Developer Guide: Android Object API Applications

Sybase Unwired Platform 2.1 ESD #1

Contents

Getting Started with Android Development

Use advanced Sybase® Unwired Platform features to create applications for Android devices. The audience is advanced developers who may be new to Sybase Unwired Platform.

This guide describes requirements for developing a device application for the platform, how to generate application code, and how to customize the generated code using the Client Object API. Also included are task flows for the development options, procedures for setting up the development environment, and Client Object API documentation.

Companion guides include:

- *Sybase Unwired WorkSpace – Mobile Business Object* Development
- *Troubleshooting for Sybase Unwired Platform*.
- *A complete Client Object API reference is available in the Unwired Platform installation directory* `<UnwiredPlatform_InstallDir>\MobileSDK\ObjectAPI\apidoc`.
- *Fundamentals* contains high-level mobile computing concepts, and a description of how Sybase Unwired Platform implements the concepts in your enterprise.

Object API Applications

Object API applications are customized, full-featured mobile applications that use mobile business objects (MBOs) to facilitate connection with a variety of enterprise systems and leverage synchronization to support offline capabilities.

The Object API application model enables developers to write custom code — C#, Java, or Objective-C, depending on the target device platform — to create device applications.

Development of Object API applications provides the most flexibility in terms of leveraging platform specific services, but each application must be provisioned individually after being compiled, even for minor changes or updates.

Development involves both server-side (MBO development) and client-side (native application) components. Unwired Server brokers data synchronization and transaction processing between the server and the client components.

- Server-side components address the interaction between the enterprise information system (EIS) data source and the data cache. EIS data subsets and business logic are encapsulated in artifacts, called mobile business objects, that are packaged and deployed to Unwired Server.
- Client-side components are built into the mobile application and address the interaction between the data cache and the mobile device data store. This can include synchronizing data with server, offline data access capabilities, data change notification.

These applications:

- Allow users to connect to data from a variety of EIS systems, including SAP® systems.
- Build in more complex data handling and logic.
- Leverage data synchronization to optimize and balance device response time and need for real-time data.
- Ensure secure and reliable transport of data.

Best Uses for Object API Applications

Synchronization applications provide operation replay between the mobile device, the middleware, and the back-end system. Custom native applications are designed and built to suit specific business scenarios from the ground up, or start with a bespoke application and be adapted with a large degree of customization.

Cache Synchronization

Cache synchronization allows mapping mobile data to SAP Remote Function Calls (RFCs) using Java Connector (JCO) and to other non-SAP data sources such as databases and Web services. When Sybase Unwired Platform is used in a stand-alone manner for data synchronization (without Data Orchestation Engine), it utilizes an efficient bulk transfer and data insertion technology between the middleware cache and the device database.

In an Unwired Platform standalone deployment, the mobile application is designed such that the developer specifies how to load data from the back end into the cache and then filters and downloads cache data using device-supplied parameters. The mobile content model and the mapping to the back end are directly integrated.

This style of coupling between device and back-end queries implies that the back end must be able to respond to requests from the middleware based on user-supplied parameters and serve up mobile data appropriately. Normally, some mobile-specific adaptation is required within SAP Business Application Programming Interfaces (BAPI). Because of the direct nature of application parameter mapping and RBS protocol efficiencies, Sybase Unwired Platform cache synchronization deployment is ideal:

- With large payloads to devices (may be due to mostly disconnected scenarios)
- Where ad hoc data downloads might be expected
- For SAP® or non-SAP back ends

Large payloads, for example, can occur in task worker (service) applications that must access large product catalogs, or where service occurs in remote locations and workers might synchronize once a day. While Sybase Unwired Platform synchronization does benefit from middleware caching, direct coupling requires the back end to support an adaptation where mobile user data can be determined.

Client Runtime Architecture

The goal of synchronization is to keep views (that is, the state) of data consistent among multiple tiers. The assumption is that if data changes on one tier (for example, the enterprise system of record), all other tiers interested in that data (mobile devices, intermediate staging areas/caches and so on) are eventually synchronized to have the same data/state on that system.

The Unwired Server synchronizes data between the device and the back-end by maintaining records of device synchronization activity in its cache database along with any cached data that may have been retrieved from the back-end or pushed from the device. The Unwired Server employs several components in the synchronization chain.

Mobile Channel Interfaces

Mobile channel interfaces provide a conduit for transporting data to and from remote devices. Two main channel interfaces provide messaging and replication.

- The messaging channel serves as the abstraction to all device-side notifications (BlackBerry Enterprise Service, Apple Push Notification Service, and others) so that when changes to back-end data occur, devices can be notified of changes relevant for their application and configuration. This channel also enables data synchronization on iOS.

  The messaging channel sends these types of notifications:

  - Change notifications - when Unwired Server detects changes in the back-end EIS, Unwired Server can send a notification to the device. By default, sending change notifications is disabled, but you can enable sending change notifications per synchronization group.

    To capture change notifications, you can register an onSynchronize callback. The synchronization content in the callback has a status you can retrieve.
  - When synchronizing, operation replay records are sent to the Unwired Server and the messaging channel sends a notification of `replayFinished`. The application must call another synchronize method to retrieve the result.
- The synchronization channel sends data to keep the Unwired Server and client synchronized. The synchronization is bi-directional.

Mobile Middleware Services

Mobile middleware services (MMS) arbitrate and manage communications between device requests from the mobile channel interfaces in the form that is suitable for transformation to a common MBO service request and a canonical form of enterprise data supplied by the data services.

Data Services

Data services is the conduit to enterprise data and operations within the firewall or hosted in the cloud. Data services and mobile middleware services together manage the cache database (CDB) where data is cached as it is synchronized with client devices.

Once a mobile application model is designed, it can be deployed to the Unwired Server where it operates as part of a specialized container-managed package interfacing with the mobile middleware services and data services components. Cache data and messages persist in the databases in the data tier. Changes made on the device are passed to the mobile middleware services component as an operation replay and replayed against the data services interfaces with the back-end. Data that changes on the back- end as a result of device changes, or those originating elsewhere, are replicated to the device database.

Documentation Roadmap for Unwired Platform

Sybase® Unwired Platform documents are available for administrative and mobile development user roles. Some administrative documents are also used in the development and test environment; some documents are used by all users.

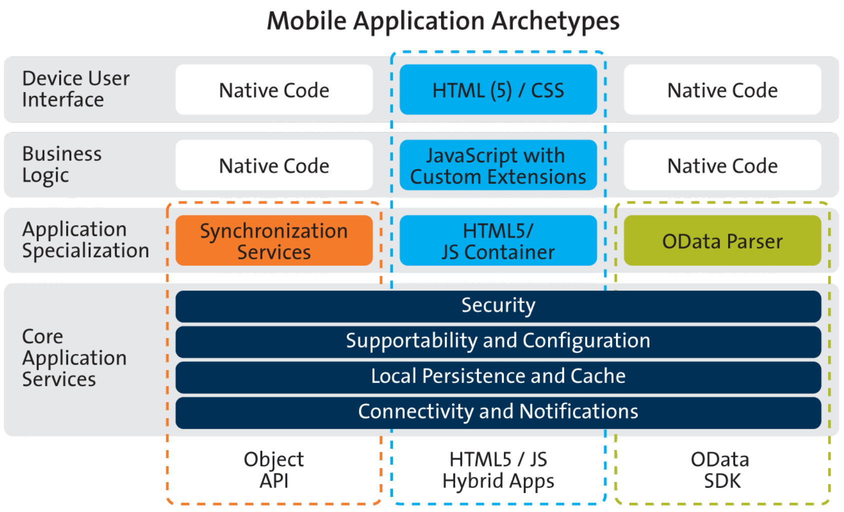
See *Documentation Roadmap* in *Fundamentals* for document descriptions by user role. *Fundamentals* is available on the Sybase Product Documentation Web site.

Check the Sybase Product Documentation Web site regularly for updates: access *http://sybooks.sybase.com/nav/summary.do?prod=1289*, then navigate to the most current version.

Development Task Flow for Native Applications

Describes the overall development task flow for native applications, and provides information and procedures for setting up the development environment, and developing device applications.

This diagram illustrates how you can develop a device application directly from mobile business objects (MBOs), using the Object API and custom device application coding. This is how you create device applications with sophisticated UI interaction, validation, business logic, and performance.


Mobile Application Archetypes
Device User Interface
Native Code
HTML (5) / CSS
Native Code
Business Logic
Native Code
JavaScript with Custom Extensions
Native Code
Application Specialization
Synchronization Services
HTML5/ JS Container
OData Parser
Core Application Services
Security
Supportability and Configuration
Local Persistence and Cache
Connectivity and Notifications
Object API
HTML5 / JS Hybrid Apps
OData SDK

The Object API provides the core application services described in the diagram.

The Authentication APIs provide security by authenticating he client to the Unwired Server.

The Synchronization APIs allow you to synchronize mobile business objects (MBOs) based on synchronization parameters, for individual MBOs, or as a group, based on the group's synchronization policy.

The Application and Connection APIs allow clients to register with and connect to the Unwired Server. The Callback Handler and Listener APIs, and the Target Change Notification APIs provide notifications to the client on operation success or failure, or changes in data.

1. *Installing the Android Development Environment*

   Install the Android development environment, and prepare Android devices for authentication.

2. *Creating a Project*

   Build a device application project.
3. *Generating Java Object API Code*

   Use the Code Generation Utility to generate object API code, which allows you to use APIs to develop device applications for Android devices.
4. *Customizing the Application Using the Object API*

   Use the Object API to customize the application. An application consists of building blocks which the developer uses to start the application, perform functions needed for the application, and shutdown and uninstall the application.
5. *Testing Applications*

   Test native applications on a device or simulator.
6. *Localizing Applications*

   Localize an Android application by creating default and alternate resources.
7. *Packaging Applications*

   Package applications according to your security or application distribution requirements.

Installing the Android Development Environment

Install the Android development environment, and prepare Android devices for authentication.

1. *Installing the Android SDK and ADT Plug-in*

   Install the Android SDK and Android Development Tools (ADT) plug-in for use with Sybase Unwired WorkSpace.
2. *Installing X.509 Certificates on Android Devices and Emulators*

   Install the .p12 certificate on the Android device or emulator for authentication. A certificate provides an additional level of secure access to an application, and may be required by an organization's security policy.

See also

- *Creating a Project* on page 8

Installing the Android SDK and ADT Plug-in

Install the Android SDK and Android Development Tools (ADT) plug-in for use with Sybase Unwired WorkSpace.

1. Confirm your system meets the requirements at *http://developer.android.com/sdk/requirements.html*.

2. Download and install the SDK starter package from *http://developer.android.com/sdk/index.html*.
3. Launch the **Android SDK and AVD Manager**, select **Available Packages**, and install the Android SDK tools, platform, and compatibility package for Android.
4. Install and configure the ADT plug-in within the Sybase Unwired WorkSpace Eclipse environment using the steps at *http://developer.android.com/sdk/eclipse-adt.html*.
5. In the **Android SDK and AVD Manager**, select **Virtual Devices** and create a virtual Android device to use as your simulator.

Installing X.509 Certificates on Android Devices and Emulators

Install the .p12 certificate on the Android device or emulator for authentication. A certificate provides an additional level of secure access to an application, and may be required by an organization's security policy.

Prerequisites

- Java SE Development Kit (JDK) must be installed.
- The Android SDK must be installed.

Task

1. Connect the Android device to your computer with the USB cable.
2. To install using Eclipse with the ADT plugin:

   Note: USB debugging must be enabled.

   a) Open the Windows File Explorer view. From the menu bar, navigate to **Window** > **Show View** > **Other**.
   b) In the Show View dialog, expand the Android folder and select **File Explorer**.
   c) Expand **mnt > sdcard** and select the **sdcard** folder.
   d) In the top right of the File Explorer view, click **Push a file onto the device**.
   e) In the Put File on Device dialog, select the certificate and click **Open**.
3. To install using Windows Explorer:

   Note: USB debugging must be disabled.

   a) Open **Windows Explorer**
   b) Under your computer, click the Android device to expand the folder.
   c) Click **Device Storage**, navigate to and select the certificate.
   d) Import the certificate to the Device Storage folder.
4. To install using the Android Debug Bridge (adb):

   Note: USB debugging must be enabled. You can enable USB debug mode from the device menu by selecting Settings > Application > USB Debugging.

a) Open the command line directory to the `adb.exe` file, for example, `C:\Program Files\android-sdk-windows\tools`, or `C:\Program Files\android-sdk-windows\platform-tools`

b) Run the command: `adb push %PathToCert%\MyCert.p12 /sdcard/MyCert.p12`

Creating a Project

Build a device application project.

1. *Creating a Project in Unwired WorkSpace*

   Create a project for your Android device application in Sybase Unwired WorkSpace.

2. *Importing Libraries and Code*

   Create a specific directory structure, within your Eclipse project, containing the library resources needed to compile your Android client code.

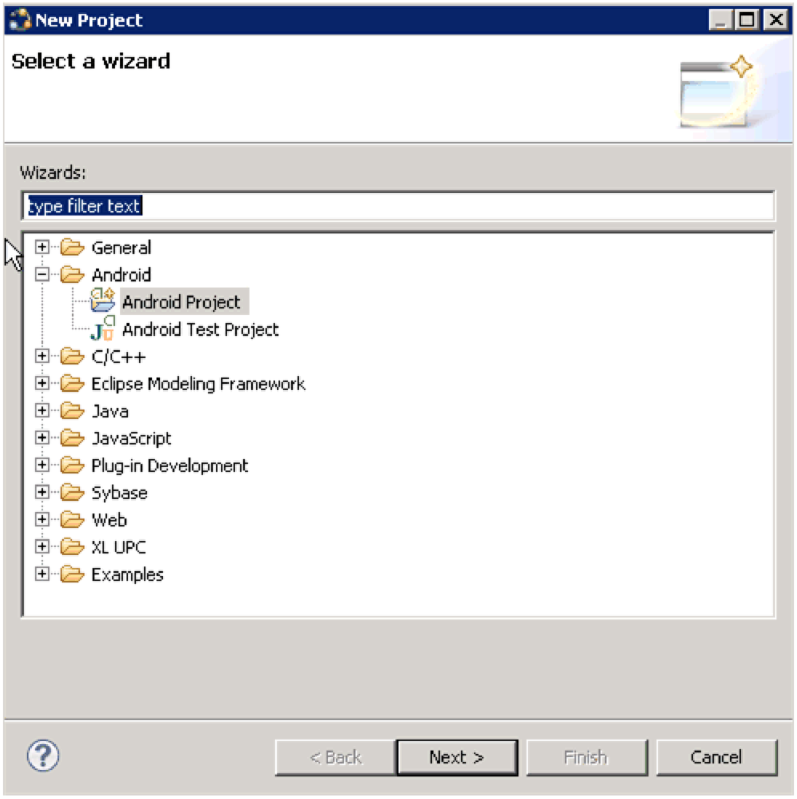
See also

- *Installing the Android Development Environment* on page 6
- *Generating Java Object API Code* on page 11

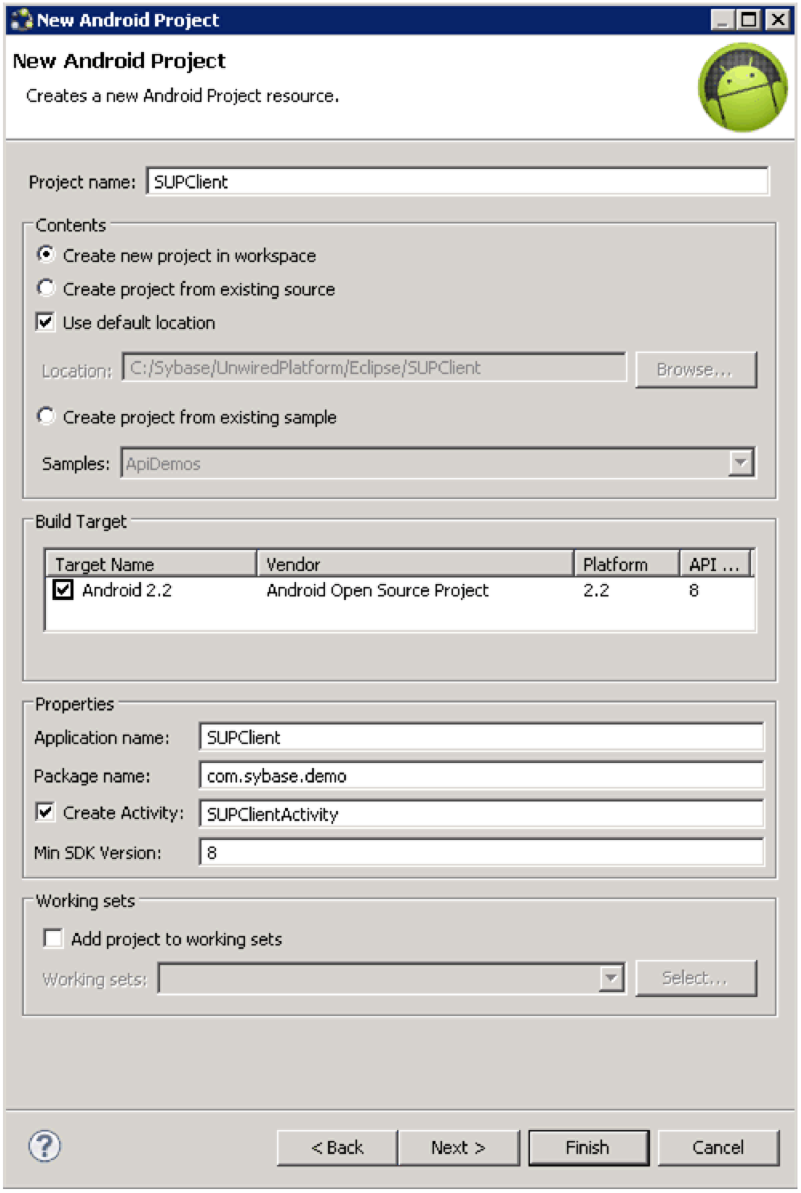
Creating a Project in Unwired WorkSpace

Create a project for your Android device application in Sybase Unwired WorkSpace.

1. In Sybase Unwired WorkSpace, select **File** > **New** > **Project**.
2. Select **Android** > **Android Project**.



3. In the **New Android Project** wizard, enter these values and click **Finish**:
   - **Project name:** – `SUPClient`
   - **Package name:** – `com.sybase.demo`
   - **Min SDK Version:** – 8



New Android Project

New Android Project

Creates a new Android Project resource.

Project name: SUPClient

Contents

- (●) Create new project in workspace
- ( ) Create project from existing source
- [✓] Use default location

Location: C:/Sybase/UnwiredPlatform/Eclipse/SUPClient

- ( ) Create project from existing sample

Samples: ApiDemos

Build Target

Target Name	Vendor	Platform	API ...
✓ Android 2.2	Android Open Source Project	2.2	8

Properties

Application name: SUPClient

Package name: com.sybase.demo

[✓] Create Activity: SUPClientActivity

Min SDK Version: 8

Working sets

[ ] Add project to working sets

Working sets:

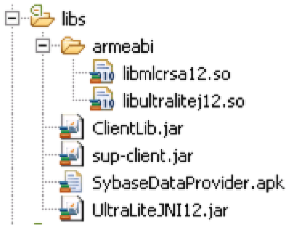
4. Add the following user permissions in `AndroidManifest.xml`:

```
<uses-permission android:name="android.permission.INTERNET"></
uses-permission>
<uses-permission
android:name="android.permission.READ_PHONE_STATE"></uses-
permission>
```

Importing Libraries and Code

Create a specific directory structure, within your Eclipse project, containing the library resources needed to compile your Android client code.

1. In your Sybase Unwired WorkSpace project, create a `libs` directory.
2. Copy the following library and JAR files from `<UnwiredPlatform_InstallDir>\UnwiredPlatform\MobileSDK\ObjectAPI\Android` into the `libs` directory within your project, using the exact directory structure shown here:



```
libs
  armeabi
    libmlcrsa12.so
    libultralitej12.so
  ClientLib.jar
  sup-client.jar
  SybaseDataProvider.apk
  UltraLiteJNI12.jar
```

3. Select **Project** > **Properties** > **Java Build Path**. On the **Libraries** tab, add the libraries to the project.

Generating Java Object API Code

Use the Code Generation Utility to generate object API code, which allows you to use APIs to develop device applications for Android devices.

Prerequisites

- Use Unwired WorkSpace to develop and package your mobile business objects. See *Sybase Unwired WorkSpace - Mobile Business Object Development* > *Develop* > *Developing a Mobile Business Object*.
- Deploy the package to Unwired Server, creating files required for code generation from the command line. See *Sybase Unwired WorkSpace - Mobile Business Object Development* > *Develop* > *Packaging and Deploying Mobile Business Objects* >*Automated Deployment of Unwired WorkSpace Projects*

Task

1. Locate `<domain name>_package.jar` in your mobile project folder. For the SUP101 example, the project is deployed to the default domain, and the deploy jar file is in the following location: `SUP101\Deployment\.pkg.profile\My_Unwired_server\default_package.jar`.
2. Make sure that the JAR file contains this file:

- `deployment_unit.xml`

3. Use a utility to extract the `deployment_unit.xml` file to another location.
4. From `<UnwiredPlatform_InstallDir>\MobileSDK\ObjectAPI\Utils\bin`, run the `codegen.bat` utility, specifying the following parameters:

   ```
   codegen.bat -java -client -android -ulj deployment_unit.xml [-
   output <output_dir>] [-doc]
   ```

   - The `-output` parameter allows you to specify an output directory. If you omit this parameter, the output goes into the `<UnwiredPlatform_InstallDir>\MobileSDK\ObjectAPI\Utils\genfiles` directory, assuming codegen.bat is run from the `<UnwiredPlatform_InstallDir>\MobileSDK\ObjectAPI\Utils\genfiles` directory.
   - The `-doc` parameter specifies that documentation is generated for the generated code.

   Ignore these warnings:

   ```
   log4j:WARN No appenders could be found for logger ...
   log4j:WARN Please initialize the log4j system properly.
   ```

See also

- *Creating a Project* on page 8
- *Customizing the Application Using the Object API* on page 15

Generated Code Location and Contents

By default, generated object API code is stored in the `<UnwiredPlatform_InstallDir>\UnwiredPlatform\MobileSDK\ObjectAPI\Utils\genfiles` folder after you you generate code .

The contents of the folder is determined by the options you selected from the Generate Code wizard, and include generated class files that contain:

- MBO – class which handles persistence and operation replay of your MBOs.
- Synchronization parameters – any synchronization parameters for the MBOs.
- Personalization parameters – personalization parameters used by the package.
- Metadata – Metadata class that allow you to query meta data including MBOs, their attributes, operations, in a persistent table at runtime..

Validating Generated Code

Validation rules are enforced when generating client code for C# and Java. Define prefix names in the Mobile Business Object Preferences page of the Code Generation wizard to correct validation errors.

Sybase Unwired WorkSpace validates and enforces identifier rules and checks for keyword conflicts in generated Java and C# code, for example, by displaying error messages in the Properties view or in the wizard. Other than the known name conversion rules (converting '.' to

'_', removing white space from names, and so on), there is no other language-specific name conversion. For example, cust_id is not changed to custId.

You can specify the prefix string for mobile business object, attribute, parameter, or operation names from the Mobile Business Object Preferences page. This allows you to decide what prefix to use to correct any errors generated from the name validation.

1. Select **Window > Preferences**.
2. Expand **Sybase, Inc > Mobile Development**.
3. Select **Mobile Business Object**.
4. Add or modify the **Naming Prefix** settings as needed.

The defined prefixes are added to the names (object, attribute, operation, and parameter) whenever these are autogenerated, for example, when you drag and drop a data source onto the Mobile Application Diagram.

Customizing the Application Using the Object API

Use the Object API to customize the application. An application consists of building blocks which the developer uses to start the application, perform functions needed for the application, and shutdown and uninstall the application.

See also

- *Generating Java Object API Code* on page 11
- *Testing Applications* on page 37

Initializing an Application

Initialize the application when it starts the first time and subsequently.

- *Initially Starting an Application*

  Starting an application the first time.
- *Subsequently Starting an Application*

  Subsequent start-ups are different from the first start-up.

Initially Starting an Application

Starting an application the first time.

1. *Setting up Application Properties*

   The Application instance contains the information and authentication credentials needed to register and connect to the Sybase Unwired Platform server.
2. *Registering an Application*

   Each device must register with the server before establishing a connection.
3. *Setting Up the Connection Profile*

   The Connection Profile stores information detailing where and how the local database is stored, including location and page size. The connection profile also contains UltraLiteJ runtime tuning values.
4. *Setting Up Connectivity*

   Store connection information to the Sybase Unwired Server data synchronization channel.
5. *Creating and Deleting a Device's Local Database*

   There are methods in the generated package database class that allow programmers to delete or create a device's local database. A device local database is automatically created when needed by the Object API. The application can also create the database programatically by calling the createDatabase method. The device's local database should be deleted when uninstalling the application.

6. *Logging In*

   Use online authentication with the server, and offline authentication with the device.
7. *Turn Off API Logger*

   In production environments, turn off the API logger to improve performance.
8. *Setting Up Callbacks and Listeners*

   When your application starts, it can register database and MBO callback listeners, as well as synchronization listeners.
9. *Connecting to the Device Database*

   Establish a connection to the database on the device.
10. *Synchronizing*

    Synchronize package data between the device and the server.
11. *Specifying Personalization Parameters*

    Use personalization parameters to provide default values used with synchronization, connections with back-end systems, MBO attributes, or EIS arguments. The PersonalizationParameters class is within the generated code for your project.
12. *Specifying Synchronization Parameters*

    Use synchronization parameters within the mobile application to download filtered MBO data.

See also

- *Application APIs* on page 45
- *Connection APIs* on page 51

Setting up Application Properties

The Application instance contains the information and authentication credentials needed to register and connect to the Sybase Unwired Platform server.

The following code illustrates how to set up the minimum required fields:

```
// Initialize Application settings
Application app = Application.getInstance();

// The identifier has to match the application ID deployed to the SUP 
server
app.setApplicationIdentifier("SUP101");
// Set the android.content.Context for the application
app.setApplicationContext(context); // context is the 
android.content.Context

// ConnectionProperties has the infomation needed to register
// and connect to SUP server
ConnectionProperties connProps = app.getConnectionProperties();
```

```
connProps.setServerName("supserver.mycompany.com");
connProps.setPortNumber(5001);
// Other connection properties need to be set when connecting through
relay server

// provide user credentials
LoginCredentials loginCred = new LoginCredentials("supAdmin",
"supPwd");
connProps.setLoginCredentials(loginCred);

// Initialize generated package database class with this Application
instance
SUP101DB.setApplication(app);
```

Note: `setApplicationIdentifier` and `setApplicationContext` must be called in the user interface thread.

See also

- *Application APIs* on page 45

Registering an Application

Each device must register with the server before establishing a connection.

To register the device with the server during the initial application startup, use the `registerApplication` method in the `com.sybase.mobile.Application` class. You do not need to use the `registerApplication` method for subsequent application startups.To start the connection to complete the registration process, use the `Application.startConnection` method.

Call the generated database's `setApplication` method before starting the connection or registering the device.

The following code shows how to register the application and device.

```
// Initialize Application settings
Application app = Application.getInstance();

// The identifier has to match the
// application ID deployed to the SUP server
app.setApplicationIdentifier("SUP101");
ApplicationCallback appCallback = new ApplicationCallback();
app.setApplicationCallback(appCallback); // optional
app.setApplicationContext(myAndroidContext); // required
              // use the android.content.Context for the application

// set connection properties, login credentials,  etc
...

// Register the application
SUP101DB.setApplication(app);
if (app.getRegistrationStatus() != RegistrationStatus.REGISTERED)
{
   // If the application has not been registered to the server,
   // register now
   app.registerApplication(<timeout_value>);
}
else
{
   // start the connection to server
   app.startConnection(<timeout_value>);
}
```

See also

- *Application APIs* on page 45

Setting Up the Connection Profile

The Connection Profile stores information detailing where and how the local database is stored, including location and page size. The connection profile also contains UltraLiteJ runtime tuning values.

Set up the connection profile before the first database access, and check if the database exists by calling the databaseExists`databaseExists` method in the generated package database class. Any settings you establish after the connection has already been established will not go into effect.

The generated database class automatically contains all the default settings for the connection profile. You may add other settings if necessary. For example, you can set the database to be stored in an SD card or set the encryption key of the database.

Use the `com.sybase.persistence.ConnectionProfile` class to set up the locally generated database:

1. Retrieve the connection profile object using the Sybase Unwired Platform database's `getConnectionProfile` method.
2. Use the connection profile object's `save` method to set the values once when the application first starts. On subsequent usage of the application, the connection profile will contain all the settings from the last `save` call.

```

// Initialize the device database connection profile (if needed)
ConnectionProfile connProfile = SUP101DB.getConnectionProfile();

// Store the database in an SD card
connProfile.setProperty("databaseFile",
android.os.Environment.getExternalStorageDirectory().getPath()  "/
SUP1011_0.ulj");

// encrypt the database
connProfile.setEncryptionKey("encryption key must be 16 characters
or longer");

// use 100K for cache size
connProfile.setCacheSize(102400);
```

```
// save it
connProfile.save();
```

You can also automatically generate a encryption key and store it inside a data vault.

See also

- *ConnectionProfile* on page 51

Setting Up Connectivity

Store connection information to the Sybase Unwired Server data synchronization channel.

See also

- *Creating and Deleting a Device's Local Database* on page 19

Synchronization Profile

You can set Unwrired Server synchronization channel information by calling the synchronization profile's setter method. By default, this information includes the server host, port, domain name, certificate and public key that are pushed by the message channel during the registration process. Developers do not need to set these parameters manually. When the client registers and starts the application, the certificate is downloaded to the client, so that the client can be assigned the trusted certificate.

Set up a secured connection using the `ConnectionProfile` object.

1. Retrieve the synchronization profile object using the Sybase Unwired Platform database's `getSynchronizationionProfile` method, which returns a `ConnectionProfile` object:

   ```
   ConnectionProfile cp = SUP101DB.getSynchronizationProfile();
   ```

2. Set the connection fields in the `ConnectionProfile` object:

   ```
   cp.setServerName("SUP_Host");
   cp.setPortNumber(2481);
   cp.getStreamParams().setTrusted_Certificates("rsa_public_cert.crt
   ");
   cp.setNetworkProtocol("https");
   ```

See also

- *Synchronization Profile* on page 53

Creating and Deleting a Device's Local Database

There are methods in the generated package database class that allow programmers to delete or create a device's local database. A device local database is automatically created when needed by the Object API. The application can also create the database programatically by calling the `createDatabase` method. The device's local database should be deleted when uninstalling the application.

Check if the locally generated database exists, create the database, or delete the database:

1. Check if an instance of the generated database exists by calling the generated database instance's `databaseExists` method.
2. If an instance of a the generated database does not exist, call the generated database instance's `createDatabase` method.

   ```
   if (!SUP101DB.databaseExists())
       {
           SUP101DB.createDatabase();
       }
   ```
3. Connect to the generated database by calling the generated database instance's `openConnection` method.

   ```
   SUP101DB.openConnection();
   ```

   If the database does not already exist, the `openConnection` method creates it.
4. When the local database is no longer needed, delete it by calling the generated database instance's `deleteDatabase` method.

   ```
   SUP101DB.deleteDatabase();
   ```

See also

- *Setting Up Connectivity* on page 19

Logging In

Use online authentication with the server, and offline authentication with the device.

1. Normally, the user is authenticated through the `registerApplication` and `startConnection` methods in the `Application` class. Once this is done there is no need to authenticate again. However, the user can authenticate directly with the server at any time during the application's execution by calling the generated database instance's `onlineLogin` method.
2. Authenticate using the last successful credentials on the device by calling the generated database instance's `offlineLogin` method.

Turn Off API Logger

In production environments, turn off the API logger to improve performance.

```
SUP101DB.getLogger().setLogLevel(LogLevel.OFF);
```

Setting Up Callbacks and Listeners

When your application starts, it can register database and MBO callback listeners, as well as synchronization listeners.

Callback handler and listener interfaces are provided so your application can monitor changes and notifications from Sybase Unwired Platform:

- The `com.sybase.mobile.ApplicationCallback` class is used for monitoring changes to application settings, messaging connection status, and application registration status.
- The `com.sybase.persistence.CallbackHandler` interface is used to monitor notifications and changes related to the database. Register callback handlers at the package level use the `registerCallbackHandler` method in the generated database class. To register for a particular MBO, use the `registerCallbackHandler` method in the generated MBO class.
- The `com.sybase.persistence.SyncStatusListener` class is used for debugging and performance measures when monitoring stages of a synchronization session, and can be used in the user interface to indicate synchronization progress.

See also
- *Connecting to the Device Database* on page 25
- *Callback and Listener APIs* on page 76

Setting Up Callback Handlers

Use the callback handlers for event notifications.

Use the `com.sybase.persistence.CallbackHandler` API for event notifications including login for synchronization and replay. If you do not register your own implementation of the `com.sybase.persistence.CallbackHandler` interface, the generated code will regsiter a new default callback handler.

1. The generated database class contains a method called `registerCallbackHandler`. Use this method to install your implementation of `CallbackHandler`.
   For example:
   ```
   SUP101DB.registerCallbackHandler(new MyCallbackHandler());
   ```
2. Each generated MBO class also has the same method to register your implementation of the `CallbackHandler` for that particular type. For example, if `Customer` is a generated MBO class, you can use the following code:
   ```
   Customer.registerCallbackHandler(new
   MyCustomerMBOCallbackHandler());
   ```

Create a Custom Callback Handler

If an application requires a callback (for example, to allow the client framework to provide notification of synchronization results) create a custom callback handler.

```
import com.sybase.persistence.DefaultCallbackHandler;
……
public class Test
{
   public static void main(String[] args)
   {
      SUP101DB.registerCallbackHandler(new MyCallbackHandler());
```

```
      GenericList<SynchronizationGroup> sgs = new
GenericList<SynchronizationGroup>();
      sgs.add(SUP101DB.getSynchronizationGroup("sg1"));
      sgs.add(SUP101DB.getSynchronizationGroup("sg2"));
      SUP101DB.beginSynchronize(sgs, "my test synchronization
context");
   }
}

class MyCallbackHandler extends DefaultCallbackHandler
{
   public int onSynchronize(GenericList groups,
SynchronizationContext context)
   {
      if ( context == null )
      {
         return SynchronizationAction.CANCEL;
      }

      if ("my test synchronization context".equals((String)
(context.getUserContext())))
      {
         return super.onSynchronize(groups, context);
      }

      switch (context.getStatus())
      {
         case SynchronizationStatus.STARTING:
            if (waitForMoreChanges()
            {
               return SynchronizationAction.CANCEL;
            }
            else
            {
               return SynchronizationAction.CONTINUE;
            }
         default:
            return SynchronizationAction.CONTINUE;
      }
   }
}
```

Asynchronous Operation Replay

Upload operation replay records asynchronously.

When an application calls `submitPending` on an MBO on which a create, update, or delete operation is performed, an operation replay record is created on the device local database.

When `synchronize` is called, the operation replay records are uploaded to the server. The method returns without waiting for the backend to replay those records. The `synchronize` method downloads all the latest data changes and the results of the previously uploaded operation replay records that the backend has finished replaying. If you choose to disable asynchronous operation replay, each `synchronize` call will wait for the backend to finish replaying all the current uploaded operation replay records.

This feature is enabled by default. You can enable or disable the feature by setting the `asyncReplay` property in the synchronization profile. The following code shows how to disable asynchronous replay:

```
SUP101DB.getSynchronizationProfile().setAsyncReplay(false);
```

When asynchronous replay is enabled and the replay is finished, the onSynchronize callback method is invoked with a SynchronizationStatus value of `SynchronizationStatus.ASYNC_REPLAY_COMPLETED`. Use this callback method to invoke a synchronize call to pull in the results, as shown in the following callback handler.

```
public class MyCallbackHandler extends DefaultCallbackHandler
{
  public int onSynchronize(ObjectList groups, SynchronizationContext 
context)
  {
    switch(context.getStatus())
    {
      case SynchronizationStatus.ASYNC_REPLAY_UPLOADED:
        LogMessage("AsyncReplay uploaded");
        break;
      case SynchronizationStatus.ASYNC_REPLAY_COMPLETED:
        // operation replay finished, return 
SynchronizationAction.CONTINUE
        // will start a background synchronization to pull in the 
results.
        LogMessage("AsyncReplay Done");
        break;
      default:
        break;
    }

    return SynchronizationAction.CONTINUE;
  }
}
```

Synchronize Status Listener

Retrieve the synchronization status.

Synchronize Status Listener is mainly for debugging and performance measuring purposes to monitor stages of a synchronize session. It could also be used in UI for synchronization progress status. Below is a sample Synchronize Status Listener.

```
import com.sybase.persistence.ObjectSyncStatusData;
import com.sybase.persistence.SyncStatusListener;
import com.sybase.persistence.SyncStatusState;

public class MySyncStatusListener implements SyncStatusListener
{
    long start;
    public MySyncStatusListener()
    {
        start = System.currentTimeMillis();
    }

    public boolean objectSyncStatus(ObjectSyncStatusData statusData)
    {
        long now = System.currentTimeMillis();
        long interval = now - start;
        start = now;
        String infoMessage;

        int syncState = statusData.getSyncStatusState();

        switch (syncState)
        {
            case SyncStatusState.SYNC_STARTING:
                infoMessage = "START [" interval "]";
                break;
            case SyncStatusState.APPLICATION_SYNC_SENDING_HEADER:
                infoMessage = "SENDING HEADERS [" interval "]";
                break;
            case SyncStatusState.APPLICATION_SYNC_SENDING_SCHEMA:
                infoMessage = "SENDING SCHEMA [" interval "]";
                break;
            case SyncStatusState.APPLICATION_DATA_UPLOADING:
                infoMessage = "DATA UPLOADING [" interval "] "
                    + statusData.getCurrentMBO() ": (S>"
                    + statusData.getSentByteCount() ":"
                    + statusData.getSentRowCount() " R<"
                    + statusData.getReceivedByteCount() ":"
                    + statusData.getReceivedRowCount() ")";
                break;
            case
SyncStatusState.APPLICATION_SYNC_RECEIVING_UPLOAD_ACK:
                infoMessage = "RECEIVING UPLOAD ACK [" interval "]";
                break;
            case SyncStatusState.APPLICATION_DATA_UPLOADING_DONE:
                infoMessage = "UPLOAD DONE [" interval "] "
                    + statusData.getCurrentMBO() ": (S>"
                    + statusData.getSentByteCount() ":"
                    + statusData.getSentRowCount() " R<"
                    + statusData.getReceivedByteCount() ":"
                    + statusData.getReceivedRowCount() ")";
                break;
            case SyncStatusState.APPLICATION_DATA_DOWNLOADING:
                infoMessage = "DATA DOWNLOADING[" interval "] "
                    + statusData.getCurrentMBO() ": (S>"
                    + statusData.getSentByteCount() ":"
                    + statusData.getSentRowCount() " R<"
                    + statusData.getReceivedByteCount() ":"
                    + statusData.getReceivedRowCount() ")";
                break;
            case SyncStatusState.APPLICATION_SYNC_DISCONNECTING:
                infoMessage = "DISCONNECTING [" interval "]";
                break;
            case
SyncStatusState.APPLICATION_SYNC_CHECKING_LAST_UPLOAD:
                infoMessage = "CHECKING LAST UPLOAD [" interval "]";
                break;
            case
SyncStatusState.APPLICATION_SYNC_COMMITTING_DOWNLOAD:
                infoMessage = "COMMITTING DOWNLOAD [" interval "] "
                    + statusData.getCurrentMBO() ": (S>"
                    + statusData.getSentByteCount() ":"
                    + statusData.getSentRowCount() " R<"
                    + statusData.getReceivedByteCount() ":"
                    + statusData.getReceivedRowCount() ")";
                break;
            case SyncStatusState.APPLICATION_SYNC_CANCELLED:
                infoMessage = "SYNC CANCELED ["+ interval "]";
                break;
            case SyncStatusState.APPLICATION_DATA_DOWNLOADING_DONE:
               infoMessage = "DATA DOWNLOADING DONE [" interval "]";
                break;
            case SyncStatusState.SYNC_DONE:

                infoMessage = "DONE [" interval "]";
                break;
            default:
                infoMessage = "STATE" syncState "[" interval "]";
                break;
        }
        LogMessage(infoMessage);
        return false;
    }
}
```

Connecting to the Device Database

Establish a connection to the database on the device.

After completing the device registration, call the generated database's `openConnection` method to connect to the UltraLite/UltraLiteJ database on the device. If no device database exists, the `openConnection` method creates one.

See also

- *Setting Up Callbacks and Listeners* on page 20

Synchronizing

Synchronize package data between the device and the server.

The generated database provides you with synchronization methods that apply to either all synchronization groups in the package or a specified list of groups.

See also

- *Specifying Personalization Parameters* on page 27
- *Synchronization APIs* on page 58

- *Specifying Synchronization Parameters* on page 28

Configuring Data Synchronization Using SSL Encryption

Enable SSL encryption by configuring the synchronization HTTPS port.

1. In the left navigation pane of Sybase Control Center for Unwired Platform, expand the **Servers** node and click the server name.
2. Click **Server Configuration**.
3. In the right administration pane, click the **Replication** tab.
4. Select **Secure synchronization port** 2481 as the protocol used for synchronization, and configure the certificate properties. In the optional properties section, specify the security certificate file, the public security certificate file using the fully qualified path to the file, along with the password you entered during certificate creation.

   Note: In a clustered environment, this fully qualified path must work for all nodes in the cluster. You can do this via a shared disk, or manually distribute the certificate file to all nodes.

Nonblocking Synchronization

An example that illustrates the basic code requirements for connecting to Unwired Server, updating mobile business object (MBO) data, and synchronizing the device application from a device application based on the Client Object API.

Subscribe to the package using synchronization APIs in the generated database class, specify the groups to be synchronized, and invoke the asynchronous synchronization method (`beginSynchronize`).

1. If you have not yet synchronized with Unwired Server, perform a synchronization.
   ```
   SUP101DB.synchronize("system")
   ```
2. Set the synchronization parameters if there are any.
   ```
   CustomerSynchronizationParameters syncParameter =
   Customer.getSynchronizationParameters();
   syncParameter.setYourParameters(...);
   syncParameter.save();
   ```
3. Make a blocking synchronize call to Unwired Server to pull in all MBO data:
   ```
   SUP101DB.synchronize();
   ```
4. List all customer MBO instances from the local database using an object query, such as `FindAll`, which is a predefined object query.
   ```
   GenericList<Customer> customers = Customer.findAll();
   int n = customers.size();
   for (int i = 0; i < n; i )
   {
     Customer customer = customers.get(i);
     //Work on customer information
   }
   ```

5. Find and update a particular MBO instance, and save it to the local database.

   ```
   Customer cust = Customer.findByPrimaryKey(100);
   cust.setAddress("1 Sybase Dr.");
   cust.setPhone("9252360000");
   cust.save();//or cust.update();
   ```

6. Submit the pending changes. The changes are ready for upload, but have not yet been uploaded to the Unwired Server.

   ```
   cust.submitPending();
   ```

7. Use non-blocking synchronize call to upload the pending changes to the Unwired Server. The previous replay results and new changes are downloaded to the client device in the download phase of the synchronization session.

   ```
   GenericList<SynchronizationGroup> sgs = new
   GenericList<SynchronizationGroup>();
   sgs.add(SUP101DB.getSynchronizationGroup("default")); // Customer
   MBO is in "default" sync group
   SUP101DB.beginSynchronize(sgs, "mycontext");
   ```

Enabling Change Notifications

A synchronization group can enable or disable its change notification.

By default, change notifcations are disabled for synchronization groups. To enable change notification, call the `SynchronizationGroup` object's `setEnableSIS` method.

```
com.sybase.persistence.SynchronizationGroup sg =
SUP101DB.getSynchronizationGroup("PushEnabled");

if (!sg.getEnableSIS())
{
  sg.setEnableSIS(true);
  sg.setInterval(2);
  sg.save();
  SUP101DB.synchronize("PushEnabled");
}
```

Specifying Personalization Parameters

Use personalization parameters to provide default values used with synchronization, connections with back-end systems, MBO attributes, or EIS arguments. The `PersonalizationParameters` class is within the generated code for your project.

1. To instantiate a `PersonalizationParameters` object, call the generated database instance's `getPersonalizationParameters` method:

   ```
   PersonalizationParameters pp =
   MyPackageDB.getPersonalizationParameters();
   ```

2. Assign values to the `PersonalizationParameters` object:

   ```
   pp.setPKCity( "New York" );
   ```

3. Save the `PersonalizationParameters` value to the local database:

   ```
   pp.save();
   ```

Note: If you define a default value for a personalization key that value will take effect, unless you call `pp.save()`.

4. Synchronize the `PersonalizationParameters` value to the Sybase Unwired Platform:

   ```
   MyPackageDB.synchronize();
   ```

See also

- *Synchronizing* on page 25
- *Personalization APIs* on page 57

Specifying Synchronization Parameters

Use synchronization parameters within the mobile application to download filtered MBO data.

Assign the synchronization parameters of an MBO before a synchronization session. The next synchronize sends the updated synchronization parameters to the server. The `SynchronizationParameters` class is within the generated code for your project.

Note: If you do not save the `SynchronizationParameters`, no data is downloaded to the device even if there are default values set for those `SynchronizationParameters`. Call the `save` method for all `SynchronizationParameters` and for all MBOs when the application is first started. Do this after application registration and the first synchronization.

1. Retrieve the synchronization parameters object from the MBO instance. For example, if you have an MBO named `Customer`, the synchronization parameters object is accessed as a public field and returned as a `CustomerSynchronizationParameters` object:

   ```
   CustomerSynchronizationParameters sp =
   Customer.getSynchronizationParameters();
   ```

2. Assign values to the synchronization parameter. For example, if the Customer MBO contains a parameter named `cityname`, assign the value to the `CustomerSynchronizationParameters` object's `Cityname` field:

   ```
   sp.setCityname("Kansas City");
   ```

3. Save your changes by calling the synchronization parameters object's `save` method:

   ```
   sp.save();
   ```

   Note: If you defined a default value or bound a PersonalizationParameters in the `SynchronizationParameters`, then that value will not take effect unless you call `sp.save()`.

   After you save the synchonization parameters, call another **synchronize()** to download the data.

4. When using synchronization parameters to retrieve data from an MBO during a synchronization session, clear the previous synchronization parameter values:

```
CustomerSynchronizationParameters sp =
Customer.getSynchronizationParameters();
sp.delete();
sp = Customer.getSynchronizationParameters();//Must re-get
synchronization parameter instance.
sp.setCityname("New City");
sp.save();
```

See also

- *Synchronizing* on page 25
- *Synchronization APIs* on page 58

Subsequently Starting an Application

Subsequent start-ups are different from the first start-up.

Starting an application on subsequent occasions:

1. Set up the `com.sybase.mobile.Application` instance with the required `com.sybase.mobile.ConnectionProperties`, including user credentials.
2. Set up the connection profile properties if needed for database location and tuning parameters.
3. Set up the synchronization profile properties if needed for SSL or a relay server.
4. Start the application connection to the server.
5. Open the database connection.
   You can do this in parallel with starting the application connection to the server.

See also

- *Application APIs* on page 45

Accessing MBO Data

Use MBO object queries to retrieve lists of MBO instances, or use dynamic queries that return results sets or object lists.

See also

- *Query APIs* on page 78
- *Object Queries* on page 30
- *Dynamic Queries* on page 30
- *MBOs with Complex Types* on page 31
- *Relationships* on page 32

Object Queries

Use the generated static methods in the MBO classes to retrieve MBO instances.

1. To find all instances of an MBO, invoke the static `findAll` method contained in that MBO. For example, an MBO named `Customer` contains a method such as `public static com.sybase.collections.GenericList<SUP101.Customer> findAll()`.
2. To find a particular instance of an MBO using the primary key, invoke `MBO.findByPrimaryKey(...)`. For example, if a Customer has the primary key "id" as int, the Customer MBO would contain the `public static Customer findByPrimaryKey(int id)` method, which performs the equivalent of `Select x.* from Customer x where x.id = :id`.

If the return type is a list, additional methods are generated for you to further process the result, for example, to use paging. For example, consider this method, which returns a list of MBOs containing the specified city name: `com.sybase.collections.GenericList<SUP101.Customer> findByCity(String city, int skip, int take);`. The `skip` parameter specifies the number of rows to skip, and the `take` parameter specifies the maximum number of rows to return.

See also

- *Accessing MBO Data* on page 29
- *Query APIs* on page 78

Dynamic Queries

Build queries based on user input.

Use the `com.sybase.persistence.Query` class to retrieve a list of MBOs.

1. Specify the where condition used in the dynamic query.

```
Query query = new Query();

AttributeTest aTest = new AttributeTest();

aTest.setAttribute("state");
aTest.setTestValue("NY");
aTest.setTestType(AttributeTest.EQUAL);
query.setTestCriteria(aTest);

SortCriteria sort = new SortCriteria();
sort.add("lname", SortOrderType.ASCENDING);
sort.add("fname", SortOrderType.ASCENDING);
query.setSortCriteria(sort);
```

2. Use the `findWithQuery` method in the MBO to dynamically retrieve a list of MBOs acccording to the specified attributes.

```
GenericList<Customer> customers = Customer.findWithQuery(query);
int n = customers.count();
for (int i = 0; i < n;   i)
{
   Customer c = (Customer)customers.get(i);
   System.out.println("Customer " + i + ": "
       + c.getLname() + ", "  + c.getFname());
}
```

3. Use the generated database's `executeQuery` method to query multiple MBOs through the use of joins.

```
Query query = new Query();

query.select("c.fname,c.lname,s.order_date,s.id");
query.from("Customer", "c");
query.join("Sales_order", "s", "s.cust_id", "c.id");

AttributeTest ts = new AttributeTest();
ts.setAttribute("lname");
ts.setTestValue("Smith");
ts.setOperator(AttributeTest.EQUAL);
query.setTestCriteria(ts);
QueryResultSet qrs = SUP101DB.executeQuery(query);

while(qrs.next())
{
   System.out.println("order: "
      qrs.getInt(4) +           // 4 is s.id
      qrs.getString(1) +        // 1 is c.fname
      ", " + qrs.getString(2) + // 2 is c.lname
      " "  + qrs.getDate(3));   // 3 is s.order_date
}
```

See also

- *Accessing MBO Data* on page 29
- *Query APIs* on page 78

MBOs with Complex Types

Mobile business objects are mapped to classes containing data and methods that support synchronization and data manipulation. You can develop complex types that support interactions with backend data sources such as SAP® and Web services. When you define an MBO with complex types, Sybase Unwired Platform generates one class for each complex type.

Using a complex type to create an MBO instance.

1. Suppose you have an MBO named `SimpleCaseList` and want to use a complex data type called `AuthenticationInfo` to its `Create` method's parameter. Begin by creating the complex datatype:

```
AuthenticationInfo authen = new AuthenticationInfo();
authen.setUserName("Demo");
```

2. Instantiate the MBO object:

```
SimpleCaseList newCase = new SimpleCaseList();
newCase.setCase_Type("Incident");
newCase.setCategory("Networking");
newCase.setCreate_Time(new
java.sql.Timestamp(System.currentTimeMillis()));
```

3. Call the `create` method of the SimpleCaseList MBO with the complex type parameter as well as other parameters, and call `submitPending()` to submit the `create` operation to the operation replay record. Subsequent synchronizations upload the operation replay record to the Unwired Server and get replayed.

```
newCase.create(authen, "Other", "Other", "Demo", “false”,
“worklog”);
newCase.submitPending();
```

See also

- *Accessing MBO Data* on page 29
- *Query APIs* on page 78

Relationships

The Object API supports one-to-one, one-to-many, and many-to-one relationships.

Navigate between MBOs using relationships.

1. Suppose you have one MBO named `Customer` and another MBO named `SalesOrder`. This code illustrates how to navigate from the `Customer` object to its child `SalesOrder` objects:

```
Customer cust = Customer.findById(101);
com.sybase.collections.ObjectList orders =
customer.getSalesOrders();
```

2. To filter the returned child MBO's list data, use the `Query` class:

```
Query query = new Query();
AttributeTest at = new AttributeTest("sales_rep", new
Integer(129), AttributeTest.EQUAL);
query.where(at);
orders = cust.getSalesOrdersFilterBy(query);
```

3. For composite relationship, you can call the parent's `SubmitPending` method to submit the entire object tree of the parent and its children. Submitting the child MBO also submits the parent and the entire object tree. (If you have only one child instance, it would not make any difference. To be efficient and get one transaction for all child operations, it is recommened to submit the parent MBO once, instead of submitting every child).

   If the primary key for a parent is assigned by the EIS, you can use a multilevel insert cascade operation to create the parent and child objects in a single operation without synchronizing multiple times. The returned primary key for the parent's `create` operation populates the children prior to their own creation.

The following example illustrates how to submit the parent MBO which also submits the child's operation:

```
Customer cust = Customer.findById(101);
Sales_order order = new Sales_order();
order.setId(1001);
order.setCustomer(cust);
order.setOrder_date(new Date());
order.setFin_code_id("r1");
order.setRegion("Eastern");
order.setSales_rep(101);
order.save(); // or order.create();
cust.save();
cust.submitPending();
```

See also

- *Accessing MBO Data* on page 29
- *Query APIs* on page 78

Manipulating Data

Create, update, and delete instances of generated MBO classes.

You can create a new instance of a generated MBO class, fill in the attributes, and call the `create` method for that MBO instance.

You can modify an object loaded from the database by calling the `update` method for that MBO instance.

You can load an MBO from the database and call the `delete` method for that instance.

See also

- *Persistence APIs* on page 88

Creating, Updating, and Deleting MBOs

Perform create, update, and delete operations on MBO instances.

You can call the `create`, `update`, and `delete` methods for MBO instances.

1. Suppose you have an MBO named `Customer`. To create an instance within the database, invoke its `create` method, which causes the object to enter a pending state. Then call the MBO instance's `submitPending` method. Finally, synchronize with the generated database:

```
Customer newcustomer = new Customer();
//Set the required fields for the customer
```

```
// …

newcustomer.create();
newcustomer.submitPending();
SUP101DB.synchronize();
```

2. To update an existing MBO instance, retrieve the object instance through a query, update its attributes, and invoke its `update` method, which causes the object to enter a pending state. Then call the MBO instance's `submitPending` method. Finally, synchronize with the generated database:

   ```
   Customer customer = Customer.findByPrimary(myCustomerId) //find
   by primary key
   customer.setCity("Dublin"); //update any field to a new value
   customer.update();
   customer.submitPending();
   SUP101DB.synchronize();
   ```

3. To delete an existing MBO instance, retrieve the object instance through a query and invoke its `delete` method, which causes the object to enter a pending state. Then call the MBO instance's `submitPending` method. Finally, synchronize with the generated database:

   ```
   Customer customer = Customer.FindByPrimary(myCustomerId) //find
   by primary key
   customer.delete();
   customer.submitPending();
   SUP101DB.synchronize();
   ```

See also

- *Operations APIs* on page 88

Other Operations

Use operations other than create, update, or delete.

In this example, a customized operator is used to perform a sum operation.

1. Suppose you have an MBO named `MyMBO` that has an operator that generates a customized sum. Begin by creating an object instance and assigning values to its attributes, specifying the `"Add"` operation:

   ```
   MyMBO op = new MyMBO();

   op.setOperand1(12);
   op.setOperand2(23);
   op.setOperator("Add");
   op.save();
   ```

2. Call the MBO instance's `submitPending` method and synchronize with the generated database:

   ```
   op.submitPending();
   SUP101DB.synchronize();
   ```

See also

- *Operations APIs* on page 88

Using SubmitPending and SubmitPendingOperations

You can submit a single pending MBO, all pending MBOs of a single type, or all pending MBOs in a package. Once those pending changes are submitted to the server, the MBOs enter a replay pending state.

Note that **submitPendingOperations** APIs are expesive. Sybase recommends using the **submitPending** API with the MBO instance whenever possible.

Database Classes

Submit pending operations for all entities in the package or synchronization group, cancel all pending operations that have not been submitted to the server, and check if there are pending oprations for all entities in the package.

1. To submit pending operations for all pending entities in the package, invoke the generated database's `submitPendingOperations` method.
2. To submit pending operations for all pending entities in the specified synchronization group, invoke the generated database's `submitPendingOperations (string synchronizationGroup)` method.
3. To cancel all pending operations that have not been submitted to the server, invoke the generated database's `cancelPendingOperations` method.
4. To check if there are pending operations for all entities in the package, invoke the generated database's `hasPendingOperations` method.

Generated MBOs

Submit pending operations for all entities for a given MBO type or a single instance, and cancel all pending operations that have not been submitted to the server for the MBO type or a single entity.

1. To submit pending operations for all pending entities for a given MBO type, invoke the MBO class' static `submitPendingOperations` method.
2. To submit pending operations for a single MBO instance, invoke the MBO object's `submitPending` method.
3. To cancel all pending operations that have not been submitted to the server for the MBO type, invoke the MBO class' static `cancelPendingOperations` method.
4. To cancel all pending operations for a single MBO instance, invoke the MBO object's `cancelPending` method.

Shutting Down the Application

Shut down an application and clean up connections.

Closing Connections

Clean up connections from the generated database instance prior to application shutdown.

1. To release an opened application connection, stop the messaging channel by invoking the application instance's `stopConnection` method.

   ```
   app.stopConnection(<timeout_value>);
   ```
2. Close all connections to device database by calling the `closeConnection` method in the generated package database class. If one application has multiple packages, invoke the `closeConnection` API in all the packages.

Uninstalling the Application

Uninstall the application and clean up all package- and MBO-level data.

Deleting the Database and Unregistering the Application

Delete the package database, and unregister the application.

1. To delete the package database, call the generated database's `deleteDatabase` method.

   ```
   SUP101DB.deleteDatabase();
   ```
2. Unregister the application by invoking the `Application` instance's `unregisterApplication` method.

   ```
   app.unregisterApplication(0);
   ```

Testing Applications

Test native applications on a device or simulator.

See also

- *Customizing the Application Using the Object API* on page 15
- *Localizing Applications* on page 41

Testing an Application Using a Emulator

Run and test the application on an emulator and verify that the application automatically registers to Unwired Server using the default application connection template.

Prerequisites

You must have created an Android Virtual Device when you installed the Android SDK in your Android development environment. The Android Virtual Device (AVD) must use the same target as the test package.

Task

1. In the Eclipse Package Explorer, right-click the project and select **Run As** > **Run Configuration**.
   The ADT plugin for Eclipse installs your application, starts the emulator automatically, and launches the application. The application will automatically register with Unwired Server using the default application connection template. Once you build your application, deploy the Android package (APK) file. For more information on publishing your Android application, see *http://developer.android.com/guide/publishing/publishing_overview.html*.
2. In Sybase Control Center verify that the application connection was created in **Applications** > **Application Connections**.
   When the application has successfully registered, the application connection displays a value of zero in the Pending Items column.
3. Test the functionality of the application. Use debug tools as necessary, setting breakpoints at appropriate places in the application.

Client-Side Debugging

Identify and resolve client-side issues while debugging the application.

Problems on the device client side that may cause client application problems:

- Unwired Server connection failed - use your device browser to check the connectivity of your device to the server.
- Data does not appear on the client device - check if your synchronization and personalization parameters are set correctly. If you are using queries, check if your query conditions are correctly constructed and if the device data match your query conditions.
- Physical device problems, such as low memory - implement `ApplicationCallback.onDeviceConditionChanged` to be notified if device storage gets too low, or recovers from an error.
- Unwired Server connection failed. Use your device browser to check the connectivity of your device to the server.
- Data does not appear on the client device. Check if your synchronization and personalization parameters are set correctly. If you are using queries, check if your query conditions are correctly constructed and that the device data matches your query conditions.
- Physical device problems, such as low battery or low memory.

To find out more information on the device client side:

- If you have implemented debugging in your generated or custom code (which Sybase recommends), turn on debugging and review the debugging information. See the API Reference information about using the `Logger` class to add logs to the client log record and synchronize them to the server (viewable in Sybase Control Center).
- Check the log record on the device. Use the **<PkgName>DB.getLogRecords (com.sybase.persistence.Query)** or **Entity.getLogRecords()** methods.

  This is the log format

  ```
  level,code,eisCode,message,component,entityKey,operation,requestI
  d,timestamp
  ```

  This log format generates output similar to:

  ```
  level code eisCode message component entityKey operation requestId
  timestamp
   5,500,'','java.lang.SecurityException:Authorization failed:
  Domain = default Package = end2end.rdb:1.0 mboName =
  simpleCustomer action =
  delete','simpleCustomer','100001','delete','100014','2010-05-11
  14:45:59.710'
  ```

  - `level` – the log level currently set. Values include: 1 = TRACE, 2 = DEBUG, 3 = INFO, 4 = WARN, 5 = ERROR, 6 = FATAL, 7 = OFF.
  - `code` – Unwired Server administration codes.
    - Synchronization codes:
      - 200 – success.
      - 500 – failure.

  - `eisCode` – maps to HTTP error codes. If no mapping exists, defaults to error code 500 (an unexpected server failure).
  - `message` – the message content.
  - `component` – MBO name.
  - `entityKey` – MBO surrogate key, used to identify and track MBO instances and data.
  - `operation` – operation name.
  - `requestId` – operation replay request ID or messaging-based synchronization message request ID.
  - `timestamp` – message logged time, or operation execution time.
- If you have implemented `ApplicationCallback.`**onConnectionStatusChanged** for synchronization in the `CallbackHandler`, the connection status between Unwired Server and the device is reported on the device. See the `CallbackHandler` API reference information. The device connection status, device connection type, and connection error message are reported on the device:
  - 1 – current device connection status.
  - 2 – current device connection type.
  - 3 – connection error message.
- For other issues, you can turn on SQLTrace trace on the device side to trace Client Object API activity. To enable SQLTrace using the ConnectionProfile's enableTrace API:

```
// To enable SQL trace with values also displayed
SUP101DB.getConnectionProfile().enableTrace(true, true);
```

Server-Side Debugging

Identify and resolve server-side issues while debugging the application.

Problems on the Unwired Server side may cause device client problems:

- The domain or package does not exist. If you create a new domain, with a default status of disabled, it is unavailable until enabled.
- Authentication failed for the application user credentials.
- The operation role check failed for the synchronizing user.
- Back-end authentication failed.
- An operation failed on the remote, replication database back end, for example, a table or foreign key does not exist.
- An operation failed on the Web Service, REST, or SAP® back end.

To find out more information on the Unwired Server side:

- Check the Unwired Server log files.
- For message-based synchronization mode, you can set the log level to DEBUG to obtain detailed information in the log files:

1. Set the log level using Sybase Control Center. See *Sybase Control Center for Unwired Platform > Administer > Server Log > Configuring Server Log Setting*.

Note: Return to INFO mode as soon as possible, since DEBUG mode can affect system performance.

- Obtain DEBUG information for a specific device:
  - In the SCC administration console:
    1. Set the DEBUG level to a higher value for a specified device:
       a. In SCC, select **Application Connections**, then select **Properties... > Device Advanced**.
       b. Set the Debug Trace Level value.
    2. Set the TRACE file size to be greater than 50KB.
    3. View the trace file through SCC.
  - Check the `<*server_install_folder*>\UnwiredPlatform\Servers\MessagingServer\Data\ClientTrace` directory to see the mobile device client log files for information about a specific device.

Note: Return to INFO mode as soon as possible, since DEBUG mode can affect system performance.

Localizing Applications

Localize an Android application by creating default and alternate resources.

For information, best practices, and tutorials on localizing Android applications, see *http://developer.android.com/guide/topics/resources/localization.html*

See also

- *Testing Applications* on page 37

Packaging Applications

Package applications according to your security or application distribution requirements.

You can package all libraries into one package. This packaging method provide more security since packaging the entire application as one unit reduces the risk of tampering of individual libraries.

You may package and install modules separately only if your application distribution strategy requires sharing libraries between Sybase Unwired Platform applications.

Signing

Code signing is required for applications to run on physical devices and emulators.

All applications must be signed. The system will not install an application on an emulator or a device if it is not signed.

To test and debug your application, the build tools sign your application with a special debug key that is created by the Android SDK build tools.

Client Object API Usage

The Sybase Unwired Platform Client Object API consists of generated business object classes that represent mobile business objects (MBOs) that are designed and built in the Unwired WorkSpace development environment. Device applications use the Client Object API to retrieve data and invoke mobile business object operations.

Refer to these sections for more information on using the APIs described in *Developer Guide: Android Object API Application* > *Customizing the Application Using the Object API*.

Client Object API Reference

Use the Sybase Client Object API Javadocs as a Client Object API reference.

Review the reference details in the Client Object API documentation, located in the Unwired Platform installation directory `<UnwiredPlatform_InstallDir>\MobileSDK \ObjectAPI\apidoc`.

There is a subdirectory for `android`.

From the `index.html` file, the top-left navigation pane lists all packages installed with Unwired Platform. The applicable documentation is available with each package. Click this link and navigate through the Javadoc.

Application APIs

The `Application` class, in the `com.sybase.mobile` Java package, manages mobile application registrations, connections and context.

See also

- *Initially Starting an Application* on page 15
- *Setting up Application Properties* on page 16
- *Registering an Application* on page 17
- *Subsequently Starting an Application* on page 29

getInstance

Retrieves the `Application` instance for the current mobile application.

Syntax

```
public static Application getInstance()
```

Returns

`getInstance` returns a singleton `Application` object.

Examples

- **Get the Application Instance –**

```
Application app = Application.getInstance();
```

setApplicationIdentifier

Sets the identifier for the current application.

Set the application identifer before calling `startConnection`, `registerApplication` or `unregisterApplication`.

Syntax

```
public void setApplicationIdentifier(java.lang.String value)
```

Parameters

- **value –** The identifier for the current application.

Examples

- **Set the Application Identifier –** Sets the application identifier to `SUP101`.

```
// Initialize Application settings
Application app = Application.getInstance();

// The identifier has to match the
// application ID deployed to the SUP server
app.setApplicationIdentifier("SUP101");
```

Usage

This method must be called in the user interface thread.

getRegistrationStatus

Retrieves the current status of the mobile application registration.

Syntax

```
public int getRegistrationStatus()
```

Returns

`getRegistrationStatus` returns one of the values defined in the `RegistrationStatus` class.

```
public class RegistrationStatus {

public static final int REGISTERED = 203;
public static final int REGISTERING = 202;
public static final int REGISTRATION_ERROR = 201;
public static final int UNREGISTERED = 205;
public static final int UNREGISTERING = 204;
}
```

Examples

- **Get the Registration Status –** Registers the application if it is not already registered.

```
if (app.getRegistrationStatus() ==
RegistrationStatus.UNREGISTERED)
{
   // If the application has not been registered to the server,
   // register now
   app.registerApplication();
}
else
{
   // start the connection to server
   app.startConnection();
}
```

registerApplication

Creates the registration for this application and starts the connection.

Syntax

```
public void registerApplication(int timeout)
```

Parameters

- **timeout –** Number of seconds to wait until the registration is created. If the the timeout is greater than zero and the registration is not created within the timeout period, an `ApplicationTimeoutException` is thrown (the operation might still be completing in a background thread).

Examples

- **Register an Application –** Registers the application with a one minute waiting period.

```
app.registerApplication(60);
```

setApplicationCallback

Sets the callback for the current application. It is optional, but recommended, to register a callback so the application can respond to changes in connection status, registration status, and application settings.

Syntax

```
public void setApplicationCallback(ApplicationCallback value)
```

Parameters

- **value –** The mobile application callback handler.

Examples

- **Set the Application Callback –**

  ```
  // Initialize Application settings
  Application app = Application.getInstance();

  // The identifier has to match the
  // application ID deployed to the SUP server
  app.setApplicationIdentifier("SUP101");
  ApplicationCallback appCallback = new MyApplicationCallback();
  app.setApplicationCallback(appCallback);
  ```

getApplicationContext

Returns the Android application context which allows access to application-specific resources and classes.

Syntax

```
public android.content.Context getApplicationContext()
```

Returns

`getApplicationContext` returns a single Context object.

Examples

- **Get the Application Context –**

  ```
  getApplicationContext()
  ```

setApplicationContext

Sets the Android application context, which is required before calling the`startConnection`, `registerApplication` or `unregisterApplication` methods. This method must be called in an user interface thread, not a background thread.

Syntax

```
public void setApplicationContext(android.content.Context context)
```

Returns

None.

Examples

- **Set the Application Context –**
  ```
  setApplicationContext(android.content.Context context)
  ```

startConnection

Starts the connection for this application. This method is equivalent to calling `startConnection(0)`, but is a non-blocking call which returns immediately. Use `getConnectionStatus` or the `ApplicationCallback` to retrieve the connection status.

Syntax

```
public void startConnection()
```

Returns

None.

Examples

- **Start the Application –**
  ```
  startConnection()
  ```

startConnection (int timeout)

Starts the connection for this application. If the connection was previously started, then this operation has no effect. You must set the appropriate `connectionProperties` before calling this operation.

If connection properties are improperly set, a `ConnectionPropertyException` is thrown. You can set the `applicationCallback` before calling this operation to receive asynchronous notification of connection status changes. If a callback handler is registered and network connectivity is available, the sequence of callbacks as a result of calling `startConnection` is:

```
onConnectionStatusChanged(ConnectionStatus.CONNECTING, 0, "")
 onConnectionStatusChanged(ConnectionStatus.CONNECTED, 0, "")
```

If a callback handler is registered and network connectivity is unavailable, the sequence of callbacks as a result of calling `startConnection` is:

```
onConnectionStatusChanged(ConnectionStatus.CONNECTING, 0, null)
 onConnectionStatusChanged(ConnectionStatus.CONNECTION_ERROR, code,
message)
```

After a connection is successfully established, it can transition at any later time to CONNECTION_ERROR status or NOTIFICATION_WAIT status and subsequently back to CONNECTING and CONNECTED when connectivity resumes.

Syntax

```
public void startConnection(int timeout)
```

Parameters

- **timeout –** The number of seconds to wait until the connection is started. If the timeout is greater than zero and the connection is not started within the timeout period, an `ApplicationTimeoutException` is thrown (the operation may still be completing in a background thread).

Returns

None.

Examples

- **Start the Application –**

  ```
  startConnection(int timeout)
  ```

getConnectionStatus

Return current status of the mobile application connection.

Syntax

```
public int getConnectionStatus()
```

Returns

`getConnectionStatus` returns one of the `ConnectionStatus` class values.

Examples

- **Get the Application Context –**

  ```
  getConnectionStatus()
  ```

Connection APIs

The Connection APIs contain methods for managing local database information, establishing a connection with the Unwired Server, and authenticating.

See also

- *Initially Starting an Application* on page 15

ConnectionProfile

The `ConnectionProfile` class manages local database information. Set its properties, including the encryption key, during application initialization, and before creating or accessing the local client database.

By default, the database class name is generated as "packageName"+"DB".

```
ConnectionProfile profile = <PkgName>DB.getConnectionProfile();
profile.setPageSize( 4*1024 );
profile.setEncryptionKey("Your key of more than 16 characters");
```

You can also generate an encryption key by calling the generated database's `generateEncryptionKey` method, and then store the key inside a `DataVault` object. The `generateEncryptionKey` method automatically sets the encryption key in the connection profile.

See also

- *Setting Up the Connection Profile* on page 18

Managing Device Database Connections

Use the `openConnection()` and `closeConnection()` methods generated in the package database class to manage device database connections.

Note: Any database operation triggers the establishment of the database connection. You do not need to explicitly call the `openConnection` API.

The `openConnection()` method checks that the package database exists, creates it if it does not, and establishes a connection to the database. This method is useful when first starting the application: since it takes a few seconds to open the database when creating the first connection, if the application starts up with a login screen and a background thread that performs the `openConnection()` method, after logging in, the connection already exists and is immediately available to the user.

The `closeConnection()` method closes the current database connection, and releases it from the used connection pool.

Improving Device Application Performance with One Writer Thread and Multiple Database Access Threads

The `maxDbConnections` property improves device application performance by allowing multiple threads to access data concurrently from the same local database.

Connection management allows you to have at most one writer thread concurrent with multiple reader threads. There can be other reader threads at the same time that the writer thread is writing to the database. The total number of threads are controlled by the `maxDbConnections` property.

In a typical device application such as Sybase Mobile CRM, a list view lists all the entities of a selected type. When pagination is used, background threads load subsequent pages. When the device application user selects an entry from the list, the detail view of that entry appears, and loads the details for that entry.

Prior to the implementation of `maxDbConnections`, access to the package on the local database was serialized. That is, an MBO database operation, such as, create, read, update, or delete (CRUD) operation waited for any previous operation to finish before the next was allowed to proceed. In the list view to detail view example, when the background thread is loading the entire list, and a user selects the details of one entry for display, the loading of details for that entry must wait until the entire list is loaded, which can be a long while, depending on the size of the list.

You can specify the number of total threads using `maxDbConnections`.

The `ConnectionProfile` class in the persistence package includes the `maxDbConnections` property, which you set before performing any operation in the application. The default value (maximum number of concurrent read threads) is 2.

```
ConnectionProfile connectionProfile =
MyPackageDB.getConnectionProfile();
```

To allow 6 concurrent threads, set the `maxDbConnections` property to 6 in `ConnectionProfile` before accessing the package database at the beginning of the application.

```
    connectionProfile.setMaxDbConnections(6);
```

Set Database File Property

You can use `setProperty` to specify the database file name on the device, such as the directory of the running program, a specific directory path, or a secure digital (SD) card.

```
ConnectionProfile cp = MyDatabaseClass.getConnectionProfile();
cp.setProperty("databaseFile", "databaseFile");
cp.save();
```

Examples

If you specify the *databaseFile* name only, with no path, the *databaseFile* is created in the path where the program is running:

```
/mydb.udb
```

The *databaseFile* is created on an SD card:

```
Environment.getExternalStorageDirectory().getAbsolutePath() + "/
mydb.udb"
```

Note: For the database file path and name, the forward slash (/) is required as the path delimiter, for example `/smartcard/supprj.udb`.

Usage

- Be sure to call this API before the database is created..
- The database is UltraLiteJ™; use an absolute path to the database file name like `/sdcard/mydb.ulj`.
- If the device client user changes the file name, he or she must make sure the input file name is a valid name and path on the client side.

Synchronization Profile

Before synchronizing with Unwired Server, you must configure a client with information for establishing a connection with the Unwired Server's data synchronization channel where the server package has been deployed. The `com.sybase.persistence.ConnectionProfile` class manages that information.

The generated package database class initially has default settings for the synchronization connection profile. You can modify these setttings if you require different settings than the generated code, or set certificate settings.

```
ConnectionProfile profile = <PkgName>DB.getSynchronizationProfile();
profile.setDomainName( "default" );
profile.setServerName( "sup.sybase.com" );
profile.setPortNumber( 2480 );
profile.setNetworkProtocol( "http" );
profile.getStreamParams().setTrusted_Certificates( "rsa_public_cert
.crt" );
```

See also

- *Synchronization Profile* on page 19

Connect the Data Synchronization Channel Through a Relay Server

To enable your client application to connect through a relay server, you must make manual configuration changes in the object API code to provide the relay server properties.

Edit <package-name>DB by modifying the values of the relay server properties for your Relay Server environment.

To update properties for the relay server installed on Apache on Linux:

```
getSynchronizationProfile().setServerName("examplexp-vm1");
getSynchronizationProfile().setPortNumber(80);
getSynchronizationProfile().setNetworkProtocol("http");
NetworkStreamParams streamParams =
getSynchronizationProfile().getStreamParams();
streamParams.setUrl_Suffix("/cli/iarelayserver/<FarmName>");
getSynchronizationProfile().setDomainName("default");
```

To update properties for the relay server installed on Internet Information Services (IIS) on Microsoft Windows:

```
getSynchronizationProfile().setServerName("examplexp-vm1");
getSynchronizationProfile().setPortNumber(2480);
getSynchronizationProfile().setNetworkProtocol("http");
NetworkStreamParams streamParams =
getSynchronizationProfile().getStreamParams();
streamParams.setUrl_Suffix("/ias_relay_server/client/rs_client.dll/
<FarmName>");
getSynchronizationProfile().setDomainName("default");
```

For more information on relay server configuration, see *System Administration* and *Sybase Control Center for Unwired Server*.

Authentication APIs

You can log in to the Unwired Server with your user name and credentials and use the X.509 certificate you installed in the task flow for single sign-on.

Logging In

The generated package database class provides a default synchronization connection profile according to the Unwired Server connection profile and server domain selected during code generation. You can log in to the Unwired Server with your user name and credentials.

The package database class provides these methods for logging in to the Unwired Server:

- **`onlineLogin(String username, String password)`** – authenticates credentials against the Unwired Server.
- **`offlineLogin(String username, String password)`** – authenticates against the most recent successfully authenticated credentials. Once the client connects for

the first time, the server validated user name and password are stored locally. `offlineLogin` verifies with the client database if those credentials are valid. The method returns YES if the user name and password are correct, otherwise the method returns NO.

There is no communication with Unwired Server in this method. This method is useful if there is no connection the the Unwired Server and you want to access the client application locally.

Sample Code

Illustrates importing the certificate and setting up login credentials, as well as other APIs related to certificate handling:

```
/// SUP101DB is a generated database class
///First install certificates on your simulator, for example
"Sybase101.p12"


//Getting certificate from certificate store
CertificateStore myStore =
CertificateStore.getDefault();
String filter1 = "Sybase";
StringList labels = myStore.certificateLabels(filter1, null);
String aLabel = labels.item(0);
LoginCertificate lc = myStore.getSignedCertificate(aLabel,
"password");

// Save the login certificate to your synchronization profile
SUP101DB.getSynchronizationProfile().setCertificate(lc);

// Login to and synchronize with Unwired Server
SUP101DB.subscribe();
SUP101DB.synchronize();

// Save the login certificate to your data vault
// The vault must be unlocked before saving
// SybaseDataProvider.apk package must be installed on Android device
String vaultName = "myVault";
DataVault vault = null;
if(!DataVault.vaultExists(vaultName))
{
    vault = DataVault.createVault(vaultName, "password", "salt");
}
else
{
    vault = DataVault.getVault(vaultName);
}
vault.unlock("password", "salt");
lc.save("myLabel", vault);

//Loading and deleting certificate
```

```
LoginCertificate newLc = LoginCertificate.load("myLabel", vault);
LoginCertificate.delete("myLabel", vault);
```

Single Sign-On With X.509 Certificate Related Object API

Use these classes and attributes when developing mobile applications that require X.509 certificate authentication.

- `CertificateStore` class - wraps platform-specific key/certificate store class, or file directory
- `LoginCertificate` class - wraps platform-specific X.509 distinguished name and signed certificate
- `ConnectionProfile` class - includes the certificate attribute used for Unwired Server synchronization.

Refer to the API Reference for implementation details.

Importing a Certificate into the Data Vault

Obtain a certificate reference and store it in a password-protected data vault to use for X.509 certificate authentication.

The difference between importing a certificate from a system store or a file directory is determined by how you obtain the `CertificateStore` object. In either case, only a label and password are required to import a certificate blob, which is a digitally signed copy of the public X.509 certificate.

```
// Obtain a reference to the certificate store
CertificateStore certStore = CertificateStore.getDefault();

// Obtain a list of certificates
StringList labels = certStore.certificateLabels();

// Import a certificate blob from store (into memory)
String label = ...; // ask user to select a label
String password = ...; // ask the user for a password
LoginCertificate cert = certStore.getSignedCertificate(label,
password);

// Lookup or create data vault
String vaultPassword = ...; // ask user or from O/S protected storage
String vaultName = "..."; // e.g. "SAP.CRM.CertificateVault"
String vaultSalt = "..."; // e.g. a hard-coded random GUID
DataVault vault;
try
{
    vault = DataVault.getVault(vaultName);
    vault.unlock(vaultPassword, vaultSalt);
}
catch (DataVaultException ex)
{
    vault = DataVault.createVault(vaultName, vaultPassword,
vaultSalt);
}
```

```
// Save certificate into data vault
cert.save("myCert", vault);
```

Selecting a Certificate for Unwired Server Connections

Select the X.509 certificate from the data vault for Unwired Server authentication.

```
LoginCertificate cert = LoginCertificate.load("myCert", vault);
ConnectionProfile syncProfile =
MyDatabase.getSynchronizationProfile();
syncProfile.setCertificate(cert);
```

Connecting to Unwired Server with a Certificate

Once the certificate property is set, use the `onlineLogin()` API with no parameters. Do not use the `onlineLogin()` API with username and password.

```
SUP101DB onlineLogin();
```

Personalization APIs

Personalization keys allow the application to define certain input parameter values that are personalized for each mobile user. Personalization parameters provide default values for synchronization parameters when the synchronization key of the object is mapped to the personalization key while developing a mobile business object. The Personalization APIs allow you to manage personalization keys, and get and set personalization key values.

See also

- *Specifying Personalization Parameters* on page 27

Type of Personalization Keys

There are three types of personalization keys: client, server, and transient (or session). Client personalization keys are persisted in the local database. Server personalization keys are persisted on the Unwired Server. Session personalization keys are not persisted and are lost when the device application terminates.

A personalization parameter can be a primitive or complex type.

A personalization key is metadata that enables users to store their search preferences on the client, the server, or by session. The preferences narrow the focus of data retrieved by the mobile device (also known as the filtering of data between client and Unwired Server). Often personalization keys are used to hold backend system credentials, so that they can be propagated to the EIS. To use a personalization key for filtering, it must be mapped to a synchronization parameter. The developer can also define personalization keys for the application, and can use built-in personalization keys available in Unwired Server. Two key built-in personalization keys — username and password — can be used to perform single sign-on from the device application to the Unwired Server, authentication and authorization on Unwired Server, as well as connecting to the back-end EIS using the same set of credentials. The password is never saved on the server.

Getting and Setting Personalization Key Values

The `PersonalizationParameters` class is generated automatically for managing personalization keys. When a personalization parameter value is changed, the call to `save` automatically propagates the change to the server.

An operation can have a parameter that is one of the Sybase Unwired Platform list types (such as `IntList`, `StringList`, or `ObjectList`). This code shows how to set a personalization key, and pass an array of values and an array of objects:

```
PersonalizationParameters pp =
SUP101DB.getPersonalizationParameters();
pp.setMyIntPK(10002);
pp.save();
IntList il = new IntList(2);
il.add(10001);
il.add(10002);
pp.setMyIntListPK(il);
pp.save();

MyDataList dl = new MyDataList();
//MyData is a structure type defined in tooling
MyData md = new MyData();
md.setIntMember( ... );
md.setStringMember2( ... );
dl.add(md);
pp.setMyDataList( dl );
pp.save();
```

If a synchronization parameter is personalized, you can overwrite the value of that parameter with the personalization value.

Note: For a detailed description on personalization key usage, see the *Sybase Unwired Platform online help*.

Synchronization APIs

You can synchronize mobile business objects (MBOs) based on synchronization parameters, for individual MBOs, or as a group, based on the group's synchronization policy.

Note: The `loginToSync` API is now deprecated. For RBS, call `synchronize` or `beginSynchronize` before saving synchronization parameters. After saving the synchronization parameters, call `synchronize` or `beginSynchronize` again to retrieve the new values filtered by those parameters. For MBS, call `subscribe` before saving synchronization parameters.

See also

- *Synchronizing* on page 25
- *Specifying Synchronization Parameters* on page 28

Changing Synchronization Parameters

Synchronization parameters let an application change the parameters that retrieve data from an MBO during a synchronization session.

The primary purpose of synchronization parameters is to partition data. Change the synchronization parameters to affect the data you are working with (including searches), and synchronization.

When a synchronization parameter value is changed, the call to `save` automatically propagates the change to the Unwired Server.

```
CustomerSynchronizationParameters sp =
Customer.getSynchronizationParameters();
sp.setMyid(10001);
sp.save();
```

Note: The Sybase Unwired Platform server will not send MBO data to a device if an MBO has synchronization parameters defined, unless the application client code calls the `save` method. The next synchronize call will retrieve data from the server. This is true even if default values are defined for its synchronization parameters.

Performing Mobile Business Object Synchronization

A synchronization group is a group of related MBOs. A mobile application can have predefined synchronization groups. An implicit default synchronization group includes all the MBOs that are not in any other synchronization group.

This code synchronizes an MBO package using a specified connection:

```
SUP101DB.synchronize (string synchronizationGroup)
```

The package database class includes two synchronization methods. You can synchronize a specified group of MBOs using the synchronization group name:

```
SUP101DB.synchronize("my-sync-group");
```

Or, you can synchronize all synchronization groups:

```
SUP101DB.synchronize();
```

There is a default synchronization group within every package. The default synchronization group includes all MBOs except those already included by other synchronization groups. To synchronize a default synchronization group call
`DBClass.beginSynchronize("default");` or
`DBClass.synchronize("default");`

If there is no other synchronization group, call `DBClass.beginSynchronize();` or `DBClass.synchronize();`

To synchronize a synchronization group asynchronously:

```
ObjectList syncGroups = new ObjectList();
syncGroups.add(SUP101DB.getSynchronizationGroup("my-sync-group"));
SampleAppDB.beginSynchronize(syncGroups, "");
```

When an application uses a create, update, or delete operation in an MBO and calls the `submitPending` metod, an `OperationReplay` object is created for that change. The application must invoke either the `synchronize` or `beginSynchronize` method to upload the `OperationReplay` object to the server to replay the change on the backend data source. The `isReplayQueueEmpty` API is used to check if there are unsent operation replay objects and decide whether a synchronize call is needed.

```
if (!SUP101DB.isReplayQueueEmpty())
{
   // There are OperationReplay not uploaded to server
   ObjectList sgs = new ObjectList();
   sgs.add(MyPackageDB.getSynchronizationGroup("system"));
   MyPackageDB.beginSynchronize(sgs, "upload OperationReplay
objects");
}
```

Push Synchronization Applications

Clients receive device notifications when a data change is detected for any of the MBOs in the synchronization group to which they are subscribed.

Sybase Unwired Platform uses a messaging channel to send change notifications from the server to the client device. By default, change notification is disabled. You can enable the change notification of a synchronization group:

```
ISynchronizationGroup sg =
MyPackageDB.getSynchronizationGroup("TCNEnabled");

if (!sg.EnableSIS)
{
  sg.setEnableSIS(true);
  sg.setInterval(2);
  sg.save();
  MyPackageDB.synchronize("TCNEnabled");
}
```

When the server detects changes in an MBO affecting a client device, and the synchronization group of the MBO has the change detection enabled, the server will send a notification to client device through messaging channel. When the server detects changes in an MBO affecting a client device, and the synchronization group of the MBO has the change detection enabled, the server will send a notification to client device through messaging channel. By default, a background synchronization downloads the changes for that synchronization group. The application can implement the onSynchronize callback method to monitor this condition, and either allow or disallow background synchronization.

```
public int OnSynchronize(GenericList<ISynchronizationGroup> groups,
SynchronizationContext context)
{
  int status = context.getStatus();
  if (status == SynchronizationStatus.STARTING_ON_NOTIFICATION)
  {
    // There is changes on the synchronization group
    if (busy)
    {
      return SynchronizationAction.CANCEL;
    }
    else
    {
      return SynchronizationAction.CONTINUE;
    }
  }

  // return CONTINUE for all other status
  return SynchronizationAction.CONTINUE;
}
```

Retrieving Information about Synchronization Groups

The package database class provides the following two methods for querying the synchronized state and the last synchronization time of a certain synchronization group:

```
/// Determines if the synchronization group was synchronized
public static boolean isSynchronized(java.lang.String
synchronizationGroup)

/// Retrieves the last synchronization time of the synchronization
group
public static java.util.Date
getLastSynchronizationTime(java.lang.String synchronizationGroup)
```

Log Record APIs

The Log Record APIs allow you to customize aspects of logging.

- Writing and retrieving log records (successful operations are not logged).
- Configuring log levels for messages reported to the console.
- Enabling the printing of server message headers and message contents, database exceptions, and `LogRecord` objects written for each import.
- Viewing detailed trace information on database calls.
- The change log can be enabled or disabled with the `enableChangeLog` and `disableChangeLog` methods. You can retrieve the change log by calling the `getChangeLogs` method.

LogRecord API

`LogRecord` stores two types of logs.

- Operation logs on the Unwired Server. These logs can be downloaded to the device.
- Client logs. These logs can be uploaded to the Unwired Server.

This code executes an update operation and examines the log records for the Customer MBO:

```
int id = 101;
Customer result = Customer.findById(id);
result.setFname("newFname");
result.save();
result.submitPending();
SUP101DB.synchronize();
result = Customer.findById(id);
for(com.sybase.persistence.LogRecord logRecord :
result.getLogRecords())
{
//Working with logRecord
}
```

The code in the log record is an HTTP status code. See *Developer Guide: Android Object API Applications > Client Object API Usage > Exceptions > Handling Exceptions > HTTP Error Codes*.

There is no logRecord generated for a successful operation replay. The Unwired Server only creates a logRecord when an operation fails.

Logging APIs

Retrieve client log records.

Use the `Logger` API to set the log level and create log records on the client. Each package has a `Logger`. To obtain the package logger, use the `getLogger` method in the generated database class.

```
Logger logger = SUP101DB.getLogger();

// set log level to debug
logger.setLogLevel(LogLevel.DEBUG);

// create a log record with ERROR level and the error message.
logger.Error("Some error message");
```

Change Log API

The change log allows a client to retrieve a list of changes from a particular MBO, and reconstruct the list of changes without invoking findAll.

enableChangeLog

By default, Change Log is disabled. To enable the change log, invoke the `enableChangeLog` API in the generated database class. The next synchronization will have change logs sent to the client.

Syntax

```
enableChangeLog();
```

Returns

None.

Examples

- **Enable Change Log –**

  ```
  SUP101DB.enableChangeLog();
  ```

getChangeLogs

Retrieve a list of change logs.

Syntax

```
GenericList<com.sybase.persistence.ChangeLog>
getChangeLogs(com.sybase.persistence.Query query);
```

Returns

Returns a GenericList of type <Change Log>.

Examples

- **Get Change Logs –**

  ```
  GenericList<com.sybase.persistence.ChangeLog>
  getChangeLogs(query);
  ```

deleteChangeLogs

You are recommended to delete all change logs after the application has completed processing them. Use the `deleteChangeLogs` API in the generated database class to delete all change logs on the device.

Syntax

```
deleteChangeLogs();
```

Returns

None.

Examples

- **Delete Change Logs –**
  ```
  SUP101DB.deleteChangeLogs();
  ```

Usage

Ensure that when calling `deleteChangeLogs()`, there are no change logs created from a background synchronization that are not part of the original change log list returned by a specific query:

```
GenericList<ChangeLog> changes = getChangeLogs(myQuery);
```

You should only call `deleteChangeLogs()` in the `onSynchronize()` callback where there are no multiple synchronizations occurring simulatenously.

disableChangeLog

Creating change logs consumes some processing time, which can impact application performance. The application may can disable the change log using the `disableChangeLog` API.

Syntax

```
disableChangeLog();
```

Returns

`getInstance` returns a singleton `Application` object.

Examples

- **Disable Change Log –**
  ```
  SUP101DB.disableChangeLog();
  ```

Code Samples

Enable the change log and list all changes, or only the change logs for a particular entity, Customer.

```
SUP101DB.enableChangeLog();
SUP101DB.synchronize();

// Retrieve all change logs
GenericList<ChangeLog> logs = SUP101DB.getChangeLogs(new Query());
System.out.println("There are " + logs.size() + " change logs");
```

```
for (ChangeLog log : logs)
{
  System.out.println(log.getEntityType()
    + "(" + log.getSurrogateKey()
    + "): " + log.getOperationType());
}

// Retrieve only the change logs for Customer:
Query query = new Query();
AttributeTest at = new AttributeTest("entityType",
               new java.lang.Integer(SUP101.EntityType.Customer),
               AttributeTest.EQUAL);
 AL);
query.setTestCriteria(at);
logs = SUP101DB.getChangeLogs(query);
System.out.println("There are " + logs.size() + " change logs for
Customer");
for (ChangeLog log : logs)
{
  System.out.println(log.getEntityType()
    + "(" + log.getSurrogateKey()
    + "): " + log.getOperationType());
}
```

Security APIs

The security APIs allow you to customize some aspects of connection and database security.

Encrypt the Database

You can set the encryption key of a local database. Set the key during application initialization, and before creating or accessing the client database.

The length of the encyption key cannot be fewer than 16 characters.

```
ConnectionProfile profile = <PkgName>DB.getConnectionProfile();
profile.setEncryptionKey("Your key of length 16 or more
characters");
```

You can use the `generateEncryptionKey()` method to encrypt the local database with a random encryption key.

```
SUP101DB.generateEncryptionKey();
// store the encryption key at somewhere for reuse later
ConnectionProfile profile = SUP101DB.getConnectionProfile();
String key = profile.getEncryptionKey();
...
SUP101DB.createDatabase();
```

End to End Encryption and Compression Support APIs

Use encryption communication parameters to ensure end to end encryption and eliminate any WAP gap security problems.

You can use the Client Object API to set up end to end encryption, supported by Ultralite, and HTTPS items in the synchronization profile.

Refer to the following APIs when setting up end to end encryption and compression support:

- `com.sybase.persistence.ConnectionProfile.getStreamParams`
- `com.sybase.persistence.NetworkStreamParams.getTrusted_Certificates`
- `com.sybase.persistence.NetworkStreamParams.setTrusted_Certificates`
- `com.sybase.persistence.NetworkStreamParams.getE2ee_Type`
- `com.sybase.persistence.NetworkStreamParams.setE2ee_Type`
- `com.sybase.persistence.NetworkStreamParams.getE2ee_Public_Key`
- `com.sybase.persistence.NetworkStreamParams.setE2ee_Public_Key`
- `com.sybase.persistence.NetworkStreamParams.setZlibCompression`
- `com.sybase.persistence.NetworkStreamParams.setZlib_Upload_Window_Size`
- `com.sybase.persistence.NetworkStreamParams.setZlib_Download_Window_Size`

The following code example shows how to set E2EE:

```
ConnectionProfile conn=E2EEDB.getSynchronizationProfile();
conn.setNetworkProtocol("HTTP");
conn.setPortNumber(2480);
conn.getStreamParams().setE2ee_Type("rsa");
conn.getStreamParams().setE2ee_Public_Key("e2ee_public_key.key");
conn.save();
```

DataVault

The `DataVault` class provides encrypted storage of occasionally used, small pieces of data. All exceptions thrown by `DataVault` methods are of type `DataVaultException`.

If you have installed the `SybaseDataProvider.apk` package, you can use the `DataVault` class for on-device persistent storage of certificates, database encryption keys, passwords, and other sensitive items. Use this class to:

- Create a vault
- Set a vault's properties

- Store objects in a vault
- Retrieve objects from a vault
- Change the password used to access a vault

The contents of the data vault are strongly encrypted using AES-256. The `DataVault` class allows you create a named vault, and specify a password and salt used to unlock it. The password can be of arbitrarily length and can include any characters. The password and salt together are used to generate the AES key. If the user enters the same password when unlocking, the contents are decrypted. If the user enters an incorrect password, exceptions will occur. If the user enters the incorrect password a configurable number of times, the vault is deleted and any data stored within it becomes unrecoverable. The vault can also re-lock itself after a configurable amount of time.

Typical usage of the `DataVault` would be to implement an application login screen. Upon application start, the user is prompted for a password, which is then used to unlock the vault. If the unlock attempt is successful, the user is allowed into the rest of the application. User credentials needed for synchronization can also be extracted from the vault so the user is not repeatedly prompted to re-enter passwords.

createVault

Creates a new secure store.

Creates a vault. A unique name is assigned, and after creation, the vault is referenced and accessed by that name. This method also assigns a password and salt value to the vault. If a vault already exists with the same name, this method throws an exception. When created, the vault is in the unlocked state.

Syntax

```
public static DataVault createVault(
   String name,
   String password,
   String salt
)
```

Parameters

- **name –** The vault name.
- **password –** The password.
- **salt –** The encryption salt value.

Returns

createVault creates a `DataVault` instance.

If a vault already exists with the same name, a `DataVaultException` is thrown this with the reason `ALREADY_EXISTS`.

Examples

- **Create a Data Vault –** Creates a new data vault called `myVault`.

  ```
  DataVault vault = null;
  if (!DataVault.vaultExists("myVault"))
  {
     vault = DataVault.createVault("myVault", "password", "salt");
  }
  else
  {
     vault = DataVault.getVault("myVault");
  }
  ```

vaultExists

Tests whether the specified vault exists.

Syntax

```
public static boolean vaultExists(String name)
```

Parameters

- **name –** The vault name.

Returns

vaultExists can return the following values:

Returns	Indicates
true	The vault exists.
false	The vault does not exist.

Examples

- **Check if a Data Vault Exists –** Checks if a data vault called `myVault` exists, and if so, deletes it.

  ```
  if (DataVault.vaultExists("myVault"))
  {
     DataVault.deleteVault("myVault");
  }
  ```

getVault

Retrieves a vault.

Syntax

```
public static DataVault getVault(String name)
```

Parameters

- **–** The vault name.

Returns

getVault returns a `DataVault` instance.

If the vault does not exist, a `DataVaultException` is thrown.

deleteVault

Deletes the specified vault from on-device storage.

Deletes a vault having the specified name. If the vault does not exist, this method throws an exception. The vault need not be in the unlocked state, and can be deleted even if the password is unknown.

Syntax

```
public static void deleteVault(String name)
```

Parameters

- **name –** The vault name.

Examples

- **Delete a Data Vault –** Deletes a data vault called `myVault`.

  ```
  if (DataVault.vaultExists("myVault"))
  {
     DataVault.deleteVault("myVault");
  }
  ```

lock

Locks the vault.

Once a vault is locked, you must unlock it before changing the vault's properties or storing anything in it. If the vault is already locked, this method has no effect.

Syntax

```
public void lock()
```

Examples

- **Locks the data vault. –** Prevents changing the vaults properties or stored content.

  ```
  vault.lock();
  ```

isLocked

Tests whether the vault is locked.

Syntax

```
public boolean isLocked()
```

Returns

isLocked can return the following values:

Returns	Indicates
true	The vault is locked.
false	The vault is unlocked.

unlock

Unlocks the vault.

Unlock the vault before changing the its properties or storing anything in it. If the incorrect password or salt is used, this method throws an exception. If the number of unsuccessful unlock attempts exceeds the retry limit, the vault is deleted.

Syntax

```
public void unlock(String password, String salt)
```

Parameters

- **password –** The password.
- **salt –** The encryption salt value.

Returns

If the incorrect password or salt is used, a `DataVaultException` is thrown this with the reason `INVALID_PASSWORD`.

Examples

- **Unlocks the data vault. –** Once the vault is unlocked you can change the its properties and stored content.

  ```
  if (vault.isLocked())
  {
     vault.unlock("password", "salt");
  }
  ```

setLockTimeout

Determines how long a vault remains unlocked.

Determines how many seconds a vault remains unlocked before it automatically locks. The default value, 0, indicates that the lock never times out.

Syntax

```
public void setLockTimeout(int timeout)
```

Parameters

- **–** The number of seconds before the lock times out.

Examples

- **Set the Lock Timeout –** Sets the lock timeout to 1 hour.

  ```
  vault.setLockTimeout( 3600 );
  ```

getLockTimeout

Retrieves the configured lock timeout period.

Retrieves the number of seconds a vault remains unlocked before it automatically locks. The default value, 0, indicates that the lock never times out.

Syntax

```
public int getLockTimeout()
```

Returns

getLockTimeout returns an integer value indicating the number of seconds a vault remains unlocked before it automatically locks. The default value, 0, indicates that the lock never times out.

Examples

- **Set the Lock Timeout –** Retrieves the lock timeout in seconds.

  ```
  int timeout = vault.getLockTimeout();
  ```

setRetryLimit

Sets the retry limit value for the vault.

Determines how many consecutive unlock attempts (with wrong password) are allowed. If the retry limit is exceeded, the vault is automatically deleted. The default value, 0, means that an unlimited number of attempts are permitted. An exception is thrown if the vault is locked when this method is called.

Syntax

```
public void setRetryLimit(int limit)
```

Parameters

- **limit –** The number of consecutive unlock attempts (with wrong password) are allowed.

Examples

- **Set the Retry Limit –** Sets the retry limit to 5 attempts.

  ```
  vault.setRetryLimit( 5 );
  ```

getRetryLimit

Retrieves the retry limit value for the vault.

Retrieves the number of consecutive unlock attempts (with wrong password) are allowed. If the retry limit is exceeded, the vault is automatically deleted. The default value, 0, means that an unlimited number of attempts are permitted.

Syntax

```
public int getRetryLimit()
```

Returns

getRetryLimit returns an integer value indicating the number of consecutive unlock attempts (with wrong password) are allowed. If the retry limit is exceeded, the vault is automatically deleted. The default value, 0, means that an unlimited number of attempts are permitted.

Examples

- **Set the Retry Limit –** Retrieves the number of consecutive unlock attempts (with wrong password) that are allowed.

  ```
  int retrylimit = vault.getRetryLimit();
  ```

setString

Stores a string object in the vault.

Stores a string under the specified name. An exception is thrown if the vault is locked when this method is called.

Syntax

Parameters

- **name –** The name associated with the string object to be stored.

- **value –** The string object to store in the vault.

Examples

- **Set a String Value –** Creates a test string, unlocks the vault, and sets a string value associated with the name `"testString"` in the vault. The `finally` clause in the `try/catch` block ensure that the vault ends in a secure state even if an exception occurs.

```
string teststring = "ABCDEFabcdef";
try
{
   vault.unlock("password", "salt");
   vault.setString("testString", teststring);
}
catch (DataVaultException e)
{
   System.out.println("Exception: " + e.toString());
}
finally
{
   vault.lock();
}
```

getString

Retrieves a string value from the vault.

Retrieves a string stored under the specified name in the vault. An exception is thrown if the vault is locked when this method is called.

Syntax

```
public String getString(String name)
```

Parameters

- **name –** The name associated with the string object to be retrieved.

Returns

getString returns a string data value, associated with the specified name, from the vault. An exception is thrown if the vault is locked when this method is called.

Examples

- **Get a String Value –** Unlocks the vault and retrieves a string value associated with the name `"testString"` in the vault. The `finally` clause in the `try/catch` block ensure that the vault ends in a secure state even if an exception occurs.

```

try
{
   vault.unlock("password", "salt");
   string retrievedstring = vault.getString("testString");
}
catch (DataVaultException e)
{
   System.out.println("Exception: " + e.toString());
}
finally
{
   vault.lock();
}
```

setValue

Stores a binary object in the vault.

Stores a binary object under the specified name. An exception is thrown if the vault is locked when this method is called.

Syntax

```
public void setValue(
   string name,
   byte[] value
)
```

Parameters

- **name –** The name associated with the binary object to be stored.
- **value –** The binary object to store in the vault.

Examples

- **Set a Binary Value –** Unlocks the vault and stores a binary value associated with the name `"testValue"` in the vault. The `finally` clause in the `try/catch` block ensure that the vault ends in a secure state even if an exception occurs.

```
try
{
   vault.unlock("password", "salt");
   vault.setValue("testValue", new byte[] { 1, 2, 3, 4, 5});
}
catch (DataVaultException e)
{
   System.out.println("Exception: " + e.toString());
}
finally
{
   vault.lock();
}
```

getValue

Retrieves a binary object from the vault.

Retrieves a binary object under the specified name. An exception is thrown if the vault is locked when this method is called.

Syntax

```
public byte[] getValue(string name)
```

Parameters

- **name –** The name associated with the binary object to be retrieved.

Returns

getValue returns a binary data value, associated with the specified name, from the vault. An exception is thrown if the vault is locked when this method is called.

Examples

- **Get a Binary Value –** Unlocks the vault and retrieves a binary value associated with the name `"testValue"` in the vault. The `finally` clause in the `try/catch` block ensure that the vault ends in a secure state even if an exception occurs.

  ```
  try
  {
     vault.unlock("password", "salt");
     byte[] retrievedvalue = vault.getValue("testValue");
  }
  catch (DataVaultException e)
  {
     System.out.println("Exception: " + e.toString());
  }
  finally
  {
     vault.lock();
  }
  ```

changePassword

Changes the password for the vault.

Modifies all name/value pairs in the vault to be encrypted with a new password/salt. If the vault is locked or the new password is empty, an exception is thrown.

Syntax

Parameters

- **newPassword –** The new password.
- **newSalt –** The new encryption salt value.

Examples

- **Change the Password for a Data Vault –** Changes the password to `"newPassword"`. The `finally` clause in the `try/catch` block ensure that the vault ends in a secure state even if an exception occurs.

```
try
{
   vault.unlock("password", "salt");
   vault.changePassword("newPassword", "newSalt");
}
catch (DataVaultException e)
{
   System.out.println("Exception: " + e.toString());
}
finally
{
   vault.lock();
}
```

Callback and Listener APIs

The callback and listener APIs allow you to optionally register a callback handler and listen for device events, application connection events, and package synchronize and replay events.

See also

- *Setting Up Callbacks and Listeners* on page 20

Callback Handlers

To receive callbacks, you must register a `CallBackHandler` with the generated database class, the entity class, or both. You can create a handler by extending the `DefaultCallbackHandler` class or by implementing the `com.sybase.persistence.CallbackHandler` interface.

In your handler, override the particular callback that you are interested in (for example, `void onReplayFailure(java.lang.Object entity)`). The callback is executed in the thread that is performing the action (for example, replay). When you receive the callback, the particular activity is already complete.

Table 1. Callbacks in the `CallbackHandler` Interface

Callback	Description
`void onReplayFailure(java.lang.Object entity)`	Replay failure response notification. *entity* is a client MBO instance.
`void onReplaySuccess(java.lang.Object entity)`	Replay success response notification. *entity* is a client MBO instance.
`int onSynchronize(com.sybase.collections.ObjectList groups,SynchronizationContext context)`	This method is invoked at the specified status of the synchronization.*groups* is a list of synchronization group names. *context* is the synchronization context. This method can only be received from the generated database class.

This code shows how to create and register a handler to receive callbacks:

```
public class MyCallbackHandler extends DefaultCallbackHandler
{
    // implementation
}

CallbackHandler handler = new MyCallbackHandler();
<PkgName>DB.registerCallbackHandler(handler);
```

SyncStatusListener API

You can implement a synchronization status listener to track synchronization progress.

Create a listener that implements the `SyncStatusListener` interface.

```
public interface SyncStatusListener
{
    boolean objectSyncStatus(ObjectSyncStatusData statusData);
}

public class MySyncListener extends SyncStatusListener
{
// implementation
}
```

Pass an instance of the listener to the synchronize methods.

```
MySyncListener listener = new MySyncListener();
<PkgName>DB.synchronize("sync_group", listener);
// or <PkgName>DB.synchronize(listener); if we want to synchronize
all
// synchronization groups
```

As the application synchronization progresses, the `objectSyncStatus` method defined by the `SyncStatusListener` interface is called and is passed an

ObjectSyncStatusData object. The ObjectSyncStatusData object contains information about the MBO being synchronized, the connection to which it is related, and the current state of the synchronization process. By testing the State property of the ObjectSyncStatusData object and comparing it to the possible values in the SyncStatusState enumeration, the application can react accordingly to the state of the synchronization.

Possible uses of objectSyncStatus method include changing form elements on the client screen to show synchronization progress, such as a green image when the synchronization is in progress, a red image if the synchronization fails, and a gray image when the synchronization has completed successfully and disconnected from the server.

Note: The objectSyncStatus method of SyncStatusListener is called and executed in the data synchronization thread. If a client runs synchronizations in a thread other than the primary user interface thread, the client cannot update its screen as the status changes. The client must instruct the primary user interface thread to update the screen regarding the current synchronization status.

This is an example of SyncStatusListener implementation:

```
public class SyncListener extends syncStatusListener
{
  public boolean objectSyncStatus(ObjectSyncStatusData data)
  {
    switch (data.getSyncStatusState()) {
    case SyncStatusState.APPLICATION_SYNC_DONE:
      //implement your own UI indicator bar
      break;
    case SyncStatusState.APPLICATION_SYNC_ERROR:
      //implement your own UI indicator bar
      break;
    case SyncStatusState.SYNC_DONE:
      //implement your own UI indicator bar
      break;
    case SyncStatusState.SYNC_STARTING:
      //implement your own UI indicator bar
      break;
    ...
    }
    return false;
  }
}
```

Query APIs

The Query API allows you to retrieve data from mobile business objects, to page data, and to retrieve a query result by filtering. You can also use the Query API to filter children MBOs of a parent MBO in a one to many relationship.

See also

- *Accessing MBO Data* on page 29
- *Object Queries* on page 30
- *Dynamic Queries* on page 30
- *MBOs with Complex Types* on page 31
- *Relationships* on page 32

Retrieving Data from Mobile Business Objects

You can retrieve data from mobile business objects through a variety of queries, including object queries, arbitrary find, and through filtering query result sets.

Object Queries

To retrieve data from a local database, use one of the static Object Query methods in the `MBO` class.

Object Query methods are generated based on the object queries defined by the modeler in Unwired WorkSpace. Object Query methods carry query names, parameters, and return types defined in Unwired WorkSpace. Object Query methods return either an object, or a collection of objects that match the specified search criteria.

The following examples demonstrate how to use the Object Query methods of the Customer MBO to retrieve data.

This method retrieves all customers:

```
public static com.sybase.collections.GenericList<Customer> findAll()

com.sybase.collections.GenericList<Customer> customers = findAll();
```

This method retrieves all customers in a certain page:

```
public static com.sybase.collections.GenericList<Customer>
findAll(int skip, int take)

com.sybase.collections.GenericList<Customer> customers =
Customer.findAll(10, 5);
```

Suppose the modeler defined the following Object Query for the Customer MBO in Sybase Unwired Workspace:

- **name –** findByFirstName
- **parameter –** String firstName
- **query definition –** SELECT x.* FROM Customer x WHERE x.fname = :firstName
- **return type –** Sybase.Collections.GenericList

The preceding Object Query results in this generated method:

```
public static com.sybase.collections.GenericList<Customer>
findByFirstName(String firstName)
```

```
com.sybase.collections.GenericList<Customer> customers =
Customer.findByFirstName("fname");
```

Query and Related Classes

The following classes define arbitrary search methods and filter conditions, and provide methods for combining test criteria and dynamically querying result sets.

Table 2. Query and Related Classes

Class	Description
Query	Defines arbitrary search methods and can be composed of search conditions, object/row state filter conditions, and data ordering information.
AttributeTest	Defines filter conditions for MBO attributes.
CompositeTest	Contains a method to combine test criteria using the logical operators AND, OR, and NOT to create a compound filter.
QueryResultSet	Provides for querying a result set for the dynamic query API.
SelectItem	Defines the entry of a select query. For example, "select x.attr1 from MBO x", where "X.attr1" represents one SelectItem.
Column	Used in a subquery to reference the outer query's attribute.

In addition queries support **select**, **where**, and **join** statements.

Arbitrary Find

The arbitrary find method lets custom device applications dynamically build queries based on user input. The `Query.DISTINCT` property lets you exclude duplicate entries from the result set.

The arbitrary find method also lets the user specify a desired ordering of the results and object state criteria. A `Query` class is included in the client object API. The `Query` class is the single object passed to the arbitrary search methods and consists of search conditions, object/row state filter conditions, and data ordering information.

Define these conditions by setting properties in a query:

- **TestCriteria –** criteria used to filter returned data.
- **SortCriteria –** criteria used to order returned data.
- **Skip –** an integer specifying how many rows to skip. Used for paging.

- **Take –** an integer specifying the maximum number of rows to return. Used for paging.

Set the `Query.Distinct` property to `true` to exclude duplicate entries from the result set. The default value is `false` for entity types, and its usage is optional for all other types.

```
Query query1 = new Query();
query1.setDistinct(true);
```

`TestCriteria` can be an `AttributeTest` or a `CompositeTest`.

TestCriteria

You can construct a query SQL statement to query data from a local database. You can create a `TestCriteria` object (in this example, `AttributeTest`) to filter results. You can also query across multiple tables (MBOs) when using the `executeQuery` API.

```
Query query2 = new Query();
query2.select("c.fname,c.lname,s.order_date,s.region");
query2.from("Customer", "c");
//
// Convenience method for adding a join to the query
// Detailed construction of the join criteria
query2.join("Sales_order", "s", "c.id", "s.cust_id");
AttributeTest ts = new AttributeTest();
ts.setAttribute("fname");
ts.setTestValue("Beth");
query2.where(ts);
QueryResultSet qrs = SampleAppDB.executeQuery(query2);
```

Note: You must use explicit column names in **select** clauses; you cannot use wildcards.

AttributeTest

An `AttributeTest` defines a filter condition using an MBO attribute, and supports multiple conditions.

- IS_NULL
- NOT_NULL
- EQUAL
- NOT_EQUAL
- LIKE
- NOT_LIKE
- LESS_THAN
- LESS_EQUAL
- GREATER_THAN
- GREATER_EQUAL
- CONTAINS
- STARTS_WITH
- ENDS_WITH

- DOES_NOT_START_WITH
- DOES_NOT_END_WITH
- DOES_NOT_CONTAIN
- IN
- NOT_IN
- EXISTS
- NOT_EXISTS

For example, the Java code shown below is equivalent to this SQL query:

```
SELECT * from A where id in [1,2,3]
```

```
Query query = new Query();
AttributeTest test = new AttributeTest();
test.setAttribute("id");
com.sybase.collections.ObjectList v = new
com.sybase.collections.ObjectList();
v.add("1");
v.add("2");
v.add("3");
test.setValue(v);
test.setOperator(AttributeTest.IN);
query.where(test);
```

When using EXISTS and NOT_EXISTS, the attribute name is not required in the `AttributeTest`. The query can reference an attribute value via its alias in the outer scope. The Java code shown below is equivalent to this SQL query:

```
SELECT a.id from AllType a where exists (select b.id from AllType b
where b.id = a.id)
```

```
Query query = new Query();
query.select("a.id");
query.from("AllType", "a");
AttributeTest test = new AttributeTest();

Query existQuery = new Query();
existQuery.select("b.id");
existQuery.from("AllType", "b");
Column cl = new Column();
cl.setAlias("a");
cl.setAttribute("id");
AttributeTest test1 = new AttributeTest();
test1.setAttribute ("b.id");
test1.setValue(cl);
test1.setOperator(AttributeTest.EQUAL);
existQuery.where(test1);
test.setValue(existQuery);
test.setOperator(AttributeTest.EXISTS);
query.where(test);
QueryResultSet qs = DsTestDB.executeQuery(query);
```

SortCriteria

`SortCriteria` defines a `SortOrder`, which contains an attribute name and an order type (ASCENDING or DESCENDING).

For example,

```
Query query = new Query();

query.select("c.lname, c.fname");
query.from("Customer", "c");

AttributeTest aTest = new AttributeTest();
aTest.setAttribute("state");
aTest.setTestValue("CA");
aTest.setTestType(AttributeTest.EQUAL);
query.setTestCriteria(aTest);

SortCriteria sort = new SortCriteria();
sort.add("lname", SortOrderType.ASCENDING);
sort.add("fname", SortOrderType.ASCENDING);
query.setSortCriteria(sort);
```

Paging Data

On low-memory devices, retrieving up to 30,000 records from the database may cause the custom client to fail and throw an `OutOfMemoryException.`

Consider using the Query object to limit the result set:

```
Query props = new Query();
props.setSkip(10);
props.setTake(5);

com.sybase.collections.ObjectList customers =
Customer.findWithQuery(props);
```

Aggregate Functions

You can use aggregate functions in dynamic queries.

When using the `Query.select(String)` method, you can use any of these aggregate functions:

Aggregate Function	Supported Datatypes
`COUNT`	integer
`MAX`	string, binary, char, byte, short, int, long, integer, decimal, float, double, date, time, dateTime
`MIN`	string, binary, char, byte, short, int, long, integer, decimal, float, double, date, time, dateTime

Aggregate Function	Supported Datatypes
`SUM`	byte, short, int, long, integer, decimal, float, double
`AVG`	byte, short, int, long, integer, decimal, float, double

If you use an unsupported type, a `PersistenceException` is thrown.

```
Query query1 = new Query();
query1.select("MAX(c.id), MIN(c.name) as minName");
```

For iOS, we need a code sample equivalent to this WM sample:

Grouping Results

Apply grouping criteria to your results.

To group your results according to specific attributes, use the `Query.groupBy(String groupByItem)` method. For example, to group your results by ID and name, use:

```
String groupByItem = ("c.id, c.name");
Query query1 = new Query();

//other code for query1

query1.groupBy(groupByItem);
```

Filtering Results

Specify test criteria for group queries.

You can specify how your results are filtered by using the `Query.having(com.sybase.persistence.TestCriteria)` method for queries using `GroupBy`. For example, limit your AllType MBO's results to `c.id` attribute values that are greater than or equal to 0 using:

```
Query query2 = new Query();
query2.select("c.id, SUM(c.id)");
query2.from("AllType", "c");
AttributeTest ts = new AttributeTest();
ts.setAttribute("c.id");
ts.setValue("0");
ts.setOperator(AttributeTest.GREATER_EQUAL);
query2.where(ts);
query2.groupBy("c.id");

AttributeTest ts2 = new AttributeTest();
ts2.setAttribute("c.id");
ts2.setValue("0");
ts2.setOperator(AttributeTest.GREATER_EQUAL);
query2.having(ts2);
```

Concatenating Queries

Concatenate two queries having the same selected items.

The `Query` class methods for concatenating queries are:

- `Union(Query)`
- `UnionAll(Query)`
- `Except(Query)`
- `Intersect(Query)`

This example obtains the results from one query except for those results appearing in a second query:

```
Query query1 = new Query();
... ... //other code for query1

Query query2 = new Query();
... ... //other code for query 2

Query query3 = query1.except(query2);
SampleAppDB.executeQuery(query3);
```

Subqueries

Execute subqueries using clauses, selected items, and attribute test values.

You can execute subqueries using the `Query.from(Query query, String alias)` method. For example, the Java code shown below is equivalent to this SQL query:

```
SELECT a.id FROM (SELECT b.id FROM AllType b) AS a WHERE a.id = 1
```

Use this Java code:

```
Query query1 = new Query();
query1.select("b.id");
query1.from("AllType", "b");
Query query2 = new Query();
query2.select("a.id");
query2.from(query1, "a");
AttributeTest ts = new AttributeTest();
ts.setAttribute("a.id");
ts.setValue(1);
query2.where(ts);
com.sybase.persistence.QueryResultSet qs =
DsTestDB.executeQuery(query2);
```

You can use a subquery as the selected item of a query. Use the `SelectItem` to set selected items directly. For example, the Java code shown below is equivalent to this SQL query:

```
SELECT (SELECT count(1) FROM AllType c WHERE c.id >= d.id) AS cn, id
FROM AllType d
```

Use this Java code:

```
Query selQuery = new Query();
selQuery.select("count(1)");
selQuery.from("AllType", "c");
AttributeTest ttt = new AttributeTest();
ttt.setAttribute("c.id");
ttt.setOperator(AttributeTest.GREATER_EQUAL);
Column cl = new Column();
cl.setAlias("d");
cl.setAttribute("id");
ttt.setValue(cl);
selQuery.where(ttt);

com.sybase.collections.GenericList<com.sybase.persistence.SelectIte
m> selectItems = new
com.sybase.collections.GenericList<com.sybase.persistence.SelectIte
m>();
SelectItem item = new SelectItem();
item.setQuery(selQuery);
item.setAlias("cn");
selectItems.add(item);
item = new SelectItem();
item.setAttribute("id");
item.setAlias("d");
selectItems.add(item);
Query subQuery2 = new Query();
subQuery2.setSelectItems(selectItems);
subQuery2.from("AllType", "d");
com.sybase.persistence.QueryResultSet qs =
DsTestDB.executeQuery(subQuery2);
```

CompositeTest

A `CompositeTest` combines multiple `TestCriteria` using the logical operators AND, OR, and NOT to create a compound filter.

Complex Example

This example shows the usage of `CompositeTest`, `SortCriteria`, and `Query` to locate all customer objects based on particular criteria.

- FirstName = John AND LastName = Doe AND (State = CA OR State = NY)
- Customer is New OR Updated
- Ordered by LastName ASC, FirstName ASC, Credit DESC
- Skip the first 10 and take 5

```
Query props = new Query();
//define the attribute based conditions
//Users can pass in a string if they know the attribute name. R1
column name = attribute name.
CompositeTest innerCompTest = new CompositeTest();
innerCompTest.setOperator(CompositeTest.OR);
innerCompTest.add(new AttributeTest("state", "CA",
AttributeTest.EQUAL));
innerCompTest.add(new AttributeTest("state", "NY",
AttributeTest.EQUAL));
CompositeTest outerCompTest = new CompositeTest();
outerCompTest.setOperator(CompositeTest.OR);
outerCompTest.add(new AttributeTest("fname", "Jane",
AttributeTest.EQUAL));
outerCompTest.add(new AttributeTest("lname", "Doe",
AttributeTest.EQUAL));
outerCompTest.add(innerCompTest);
//define the ordering
SortCriteria sort = new SortCriteria();

sort.add("fname", SortOrder.ASCENDING);
sort.add("lname", SortOrder.ASCENDING);
//set the Query object
props.setTestCriteria(outerCompTest);
props.setSortCriteria(sort);
props.setSkip(10);
props.setTake(5);
com.sybase.collections.GenericList<Customer> customers2 =
Customer.FindWithQuery(props);
```

QueryResultSet

The `QueryResultSet` class provides for querying a result set from the dynamic query API. `QueryResultSet` is returned as a result of executing a query.

The following example shows how to filter a result set and get values by taking data from two mobile business objects, creating a `Query`, filling in the criteria for the query, and filtering the query results:

```
com.sybase.persistence.Query query = new
com.sybase.persistence.Query();
query.select("c.fname,c.lname,s.order_date,s.region");
query.from("Customer ", "c");
query.join("SalesOrder ", "s", " s.cust_id ", "c.id");
AttributeTest at = new AttributeTest();
at.setAttribute("lname");
at.setTestValue("Devlin");
query.setTestCriteria(at);
QueryResultSet qrs = SampleAppDB.executeQuery(query);
while(qrs.next())
{
  System.out.print(qrs.getString(1));
  System.out.print(",");
  System.out.println(qrs.getStringByName("c.fname"));

  System.out.print(qrs.getString(2));
  System.out.print(",");
  System.out.println(qrs.getStringByName("c.lname"));

  System.out.print(qrs.getString(3));
  System.out.print(",");
  System.out.println(qrs.getStringByName("s.order_date"));

  System.out.print(qrs.getString(4));
  System.out.print(",");
  System.out.println(qrs.getStringByName("s.region"));
}
```

Retrieving Relationship Data

A relationship between two MBOs allows the parent MBO to access the associated MBO. A bidirectional relationship also allows the child MBO to access the associated parent MBO.

Assume there are two MBOs defined in Unwired Server. One MBO is called Customer and contains a list of customer data records. The second MBO is called SalesOrder and contains order information. Additionally, assume there is an association between Customers and Orders on the customer ID column. The Orders application is parameterized to return order information for the customer ID.

```
Customer customer = Customer.findById (101);
com.sybase.collections.ObjectList orders =
customer.getSalesOrders();
```

You can also use the `Query` class to filter the return MBO list data.

```
Query props = new Query();
// set query parameters
......
com.sybase.collections.ObjectList orders =
customer.getSalesOrdersFilterBy(props);
```

Persistence APIs

The persistence APIs include operations and object state APIs.

See also

- *Manipulating Data* on page 33

Operations APIs

Mobile business object operations are performed on an MBO instance. Operations in the model that are marked as create, update, or delete (CUD) operations create non-static instances of operations in the generated client-side objects.

Any parameters in the create, update, or delete operation that are mapped to the object's attributes are handled internally by the client object API, and are not exposed. Any parameters not mapped to the object's attributes are left as parameters in the generated object API. The code examples for create, update, and delete operations are based on the **fill from attribute** being set. Different MBO settings affect the operation methods.

Note: If the Sybase Unwired Platform object model defines one instance of a create operation and one instance of an update operation, and all operation parameters are mapped to the object's attributes, then a `Save` method can be automatically generated which, when called internally, determines whether to insert or update data to the local client-side database. In other situations, where there are multiple instances of create or update operations, methods such as `Save` cannot be automatically generated.

See also

- *Creating, Updating, and Deleting MBOs* on page 33
- *Other Operations* on page 34

Client Database APIs

The generated package database class provides methods for managing the client database.

```
public static void createDatabase()
public static void deleteDatabase()
```

Typically, `createDatabase` does not need to be called since it is called internally when necessary. An application may use `deleteDatabase` when the client database contains corrupted data and needs to be cleared.

Create Operation

The `create` operation allows the client to create a new record in the local database. To execute a create operation on an MBO, create a new MBO instance, and set the MBO attributes, then call the `save()` or `create()` operation. To propagate the changes to the server, call `submitPending`.

```
Customer cust = new Customer();
cust.setFname ( "supAdmin" );
cust.setCompany_name( "Sybase" );
cust.setPhone( "777-8888" );
cust.create();// or cust.save();
cust.submitPending();
<PkgName>DB.synchronize();
// or <PkgName>DB.synchronize (String synchronizationGroup)
```

Update Operation

The `update` operation updates a record in the local database on the device. To execute update operations on an MBO, get an instance of the MBO, set the MBO attributes, then call either the `save()` or `update()` operation. To propagate the changes to the server, call `submitPending`.

```
Customer cust = Customer.findById(101);
cust.setFname("supAdmin");
cust.setCompany_name("Sybase");
cust.setPhone("777-8888");
cust.save(); // or cust.update();
cust.submitPending();
<PkgName>DB.synchronize();
// or <PkgName>DB.synchronize (String synchronizationGroup)
```

To update multiple MBOs in a relationship, call `submitPending()` on the parent MBO, or call `submitPending()` on the changed child MBO:

```
Customer cust = Customer.findById(101);
com.sybase.collections.ObjectList orders = cust.getSalesOrders();
```

```
SalesOrder order = (SalesOrder)orders.getByIndex(0);
order.setOrder_date(new java.util.Date());
order.save();
cust.submitPending();
```

Delete Operation

The `delete` operation allows the client to delete a new record in the local database. To execute delete operations on an MBO, get an instance of the MBO, set the MBO attributes, then call the `delete` operation. To propagate the changes to the server, call `submitPending`.

```
Customer cust = Customer.findById(101);
cust.delete();
```

For MBOs in a relationship, perform a delete as follows:

```
 Customer cust = Customer.findById(101);
        com.sybase.collections.ObjectList orders =
cust.getSalesOrders();
        SalesOrder order = (SalesOrder)orders.getByIndex(0);
        order.delete();
        cust.submitPending();
<PkgName>DB.synchronize();
// or <PkgName>DB.synchronize (String synchronizationGroup)
```

Save Operation

The `save` operation saves a record to the local database. In the case of an existing record, a `save` operation calls the `update` operation. If a record does not exist, the `save` operation creates a new record.

```
//Update an existing customer
Customer cust = Customer.findById(101);
cust.save();

//Insert a new customer
Customer cust = new Customer();
cust.save();
```

Other Operation

Operations other than `create`, `update`, or `delete` operations are called "other" operations. An `Other` operation class is generated for each operation in the MBO that is not a `create`, `update`, or `delete` operation.

Suppose the Customer MBO has an Other operation "other", with parameters "P1" (string), "P2" (int), and "P3" (date). This results in a `CustomerOtherOperation` class being generated, with "P1", "P2", and "P3" as its attributes.

To invoke the Other operation, create an instance of `CustomerOtherOperation`, and set the correct operation parameters for its attributes. For example:

```
CustomerOtherOperation other = new CustomerOtherOperation();
other.setP1("somevalue");
other.setP2(2);
other.setP3(new Date());
other.save();
other.submitPending();
<PkgName>DB.synchronize(); // or <PkgName>DB.synchronize (String
synchronizationGroup)
```

Pending Operation

You can manage the pending state.

- **cancelPending –** cancels the previous `create`, `update`, or `delete` operations on the MBO. It cannot cancel submitted operations.
- **submitPending –** submits the operation so that it can be replayed on the Unwired Server. A request is sent to the Unwired Server during a synchronization.
- **submitPendingOperations –** submits all the pending records for the entity to the Unwired Server. This method internally invokes the `submitPending` method on each of the pending records.
- **cancelPendingOperations –** cancels all the pending records for the entity. This method internally invokes the `cancelPending` method on each of the pending records.

```
Customer customer = Customer.findById(101);
if (errorHappened) {
    customer.cancelPending();
}
else {
    customer.submitPending();
}
```

You can group multiple operations into a single transaction for improved performance:

```
// load the customer MBO with customer ID 100
Customer customer = Customer.findByPrimaryKey(100);

// Change phone number of that customer
customer.setPhone("8005551212");

// use one transaction to do save and submitPending
com.sybase.persistence.LocalTransaction tx =
MyPackageDB.beginTransaction();
try
{
  customer.save();
  customer.submitPending();
  tx.commit();
}
catch (Exception e)
{
  tx.rollback();
}
```

Complex Attribute Types

Some back-end datasources require complex types to be passed in as input parameters. The input parameters can be any of the allowed attribute types, including primitive lists, objects, and object lists. The MBO examples have attributes that are primitive types (such as `int`, `long`, or `string`), and make use of the basic database operations (`create`, `update`, and `delete`).

Passing Structures to Operations

An Unwired WorkSpace project includes an example MBO that is bound to a Web service data source that includes a `create` operation that takes a structure as an operation parameter. MBOs differ depending on the data source, configuration, and so on, but the principles are similar.

The SimpleCaseList MBO contains a `create` operation that has a number of parameters, including one named _HEADER_ that is a structure datatype named `AuthenticationInfo`, defined as:

```
AuthenticationInfo
   userName: String
   password: String
   authentication: String
   locale: String
   timeZone: String
```

Structures are implemented as classes, so the parameter _HEADER_ is an instance of the `AuthenticationInfo` class. The generated code for the `create` operation is:

```
public  void create(complex.AuthenticationInfo
_HEADER_,java.lang.String escalated,java.lang.String
hotlist,java.lang.String orig_Submitter,java.lang.String
pending,java.lang.String workLog)
```

This example demonstrates how to initialize the `AuthenticationInfo` class instance and pass it, along with the other operation parameters, to the `create` operation:

```
AuthenticationInfo authen = new AuthenticationInfo();
        authen.setUserName("Demo");
        authen.setPassword("");
        authen.setAuthentication("");
        authen.setLocale("EN_US");
        authen.setTimeZone("GMT");

        SimpleCaseList newCase = new SimpleCaseList();
        newCase.setCase_Type("Incident");
        newCase.setCategory("Networking");
        newCase.setDepartment("Marketing");
        newCase.setDescription("A new help desk case.");
        newCase.setItem("Configuration");
        newCase.setOffice("#3 Sybase Drive");
        newCase.setSubmitted_By("Demo");
        newCase.setPhone_Number("#0861023242526");
        newCase.setPriority("High");
        newCase.setRegion("USA");
        newCase.setRequest_Urgency("High");
        newCase.setRequester_Login_Name("Demo");
        newCase.setRequester_Name("Demo");
        newCase.setSite("25 Bay St, Mountain View, CA");
        newCase.setSource("Requester");
        newCase.setStatus("Assigned");
        newCase.setSummary("MarkHellous was here Fix it.");
        newCase.setType("Access to Files/Drives");
        newCase.setCreate_Time(new
        java.sql.Timestamp(System.currentTimeMillis()));

        newCase.create(authen, "Other", "Other", "Demo", "false",
"worklog");
        newCase.submitPending();
```

Object State APIs

The object state APIs provide methods for returning information about the state of an entity in an application.

Entity State Management

The object state APIs provide methods for returning information about entities in the database.

All entities that support pending state have the following attributes:

Name	Type	Description
`isNew`	`boolean`	Returns true if this entity is new, but has not yet been created in the client database.
`isCreated`	`boolean`	Returns true if this entity has been newly created in the client database, and one of the following is true: • The entity has not yet been submitted to the server with a replay request. • The entity has been submitted to the server, but the server has not finished processing the request. • The server rejected the replay request (`replay-Failure` message received).
`isDirty`	`boolean`	Returns true if this entity has been changed in memory, but the change has not yet been saved to the client database.
`isDeleted`	`boolean`	Returns true if this entity was loaded from the database and subsequently deleted.

Name	Type	Description
`isUpdated`	`boolean`	Returns true if this entity has been updated or changed in the database, and one of the following is true: • The entity has not yet been submitted to the server with a replay request. • The entity has been submitted to the server, but the server has not finished processing the request. • The server rejected the replay request (`replayFailure` message received).
`pending`	`boolean`	Returns true for any row that represents a pending `create`, `update`, or `delete` operation, or a row that has cascading children with a pending operation.
`pendingChange`	char	If pending is true, this attribute's value is 'C' (create), 'U' (update), 'D' (delete), or 'P' (to indicate that this MBO is a parent in a cascading relationship for one or more pending child objects, but this MBO itself has no pending create, update or delete operations). If pending is false, this attribute's value is 'N'.
`replayCounter`	long	Returns a `long` value that is updated each time a row is created or modified by the client. This value is a unique value obtained from `KeyGenerator.generateID` method. Note that the value increases every time it is retrieved.
`replayPending`	long	Returns a `long` value. When a pending row is submitted to the server, the value of `replayCounter` is copied to `replayPending`. This allows the client code to detect if a row has been changed since it was submitted to the server (that is, if the value of `replayCounter` is greater than `replayPending`).
`replayFailure`	long	Returns a `long` value. When the server responds with a `replayFailure` message for a row that was submitted to the server, the value of `replayCounter` is copied to `replayFailure`, and `replayPending` is set to 0.

Entity State Example

Shows how the values of the entities that support pending state change at different stages during the MBO update process. The values that change between different states appear in bold.

Note these entity behaviors:

- The `isDirty` flag is set if the entity changes in memory but is not yet written to the database. Once you save the MBO, this flag clears.
- The `replayCounter` value that gets sent to the Unwired Server is the value in the database before you call `submitPending`. After a successful replay, that value is imported from the Unwired Server.
- The last two entries in the table are two possible results from the operation; only one of these results can occur for a replay request.

Description	Flags/Values

After reading from the database, before any changes are made.	isNew=false
	isCreated=false
	isDirty=false
	isDeleted=false
	isUpdated=false
	pending=false
	pendingChange='N'
	replayCounter=33422977
	replayPending=0
	replayFailure=0

Description	Flags/Values

One or more attributes are changed, but changes not saved.	isNew=false
	isCreated=false
	isDirty=**true**
	isDeleted=false
	isUpdated=false
	pending=false
	pendingChange='N'
	replayCounter=33422977
	replayPending=0
	replayFailure=0

After `entity.save()[entity save]` or `entity.update()[entity update]` is called.	isNew=false
	isCreated=false
	isDirty=**false**
	isDeleted=false
	isUpdated=**true**
	pending=**true**
	pendingChange=**'U'**
	replayCounter=**33424979**
	replayPending=0
	replayFailure=0

Description	Flags/Values

After `entity.submitPending()[entity submitPending]` is called to submit the MBO to the server.	isNew=false
	isCreated=false
	isDirty=false
	isDeleted=false
	isUpdated=true
	pending=true
	pendingChange='U'
	replayCounter=33424981
	replayPending=**33424981**
	replayFailure=0

Possible result: the Unwired Server accepts the update, sends an import and a `replayResult` for the entity, and then refreshes the entity from the database.	isNew=false
	isCreated=false
	isDirty=false
	isDeleted=false
	isUpdated=**false**
	pending=**false**
	pendingChange=**'N'**
	replayCounter=**33422977**
	replayPending=**0**
	replayFailure=0

Description	Flags/Values

Possible result: The Unwired Server rejects the update, sends a `replayFailure` for the entity, and refreshes the entity from the database	isNew=false
	isCreated=false
	isDirty=false
	isDeleted=false
	isUpdated=true
	pending=true
	pendingChange='U'
	replayCounter=33424981
	replayPending=**0**
	replayFailure=**33424981**

Mobile Business Object States

A mobile business object can be in one of three states.

- Original state – the state before any CUD operation.
- Downloaded state – the state downloaded from the Unwired Server.
- Current state – the state after any CUD operation.

The mobile business object class provides properties for querying the original state and the downloaded state:

```
public Customer getOriginalState();
public Customer getDownloadState();
```

```
Customer cust = Customer.findById(101);        // state 1
cust.setFname("firstName");
cust.setCompany_name("Sybase");
cust.setPhone("777-8888");
cust.save();                                   // state 2
Customer org = cust.getOriginalState();        // state 1
//suppose there is new download for Customer 101 here
Customer download = cust.getDownloadState();   // state 3
cust.cancelPending();                          // state 3
```

Using all three states, the application can resolve most conflicts that may occur.

Refresh Operation

The refresh operation of an MBO allows you to refresh the MBO state from the client database.

For example:

```
Customer cust = Customer.findById(101);
cust.setFname("newName");
cust.refresh();// newName is discarded
```

MetaData and Object Manager API

The MetaData and Object Manager API allows you to access metadata for database, classes, entities, attributes, operations, and parameters.

MetaData and Object Manager API

Some applications or frameworks can operate against MBOs generically by invoking MBO operations without prior knowledge of MBO classes. This can be achieved by using the MetaData and Object Manager APIs.

These APIs allow retrieving the metadata of packages, MBOs, attributes, operations, and parameters during runtime. The APIs are especially useful for a runtime environment without a reflection mechanism such as J2ME.

You can generate metadata classes using the `-md` code generation option. You can use the `-rm` option to generate the object manager class. You can also generate metadata classes by selecting the option **Generate metadata classes** or **Generate metadata and object manager classes** option in the code generation wizard in the mobile application project.

ObjectManager

The `ObjectManager` class allows an application to call the Object API in a reflection style. The Object Manager is useful for platforms without native reflection support (such as J2ME). As the Android platform provides its own reflection API, it is recommended to use platform native reflection API instead.

```
Customer object = Customer.findById(123);
ObjectManager rm = new <PkgName>DB_RM();
ClassMetaData customer =
<PkgName>DB.getMetaData().getClass("Customer");
AttributeMetaData lname = customer.getAttribute("lname");
OperationMetaData save = customer.getOperation("save");
Object myMBO = rm.newObject(customer);
rm.setValue(myMBO, lname, "Steve");
rm.invoke(object, save, new ObjectList());
```

DatabaseMetaData

The `DatabaseMetaData` class holds package-level metadata. You can use it to retrieve data such as synchronization groups, the default database file, and MBO metadata.

Any entity for which "allow dynamic queries" is enabled generates attribute metadata. Depending on the options selected in the Eclipse IDE, metadata for attributes and operations may be generated for all classes and entities.

```
DatabaseMetaData dmd = <PkgName>DB.getMetaData();
com.sybase.collections.StringList syncGroups =
dmd.getSynchronizationGroups();
for(int i=0; i<syncGroups.size(); i++)
{
String syncGroup = syncGroups.item(i);
System.out.println(syncGroup);
}
```

ClassMetaData

The `ClassMetaData` class holds metadata for the MBO, including attributes and operations.

```
AttributeMetaData lname = customerMetaData.getAttribute("lname");
OperationMetaData save = customerMetaData.getOperation("save");
...
```

AttributeMetaData

The `AttributeMetaData` class holds metadata for an attribute such as attribute name, column name, type, and maxlength.

```
System.out.println(lname.getName());
System.out.println(lname.getColumn());
System.out.println(lname.getMaxLength());
```

Exceptions

Reviewing exceptions allows you to identify where an error has occurred during application execution.

Handling Exceptions

The Client Object API defines server-side and client-side exceptions.

Server-Side Exceptions

A server-side exception occurs when a client tries to update or create a record and the Unwired Server throws an exception.

A server-side exception results in a stack trace in the server log, and a log record (`LogRecordImpl`) imported to the client with information on the problem.

HTTP Error Codes

Unwired Server examines the EIS code received in a server response message and maps it to a logical HTTP error code, if a corresponding error code exists. If no corresponding code exists, the 500 code is assigned to signify either a Sybase Unwired Platform internal error, or an unrecognized EIS error. The EIS code and HTTP error code values are stored in log records.

These tables list recoverable and unrecoverable error codes. All error codes that are not explicitly considered recoverable are considered unrecoverable.

Table 3. Recoverable Error Codes

Error Code	Probable Cause
409	Backend EIS is deadlocked.
503	Backend EIS is down, or the connection is terminated.

Table 4. Unrecoverable Error Codes

Error Code	Probable Cause	Manual Recovery Action
401	Backend EIS credentials wrong.	Change the connection information, or backend user password.
403	User authorization failed on Unwired Server due to role constraints (applicable only for MBS).	N/A
404	Resource (table/Web service/BAPI) not found on backend EIS.	Restore the EIS configuration.
405	Invalid license for the client (applicable only for MBS).	N/A
412	Backend EIS threw a constraint exception.	Delete the conflicting entry in the EIS.
500	Sybase Unwired Platform internal error in modifying the CDB cache.	N/A

Error code 401 is not treated as a simple recoverable error. If the `SupThrowCredentialRequestOn401Error` context variable is set to true (the default), error code 401 throws a `CredentialRequestException`, which sends a credential request notification to the user's inbox. You can change this behavior by modifying the value of the `SupThrowCredentialRequestOn401Error` context variable in Sybase Control Center. If `SupThrowCredentialRequestOn401Error` is set to false, error code 401 is treated as a normal recoverable exception.

Mapping of EIS Codes to Logical HTTP Error Codes

A list of SAP® error codes mapped to HTTP error codes. By default, SAP error codes that are not listed map to HTTP error code 500.

Table 5. Mapping of SAP Error Codes to HTTP Error Codes

Constant	Description	HTTP Error Code
JCO_ERROR_COMMUNICATION	Exception caused by network problems, such as connection breakdowns, gateway problems, or unavailability of the remote SAP system.	503
JCO_ERROR_LOGON_FAILURE	Authorization failures during login. Usually caused by unknown user name, wrong password, or invalid certificates.	401
JCO_ERROR_RESOURCE	Indicates that JCO has run out of resources such as connections in a connection pool.	503
JCO_ERROR_STATE_BUSY	The remote SAP system is busy. Try again later.	503

Client-Side Exceptions

Device applications are responsible for catching and handling exceptions thrown by the client object API.

Note: See *Callback Handlers*.

Exception Classes

The Client Object API supports exception classes for queries and for the messaging client.

- **SynchronizeException –** thrown when an error occurs during synchronization.
- **PersistenceException –** thrown when trying to access the local database.
- **ObjectNotFoundException –** thrown when trying to load an MBO that is not inside the local database.
- **NoSuchOperationException –** thrown when trying to call a method (using the Object Manager API) but the method is not defined for the MBO.
- **NoSuchAttributeException –** thrown when trying to access an attribute (using the Object Manager API) but the attribute is not defined for the MBO.

- **ApplicationRuntimeException –** thrown when a call to start the connection, register the application, or unregister the application cannot be completed due to an error.
- **ConnectionPropertyException –** thrown when a call to start the connection, register the application, or unregister the application cannot be completed due to an error in a connection property value or application identifier.

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