SYBASE®

Users Guide

Adaptive Server® Enterprise ODBC Driver by Sybase

15.5

[Microsoft Windows, UNIX, and Apple Mac OS X]

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Sybase, Inc., One Sybase Drive, Dublin, CA 94568.

Contents

About This Book

Audience

This document is intended for application developers who need access to data from Adaptive Server® Enterprise on Microsoft Windows, UNIX, and Mac OS X platforms, using Open Database Connectivity (ODBC).

How to use this book

The information in this book is organized as follows:

- Chapter 1, “Introduction to ODBC Programming,” contains information for developing applications that directly call the ODBC programming interface.
- Chapter 2, “Connecting to a Database,” describes how client applications connect to Adaptive Server using ODBC.
- Chapter 3, “Supported Adaptive Server Features,” describes the Adaptive Server features that you can use with the Adaptive Server ODBC Driver.

Related documents

See these books for more information:

- The *Software Developer’s Kit Release Bulletin* for your platform contains important last-minute information about Adaptive Server ODBC Driver and Software Developer’s Kit (SDK).
- The *Software Developer’s Kit and Open Server Installation Guide* contains information about installing SDK and its Adaptive Server ODBC Driver component.
- The *Adaptive Server Enterprise Installation Guide* contains information about installing Adaptive Server.
- The *Adaptive Server Enterprise Release Bulletin* for your platform contains information about known problems and recent updates to Adaptive Server.

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3 Select a product.

4 Specify a time frame and click Go. A list of EBF/Maintenance releases is displayed.

Padlock icons indicate that you do not have download authorization for certain EBF/Maintenance releases because you are not registered as a Technical Support Contact. If you have not registered, but have valid information provided by your Sybase representative or through your support contract, click Edit Roles to add the "Technical Support Contact" role to your MySybase profile.

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Conventions

The following conventions are used in this book.

- Functions, command names, command option names, program names, program flags, properties, keywords, statements, and stored procedures are printed as follows:

  Use the SQLSetConnectAttr function to control details of the connection. For example, the following statement turns off ODBC autocommit behavior:

```
sr = SQLSetConnectAttr(ConnectionHandle,
   SQL_ATTR_AUTOCOMMIT,
   (SQLPOINTER)SQL_AUTOCOMMIT_OFF,
   SQL_IS_UINTEGER);
```

- Variables, parameters, and user-supplied words are in italics in syntax and in paragraph text, are printed as follows:

  For example, the following statement allocates a `SQL_HANDLE_STMT` handle the with name ***`stmt`***, on a connection with a handle named *dbc*.

- Names of database objects such as databases, tables, columns, and datatypes, are printed as follows:

  The value of the pubs2 object.

- Examples that show the use of functions are printed as follows:

```
retcode = SQLConnect( dbc,
     (SQLCHAR*) "MANGO",  SQL_NTS,
     (SQLCHAR* ) "sa", SQL_NTS,
     (SQLCHAR*) "", SQL_NTS );
```

Syntax formatting conventions are summarized in the following table.

Table 1: Syntax formatting conventions

Key	Definition
{ }	Curly braces mean you must choose at least one of the enclosed options. Do not include braces in the command.
[ ]	Brackets mean you can choose or omit enclosed options. Do not include brackets in the command.
|	Vertical bars mean you can choose no more than one option (enclosed in braces or brackets).
,	Commas mean you can choose as many options as you need (enclosed in braces or brackets). Separate your choices with commas, to be typed as part of the command. Commas can also be required in other syntax contexts.
( )	Parentheses are to be typed as part of the command.
. . .	An ellipsis (three dots) means you can repeat the last unit as many times as you need. Do not include ellipses in the command.

Accessibility features

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Software Developer's Kit version 15.0 and the HTML documentation have been tested for compliance with U.S. government Section 508 Accessibility requirements. Documents that comply with Section 508 generally also meet non-U.S. accessibility guidelines, such as the World Wide Web Consortium (W3C) guidelines for Web sites.

The online help for this product is also provided in HTML, which you can navigate using a screen reader.

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CHAPTER 1

Introduction to ODBC Programming

This chapter presents information for developing applications that directly call the Open Database Connectivity (ODBC) programming interface.

The primary documentation for ODBC application development is the Microsoft ODBC SDK documentation at http://msdn.microsoft.com. This chapter provides introductory material and describes features specific to Adaptive Server® Enterprise ODBC Driver by Sybase but is not a complete guide to ODBC application programming.

Introduction to ODBC

The ODBC interface is a call-based application programming interface defined by Microsoft Corporation as a standard interface to database management systems on Microsoft Windows. In addition, ODBC is now widely used on many non-Windows platforms, such as Linux.

Software requirements

To write ODBC applications for Adaptive Server Enterprise, you need:

- Adaptive Server Enterprise
- A C compiler capable of creating programs for your environment
- ODBC Software Development Kit (SDK):
  - For non-Windows platforms, there are commercial and open source projects such as unixODBC and iODBC that provide the ODBC SDK, including the ODBC Driver Manager and header files. Linux and Mac OS X operating systems include such open source distributions.
  - On HP HP-UX, IBM AIX, and Sun Solaris, you can use the iAnywhere ODBC Driver Manager, which is included in your Adaptive Server ODBC Driver installation. You can also use other commercial or open source distributions of the ODBC SDK, however, to do so, you must install them separately.

Note The iAnywhere ODBC Driver Manager does not map calls to ODBC versions 1.0 and 2.0 to calls to ODBC version 3.x. Applications using the iAnywhere ODBC Driver Manager must restrict their use of the ODBC feature set to versions 3.0 and later.

Supported platforms

See the *Open Server and SDK New Features for Microsoft Windows, Linux, UNIX, and Mac OS X* for a list of platforms on which Adaptive Server ODBC Driver is available.

Note Significant portions of this book deal with writing C programs to access data using ODBC functions with Adaptive Server ODBC Driver. There are utilities, programs, and 4GL RAD tools that can use ODBC connections. For example, you can write a PowerBuilder® application or a PHP Web page that connects to an ODBC datasource. For such uses, you only need to know how to set up a datasource using Adaptive Server ODBC Driver. Once the datasource has been set up, these tools completely abstract the underlying ODBC function calls.

ODBC conformance

The Adaptive Server ODBC Driver conforms to ODBC 3.52 specification.

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*.

The Adaptive Server ODBC Driver meets Level 2 conformance with the following exceptions:

- **Level 1 conformance** The Adaptive Server ODBC Driver supports all Level 1 features except SQLSetPos with SQL_REFRESH.
- **Level 2 conformance** The Adaptive Server ODBC Driver supports all Level 2 features except for using bookmarks in SQLBulkOperations (SQL_FETCH_BY_BOOKMARK, SQL_UPDATE_BY_BOOKMARK, SQL_DELEET_BY_BOOKMARK).

Applications developed using older versions of ODBC continue to work with the Adaptive Server ODBC Driver and the newer ODBC Driver Manager. The new ODBC features are not available for older applications.

ODBC Driver Manager

The ODBC Driver Manager manages the communications between the user applications and the ODBC Drivers. Typically, user applications are linked against the ODBC Driver Manager. The Driver Manager manages the job of loading and unloading the appropriate ODBC Driver for the application. Applications make ODBC calls to the ODBC Driver Manager, which performs basic error checking and then processes these calls or passes them on to the underlying ODBC Driver.

The ODBC Driver Manager is not a required component, but it exists to solve many issues surrounding ODBC application development and deployment. Some advantages of using an ODBC Driver Manager are:

- Portable data access: Applications do not need to be rebuilt to use a different DBMS.
- Runtime binding to a datasource.
- Ability to easily change a datasource.

To use the Adaptive Server ODBC Driver without using the ODBC Driver Manager, link your application directly to the Adaptive Server ODBC Driver library. The resulting executable connects only to Adaptive Server datasources.

The Adaptive Server ODBC Driver has been tested with these ODBC Driver Managers:

- On Microsoft Windows, the Microsoft ODBC Driver Manager that is included with Microsoft Windows
- On Linux, the unixODBC Driver Manager that is included with Red Hat and SuSE
- On HP HP-UX, IBM AIX, and Sun Solaris, the unixODBC Driver Manager version 2.2.14 and the Sybase iAnywhere ODBC Driver Manager included with the Adaptive Server ODBC Driver installation
- On Apple Mac OS X, the iODBC Driver Manager that is included with Apple Mac OS X

Building applications using an ODBC Driver Manager

This section discusses how to build applications using an ODBC Driver Manager.

Microsoft Windows

The Microsoft ODBC Driver Manager includes either a DLL named *odbc32.dll* or an import library named *odbc32.lib*. The *odbc32.dll* file is located in *%SystemRoot%\system32*. The *odbc32.lib* file can appear in a number of locations, depending on which products you have installed. If you use Microsoft Visual Studio.NET, the *odbc32.lib* is located in the *%Install Path to Microsoft Visual Studio%\ Vc7\PlatformSDK\Lib*.

To link an ODBC application to the Microsoft ODBC Driver Manager, use *odbc32.lib*.

UNIX using unixODBC Driver Manager

The unixODBC Driver Manager includes a shared library named *libodbc.so*, which is a soft link to a library named *libodbc.so.1*. This file is typically located in the */usr/lib* directory.

Note Some older Driver Manager packages do not create the soft link from *libodbc.so.1* to *libodbc.so*. Sybase recommends that you manually create this link. The ODBC Driver Manager also includes another shared library called *libodbcinst.so.1*. A soft link from this file to *libodbcinst.so* should also exist. If it is not on your system, you should create one.

To link an ODBC application against the unixODBC Driver Manager, pass the `-lodbc` flag to the linker.

If the unixODBC Driver Manager is not installed in the */usr/lib* directory, you must also pass this to the linker:

```
-Ldir
```

where *dir* is the directory where the unixODBC Driver Manager shared libraries are located.

UNIX using the Sybase iAnywhere ODBC Driver Manager

To link an ODBC application against the Sybase iAnywhere ODBC Driver Manager, pass the -liodbc or -ldbodm flag to the linker. You must also pass the -L*dir* flag to the linker, where *dir* is the directory where the Sybase iAnywhere ODBC Driver Manager shared libraries are located.

Apple Mac OS X

The iODBC Driver Manager includes a dynamic library named *libiodbc.dylib*, typically located in the */usr/lib* directory. To link an ODBC application against the iODBC Driver manager, pass the -liodbc flag to the linker.

If you use the unixODBC Driver Manager instead of iODBC, the linker flag should be `-lodbc`.

If the ODBC Driver Manager is not installed in the */usr/lib* directory, you must also pass this flag to the linker:

```
-Ldir
```

where *dir* is the directory where the ODBC Driver Manager shared libraries are located.

Building applications without using an ODBC Driver Manager

You can build applications without using an ODBC Driver Manager on UNIX and Apple Mac OS X Intel. The Adaptive Server ODBC Driver is a shared dynamic library called *libsybdrvodb.so*, which is located in *$SYBASE/DataAccess/ODBC/lib* or *$SYBASE/DataAccess64/ODBC/lib*.

Note You cannot build your applications directly against the Adaptive Server ODBC Driver on Microsoft Windows; build your applications against an ODBC Driver Manager.

❖ **Linking an ODBC application with the Adaptive Server ODBC Driver on UNIX**

1 Pass the -lsybdrvodb and -L<*dir to Adaptive Server ODBC Driver*> flags to the linker.

2 When deploying your application, verify that *$SYBASE/DataAccess/ODBC/lib* (for 32-bit ODBC drivers) or *$SYBASE/DataAccess64/ODBC/lib* (for 64-bit ODBC drivers), the directory containing the Adaptive Server ODBC Driver shared library, is included in your library path. The library path variable for your platform is:

   - On HP HP-UX Itanium: SHLIB_PATH
   - On IBM AIX: LIBRARY_PATH
   - On Linux and Sun Solaris: LD_LIBRARY_PATH
   - On Mac OS X: DYLD_LIBRARY_PATH

Using the Adaptive Server ODBC Driver samples

The Adaptive Server ODBC Driver samples are located in:

- 32-bit Linux and Apple Mac OS X: *$SYBASE\DataAccess\ODBC\samples*
- 64-bit UNIX: *$SYBASE\DataAccess64\ODBC\samples*
- Microsoft Windows: *%SYBASE%\DataAccess\ODBC\samples* or *%SYBASE%\DataAccess64\ODBC\samples*

Each directory and sample includes a *README* file that contains instructions on building and running the following samples. These samples are available on Microsoft Windows, UNIX, and Apple Mac OS X:

- *advanced*
- *asynchexec*
- *cursors*
- *simple*

These samples are available on Microsoft Windows only:

- *adovbsample*
- *kerberos*

Defining 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 on 32-bit platforms and a 64-bit value on 64-bit platforms.

The handle types required for ODBC programs are:

Item	Handle type
Environment	SQLHENV
Connection	SQLHDBC
Statement	SQLHSTMT
Descriptor	SQLHDESC

The following handles are used in 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.

  This code allocates 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 datasource. 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.

  This code allocates 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 (such as INSERT, UPDATE, and DELETE).

  This code allocates a statement handle:

  ```
  SQLHSTMT stmt; SQLRETURN rc;
  ```

```
rc = SQLAllocHandle( SQL_HANDLE_STMT, dbc, &stmt );
```

- **Descriptor** A descriptor is a collection of metadata that describes the parameters of a SQL statement or the columns of a result set, as seen by the application or driver. Thus, a descriptor can fill any of four roles:
  - Application Parameter Descriptor (APD) – contains information about the application buffers bound to the parameters in an SQL statement, such as their addresses, lengths, and C datatypes.
  - Implementation Parameter Descriptor (IPD) – contains information about the parameters in a SQL statement, such as their SQL datatypes, lengths, and nullability.
  - Application Row Descriptor (ARD) – contains information about the application buffers bound to the columns in a result set, such as their addresses, lengths, and C datatypes.
  - Implementation Row Descriptor (IRD) – contains information about the columns in a result set, such as their SQL datatypes, lengths, and nullability.

  The following example illustrates how to retrieve implicitly allocated descriptors:

```
SQLRETURN rc;
SQLHDESC aparamdesc;
SQLHDESC iparamdesc;
SQLHDESC irowdesc;
SQLHDESC arowdesc;
rc = SQLGetStmtAttr(stmt, SQL_ATTR_APP_PARAM_DESC,
   &aparamdesc, SQL_IS_POINTER);

rc = SQLGetStmtAttr(stmt, SQL_ATTR_APP_ROW_DESC,
   &arowdesc, SQL_IS_POINTER);

rc = SQLGetStmtAttr(stmt, SQL_ATTR_APP_ROW_DESC,
   &iparamdesc, SQL_IS_POINTER);

rc = SQLGetStmtAttr(stmt, SQL_ATTR_APP_ROW_DESC,
   &irowdesc, SQL_IS_POINTER);
```

  Implicit descriptors are automatically freed when the statement handle is freed by calling SQLFreeHandle(SQL_HANDLE_STMT, stmt).

Allocating ODBC handles

❖ **Allocating an ODBC handle**

1 Call the SQLAllocHandle function, which 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 Programmer's Reference*.

2 Use the handle in subsequent function calls.

3 Free the object using SQLFreeHandle, which 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 Programmer's Reference*.

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
}
```

Connecting to a datasource

This section describes how to use ODBC functions to establish a connection to an Adaptive Server Enterprise database.

Note In general, the examples in this chapter use SQLConnect.

Choosing an ODBC connection function

ODBC supplies a set of connection functions. Which of the following you use depends on how you expect your application to be deployed and used:

- SQLConnect, which is the simplest connection function

  SQLConnect takes a datasource name (DSN), and an optional user ID and password. You might want to use SQLConnect if you hard-code a datasource name into your application.

  For more information, see SQLConnect in the *Microsoft ODBC Programmer's Reference*.

- SQLDriverConnect, which connects to a datasource using a connection string

  SQLDriverConnect allows the application to use Adaptive Server Enterprise-specific connection information that is external to the datasource.

  Note On UNIX and Apple Mac OS X, the Adaptive Server ODBC Driver supports only SQL_DRIVER_NOPROMPT.

  You can also use SQLDriverConnect to connect without specifying a datasource.

  For more information, see SQLDriverConnect in the *Microsoft ODBC Programmer's Reference*.

- SQLBrowseConnect, which connects to a datasource using a connection string, like SQLDriverConnect.

  SQLBrowseConnect allows your application to build its own dialog boxes to prompt for connection information, and to browse for datasources used by a particular driver—in this case, the Adaptive Server ODBC Driver.

  For more information, see SQLBrowseConnect in the *Microsoft ODBC Programmer's Reference*.

For a complete list of connection parameters that can be used in connection strings, see Chapter 2, “Connecting to a Database.”

Establishing a connection

Your application must establish a connection before it can carry out any database operations.

❖ **Establishing an ODBC connection**

1 Allocate an ODBC environment:

```
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 datasource or connection string.

Depending on your application, you can have a hard-coded datasource or connection string, or you can store it externally for greater flexibility.

4 Allocate an ODBC connection handle:

```
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, while others can be set either before or after.) For example:

```
retcode = SQLSetConnectAttr( dbc, SQL_AUTOCOMMIT,
   (SQLPOINTER)SQL_AUTOCOMMIT_OFF, SQL_IS_UINTEGER);
```

6 Call the ODBC connection function:

```
if (retcode == SQL_SUCCESS || retcode ==
   SQL_SUCCESS_WITH_INFO)
{
   printf( "dbc allocated\n" );
   retcode = SQLConnect( dbc, (SQLCHAR*) "MANGO",
      SQL_NTS, (SQLCHAR*) "sa", SQL_NTS,
      (SQLCHAR*) "", SQL_NTS );
   if (retcode == SQL_SUCCESS || retcode ==
      SQL_SUCCESS_WITH_INFO)
      {
         // successfully connected.
```

```
        }
    }
```

You can find a complete sample of establishing a connection in your installation directory.

Notes on usage

- 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).
- 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, SQL_IS_UINTEGER );
```

Many aspects of the connection can be controlled through the connection parameters. See Chapter 2, “Connecting to a Database.”

For more information including a list of connection attributes, see SQLSetConnectAttr in the *Microsoft ODBC Programmer's Reference*.

Using threads and connections in ODBC applications

You can develop multithreaded ODBC applications for Adaptive Server Enterprise. Sybase recommends that you use a separate connection for each thread. However, you are allowed to share an open connection among multiple threads.

Executing SQL statements

ODBC includes several functions for executing SQL statements:

- **Direct execution** Adaptive Server parses the SQL statement, prepares an access plan, and executes the statement. Parsing and access plan preparation are called preparing the statement.
- **Bound parameter execution** You can construct and execute a SQL statement using bound parameters to set values for statement parameters at runtime. Bind parameters are also used with prepared statements to provide performance benefits for statements that are executed more than once.

- **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 as a result improves performance.

Executing statements directly

The SQLExecDirect function prepares and executes a SQL statement. Optionally, the statement can 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.

❖ **Executing a SQL statement in an ODBC application**

1 Allocate a handle for the statement using SQLAllocHandle.

For example, the following statement allocates a `SQL_HANDLE_STMT` handle with the name "stmt," on a connection with a handle named "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:

```
SQLCHAR *deletestmt =
   "DELETE FROM department WHERE dept_id = 201";
SQLExecDirect( stmt, deletestmt, SQL_NTS) ;
```

See SQLExecDirect in the *Microsoft ODBC Programmer's Reference*.

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.

❖ **Executing 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 `SQL_HANDLE_STMT` handle the with name "stmt", on a connection with a handle named "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, as well as for the statement string itself. Then, they bind parameters to the first, second, and third parameters of a statement executed using the "stmt" statement handle.

```
#defined DEPT_NAME_LEN 20

SQLINTEGER cbDeptID = 0,
   cbDeptName = SQL_NTS, cbManagerID = 0;
SQLCHAR deptname[ DEPT_NAME_LEN ];
SQLSMALLINT deptID, managerID;
SQLCHAR *insertstmt =
   "INSERT INTO department "
   "( dept_id, dept_name, dept_head_id )"
   "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;
```

Usually, these variables are 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 "stmt" statement handle.

```
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.

See SQLExecDirect in the *Microsoft ODBC Programmer's Reference*.

Executing prepared statements

The Adaptive Server ODBC Driver provides a full set of functions for using prepared statements that provide performance advantages for statements that are used repeatedly.

❖ **Executing 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 department"
   "( dept_id, dept_name, dept_head_id )"
   "VALUES (?, ?, ?,)", SQL_NTS);
```

where:

- *retcode* holds a return code that should be tested for success or failure of the operation.
- *stmt* provides a handle to the statement.
- *?* is a statement parameter marker.

2 Set statement parameter values using SQLBindParameter.

For example, the following function call sets the value of the *dept_id* variable:

```
SQLBindParameter( stmt,
   1,
   SQL_PARAM_INPUT,
   SQL_C_SHORT,
   SQL_INTEGER,
   0,
   0,
   &sDeptID,
   0,
   &cbDeptID);
```

where:

- *stmt* is the statement handle.
- *1* indicates that this call sets the value of the first parameter.
- *SQL_PARAM_INPUT* indicates that the parameter is an input statement.

- *SQL_C_SHORT* indicates the C datatype being used in the application.
- *SQL_INTEGER* indicates the SQL datatype being used in the database.
- *0* indicates the column precision.
- *0* indicates the number of decimal digits.
- *&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:

```
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);
```

4 Execute:

```
retcode = SQLExecute( stmt);
```

You can repeat steps 2 through 4 multiple times.

5 Drop the statement using SQLFreeHandle.

Dropping the statement frees resources associated with the statement itself.

Working with result sets

ODBC applications use cursors to manipulate and update result sets. The Adaptive Server ODBC Driver provides extensive support for different kinds of cursors and cursor operations.

Choosing cursor characteristics

ODBC functions that execute statements and manipulate result sets use cursors to carry out their tasks. Applications open a cursor implicitly when they execute a statement that returns a result set.

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 the Adaptive Server ODBC Driver provides a cursor optimized for performance in this case.

To set the required ODBC cursor characteristics, call the SQLSetStmtAttr function that defines statement attributes. You must call SQLSetStmtAttr before executing a statement that returns a result set.

You can use SQLSetStmtAttr to set many cursor characteristics. The characteristic that determines the cursor type for the Adaptive Server ODBC Driver is SQL_ATTR_CONCURRENCY. You can set one of the following values:

- **SQL_CONCUR_READ_ONLY** Disallow updates. This is the default.
- **SQL_CONCUR_LOCK** Use the lowest level of locking needed to verify that the row can be updated.

See SQLSetStmtAttr in the *Microsoft ODBC Programmer's Reference*.

Example

The following fragment requests an updateable cursor:

```
SQLAllocHandle( SQL_HANDLE_STMT, dbc, &stmt );
SQLSetStmtAttr( stmt, SQL_ATTR_CONCURRENCY,
   SQL_CONCUR_LOCK, 0 );
```

Note Before using cursors, verify that UseCursor property is set to 1. The default value for UseCursor is 0.

Retrieving data

To retrieve rows from a database, execute a select statement using SQLExecute or SQLExecDirect. This opens a cursor on the statement. Then, use SQLFetch or SQLFetchScroll with SQL_FETCH_NEXT option to fetch rows through the cursor. When an application frees the statement using SQLFreeStmt with SQL_CLOSE option, 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. For SQL_ATTR_MAX_LENGTH, the default value is 32KB.

The following code fragment from the *simple* sample opens a cursor on a query and retrieves data through the cursor. Error checking has been omitted to make the example easier to read.

```
SQLExecDirect( stmt, "select au_fname from authors",
   SQL_NTS ) ;
retcode = SQLBindCol( stmt, 1, SQL_C_CHAR, aufName,
   sizeof(aufName), &aufNameLen);
while(retcode == SQL_SUCCESS || retcode ==
   SQL_SUCCESS_WITH_INFO)
{
   retcode = SQLFetch( stmt );
}
```

Updating and deleting rows through a cursor

To open a cursor for updates or deletes, you can set a statement attribute called SQL_ATTR_CONCURRENCY to SQL_CONCUR_LOCK:

```
SQLSetStmtAttr(stmt,SQL_ATTR_CONCURRENCY,(SQLPOINTER)
   SQL_CONCUR_LOCK,0);
```

The following code fragment from the *cursor* sample illustrates using cursors for updates and deletes. Error checking has been omitted for clarity.

```
/* Set statement attribute for an updateable cursor */
SQLSetStmtAttr(stmt, SQL_ATTR_CONCURRENCY,
   (SQLPOINTER)SQL_CONCUR_LOCK, 0);
SQLSetCursorName(stmt1, "CustUpdate", SQL_NTS);
SQLExecDirect(stmt1, "select LastName
   from t_CursorTable ", SQL_NTS) ;
SQLFetch(stmt1);
SQLExecDirect(stmt2, "Update t_CursorTable"
   "set LastName='UpdateLastName'"
```

```
"where current of CustUpdate", SQL_NTS) ;
```

For the complete code, refer to the *cursor.cpp* sample.

Using scrollable cursors

Scrollable cursors can go backward as well as forward to more easily support screen-based applications. When a user scrolls backward and forward, the back end provides the corresponding data.

Setting the UseCursor connection property

To determine whether client-side or server-side scrollable cursors are used, you must set the UseCursor property:

- When the UseCursor connection property is set to 1, server-side scrollable cursors are used if Adaptive Server version is 15.0 or later. In earlier versions of the Adaptive Server, server-side scrollable cursors are not available.
- When the UseCursor connection property is set to 0, client-side scrollable cursors (cached result sets) are used, regardless of the Adaptive Server version.

Warning! Using client-side scrollable cursors is resource-intensive.

Support for the Static Insensitive scrollable cursor

The Adaptive Server ODBC Driver supports the Static Insensitive scrollable cursor. It implements the ODBC SQLFetchScroll method to scroll and fetch rows. The SQLFetchScroll method is a standard ODBC method defined in *Microsoft Open Database Connectivity Software Development Kit Programmer's Reference, Volume 2*, which is part of the MSDN library.

The Adaptive Server ODBC Driver supports the following scrolling types:

- SQL_FETCH_NEXT – return the next rowset.
- SQL_FETCH_PRIOR – return the prior rowset.
- SQL_FETCH_RELATIVE – return the rowset *n* from the start of the current rowset.

- SQL_FETCH_FIRST – return the first rowset in the result set.
- SQL_FETCH_LAST – return the last complete rowset in the result set.
- SQL_FETCH_ABSOLUTE – return the rowset starting at row *n*.

Setting scrollable cursor attributes

You must set the following attributes to use scrollable cursors:

- SQL_ATTR_CURSOR_SCROLLABLE – the type of scrollable cursor you are using. It should be set to the value of SQL_SCROLLABLE. Possible values are static, semi-sensitive, and insensitive.
- SQL_ATTR_CURSOR_SENSITIVITY – the sensitivity value for this scrollable cursor. The only supported value for this is SQL_INSENSITIVE.

The following are *optional* attributes when using scrollable cursors:

- SQL_ATTR_ROW_ARRAY_SIZE – the number of rows that you want returned from each call to the SQLFetchScroll() method. If you do not set this value, the default value of one row is used.
- SQL_ATTR_CURSOR_TYPE – The type of scrollable cursor you are using. The only supported values for this are SQL_CURSOR_FORWARD_ONLY or SQL_CURSOR_STATIC.
- SQL_ATTR_ROWS_FETCHED_PTR – the address where the number of rows fetched are stored. The SQL_ATTR_ROWS_FETCHED_PTR points to a variable of datatype SQLUINTEGER.
- SQL_ATTR_ROW_STATUS_PTR – the address where the row status is stored. The SQL_ATTR_ROW_STATUS_PTR points to a variable of datatype SQLUSMALLINT.

Executing scrollable cursors

❖ **Setting up a program to execute a scrollable cursor**

1. Set the scrollable cursor attributes for your environment.

   See “Setting scrollable cursor attributes” on page 20 for more information.

2. Bind the results. For example, add the following to your program:

```
res=SQLBindCol(m_StatementHandle, 2, SQL_C_DOUBLE, price, 0, NULL);
res=SQLBindCol(m_StatementHandle, 3, SQL_C_LONG, quantity, 0, NULL);
```

3 Scroll and fetch by using SQLFetchScroll(). For example, add the following to your program:

```
res = SQLSetStmtAttr(m_StatementHandle, SQL_ATTR_CURSOR_SCROLLABLE,
   (SQLPOINTER)SQL_SCROLLABLE,SQL_IS_INTEGER);

res = SQLSetStmtAttr(m_StatementHandle, SQL_ATTR_CURSOR_SENSITIVITY,
   (SQLPOINTER)SQL_INSENSITIVE, SQL_IS_INTEGER);

res = SQLFetchScroll(m_StatementHandle, SQL_FETCH_NEXT,0);
res = SQLFetchScroll(m_StatementHandle, SQL_FETCH_PRIOR,0);
res = SQLFetchScroll(m_StatementHandle, SQL_FETCH_FIRST,0);
res = SQLFetchScroll(m_StatementHandle, SQL_FETCH_LAST,0);
res = SQLFetchScroll(m_StatementHandle, SQL_FETCH_ABSOLUTE,2);
res = SQLFetchScroll(m_StatementHandle, SQL_FETCH_ABSOLUTE,-2);
res = SQLFetchScroll(m_StatementHandle, SQL_FETCH_RELATIVE,1);
```

4 Execute the Select statement. For example, add the following to your program:

```
res = SQLExecDirect(m_StatementHandle,
   (SQLCHAR "select price, quantity from book" SQL_NTS);
```

5 Close the result set and the cursor. For example, add the following to your program:

```
res = SQLFreeStmt(m_StatementHandle,SQL_CLOSE);
```

Looking at results

After you execute a scrollable cursor, you see these results, assuming a total of *N* rows and a rowset *m* where $N > m$:

Result	Interpretation
Absolute 0	No row is returned, error.
Absolute 1	*m* row is returned.
Absolute *N*	1 row is returned.
Absolute *N*+1	No row is returned, error.
First	The first (1..*m*) rows are returned.
Last	The last (*N*-*m*+1 .. *N*) rows are returned.
Next	The same as SQLFetch().
Prior	Return the rowset that is before current rowset.

The following results are expected if the current cursor points to row *k* and $k\text{-}a > 0$, $k + m + a < N$, $a >= 0$:

Result	Interpretation
Relative *-a*	The rows (*k-a*, *k-a* + *m* -1) are returned.
Relative *a*	The rows (*k* + *a*, *k*+*a* + *m* -1) are returned.

Implicit setting of scrolling cursor attributes

Certain attributes are set implicitly when your application sets specific attributes. The supported ODBC scrollable cursor attributes set implicitly are as follows:

Application sets attribute to	Other attributes set implicitly
SQL_ATTR_CONCURRENCY to SQL_CONCUR_READ_ONLY	SQL_ATTR_CURSOR_SENSITIVITY to SQL_INSENSITIVE
SQL_ATTR_CONCURRENCY to SQL_CONCUR_LOCK	SQL_ATTR_CURSOR_SENSITIVITY to SQL_SENSITIVE
SQL_ATTR_CURSOR_SCROLLABLE to SQL_NONSCROLLABLE	SQL_ATTR_CURSOR_TYPE to SQL_CURSOR_FORWARD_ONLY
SQL_ATTR_CURSOR_SENSITIVITY to SQL_INSENSITIVE	SQL_ATTR_CONCURRENCY to SQL_CONCUR_READ_ONLY SQL_ATTR_CURSOR_TYPE to SQL_CURSOR_STATIC
SQL_ATTR_CURSOR_TYPE to SQL_CURSOR_FORWARD_ONLY	SQL_ATTR_CURSOR_SCROLLABLE to SQL_NONSCROLLABLE
SQL_ATTR_CURSOR_TYPE to SQL_CURSOR_STATIC	SQL_ATTR_CURSOR_SCROLLABLE to SQL_SCROLLABLE

Calling stored procedures

This section describes how to create and call stored procedures, and how to process the results from an ODBC application.

For a full description of stored procedures and triggers, see the *Adaptive Server Enterprise Reference Manual*.

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 SQLFetchScroll just like any other cursor.

Pass parameters to procedures 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.

Example

The *advanced* sample illustrates a stored procedure that returns an output parameter and a return value, and another stored procedure that returns multiple result sets. Error checking has been omitted to make the example easier to read.

```
/*
Example 1: How to call a stored procedure and use input and output parameters
*/

SQLBindParameter(stmt, 1, SQL_PARAM_OUTPUT, SQL_C_SLONG,
   SQL_INTEGER, 0, 0, &retVal, 0, SQL_NULL_HANDLE);
SQLBindParameter(stmt, 2, SQL_PARAM_INPUT, SQL_C_CHAR,
   SQL_CHAR, 4, 0, stor_id, sizeof(stor_id), SQL_NULL_HANDLE);
SQLBindParameter(stmt, 3, SQL_PARAM_OUTPUT, SQL_C_CHAR,
   SQL_VARCHAR, 20, 0, ord_num, sizeof(ord_num), &ordnumLen);
SQLBindParameter(stmt, 4, SQL_PARAM_INPUT, SQL_C_CHAR,
   SQL_VARCHAR, 40, 0, date, sizeof(date), &dateLen);

SQLExecDirect( stmt, "{ ? = call sp_selectsales(?,?,?) }", SQL_NTS);

/*
At this point retVal contains the return value as returned from the stored
procedure and the ord_num contains the order number as returned from the
stored procedure
*/


/*
Example 2: How to call stored procedures returning multiple result sets
*/

SQLBindParameter(stmt, 1, SQL_PARAM_INPUT, SQL_C_CHAR,
   SQL_CHAR , 4, 0, stor_id, sizeof(stor_id), SQL_NULL_HANDLE);

SQLExecDirect(stmt, "{ call sp_multipleresults(?) }", SQL_NTS);
SQLBindCol( stmt, 1, SQL_C_CHAR, dbValue, sizeof(dbValue), &dbValueLen);
SQLSMALLINT count = 1;

while(retcode == SQL_SUCCESS || retcode == SQL_SUCCESS_WITH_INFO)
{
   retcode = SQLFetch( stmt );
   if (retcode == SQL_NO_DATA)
```

```
    {
      /*
      -- End of first result set --
      */
      if(count == 1)
      {
         retcode = SQLMoreResults(stmt);
         count ++;
      }
      /*
       At this point dbValue contains the value in the current row of the
       result
      */
    }
}
```

Handling errors

Errors in ODBC are reported using the return value from each of the ODBC function calls and either the SQLGetDiagField 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 replaced by the SQLGetDiagRec and SQLGetDiagField functions.

Every ODBC function returns a SQLRETURN that 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 SQLGetDiagRec will indicate a warning. The most common cause for this status is that a value being returned is too long for the buffer provided by the application.
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.

Status code	Description
SQL_NO_DATA	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 Software Development Kit 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 SQLGetDiagRec returns the information for one error and removes the information for that error. If you do not call 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 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.

SQLGetDiagRec returns 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 fragments use SQLGetDiagRec and return codes:

```
retcode = SQLAllocHandle(SQL_HANDLE_STMT, dbc, &stmt );
if( retcode == SQL_ERROR )
{
   SQLGetDiagRec(SQL_HANDLE_DBC,dbc, 1, NULL, NULL,
     errmsg, 100, NULL);
   /* Assume that print_error is defined */
   print_error( "Allocation failed", errmsg );
   return;
}
```

Example 2

```
retcode = SQLExecDirect( stmt,
   "delete from sales_order_items where id=2015",
   SQL_NTS );
if( retcode == SQL_ERROR )
{
   SQLGetDiagRec(SQL_HANDLE_STMT,stmt, 1, NULL, NULL,
```

```
        errmsg, 100, NULL);
    /* Assume that print_error is defined */
    print_error( "Failed to delete items", errmsg );
    return;
}
```

Datatype mappings

Table 1-1 describes the Adaptive Server ODBC Driver datatype mappings.

Table 1-1: Datatype mappings

ASE datatype	ODBC SQL datatype	ODBC bind datatype
bigdatetime	SQL_TYPE_TIMESTAMP	SQL_C_TYPE_TIMESTAMP or SQL_C_CHAR
bigtime	SQL_TYPE_TIME	SQL_C_TYPE_TIME or SQL_C_CHAR
bigint	SQL_BIGINT	SQL_C_BIGINT
binary	SQL_BINARY	SQL_C_BINARY
bit	SQL_BIT	SQL_C_BIT
char	SQL_CHAR	SQL_C_CHAR
date	SQL_TYPE_DATE	SQL_C_TYPE_DATE or SQL_C_CHAR
datetime	SQL_TYPE_TIMESTAMP	SQL_C_TYPE_TIMESTAMP or SQL_C_CHAR
decimal	SQL_DECIMAL	SQL_C_NUMERIC or SQL_C_CHAR
double	SQL_DOUBLE	SQL_C_DOUBLE
float(<16)	SQL_REAL	SQL_C_FLOAT
float(>=16)	SQL_DOUBLE	SQL_C_DOUBLE
image	SQL_LONGVARBINARY	SQL_C_BINARY
int[eger]	SQL_INTEGER	SQL_C_LONG
money	SQL_DECIMAL	SQL_C_NUMERIC or SQL_C_CHAR
nchar	SQL_CHAR	SQL_C_CHAR
nvarchar	SQL_VARCHAR	SQL_C_CHAR
numeric	SQL_NUMERIC	SQL_C_NUMERIC or SQL_C_CHAR
real	SQL_REAL	SQL_C_FLOAT
smalldatetime	SQL_TYPE_TIMESTAMP	SQL_C_TYPE_TIMESTAMP or SQL_C_CHAR
smallint	SQL_SMALLINT	SQL_C_SHORT
smallmoney	SQL_DECIMAL	SQL_C_NUMERIC or SQL_C_CHAR
text	SQL_LONGVARCHAR	SQL_C_CHAR
time	SQL_TYPE_TIME	SQL_C_TYPE_TIME or SQL_C_CHAR
timestamp	SQL_BINARY	SQL_C_BINARY
tinyint	SQL_TINYINT	SQL_C_TINYINT
unichar	SQL_WCHAR	SQL_C_CHAR
unitext	SQL_WLONGVARCHAR	SQL_C_CHAR

ASE datatype	ODBC SQL datatype	ODBC bind datatype
univarchar	SQL_WVARCHAR	SQL_C_CHAR
unsignedbigint	SQL_BIGINT	SQL_C_UBIGINT
unsignedint	SQL_INTEGER	SQL_C_ULONG
unsignedsmallint	SQL_SMALLINT	SQL_C_USHORT
varbinary	SQL_VARBINARY	SQL_C_BINARY
varchar	SQL_VARCHAR	SQL_C_CHAR

Special instructions for unichar, varchar, and unitext

When you use the Adaptive Server datatypes unichar, univarchar, and unitext, and then bind any of them to SQL_C_CHAR, the Adaptive Server ODBC Driver must convert the data from Unicode to multibyte and vice versa. For this conversion, it must have the SYBASE charsets installed in the *$SYBASE* directory. The installation program includes an option to install these charset files.

If the driver does not find the charsets, or if the *$SYBASE* environment variable is not set, then an appropriate error is propagated to the application. To install the SYBASE charsets, you must reinstall the ODBC Driver. See the *Software Developer's Kit and Open Server Installation Guide* for your platform.

Note To support older applications, the Adaptive Server ODBC Driver assumes that the default type is SQL_C_CHAR when a unitext, univarchar, or unichar column is bound as SQL_C_DEFAULT. To bind as unicode, the application must explicitly use a bind type of SQL_C_WCHAR.

Using computed columns

The Adaptive Server Drivers support computed columns that allow you to create a shorthand term for an expression, such as "Pay" for "Salary + Commission," and to make that column indexable, as long as its datatype can be indexed. Computed columns are defined by an expression, whether from regular columns in the same row, functions, arithmetic operators, and path names, including their metadata information.

Using server-specified packet size

Clients and servers have to be prepared to reserve memory to store the packages used for communication between them. These packages are called Protocol Data Units, or PDUs. Every PDU starts with an 8-byte header containing a 2-byte, unsigned integer describing the actual size in bytes of the current PDU (including the header itself). Clients and servers must know the maximum size that a PDU sent by the other party could be, and this is called the *packet size*. The packet size is negotiated at login time.

When connected to Adaptive Server 15.0 and later, the Adaptive Server ODBC Driver lets the server select the packet size to optimize performance. When connected to an earlier version of Adaptive Server, the Adaptive Server ODBC Driver uses 512 as the packet size, unless you specify the packetsize property. If you do not want the server to decide the packet size, you need to set EnableServerPacketSize to 0. If you have memory restrictions, set RestrictMaximumPacketSize to a number (in multiples of 512) so that Adaptive Server and the Adaptive Server ODBC Driver do not negotiate a packet size greater than the one you specified.

Using large identifiers for database objects

The Adaptive Server ODBC Driver supports object names or identifiers that have lengths of up to 255 bytes. For information on Adaptive Server large identifiers, see *What's New in Adaptive Server Enterprise 15.0?*

Warning! If you use large identifiers in your C++ programs or client applications, you must allocate sufficient buffer lengths to avoid data truncation.

CHAPTER 2

Connecting to a Database

This chapter describes how client applications connect to Sybase Adaptive Server Enterprise using ODBC.

Introduction to connections

Any client application that uses Adaptive Server Enterprise must establish a connection to the Adaptive server before any work can be done. The connection forms a channel through which all activity from the client application takes place. For example, your user ID determines permissions to carry out actions on the database—and the database server has your user ID because it is part of the request to establish a connection. The Adaptive Server ODBC Driver uses connection information included in the call from the client application (perhaps together with information held on disk in an initialization file) to locate and connect to an Adaptive Server server running the required database.

Installing ODBC MetaData stored procedures

The ODBC MetaData stored procedures ensure that ODBC functionalities behave as expected. Sybase recommends that you install these procedures on all the Adaptive Server servers that you need to connect to using ODBC.

❖ **Installing the MetaData stored procedures**

This procedure installs the ODBC MetaData stored procedures in sybsystemprocs.

To run the script successfully, you need permission to create stored procedures in sybsystemprocs.

1 Go to the *sp* directory under the Adaptive Server ODBC Driver installation directory:

- Adaptive Server ODBC Driver 32-bit for Microsoft Windows: *%SYBASE%\DataAccess\ODBC\sp*
- Adaptive Server ODBC Driver 64-bit for Microsoft Windows: *%SYBASE%\DataAccess64\ODBC\sp*
- Adaptive Server ODBC Driver 32-bit for Linux and Apple Mac OS X: *$SYBASE\DataAccess\ODBC\sp*
- Adaptive Server ODBC Driver 64-bit for UNIX: *$SYBASE\DataAccess64\ODBC\sp*

2 Execute the *install_odbc_sprocs* script.

- Adaptive Server ODBC Driver for Microsoft Windows:

```
install_odbc_sprocs ServerName username
   [password]
```

- Adaptive Server ODBC Driver for UNIX and Apple Mac OS X:

```
./install_odbc_sprocs ServerName username
   [password]
```

where:

- *ServerName* is the name of the Adaptive Server.
- *username* is the user name to connect to the server.
- *[password]* is the password for the user name. If the value is null, leave the parameter empty.

How connection parameters work

When an application connects to a database, it uses a set of connection parameters to define the connection. Connection parameters include information such as the server name, the database name, and a user ID. A keyword-value pair (of the form parameter=value) specifies each connection parameter. For example, you specify the user ID connection parameter as follows:

```
UID=sa
```

Connection parameters passed as connection strings

Connection parameters are passed to the Adaptive Server ODBC driver as a connection string and are separated by semicolons:

```
parameter1=value1;parameter2=value2;...
```

In general, the connection string built by an application and passed to the driver does not correspond directly to the way a user enters the information. Instead, a user can fill in a dialog box, or the application can read connection information from an initialization file.

Character sets

The CharSet connection property defines the character set that the driver uses to send character data to Adaptive Server, while the ClientCharset connection property defines the character set used by client applications.

The valid CharSet values are:

- ServerDefault – when specified, Adaptive Server ODBC Driver communicates with Adaptive Server using the server's default character set. The Adaptive Server ODBC Driver converts character data for the client if the client and server use different character sets.
- ClientDefault –when specified, Adaptive Server ODBC Driver communicates with Adaptive Server using the client-specified character set. In this case, if the default Adaptive Server character set is different from the client's, Adaptive Server converts character data to the client character set. Adaptive Server uses additional resources when performing character set conversions.

- NoConversions – when specified, Adaptive Server ODBC Driver ignores the client's character set and does not convert character data. In this setting, the client application must ensure that character data is correctly converted between the client's character set and the default Adaptive Server character set. Use this value only under specific circumstances. For example, when character data stored in Adaptive Server must be converted in the client application using a customized character set conversion logic.

Note In the Microsoft Windows ODBC Data Source Administrator, the “Server Default,” “Client Charset,” and "No Conversions" fields found in the Advanced window correspond to the CharSet values ServerDefault, ClientDefault, and NoConversions, respectively.

The Adaptive Server ODBC Driver determines the client character set, depending on the platform:

- On Microsoft Windows, the default client character set selected is the ANSI code page for your login session. The valid code page types are ANSI, OEM, and Other. If Other is chosen, you must enter a valid Windows code page value.
- By default, on UNIX and Apple Mac OS X, the Adaptive Server ODBC Driver examines the LC_CTYPE and LANG environment variables. If they are not set, the driver defaults to ISO 8859-1. If one of these environment variables are set, the driver looks for *locales.dat* in the *$SYBASE/locales/locales.dat* directory to pick up the corresponding Adaptive Server character set. If the file is not found, the driver looks into its own map in memory to lookup the corresponding Adaptive Server character set.

Configuring the Adaptive Server ODBC Driver

When connecting to the database, ODBC applications typically use ODBC datasources. An ODBC datasource is a set of connection parameters, stored in the registry or in a file. ODBC datasources on non-Windows platforms typically reside in an *ini* file. Most ODBC Driver Managers provide a GUI tool to configure ODBC Driver and datasources.

Microsoft Windows

When you use the Sybase SDK installation program to install the Adaptive Server ODBC Driver, it registers the driver on the local machine. You can manually register the Adaptive Server ODBC Driver on Microsoft Windows using the regsvr32 utility.

Registering the Adaptive Server ODBC Driver

Note You do not need to manually register the Adaptive Server ODBC Driver if you have used the Sybase SDK installation program to install Adaptive Server ODBC Driver.

- **Manually registering Adaptive Server ODBC Driver 32-bit on Microsoft Windows x86 32-bit**

  1 Change to the *%SYBASE%\DataAccess\ODBC\dll* directory, which contains the Adaptive Server ODBC Driver DLL.

  2 Run the regsvr32 utility to create registry entries in the *HKEY_LOCAL_MACHINE\SOFTWARE\ODBC\ODBCINST.INI* key:

  ```
  regsvr32 sybdrvodb.dll
  ```

- **Manually registering Adaptive Server ODBC Driver 64-bit on Microsoft Windows x86-64 64-bit**

  1 Change to the *%SYBASE%\DataAccess64\ODBC\dll* directory, which contains the Adaptive Server ODBC Driver DLL.

  2 Run the regsvr32 utility to create registry entries in the *HKEY_LOCAL_MACHINE\SOFTWARE\ODBC\ODBCINST.INI* key:

  ```
  regsvr32 sybdrvodb64.dll
  ```

- **Manually registering Adaptive Server ODBC Driver 32-bit on Microsoft Windows x86-64 64-bit**

  1 Change to the *%SYBASE%\DataAccess\ODBC\dll* directory, which contains the Adaptive Server ODBC Driver DLL.

  2 Run the regsvr32 utility to create registry entries in the *HKEY_LOCAL_MACHINE\SOFTWARE\Wow6432Node\ODBC\ODBCINST.INI key*:

```
regsvr32 sybdrvodb.dll
```

Note To configure a datasource using Adaptive Server ODBC Driver 32-bit on Microsoft Windows x86-64 64-bit, use the 32-bit ODBC Data Source Administrator odbcad32.exe located by default at *C:\WINDOWS\SysWOW64*.

Configuring a datasource

❖ **Configuring a datasource**

1 Launch the ODBC Administrator. See the online help for your specific Microsoft Windows operating system for detailed instructions.

2 Select the User DSN tab. Click Add.

3 Choose "Adaptive Server Enterprise" from the list of drivers.

4 Click Finish.

5 Select the General tab. Enter values in the following fields:

- Data Source Name – a name for your datasource
- Description – a description for your datasource
- Server Name – an Adaptive Server Enterprise host name
- Server Port – an Adaptive Server Enterprise port number
- Database Name – a database name
- Logon ID – a user name to log in to the Adaptive Server Enterprise database

6 Select Use Cursors to open cursors for every select statement.

7 Complete the Connection and Advanced tabs as needed.

8 Click OK to save the changes.

Note For a detailed explanation of connection parameters, see "Using connection parameters" on page 42.

UNIX

The unixODBC Driver Manager supports configuring drivers and datasources from a GUI as well as the command line. Refer to the ODBC Driver Manager's documentation for instructions on the GUI tool and command line syntax.

Note The Adaptive Server ODBC Driver and datasources that use this driver cannot be configured using the GUI tools from the unixODBC Driver Manager. You must use the command line interface.

When configuring the driver and datasources using the unixODBC Driver Manager command line tool, you must supply a template file. Sample templates are described in the following section. You can also find these templates in:

- Adaptive Server ODBC Driver 32-bit: *$SYBASE/DataAccess/ODBC/samples*
- Adaptive Server ODBC Driver 64-bit: *$SYBASE/DataAccess64/ODBC/samples*

The following is an example of a driver template file:

```
[Adaptive Server Enterprise]
Description=Sybase ODBC Driver
Driver=/install dir/driver library name
FileUsage=-1
```

where:

- *install dir* is the path to the Adaptive Server ODBC Driver installation.
- *driver library name* is the name of the driver library.

Installing the Adaptive Server ODBC Driver

To install the Adaptive Server ODBC Driver using the unixODBC command line tool, execute:

```
# odbcinst -i -d -f driver template file
```

where *driver template file* is the complete path to the Adaptive Server ODBC Driver template file.

Note In most cases, this command needs to be executed as the root user because it modifies the *odbcinst.ini* file that is owned by root.

Configuring a datasource

unixODBC Driver Manager

This is a datasource template:

```
[sampledsn]
Description=Sybase ODBC Data Source
UserID=sa
Password=
Driver=Adaptive Server Enterprise
Server=sampleserver
Port=4100
Database=pubs2
UseCursor=1
```

Execute the following command to configure a datasource for the Adaptive Server ODBC Driver using the unixODBC command line tool:

```
#  odbcinst -i -s -f dsn template file
```

where *dsn template file* is the complete path to the Adaptive Server ODBC datasource template file. This creates entries for the datasource in the *odbc.ini* file.

Note The exact command you need to configure ODBC datasources depends on the ODBC Driver Manager you are using.

Sybase iAnywhere ODBC Driver Manager

The Sybase iAnywhere ODBC Driver Manager uses the information provided in the *odbc.ini* file to locate the driver and other connection information. The ODBCINI variable defines the location of the *odbc.ini* file.

❖ **Manually configuring the ODBC driver and datasource**

1 Create an *odbc.ini* file:

```
[sampledsn]
Description=Sybase ODBC Data Source
UserID=sa
Password=
Driver=complete_path_to_libsybdrvodb.so
Server=sampleserver
Port=4100
Database=pubs2
UseCursor=1
```

2 Set the ODBCINI environment variable to the complete path to the *odbc.ini* file.

Apple Mac OS X

During the Adaptive Server ODBC Driver installation, the Adaptive Server ODBC Driver is configured in the */Library/ODBC/odbcinst.ini* file. To manually configure the Adaptive Server ODBC Driver, use the iODBC Administrator, as described in the following procedure.

Manually configuring the ODBC Driver

❖ **Using the iODBC Driver Manager**

1 Start the iODBC Administrator from Applications | Utilities.

2 Select the Drivers tab and click Add.

3 In the Description field, enter "Adaptive Server Enterprise" as the Driver description.

4 Click Choose to select the installation path in the Driver file field.

You do not need to enter values in the setup file or keyword value pairs fields.

5 Click OK to save the changes.

Configuring a datasource

You can configure the Adaptive Server ODBC Driver using the iODBC Administrator.

❖ **Configuring a datasource**

1 Start the iODBC Administrator from Applications | Utilities.

2 Select the User DSN tab. The Choose a Driver window opens.

3 Select the Adaptive Server Enterprise Driver you want to use.

4 Click OK.

5 Provide a name for your datasource in the Data Source Name (DSN) field.

6 Provide a description for your datasource in the Description field.

7 Click Add to add keyword value pairs. Repeat this step until you have added all the keyword value pairs. For example:

```
Keyword     Value
UserID      sa
Password
```

```
Server      sampleserver
Port        4100
Database    pubs2
UseCursor    1
```

8 Click OK to save the changes.

Note For more information on installing and configuring drivers and datasources using the iODBC Administrator on Apple Mac OS X, look up the iODBC Administrator online help.

ODBC *ini* files

The ODBC Driver Manager stores driver and datasource information in *ini* files or the system registry.

Note Refer to your ODBC Driver Manager documentation for the exact path for these *ini* files.

Microsoft Windows

The *odbc.ini* and *odbcinst.ini* files are located in the *c:\winnt* directory. The Microsoft ODBC Driver Manager looks up these files or the registry at runtime when an application requests a connection to a datasource.

UNIX

Information about the ODBC Driver installed on the system is saved in the *odbcinst.ini* file. This file is typically located at */etc/odbcinst.ini*.

The information about datasources is saved in one of two files:

- User datasource information, available only to that user, is saved in the *$HOME/.odbc.ini* file, where *$HOME* is the user home directory.
- System datasource information, available to any user on the system, is usually saved in the */etc/odbc.ini* file. If the same datasource is defined in both files, the user datasource takes precedence.

The ODBC Driver Manager looks up these files at runtime when an application requests a connection to a datasource. Refer to your ODBC Driver Manager documentation for the exact path for these *ini* files. Some Driver Manager use alternate locations.

If your application is not using ODBC Driver Manager and uses the Adaptive Server ODBC Driver directly, the *ini* file is searched differently: The Adaptive Server ODBC Driver first looks for a file named *odbc.ini* in the current working directory; if the file is not found or the datasource not found in the file, it looks for *$SYBASE/odbc.ini*.

If your application uses the Sybase iAnywhere ODBC Driver Manager, set the ODBCINI environment variable to the complete path to the *odbc.ini* file. By default, *odbc.ini* is located under *$SYBASE*.

Apple Mac OS X

When you use the iODBC ODBC Administrator tool, the *odbcinst.ini* and the *odbc.ini* files are typically located in the */Library/ODBC* directory if the driver or datasource was installed system-visible. If the driver or datasource was installed to be user-visible, the *odbcinst.ini* and the *odbc.ini* files are in the *$HOME/Library/ODBC* directory.

At runtime, the iODBC Driver Manager searches for DSN information in *$HOME/Library/ODBC/odbc.ini*. If your DSN information is in */Library/ODBC/odbc.ini* or in any other location, you need to set an environment variable called ODBCINI to the path to the *odbc.ini* file. For example:

```
setenv ODBCINI full pathname to the odbc.ini file
```

Connecting using a datasource

ODBC applications usually use datasources on the client computer for each database you want to connect to. You can store sets of Adaptive Server Enterprise connection parameters as an ODBC datasource, in either the system registry or *ini* files. If you have a datasource, your connection string can simply name the datasource by using the DataSourceName (DSN) connection parameter:

```
DSN=my data source
```

Using connection parameters

Table 2-1 lists the connection parameters other than from the DSN parameter that can be supplied to the Adaptive Server ODBC Driver.

Table 2-1: Connection parameters

Property names	Description	Required	Default value
AlternateServers	A list of comma-separated host:port pairs such as server1:port1,server2:port2,...,serverN:portN; When establishing a connection, the Adaptive Server ODBC Driver first connects to the host and port specified by the Server and Port properties before going through the list of hosts and ports listed in AlternateServers. See "Supported Adaptive Server Cluster Edition features" on page 51 for information about how AlternateServers is used in a high availability environment.	No	Empty
AnsiNull	Strict ODBC compliance where you cannot use "= NULL." Instead, you must use "IsNull."	No	1
ApplicationName	The name used by Adaptive Server to identify the client application.	No	Empty
AuthenticationClient	The type of client library to be used for Kerberos Authentication. Valid values include: • activedirectory • cybersafekerberos • mitkerberos	No	Empty
BackEndType	Specifies the target type of the datasource you are defining. The Adaptive Server ODBC Driver can communicate with multiple target objects, including database systems such as Adaptive Server, and gateways to non-Sybase database systems. Valid values include: • ASE • DC DB2 Access Service • DC TRS • MFC Gatewayless See "Support for Mainframe Connect and DirectConnect for z/OS Option" on page 63 for more information.	No	ASE

Property names	Description	Required	Default value
BufferCacheSize	Keeps the input / output buffers in pool. When large results will occur, increase this value to boost performance.	No	20
CharSet	Specifies the character set that is used to communicate to Adaptive Server. The valid values are ServerDefault, ClientDefault, NoConversions. See "Character sets" on page 33.	No	ServerDefault
ClientCharset	Specifies the client character set. See "Character sets" on page 33.	No	The character set currently used by the operating system.
ClientHostName	The name of the client host passed in the login record to the server.	No	Empty
ClientHostProc	The identity of client process on this host machine passed in the login record to the server.	No	Empty
CodePageType	Specifies the type of character encoding used. The valid values are ANSI, OEM, and Other.	No	ANSI
CommandTimeOut	The time, in seconds, that a client has to wait for a command to execute. If a command does not execute within the time given, the client cancels the command and generates an error.	No	0. A value of 0 indicates no time limit, allowing client to execute a command indefinitely its until return.
ConnectionTimeOut	The time, in seconds, that a client has to wait to establish a connection. If a connection is not established within the time given, the client cancels the attempt and generates an error.	No	0. A value of 0 indicates no time limit, allowing ODBC to wait indefinitely for a database connection to be established.

Property names	Description	Required	Default value
CRC	By default, the driver returns the total records updated when multiple update statements are executed in a stored procedure. This count will also include all updates happening as part of the triggers set on an update or an insert. Set this property to 0 if you want the driver to return only the last update count.	No	1
Database	The database to which you want to connect.	No	Empty
DataIntegrity	Enables Kerberos Data Integrity.	No	0 (disabled)
DSPassword	The password used to authenticate on the LDAP server, if the LDAP server does not allow anonymous access. The password can be specified in the Directory Service URL (DSURL) as well.	No	Empty
DSPrincipal	The user name used to authenticate on the LDAP server, if the LDAP server does not allow anonymous access. The principal can be specified in the DSURL as well.	No	Empty
DSURL	The URL to the LDAP server.	No	Empty
DTCProtocol (Microsoft Windows only)	Allows the driver to use either an XA protocol or OleNative protocol when using distributed transactions. See “Using distributed transactions” on page 54, in Chapter 3, “Supported Adaptive Server Features.”	No	XA
DynamicPrepare	When set to 1, the driver sends SQLPrepare calls to Adaptive Server to compile/prepare. This can boost performance if you use the same query repeatedly.	No	0
EnableBulkLoad	Specifies whether bulk-load support is enabled: • 0 – bulk-load support is disabled. • 1 – bulk-load using array insert is enabled. • 2 – bulk-load using the bulk copy interface is enabled. See “Bulk-load support” on page 61.	Yes	0
EnableServerPacketSize	Allows Adaptive Server server versions 15.0 or later to choose the optimal packet size.	No	1
Encryption	The designated encryption. Possible values: ssl.	No	Empty

Property names	Description	Required	Default value
EncryptPassword	Specifies whether password is transmitted in an encrypted format: • 0 – use plain text password. • 1 – use encrypted password. If it is not supported, return an error message. • 2 – use encrypted password. If it is not supported, use plain text password. **Note** When password encryption is enabled, and the server supports asymmetric encryption, this format is used instead of symmetric encryption.	No	0
FetchArraySize	Specifies the number of rows the driver retrieves when fetching results from the server.	No	25
HASession	Specifies if high availability is enabled. 0 indicates high availability disabled, 1 high availability enabled.	No	0
IgnoreErrorsIfRS Pending	Specifies whether the driver is to continue processing or stop if error messages are present. When set to 1, the driver ignores errors and continues processing the results if more results are available from the server. When set to 0, the driver stops processing the results if an error is encountered even if there are results pending	No	0
UseCursor	Specifies whether cursors are to be used by the driver. 0 indicates do not use cursors, and 1 indicates use cursors.	No	0
Language	The language in which Adaptive Server returns error messages.	No	Empty – Adaptive Server uses English by default
LoginTimeOut	Number of seconds to wait for a login attempt before returning to the application. If set to 0, the timeout is disabled, and a connection attempt waits for an indefinite period of time.	No	15

Property names	Description	Required	Default value
NormalizeWCharParams	Specifies whether to enable Unicode string normalization. Set this property to 1 when the Adaptive Server configuration option enable unicode normalization is set to 0. Valid values are: • 0 – disables Unicode string normalization. • 1 – enables Unicode string normalization.	No	0
OldPassword	The current password. If OldPassword contains a value that is not null or an empty string, the current password is changed to the value contained in PWD.	No	Empty
PacketSize	The number of bytes per network packet transferred between Adaptive Server and the client.	No	Server-determined when driver is connected to Adaptive Server 15.0 or later. For older versions, the default is 512.
Port	The port number of Adaptive Server.	Yes	Empty
PWD, Password	Contains the value of the password. When performing a normal login, OldPassword is not set and PWD contains the value of the current password. When changing the password, OldPassword is set to the current password, and PWD contains the value of the new password.	No, if the user name does not require a password	Empty
QuotedIdentifier	Specifies if Adaptive Server treats character strings enclosed in double quotes as identifiers: • 0 – does not enable quoted identifiers. • 1 – enables quoted identifiers.	No	0
ReplayDetection	Enables Kerberos Replay Detection.	No	0
RestrictMaximum PacketSize	If there are memory constraints when EnableServerPacketSize is set to 1, set this property to an int value in multiples of 512 to a maximum of 65536.	No	0
SecondaryPort	The port number of the Adaptive Server acting as a failover server in an active-active or active-passive setup.	Yes, if HASession is set to 1.	Empty

Property names	Description	Required	Default value
SecondaryServer	The name or the IP address of the Adaptive Server acting as a failover server in an active-active or active-passive setup.	Yes, if HASession is set to 1.	Empty
Server	The name or IP address of the Adaptive Server.	Yes	Empty
ServerInitiated Transactions	When SQL_ATTR_AUTOCOMMIT is set to 1, Adaptive Server starts managing transactions as needed. The driver issues a set chained on command on the connection. Older ODBC drivers do not use this feature and manage the job of starting transactions by calling begin tran. Set this property to 0 to maintain the old behavior or require that your connection not use "chained" transaction mode.	No	1
ServerPrincipal	The logical name or the principal Adaptive Server name as configured in the Key Distribution Center (KDC). Adaptive Server ODBC Driver uses the information to negotiate Kerberos authentication with the configured KDC and Adaptive Server.	No	Empty
ServiceName	Specifies the service name used to connect to the host. ServiceName can hold any string value. See "Support for Mainframe Connect and DirectConnect for z/OS Option" on page 63.	No	Empty
TextSize	The maximum size of binary or text data that can be sent over the wire.	No	Empty – Adaptive Server default is 32K.
TightlyCoupled Transaction (Microsoft Windows only)	When using distributed transactions, if you are using two DSNs that connect to the same Adaptive Server, set this to 1. See "Using distributed transactions" on page 54, in Chapter 3, "Supported Adaptive Server Features."	No	0
TrustedFile	If encryption is set to ssl, set this property to the path to the Trusted File.	No	Empty
UID, UserID	A case-sensitive user ID required to connect to the Adaptive Server.	Yes	Empty

CHAPTER 3

Supported Adaptive Server Features

This chapter describes the advanced Adaptive Server features you can use with the Adaptive Server ODBC Driver.

Microsecond granularity for time data

Adaptive Server ODBC Driver provides microsecond-level precision for time data by supporting the SQL datatypes bigdatetime and bigtime.

bigdatetime and bigtime function similarly to and have the same data mappings as the SQL datetime and time datatypes:

- bigdatetime corresponds to the Adaptive Server bigdatetime datatype and indicates the number of microseconds that have passed since January 1, 0000 00:00:00.000000. The range of legal bigdatetime values is from January 1, 0001 00:00:00.000000 to December 31, 9999 23:59:59.999999.
- bigtime corresponds to the Adaptive Server bigtime datatype and indicates the number of microseconds that have passed since the beginning of the day. The range of legal bigtime values is from 00:00:00.000000 to 23:59:59.999999.

Usage

- When connecting to Adaptive Server 15.5, the Adaptive Server ODBC Driver transfers data using the bigdatetime and bigtime datatypes, even if the receiving Adaptive Server columns are defined as datetime and time.

  This means that Adaptive Server may silently truncate the values from the Adaptive Server ODBC Driver to fit the Adaptive Server columns. For example, a bigtime value of 23:59:59.999999 is saved as 23:59:59.996 in an Adaptive Server column with datatype time.
- When connecting to Adaptive Server 15.0.x and earlier, the Adaptive Server ODBC Driver transfers data using the datetime and time datatypes.

Asynchronous execution for ODBC

By default, drivers execute ODBC functions synchronously. That is, the application calls a function and the driver returns control to the application when execution is complete. With asynchronous execution, the driver returns control to the application after minimal processing and before execution is complete. This allows the application to execute in parallel other functions while the first function is still executing. Asynchronous execution is beneficial when a task is complex and requires a significant amount of time to execute.

The Adaptive Server ODBC Driver by Sybase supports a maximum of one concurrent statement in asynchronous mode. Only one concurrent statement, synchronous or asynchronous, can be executed if server-side cursors are used or if the connection's auto-commit is disabled.

To use connection-level asynchronous execution with the Adaptive Server ODBC Driver by Sybase, call SQLSetConnectAttr and set *SQL_ATTR_ASYNC_ENABLE* to SQL_ASYNC_ENABLE_ON.

For more information about asynchronous execution and its application, refer to the *ODBC Programmer's Reference* that is available at the Microsoft Developers Network at http://msdn.microsoft.com/.

Note Calling SQLCancel when no processing is being done will not close the associated cursors. ODBC applications should explicitly call SQLFreeStmt or SQLCloseCursor to close cursors.

Supported Adaptive Server Cluster Edition features

This section describes the Adaptive Server ODBC Driver features that support the Cluster Edition, where multiple Adaptive Servers connect to a shared set of disks and a high-speed private interconnection. This allows Adaptive Server to scale using multiple physical and logical hosts.

See the *Adaptive Server Enterprise Clusters Users Guide*.

Login redirection

At any given time, some servers within a Cluster Edition environment are usually more loaded with work than others. When a client application attempts to connect to a busy server, the login redirection feature helps balance the load of the servers by allowing the server to redirect the client connection to less busy servers within the cluster. The login redirection occurs during the login sequence and the client application does not receive notification that it was redirected. Login redirection is enabled automatically when a client application connects to a server that supports this feature.

Note When a client application connects to a server that is configured to redirect clients, the login time may increase because the login process is restarted whenever a client connection is redirected to another server.

Connection migration

The connection migration feature allows a server in a Cluster Edition environment to dynamically distribute load, and seamlessly migrate an existing client connection and its context to another server within the cluster. This feature enables the Cluster Edition environment to achieve optimal resource utilization and decrease computing time. Because migration between servers is seamless, the connection migration feature also helps create a high availability (HA), zero-downtime environment. Connection migration is enabled automatically when a client application connects to a server that supports this feature.

Note Command execution time may increase during server migration. Sybase recommends that you increase the command timeouts accordingly.

Connection failover in Cluster Edition

Connection failover allows a client application to switch to an alternate Adaptive Server if the primary server becomes unavailable due to an unplanned event, like power outage or a socket failure. In the Adaptive Server Cluster Edition, client applications can failover numerous times to multiple servers using dynamic failover addresses.

With high availability enabled, the client application does not need to be configured to know the possible failover targets. Adaptive Server keeps the client updated with the best failover list based on cluster membership, logical cluster usage and load distribution. During failover, the client refers to the ordered failover list while attempting to reconnect. If the driver successfully connects to a server, the driver internally updates the list of host values based on the list returned. Otherwise, the driver throws a connection failure exception.

See “Using failover in high availability systems” on page 73.

Enabling Cluster Edition connection failover

Using the Adaptive Server ODBC Driver user interface (Windows only)

You can enable the Cluster Edition connection failover in the Adaptive Server ODBC Driver through its user interface.

❖ **Using the user interface to enable extended failover**

1 Open the Adaptive Server Enterprise dialog box.

2 Go to the Connection tab.

3 Select Enable High Availability.

4 (Optional) Enter alternate servers and ports in the Alternate Servers field using this format:

```
server1:port1,server2:port2,...,serverN:portN;
```

In establishing a connection, the Adaptive Server ODBC Driver first attempts to connect to the primary host and port defined in the General tab of the Adaptive Server Enterprise dialog box. If Adaptive Server ODBC Driver fails to establish a connection, it then searches through the list of hosts and ports specified in the Alternate Servers field.

Using the Adaptive Server ODBC Driver connection string

To use the connection string to enable the connection failover in Adaptive Server ODBC Driver, set the HASession connection string property to 1. You can use SQLDriverConnect to specify a connection string. For example:

```
Driver=AdaptiveServerEnterprise;server=server1;
port=port1;UID=sa;PWD=;HASession=1;
AlternateServers=server2:port2,...,serverN:portN;
```

The preceding example defines server1 and port1 as the primary server and port. If Adaptive Server ODBC Driver fails to establish connection to the primary server, and alternate servers are defined, it searches through the ordered list of servers and ports specified in the Alternate Servers field until a connection is established or until the end of the list is reached.

Using the unixODBC Driver Manager (UNIX only)

If you are linking to the unixODBC Driver Manager, edit the Adaptive Server ODBC datasource template, *odbc.ini*, and reinstall the datasource using the unixODBC command line tool:

```
# odbcinst -i -s -f dsn_template_file
```

where *dsn_template_file* is the complete path to the Adaptive Server ODBC datasource template file.

Using the Adaptive Server ODBC Driver or the Sybase iAnywhere ODBC Driver Manager

If you are directly linking to the Adaptive Server ODBC Driver or the Sybase iAnywhere ODBC Driver Manager, modify the *odbc.ini* file to add the alternate servers. For example:

```
ODBC Data Source UserID=sa
Password= Driver=Adaptive
Server Enterprise Server=sampleserver
Port=4100
Database=pubs2
```

```
UseCursor=1
HASession=1
AlternateServers=server2:port2,server3:port3;
```

Note The list of alternate servers specified in the GUI or the connection string is used only during initial connection. After the connection is established with any available instance, and if the client supports high availability, the client receives an updated list of the best possible failover targets from the server. This new list overrides the specified list.

Using distributed transactions

This section describes how you can use Adaptive Server ODBC Driver to participate in two-phase commit transactions. This feature is supported only on Microsoft Windows and requires that Microsoft Distributed Transaction Coordinator (MS DTC) be the transaction coordinator managing two-phase commit.

Sybase supports all of these programming models:

- Applications using MS DTC directly
- Applications using Sybase EAServer
- Applications using Microsoft Transaction Server (MTS) or COM+

Programming for MS DTC

❖ **Programming using Microsoft Distributed Transaction Coordinator (MS DTC)**

1 Connect to MS DTC by using the DtcGetTransactionManager function. For information about MS DTC, see Microsoft Distributed Transaction Coordinator documentation.

2 Call SQLDriverConnect or SQLConnect once for each Adaptive Server connection to establish.

3 Call the ITransactionDispenser::BeginTransaction function to begin an MS DTC transaction and to obtain an OLE Transaction object that represents the transaction.

4 Call SQLSetConnectAttr one or more times for each ODBC connection you want to enlist in the MS DTC transaction. SQLSetConnectAttr must be called with an attribute of SQL_ATTR_ENLIST_IN_DTC and a ValuePtr of the Transaction object (obtained in step 3).

5 Call SQLExecDirect one or more times for each insert or update SQL statement.

6 Call the ITransaction::Commit function to commit the MS DTC transaction. The Transaction object is no longer valid.

To perform a series of MS DTC transactions, repeat steps 3 through 6.

To release the reference to the Transaction object, call the ITransaction::Release function.

To use an ODBC connection with an MS DTC transaction and then use the same connection with a local Adaptive Server transaction, call SQLSetConnectAttr with a ValuePtr of SQL_DTC_DONE to unenlist the connection from the transaction.

Note Also, you can call SQLSetConnectAttr and SQLExecDirect separately for each Adaptive Server, instead of calling them as suggested in steps 4 and 5.

Programming components deployed in Sybase EAServer, MTS, or COM+

The following procedure describes how to create components that participate in distributed transactions in Sybase EAServer, MTS, or COM+.

❖ **Programming components deployed in Sybase EAServer, MTS or COM+**

1 Call SQLDriverConnect once for each Adaptive Server connection you want to establish.

2 Call SQLExecDirect once for each insert or update SQL statement.

3 Deploy your component to MTS, and configure the transaction attributes as needed.

The transaction coordinator creates a distributed transaction as needed, and the component that uses the Adaptive Server ODBC Driver automatically enlists in the global transaction. Then, the transaction coordinator commits or rolls back the distributed transaction.

Connection properties for distributed transaction support

The following describes the Connection properties:

- Distributed Transaction Protocol (DistributedTransactionProtocol) – to specify the protocol used to support the distributed transaction, either XA Interface standard or MS DTC OLE Native protocol, select the Distributed Transaction Protocol in the ODBC Data Source dialog, or set the property DistributedTransactionProtocol = *OLE* native protocol in the connection string. The default is *XA*.
- Tightly Coupled Transaction (TightlyCoupledTransaction) – when a distributed transaction using two resource managers points to the same Adaptive Server, it is a "Tightly Coupled Transaction." Under these conditions, if you do not set this property to 1, the distributed transaction may fail.

To summarize, if you open two database connections to the same Adaptive Server and then enlist these connections in the same distributed transaction, you must set TightlyCoupledTransaction=1. To set this property, select the Tightly Coupled Transaction in the ODBC Data Source dialog box, or pass the property TightlyCoupledTransaction=1 in the connection string.

Warning! Enlistment with SQLSetConnectAttr returns a SQL_ERROR if the connection has already begun a local transaction, either by using SQLSetConnectAttr with the SQL_AUTOCOMMIT_OFF or by executing the BEGIN TRANSACTION statement explicitly using SQLExecDirect.

Using directory services

Directory services allow the Adaptive Server ODBC Driver to get connection and other information from a central LDAP server; then, it uses this information to connect to an Adaptive Server. It uses a property called Directory Service URL (DSURL), that indicates which LDAP server to use.

LDAP as a directory service

Lightweight Directory Access Protocol (LDAP) is an industry standard for accessing directory services. Directory services allow components to look up information by a distinguished name (DN) from an LDAP server that stores and manages server, user, and software information that is used throughout the enterprise or over a network.

LDAP defines the communication protocol and the contents of messages exchanged between clients and servers. The LDAP server can store and retrieve information about:

- Adaptive Server, such as IP address, port number, and network protocol
- Security mechanisms and filters
- High-availability companion server name

See the *Adaptive Server Enterprise System Administration Guide* for more information.

You can use these access restrictions when configuring the LDAP server:

- Anonymous authentication – all data is visible to any user.
- User name and password authentication – Adaptive Server uses the default user name and password from the file.

User name and password authentication properties establish and end a session connection to an LDAP server.

Note The LDAP server can be located on a different platform from the one on which Adaptive Server or the clients are running.

Using directory services

To use directory services, add the following properties to ConnectString:

```
DSURL=ldap://SYBLDAP:389/dc=sybase,dc=com??one?sybase
Servername=MANGO
```

The URL is an LDAP URL and uses LDAP libraries to resolve the URL.

To support high availability on the LDAP server, the DSURL accepts multiple URLs, separated by a semicolon:

```
DSURL={ldap://SYBLDAP:389/dc=sybase,dc=com??one?sybase
```

```
Servername=MANGO};
```

The provider attempts to get the properties from the LDAP servers in the order specified. For example:

```
ldap://hostport/dn[?attrs[?scope[?filter[?userdn?userp
ass]]]]
```

where:

- *hostport* is a host name with an optional `portnumber`, for example, `SYBLDAP1:389`.
- *dn* is the search base, for example, `dc=sybase,dc-com`.
- *attrs* is a comma-separated list of attributes requested from the LDAP server. You must leave it blank. Data Provider requires all attributes.
- *scope* is one of three strings:
  - *base* (the default) searches the base.
  - *one* searches immediate children.
  - *sub* searches the sub-tree.
- *filter* is the search filter, which is, generally, the sybaseServername. You can leave the search filter blank and set the datasource or server name property in the ConnectionString.
- *userdn* is the user's distinguished name (dn). If the LDAP server does not support anonymous login, you can set the user's dn here, or you can set the DSPrincipal property in the ConnectionString.
- *userpass* is the password. If the LDAP server does not support anonymous login, you can set the password here, or you can set the DSPassword property in the ConnectionString.

The URL can contain *sybaseServername*, or you can set the property Server Name to the service name of the LDAP Sybase server object.

The following properties are useful when using Directory Services:

- DSURL – set to LDAP URL. The default is an empty string.
- Server – the service name of the LDAP Sybase server object. The default is an empty string.
- DSPrincipal – the user name to log in to the LDAP server if it is not a part of DSURL and the LDAP server does not allow anonymous access.

- DSPassword or Directory Service Password – the password to authenticate on the LDAP server if it is not a part of DSURL and the LDAP server does not allow anonymous access.

Enabling directory services

This section describes how to enable directory services on the platform you are using.

Microsoft Windows

❖ **Enabling directory services on Microsoft Windows**

1 Launch the ODBC DataSource Administrator.

2 Select the datasource that you want to use and choose Configure.

3 Click the Connection tab.

4 In the Directory Service Information group, provide the complete URL in the URL field. You can also provide the user name in the User ID field and the LDAP Service Name in the Service Name Field, to log in to the LDAP server.

Linux

❖ **Enabling directory services for Linux**

Install the following packages:

- openldap-2.0 (runtime)
- openldap-devel-2.0

The Adaptive Server ODBC Driver attempts to load a file named *libldap.so*, but to create a symbolic link with this file, you must install the openldap-devel package. The openldap runtime package does not create the symbolic link.

If you are linking to the unixODBC Driver Manager:

1 Edit the Adaptive Server ODBC datasource template, *odbc.ini*.

2 Reinstall the datasource using the unixODBC command line tool:

```
# odbcinst -i -s -f <dsn template file>
```

where *dsn template file* is the complete path to the Adaptive Server ODBC datasource template file.

If you are directly linking to the Adaptive Server ODBC Driver, modify the *odbc.ini* file. For example:

```
[sampledsn]
Description=Sybase ODBC Data Source
UserID=sa
Password= Driver=Adaptive
Server Enterprise Server=sampleserver
Port=4100
Database=pubs2
UseCursor=1
DSURL=ldap://SYBLDAP1:389/dc=sybase,dc=com??one?sybase
Servername=MANGO
```

Apple Mac OS X

❖ **Enabling directory services for Apple Mac OS X**

1 Launch the iODBC Administrator from Applications | Utilities.

2 Select the datasource you want to use and add two new keyword value pairs:

```
DSURL=ldap://SYBLDAP1:389/dc=sybase,dc=com??one?syb
aseServername=MANGO
```

Bookmark and bulk support

Sybase supports bookmarks and SQL bulk operations for the ODBC Driver.

Bulk insertions that use SQLBulkOperations with the option of SQL_ADD and cursor positioned updates and deletions using SQLSetPos (SQL_UPDATE, SQL_DELETE, SQL_POSITION). For instructions on using SQL_ADD and SQLSetPos, refer to the *ODBC Programmer's Reference* found in the Microsoft Developer Network library at http://msdn.microsoft.com.

Bulk-load support

The Adaptive Server ODBC Driver supports bulk-load interface for fast insertions of large sets of rows to Adaptive Server. This interface is invoked when SQLBulkOperations is used with the SQL_ADD option. Two types of bulk loading are supported:

- Array Inserts – you can use this type of bulk-loading within a single or multistatement transaction; the database connection can be set to autocommit off.
- Bulk Copy – this is supported only in single statement transactions, and you must to ensure that:
  - The database connection is set to autocommit on.
  - The select into/bulkcopy option on Adaptive Server is turned on.

  If the target table meets the criteria for high-speed version of bulk copy, Adaptive Server inserts the rows using this version of bulk copy.

Note Using the bulk copy mode with the select into/bulkcopy option enabled affects the recoverability of the database. After the bulk copy operation is complete, the system administrator must dump the database to ensure its future recoverability.

The following table guides you on what bulk-load option to use.

Table 3-1: Bulk-load option usage

Use case	Additional consideration	Bulk-load option to use	Note
Insertion of single or small number of rows.		None	

Use case	Additional consideration	Bulk-load option to use	Note
Insertion of large batch of rows.	The batch is part of a multistatement transaction.	Array Inserts	Rows are inserted faster than when bulk load is disabled.
	You cannot enable the Adaptive Server select into or bulkcopy option because of recoverability considerations.	Array Inserts	Rows are inserted faster than when bulk load is disabled.
	The batch is a single transaction and the Adaptive Server select into/bulkcopy option is enabled.	Bulk Copy	Adaptive Server can use high-speed bulk copy, which is faster than array inserts. The performance of Bulk Copy is still slightly faster than Array Inserts even if high-speed bulk copy is not used.

See the *Adaptive Server Enterprise Utility Guide* for information about the implications of enabling select into/bulkcopy and the conditions under which high-speed or logged bulk copy is used.

ENABLEBULKLOAD connection property

Enable or disable bulk-load support using the ENABLEBULKLOAD connection property:

- 0 – the default value, which disables bulk load.
- 1 – enables bulk load using array insert.
- 2 – enables bulk load using the bulk copy interface.

Performance considerations

Although this feature does not require special configuration on the server, a larger page size and network packet size significantly improves performance. Depending on the client memory, using larger batches also improves performance.

Limitations

Computed and encrypted columns are not supported. Also, triggers are ignored on tables selected for bulk loading.

Enabling bulk load

❖ **Enabling bulk load using the ODBC Data Source Administrator user interface**

1 Open the Data Source Name (DSN) Configure window from the ODBC Data Source Administrator.

2 Select the Advanced tab.

3 Select the appropriate option under “Enable Bulk Load.”

The default value of ENABLEBULKLOAD is 0, which means insert commands are used.

❖ **Enabling bulk load using the ODBC connection string**

1 Use SQLDriverConnect to specify a connection string.

2 Set the ENABLEBULKLOAD connection string property to 0, 1, or 2, as appropriate. For example:

```
Driver=AdaptiveServerEnterprise;server=server1;
port=port1;UID=sa;PWD=;ENABLEBULKLOAD=1;
```

Support for Mainframe Connect and DirectConnect for z/OS Option

Adaptive Server ODBC Driver by Sybase supports Mainframe Connect DirectConnect™ for z/OS Option through the ServiceName and BackEndType configuration properties.

ServiceName configuration property

The ServiceName property specifies the service name used to connect to the host. ServiceName can hold any string value. Its default value is an empty string ("").

BackEndType configuration property

The BackEndType configuration property specifies the target type of the DSN you are defining. The ODBC Driver can communicate with multiple targets including database systems like Adaptive Server and gateways to non-Sybase database systems. Currently, the Adaptive Server ODBC Driver supports these back-end types:

- ASE (default)
- MFC Gatewayless
- DC DB2 Access Service

- DC TRS

DSN Migration tool

The ODBC DSN Migration tool can help you migrate from the Data Direct ODBC driver to the Adaptive Server ODBC Driver by Sybase.

Using the migration tool

The dsnmigrate tool uses switches to control which DSNs are migrated. From the command line, enter:

```
dsnmigrate.exe [/?|/help] [l|/ul|/sl][/a|/ua|/sa]
   [[/dsn|/udsn|/sdsn]=dsn] [/suffix=suffix]
```

All DSNs that are converted are renamed to “<dsn>-backup” before the conversion is completed. When the new Sybase DSNs are created and the conversion is completed, the name is changed to“<dsn>,” which allows existing applications to continue to run without any modifications.

Conversion switches

Table 3-2 lists and describes the switches used in the conversion.

Table 3-2: Conversion switches

Switches	Description of results
/?,/h,/help	Lists and describes the switches. The list also appears if you call dsnmigrate with no command line arguments.
/l	Displays a list of all Sybase Data Direct user and system DSNs.
/ul	Displays a list of all Sybase Data Direct user DSNs.
/sl	Displays a list of all Sybase Data Direct system DSNs.
/a	Converts all Sybase Data Direct user and system DSNs.
/ua	Converts all Sybase Data Direct user DSNs.
/sa	Converts all Sybase Data Direct system DSNs.
/dsn	Converts specific Sybase Data Direct user or system DSNs.
/udsn	Converts specific Sybase Data Direct user DSNs.
/sdsn	Converts specific Sybase Data Direct system DSNs.
dsn	The name of the DSN to be converted.
/suffix	An optional switch that changes the way DSNs are named. If this switch is used, the original DSN is retained and the new DSN is named "<dsn>-<suffix>."
suffix	The suffix that is used to name the new DSN.

Password encryption

By default, the Adaptive Server ODBC Driver sends plain-text passwords over the network to Adaptive Server for authentication. However, the Adaptive Server ODBC Driver also supports symmetrical and asymmetrical password encryption; you can change the default behavior of and encrypt your password before it is sent over the network.

The symmetrical encryption mechanism uses the same key to encrypt and decrypt the password, whereas an asymmetrical encryption mechanism uses one key (the public key) to encrypt the password and another key (the private key) to decrypt the password. Because the private key is not shared across the network, the asymmetrical encryption is considered more secure than symmetrical encryption. When password encryption is enabled, and the server supports asymmetric encryption, this format is used instead of symmetric encryption.

You can encrypt login and remote passwords using the Sybase Common Security Infrastructure (CSI). CSI 2.6 complies with the Federal Information Processing Standard (FIPS) 140-2.

Enabling password encryption

To enable password encryption, you must set the EncryptPassword connection property, which specifies whether the password is transmitted in encrypted format. When password encryption is enabled, the password is sent over the wire only after a login is negotiated; the password is first encrypted and then sent. The EncryptPassword values are:

- 0 – use plain text password. This is the default value.
- 1 – use encrypted password. If encryption is not supported, return an error message.
- 2 – use encrypted password. If encryption is not supported, use plain text password.

Note To use the password encryption feature, you must have a server that supports password encryption, such as Adaptive Server 15.0.2. Asymmetrical encryption requires additional processing time and may cause a slight delay in login time.

Password encryption on Microsoft Windows

❖ **Encrypting passwords on Microsoft Windows**

1 Launch the ODBC DataSource Administrator.

2 Select the datasource you want to use and choose Configure.

3 Click the Advanced tab.

4 Select EncryptPassword.

You can use the EncryptPassword connection property in a call to `SQLDriverConnect`.

Note You can only use the user interface to set EncryptPassword to 0 or 1. To set EncryptPassword to 2, use a connection string.

Password encryption on UNIX

To link to the unixODBC Driver Manager, edit the datasource template and reinstall the datasource using the unixODBC command line tool:

```
# odbcinst -i -s -f dsn template file
```

where *dsn template file* is the complete path to the Adaptive Server ODBC datasource template file.

If you are directly linking to the Adaptive Server ODBC Driver or the Sybase iAnywhere ODBC Driver Manager, modify the *odbc.ini* file.

This is an example of an *odbc.ini* datasource template file:

```
[sampledsn]
Description=Sybase ODBC Data Source
UserID=sa
Password=
Driver=Adaptive Server Enterprise
Server=sampleserver
Port=4100
Database=pubs2
UseCursor=1
EncryptPassword=1
```

Password encryption on Apple Mac OS X

❖ **Encrypting passwords on Mac OS X**

1 Launch the iODBC Administrator from Applications | Utilities.

2 Select the datasource you want to use and add a new keyword value pair. For example:

```
EncryptPassword=1
```

Password expiration handling

Every company has a specific set of password policies for its database system. Depending on the policies, the password expires at a specific date and time. Unless the password is reset, the Adaptive Server ODBC Driver connected to a database throws password expired errors and suggests that the user change the password using isql. The password expiration handling feature allows users to change their expired passwords using the Adaptive Server ODBC Driver.

Changing the password through the connection string properties

Set these two connection string properties:

- OldPassword – the current password. If OldPassword contains a value that is not null or an empty string, the current password is changed to the value contained in PWD.
- PWD – contains the value of the password. If OldPassword is set and is not null, PWD contains the value of the current password. If OldPassword does not exist, or is null, PWD contains the value of the new password.

Changing the password through a dialog box

A change password dialog is activated when "SQLDriverConnect with SQL_DRIVER_PROMPT" is set to true. In this dialog, enter the current password and the new password.

Using SSL

Secure Sockets Layer (SSL) is an industry standard for sending wire- or socket-level encrypted data over client-to-server and server-to-server connections. Before the SSL connection is established, the server and the client negotiate and agree upon a secure encrypted session. This is called the "SSL handshake."

Note Additional overhead is required to establish a secure session, because data increases in size when it is encrypted; it also requires additional computation to encrypt or decrypt information. Under normal circumstances, the additional I/O accrued during the SSL handshake can make user login 10 to 20 times slower.

SSL handshake

When a client application requests a connection, the SSL-enabled server presents its certificate to prove its identity before data is transmitted. Essentially, the SSL handshake consists of the following steps:

1 The client sends a connection request to the server. The request includes the SSL (or Transport Layer Security, TLS) options that the client supports.

2 The server returns its certificate and a list of supported cipher suites, which includes SSL/TLS support options, the algorithms used for key exchange, and digital signatures. Cipher suites are preferential lists of key-exchange algorithms, hashing methods, and encryption methods used by the SSL protocol.

3 A secure, encrypted session is established when both client and server have agreed upon a cipher suite.

Cipher suites

During the SSL handshake, the client and server negotiate a common security protocol through a cipher suite.

By default, the strongest cipher suite supported by both the client and the server is the cipher suite used for the SSL-based session. Server connection attributes are specified in the connection string or through directory services such as LDAP.

The Adaptive Server ODBC Driver and Adaptive Server support the cipher suites that are available with the SSL Plus library API and the cryptographic engine, Security Builder, both from Certicom Corp.

Note The following list of cipher suites conform to the Transport Layer Security (TLS) specification, which is an enhanced version of SSL 3.0, and an alias for the SSL version 3.0 cipher suites.

These are the cipher suites, ordered from the strongest to the weakest, supported in Adaptive Server OBDC Driver:

- TLS_RSA_WITH_3DES_EDE_CBC_SHA
- TLS_RSA_WITH_RC4_128_SHA
- TLS_RSA_WITH_RC4_128_MD5
- TLS_DHE_DSS_WITH_3DES_EDE_CBC_SHA
- TLS_DHE_DSS_WITH_RC4_128_SHA
- TLS_DHE_RSA_WITH_3DES_EDE_CBC_SHA
- TLS_RSA_WITH_DES_CBC_SHA
- TLS_DHE_DSS_WITH_DES_CBC_SHA
- TLS_DHE_RSA_WITH_DES_CBC_SHA
- TLS_RSA_EXPORT1024_WITH_DES_CBC_SHA
- TLS_RSA_EXPORT1024_WITH_RC4_56_SHA
- TLS_DHE_DSS_EXPORT1024_WITH_RC4_56_SHA
- TLS_DHE_DSS_EXPORT1024_WITH_DES_CBC_SHA
- TLS_RSA_EXPORT_WITH_RC4_40_MD5
- TLS_RSA_EXPORT_WITH_DES40_CBC_SHA

- TLS_DHE_DSS_EXPORT_WITH_DES40_CBC_SHA
- TLS_DHE_RSA_EXPORT_WITH_DES40_CBC_SHA

For more specific information about the SSL handshake and the SSL/TLS protocol, see the Internet Engineering Task Force Web site at http://www.ietf.org.

For a complete description of cipher suites, go to the IETF organization Web site at http://www.ietf.org/rfc/rfc2246.txt.

SSL security levels in Adaptive Server ODBC Driver

In Adaptive Server ODBC Driver, SSL provides the following levels of security:

- When the SSL session is established, user name and password are transmitted over a secure, encrypted connection.
- When establishing a connection to an SSL-enabled server, the server authenticates itself—proves that it is the server you intended to contact—and an encrypted SSL session begins before any data is transmitted.
- A comparison of the server certificate's digital signature can determine if any information received from the server was modified in transit.

Validating the server by its certificate

Any Adaptive Server OBDC Driver client connection to an SSL-enabled server requires have a certificate file, which consists of the server's certificate and an encrypted private key. The certificate must also be digitally signed by a signing/certification authority (CA). Adaptive Server OBDC Driver client applications establish a socket connection to Adaptive Server similar to the way that existing client connections are established. Before any user data is transmitted, an SSL handshake occurs on the socket when the network transport-level connect call completes on the client side and the accept call completes on the server side.

To make a successful connection to an SSL-enabled server:

1 The SSL-enabled server must present its certificate when the client application makes a connection request.

2 The client application must recognize the CA that signed the certificate. A list of all "trusted" CAs is in the "trusted roots file."

The trusted roots file

The list of known and trusted CAs is maintained in the trusted roots file. The trusted roots file is similar in format to a certificate file, except that it contains certificates for CAs known to the entity (such as client applications, servers, network resources, and so on). The system security officer adds and deletes trusted CAs using a standard ASCII-text editor.

The application program specifies the location of the trusted roots file using the TrustedFile=*trusted file path* property in the ConnectString. A trusted roots file with the most widely used CAs (thawte, Entrust, Baltimore, VeriSign, and RSA) is installed in a file located at *$SYBASE/config/trusted.txt*.

For more information about certificates, see the *Open Client Client-Library/C Reference Manual*.

Enabling SSL connections

To enable SSL for Adaptive Server ODBC Driver, add Encryption=ssl and TrustedFile=<*filename*> (where *filename* is the path to the *trusted roots* file) to the ConnectString. The Adaptive Server ODBC Driver then negotiates an SSL connection with the Adaptive Server.

Note Adaptive Server must be configured to use SSL. For more information on SSL, see the *Adaptive Server Enterprise System Administration Guide*.

Microsoft Windows

Before you enable SSL, you must set the TrustedFile property in the connection string to the file name of the trusted roots file. The file name should contain the path to the file as well.

❖ **Enabling SSL connections**

1 Set the Encryption property in the connection string to ssl.

2 Launch the ODBC DataSource Administrator.

3 Select the datasource name (DSN) you would like to use and choose Configure.

4 Click the Connection tab.

5 Select UseSSL in the Secure Socket Layer Group.

6 Provide the complete path to the trusted roots file in the TrustedFile field.

UNIX

❖ **Enabling SSL connections**

1 Start the unixODBC Driver Manager odbcinst utility.

2 Open an existing datasource template or create a new one.

3 To the datasource template, add:

```
Encryption=ssl

TrustedFile=<filename>line
```

4 Reinstall the datasource using:

```
#  odbcinst -i -s -f dsn template file
```

where *dsn template file* is the complete path to the Adaptive Server ODBC datasource template file.

If you are linking directly to the Adaptive Server ODBC Driver or the Sybase iAnywhere ODBC Driver Manager, modify the *odbc.ini* file.

This is an example of the *odbc.ini* datasource template file:

```
[sampledsn]
Description=Sybase ODBC Data Source
UserID=sa
Password=
Driver=Adaptive Server Enterprise
Server=sampleserver
Port=4100
Database=pubs2
UseCursor=1
Encryption=ssl
TrustedFile=<SYBASE>/config/trusted.txt
```

Apple Mac OS X

❖ **Enabling SSL connections on Apple Mac OS X**

1 Launch the iODBC Administrator from Applications | Utilities.

2 Select the datasource you want to use and add two new keyword value pair:

```
Encryption=ssl
TrustedFile=<filename>
```

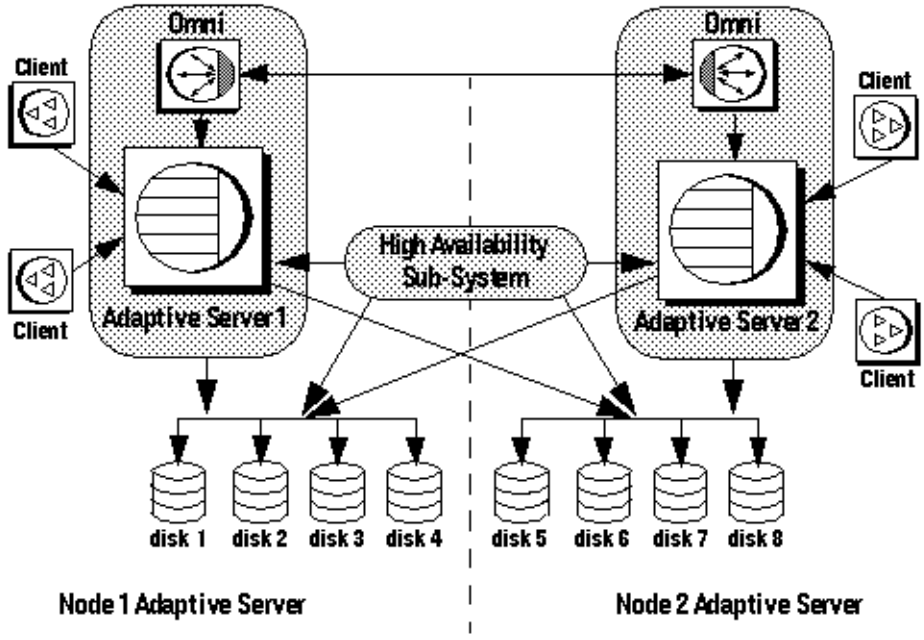
where <*filename*> is the complete path to the trusted roots file.

Using failover in high availability systems

A high availability cluster includes two or more machines that are configured so that if one machine (or application) is interrupted, the second machine assumes the workload of both machines. Each of these machines is called one node of the high availability cluster. A high availability cluster is used in an environment that must always be available, such as a banking system to which clients must connect continuously, 365 days a year.

The machines in Figure 3-1 are configured so that each machine can read the other machine's disks, although not at the same time. (All of the disks that are failed-over should be shared disks).

Figure 3-1: High availability cluster using failover



For example, if Adaptive Server 1 is the primary companion server, and it fails, Adaptive Server 2, as the secondary companion server, reads its disks (disks 1 – 4) and manages any databases on them until Adaptive Server 1 can be restarted. Any clients connected to Adaptive Server 1 are automatically connected to Adaptive Server 2.

Failover allows Adaptive Server to work in a high availability cluster in active-active or active-passive configuration.

During failover, clients connected to the primary companion using the failover property automatically reestablish their network connections to the secondary companion. Failover can be enabled by setting the connection property HASession to "1" (default value is "0"). If this property is not set, the session failover does not occur, even if the server is configured for failover. You must also set SecondaryServer (the IP address or the machine name of the secondary Adaptive Server) and SecondaryPort (the port number of the secondary Adaptive Server) properties. See *Adaptive Server Enterprise Using Sybase Failover in a High Availability System* for information about configuring your system for high availability.

When the Adaptive Server ODBC Driver detects a connection failure with the primary Adaptive Server, it first tries to reconnect to the primary. If it cannot reconnect, it assumes that a failover has occurred. Then, it automatically tries to connect to the secondary Adaptive Server using the connection properties set in SecondaryServer, and SecondaryPort.

Confirming a successful failover

If a connection to the secondary server is established, the Adaptive Server ODBC Driver returns SQL_ERROR for the function return code. To confirm a successful failover, examine the SQLState and NativeError messages for values of "08S01" and "30130" respectively. The error message returned on such failover is:

```
"Connection to Sybase server has been lost, you have
been successfully connected to the next available HA
server. All active transactions have been rolled back."
```

You can access these values by calling SQLGetDiagRec on the StatementHandle. Then, the client must reapply the failed transaction with the new connection. If failover occurs while a transaction is open, only changes that were committed to the database before failover are retained.

Verifying an unsuccessful failover

If the connection to the secondary server is *not* established, the Adaptive Server ODBC Driver returns SQL_ERROR for the function return code. To confirm that failover did *not* occur, examine the SQLState and NativeError for values of "08S01" and "30131." The error message returned on an unsuccessful failover is:

```
"Connection to Sybase server has been lost,
connection to the next available HA server
also failed. All active transactions
have been rolled back".
```

You can access these values by calling SQLGetDiagRec on the StatementHandle.

To code for a failover:

```
/* Declare required variables */
....
/* Open Database connection */
....
/* Perform a transaction */
...
/* Check return code and handle failover */
if( retcode == SQL_ERROR )
{
   retcode = SQLGetDiagRec(stmt, 1,
      sqlstate,&NativeError, errmsg,100, NULL );
   if(retcode == SQL_SUCCESS ||
      retcode == SQL_SUCCESS_WITH_INFO)
   {
        if(NativeError == 30130 )
        {
        /* Successful failover retry transaction*/
        ...
        }
     else if (NativeError == 30131)
     {
        /* Failover failed. Return error */
        ...
     }
   }
}
```

Microsoft Windows

❖ **Using failover on Microsoft Windows**

1. Launch the ODBC DataSource Administrator.
2. Select the datasource you want to use and choose Configure.
3. Click the Connection tab.
4. Select Enable High Availability in the High Availability Information Group.
5. Provide the failover server name in the Server Name field.
6. Provide the failover server port in the Server Port field.

UNIX

If you are linking to the unixODBC Driver Manager, edit the datasource template and reinstall the datasource using the unixODBC command line tool:

```
#  odbcinst -i -s -f dsn template file
```

where *dsn template file* is the complete path to the Adaptive Server ODBC datasource template file.

If you are directly linking to the Adaptive Server ODBC Driver or Sybase iAnywhere ODBC Driver Manager, modify the *odbc.ini* file.

This is an example of the *odbc.ini* datasource template file:

```
[sampledsn]
Driver=Adaptive Server Enterprise
Server=sampleserver
Port=4100
UserID=sa
Password=
Database=pubs2
HASession=1
SecondaryHost=failoverserver
SecondaryPort=5000
```

Apple Mac OS X

❖ **Using failover on Apple Mac OS X**

1 Launch the iODBC Administrator from Applications | Utilities.

2 Select the datasource you want to use and add three new keyword value pairs:

```
HASession=1
SecondaryHost=failoverserver
SecondaryPort=5000
```

Kerberos authentication

Kerberos is an industry standard network authentication system that provides simple login authentication as well as mutual login authentication. It is used for single sign-on across various applications in extremely secure environments. Instead of passing passwords around the network, a Kerberos server holds encrypted versions of the passwords for users as well as available services.

In addition, Kerberos uses encryption to provide confidentiality and data integrity.

Adaptive Server and the Adaptive Server ODBC Driver provide support for Kerberos connections. The Adaptive Server ODBC driver specifically supports MIT, CyberSafe, and Active Directory (key distribution centers, called KDCs).

Process overview

The Kerberos authentication process works as follows:

1 A client application requests a “ticket” from the Kerberos server to access a specific service.

2 The Kerberos server returns the ticket, which contains two packets, to the client: The first packet is encrypted using the user password. The second packet is encrypted using the service password. Inside each of these packets is a “session key.”

3 The client decrypts the user packet to get the session key.

4 The client creates a new authentication packet and encrypts it using the session key.

5 The client sends the authentication packet and the service packet to the service.

6 The service decrypts the service packet to get the session key and decrypts the authentication packet to get the user information.

7 The service compares the user information from the authentication packet with the user information that was also contained in the service packet. If the two match, the user has been authenticated.

8 The service creates a confirmation packet that contains service specific information, as well as validation data contained in the authentication packet.

9 The service encrypts this data with the session key and returns it to the client.

10 The client uses the session key obtained from the user packet it received from Kerberos to decrypt the packet and validates that the service is what it claims to be.

In this way, the user and the service are mutually authenticated. All future communication between the client and the service (in this case, the Adaptive Server database server) will be encrypted using the session key. This successfully protects all data sent between the service and client from unwanted viewers.

Requirements

To use Kerberos as an authentication system, you must configure Adaptive Server Enterprise to delegate authentication to Kerberos. See the *Adaptive Server Enterprise System Administration Guide*.

If Adaptive Server has been configured to use Kerberos, any client that interacts with Adaptive Server must have a Kerberos client library installed. This varies for operating system vendors, as follows:

- On Microsoft Windows, the Active Directory client library comes installed with the operating system.
- CyberSafe and MIT client libraries are available for Microsoft Windows and Linux.

For additional information, refer to vendor documentation.

Enabling Kerberos authentication

To enable Kerberos authentication for the Adaptive Server ODBC Driver, add the following connection properties:

```
AuthenticationClient=<one of 'mitkerberos'
or 'cybersafekerberos' or 'activedirectory'>
and ServerPrincipal=<Adaptive Server name>
```

where <*Adaptive Server name*> is the logical name or the principal as configured in the key distribution center (KDC). The Adaptive Server ODBC Driver uses this information to negotiate Kerberos authentication with the configured KDC and Adaptive Server.

The Kerberos client libraries are compatible across various KDCs. For example, on Linux you can set AuthenticationClient equal to mitkerberos, even if your KDC is a Microsoft Active Directory.

If you want the Kerberos client to look for the Ticket Granting Ticket (TGT) in another cache, you might want to specify the userprincipal property.

If you use SQLDriverConnect with the SQL_DRIVER_NOPROMPT, ConnectString appears similar to the following:

```
"Driver=Adaptive Server Enterprise;UID=sa;
PWD='';Server=sampleserver;
Port=4100;Database=pubs2;
AuthenticationClient=mitkerberos;
ServerPrincipal=MANGO;"
```

Microsoft Windows

❖ **Enabling Kerberos for login authentication on Microsoft Windows**

1 Start the Microsoft Windows ODBC Data Source administrator.

2 Select the Sybase Adaptive Server Enterprise ODBC Driver.

3 Select the User DSN/ System DSN tab and click the datasource that you would like to modify, or choose Add New Data Source.

4 On the Security tab, select Use Active Directory under the Kerberos Authentication Client.

5 Enter the name of the server principal in the Server Principal edit box. This name should match the name of the Adaptive Server configured in the KDC.

UNIX

❖ **Enabling Kerberos for login authentication on UNIX**

If you are linking to the UNIX ODBC Driver Manager:

1 Open an existing datasource, or create a new datasource template.

2 Add the following to the datasource template:

```
Authentication= mitkerberos
(or cybersafekerberos) ServerPrincipal=<MANGO>
to enable Kerberos Login Authentication.
```

where: <*MANGO*> is the name of the principal server used to authenticate sign-ons.

3 Reinstall the datasource using the odbcinst utility at the command line:

```
odbcinst -i-s  -f ${datasourcetemplatefile}
```

If you are linking directly to the Adaptive Server ODBC Driver or the Sybase iAnywhere ODBC Driver Manager, modify the *odbc.ini* file directly.

Following is an example of how the *odbc.ini* datasource template file should look after you modify it:

```
[sampledsn]
Description=Sybase ODBC Data Source
UserID=sa
Password=
Driver=Adaptive Server Enterprise
Server=sampleserver
Port=4100
Database=pubs2
UseCursor=1
AuthenticationClient=mitkerberos
ServerPrincipal=MANGO
```

Obtaining an initial ticket from the key distribution center

To use Kerberos authentication, you must generate an initial ticket called Ticket Granted Ticket (TGT) from the key distribution center. The procedure to obtain this ticket depends on the Kerberos libraries being used. For more information, refer to the vendor documentation.

❖ Generating TGTs for the MIT Kerberos client library

1 Start the kinit utility at the command line:

```
% kinit
```

2 Enter the kinit user name, such as *your_name*@YOUR.REALM.

3 Enter the password for *your_name*@YOUR.REALM, such as my_password. When you enter your password, the kinit utility submits a request to the Authentication Server for a TGT.

The password is used to compute a key, which in turn is used to decrypt part of the response. The response contains the confirmation of the request, as well as the session key. If you entered your password correctly, you now have a TGT.

4 Verify that you have a TGT by entering the following at the command line:

```
% klist
```

The results of the klist command should be:

```
Ticket cache: /var/tmp/krb5cc_1234
Default principal: your_name@YOUR.REALM
Valid starting       Expires              Service principal
24-Jul-95 12:58:02   24-Jul-95 20:58:15   krbtgt/YOUR.REALM@YOUR.REALM
```

Explanation of results

Ticket cache The ticket cache field tells you which file contains your credentials cache.

Default principal The default principal is the login of the person who owns the TGT (in this case, you).

Valid starting/Expires/Service principal The remainder of the output is a list of your existing tickets. Because this is the first ticket you have requested, there is only one ticket listed. The service principal (`krbtgt/YOUR.REALM@YOUR.REALM`) shows that this ticket is a TGT. Note that this ticket is good for approximately 8 hours.

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