUE. dbunload -i (undocumented) sets FALSE.
preserve_ids	dbunload sets TRUE/-m sets FALSE.
replace_db	dbunload -ar sets TRUE.
escape_char_present	dbunload -p sets TRUE. Note that escape_char must be set.
use_internal_reload	Usually set TRUE; -ix/-xx sets FALSE; -ii/-xi sets TRUE.
recompute	dbunload -dc sets TRUE. Re-compute all computed columns.
make_auxiliary	dbunload -k sets TRUE. Make auxiliary catalog (for use with diagnostic tracing).
profiling_uses_single_dbspace	dbunload -kd sets TRUE.
encrypted_tables	dbunload -et sets TRUE. Enable encrypted tables in new database (used with -an or -ar).
remove_encrypted_tables	dbunload -er sets TRUE. Remove encryption from encrypted tables.
extract	TRUE if dbxtract, otherwise FALSE.
start_subscriptions	dbxtract TRUE by default, -b sets FALSE.
exclude_foreign_keys	dbxtract -xf sets TRUE.
exclude_procedures	dbxtract -xp sets TRUE.
exclude_triggers	dbxtract -xt sets TRUE.
exclude_views	dbxtract -xv sets TRUE.
isolation_set	dbxtract -l sets TRUE.

Members	Description
include_where_subscribe	dbxtract -f sets TRUE.
exclude_hooks	dbxtract -hx sets TRUE.
startline_name	(internal use)
debug	(internal use)
compress_output	dbunload -cp sets TRUE.
schema_reload	(internal use)
genscript	(internal use)
runscript	(internal use)
display_create	-cm sets TRUE
display_create_dbinit	-cm dbinit sets TRUE
preserve_identity_values	dbunload -l sets TRUE
no_reload_status	dbunload -qr sets TRUE. Suppress index status messages on reload.
ms_filename	(internal use)
ms_reserve	(internal use)
ms_size	(internal use)
notemp_size	(internal use)
table_list	Selective table list
sysinfo	(internal use)
remote_dir	(like temp_dir) but for internal unloads on server side.
subscriber_username	Argument to dbxtract.
isolation_level	dbxtract -l sets value.
site_name	For dbxtract: specify a site name.
template_name	For dbxtract: specify a template name.
reload_db_logname	Log file name for the reload database.

Members	Description
encryption_key	-ek sets string.
encryption_algorithm	-ea sets one of "AES", "AES256", "AES_FIPS", or "AES256_FIPS".
reload_page_size	dbunload -ap sets value. Set page size of rebuilt database.
locale	(internal use) locale (language and charset).
startline	(internal use)
startline_old	(internal use)

The members correspond to features accessible from the dbunload and dbxtract utilities.

See the *dbtools.h* header file for additional comments.

See also

- "DBUnload function" on page 878
- "a_name structure" on page 891
- "dbunload type enumeration" on page 923
- "Verbosity enumeration" on page 924
- "Using callback functions" on page 865

an_upgrade_db structure

Holds information needed to upgrade a database using the DBTools library.

Syntax

```
typedef struct an_upgrade_db {
    unsigned short      version;
    const char *        connectparms;
    MSG_CALLBACK        errorrtn;
    MSG_CALLBACK        msgrtn;
    MSG_CALLBACK        statusrtn;
    a_bit_field         quiet           : 1;
    a_bit_field         jconnect        : 1;
} an_upgrade_db;
```

Members

Member	Description
version	DBTools version number.

Member	Description

connectparms	Parameters needed to connect to the database. They take the form of connection strings, such as the following:
	`"UID=DBA;PWD=sql;DBF=samples-dir\demo.db"`
	The database server would be started by the connection string START parameter. For example:
	`"START=c:\SQLAny12\bin32\dbeng12.exe"`
	A full example connection string including the START parameter:
	`"UID=DBA;PWD=sql;DBF=samples-dir\demo.db;START=c:\SQLAny12\bin32\dbeng12.exe"`
	For a list of connection parameters, see "Connection parameters" [*SQL Anywhere Server - Database Administration*].

errorrtn	Callback routine for handling an error message.
msgrtn	Callback routine for handling an information message.
statusrtn	Callback routine for handling a status message.
quiet	Operate without printing messages (1), or print messages (0).
jconnect	Upgrade the database to include jConnect procedures.

See also

- "DBUpgrade function" on page 878
- "Using callback functions" on page 865

a_validate_db structure

Holds information needed for database validation using the DBTools library.

Syntax

```
typedef struct a_validate_db {
    unsigned short      version;
    const char *        connectparms;
    p_name              tables;
    MSG_CALLBACK        errorrtn;
    MSG_CALLBACK        msgrtn;
    MSG_CALLBACK        statusrtn;
    a_bit_field         quiet : 1;
    a_bit_field         index : 1;
    a_validate_type     type;
} a_validate_db;
```


Members

Member	Description
version	DBTools version number.

connectparms	Parameters needed to connect to the database. They take the form of connection strings, such as the following:
	`"UID=DBA;PWD=sql;DBF=samples-dir\demo.db"`
	The database server would be started by the connection string START parameter. For example:
	`"START=c:\SQLAny12\bin32\dbeng12.exe"`
	A full example connection string including the START parameter:
	`"UID=DBA;PWD=sql;DBF=samples-dir\demo.db;START=c:\SQLAny12\bin32\dbeng12.exe"`
	For a list of connection parameters, see "Connection parameters" [*SQL Anywhere Server - Database Administration*].

tables	Pointer to a linked list of table names.
errorrtn	Callback routine for handling an error message.
msgrtn	Callback routine for handling an information message.
statusrtn	Callback routine for handling a status message.
quiet	Operate without printing messages (1), or print messages (0).
index	Validate indexes.
type	See "a_validate_type enumeration" on page 923.

See also

- "DBValidate function" on page 879
- "a_name structure" on page 891
- "a_validate_type enumeration" on page 923
- For more information about callback functions, see "Using callback functions" on page 865.

DBTools enumeration types

This section lists the enumeration types that are used by the DBTools library. The enumerations are listed alphabetically.

Blank padding enumeration

Used in the "a_create_db structure" on page 883, to specify the value of blank_pad.

Syntax

```
enum {
    NO_BLANK_PADDING,
    BLANK_PADDING
};
```

Members

Value	Description
NO_BLANK_PADDING	Does not use blank padding.
BLANK_PADDING	Uses blank padding.

See also

- "a_create_db structure" on page 883

a_chkpt_log_type enumeration

Used in the "a_backup_db structure" on page 880, to control copying of checkpoint log.

Syntax

```
typedef enum {
    BACKUP_CHKPT_LOG_COPY = 0,
    BACKUP_CHKPT_LOG_NOCOPY,
    BACKUP_CHKPT_LOG_RECOVER,
    BACKUP_CHKPT_LOG_AUTO,
    BACKUP_CHKPT_LOG_DEFAULT
} a_chkpt_log_type;
```

Members

Value	Description
BACKUP_CHKPT_LOG_COPY	Use to generate WITH CHECKPOINT LOG COPY clause.
BACKUP_CHKPT_LOG_NOCOPY	Use to generate WITH CHECKPOINT LOG NOCOPY clause.
BACKUP_CHKPT_LOG_RECOVER	Use to generate WITH CHECKPOINT LOG RECOVER clause.
BACKUP_CHKPT_LOG_AUTO	Use to generate WITH CHECKPOINT LOG AUTO clause.

Value	Description
BACKUP_CHKPT_LOG_DEFAULT	Use to omit WITH CHECKPOINT clause.

See also

- "a_backup_db structure" on page 880

a_db_version enumeration

Used in the "a_db_version_info structure" on page 888, to indicate the version of SQL Anywhere that initially created the database.

Syntax

```
enum {
        VERSION_UNKNOWN,
        VERSION_PRE_10,
        VERSION_10,
        VERSION_11,
        VERSION_12
   };
```

Members

Value	Description
VERSION_UNKNOWN	Unable to determine the version of SQL Anywhere that created the database.
VERSION_PRE_10	Database was created using SQL Anywhere version 9 or earlier.
VERSION_10	Database was created using SQL Anywhere version 10.
VERSION_11	Database was created using SQL Anywhere version 11.
VERSION_12	Database was created using SQL Anywhere version 12.

See also

- "DBCreatedVersion function" on page 871
- "a_db_version_info structure" on page 888

Database size unit enumeration

Used in the "a_create_db structure" on page 883, to specify the value of db_size_unit.

Syntax

```
enum {
    DBSP_UNIT_NONE,
    DBSP_UNIT_PAGES,
    DBSP_UNIT_BYTES,
    DBSP_UNIT_KILOBYTES,
    DBSP_UNIT_MEGABYTES,
    DBSP_UNIT_GIGABYTES,
    DBSP_UNIT_TERABYTES
};
```

Members

Value	Description
DBSP_UNIT_NONE	Units not specified.
DBSP_UNIT_PAGES	Size is specified in pages.
DBSP_UNIT_BYTES	Size is specified in bytes.
DBSP_UNIT_KILOBYTES	Size is specified in kilobytes.
DBSP_UNIT_MEGABYTES	Size is specified in megabytes.
DBSP_UNIT_GIGABYTES	Size is specified in gigabytes.
DBSP_UNIT_TERABYTES	Size is specified in terabytes.

See also

- "a_create_db structure" on page 883

dbtran_userlist_type enumeration

The type of a user list, as used by an "a_translate_log structure" on page 907.

Syntax

```
typedef enum dbtran_userlist_type {
    DBTRAN_INCLUDE_ALL,
    DBTRAN_INCLUDE_SOME,
    DBTRAN_EXCLUDE_SOME
} dbtran_userlist_type;
```

Members

Value	Description
DBTRAN_INCLUDE_ALL	Include operations from all users.

Value	Description
DBTRAN_INCLUDE_SOME	Include operations only from the users listed in the supplied user list.
DBTRAN_EXCLUDE_SOME	Exclude operations from the users listed in the supplied user list.

See also

- "a_translate_log structure" on page 907

dbunload type enumeration

The type of unload being performed, as used by the "an_unload_db structure" on page 912.

Syntax

```
enum {
    UNLOAD_ALL,
    UNLOAD_DATA_ONLY,
    UNLOAD_NO_DATA,
    UNLOAD_NO_DATA_FULL_SCRIPT
};
```

Members

Value	Description
UNLOAD_ALL	Unload both data and schema.
UNLOAD_DATA_ONLY	Unload data. Do not unload schema. Equivalent to dbunload -d option.
UNLOAD_NO_DATA	No data. Unload schema only. Equivalent to dbunload -n option.
UNLOAD_NO_DATA_FULL_SCRIPT	No data. Include LOAD/INPUT statements in reload script. Equivalent to dbunload -nl option.

See also

- "an_unload_db structure" on page 912

a_validate_type enumeration

The type of validation being performed, as used by the "a_validate_db structure" on page 918.

Syntax

```
typedef enum {
    VALIDATE_NORMAL = 0,
    VALIDATE_DATA,
    VALIDATE_INDEX,
    VALIDATE_EXPRESS,
    VALIDATE_FULL,
    VALIDATE_CHECKSUM,
    VALIDATE_DATABASE,
    VALIDATE_COMPLETE
} a_validate_type;
```

Members

Value	Description
VALIDATE_NORMAL	Validate with the default check only.
VALIDATE_DATA	(obsolete)
VALIDATE_INDEX	(obsolete)
VALIDATE_EXPRESS	Validate with express check. Equivalent to dbvalid -fx option.
VALIDATE_FULL	(obsolete)
VALIDATE_CHECKSUM	Validate database checksums. Equivalent to dbvalid -s option. See "Using checksums to detect corruption" [*SQL Anywhere Server - Database Administration*].
VALIDATE_DATABASE	Validate database. Equivalent to dbvalid -d option.
VALIDATE_COMPLETE	Perform all possible validation activities.

See also

- "a_validate_db structure" on page 918
- "Validation utility (dbvalid)" [*SQL Anywhere Server - Database Administration*]
- "VALIDATE statement" [*SQL Anywhere Server - SQL Reference*]

Verbosity enumeration

Specifies the volume of output.

Syntax

```
enum {
    VB_QUIET,
    VB_NORMAL,
    VB_VERBOSE
};
```


Members

Value	Description
VB_QUIET	No output.
VB_NORMAL	Normal amount of output.
VB_VERBOSE	Verbose output, useful for debugging.

See also

- “a_create_db structure” on page 883
- “an_unload_db structure” on page 912

Software component exit codes

All database tools library entry points use the following exit codes. The SQL Anywhere utilities (dbbackup, dbspawn, dbeng12, and so on) also use these exit codes.

Code	Status	Explanation
0	EXIT_OKAY	Success
1	EXIT_FAIL	General failure
2	EXIT_BAD_DATA	Invalid file format
3	EXIT_FILE_ERROR	File not found, unable to open
4	EXIT_OUT_OF_MEMORY	Out of memory
5	EXIT_BREAK	Terminated by the user
6	EXIT_COMMUNICATIONS_FAIL	Failed communications
7	EXIT_MISSING_DATABASE	Missing a required database name
8	EXIT_PROTOCOL_MISMATCH	Client/server protocol mismatch
9	EXIT_UNABLE_TO_CONNECT	Unable to connect to the database server
10	EXIT_ENGINE_NOT_RUNNING	Database server not running
11	EXIT_SERVER_NOT_FOUND	Database server not found
12	EXIT_BAD_ENCRYPT_KEY	Missing or bad encryption key

Code	Status	Explanation
13	EXIT_DB_VER_NEWER	Server must be upgraded to run database
14	EXIT_FILE_INVALID_DB	File is not a database
15	EXIT_LOG_FILE_ERROR	Log file was missing or other error
16	EXIT_FILE_IN_USE	File in use
17	EXIT_FATAL_ERROR	Fatal error occurred
18	EXIT_MISSING_LICENSE_FILE	Missing server license file
19	EXIT_BACK-GROUND_SYNC_ABORTED	Background synchronization aborted to allow higher priority operations proceed
20	EXIT_FILE_ACCESS_DENIED	Database cannot be started because access is denied
255	EXIT_USAGE	Invalid parameters on the command line

These exit codes are defined in the *install-dir\sdk\include\sqldef.h* file.

Deploying databases and applications

When you have completed a database application, you must deploy the application to your end users. Depending on the way in which your application uses SQL Anywhere (as an embedded database, in a client/server fashion, and so on) you may have to deploy components of the SQL Anywhere software along with your application. You may also have to deploy configuration information, such as data source names, that enable your application to communicate with SQL Anywhere.

Check your license agreement
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The following deployment steps are examined in this section:

- Determining required files based on the choice of application platform and architecture.
- Configuring client applications.

Much of the section deals with individual files and where they need to be placed. However, the recommended way of deploying SQL Anywhere components is to use the **Deployment Wizard** or to use a silent install. For information, see "Using the Deployment Wizard" on page 931 and "Using a silent install for deployment" on page 935.

Types of deployment

The files you need to deploy depend on the type of deployment you choose. Here are some possible deployment models:

- **Client deployment** You may deploy only the client portions of SQL Anywhere to your end users, so that they can connect to a centrally located network database server.
- **Network server deployment** You may deploy network servers to offices, and then deploy clients to each of the users within those offices.
- **Embedded database deployment** You may deploy an application that runs with the personal database server. In this case, both client and personal server need to be installed on the end-user's computer.
- **SQL Remote deployment** Deploying a SQL Remote application is an extension of the embedded database deployment model.
- **MobiLink deployment** For information about deploying MobiLink servers, see "Deploying MobiLink applications" [*MobiLink - Server Administration*].
- **Administration tools deployment** You may deploy Interactive SQL, Sybase Central and other management tools.

Ways to distribute files

There are two ways to deploy SQL Anywhere:

- **Use the SQL Anywhere installer** You can make the installer available to your end users. By selecting the proper option, each end user is guaranteed to receive the files they need.

  This is the simplest solution for many deployment cases. In this case, you must still provide your end users with a method for connecting to the database server (such as an ODBC data source).

  For more information, see "Using the Deployment Wizard" on page 931 or "Using a silent install for deployment" on page 935.

- **Develop your own installation** There may be reasons for you to develop your own installation program that includes SQL Anywhere files. This is a more complicated option, and most of this section addresses the needs of those who are developing their own installation.

  If SQL Anywhere has already been installed for the server type and operating system required by the client application architecture, the required files can be found in the appropriately-named subdirectory, located in the SQL Anywhere installation directory. For example, the *bin32* subdirectory of your installation directory contains the files required to run the server for 32-bit Windows operating systems.

Whichever option you choose, you must not violate the terms of your license agreement.

Understanding installation directories and file names

For a deployed application to work properly, the database server and client applications must each be able to locate the files they need. The deployed files should be located relative to each other in the same fashion as your SQL Anywhere installation.

In practice, this means that on Windows, most files belong in a single directory. For example, on Windows both client and database server required files are installed in a single directory, which is the *bin32* subdirectory of the SQL Anywhere installation directory.

For a full description of the places where the software looks for files, see "How SQL Anywhere locates files" [*SQL Anywhere Server - Database Administration*].

Linux, Unix, and Mac OS X deployment issues

Unix deployments are different from Windows deployments in some ways:

- **Directory structure** For Linux, Unix, and Mac OS X installations, the default directory structure is as follows:

Directory	Contents
/opt/sqlanywhere12/bin32 and */opt/sqlanywhere12/bin64*	Executable files, License files
/opt/sqlanywhere12/lib32 and */opt/sqlanywhere12/lib64*	Shared objects and libraries
/opt/sqlanywhere12/res	String files

On AIX, the default root directory is */usr/lpp/sqlanywhere12* instead of */opt/sqlanywhere12*.

On Mac OS X, the default root directory is */Applications/SQLAnywhere12/System* instead of */opt/sqlanywhere12*.

Depending on the complexity of your deployment, you might choose to put all of the files that you require for your application into a single directory. You may find that this is a simpler deployment option, especially if a small number of files are required for your deployment. This directory could be the same directory that you use for your own application.

- **File suffixes** In the tables in this section, the shared objects are listed with a suffix of *.so* or *.so.1*. The version number, 1, could be higher as updates are released. For simplicity, the version number is often not listed.

  For AIX, the suffix does not contain a version number so it is simply *.so*.

- **Symbolic links** Each shared object is installed as a symbolic link (symlink) to a file of the same name with the additional suffix *.1* (one). For example, *libdblib12.so* is a symbolic link to the file *libdblib12.so.1* in the same directory.

  The version suffix *.1* could be higher as updates are released and the symbolic link must be redirected.

  On Mac OS X, you should create a jnilib symbolic link for any dylib that you want to load directly from your Java client application.

- **Threaded and non-threaded applications** Most shared objects are provided in two forms, one of which has the additional characters *_r* before the file suffix. For example, in addition to *libdblib12.so.1*, there is a file named *libdblib12_r.so.1*. In this case, threaded applications must be linked to the shared object whose name has the *_r* suffix, while non-threaded applications must be linked to the shared object whose name does not have the *_r* suffix. Occasionally, there is a third form of shared object with *_n* before the file suffix. This is a version of the shared object that is used with non-threaded applications.

- **Character set conversion** If you want to use database server character set conversion, you need to include the following files:
  - *libdbicu12.so.1*
  - *libdbicu12_r.so.1*
  - *libdbicudt12.so.1*
  - *sqlany.cvf*
- **Environment variables** On Linux, Unix, and Mac OS X, environment variables must be set for the system to be able to locate SQL Anywhere applications and libraries. It is recommended that you use the appropriate file for your shell, either *sa_config.sh* or *sa_config.csh* (located in the directories */opt/sqlanywhere12/bin32* and */opt/sqlanywhere12/bin64*) as a template for setting the required environment variables. Some of the environment variables set by these files include PATH, LD_LIBRARY_PATH, and SQLANY12.

For a description of how SQL Anywhere looks for files, see "How SQL Anywhere locates files" [*SQL Anywhere Server - Database Administration*].

File naming conventions

SQL Anywhere uses consistent file naming conventions to help identify and group system components.

These conventions include:

- **Version number** The SQL Anywhere version number is indicated in the file name of the main server components (executable files, dynamic link libraries, shared objects, license files, and so on).

  For example, the file *dbeng12.exe* is a version 12 executable for Windows.
- **Language** The language used in a language resource library is indicated by a two-letter code within its file name. The two characters before the version number indicate the language used in the library. For example, *dblgen12.dll* is the message resource library for the English language. These two-letter codes are specified by ISO standard 639-1.

  For more information about language labels, see "Language Selection utility (dblang)" [*SQL Anywhere Server - Database Administration*].

  For a list of the languages available in SQL Anywhere, see "Localized versions of SQL Anywhere" [*SQL Anywhere Server - Database Administration*].

Identifying other file types

The following table identifies the platform and function of SQL Anywhere files according to their file extension. SQL Anywhere follows standard file extension conventions where possible.

File extension	Platform	File type
.bat, .cmd	Windows	Batch command files

File extension	Platform	File type
.chm, .chw	Windows	Help system file
.dll	Windows	Dynamic Link Library
.exe	Windows	Executable file
.ini	All	Initialization file
.lic	All	License file
.lib	Varies by development tool	Static runtime libraries for the creation of embedded SQL executables
.res	Linux, Unix, Mac OS X	Language resource file for non-Windows environments
.so	Linux, Unix	Shared object or shared library file (the equivalent of a Windows DLL)
.bundle, .dylib	Mac OS X	Shared object file (the equivalent of a Windows DLL)

Database file names

SQL Anywhere databases are composed of two elements:

- **Database file** This is used to store information in an organized format. By default, this file uses a *.db* file extension. There may also be additional dbspace files. These files could have any file extension including none.
- **Transaction log file** This is used to record all changes made to data stored in the database file. By default, this file uses a *.log* file extension, and is generated by SQL Anywhere if no such file exists and a log file is specified to be used. A transaction log mirror has the default extension of *.mlg*.

These files are updated, maintained and managed by the SQL Anywhere relational database management system.

Using the Deployment Wizard

The SQL Anywhere **Deployment Wizard** is the preferred tool for creating 32-bit deployments of SQL Anywhere for Windows. The **Deployment Wizard** can create installer files that include some or all the following components:

- Client interfaces such as ODBC
- SQL Anywhere server, including remote data access, database tools, and encryption
- UltraLite relational database
- MobiLink server, client, and encryption
- QAnywhere messaging
- Administration tools such as Interactive SQL and Sybase Central

The **Deployment Wizard** does not include support for creating deployments of the 64-bit software components.

You can use the **Deployment Wizard** to create a Microsoft Windows Installer Package file or a Microsoft Windows Installer Merge Module file:

- **Microsoft Windows Installer Package file** A storage file containing the instructions and data required to install an application. An Installer Package file has the extension *.msi*.
- **Microsoft Windows Installer Merge Module file** A simplified type of Microsoft Installer Package file that includes all files, resources, registry entries, and setup logic to install a shared component. A merge module has the extension *.msm*.

  A merge module cannot be installed alone because it lacks some vital database tables that are present in an installer package file. Merge modules also contain additional tables that are unique to themselves. To install the information delivered by a merge module with an application, the module must first be merged into the application's Installer Package (*.msi*) file. A merge module consists of the following parts:

  - A merge module database containing the installation properties and setup logic being delivered by the merge module.
  - A merge module Summary Information Stream describing the module.
  - A *MergeModule.CAB* cabinet file stored as a stream inside the merge module. This cabinet contains all the files required by the components delivered by the merge module. Every file delivered by the merge module must be stored inside of a cabinet file that is embedded as a stream in the merge module's structured storage. In a standard merge module, the name of this cabinet is always: *MergeModule.CAB*.

Note
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To create a deployment file

1. Start the **Deployment Wizard**:

- Choose **Start** » **Programs** » **SQL Anywhere 12** » **Administration Tools** » **Deploy to Windows**or from the *Deployment* subdirectory of your SQL Anywhere installation, run *DeploymentWizard.exe*.

2. Follow the instructions in the wizard.

The **Deployment Wizard** allows you to select subsets of the components included in SQL Anywhere. Each component has dependencies on other components so the files that are selected by the wizard may include files from other categories.

In **Select Features**, the available categories are **Databases**, **Synchronization**, and **Administration Tools**.

Databases

Use to select or deselect all of its subcategories.

- **SQL Anywhere (32-bit)** Use to select or deselect all of its subcategories.

  The following subcategories are available:

  - **Client Interfaces** Use to select or deselect all of its subcategories.
    - **ODBC** The SQL Anywhere ODBC driver.
    - **Embedded SQL** The SQL Anywhere Embedded SQL library.
    - **OLEDB** The SQL Anywhere OLE DB provider.
    - **ADO.NET** The SQL Anywhere .NET provider.
    - **JDBC** The SQL Anywhere JDBC driver.
    - **Client Tools** The SQL Anywhere client libraries such as dblib12, dbtool12 and client utilities like dblocate, dbping, and dbdsn, and so on.
    - **Client Resources** The SQL Anywhere language resource files such as dblgen12, dblgde12, and dblges12 and the dblang language selection tool.
  - **SQL Anywhere Server** Use to select or deselect all of its subcategories.
    - **Personal Server** The SQL Anywhere personal server and license file.
    - **Network Server** The SQL Anywhere network server and license file.
    - **Server Tools** The SQL Anywhere server utilities like dbbackup, dberase, dbinit, dblog, dbsvc, dbunload and so on.
    - **Unload Support** Support for unloading version 9 and earlier databases.

- **UltraLite** Use to select or deselect all of its subcategories.

  The following subcategory is available:

- **UltraLite Engine** The UltraLite engine, utilities, and libraries such as uleng12, ulerase, ulinit, ullgen12, ullgde12, ulrt12, and ulunload.

Synchronization

Use to select or deselect all of its subcategories.

- **MobiLink** Use to select or deselect all of its subcategories.
  - **MobiLink Client** The MobiLink Client tools and libraries such as dblsn, dbmlsync, mlasinst, dbmlsynccli12, and the MobiLink .NET client provider.
  - **MobiLink Server** The MobiLink server, tools and libraries such as the server, ODBC driver, JDBC driver, and the MobiLink .NET provider.
- **QAnywhere** The QAnywhere application-to-application messaging tools.
- **SQL Remote** The SQL Remote tools and libraries including dbremote, dbxtract, and the message transport libraries such as dbsmtp12.

Administration Tools

Use to select or deselect all of its subcategories.

- **Sybase Central** The Sybase Central database manager and plug-ins. Use to select or deselect all of its subcategories.
  - **SQL Anywhere Plug-in** The SQL Anywhere plug-in.
  - **MobiLink Plug-in** The MobiLink plug-in.
  - **UltraLite Plug-in** The UltraLite plug-in.
  - **QAnywhere Plug-in** The QAnywhere plug-in.
- **ISQL** The Interactive SQL tool.
- **DBConsole** The administration and monitoring tool for database server connections.

If you would like to determine what files are included in each selectable component, create an MSI installer image selecting all components. A log file is created that details what files are included in every component. This text file can be examined with a text editor. You will see headings like "Feature: SERVER32_TOOLS" and "Feature: CLIENT32_TOOLS". The headings closely correspond to the Deployment Wizard components. This will give you an idea of what is included in each group.

To install a deployment file

- Use the Microsoft Windows Installer to install the deployment file. Here is a sample command:

  ```
  msiexec /package sqlany12.msi
  ```

  A silent install can be performed using a command like the following:


```
msiexec /qn /package sqlany12.msi SQLANYDIR=c:\sa12
```

- **/package <package-name>** This parameter tells the Microsoft Windows Installer to install the specified package (in this case, *sqlany12.msi*).
- **/qn** This parameter tells the Microsoft Windows Installer to operate in the background with no user interaction.
- **SQLANYDIR** The value of this parameter is the path to where the software is to be installed.

To uninstall a deployment

- It is also possible to perform a silent uninstall. The following is an example of a command line that would do this.

  ```
  msiexec /uninstall sqlany12.msi
  ```

  Alternately, a product code can be specified.

  ```
  msiexec.exe /qn /uninstall {19972A31-72EF-126F-31C7-5CF249B8593F}
  ```

  - **/qn** This parameter tells the Microsoft Windows Installer to operate in the background with no user interaction.
  - **/uninstall <package-name> | <product-code>** This parameter tells the Microsoft Windows Installer to uninstall the product associated with the specified MSI file or product code.

For more tips on how to do silent installs, see "Using a silent install for deployment" on page 935.

Using a silent install for deployment

Silent installs run without user input and with no indication to the user that an install is occurring. On Windows operating systems, you can call the SQL Anywhere installer from your own install program in such a way that the SQL Anywhere install is silent.

The common options for the SQL Anywhere install program *setup.exe* are:

- **/L:language_id** The language identifier is a locale number that represents the language for the install. For example, locale ID 1033 identifies U.S. English, locale ID 1031 identifies German, locale ID 1036 identifies French, locale ID 1041 identifies Japanese, and locale ID 2052 identifies Simplified Chinese.
- **/S** This option hides the initialization window. Use this option in conjunction with **/V**.
- **/V** Specify parameters to MSIEXEC, the Microsoft Windows Installer tool.

The following command line example assumes that the install image directory is in the *software\SQLAnywhere* directory on the disk in drive *d:*.

```
d:\software\sqlanywhere\setup.exe /l:1033 /s "/v: /qn
    REGKEY=QEDEV-B888A-6L123-45678-90123 INSTALLDIR=c:\sa12 DIR_SAMPLES=c:
\sa12\Samples"
```

Note
The setup.exe in the command above is the one located in the same directory as the SQLANY32.msi and SQLANY64.msi files. The setup.exe in the parent directory of those files does NOT support silent installs.

The following properties apply to the SQL Anywhere installer:

- **INSTALLDIR** The value of this parameter is the path to where the software is installed.
- **DIR_SAMPLES** The value of this parameter is the path to where the sample programs are installed.
- **DIR_SQLANY_MONITOR** The value of this parameter is the path to where the SQL Anywhere Monitor database (*samonitor.db*) is installed.
- **USERNAME** The value of this parameter is the user name to record for this installation (for example, USERNAME=\"John Smith\").
- **COMPANYNAME** The value of this parameter is the company name to record for this installation (for example, COMPANYNAME=\"Smith Holdings\").
- **REGKEY** The value of this parameter must be a valid software registration key.
- **REGKEY_ADD_1** The value of this parameter must be a valid software registration key for an add-on feature such as ECC or FIPS encryption. This property applies only if you have optional add-on features to be installed during this run of the installer.
- **REGKEY_ADD_2** The value of this parameter must be a valid software registration key for an add-on feature such as ECC or FIPS encryption. This property applies only if you have optional add-on features to be installed during this run of the installer.
- **REGKEY_ADD_3** The value of this parameter must be a valid software registration key for an add-on feature such as ECC or FIPS encryption. This property applies only if you have optional add-on features to be installed during this run of the installer.

The following example shows how to specify the SQL Anywhere install properties:

```
d:\software\sqlanywhere\setup.exe /S "/v: /qn
USERNAME=\"John Smith\"
COMPANYNAME=\"Smith Holdings\"
REGKEY=QEDEV-B888A-6L123-45678-90123
REGKEY_ADD_1=<an add-on software registration key>
REGKEY_ADD_2=<another add-on software registration key>
INSTALLDIR=c:\sa12
DIR_SAMPLES=c:\sa12\Samples
DIR_SQLANY_MONITOR=c:\sa12\Monitor"
```

Although the above text is shown over several lines for reasons of length, it would be specified as a single line of text. Note the use of the backslash character to escape the interior quotation marks.

The following properties apply to the SQL Anywhere Monitor installer:

- **INSTALLDIR** The value of this parameter is the path to where the software is installed.

- **DIR_SQLANY_MONITOR** The value of this parameter is the path to where the SQL Anywhere Monitor database (*samonitor.db*) is installed.
- **REGKEY** The value of this parameter must be a valid software installation key.
- **REGKEY_ADD_1** The value of this parameter must be a valid software installation key for an add-on feature such as ECC or FIPS encryption. This property applies only if you have optional add-on features to be installed during this run of the installer.
- **REGKEY_ADD_2** The value of this parameter must be a valid software installation key for an add-on feature such as ECC or FIPS encryption. This property applies only if you have optional add-on features to be installed during this run of the installer.

The following example shows how to specify the SQL Anywhere Monitor install properties:

```
d:\software\monitor\setup.exe /S "/v: /qn
REGKEY=<SQLAnywhere Monitor registration key>
REGKEY_ADD_1=<an add-on software registration key>
REGKEY_ADD_2=<another add-on software registration key>
INSTALLDIR=c:\sa12"
```

In addition to setting the property values described above, the following SQL Anywhere components or features may be selected from the command-line:

Feature	Property
Administration Tools (32-bit)	AT32
Administration Tools (64-bit)	AT64
CAC Authentication	CAC *
ECC Strong Encryption	ECC *
FIPS-approved Strong Encryption	FIPS *
High Availability	HA *
In-Memory Mode	IM *
MobiLink (32-bit)	ML32
MobiLink (64-bit)	ML64
QAnywhere	QA32
Read-only scale-out	SON *
Relay Server (32-bit)	RS32
Relay Server (64-bit)	RS64

Feature	Property
Samples	SAMPLES
SQL Anywhere (32-bit)	SA32
SQL Anywhere (64-bit)	SA64
SQL Anywhere for Windows Mobile	MOBILE
SQL Anywhere Monitor (32-bit)	SM32
SQL Anywhere Monitor (64-bit)	SM64
SQL Remote (32-bit)	SR32
SQL Remote (64-bit)	SR64
UltraLite	UL

* These features require an additional appropriate software registration key.

Set the property value to 1 to select the feature or to 0 to omit the feature. For example, to omit 32-bit MobiLink, set ML32=0. To select the 32-bit Administration Tools, set AT32=1. These properties are used to override the default selection.

You don't need to specify the selection state of a feature if the default is applicable. For example, to override the default selection on a 64-bit computer by installing the 32-bit MobiLink feature and not installing the Samples, use the following command line:

```
setup.exe "/v ml32=1 samples=0"
```

Note that property names are case insensitive.

Note that your registration key may limit the available features. The command-line switches cannot be used to override those limitations. For example, if your registration key does not allow the install of ECC Strong Encryption, then using ECC=1 on the command-line will not select the feature.

To generate an MSI log add the following to the command line after the `/v:`.

```
/l*v! logfile
```

In this example, `logfile` is the full path and file name of the log file. The path must already exist. Note that this switch will generate an extremely verbose log and will significantly lengthen the time required to execute the install. For information about reducing the output to the log file, see http://msdn.microsoft.com/en-us/library/aa367988.aspx.

In addition to a silent install, it is also possible to perform a silent uninstall. The following is an example of a command line that would do this.

```
msiexec.exe /qn /uninstall {1DFA77E6-91B2-4DCC-B8BE-98EA70705D39}
```


In the above example, you call the Microsoft Windows Installer tool directly.

- **/qn** This parameter tells the Microsoft Windows Installer to operate in the background with no user interaction.
- **/uninstall <product-code>** This parameter tells the Microsoft Windows Installer to uninstall the product associated with the specified product code. The code shown above is for the SQL Anywhere software.

The product codes for SQL Anywhere are:

- **{1DFA77E6-91B2-4DCC-B8BE-98EA70705D39}** SQL Anywhere software
- **{A8429447-7813-4717-9803-EB505ECAE698}** SQL Anywhere Client-only software
- **{2E34270B-A38A-4C97-986F-0FC4BBEBA181}** SQL Anywhere Monitor

Deploying client applications

To deploy a client application that runs against a network database server, you must provide each end user with the following items:

- **Client application** The application software itself is independent of the database software, and so is not described here.
- **Database interface files** The client application requires the files for the database interface it uses (.NET, ADO, OLE DB, ODBC, JDBC, embedded SQL, or Open Client).
- **Connection information** Each client application needs database connection information.

The interface files and connection information required varies with the interface your application is using. Each interface is described separately in the following sections.

The simplest way to deploy clients is to use the **Deployment Wizard**. For more information, see "Using the Deployment Wizard" on page 931.

Deploying .NET clients

The simplest way to deploy .NET assemblies is to use the **Deployment Wizard**. For more information, see "Using the Deployment Wizard" on page 931.

If your end users will be developing .NET applications, then consider integrating the SQL Anywhere .NET tools into Microsoft Visual Studio. On the client computer, you must do the following.

- Ensure Visual Studio is not running.

- Run *install-dir\Assembly\v2\SetupVSPackage.exe /install*.

If you want to create your own installation, this section describes the files to deploy to the end users. There are several message files each supporting a different language. If you want to install support for different languages, you have to include the resource files for these languages. Replace **[LL]** with the language code (for example, **en**, **de**, **jp**, etc.).

Each .NET client computer must have the following:

- **A working .NET 2.0, 3.0, 3.5 or 4.0 installation** Microsoft .NET assemblies and instructions for their redistribution are available from Microsoft Corporation. They are not described in detail here.

- **SQL Anywhere provider for .NET 2.0/3.0 Framework** The SQL Anywhere installation places the Windows assemblies for the .NET Framework versions 2.0 and 3.0 in the *Assembly\V2* subdirectory of your SQL Anywhere installation directory. The other files are placed in the operating-system binaries directory of your SQL Anywhere installation directory (for example, *bin32* or *bin64*). The following files are required.

  ```
  iAnywhere.Data.SQLAnywhere.dll
  policy.12.0.iAnywhere.Data.SQLAnywhere.dll
  dblg[LL]12.dll
  dbcon12.dll
  ```

- **SQL Anywhere provider for .NET 3.5 Framework** The SQL Anywhere installation places the Windows assemblies for the .NET Framework version 3.5 in the *Assembly\V3.5* subdirectory of your SQL Anywhere installation directory. The other files are placed in the operating-system binaries directory of your SQL Anywhere installation directory (for example, *bin32* or *bin64*). The following files are required.

  ```
  iAnywhere.Data.SQLAnywhere.v3.5.dll
  policy.12.0.iAnywhere.Data.SQLAnywhere.v3.5.dll
  dblg[LL]12.dll
  dbcon12.dll
  ```

- **SQL Anywhere provider for .NET 4.0 Framework** The SQL Anywhere installation places the Windows assemblies for the .NET Framework version 4.0 in the *Assembly\V4* subdirectory of your SQL Anywhere installation directory. The other files are placed in the operating-system binaries directory of your SQL Anywhere installation directory (for example, *bin32* or *bin64*). The following files are required.

  ```
  iAnywhere.Data.SQLAnywhere.v4.0.dll
  policy.12.0.iAnywhere.Data.SQLAnywhere.v4.0.dll
  dblg[LL]12.dll
  dbcon12.dll
  SSDLToSA12.tt
  ```

  SSDLToSA12.tt is used for generating database schema DDL for Entity Data Models. The SQL Anywhere installer copies this file to the Visual Studio 2010 directory. The user should set the DDL Generation property to this file when generating database schema DDL for Entity Data Models.

- **SQL Anywhere provider for .NET 2.0 Compact Framework** The SQL Anywhere installation places the Windows Mobile assemblies for the .NET Compact Framework in *CE\Assembly\V2*. The other file is placed in the Windows Mobile binaries subdirectory of your SQL Anywhere installation directory (for example, *CE\Arm.50*). The following files are required.


```
iAnywhere.Data.SQLAnywhere.dll
iAnywhere.Data.SQLAnywhere.gac
dblg[LL]12.dll
```

For more information about deploying the SQL Anywhere .NET provider, see "Deploying the SQL Anywhere .NET Data Provider" on page 67.

Deploying OLE DB and ADO clients

The simplest way to deploy OLE DB client libraries is to use the **Deployment Wizard**. For more information, see "Using the Deployment Wizard" on page 931.

If you want to create your own installation, this section describes the files to deploy to the end users.

Each OLE DB client computer must have the following:

- **A working OLE DB installation** OLE DB files and instructions for their redistribution are available from Microsoft Corporation. They are not described in detail here.
- **The SQL Anywhere OLE DB provider** The following table shows the files needed for a working SQL Anywhere OLE DB provider. These files should be placed in a single directory. The SQL Anywhere installation places them all in the operating-system subdirectory of your SQL Anywhere installation directory (for example, *bin32* or *bin64*). For Windows, there are two provider DLLs. The second DLL (*dboledba12*) is an assist DLL used to provide schema support.

Description	Windows
OLE DB driver file	*dboledb12.dll*
OLE DB driver file	*dboledba12.dll*
Language-resource library	*dblg[LL]12.dll*
Connect window	*dbcon12.dll*
Elevated operations agent	*dbelevate12.exe* (Windows Vista or later only)

The table above shows a file with the designation **[LL]**. There are several message files each supporting a different language. If you want to install support for different languages, you have to include the resource files for these languages. Replace **[LL]** with the language code (for example, **en**, **de**, **jp**, etc.).

OLE DB providers require many registry entries. You can make these by self-registering the *dboledb12.dll* and *dboledba12.dll* DLLs using the regsvr32 utility.

Note that for Windows Vista or later versions of Windows, you must include the SQL Anywhere elevated operations agent which supports the privilege elevation required when DLLs are registered or unregistered. This file is only required as part of the OLE DB provider install or uninstall procedure.

For Windows clients, it is recommended that you use Microsoft MDAC 2.7 or later.

Customizing the OLE DB provider

When installing the OLE DB provider, the Windows Registry must modified. Typically, this is done using the self-registration capability built into the OLE DB provider. For example, you would use the Windows regsvr32 tool to do this. A standard set of registry entries are created by the provider.

In a typical connection string, one of the components is the Provider attribute. To indicate that the SQL Anywhere OLE DB provider is to be used, you specify the name of the provider. Here is a Visual Basic example:

```
connectString = "Provider=SAOLEDB;DSN=SQL Anywhere 12 Demo"
```

With ADO and/or OLE DB, there are many other ways to reference the provider by name. Here is a C++ example in which you specify not only the provider name but also the version to use.

```
hr = db.Open(_T("SAOLEDB.12"), &dbinit);
```

The provider name is looked up in the registry. If you were to examine the registry on your computer system, you would find an entry in HKEY_CLASSES_ROOT for SAOLEDB.

```
[HKEY_CLASSES_ROOT\SAOLEDB]
@="SQL Anywhere OLE DB Provider"
```

It has two subkeys that contain a class identifier (Clsid) and current version (CurVer) for the provider. Here is an example.

```
[HKEY_CLASSES_ROOT\SAOLEDB\Clsid]
@="{41dfe9f7-db91-11d2-8c43-006008d26a6f}"

[HKEY_CLASSES_ROOT\SAOLEDB\CurVer]
@="SAOLEDB.12"
```

There are several more similar entries. They are used to identify a specific instance of an OLE DB provider. If you look up the Clsid in the registry under HKEY_CLASSES_ROOT\CLSID and examine the subkeys, you see that one of the entries identifies the location of the provider DLL.

```
[HKEY_CLASSES_ROOT\CLSID\
{41dfe9f3-db91-11d2-8c43-006008d26a6f}\
InprocServer32]

@="c:\\sa12\\bin64\\dboledb12.dll"
"ThreadingModel"="Both"
```

The problem here is that the structure is very monolithic. If you were to uninstall the SQL Anywhere software from your system, the OLE DB provider registry entries would be removed from your registry and then the provider DLL would be removed from your hard drive. Any applications that depend on the provider would no longer work.

Similarly, if applications from different vendors all use the same OLE DB provider, then each installation of the same provider would overwrite the common registry settings. The version of the provider that you intended your application to work with would be supplanted by another newer (or older!) version of the provider.

Clearly, the instability that could arise from this situation is undesirable. To address this problem, the SQL Anywhere OLE DB provider can be customized.

In the following exercise, you generate a unique set of GUIDs, choose a unique provider name and unique DLL names. These three things will help you create a unique OLE DB provider which you can deploy with your application.

Here are the steps involved in creating a custom version of the OLE DB provider.

To customize the OLE DB provider

1. Make a copy of the sample registration file shown below. It is listed after these steps because it is quite lengthy. The file name should have a *.reg* suffix. The names of the registry values are case sensitive.

2. Use the Microsoft Visual Studio uuidgen utility to create 4 sequential UUIDs (GUIDs).

   ```
   uuidgen -n4 -s -x >oledbguids.txt
   ```

3. The 4 UUIDs or GUIDs are assigned in the following sequence:

   a. The Provider class ID (GUID1 below).

   b. The Enum class ID (GUID2 below).

   c. The ErrorLookup class ID (GUID3 below).

   d. The Provider Assist class ID (GUID4 below). This last GUID is not used in Windows Mobile deployments.

   It is important that they be sequential (that is what -x in the uuidgen command line does for you). Each GUID should appear similar to the following.

Name	GUID
GUID1	41dfe9f3-db92-11d2-8c43-006008d26a6f
GUID2	41dfe9f4-db92-11d2-8c43-006008d26a6f
GUID3	41dfe9f5-db92-11d2-8c43-006008d26a6f
GUID4	41dfe9f6-db92-11d2-8c43-006008d26a6f

   Note that it is the first part of the GUID (for example, 41dfe9f3) that is incrementing.

4. Use the search/replace capability of an editor to change all the GUID1, GUID2, GUID3, and GUID4 in the text to the corresponding GUID (for example, GUID1 would be replaced by 41dfe9f3-db92-11d2-8c43-006008d26a6f if that was the GUID generated for you by uuidgen).

5. Decide on your Provider name. This is the name that you will use in your application in connection strings, and so on (for example, Provider=SQLAny). Do not use any of the following names. These names are used by SQL Anywhere.

Version 10 or later	Version 9 or earlier
SAOLEDB	ASAProv

Version 10 or later	Version 9 or earlier
SAErrorLookup	ASAErrorLookup
SAEnum	ASAEnum
SAOLEDBA	ASAProvA

6. Use the search/replace capability of an editor to change all the occurrences of the string SQLAny to the provider name that you have chosen. This includes all those places where SQLAny may be a substring of a longer string (for example, SQLAnyEnum).

   Suppose you chose Acme for your provider name. The names that will appear in the HKEY_CLASSES_ROOT registry hive are shown in the following table along with the SQL Anywhere names (for comparison).

SQL Anywhere provider	Your custom provider
SAOLEDB	Acme
SAErrorLookup	AcmeErrorLookup
SAEnum	AcmeEnum
SAOLEDBA	AcmeA

7. Make copies of the SQL Anywhere provider DLLs (*dboledb12.dll* and *dboledba12.dll*) under different names. Note that there is no *dboledba12.dll* for Windows Mobile.

   ```
   copy dboledb12.dll myoledb12.dll
   copy dboledba12.dll myoledba12.dll
   ```

   A special registry key will be created by the script that is based on the DLL name that you choose. It is important that the name be different from the standard DLL names (such as *dboledb12.dll* or *dboledba12.dll*). If you name the provider DLL *myoledb12* then the provider will look up a registry entry in HKEY_CLASSES_ROOT with that same name. The same is true of the provider schema assist DLL. If you name the DLL *myoledba12* then the provider will look up a registry entry in HKEY_CLASSES_ROOT with that same name. It is important that the name you choose is unique and is unlikely to be chosen by anyone else. Here are some examples.

DLL name(s) chosen	Corresponding HKEY_CLASSES_ROOT\name
myoledb12.dll	HKEY_CLASSES_ROOT\myoledb12
myoledba12.dll	HKEY_CLASSES_ROOT\myoledba12
acmeOledb.dll	HKEY_CLASSES_ROOT\acmeOledb
acmeOledba.dll	HKEY_CLASSES_ROOT\acmeOledba

DLL name(s) chosen	Corresponding HKEY_CLASSES_ROOT\name
SAcustom.dll	HKEY_CLASSES_ROOT\SAcustom
SAcustomA.dll	HKEY_CLASSES_ROOT\SAcustomA

8. Use the search/replace capability of an editor to change all the occurrences of *myoledb12* and *myoledba12* in the registry script to the two DLL names you have chosen.

9. Use the search/replace capability of an editor to change all the occurrences of *d:\\mypath\\bin32* in the registry script to the installed location for the DLLs. Be sure to use a pair of slashes to represent a single slash. This step will have to be customized at the time of your application install.

10. Save the registry script to disk and run it.

11. Give your new provider a try. Do not forget to change your ADO / OLE DB application to use the new provider name.

Here is the listing of the registry script that is to be modified.

```
REGEDIT4
; Special registry entries for a private OLE DB provider.
[HKEY_CLASSES_ROOT\myoledb12]
@="Custom SQL Anywhere OLE DB Provider 12.0"
[HKEY_CLASSES_ROOT\myoledb12\Clsid] @="{GUID1}"
; Data1 of the following GUID must be 3 greater than the
; previous, for example, 41dfe9f3 + 3 => 41dfe9ee.
[HKEY_CLASSES_ROOT\myoledba12]
@="Custom SQL Anywhere OLE DB Provider 12.0"
[HKEY_CLASSES_ROOT\myoledba12\Clsid] @="{GUID4}"
; Current version (or version independent prog ID)
; entries (what you get when you have "SQLAny"
; instead of "SQLAny.12")
[HKEY_CLASSES_ROOT\SQLAny]
@="SQL Anywhere OLE DB Provider"
[HKEY_CLASSES_ROOT\SQLAny\Clsid]
@="{GUID1}"
[HKEY_CLASSES_ROOT\SQLAny\CurVer]
@="SQLAny.12"
[HKEY_CLASSES_ROOT\SQLAnyEnum]
@="SQL Anywhere OLE DB Provider Enumerator"
[HKEY_CLASSES_ROOT\SQLAnyEnum\Clsid]
@="{GUID2}" [HKEY_CLASSES_ROOT\SQLAnyEnum\CurVer]
@="SQLAnyEnum.12" [HKEY_CLASSES_ROOT\SQLAnyErrorLookup]
@="SQL Anywhere OLE DB Provider Extended Error Support"
[HKEY_CLASSES_ROOT\SQLAnyErrorLookup\Clsid]
@="{GUID3}"
[HKEY_CLASSES_ROOT\SQLAnyErrorLookup\CurVer]
@="SQLAnyErrorLookup.12"
[HKEY_CLASSES_ROOT\SQLAnyA]
@="SQL Anywhere OLE DB Provider Assist"
[HKEY_CLASSES_ROOT\SQLAnyA\Clsid]
@="{GUID4}"
[HKEY_CLASSES_ROOT\SQLAnyA\CurVer]
@="SQLAnyA.12"
; Standard entries (Provider=SQLAny.12)
[HKEY_CLASSES_ROOT\SQLAny.12]
@="Sybase SQL Anywhere OLE DB Provider 12.0"
```

```
[HKEY_CLASSES_ROOT\SQLAny.12\Clsid]
@="{GUID1}"
[HKEY_CLASSES_ROOT\SQLAnyEnum.12]
@="Sybase SQL Anywhere OLE DB Provider Enumerator 12.0"
[HKEY_CLASSES_ROOT\SQLAnyEnum.12\Clsid]
@="{GUID2}"
[HKEY_CLASSES_ROOT\SQLAnyErrorLookup.12]
@="Sybase SQL Anywhere OLE DB Provider Extended Error Support 12.0"
[HKEY_CLASSES_ROOT\SQLAnyErrorLookup.12\Clsid]
@="{GUID3}"
[HKEY_CLASSES_ROOT\SQLAnyA.12]
@="Sybase SQL Anywhere OLE DB Provider Assist 12.0"
[HKEY_CLASSES_ROOT\SQLAnyA.12\Clsid]
@="{GUID4}"
; SQLAny (Provider=SQLAny.12)
[HKEY_CLASSES_ROOT\CLSID\{GUID1}]
@="SQLAny.12"
"OLEDB_SERVICES"=dword:ffffffff
[HKEY_CLASSES_ROOT\CLSID\{GUID1}\ExtendedErrors]
@="Extended Error Service"
[HKEY_CLASSES_ROOT\CLSID\{GUID1}\ExtendedErrors\{GUID3}]
@="Sybase SQL Anywhere OLE DB Provider Error Lookup"
[HKEY_CLASSES_ROOT\CLSID\{GUID1}\InprocServer32]
@="d:\\mypath\\bin32\\myoledb12.dll"
"ThreadingModel"="Both"
[HKEY_CLASSES_ROOT\CLSID\{GUID1}\OLE DB Provider]
@="Sybase SQL Anywhere OLE DB Provider 12.0"
[HKEY_CLASSES_ROOT\CLSID\{GUID1}\ProgID]
@="SQLAny.12"
[HKEY_CLASSES_ROOT\CLSID\{GUID1}\VersionIndependentProgID]
@="SQLAny"
; SQLAnyErrorLookup
[HKEY_CLASSES_ROOT\CLSID\{GUID3}]
@="Sybase SQL Anywhere OLE DB Provider Error Lookup 12.0"
@="SQLAnyErrorLookup.12"
[HKEY_CLASSES_ROOT\CLSID\{GUID3}\InprocServer32]
@="d:\\mypath\\bin32\\myoledb12.dll"
"ThreadingModel"="Both"
[HKEY_CLASSES_ROOT\CLSID\{GUID3}\ProgID]
@="SQLAnyErrorLookup.12"
[HKEY_CLASSES_ROOT\CLSID\{GUID3}\VersionIndependentProgID]
@="SQLAnyErrorLookup"
; SQLAnyEnum [HKEY_CLASSES_ROOT\CLSID\{GUID2}]
@="SQLAnyEnum.12"
[HKEY_CLASSES_ROOT\CLSID\{GUID2}\InprocServer32]
@="d:\\mypath\\bin32\\myoledb12.dll"
"ThreadingModel"="Both"
[HKEY_CLASSES_ROOT\CLSID\{GUID2}\OLE DB Enumerator]
@="Sybase SQL Anywhere OLE DB Provider Enumerator"
[HKEY_CLASSES_ROOT\CLSID\{GUID2}\ProgID]
@="SQLAnyEnum.12"
[HKEY_CLASSES_ROOT\CLSID\{GUID2}\VersionIndependentProgID]
@="SQLAnyEnum"
; SQLAnyA [HKEY_CLASSES_ROOT\CLSID\{GUID4}]
@="SQLAnyA.12"
[HKEY_CLASSES_ROOT\CLSID\{GUID4}\InprocServer32]
@="d:\\mypath\\bin32\\myoledba12.dll"
"ThreadingModel"="Both"
[HKEY_CLASSES_ROOT\CLSID\{GUID4}\ProgID]
@="SQLAnyA.12"
[HKEY_CLASSES_ROOT\CLSID\{GUID4}\VersionIndependentProgID]
@="SQLAnyA"
```


Deploying ODBC clients

The simplest way to deploy ODBC clients is to use the **Deployment Wizard**. For more information, see "Using the Deployment Wizard" on page 931.

Each ODBC client computer must have the following:

- **ODBC Driver Manager** Microsoft provides an ODBC Driver Manager for Windows operating systems. SQL Anywhere includes an ODBC Driver Manager for Linux, Unix, and Mac OS X. There is no ODBC Driver Manager for Windows Mobile. ODBC applications can run without a driver manager but, on platforms for which an ODBC driver manager is available, this is not recommended.
- **Connection information** The client application must have access to the information needed to connect to the server. This information is typically included in an ODBC data source.
- **The SQL Anywhere ODBC driver** The files that must be included in a deployment of an ODBC client application are described next in "ODBC driver required files".

ODBC driver required files

The following table shows the files needed for a working SQL Anywhere ODBC driver. These files should be placed in a single directory. The SQL Anywhere installation places them all in the operating-system subdirectory of your SQL Anywhere installation directory (for example, *bin32* or *bin64*).

The multithreaded version of the ODBC driver for Linux, Unix, and Mac OS X platforms is indicated by "MT".

Platform	Required files
Windows	*dbodbc12.dll* *dbcon12.dll* *dbicu12.dll* *dbicudt12.dll* *dblg[LL]12.dll* *dbelevate12.exe*

Platform	Required files
Windows Mobile	*dbodbc12.dll* *dbicu12.dll* (optional) *dbicudt12.dat* (optional) *dblg[LL]12.dll*
Linux, Solaris, HP-UX	*libdbodbc12.so.1* *libdbodbc12_n.so.1* *libdbodm12.so.1* *libdbtasks12.so.1* *libdbicu12.so.1* *libdbicudt12.so.1* *dblg[LL]12.res*
Linux, Solaris, HP-UX MT	*libdbodbc12.so.1* *libdbodbc12_r.so.1* *libdbodm12.so.1* *libdbtasks12_r.so.1* *libdbicu12_r.so.1* *libdbicudt12.so.1* *dblg[LL]12.res*
AIX	*libdbodbc12.so* *libdbodbc12_n.so* *libdbodm12.so* *libdbtasks12.so* *libdbicu12.so* *libdbicudt12.so* *dblg[LL]12.res*

Platform	Required files
AIX MT	*libdbodbc12.so* *libdbodbc12_r.so* *libdbodm12.so* *libdbtasks12_r.so* *libdbicu12_r.so* *libdbicudt12.so* *dblg[LL]12.res*
Mac OS X	*dbodbc12.bundle* *libdbodbc12.dylib* *libdbodbc12_n.dylib* *libdbodm12.dylib* *libdbtasks12.dylib* *libdbicu12.dylib* *libdbicudt12.dylib* *dblg[LL]12.res*
Mac OS X MT	*dbodbc12_r.bundle* *libdbodbc12.dylib* *libdbodbc12_r.dylib* *libdbodm12.dylib* *libdbtasks12_r.dylib* *libdbicu12_r.dylib* *libdbicudt12.dylib* *dblg[LL]12.res*

Notes

- For Linux and Solaris platforms, you should create a link to the *.so.1* files. The link name should match the file name with the ".1" version suffix removed.
- There are multithreaded (MT) versions of the ODBC driver for Linux, Unix, and Mac OS X platforms. The file names contain the "_r" suffix. Deploy these files if your application requires them.
- For Windows, a driver manager is included with the operating system. For Linux, Unix, and Mac OS X, SQL Anywhere provides a driver manager. The file name begins with *libdbodm12*.
- Note that for Windows Vista or later versions of Windows, you must include the SQL Anywhere elevated operations agent (*dbelevate12.exe*) which supports the privilege elevation required to register or unregister the ODBC driver. This file is only required as part of the ODBC driver install or uninstall procedure.
- A language resource library file should also be included. The table above show files with the designation **[LL]**. There are several message files each supporting a different language. If you want to install support for different languages, you have to include the resource files for these languages. Replace **[LL]** with the language code (for example, **en**, **de**, **jp**, etc.).
- For Windows, the Connect window support code (*dbcon12.dll*) is needed if your end users will create their own data sources, if they need to enter user IDs and passwords when connecting to the database, or if they need to display the Connect window for any other purpose.

Configuring the ODBC driver

In addition to copying the ODBC driver files onto disk, your installation program must also make a set of registry entries to install the ODBC driver properly.

Windows

The SQL Anywhere installer makes changes to the Windows Registry to identify and configure the ODBC driver. If you are building an installation program for your end users, you should make the same registry settings.

The simplest way to do this is to use the self-registering capability of the ODBC driver. You use the regsvr32 utility on Windows or the regsvrce utility on Windows Mobile. Note that for 64-bit versions of Windows, you can register both the 64-bit and 32-bit versions of the ODBC driver. By using the self-registering feature of the ODBC driver, you are ensured that the proper registry entries are created.

You should give custom names to your 32-bit and 64-bit versions of the SQL Anywhere ODBC driver. This facilitates the installation and registration of multiple independent copies of the SQL Anywhere ODBC driver using regsvr32, and prevents your registry settings from being overwritten if another application install registers the SQL Anywhere ODBC driver.

To customize the names of your 32-bit and 64-bit versions of the ODBC driver, open a command prompt and rename them as follows where *custom-name* is a meaningful string such as your company name:


```
ren install-dir\bin32\dbodbc12.dll dbodbc12custom-name.dll
ren install-dir\bin64\dbodbc12.dll dbodbc12custom-name.dll
```

Make sure to preserve the dbodbc12 prefix when renaming the files.

To register the 32-bit and 64-bit versions of the ODBC driver using the custom names, issue the following commands:

```
regsvr32 install-dir\bin32\dbodbc12custom-name.dll
regsvr32 install-dir\bin64\dbodbc12custom-name.dll
```

You can use the regedit utility to inspect the registry entries created by the ODBC driver.

The SQL Anywhere ODBC driver is identified to the system by a set of registry values in the following registry key:

```
HKEY_LOCAL_MACHINE\
   SOFTWARE\
      ODBC\
         ODBCINST.INI\
            SQL Anywhere 12
```

Sample values for 32-bit Windows are shown below:

Value name	Value type	Value data
Driver	String	*install-dir\bin32\dbodbc12custom-name.dll*
Setup	String	*install-dir\bin32\dbodbc12custom-name.dll*

There is also a registry value in the following key:

```
HKEY_LOCAL_MACHINE\
   SOFTWARE\
      ODBC\
         ODBCINST.INI\
            ODBC Drivers
```

The value is as follows:

Value name	Value type	Value data
SQL Anywhere 12 - *custom-name*	String	Installed

64-bit Windows

For 64-bit Windows, the 32-bit ODBC driver registry entries ("SQL Anywhere 12 - *custom-name*" and "ODBC Drivers") are located under the following key:

```
HKEY_LOCAL_MACHINE\
   SOFTWARE\
      Wow6432Node\
         ODBC\
            ODBCINST.INI
```

To view these entries, you must be using a 64-bit version of regedit. If you cannot locate Wow6432Node on 64-bit Windows, then you are using the 32-bit version of regedit.

Third party ODBC drivers

If you are using a third-party ODBC driver on an operating system other than Windows, consult the documentation for that driver on how to configure the ODBC driver.

Deploying connection information

ODBC client connection information is generally deployed as an ODBC data source. You can deploy an ODBC data source in one of the following ways:

- **Programmatically** Add a data source description to your end-user's registry or ODBC initialization files.
- **Manually** Provide your end users with instructions, so that they can create an appropriate data source on their own computer.

  On Windows, you create a data source manually using the ODBC Data Source Administrator, from the User DSN tab or the System DSN tab. The SQL Anywhere ODBC driver displays the configuration window for entering settings. Data source settings include the location of the database file, the name of the database server, and any start up parameters and other options.

  On Unix platforms, you can create a data source manually using the SQL Anywhere dbdsn utility. Data source settings include the location of the database file, the name of the database server, and any start up parameters and other options.

This section provides you with the information you need to know for either approach.

Types of data source (Windows)

There are three kinds of data sources: User data sources, System data sources, and File data sources.

User data source definitions are stored in the part of the registry containing settings for the specific user currently logged on to the system. System data sources, however, are available to all users and to Windows services, which run regardless of whether a user is logged onto the system or not. Given a correctly configured System data source named MyApp, any user can use that ODBC data source by providing DSN=MyApp in the ODBC connection string.

File data sources are not held in the registry, but are stored on disk. A connection string must provide a FileDSN connection parameter to use a File data source. The default location of File data sources is specified by the **HKEY_CURRENT_USER\Software\ODBC\odbc.ini\ODBC File DSN\DefaultDSNDir** registry entry or by the **HKEY_LOCAL_MACHINE\Software\ODBC\odbc.ini\ODBC File DSN\DefaultDSNDir** registry entry (if the former is not defined). The path can be included in the FileDSN connection parameter to help locate the File data source when it is located elsewhere.

Data source registry entries (Windows)

User and System data source definitions are stored in the Windows registry. The simplest way to ensure the correct creation of registry entries for data source definitions is to use the SQL Anywhere dbdsn utility to create them.

Otherwise, you must create a set of registry values in a particular registry key.

For User data sources, the registry key is as follows:

```
HKEY_CURRENT_USER\
   SOFTWARE\
      ODBC\
         ODBC.INI\
            user-data-source-name
```

For System data sources, the registry key is as follows:

```
HKEY_LOCAL_MACHINE\
   SOFTWARE\
      ODBC\
         ODBC.INI\
            system-data-source-name
```

The key contains a set of registry values, each of which corresponds to a connection parameter (except for the Driver string). The Driver string is automatically added to the registry by the Microsoft ODBC Driver Manager when a Data Source is created using the Microsoft ODBC Data Source Administrator or the dbdsn utility. For example, the SQL Anywhere 12 Demo key corresponding to the SQL Anywhere 12 Demo system Data Source Name (DSN) contains the following settings for 32-bit Windows:

Value name	Value type	Value data
AutoStop	String	YES
DatabaseFile	String	*samples-dir\demo.db*
Description	String	SQL Anywhere 12 Sample Database
Driver	String	*install-dir\bin32\dbodbc12.dll*
Password	String	sql
ServerName	String	demo12
StartLine	String	*install-dir\bin32\dbeng12.exe*
UserID	String	DBA

Note
It is recommended that you include the ServerName parameter in connection strings for deployed applications. This ensures that the application connects to the correct server if a computer is running multiple SQL Anywhere database servers and can help prevent timing-dependent connection failures.

In these entries, *install-dir* is the SQL Anywhere installation directory. For 64-bit Windows, *bin32* would be replaced by *bin64*.

On 64-bit Windows, there is only one registry entry for User data sources that is shared by both 64-bit and 32-bit applications. For these types of data sources, it is recommended that you remove the path in the Driver string. If the path designates the 64-bit ODBC driver, then a 32-bit application that connects/disconnects often will incur a performance penalty (as well as a memory leak) when using the Microsoft ODBC Driver Manager. Similarly, If the path designates the 32-bit ODBC driver, then a 64-bit application that connects/disconnects often will incur a similar penalty. At the time of writing, this is a flaw in the Microsoft ODBC Driver Manager. For this reason, System data sources are a better choice for 64-bit Windows systems.

In addition, you must add the data source name to the list of data sources in the registry. For user data sources, you use the following key:

```
HKEY_CURRENT_USER\
   SOFTWARE\
      ODBC\
         ODBC.INI\
            ODBC Data Sources
```

For system data sources, use the following key:

```
HKEY_LOCAL_MACHINE\
   SOFTWARE\
      ODBC\
         ODBC.INI\
            ODBC Data Sources
```

The value associates each data source with an ODBC driver. The value name is the data source name, and the value data is the ODBC driver name. For example, the system data source installed by SQL Anywhere is named SQL Anywhere 12 Demo, and has the following value:

Value name	Value type	Value data
SQL Anywhere 12 Demo	String	SQL Anywhere 12

Caution: ODBC settings are easily viewed
User data source configurations can contain sensitive database settings such as a user's ID and password. These settings are stored in the registry in plain text, and can be viewed using the Windows Registry editors *regedit.exe* or *regedt32.exe*, which are provided by Microsoft with the operating system. You can choose to encrypt passwords, or require users to enter them when connecting.

Required and optional connection parameters

You can identify the data source name in an ODBC connection string in this manner,

```
DSN=UserDataSourceName
```

On Windows, when a DSN parameter is provided in the connection string, the Current User data source definitions in the Windows Registry are searched, followed by System data sources. File data sources are searched only when FileDSN is provided in the ODBC connection string.

The following table illustrates the implications to the user and the application developer when a data source exists and is included in the application's connection string as a DSN or FileDSN parameter.

When the data source ...	The connection string must also identify ...	The user must supply ...
Contains the ODBC driver name and location; the name of the database file/server; startup parameters; and the user ID and password.	No additional information	No additional information.
Contains the ODBC driver name and location; the name of the database file/server; startup parameters.	No additional information	User ID and password if not provided in the ODBC data source.
Contains only the name and location of the ODBC driver.	The name of the database file (DBF=) and/or the database server (SERVER=). Optionally, it may contain other connection parameters such as Userid (UID=) and PASSWORD (PWD=).	User ID and password if not provided in the ODBC data source or ODBC connection string.
Does not exist	The name of the ODBC driver to be used (Driver=) and the database name (DBN=), the database file (DBF=), and/or the database server (SERVER=). Optionally, it may contain other connection parameters such as Userid (UID=) and PASSWORD (PWD=).	User ID and password if not provided in the ODBC connection string.

For more information about ODBC connections and configurations, see the following:

- "SQL Anywhere database connections" [*SQL Anywhere Server - Database Administration*].
- The Open Database Connectivity (ODBC) SDK, available from Microsoft.

Deploying embedded SQL clients

The simplest way to deploy embedded SQL clients is to use the **Deployment Wizard**. For more information, see "Using the Deployment Wizard" on page 931.

Deploying embedded SQL clients involves the following:

- **Installed files** Each client computer must have the files required for a SQL Anywhere embedded SQL client application.
- **Connection information** The client application must have access to the information needed to connect to the server. This information may be included in an ODBC data source.

Installing files for embedded SQL clients

The following table shows which files are needed for embedded SQL clients.

Description	Windows	Linux / Unix	Mac OS X
Interface library	*dblib12.dll*	*libdblib12_r.so*	*libdblib12_r.dylib*
optional encryption support	*dbecc12.dll*	*libdbecc12_r.so*	*libdbecc12_r.dylib*
optional encryption support	*dbfips12.dll*	*libdbfips12_r.so*	*libdbfips12_r.dylib*
optional encryption support	*dbrsa12.dll*	*libdbrsa12_r.so*	*libdbrsa12_r.dylib*
Thread support library	N/A	*libdbtasks12_r.so*	*libdbtasks12_r.dylib*
Language resource library	*dblg[LL]12.dll*	*dblg[LL]12.res*	*dblg[LL]12.res*
Connect window	*dbcon12.dll*	N/A	N/A

Notes

- A language resource library file should also be included. The table above show files with the designation **[LL]**. There are several message files each supporting a different language. If you want to install support for different languages, you have to include the resource files for these languages. Replace **[LL]** with the language code (for example, **en**, **de**, **jp**, etc.).
- For non-multithreaded applications on Linux/Unix, use *libdblib12.so* and *libdbtasks12.so*.
- For non-multithreaded applications on Mac OS X, use *libdblib12.dylib* and *libdbtasks12.dylib*.
- If the client application uses encryption then the appropriate encryption support (*dbecc12.dll*, *dbfips12.dll*, or *dbrsa12.dll*) should also be included.
- If the client application uses an ODBC data source to hold the connection parameters, your end user must have a working ODBC installation. Instructions for deploying ODBC are included in the Microsoft ODBC SDK.

For more information about deploying ODBC information, see "Deploying ODBC clients" on page 947.

- The ODBC Configuration support module for Windows (*dbcon12.dll*) is needed if your end users will be creating their own data sources.

Connection information

You can deploy embedded SQL connection information in one of the following ways:

- **Manual** Provide your end users with instructions for creating an appropriate data source on their computer.
- **File** Distribute a file that contains connection information in a format that your application can read.
- **ODBC data source** You can use an ODBC data source to hold connection information.

Deploying JDBC clients

You must install a Java Runtime Environment (JRE) to use JDBC. Version 1.6.0 or later is recommended.

In addition to a JRE, each JDBC client requires a SQL Anywhere JDBC driver or jConnect.

SQL Anywhere JDBC 4.0 driver

To deploy the SQL Anywhere JDBC 4.0 driver, you must deploy the following files:

- *sajdbc4.jar* This must be in the application's classpath. This file is located in the SQL Anywhere installation *java* folder.
- *dbjdbc12.dll* This must be locatable in the system path. On Linux and Unix environments, the file is a shared library called *libdbjdbc12.so*. On Mac OS X, the file is a shared library called *libdbjdbc12.dylib*.
- The ODBC driver files. For more information, see "ODBC driver required files" on page 947.

SQL Anywhere JDBC 3.0 driver

To deploy the SQL Anywhere JDBC 3.0 driver, you must deploy the following files:

- *sajdbc.jar* This must be in the application's classpath. This file is located in the SQL Anywhere installation *java* folder.
- *dbjdbc12.dll* This must be locatable in the system path. On Linux and Unix environments, the file is a shared library called *libdbjdbc12.so*. On Mac OS X, the file is a shared library called *libdbjdbc12.dylib*.
- The ODBC driver files. For more information, see "ODBC driver required files" on page 947.

jConnect JDBC driver

To deploy the jConnect JDBC driver, you must deploy the following files:

- The jConnect driver files. For a version of the jConnect software and the jConnect documentation, see http://www.sybase.com/products/allproductsa-z/softwaredeveloperkit/jconnect.

- When you use a TDS client (either Open Client or jConnect based), you have the option of sending the connection password in clear text or in encrypted form. The latter is done by performing a TDS encrypted password handshake. The handshake involves using private/public key encryption. The support for generating the RSA private/public key pair and for decrypting the encrypted password is included in a special library. The library file must be locatable by the SQL Anywhere server in its system path. For Windows, this file is called *dbrsakp12.dll*. There are both 64-bit and 32-bit versions of the DLL. On Linux and Unix environments, the file is a shared library called *libdbrsakp12.so*. On Mac OS X, the file is a shared library called *libdbrsakp12.dylib*. The file is not necessary if you do not use this feature.

JDBC database connection URL

Your Java application needs a URL to connect to the database. This URL specifies the driver, the computer to use, and the port on which the database server is listening.

For more information about URLs, see "Supplying a URL to the driver" on page 404.

Deploying PHP clients

To deploy the SQL Anywhere PHP extension, you must install the following components on the target platform:

- The PHP 5 binaries for your platform, which are available for download at http://www.php.net. For Windows platforms, the thread-safe version of PHP must be used with the SQL Anywhere PHP extension.

- A web server such as Apache HTTP Server if you want to run PHP scripts within a web server.

  SQL Anywhere can be run on the same computer as the web server, or on a different computer.

- SQL Anywhere provides prebuilt PHP extensions for PHP versions 5.1.1 to 5.2.11 and 5.3.0 to 5.3.2. At the time of writing, PHP version 5.2.11 and 5.3.2 were the most recent stable releases.

- Supporting SQL Anywhere shared objects or libraries.

The following table summarizes the files required for PHP clients.

Description	Windows	Linux / Unix	Mac OS X
PHP installation (third-party)	*php.exe*	*php*	*php*

Description	Windows	Linux / Unix	Mac OS X
PHP 5.1.x calls	*php-5.1.[1-6]_sqlanywhere_extenv12.dll*	*php-5.1.[1-6]_sqlanywhere_extenv12_r.so* or build from source code	Build from source code
PHP 5.2.x calls	*php-5.2.[0-11]_sqlanywhere_extenv12.dll*	*php-5.2.[0-11]_sqlanywhere_extenv12_r.so* or build from source code	Build from source code
PHP 5.3.x calls	*php-5.3.[0-2]_sqlanywhere_extenv12.dll*	*php-5.3.[0-2]_sqlanywhere_extenv12_r.so* or build from source code	Build from source code
SQL Anywhere C API runtime	*dbcapi.dll*	*libdbcapi_r.so*	*libdbcapi_r.dylib*
DBLIB (threaded)	*dblib12.dll*	*libdblib12_r.so*	*libdblib12_r.dylib*
Thread support library	N/A	*libdbtasks12_r.so*	*libdbtasks12_r.dylib*
optional encryption support	*dbecc12.dll*	*libdbecc12_r.so*	*libdbecc12_r.dylib*
optional encryption support	*dbfips12.dll*	*libdbfips12_r.so*	*libdbfips12_r.dylib*
optional encryption support	*dbrsa12.dll*	*libdbrsa12_r.so*	*libdbrsa12_r.dylib*
Language resource library	*dblg[LL]12.dll*	*dblg[LL]12.res*	*dblg[LL]12.res*
Connect window	*dbcon12.dll*	N/A	N/A

Notes

- For the latest SQL Anywhere PHP drivers, see http://www.sybase.com/detail?id=1019698.
- A language resource library file should also be included. The table above show files with the designation **[LL]**. There are several message files each supporting a different language. If you want to install support for different languages, you have to include the resource files for these languages. Replace **[LL]** with the language code (for example, **en**, **de**, **jp**, etc.).
- If the client application uses encryption then the appropriate encryption support should also be included.
- If the client application uses an ODBC data source to hold the connection parameters, your end user must have a working ODBC installation. Instructions for deploying ODBC are included in the Microsoft ODBC SDK.

For more information about deploying ODBC information, see "Deploying ODBC clients" on page 947.

- The ODBC Configuration support module for Windows (*dbcon12.dll*) is needed if your end users will be creating their own data sources.

For additional information about installing PHP, see http://www.sybase.com/detail?id=1057714.

The following sections provide assistance with installing the SQL Anywhere PHP extension.

Choosing which PHP extension to use

On Windows, SQL Anywhere includes thread-safe extensions for PHP versions 5.1.1 to 5.2.11 and 5.3.0 to 5.3.2. A thread-safe version of PHP must be used with the SQL Anywhere PHP extension. The extension file names for the supported PHP versions follow this pattern:

```
php-5.x.y_sqlanywhere.dll
```

On Linux and Solaris, SQL Anywhere includes both 64-bit and 32-bit versions of the extensions for PHP versions 5.1.1 to 5.2.11 and 5.3.0 to 5.3.2. It also includes both threaded and non-threaded extensions. If you are using the CGI version of PHP or if you are using Apache 1.x, use the non-threaded extension. If you are using Apache 2.x, use the threaded extension. The extension file names for the supported PHP versions follow this pattern:

```
php-5.x.y_sqlanywhere[_r].so
```

The "5.x.y" represents the PHP version (for example, 5.2.11). For Linux and Solaris, the threaded version of the PHP extension has *_r* appended to the file name. Windows versions are implemented as Dynamic Link Libraries and Linux/Solaris versions are implemented as Shared Objects. If you are using a later version of PHP, then you can check the Internet for the latest SQL Anywhere PHP drivers at http://www.sybase.com/detail?id=1019698.

Installing the PHP extension on Windows

To use the SQL Anywhere PHP extension on Windows, you must copy the DLL from the SQL Anywhere installation directory and add it to your PHP installation. Optionally, you can add an entry to your PHP initialization file to load the extension, so you do not need to load it manually in each script.

To install the PHP extension on Windows

1. Locate the *php.ini* file for your PHP installation, and open it in a text editor. Locate the line that specifies the location of the **extension_dir** directory. If **extension_dir** is not set to any specific directory, it is a good idea to set it to point to an isolated directory for better system security.

2. Copy the file *php-5.x.y_sqlanywhere.dll* from the *Bin32* subdirectory of your SQL Anywhere installation to the directory specified by the **extension_dir** entry in the *php.ini* file.

Note
The string *5.x.y* is the PHP version number corresponding to the version that you have installed.

If your version of PHP is more recent than the SQL Anywhere PHP extensions provided by SQL Anywhere, try using the most recent extension provided. Note that a version 5.2.x SQL Anywhere PHP extension will not work with a version 5.3.x PHP.

3. Add the following line to the Dynamic Extensions section of the *php.ini* file to load the SQL Anywhere PHP driver automatically.

   ```
   extension=php-5.x.y_sqlanywhere.dll
   ```

   where *5.x.y* reflects the version number of the SQL Anywhere PHP extension copied in the previous step.

   Save and close *php.ini*.

   An alternative to automatically loading the PHP driver is to load it manually in each script that requires it. See "Configuring the SQL Anywhere PHP extension" on page 963.

4. Make sure that the *Bin32* subdirectory of your SQL Anywhere installation is in your path. The SQL Anywhere PHP extension DLL requires the *Bin32* directory to be in your path.

For more information, see "Running PHP test scripts in your web pages" on page 630.

Installing the PHP extension on Linux/Solaris

To use the SQL Anywhere PHP extension on Linux or Solaris, you must copy the shared object from the SQL Anywhere installation directory and add it to your PHP installation. Optionally, you can add an entry to your PHP initialization file, *php.ini*, to load the extension, so you do not need to load it manually in each script.

To install the PHP extension on Linux/Solaris

1. Locate the *php.ini* file of your PHP installation, and open it in a text editor. Locate the line that specifies the location of the **extension_dir** directory. If **extension_dir** is not set to any specific directory, it is a good idea to set it to point to an isolated directory for better system security.

2. Copy the shared object from the *lib32* or *lib64* subdirectory of your SQL Anywhere installation to the directory specified by the **extension_dir** entry in the *php.ini* file. Your choice of shared object will depend on the version of PHP that you have installed and whether it is a 32-bit or a 64-bit version.

Note
If your version of PHP is more recent than the shared object provided by SQL Anywhere, try using the most recent shared object provided. Note that a version 5.2.x SQL Anywhere PHP extension will not work with a version 5.3.x PHP.

For information about which version of the shared object to use, see "Choosing which PHP extension to use" on page 960.

3. Add the following line to the Dynamic Extensions section of the *php.ini* file to load the SQL Anywhere PHP driver automatically. The entry must identify the shared object you copied, which is either

   ```
   extension=php-5.x.y_sqlanywhere.so
   ```

   or, for the thread-safe shared object,

   ```
   extension=php-5.x.y_sqlanywhere_r.so
   ```

   where *5.x.y* is the version number of the PHP shared object copied in the previous step.

   Save and close *php.ini*.

   An alternative to automatically loading the PHP driver is to load it manually in each script that requires it. See "Configuring the SQL Anywhere PHP extension" on page 963.

4. Before attempting to use the PHP extension, verify that your PHP execution environment is set up for SQL Anywhere. Depending on which shell you are using, you must edit the configuration script for your web server's environment and add the appropriate command to source the SQL Anywhere configuration script from the SQL Anywhere installation directory:

In this shell ...	... use this command
sh, ksh, or bash	. /bin32/sa_config.sh
csh or tcsh	source /bin32/sa_config.csh

   The 32-bit version of the SQL Anywhere PHP extension DLL requires the *bin32* directory to be in your path. The 64-bit version of the SQL Anywhere PHP extension DLL requires the *bin64* directory to be in your path.

   The configuration file in which this line should be inserted is different for different web servers and on different Linux distributions. Here are some examples for the Apache server on the indicated distributions:

   - **RedHat/Fedora/CentOS** /etc/sysconfig/httpd
   - **Debian/Ubuntu** /etc/apache2/envvars

   The web server must be restarted after editing its environment configuration.

For more information, see "Running PHP test scripts in your web pages" on page 630.

Building the PHP extension on Unix and Mac OS X

To use the SQL Anywhere PHP extension on other versions of Unix or Mac OS X, you must build the PHP extension from the source code which is installed in the *sdk/php* subdirectory of your SQL

Anywhere installation. See "Building the SQL Anywhere PHP extension on Unix and Mac OS X" on page 637.

Configuring the SQL Anywhere PHP extension

The behavior of the SQL Anywhere PHP driver can be controlled by setting values in the PHP initialization file, *php.ini*. The following entries are supported:

- **extension** Causes PHP to load the SQL Anywhere PHP extension automatically each time PHP starts. Adding this entry to your PHP initialization file is optional, but if you don't add it, each script you write must start with a few lines of code that ensure that this extension is loaded. The following entry is used for Windows platforms.

  ```
  extension=php-5.x.y_sqlanywhere.dll
  ```

  On Linux platforms, use one of the following entries. The second entry is thread safe.

  ```
  extension=php-5.x.y_sqlanywhere.so

  extension=php-5.x.y_sqlanywhere_r.so
  ```

  In these entries, *5.x.y* identifies the PHP version.

  If the SQL Anywhere extension is not always automatically loaded when PHP starts, you must prefix each script you write with the following lines of code. This code ensures that the SQL Anywhere PHP extension is loaded.

  ```
  # Ensure that the SQL Anywhere PHP extension is loaded
  if( !extension_loaded('sqlanywhere') ) {
      # Find out which version of PHP is running
      $version = phpversion();
      $extension_name = 'php-'.$version.'_sqlanywhere';
      if( strtoupper(substr(PHP_OS, 0, 3) == 'WIN' )) {
          $extension_ext = '.dll';
      } else {
          $extension_ext = '.so';
      }
      dl( $extension_name.$extension_ext );
  }
  ```

- **allow_persistent** Allows persistent connections when set to On. It does not allow them when set to Off. The default value is On.

  ```
  sqlanywhere.allow_persistent=On
  ```

- **max_persistent** Sets the maximum number of persistent connections. The default value is -1, which means no limit.

  ```
  sqlanywhere.max_persistent=-1
  ```

- **max_connections** Sets the maximum number of connections that can be opened at once through the SQL Anywhere PHP extension. The default value is -1, which means no limit.

```
sqlanywhere.max_connections=-1
```

- **auto_commit** Specifies whether the database server performs a commit operation automatically. The commit is performed immediately following the execution of each statement when set to On. When set to Off, transactions should be ended manually with either the sasql_commit or sasql_rollback functions, as appropriate. The default value is On.

  ```
  sqlanywhere.auto_commit=On
  ```

- **row_counts** Returns the exact number of rows affected by an operation when set to On or an estimate when set to Off. The default value is Off.

  ```
  sqlanywhere.row_counts=Off
  ```

- **verbose_errors** Returns verbose errors and warnings when set to On. Otherwise, you must call the sasql_error or sasql_errorcode functions to get further error information. The default value is On.

  ```
  sqlanywhere.verbose_errors=On
  ```

For more information, see "sasql_set_option" on page 661.

Deploying Open Client applications

To deploy Open Client applications, each client computer needs the Sybase Open Client product. You must purchase the Open Client software separately from Sybase. It contains its own installation instructions.

When you use a TDS client (either Open Client or jConnect based), you have the option of sending the connection password in clear text or in encrypted form. The latter is done by performing a TDS encrypted password handshake. The handshake involves using private/public key encryption. The support for generating the RSA private/public key pair and for decrypting the encrypted password is included in a special library. The library file must be locatable by the SQL Anywhere server in its system path. For Windows, this file is called *dbrsakp12.dll*. There are both 64-bit and 32-bit versions of the DLL. On Linux and Unix environments, the file is a shared library called *libdbrsakp12.so*. On Mac OS X, the file is a shared library called *libdbrsakp12_r.dylib*. The file is not necessary if you do not use this feature.

Connection information for Open Client clients is held in the interfaces file. For information about the interfaces file, see the Open Client documentation and "Configuring Sybase Open Server" [*SQL Anywhere Server - Database Administration*].

Deploying administration tools

Subject to your license agreement, you can deploy a set of administration tools including Interactive SQL, Sybase Central, and the SQL Anywhere Console utility.

The simplest way to deploy the administration tools is to use the **Deployment Wizard**. For more information, see "Using the Deployment Wizard" on page 931.

For information about system requirements for administration tools, see http://www.sybase.com/detail?id=1002288.

Initialization files can simplify the deployment of the administration tools. Each of the launcher executables for the administration tools (Sybase Central, Interactive SQL, and the Console utility) can have a corresponding *.ini* file. This eliminates the need for registry entries and a fixed directory structure for the location of the JAR files. These *ini* files are located in the same directory and with the same file name as the executable file.

- **dbconsole.ini** This is the name of the Console utility initialization file.
- **dbisql.ini** This is the name of the Interactive SQL initialization file.
- **scjview.ini** This is the name of the Sybase Central initialization file.

The initialization file will contain the details on how to load the database administration tool. For example, the initialization file can contain the following lines:

- **JRE_DIRECTORY=<path>** This is the location of the required JRE. The **JRE_DIRECTORY** specification is required.
- **VM_ARGUMENTS=<any required VM arguments>** VM arguments are separated by semicolons (;). Any path values that contain blanks should be enclosed in quotation marks. VM arguments can be discovered by using the `-batch` option of the administration tool (for example, `scjview -batch`) and examining the file that is created. The **VM_ARGUMENTS** specification is optional.
- **JAR_PATHS=<path1;path2;...>** A delimited list of directories which contain the JAR files for the program. They are separated by semicolons (;). The **JAR_PATHS** specification is optional.
- **ADDITIONAL_CLASSPATH=<path1;path2;...>** Classpath values are separated by semicolons (;). The **ADDITIONAL_CLASSPATH** specification is optional.
- **LIBRARY_PATHS=<path1;path2;...>** These are paths to the DLLs/shared objects. They are separated by semicolons (;). The **LIBRARY_PATHS** specification is optional.
- **APPLICATION_ARGUMENTS=<arg1;arg2;...>** These are any application arguments. They are separated by semicolons (;). Application arguments can be discovered by using the `-batch` option of the administration tool (for example, `scjview -batch`) and examining the file that is created. The **APPLICATION_ARGUMENTS** specification is optional.

Here are the contents of a sample initialization file for Sybase Central.

```
JRE_DIRECTORY=c:\Sun\JRE160_x86
VM_ARGUMENTS=-Xmx200m
JAR_PATHS=c:\scj\jars;c:\scj\jhelp
ADDITIONAL_CLASSPATH=
LIBRARY_PATHS=c:\scj\bin
APPLICATION_ARGUMENTS=-screpository=C:\Documents and Settings\All Users
\Documents\Sybase Central 6.1.0;-installdir=c:\scj
```

This scenario assumes that a copy of the 32-bit Sun JRE is located in *c:\Sun\JRE160_x86*. As well, the Sybase Central executable and shared libraries (DLLs) like *jsyblib610* are stored in *c:\scj\bin*. The SQL Anywhere JAR files are stored in *c:\scj\jars*. The Sun JavaHelp 2.0 JAR files are stored in *c:\scj\jhelp*.

Note
When you are deploying applications, the personal database server (dbeng12) is required for creating databases using the dbinit utility. It is also required if you are creating databases from Sybase Central on the local computer when no other database servers are running.

Deploying administration tools on Windows

This section explains how to install Interactive SQL (dbisql), Sybase Central (including the SQL Anywhere, MobiLink, QAnywhere and UltraLite plug-ins), and the SQL Anywhere Console utility (dbconsole) on a Windows computer without using the Deployment Wizard. It is intended for those who want to create an installer for these administration tools.

This information applies to all Windows platforms except Windows Mobile. The instructions given here are specific to version 12.0.0 and cannot be applied to earlier or later versions of the software.

Check your license agreement
Redistribution of files is subject to your license agreement. No statements in this document override anything in your license agreement. Check your license agreement before considering deployment.

Before you begin

Before reading this section, you should have an understanding of the Windows Registry, including the REGEDIT application. The names of the registry values are case sensitive.

Modifying your registry is dangerous
Modify your registry at your own risk. It is recommended that you back up your system before modifying the registry.

The following steps are required to deploy the administration tools:

1. Decide what you want to deploy.
2. Copy the required files.
3. Register the administration tools with Windows.
4. Update the system path.
5. Register the plug-ins with Sybase Central.
6. Register the SQL Anywhere ODBC driver with Windows.
7. Register the online help files with Windows.

Each of these steps is explained in detail in the following sections.

Step 1: Deciding what software to deploy

You can install any combination of the following software bundles:

- Interactive SQL
- Sybase Central with the SQL Anywhere plug-in
- Sybase Central with the MobiLink plug-in
- Sybase Central with the QAnywhere plug-in
- Sybase Central with the Relay Server plug-in
- Sybase Central with the UltraLite plug-in
- SQL Anywhere Console utility (dbconsole)

The following components are also required when installing any of the above software bundles:

- The SQL Anywhere ODBC Driver.
- The Java Runtime Environment (JRE) version 1.6.0. You may want to install the 32-bit version of the JRE, the 64-bit version of the JRE, or both depending on your target platform.
- The Java Access Bridge for Microsoft Windows Operating System (if you want to enable accessibility features of the administration tools on Windows platforms). Enabling this feature will permit the administration tools to be used with screen reader technologies. At the time of writing, Sun only supports a 32-bit version of the Java Access Bridge so 32-bit versions of the JRE and the administration tools are required. See java.sun.com/javase/technologies/accessibility/accessbridge/2.0.1/docs/setup.html for more information.

The instructions in the following sections are structured so that you can install any (or all) of these bundles without conflicts.

Step 2: Copying the required files

The administration tools require a specific directory structure. You are free to put the directory tree in any directory, on any drive. Throughout the following discussion, *c:\sa12* is used as the example installation folder. The software must be installed into a directory tree structure having the following layout:

Directory	Description
sa12	The root folder. While the following steps assume you are installing into *c:\sa12*, you are free to put the directory anywhere (for example, *C:\Program Files\SQLAny12*).
sa12\Java	Holds Java program JAR files.
sa12\Bin32	Holds the native 32-bit Windows components used by the program, including the programs that launch the applications.
sa12\Bin64	Holds the native 64-bit Windows components used by the program, including the programs that launch the applications.
sa12\Sun\JavaHelp-2_0	The JavaHelp runtime library.
sa12\Sun\jre160_x86	The 32-bit Java Runtime Environment.
sa12\Sun\jre160_x64	The 64-bit Java Runtime Environment.

The following tables list the files required for each of the administration tools and the Sybase Central plug-ins. Make a list of the files you need, and then copy them into the directory structure outlined above.

The tables show files with the folder designation **BinXX**. There are 32-bit and 64-bit versions of these files, in the *Bin32* and *Bin64* folders respectively. If you are installing 32-bit and 64-bit administration tools, then you must install both sets of files in their respective folders.

The tables show files with the designation **[LL]**. There are several message files each supporting a different language. If you want to install support for different languages, you have to add the resource files for these languages. For more information, see the following section "International message and context-sensitive help files".

The administration tools require JRE 1.6.0. You should not substitute a later patch version of the JRE unless you have a specific need to do so.

If you are deploying 32-bit administration tools, then copy the 32-bit version of the JRE files from the *install-dir\Sun\jre160_x86* directory. Copy the entire *jre160_x86* tree, including subdirectories.

If you are deploying 64-bit administration tools, then copy the 64-bit version of the JRE files from the *install-dir\Sun\jre160_x64* directory. Copy the entire *jre160_x64* tree, including subdirectories.

Interactive SQL

Interactive SQL (dbisql) requires the following files.

```
BinXX\dbelevate12.exe
BinXX\dbicu12.dll
```



```
BinXX\dbicudt12.dll
BinXX\dbisql.com
BinXX\dbisql.exe
BinXX\dbjodbc12.dll
BinXX\dblg[LL]12.dll
BinXX\dblib12.dll
BinXX\dbodbc12.dll
BinXX\jsyblib610.dll
Java\batik*.jar
Java\isql.jar
Java\JComponents1200.jar
Java\jlogon.jar
Java\jodbc4.jar
Java\js.jar
Java\jsyblib610.jar
Java\pdf-transcoder.jar
Java\saip12.jar
Java\SCEditor610.jar
Java\xerces_2_5_0.jar
Java\xml-apis-ext.jar
Java\xml-apis.jar
Sun\JavaHelp-2_0\jh.jar
Sun\jre160_x86\...
Sun\jre160_x64\...
```

Some file paths above end with "...". This indicates that the entire tree, including subdirectories, should be copied. The 32-bit version of Interactive SQL requires the 32-bit version of the JRE files (*jre160_x86*). The 64-bit version of Interactive SQL requires the 64-bit version of the JRE files (*jre160_x64*).

Sybase Central

Sybase Central (scjview) requires the following files.

```
BinXX\jsyblib610.dll
BinXX\scjview.exe
BinXX\scvw[LL]610.jar
Java\jsyblib610.jar
Java\salib.jar
Java\SCEditor610.jar
Java\sybasecentral610.jar
Sun\JavaHelp-2_0\jh.jar
Sun\jre160_x86\...
Sun\jre160_x64\...
```

Some file paths above end with "...". This indicates that the entire tree, including subdirectories, should be copied. The 32-bit version of Interactive SQL requires the 32-bit version of the JRE files (*jre160_x86*). The 64-bit version of Interactive SQL requires the 64-bit version of the JRE files (*jre160_x64*).

Sybase Central with SQL Anywhere plug-in

The SQL Anywhere plug-in of Sybase Central requires the following files.

```
BinXX\dbeng12.exe
BinXX\dbfips12.dll
BinXX\dbicu12.dll
BinXX\dbicudt12.dll
BinXX\dbjodbc12.dll
BinXX\dblgen12.dll
BinXX\dblib12.dll
BinXX\dbodbc12.dll
BinXX\dbput12.dll
```

```
BinXX\dbtool12.dll
BinXX\sbgse2.dll
Java\batik*.jar
Java\debugger.jar
Java\isql.jar
Java\JComponents1200.jar
Java\jlogon.jar
Java\jodbc4.jar
Java\js.jar
Java\pdf-transcoder.jar
Java\saplugin.jar
Java\SQLAnywhere.jpr
Java\xerces_2_5_0.jar
Java\xml-apis-ext.jar
Java\xml-apis.jar
```

Sybase Central with MobiLink plug-in

The MobiLink plug-in of Sybase Central requires the following files.

```
BinXX\dbicu12.dll
BinXX\dbicudt12.dll
BinXX\dblgen12.dll
BinXX\dblib12.dll
BinXX\dbput12.dll
BinXX\dbtool12.dll
BinXX\mljodbc12.dll
Java\isql.jar
Java\JComponents1200.jar
Java\jlogon.jar
Java\jodbc4.jar
Java\mldesign.jar
Java\mlplugin.jar
Java\MobiLink.jpr
Java\stax-api-1.0.jar
Java\velocity-dep.jar
Java\velocity.jar
Java\wstx-asl-3.2.6.jar
```

Sybase Central with QAnywhere plug-in

When deploying the QAnywhere plug-in, dbinit is required. For information about deploying database tools, see “Deploying database utilities” on page 997.

The QAnywhere plug-in of Sybase Central requires the following files.

```
BinXX\dbicu12.dll
BinXX\dbicudt12.dll
BinXX\dblg[LL]12.dll
BinXX\dblib12.dll
BinXX\dbput12.dll
BinXX\dbtool12.dll
Java\JComponents1200.jar
Java\jlogon.jar
Java\jodbc4.jar
Java\mldesign.jar
Java\mlstream.jar
Java\qaconnector.jar
Java\QAnywhere.jpr
Java\qaplugin.jar
```


Sybase Central with Relay Server plug-in

The Relay Server plug-in of Sybase Central requires the following files.

```
Java\JComponents1200.jar
Java\jlogon.jar
Java\RelayServer.jpr
Java\rsplugin.jar
Java\rstool.jar
```

Sybase Central with UltraLite plug-in

The UltraLite plug-in of Sybase Central requires the following files.

```
BinXX\dbicu12.dll
BinXX\dbicudt12.dll
BinXX\dblg[LL]12.dll
BinXX\dblib12.dll
BinXX\dbput12.dll
BinXX\dbtool12.dll
BinXX\mlcecc12.dll
BinXX\mlcrsa12.dll
BinXX\mlcrsafips12.dll
BinXX\ulfips12.dll
BinXX\ulscutil12.dll
BinXX\ulutils12.dll
Java\batik*.jar
Java\isql.jar
Java\JComponents1200.jar
Java\jlogon.jar
Java\jodbc4.jar
Java\js.jar
Java\pdf-transcoder.jar
Java\ulplugin.jar
Java\UltraLite.jpr
Java\xerces_2_5_0.jar
Java\xml-apis-ext.jar
Java\xml-apis.jar
```

DBConsole

The DBConsole application requires the following files.

```
BinXX\dbconsole.exe
BinXX\dbelevate12.exe
BinXX\dbicu12.dll
BinXX\dbicudt12.dll
BinXX\dbjodbc12.dll
BinXX\dblg[LL]12.dll
BinXX\dblib12.dll
BinXX\dbodbc12.dll
BinXX\jsyblib610.dll
Java\DBConsole.jar
Java\JComponents1200.jar
Java\jlogon.jar
Java\jodbc4.jar
Java\jsyblib610.jar
Sun\JavaHelp-2_0\jh.jar
Sun\jre160_x86\...
Sun\jre160_x64\...
```

Some file paths above end with "...". This indicates that the entire tree, including subdirectories, should be copied. The 32-bit version of Interactive SQL requires the 32-bit version of the JRE files (*jre160_x86*). The 64-bit version of Interactive SQL requires the 64-bit version of the JRE files (*jre160_x64*).

International message and context-sensitive help files

All displayed text and context-sensitive help for the administration tools is translated from English into French, German, Japanese, and Simplified Chinese. The resources for each language are held in separate files. The English files contain **en** in the file names. French files have similar names, but use **fr** instead of **en**. German file names contain **de**, Japanese file names contain **ja**, and Chinese file names contain **zh**.

If you want to install support for different languages, you have to add the message files for those other languages. There are 32-bit and 64-bit versions of these files, in the Bin32 and Bin64 folders respectively. If you are installing 32-bit and 64-bit administration tools, then you must install both sets of files in their respective folders. The translated files are as follows:

dblgen12.dll	English
dblgde12.dll	German
dblgfr12.dll	French
dblgja12.dll	Japanese
dblgzh12.dll	Simplified Chinese

You must also add the context-sensitive help files for those other languages. The available translated files are as follows:

scvwen610.jar	English
scvwde610.jar	German
scvwfr610.jar	French
scvwja610.jar	Japanese
scvwzh610.jar	Simplified Chinese

These files are included with localized versions of SQL Anywhere.

Accessibility components

The Java Access Bridge provides accessibility for the Java-based administration tools (you can download the Java Access Bridge for Microsoft Windows Operating System from the Sun Java web site). Here are the install locations for the accessibility components.

accessibility.properties	*Sun\JRE160_x86\Lib*

jaccess-1_4.jar	*Sun\JRE160_x86\Lib\Ext*
access-bridge.jar	*Sun\JRE160_x86\Lib\Ext*
JavaAccessBridge.dll	a folder in the system path
JAWTAccessBridge.dll	a folder in the system path
WindowsAccessBridge.dll	a folder in the system path

Your installer must create an *accessibility.properties* file in the *JRE160_x86\Lib* folder and it must contain an **assistive_technologies** option as shown below. The SQL Anywhere installer creates this file.

```
#
# Load the Java Access Bridge class into the JVM
#
assistive_technologies=com.sun.java.accessibility.AccessBridge
screen_magnifier_present=true
```

Step 3: Registering the administration tools with Windows

You must set the following registry key for the administration tools. The names of the registry values are case sensitive.

- In **HKEY_LOCAL_MACHINE\SOFTWARE\Sybase\SQL Anywhere\12.0**
  - **Location** The fully-qualified path to the root of the installation folder (*C:\Program Files\SQL Anywhere 12* for example) containing the Sybase Central files.

You may set the following registry keys for the administration tools. The registry keys are optional and only required to be set if the OS language is different from the language that the administration tools will use. The names of the registry keys are case sensitive.

- In **HKEY_LOCAL_MACHINE\SOFTWARE\Sybase\Sybase Central\6.1.0**
  - **Language** The two-letter code for the language used by Sybase Central. This must be one of the following: **EN**, **DE**, **FR**, **JA**, or **ZH** for English, German, French, Japanese, and Simplified Chinese, respectively.
- In **HKEY_LOCAL_MACHINE\SOFTWARE\Sybase\SQL Anywhere\12.0**
  - **Language** The two-letter code for the language used by SQL Anywhere and the other administration tools. This must be one of the following: **EN**, **DE**, **FR**, **JA**, or **ZH** for English, German, French, Japanese, and Simplified Chinese, respectively.

On 64-bit Windows, the equivalent registry entries for 32-bit software are under **SOFTWARE\Wow6432Node\Sybase**.

Paths should *not* end in a backslash.

Your installer can encapsulate all this information by creating a *.reg* file and then executing it. Using our example installation folder of *c:\sa12*, the following is a sample *.reg* file:

```
REGEDIT4

[HKEY_LOCAL_MACHINE\SOFTWARE\Sybase\Sybase Central\6.1.0]
"Language"="FR"

[HKEY_LOCAL_MACHINE\SOFTWARE\Sybase\SQL Anywhere\12.0]
"Location"="c:\\sa12"
"Language"="FR"
```

Backslashes in file paths must be escaped by another backslash in a *.reg* file.

Step 4: Updating the system path

To run the administration tools, the directories with *.exe* and *.dll* files must be included in the path. You must add one of the *c:\sa12\Bin32* or *c:\sa12\Bin64* directories to the system path.

On Windows, the system path is stored in the following registry key:

```
HKEY_LOCAL_MACHINE\
  SYSTEM\
    CurrentControlSet\
      Control\
        Session Manager\
          Environment\
            Path
```

Step 5: Creating connection profiles for Sybase Central

This step involves the configuration of Sybase Central. If you are not installing Sybase Central, you can skip it.

When Sybase Central is installed on your system, a connection profile for **SQL Anywhere 12 Demo** is created in the repository file. If you do not want to create one or more connection profiles, then you can skip this step.

The following commands were used to create the **SQL Anywhere 12 Demo** connection profile. Use this as a model for creating your own connection profiles.

```
scjview -write "ConnectionProfiles/SQL Anywhere 12 Demo/Name" "SQL Anywhere
12 Demo"
scjview -write "ConnectionProfiles/SQL Anywhere 12 Demo/FirstTimeStart"
"false"
scjview -write "ConnectionProfiles/SQL Anywhere 12 Demo/Description"
"Suitable Description"
scjview -write "ConnectionProfiles/SQL Anywhere 12 Demo/ProviderId"
"sqlanywhere1200"
scjview -write "ConnectionProfiles/SQL Anywhere 12 Demo/Provider" "SQL
Anywhere 12"
scjview -write "ConnectionProfiles/SQL Anywhere 12 Demo/Data/
ConnectionProfileSettings" "DSN\eSQL^0020Anywhere^002012^0020Demo;UID
\eDBA;PWD\e35c624d517fb"
```



```
scjview -write "ConnectionProfiles/SQL Anywhere 12 Demo/Data/
ConnectionProfileName" "SQL Anywhere 12 Demo"
scjview -write "ConnectionProfiles/SQL Anywhere 12 Demo/Data/
ConnectionProfileType" "SQL Anywhere"
```

The connection profile strings and values can be extracted from the repository file. Define a connection profile using Sybase Central and then look at the repository file for the corresponding lines.

Here is a portion of the repository file that was created using the process described above. Some entries have been split across multiple lines for display purposes. In the file, each entry appears on a single line:

```
#  Version: 6.1.0.1154
#  Fri Feb 23 13:09:14 EST 2007
#
ConnectionProfiles/SQL Anywhere 12 Demo/Name=SQL Anywhere 12 Demo
ConnectionProfiles/SQL Anywhere 12 Demo/FirstTimeStart=false
ConnectionProfiles/SQL Anywhere 12 Demo/Description=Suitable Description
ConnectionProfiles/SQL Anywhere 12 Demo/ProviderId=sqlanywhere1200
ConnectionProfiles/SQL Anywhere 12 Demo/Provider=SQL Anywhere 12
ConnectionProfiles/SQL Anywhere 12 Demo/Data/ConnectionProfileSettings=
    DSN\eSQL^0020Anywhere^002012^0020Demo;
    UID\eDBA;
    PWD\e35c624d517fb
ConnectionProfiles/SQL Anywhere 12 Demo/Data/ConnectionProfileName=
    SQL Anywhere 12 Demo
ConnectionProfiles/SQL Anywhere 12 Demo/Data/ConnectionProfileType=
     SQL Anywhere
```

Step 6: Registering the SQL Anywhere ODBC driver

You must install the SQL Anywhere ODBC driver before it can be used by the administration tools JDBC driver.

For more information, see "Configuring the ODBC driver" on page 950.

Deploying administration tools on Linux, Solaris, and Mac OS X

This section explains how to install Interactive SQL (dbisql), Sybase Central (including the SQL Anywhere, MobiLink and QAnywhere plug-ins), and the SQL Anywhere Console utility (dbconsole) on Linux, Solaris, and Mac OS X computers. It is intended for those who want to create an installer for these administration tools.

The instructions given here are specific to version 12.0.0 and may not be applicable to earlier or later versions of the software.

Note also that the dbisqlc command line utility is supported on Linux, Solaris, Mac OS X, HP-UX, and AIX. See "Deploying dbisqlc" on page 985.

Check your license agreement
Redistribution of files is subject to your license agreement. No statements in this document override anything in your license agreement. Check your license agreement before considering deployment.

Before you begin

Before you begin, you must install SQL Anywhere on one computer as a source for program files. This is the **reference installation** for your deployment.

The general steps involved are as follows:

1. Decide which programs you want to deploy.
2. Copy the required files.
3. Set environment variables.
4. Register the Sybase Central plug-ins.

Each of these steps is explained in detail in the following sections.

Step 1: Deciding what software to deploy

You can install any combination of the following software bundles:

- Interactive SQL
- Sybase Central with the SQL Anywhere plug-in
- Sybase Central with the MobiLink plug-in
- Sybase Central with the QAnywhere plug-in
- SQL Anywhere Console utility (dbconsole)

The following components are also required when installing any of the above software bundles:

- The SQL Anywhere ODBC Driver
- The Java Runtime Environment (JRE) version 1.6.0. On Linux/Solaris, this would be the 32-bit version of the JRE. On Mac OS X, this would be the 64-bit version of the JRE.

Note
To check your JRE version on Mac OS X, to go to the **Apple** menu, and then choose **System Preferences** » **Software Updates**. Click **Installed Updates** for a list of updates that have been applied. If Java 1.6.0 is not in the list, go to http://developer.apple.com/java/download/.

The instructions in the next section are structured so that you can install any (or all) of these five bundles without conflicts.

Step 2: Copying the required files

Your installer should copy a subset of the files that are installed by the SQL Anywhere installer. You must keep the same directory structure.

You should preserve the permissions on the files when you copy them from your reference SQL Anywhere installation. In general, all users and groups are allowed to read and execute all files.

The administration tools require JRE 1.6.0. You should not substitute a later patch version of the JRE unless you have a specific need to do so.

For Linux/Solaris, the administration tools require the 32-bit version of JRE 1.6.0. The MobiLink server requires the 64-bit version of JRE 1.6.0. For Mac OS X, the administration tools require the 64-bit version. You should not substitute a later patch version of the JRE unless you have a specific need to do so. Not all platform versions of the JRE are bundled with SQL Anywhere. The platforms that are included with SQL Anywhere support Linux on x86/x64 and Solaris SPARC. Other platforms versions must be obtained from the appropriate vendor. For example, if you are working with a Linux install, copy the entire *jre_1.6.0_linux_sun_i586* tree, including subdirectories.

If the platform that you require is included with SQL Anywhere, copy the JRE files from an installed copy of SQL Anywhere 12. Copy the entire tree, including subdirectories.

The following tables list the files required for each of the administration tools and the Sybase Central plug-ins. Make a list of the files you need, and then copy them into the directory structure outlined above.

The tables show files with the folder designation **binXX**. Depending on the platform, there are 32-bit and 64-bit versions of these files, in the *bin32* and *bin64* folders respectively. If you are installing 32-bit and 64-bit administration tools, then you must install both sets of files in their respective folders.

The tables show files with the folder designation **libXX**. Depending on the platform, there are 32-bit and 64-bit versions of these files, in the *lib32* and *lib64* folders respectively. If you are installing 32-bit and 64-bit administration tools, then you must install both sets of files in their respective folders.

The creation of several links is required for the administration tools and Sybase Central plug-ins.

For Linux and Solaris, create symbolic links for all the shared objects that you deploy. Also, create a symbolic link in *install-dir/sun*. The symbolic link for Linux is *jre160_x86* for the 32-bit JRE. The symbolic link for other systems is *jre_160*. Here are some examples:

```
libdblib12_r.so -> install-dir/lib32/libdblib12_r.so.1
jre160_x86 -> install-dir/sun/jre_1.6.0_linux_sun_i586 (Linux)
jre160 -> install-dir/sun/jre_1.6.0_solaris_sun_sparc (Solaris)
```

For the MobiLink plug-in on 64-bit Linux, create an additional symbolic link in *install-dir/sun* . The symbolic link for Linux is *jre160_x64* for the 64-bit JRE.

```
jre160_x64 -> install-dir/sun/jre_1.6.0_linux_sun_x64 (Linux)
```

For Mac OS X, shared objects have a *.dylib* extension. Symlink (symbolic link) creation is necessary for the following dylibs:

```
libdbjodbc12.jnilib -> libdbjodbc12.dylib
libdblib12_r.jnilib -> libdblib12_r.dylib
```

```
libdbput12_r.jnilib -> libdbput12_r.dylib
libmljodbc12.jnilib -> libmljodbc12.dylib
```

The tables show files with the designation **[LL]**. There are several message files each supporting a different language. If you want to install support for different languages, you have to add the resource files for these languages. For more information, see the following section "International message and context-sensitive help files".

Interactive SQL

Interactive SQL (dbisql) requires the following files.

```
binXX/dbisql
libXX/libdbicu12_r.so (.dylib)
libXX/libdbicudt12.so (.dylib)
libXX/libdbjodbc12.so (.dylib)
res/dblg[LL]12.res
libXX/libdblib12_r.so (.dylib)
libXX/libdbodbc12_r.so (.dylib)
libXX/libdbodm12.so (.dylib)
libXX/libjsyblib610_r.so (.dylib)
java/batik*.jar
java/isql.jar
java/JComponents1200.jar
java/jlogon.jar
java/jodbc4.jar
java/js.jar
java/jsyblib610.jar
java/pdf-transcoder.jar
java/saip12.jar
java/SCEditor610.jar
java/xerces_2_5_0.jar
java/xml-apis-ext.jar
java/xml-apis.jar
sun/JavaHelp-2_0\jh.jar
sun/jre_1.6.0_linux_sun_i586/...
sun/jre_1.6.0_solaris_sun_sparc/...
```

Some file paths above end with "...". This indicates that the entire tree, including subdirectories, should be copied.

Sybase Central

Sybase Central (scjview) requires the following files.

```
libXX/libjsyblib610_r.so (.dylib)
binXX/scjview
binXX/scvw[LL]610.jar
java/jsyblib610.jar
java/salib.jar
java/SCEditor610.jar
java/sybasecentral610.jar
sun/JavaHelp-2_0\jh.jar
sun/jre_1.6.0_linux_sun_i586/...
sun/jre_1.6.0_solaris_sun_sparc/...
```

Some file paths above end with "...". This indicates that the entire tree, including subdirectories, should be copied.

Sybase Central with SQL Anywhere plug-in

The SQL Anywhere plug-in of Sybase Central requires the following files.

```
binXX/dbeng12
libXX/libdbfips12.so (.dylib)
libXX/libdbicu12_r.so (.dylib)
libXX/libdbicudt12.so (.dylib)
libXX/libdbjodbc12.so (.dylib)
res/dblg[LL]12.res
libXX/libdblib12_r.so (.dylib)
libXX/libdbodbc12_r.so (.dylib)
libXX/libdbodm12.so (.dylib)
libXX/libdbput12_r.so (.dylib)
libXX/libdbtasks12_r.so (.dylib)
libXX/libdbtool12_r.so (.dylib)
libXX/sbgse2.so
java/batik*.jar
java/debugger.jar
java/isql.jar
java/JComponents1200.jar
java/jlogon.jar
java/jodbc4.jar
java/js.jar
java/pdf-transcoder.jar
java/saplugin.jar
java/SQLAnywhere.jpr
java/xerces_2_5_0.jar
java/xml-apis-ext.jar
java/xml-apis.jar
```

Sybase Central with MobiLink plug-in

The MobiLink plug-in of Sybase Central requires the following files.

```
libXX/libdbicu12_r.so (.dylib)
libXX/libdbicudt12.so (.dylib)
res/dblg[LL]12.res
libXX/libdblib12_r.so (.dylib)
libXX/libdbput12_r.so (.dylib)
libXX/libdbtasks12_r.so (.dylib)
libXX/libdbtool12_r.so (.dylib)
libXX/libmljodbc12.so (.dylib)
java/isql.jar
java/JComponents1200.jar
java/jlogon.jar
java/jodbc4.jar
java/mldesign.jar
java/mlplugin.jar
java/MobiLink.jpr
java/stax-api-1.0.jar
java/velocity-dep.jar
java/velocity.jar
java/wstx-asl-3.2.6.jar
```

Sybase Central with QAnywhere plug-in

When deploying the QAnywhere plug-in, dbinit is required. For information about deploying database tools, see “Deploying database utilities” on page 997.

The QAnywhere plug-in of Sybase Central requires the following files.

```
libXX/libdbicu12_r.so (.dylib)
libXX/libdbicudt12.so (.dylib)
res/dblg[LL]12.res
libXX/libdblib12_r.so (.dylib)
libXX/libdbput12_r.so (.dylib)
libXX/libdbtasks12_r.so (.dylib)
libXX/libdbtool12_r.so (.dylib)
java/JComponents1200.jar
java/jlogon.jar
java/jodbc4.jar
java/mldesign.jar
java/mlstream.jar
java/qaconnector.jar
java/QAnywhere.jpr
java/qaplugin.jar
```

Sybase Central with Relay Server plug-in

The Relay Server plug-in of Sybase Central requires the following files.

```
java/JComponents1200.jar
java/jlogon.jar
java/RelayServer.jpr
java/rsplugin.jar
java/rstool.jar
```

Sybase Central with UltraLite plug-in

The UltraLite plug-in of Sybase Central is only available on Windows and Linux. The UltraLite plug-in of Sybase Central requires the following files.

```
libXX/libdbicu12_r.so (.dylib)
libXX/libdbicudt12.so (.dylib)
res/dblg[LL]12.res
libXX/libdblib12_r.so (.dylib)
libXX/libdbput12_r.so (.dylib)
libXX/libdbtasks12_r.so (.dylib)
libXX/libdbtool12_r.so (.dylib)
libXX/libmlcecc12.so (.dylib)
libXX/libmlcrsa12.so (.dylib)
libXX/libmlcrsafips12.so (.dylib)
libXX/libulfips12.so (.dylib)
libXX/libulscutil12.so (.dylib)
libXX/libulutils12.so (.dylib)
java/batik*.jar
java/isql.jar
java/JComponents1200.jar
java/jlogon.jar
java/jodbc4.jar
java/js.jar
java/pdf-transcoder.jar
java/ulplugin.jar
java/UltraLite.jpr
java/xerces_2_5_0.jar
java/xml-apis-ext.jar
java/xml-apis.jar
```

DBConsole

The DBConsole application requires the following files.


```
binXX/dbconsole
libXX/libdbicu12_r.so (.dylib)
libXX/libdbicudt12.so (.dylib)
libXX/libdbjodbc12.so (.dylib)
res/dblg[LL]12.res
libXX/libdblib12_r.so (.dylib)
libXX/libdbodbc12_r.so (.dylib)
libXX/libdbodm12.so (.dylib)
libXX/libjsyblib610.so (.dylib)
java/DBConsole.jar
java/JComponents1200.jar
java/jlogon.jar
java/jodbc4.jar
java/jsyblib610.jar
sun/JavaHelp-2_0\jh.jar
sun/jre_1.6.0_linux_sun_i586/...
sun/jre_1.6.0_solaris_sun_sparc/...
```

Some file paths above end with "...". This indicates that the entire tree, including subdirectories, should be copied.

International message and context-sensitive help files

For Linux systems only, all displayed text and context-sensitive help for the administration tools have been translated from English into German, French, Japanese, and Simplified Chinese. The resources for each language are in separate files. The English files contain **en** in the file names. German file names contain **de**, French file names contain **fr**, Japanese file names contain **ja**, and Chinese files contain **zh**.

If you want to install support for different languages, you have to add the message files for those other languages. The translated files are as follows:

dblgen12.res	English
dblgde12_iso_1.res, *dblgde12_utf8.res*	German (Linux only)
dblgja12_eucjis.res, *dblgja12_sjis.res*, *dblgja12_utf8.res*	Japanese (Linux only)
dblgzh12_cp936.res, *dblgzh12_eucgb.res*, *dblgzh12_utf8.res*	Simplified Chinese (Linux only)

You must also add the context-sensitive help files for those other languages. The available translated files are as follows:

scvwen610.jar	English
scvwde610.jar	German
scvwfr610.jar	French
scvwja610.jar	Japanese
scvwzh610.jar	Simplified Chinese

These files are included with localized versions of SQL Anywhere.

Step 3: Setting environment variables

To run the administration tools, several environment variables must be defined or modified. This is usually done in the *sa_config.sh* file, which is created by the SQL Anywhere installer. To use the *sa_config.sh* file, just copy it and set SQLANY12 to point to the deployment location.

Otherwise, to set the environment up yourself, you must do the following:

1. Set the following environment variable:

   ```
   SQLANY12="install-dir"
   ```

2. Set the PATH to include the following:

   ```
   install-dir/bin32
   ```

   (whichever is appropriate).

3. Set LD_LIBRARY_PATH to include the following:

   For Linux:

   ```
   install-dir/jre_1.6.0_linux_sun_i586/lib/i386/client
   install-dir/jre_1.6.0_linux_sun_i586/lib/i386
   install-dir/jre_1.6.0_linux_sun_i586/lib/i386/native_threads
   ```

   For Solaris:

   ```
   install-dir/jre_1.6.0_solaris_sun_sparc/lib/sparc/client
   install-dir/jre_1.6.0_solaris_sun_sparc/lib/sparc
   install-dir/jre_1.6.0_solaris_sun_sparc/lib/sparc/native_threads
   ```

On Mac OS X, the administration tools make use of a shell script stub launcher called sa_java_stub_launcher.sh, generated at install time and placed inside the Contents/MacOS folder of each Java application bundle. As generated, the script sources the System/bin64/sa_config.sh file to set up the environment and then runs the JavaApplicationStub binary, which starts the actual Java application. For deployment purposes, sa_java_stub_launcher.sh can be modified as required to set up the environment. The name of the script can be changed by modifying the *Info.plist* file inside the Java application bundle and changing the string value of the key CFBundleExecutable.

Step 4: Creating connection profiles for Sybase Central

This step involves the configuration of Sybase Central. If you are not installing Sybase Central, you can skip it.

When Sybase Central is installed on your system, a connection profile for **SQL Anywhere 12 Demo** is created in the repository file. If you do not want to create one or more connection profiles, then you can skip this step.

The following commands were used to create the **SQL Anywhere 12 Demo** connection profile. Use this as a model for creating your own connection profiles.


```
scjview -write "ConnectionProfiles/SQL Anywhere 12 Demo/Name" "SQL Anywhere
12 Demo"
scjview -write "ConnectionProfiles/SQL Anywhere 12 Demo/FirstTimeStart"
"false"
scjview -write "ConnectionProfiles/SQL Anywhere 12 Demo/Description"
"Suitable Description"
scjview -write "ConnectionProfiles/SQL Anywhere 12 Demo/ProviderId"
"sqlanywhere1200"
scjview -write "ConnectionProfiles/SQL Anywhere 12 Demo/Provider" "SQL
Anywhere 12"
scjview -write "ConnectionProfiles/SQL Anywhere 12 Demo/Data/
ConnectionProfileSettings" "DSN\eSQL^0020Anywhere^002012^0020Demo;UID
\eDBA;PWD\e35c624d517fb"
scjview -write "ConnectionProfiles/SQL Anywhere 12 Demo/Data/
ConnectionProfileName" "SQL Anywhere 12 Demo"
scjview -write "ConnectionProfiles/SQL Anywhere 12 Demo/Data/
ConnectionProfileType" "SQL Anywhere"
```

The connection profile strings and values can be extracted from the repository file. Define a connection profile using Sybase Central and then look at the repository file for the corresponding lines.

Here is a portion of the repository file that was created using the process described above. Some entries have been split across multiple lines for display purposes. In the file, each entry appears on a single line:

```
#  Version: 6.1.0.1154
#  Fri Feb 23 13:09:14 EST 2007
#
ConnectionProfiles/SQL Anywhere 12 Demo/Name=SQL Anywhere 12 Demo
ConnectionProfiles/SQL Anywhere 12 Demo/FirstTimeStart=false
ConnectionProfiles/SQL Anywhere 12 Demo/Description=Suitable Description
ConnectionProfiles/SQL Anywhere 12 Demo/ProviderId=sqlanywhere1200
ConnectionProfiles/SQL Anywhere 12 Demo/Provider=SQL Anywhere 12
ConnectionProfiles/SQL Anywhere 12 Demo/Data/ConnectionProfileSettings=
    DSN\eSQL^0020Anywhere^002012^0020Demo;
    UID\eDBA;
    PWD\e35c624d517fb
ConnectionProfiles/SQL Anywhere 12 Demo/Data/ConnectionProfileName=
    SQL Anywhere 12 Demo
ConnectionProfiles/SQL Anywhere 12 Demo/Data/ConnectionProfileType=
     SQL Anywhere
```

Configuring the administration tools

You can control which features are shown or enabled by the administration tools. Control is done through an initialization file named *OEM.ini*. This file must be in the same directory as the JAR files used by the administration tools (for example, *C:\Program Files\SQL Anywhere 12\java*). If the file is not found, default values are used. Also, defaults are used for values that are missing from *OEM.ini*.

Here is a sample *OEM.ini* file:

```
[errors]
# reportErrors type is boolean, default = true
reportErrors=true

[updates]
# checkForUpdates type is boolean, default = true
checkForUpdates=true
```

```
[dbisql]
disableExecuteAll=false
# lockedPreferences is assigned a comma-separated
# list of one or more of the following option names:
#    autoCommit
#    autoRefetch
#    commitOnExit
#    disableResultsEditing
#    executeToolbarButtonSemantics
#    fastLauncherEnabled
#    maximumDisplayedRows
#    showMultipleResultSets
#    showResultsForAllStatements
lockedPreferences=showMultipleResultSets,commitOnExit
```

Any line beginning with the # character is a comment line and is ignored. The specified option names and values are case-sensitive.

If **reportErrors** is false, the administration tool does not present a window to the user inviting them to submit error information to iAnywhere if the software crashes. Instead, the standard window appears.

If **checkForUpdates** is false, the administration tool does not check for SQL Anywhere software updates automatically, nor does it give the user the option to do it at their discretion.

If **disableExecuteAll** is true, then the **SQL** » **Execute** menu item and the F5 accelerator key are disabled in Interactive SQL. If the Execute toolbar button is configured for **Execute All Statement(s)**, then it is disabled also. Therefore, you might want to set the Execute toolbar button to **Execute Selected Statement(s)** in Interactive SQL, and then set the executeToolbarButtonSemantics option in the *OEM.ini* file to prevent users from changing the Execute toolbar button. See "Configuring the Execute Statements toolbar button" [*SQL Anywhere Server - Database Administration*].

Preventing users from changing Interactive SQL option settings

In the **[dbisql]** section of the *OEM.ini* file, you can lock the settings of Interactive SQL options so that users cannot change them. The option names are case sensitive. For some options, you can specify whether the setting is locked for SQL Anywhere databases or UltraLite databases. If you do not specify the database type, then the setting is locked for all databases. The following is an example:

```
[dbisql]
lockedPreferences=autoCommit
```

To lock the option setting for only one type of database, prefix **lockedPreferences** with the name of the database type (**SQLAnywhere** or **UltraLite**) followed by a period.

For example, if you want to lock **autoCommit** for SQL Anywhere databases, but not UltraLite, you would add the following line:

```
[dbisql]
SQLAnywhere.lockedPreferences=autoCommit
```

You can prevent users from changing the following Interactive SQL option settings (**SQLAnywhere/ UltraLite** indicates that these options can be locked for a specific database type):

- **allowPasswordsInFavorites** Prevents users from saving connection passwords in their favorites. When this option is set to false in the *OEM.ini* file then the option **Save The Connection Password** is unavailable in the **Add To Favorites** window in Interactive SQL. The default is false.

  See "Using favorites" [*SQL Anywhere Server - Database Administration*].

- **autoCommit (SQLAnywhere/UltraLite)** Prevents the user from customizing the **Commit After Every Statement** option. See "auto_commit option [Interactive SQL]" [*SQL Anywhere Server - Database Administration*].

- **autoRefetch (SQLAnywhere/UltraLite)** Prevents the user from customizing the **Automatically Refetch Results** option. See "auto_refetch option [Interactive SQL]" [*SQL Anywhere Server - Database Administration*].

- **commitOnExit (SQLAnywhere/UltraLite)** Prevents the user from customizing the **Commit On Exit Or Disconnect** option. See "commit_on_exit option [Interactive SQL]" [*SQL Anywhere Server - Database Administration*].

- **disableResultsEditing (SQLAnywhere/UltraLite)** Prevents the user from customizing the **Disable Editing** option.

- **executeToolbarButtonSemantics** Prevents the user from customizing the behavior of the **Execute** toolbar button. See "Configuring the Execute Statements toolbar button" [*SQL Anywhere Server - Database Administration*].

- **fastLauncherEnabled** Prevents the user from customizing the fast launcher option.

- **maximumDisplayedRows (SQLAnywhere/UltraLite)** Prevents the user from customizing the **Maximum Number Of Rows To Display** option. "isql_maximum_displayed_rows option [Interactive SQL]" [*SQL Anywhere Server - Database Administration*].

- **showMultipleResultSets (SQLAnywhere/UltraLite)** Prevents the user from customizing the **Show Only The First Result Set** or **Show All Result Sets** options. Also prevents the user from setting the isql_show_multiple_result_sets option. See "isql_show_multiple_result_sets [Interactive SQL]" [*SQL Anywhere Server - Database Administration*].

- **showResultsForAllStatements (SQLAnywhere/UltraLite)** Prevents the user from customizing the **Show Results From The Last Statement** or **Show Results From Each Statement** options.

Deploying dbisqlc

If your deployed application requires a query execution or scripting tool and is running on computers with limited resources, you may want to deploy the dbisqlc executable instead of Interactive SQL (dbisql). However, dbisqlc is deprecated, and no new features are being added to it. Also, dbisqlc does not contain all the features of Interactive SQL and compatibility between the two is not guaranteed.

The dbisqlc executable requires the standard embedded SQL client-side libraries.

For more information about dbisqlc, see "dbisqlc utility (deprecated)" [*SQL Anywhere Server - Database Administration*].

For more information about Interactive SQL (dbisql), see "Interactive SQL utility (dbisql)" [*SQL Anywhere Server - Database Administration*].

Deploying Documentation

The discussion below uses the designation **[LL]**. Documentation is available in different languages. Replace the **[LL]** with the language code for the documentation you are deploying (for example, **en**, **de**, **jp**, etc.).

For Windows, there are two options available for documentation. You can either use DCX help, in which case no help files need to be deployed at all (you get help from the dcx.sybase.com web site) or you can deploy HTML-based help.

HTML-based help documentation is installed to the *install-dir**Documentation* directory tree.

```
Documentation\sqlanywhere_[LL]12.map
Documentation\[LL]\htmlhelp\dbadmin12.chm
Documentation\[LL]\htmlhelp\dbprogramming12.chm
Documentation\[LL]\htmlhelp\dbreference12.chm
Documentation\[LL]\htmlhelp\dbspatial12.chm
Documentation\[LL]\htmlhelp\dbusage12.chm
Documentation\[LL]\htmlhelp\mlclient12.chm
Documentation\[LL]\htmlhelp\mlserver12.chm
Documentation\[LL]\htmlhelp\mlsisync12.chm
Documentation\[LL]\htmlhelp\mlstart12.chm
Documentation\[LL]\htmlhelp\qanywhere12.chm
Documentation\[LL]\htmlhelp\relayserver12.chm
Documentation\[LL]\htmlhelp\sachanges12.chm
Documentation\[LL]\htmlhelp\saerrors12.chm
Documentation\[LL]\htmlhelp\saintro12.chm
Documentation\[LL]\htmlhelp\sausinghelp12.chm
Documentation\[LL]\htmlhelp\scplugin12.chm
Documentation\[LL]\htmlhelp\sqlanywhere_[LL]12.chm
Documentation\[LL]\htmlhelp\sqlremote12.chm
Documentation\[LL]\htmlhelp\uladmin12.chm
Documentation\[LL]\htmlhelp\ulc12.chm
Documentation\[LL]\htmlhelp\uldotnet12.chm
Documentation\[LL]\htmlhelp\ulj12.chm
Documentation\[LL]\htmlhelp\ulmbus12.chm
```

For Linux, Unix, and Mac OS X, there are two options available for documentation. You can either use DCX help, in which case no help files need to be deployed at all (you get help from the dcx.sybase.com web site) or you can deploy Eclipse help.

Eclipse help can be installed locally with the documentation installer (*sa12_doc_[LL]_linux_x86+x64.[version].[build].tar.gz*). There are versions available for different languages.

For example, if you download *sa12_doc_en_linux_x86+x64.1200.2406.tar.gz* then the following command can be used to install the documentation.


```
/setup -ss -sqlany-dir install-dir
```

This silently installs the help to *install-dir*.

Deploying database servers

You can deploy a database server by making the SQL Anywhere installer available to your end users. By selecting the proper option, each end user is guaranteed of getting the files they need.

The simplest way to deploy a personal database server or a network database server is to use the **Deployment Wizard**. For more information, see "Using the Deployment Wizard" on page 931.

To run a database server, you need to install a set of files. The files are listed in the following table. All redistribution of these files is governed by the terms of your license agreement. You must confirm whether you have the right to redistribute the database server files before doing so.

Windows	Linux / Unix	Mac OS X
dbeng12.exe	*dbeng12*	*dbeng12*
dbeng12.lic	*dbeng12.lic*	*dbeng12.lic*
dbsrv12.exe	*dbsrv12*	*dbsrv12*
dbsrv12.lic	*dbsrv12.lic*	*dbsrv12.lic*
dbserv12.dll	*libdbserv12_r.so, libdb-tasks12_r.so*	*libdbserv12_r.dylib, libdb-tasks12_r.dylib*
dbscript12.dll	*libdbscript12_r.so*	*libdbscript12_r.dylib*
dblg[LL]12.dll	*dblg[LL]12.res*	*dblgen12.res*
dbghelp.dll	N/A	N/A
dbctrs12.dll	N/A	N/A
dbextf.dll[1]	*libdbextf.so*[1]	*libdbextf.dylib*[1]
dbicu12.dll[2]	*libdbicu12_r.so*[2]	*libdbicu12_r.dylib*[2]
dbicudt12.dll[2, 3]	*libdbicudt12.so*[2]	*libdbicudt12.dylib*[2]
sqlany.cvf	*sqlany.cvf*	*sqlany.cvf*
dbrsakp12.dll[4]	*libdbrsakp12_r.so*[4]	*libdbrsakp12_r.dylib*[4]
dbodbc12.dll[5]	*libdbodbc12.so*[5]	*libdbodbc12.dylib*[5]

Windows	Linux / Unix	Mac OS X
N/A	*libdbodbc12_n.so*[5]	*libdbodbc12_n.dylib*[5]
N/A	*libdbodbc12_r.so*[5]	*libdbodbc12_r.dylib*[5]
dbjdbc12.dll[5]	*libdbjdbc12.so*[5]	*libdbjdbc12.dylib*[5]
java\jconn3.jar[5]	*java/jconn3.jar*[5]	*java/jconn3.jar*[5]
java\sajdbc.jar[5, 9]	*java/sajdbc.jar*[5, 9]	*java/sajdbc.jar*[5, 9]
java\sajdbc4.jar[5]	*java/sajdbc4.jar*[5]	*java/sajdbc4.jar*[5]
java\sajvm.jar[5]	*java/sajvm.jar*[5]	*java/sajvm.jar*[5]
java\cis.zip[6]	*java/cis.zip*[6]	*java/cis.zip*[6]
dbcis12.dll[7]	*libdbcis12.so*[7]	*libdbcis12.dylib*[7]
libsybbr.dll[8]	*libsybbr.so*[8]	*libsybbr.dylib*[8]

[1] Required only if using system extended stored procedures and functions (xp_*).

[2] Required only if the database character set is multi-byte or if the UCA collation sequence is used.

[3] On Windows Mobile, the file name to deploy is called *dbicudt12.dat*.

[4] Required only for encrypted TDS connections.

[5] Required only if using Java in the database.

[6] Required only if using Java in the database and remote data access.

[7] Required only if using remote data access.

[8] Required only for archive backups.

[9] Required only for JDBC 3.0.

Notes

- Depending on your situation, you should choose whether to deploy the personal database server (dbeng12) or the network database server (dbsrv12).
- You must include the separate corresponding license file (*dbeng12.lic* or *dbsrv12.lic*) when deploying a database server. The license files are located in the same directory as the server executables.
- A language resource library file should also be included. The table above show files with the designation **[LL]**. There are several message files each supporting a different language. If you want to

install support for different languages, you have to include the resource files for these languages. Replace **[LL]** with the language code (for example, **en**, **de**, **jp**, etc.).

- The Java VM jar file (*sajvm.jar*) is required only if the database server is to use the Java in the Database functionality.

- The table does not include files needed to run utilities such as dbbackup.

  For information about deploying utilities, see "Deploying administration tools" on page 964.

- The database server **xd** option is useful in deployed applications since it prevents the database server from becoming the default database server. Connections are accepted only when the server name is included in the connection string.

  For information about the **xd** option, see "-xd dbeng12/dbsrv12 server option" [*SQL Anywhere Server - Database Administration*].

  For information about specifying the server name, see "ServerName (Server) connection parameter" [*SQL Anywhere Server - Database Administration*].

Windows Registry entries

To improve robustness across power failures on systems using certain Intel storage drivers, specific registry entries must be set. To determine if this step is required, first check that the parent key exists and then add a parameter value to the key (the steps are described below). Failure to set this parameter can result in lost data and corrupted databases in the event of a power failure.

To improve robustness on Intel storage drivers

1. Check that the following registry entry exists.

   ```
   HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\iastor\Parameters\
   ```

2. If it does then add a REG_DWORD value named **EnableFlush** within this key and assign it the data value 1. Here is a sample registry change file.

   ```
   REGEDIT4
   [HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\iastor\Parameters]
   "EnableFlush"=dword:00000001
   ```

3. Check that the following registry entry exists.

   ```
   HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\iastorv\Parameters\
   ```

4. If it does then add a REG_DWORD value named **EnableFlush** within this key and assign it the data value 1. Here is a sample registry change file.

   ```
   REGEDIT4
   [HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\iastorv\Parameters]
   "EnableFlush"=dword:00000001
   ```

To ensure that messages written by the server to the Event Log on Windows are formatted correctly, you must create a registry key.

To format Event Log messages properly

1. Create the following registry key:

   ```
   HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\Eventlog\Application
   \SQLANY 12.0
   ```

2. Within this key, add a REG_SZ value named **EventMessageFile** and assign it the data value of the fully qualified location of *dblgen12.dll*, for example, *C:\Program Files\SQL Anywhere 12\Bin32\dblgen12.dll*. The English language DLL, *dblgen12.dll*, can be specified regardless of the deployment language. Here is a sample registry change file.

   ```
   REGEDIT4
   [HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\Eventlog\Application
   \SQLANY 12.0]
   "EventMessageFile"="c:\\sa12\\bin32\\dblgen12.dll"
   ```

   For the 64-bit version of the server, the registry key is `SQLANY64 12.0`.

3. To ensure that messages written by MESSAGE ... TO EVENT LOG statements to the Event Log on Windows are formatted correctly, create the following registry key.

   ```
   HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\Eventlog\Application
   \SQLANY 12.0 Admin
   ```

4. Within this key, add a REG_SZ value named EventMessageFile and assign it the data value of the fully qualified location of *dblgen12.dll*, for example, *C:\Program Files\SQL Anywhere 12\Bin32\dblgen12.dll*. The English language DLL, *dblgen12.dll*, can be specified regardless of the deployment language. Here is a sample registry change file.

   ```
   REGEDIT4
   [HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\Eventlog\Application
   \SQLANY 12.0 Admin]
   "EventMessageFile"="c:\\sa12\\bin32\\dblgen12.dll"
   ```

   For the 64-bit version of the server, the registry key is **SQLANY64 12.0 Admin**.

5. You can suppress Windows event log entries by setting up a registry key. The registry key is:

   ```
   Software\Sybase\SQL Anywhere\12.0\EventLogMask
   ```

   and it can be placed in either the HKEY_CURRENT_USER or HKEY_LOCAL_MACHINE hive. To control event log entries, create a REG_DWORD value named **EventLogMask** and assign it a bit mask containing the internal bit values for the different Windows event types. The three types supported by the SQL Anywhere database server are:

   ```
   EVENTLOG_ERROR_TYPE        0x0001
   EVENTLOG_WARNING_TYPE      0x0002
   EVENTLOG_INFORMATION_TYPE  0x0004
   ```

   For example, if the **EventLogMask** key is set to zero, no messages appear at all. A better setting would be 1, so that informational and warning messages don't appear, but errors do. The default setting (no entry present) is for all message types to appear. Here is a sample registry change file.


```
REGEDIT4
[HKEY_LOCAL_MACHINE\SOFTWARE\Sybase\SQL Anywhere\12.0]
"EventLogMask"=dword:00000007
```

Registering DLLs on Windows

When deploying SQL Anywhere, there are DLL files that must be registered for SQL Anywhere to function properly. Note that for Windows Vista or later versions of Windows, you must include the SQL Anywhere elevated operations agent (*dbelevate12.exe*) which supports the privilege elevation required when DLLs are registered or unregistered.

There are many ways you can register these DLLs, including in an install script or using the regsvr32 utility on Windows or the regsvrce utility on Windows Mobile. You could also include a command, like the one in the following procedure, in a batch file.

To register a DLL

1. Open a command prompt.
2. Change to the directory where the DLL provider is installed.
3. Enter the following command to register the provider (in this example, the OLE DB provider is registered):

   ```
   regsvr32 dboledb12.dll
   ```

The following table lists the DLLs that must be registered when deploying SQL Anywhere:

File	Description
dbctrs12.dll	The SQL Anywhere Performance Monitor counters.
dbmlsynccom.dll	The Dbmlsync Integration Component (non-visual component).
dbmlsynccomg.dll	The Dbmlsync Integration Component (visual component).
dbodbc12.dll	The SQL Anywhere ODBC driver.
dboledb12.dll	The SQL Anywhere OLE DB provider.
dboledba12.dll	The SQL Anywhere OLE DB provider schema assist module.
Windows\system32\msxml4.dll	The Microsoft XML Parser.

Mac OS X considerations

On Mac OS X, DBLauncher and SyncConsole will use the User Defaults system to locate the SQL Anywhere installation. The SQL Anywhere installer writes the installation location to the user defaults

repository of the user performing the installation. Other users will be prompted for the installation directory when DBLauncher is first used. Also, the Preferences panel can be used to change this setting.

Deploying databases

You deploy a database file by installing the database file onto your end-user's disk.

As long as the database server shuts down cleanly, you do not need to deploy a transaction log file with your database file. When your end user starts running the database, a new transaction log is created.

For SQL Remote applications, the database should be created in a properly synchronized state, in which case no transaction log is needed. You can use the Extraction utility for this purpose.

For information about extracting databases, see "Extracting remote databases" [*SQL Remote*].

International considerations

When you are deploying a database worldwide, you should consider the locales in which the database is to be used. Different locales may have different sort orders or text comparison rules. For example, the database that you are going to deploy maybe have been created using the 1252LATIN1 collation and this may not be suitable for some of the environments in which it is to be used.

Since the collation of a database cannot be changed after it has been created, you might consider creating the database during the install phase and then populating the database with the schema and data that you want it to have. The database can be created during the install either by using the dbinit utility, or by starting the database server with the utility database and issuing a CREATE DATABASE statement. Then, you can use SQL statements to create the schema and do whatever else is necessary to set up your initial database.

If you decide to use the UCA collation, you can specify additional collation tailoring options for finer control over the sorting and comparing of characters using the dbinit utility or the CREATE DATABASE statement. These options take the form of *keyword=value* pairs, assembled in parentheses, following the collation name. Using the CREATE DATABASE statement, for example, a collation tailoring can be specified using syntax like the following:

```
CHAR COLLATION 'UCA( locale=es;case=respect;accent=respect )'
```

As an alternative, you could create multiple database templates, one for each of the locales in which the database is to be used. This may be suitable if the set of locales you are deploying the database to is relatively small. You can have the installer choose which database to install.

See also

- "CREATE DATABASE statement" [*SQL Anywhere Server - SQL Reference*]
- "Initialization utility (dbinit)" [*SQL Anywhere Server - Database Administration*]
- "Choosing collations" [*SQL Anywhere Server - Database Administration*]

Deploying databases on read-only media

You can distribute databases on read-only media, such as a CD-ROM, as long as you run them in read-only mode.

For more information about running databases in read-only mode, see "-r dbeng12/dbsrv12 server option" [*SQL Anywhere Server - Database Administration*].

If you need to make changes to the database, you must copy the database from the CD-ROM to a location where it can be modified, such as a hard drive.

Deploying external environment support

The following tables summarize the components that must be deployed to support external calls in SQL Anywhere.

ESQL/ODBC external calls

Component	Windows	Linux / Unix	Mac OS X
ESQL and ODBC launcher	*dbexternc12.exe*	*dbexternc12*	*dbexternc12*
Bridge	*dbextenv12.dll*	*libdbex-tenv12_r.so*	*libdbex-tenv12_r.dylib*
SQL Anywhere C API runtime	*dbcapi.dll*	*libdbcapi_r.so*	*libdbcapi_r.dylib*
DBLIB	*dblib12.dll*	*libdblib12_r.so*	*libdblib12_r.dylib*

For additional files required by embedded SQL applications, see "Deploying embedded SQL clients" on page 955.

For additional files required by ODBC applications, see "Deploying ODBC clients" on page 947.

For additional information on the ESQL/ODBC external environment, see "The ESQL and ODBC external environments" on page 589.

Java external calls

Component	Windows	Linux / Unix	Mac OS X
Java installation (third-party)	*java.exe*	*java*	*java*
Launcher	*sajvm.jar*	*sajvm.jar*	*sajvm.jar*

Component	Windows	Linux / Unix	Mac OS X
SQL Anywhere JDBC driver (server-side calls)	*dbjdbc12.dll*	*libdbjdbc12.so*	*libdbjdbc12.dylib*

For additional files required by JDBC applications, see "Deploying JDBC clients" on page 957.

For additional information on the Java external environment, see "The Java external environment" on page 598.

.NET CLR external calls

Component	Windows	Linux / Unix	Mac OS X
.NET 3.5 or later	(from Microsoft)	N/A	N/A
SQL Anywhere .NET 3.5 or 4.0 provider	(from Sybase)	N/A	N/A
.NET CLR bridge	*dbextclr12.exe*	N/A	N/A
Bridge	*dbextenv12.dll*	N/A	N/A
.NET CLR support	*dbclrenv12.dll*	N/A	N/A
DBLIB	*dblib12.dll*	N/A	N/A

For additional information on the CLR external environment, see "The CLR external environment" on page 586.

Perl external calls

Component	Windows	Linux / Unix	Mac OS X
Perl installation (third-party)	*perl.exe*	*perl*	*perl*
Perl launcher	*perlenv.pl*	*perlenv.pl*	*perlenv.pl*
Bridge	*dbextenv12.dll*	*libdbextenv12_r.so*	*libdbex-tenv12_r.dylib*
SQL Anywhere C API runtime	*dbcapi.dll*	*libdbcapi_r.so*	*libdbcapi_r.dylib*
DBLIB	*dblib12.dll*	*libdblib12_r.so*	*libdblib12_r.dylib*

For additional files required by Perl applications, also "Introduction to DBD::SQLAnywhere" on page 613.

For additional information on the Perl external environment, see "The PERL external environment" on page 603.

PHP external calls

Component	Windows	Linux / Unix	Mac OS X
PHP installation (third-party)	*php.exe*	*php*	*php*
PHP launcher	*phpenv.php*	*phpenv.php*	*phpenv.php*
Bridge	*dbextenv12.dll*	*libdbextenv12_r.so*	*libdbextenv12_r.dylib*
PHP 5.1.x external calls	*php-5.1.[1-6]_sqlanywhere_extenv12.dll*	*php-5.1.[1-6]_sqlanywhere_extenv12_r.so* or build from source code	Build from source code
PHP 5.2.x external calls	*php-5.2.[0-11]_sqlanywhere_extenv12.dll*	*php-5.2.[0-11]_sqlanywhere_extenv12_r.so* or build from source code	Build from source code
PHP 5.3.x external calls	*php-5.3.[0-2]_sqlanywhere_extenv12.dll*	*php-5.3.[0-2]_sqlanywhere_extenv12_r.so* or build from source code	Build from source code
SQL Anywhere C API runtime	*dbcapi.dll*	*libdbcapi_r.so*	*libdbcapi_r.dylib*
DBLIB (threaded)	*dblib12.dll*	*libdblib12_r.so*	*libdblib12_r.dylib*
Thread support library	N/A	*libdbtasks12_r.so*	*libdbtasks12_r.dylib*

For additional files required by PHP applications, see "SQL Anywhere PHP extension" on page 629.

For additional information on the PHP external environment, see "The PHP external environment" on page 607.

Deploying security

The following table summarizes the components that support security features in SQL Anywhere.

Security option	Security type	Included in module	Licensable
Database encryption	AES	*dbserv12.dll* *libdbserv12_r.so*	included[1]
Database encryption	FIPS-approved AES	*dbfips12.dll*	separately licensed[2]
Transport layer security	RSA	*dbrsa12.dll* *libdbrsa12.so* *libdbrsa12.dylib* *libdbrsa12_r.dylib*	included[1]
Transport layer security	FIPS-approved RSA	*dbfips12.dll*, *sbgse2.dll*	separately licensed[2]
Transport layer security	ECC	*dbecc12.dll* *libdbecc12.so*	separately licensed[2]

[1] AES and RSA strong encryption are included with SQL Anywhere and do not require a separate license, but these libraries are not FIPS-certified.

[2] The software for strong encryption using ECC or FIPS-certified technology must be ordered separately.

Deploying embedded database applications

This section provides information on deploying embedded database applications, where the application and the database both reside on the same computer.

An embedded database application includes the following:

- **Client application** This includes the SQL Anywhere client requirements.

  For information about deploying client applications, see "Deploying client applications" on page 939.

- **Database server** The SQL Anywhere personal database server.

  For information about deploying database servers, see "Deploying database servers" on page 987.

- **SQL Remote** If your application uses SQL Remote replication, you must deploy the SQL Remote Message Agent.

- **The database** You must deploy a database file holding the data the application uses.

Deploying personal servers

When you deploy an application that uses the personal server, you need to deploy both the client application components and the database server components.

The language resource library (*dblgen12.dll*) is shared between the client and the server. You need only one copy of this file.

It is recommended that you follow the SQL Anywhere installation behavior, and install the client and server files in the same directory.

Remember to provide the Java zip files and the Java DLL if your application takes advantage of Java in the Database.

Deploying database utilities

If you need to deploy database utilities (such as dbbackup) along with your application, then you need the utility executable together with the following additional files:

Description	Windows	Linux / Unix	Mac OS X
Database tools library	*dbtool12.dll*	*libdbtool12_r.so*, *libdb-tasks12_r.so*	*libdbtool12_r.dylib*, *libdbtasks12_r.dylib*
Interface Library	*dblib12.dll*	*libdblib12_r.so*	*libdblib12_r.dylib*
Language resource library	*dblg[LL]12.dll*	*dblg[LL]12.res*	*dblgen12.res*
Connect window	*dbcon12.dll*		
Version 9 or earlier physical store library	*dboftsp.dll*	*libdboftsp_r.so*	N/A

Notes

- A language resource library file should also be included. The table above show files with the designation **[LL]**. There are several message files each supporting a different language. If you want to install support for different languages, you have to include the resource files for these languages. Replace **[LL]** with the language code (for example, **en**, **de**, **jp**, etc.).
- For non-multithreaded applications on Linux and Unix, you can use *libdbtasks12.so* and *libdblib12.so*.
- For non-multithreaded applications on Mac OS X, you can use *libdbtasks12.dylib* and *libdblib12.dylib*.

- The version 9 or earlier physical store library is required by some utilities (dblog, dbtran, dberase) to access log files created by versions of the software earlier than 10.0.0. If you are not deploying these utilities, then you do not require this library.
- The personal database server (dbeng12) is required for creating databases using the dbinit utility. It is also required if you are creating databases from Sybase Central on the local computer when no other database servers are running. See "Deploying database servers" on page 987.
- The dbunload utility may require the contents of the *scripts* directory to be present.

Deploying unload support for pre 10.0.0 databases

If, in your application, you need to the ability to convert version 9.0 or older databases to the version 12 format, then you need the database unload utility, dbunload, together with the following additional files:

Description	Windows	Linux / Unix	Mac OS X
Unload support for pre-10.0 databases	*dbunlspt.exe*	*dbunlspt*	*dbunlspt*
Message resource library	*dbus[LL].dll*	*dbus[LL].res*	*dbus[LL].res*

The table above shows files with the designation **[LL]**. There are several message files each supporting a different language. If you want to install support for different languages, you have to add the resource files for these languages. The message files are as follows.

Windows message files

dbusde.dll	German
dbusen.dll	English
dbuses.dll	Spanish
dbusfr.dll	French
dbusit.dll	Italian
dbusja.dll	Japanese
dbusko.dll	Korean
dbuslt.dll	Lithuanian
dbuspl.dll	Polish
dbuspt.dll	Portuguese

dbusru.dll	Russian
dbustw.dll	Traditional Chinese
dbusuk.dll	Ukrainian
dbuszh.dll	Simplified Chinese

Linux message files

dbusde_iso_1.res, *dbusde_utf8.res*, *dbusen.res*	German
dbusen.res	English
dbusja_eucjis.res, *dbusja_sjis.res*, *dbusja_utf8.res*	Japanese
dbuszh_cp936.res, *dbuszh_eucgb.res*, *dbuszh_utf8.res*	Chinese

These files are included with localized versions of SQL Anywhere.

In addition to these files, you also need the files described in "Deploying database utilities" on page 997.

Deploying SQL Remote

If you are deploying the SQL Remote Message Agent, you need to include the following files:

Description	Windows	Linux / Solaris	Mac OS X
Message Agent	*dbremote.exe*	*dbremote*	*dbremote*
Encoding/decoding library	*dbencod12.dll*	*libdbencod12_r.so.1*	*libdbencod12_r.dylib*
FILE message link library [1]	*dbfile12.dll*	*libdbfile12_r.so.1*	*libdbfile12_r.dylib*
FTP message link library [1]	*dbftp12.dll*	*libdbftp12_r.so.1*	*libdbftp12_r.dylib*
Language resource library	*dblg[LL]12.dll*	*dblg[LL]12.res*	*dblg[LL]12.res*
Interface Library	*dblib12.dll*	*libdblib12_r.so.1*	*libdblib12_r.dylib*

Description	Windows	Linux / Solaris	Mac OS X
SMTP message link library [1]	*dbsmtp12.dll*	*libdbsmtp12_r.so.1*	*libdbsmtp12_r.dylib*
Database tools library	*dbtool12.dll*	*libdbtool12_r.so.1*	*libdbtool12_r.dylib*
Thread support library	N/A	*libdbtasks12_r.so.1*	*libdbtasks12_r.dylib*

[1] Only deploy the library for the message link you are using.

A language resource library file should also be included. The table above show files with the designation **[LL]**. There are several message files each supporting a different language. If you want to install support for different languages, you have to include the resource files for these languages. Replace **[LL]** with the language code (for example, **en**, **de**, **jp**, etc.).

It is recommended that you follow the SQL Anywhere installation behavior, and install the SQL Remote files in the same directory as the SQL Anywhere files.

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