HCL OneDB 2.0.1

OneDB JDBC Driver Programmer's Guide

Contents

Chapter 1. HCL OneDB™ JDBC Driver Guide

The *HCL OneDB™ JDBC Driver Programmer's Guide* describes how to install, load, and use HCL OneDB™ JDBC Driver to connect to the HCL OneDB™ database from within a Java™ application.

These topics describe the HCL OneDB™ extensions to JDBC in a task-oriented format; it does not include every method and parameter in the interface. For the complete reference, including all methods and parameters, see the online Javadoc™, which appears in the `doc/javadoc` directory where you installed HCL OneDB™ JDBC Driver.

You can also use OneDB® JDBC Driver for writing user-defined routines that are executed in the server.

These topics are written for Java™ programmers who use the JDBC API to connect to HCL OneDB™ databases with the OneDB® JDBC Driver. To use these topics, you should know how to program in Java™ and, in particular, understand the classes and methods of the JDBC API.

For information about software compatibility, see the HCL OneDB™ JDBC Driver release notes.

Getting started

These topics provide an overview of HCL OneDB™ JDBC Driver and the JDBC API.

What is a JDBC driver?

The JDBC API defines the Java™ interfaces and classes that programmers use to connect to databases and send queries. A JDBC driver implements these interfaces and classes for a particular DBMS vendor.

Java™ database connectivity (JDBC) is the Oracle™ specification of a standard application programming interface (API) that allows Java™ programs to access database management systems. The JDBC API consists of a set of interfaces and classes written in the Java™ programming language.

Using these standard interfaces and classes, programmers can write applications that connect to databases, send queries written in structured query language (SQL), and process the results.

Since JDBC is a standard specification, one Java™ program that uses the JDBC API can connect to any database management system (DBMS), as long as a driver exists for that particular DBMS.

A Java™ program that uses the JDBC API loads the specified driver for a particular DBMS before it actually connects to a database. The JDBC **DriverManager** class then sends all JDBC API calls to the loaded driver.

There are four types of JDBC drivers. Of the four, OneDB JDBC driver is a Type 4 driver

Native-protocol, pure-Java driver, also called Type 4 driver

Converts JDBC API calls directly into the DBMS-specific network protocol without a middle tier

This driver allows the client applications to connect directly to the database server.

Obtaining the JDBC Driver

The HCL OneDB™ JDBC Driver is present in the following locations:

- Download the HCL OneDB™ JDBC Driver for your specific platform from the HCL License and Delivery portal
- Obtain the driver from Maven Central at https://search.maven.org/. The Driver is under the following Maven Coordinates

```
<dependency>
  <groupId>com.hcl.onedb</groupId>
  <artifactId>onedb-jdbc</artifactId>
  <version>8.0.1.0</version>
</dependency>
```

HCL OneDB™ JDBC Driver

HCL OneDB™ JDBC Driver is a native-protocol, pure-Java driver that supports the JDBC specification 4.1.

For information about JDBC specification compliance, go to Java technology dependencies .

When you use OneDB® JDBC Driver in a Java™ program to interact with the HCL OneDB™ database, your session connects directly to the database or database server.

You can use the JDBC driver for Java™ applications that access the HCL OneDB™ database server. The installation includes `onedb-jdbc-complete-<version>.jar` Java library.

Javadoc™ pages describe the HCL OneDB™ extension classes, interfaces, and methods in detail and can be found in the Javadoc directory of the installation package.

Classes implemented in HCL OneDB™ JDBC Driver

To support **DataSource** objects and distributed transactions, HCL OneDB™ JDBC Driver provides classes that implement interfaces and classes for compliance with the Java™ Database Connectivity (JDBC) 4.0 specification.

HCL OneDB™ classes that implement Java™ interfaces

The following table lists the Java™ interfaces and classes and the HCL OneDB™ classes that implement them.

JDBC interface or class	HCL OneDB™ class
java.sql.Connection	com.informix.jdbc.IfmxConnection
javax.sql.DataSource	com.onedb.jdbcx.OneDBDataSource
javax.sql.XADataSource	com.informix.jdbcx.IfxXADataSource
java.sql.ParameterMetaData	com.informix.jdbc.IfxParameterMetaData

HCL OneDB™ JDBC Driver, implements the updateXXX() methods defined in the **ResultSet** interface by the JDBC 3.0 specification. These methods, such as **updateClob**, which are further defined in the JDBC specification, require that the

ResultSet object can be updated. The updateXXX() methods allow rows to be updated by using Java™ variables and objects and extend to include additional JDBC types.

These methods update JDBC types implemented with locators, not the data designated by the locators.

HCL OneDB™ classes that extend the JDBC specification

To support the HCL OneDB™ implementation of SQL statements and data types, HCL OneDB™ JDBC Driver provides classes that extend the supported JDBC specification (see Java technology dependencies). The following table lists the Java™ classes and the HCL OneDB™ classes that application programs can use to extend them.

JDBC interface or class	HCL OneDB™ class	Adds methods or constants for...
java.lang.Object	com.informix.lang.IfxTypes	Representing data types
java.lang.Object	com.informix.jdbc.IfxStatementTypes	Representing SQL statements
java.lang.Object	com.informix.jdbc.Interval[1]	Interval qualifiers and some common methods for the next two classes (base class for the next two)
java.lang.Object	com.informix.jdbc.IntervalYM[1]	Interval year-to-month
java.lang.Object	com.informix.jdbc.IntervalDF[1]	Interval day-to-fraction
java.lang.Object	com.informix.jdbc.IfxSmartBlob	Access methods for smart large objects
java.lang.Object	com.informix.jdbc.IfxLocator	Large object locator pointer
java.lang.Object	com.informix.jdbc.IfxLoStat	Statistical information about smart large objects
java.lang.Object	com.informix.jdbc.IfxLobDescriptor	Internal characteristics of smart large objects
java.lang.Object	com.informix.jdbc.IfxUDTInfo	General information about opaque and distinct types, detailed information about complex types
java.sql.Blob	com.informix.jdbc.IfxBblob	Binary large objects
java.sql.CallableStatement	com.informix.jdbc.IfmxCallableStatement	Parameter processing with HCL OneDB™ types
java.sql.Clob	com.informix.jdbc.IfxCblob	Character large objects
java.sql.Connection	com.informix.jdbc.IfmxConnection	Opaque, distinct, and complex types
java.sql.SQLData	com.informix.jdbc.IfxBSONObject [1]	HCL OneDB™ BSON data type

JDBC interface or class	HCL OneDB™ class	Adds methods or constants for...
		See the IfxBSONObjectDemo.java program in the `$ONEDB_HOME/demo/bson` directory for examples of how to insert and query JSON and BSON data and use the IfxBSONObject methods.
java.sql.PreparedStatement	com.informix.jdbc.IfmxPreparedStatement	Parameter processing with HCL OneDB™ types
java.sql.ResultSet	com.informix.jdbc.IfmxResultSet	HCL OneDB™ interval data types
java.sql.ResultSetMetaData	com.informix.jdbc.IfmxResultSetMetaData	Columns with HCL OneDB™ data types
java.sql.SQLInput	com.informix.jdbc.IfmxComplexSQLInput	Opaque, distinct, and complex types
java.sql.SQLInput	com.informix.jdbc.IfmxUDTSQLInput	Opaque, distinct, and complex types
java.sql.SQLOutput	com.informix.jdbc.IfmxComplexSQLOutput	Opaque, distinct, and complex types
java.sql.SQLOutput	com.informix.jdbc.IfmxUDTSQLOutput	Opaque, distinct, and complex types
java.sql.Statement	com.informix.jdbc.IfmxStatement	Single result sets, autofree mode, statement types, and SERIAL data type processing

Using the driver in an application

To use HCL OneDB™ JDBC Driver in an application, you must set the Java™ virtual machine (JVM) **CLASSPATH** to point to the driver libraries. The **CLASSPATH** environment variable tells the Java™ virtual machine (JVM) and other applications where to find the Java™ class libraries used in a Java™ program.

UNIX™

There are two ways to set your **CLASSPATH** environment variable:

- Add the full or relative path name of `onedb-jdbc-complete.jar` to **CLASSPATH**:

  ```
  export CLASSPATH=/path/to/onedb-jdbc-complete.jar:$CLASSPATH
  ```

- Specify the path to the driver in the java or javac -cp command line option **CLASSPATH**:

  ```
  java -cp /path/to/onedb-jdbc-complete.jar ...
  ```

Windows™

There are two ways to set your **CLASSPATH** environment variable:

- Add the full path name of `onedb-jdbc-complete.jar` to **CLASSPATH**:

  ```
  set CLASSPATH=c:\path\to\onedb-jdbc-complete.jar;%CLASSPATH%
  ```

- Specify the path to the driver in the java or javac -cp command line option **CLASSPATH**:

  ```
  java -cp /path/to/onedb-jdbc-complete.jar ...
  ```

Connect to the database

These topics explain the information you need to use HCL OneDB™ JDBC Driver to connect to the HCL OneDB™ database.

You must first establish a connection to the HCL OneDB™ database server or database before you can start sending queries and receiving results in your Java™ program.

You establish a connection by completing two actions:

1. Load OneDB® JDBC Driver.
2. Create a connection to either a database server or a specific database in one of the following ways:
   - Use a **DataSource** object.
   - Use the DriverManager.getConnection() method.

Using a **DataSource** object is preferable to using the DriverManager.getConnection() method because a **DataSource** object is portable and allows the details about the underlying data source to be transparent to the application. The target data source implementation can be modified, or the application can be redirected to a different server without affecting the application code.

A **DataSource** object can also provide support for connection pooling and distributed transactions. In addition, Enterprise JavaBeans™ and J2EE require a **DataSource** object.

Loading the HCL OneDB™ JDBC Driver

The Driver uses an automatic registration mechanism when you load the driver into your application. You should not need to manually execute any programming logic to 'load' the driver. However if you wish to do so you may

To load HCL OneDB™ JDBC Driver, use the Class.forName() method, passing in the OneDBDriver class name.

```
try {
    Class.forName("com.onedb.jdbc.OneDBDriver");
}
catch (Exception e) {
    System.out.println("ERROR: failed to load OneDB JDBC driver.");
```

```
    e.printStackTrace();
    return;
}
```

The Class.forName() method loads the HCL OneDB™ implementation of the **Driver** class, **OneDBDriver**. **OneDBDriver** then creates an instance of the driver and registers it with the **DriverManager** class.

A DataSource object

HCL OneDB™ JDBC Driver extends the standard **DataSource** interface to allow connection properties (both the standard properties and HCL OneDB™ environment variables) to be defined in a **DataSource** object instead of through the URL.

The following table describes how HCL OneDB™ connection properties correspond to **DataSource** properties.

HCL OneDB™ connection property	**DataSource property**	**Data type**	**Required?**	**Description**
HOST	host	String	Yes for client-side JDBC, unless **SQLH_TYPE** is defined; no for server-side JDBC	The IP address or the host name of the computer running the HCL OneDB™ database server
PORT	port	int	Yes for client-side JDBC, unless **SQLH_TYPE** is defined	The port number of the HCL OneDB™ database server.
DATABASE	database	String	No, however most applications would want to specify the database. Connections without a database	The name of the HCL OneDB™ database to which you want to connect If you do not specify the name of a database, a connection is made to the HCL OneDB™ database server.
USER	user	String	Yes	The user name controls (or determines) the session privileges when connected to the HCL OneDB™ database or database server Normally, you must specify both user name and password; however, if the user running the

HCL OneDB™ connection property	DataSource property	Data type	Required?	Description
				JDBC application is trusted by the DBMS, you might omit both.
PASSWORD	password	String	Yes	The password of the user Normally, you must specify both the user name and the password; however, if the user running the JDBC application is trusted by the DBMS, you might omit both.

Specify connection information

If an LDAP (Lightweight Directory Access Protocol) server or `sqlhosts` file provides the IP address, host name, or port number or service name of the HCL OneDB™ database server through the **SQLH_TYPE** property, you do not have to specify them using the standard **DataSource** properties. For more information, see Dynamically reading the HCL OneDB sqlhosts file on page 23.

Connection Properties

For a list of supported connection properties, see HCL OneDB JDBC Driver properties on page 15. For a list of HCL OneDB™ **DataSource** extensions, which allow you to define connection properties, see DataSource extensions on page 213. The driver does not consult the users environment to determine configuration property values.

High-availability data replication

You can use a **DataSource** object with High-Availability Data Replication. For more information, see Connections to the servers of a high-availability cluster on page 25.

Example: Use of a DataSource object in an example program

The following example defines and uses a **DataSource** object to connect to the database server using key/value pairs as properties:

```
import com.onedb.jdbcx.OneDBDataSource;
import com.onedb.jdbcx.OneDBParams;

OneDBDataSource ds = new OneDBDataSource();
ds.setProperty(OneDBParams.HOST, "localhost"); // default is localhost
ds.setProperty(OneDBParams.PORT, "9088"); //default is 9088
ds.setProperty(OneDBParams.DATABASE, "sysmaster");  //choose a database to connect to
try(java.sql.Connection con = ds.getConnection("username", "password")) {
   //do database work
}
catch (SQLException e) {
   e.printStackTrace();
}
```

Example: Setting parameters for a OneDBDataSource object using methods

The following are examples of using methods from the **OneDBDataSource** object to set parameters for establishing a database connection.

Example 1

```
OneDBDataSource ds = new OneDBDataSource();
ds.setLockTimeout(65);    // wait up to 65 seconds to obtain alock on the server
int waitMode = ds.getLockTimeout();
```

The DriverManager.getConnection() method

To create a connection to the HCL OneDB™ database or database server, you can use the DriverManager.getConnection() method. This method creates a **Connection** object, which is used to create SQL statements, send them to the HCL OneDB™ database, and process the results.

The **DriverManager** class tracks the available drivers and handles connection requests between appropriate drivers and databases or database servers. The *url* parameter of the getConnection() method is a database URL that specifies the subprotocol (the database connectivity mechanism), the database or database server identifier, and a list of properties.

A second parameter to the getConnection() method, *property*, is the property list. See Specify Connection Properties on page 14 for an example of how to specify a property list.

The following example shows a database URL that connects to a database called **testDB** from a client application:

```
jdbc:onedb://123.45.67.89:1533/testDB;user=onedbsa;password=onedbsapassword
```

The details of the database URL syntax are described in the next section.

The following partial example from the `CreateDB.java` program shows how to connect to database **testDB** by using DriverManager.getConnection(). In the full example, the *url* variable, described in the preceding example, is passed in as a parameter when the program is run at the command line.

```
try {
   conn = DriverManager.getConnection(url);
}
catch (SQLException e){
   System.out.println("ERROR: failed to connect!");
   System.out.println("ERROR: " + e.getErrorCode());
   e.printStackTrace();
}
```

Important: The only HCL OneDB™ connection type supported by HCL OneDB™ JDBC Driver is **tcp**. Shared memory and other connection types are not supported. For more information about connection types, see the *HCL OneDB™ Administrator's Guide* for your database server.

Important: Not all methods of the **Connection** interface are supported by HCL OneDB™ JDBC Driver. For a list of unsupported methods, see Unsupported methods and methods that behave differently on page 56.

Client applications should close the connection when it is finished its work with the database. To improve performance a connection pool can be used to manage reusable connections to the database.

Format of database URLs

The format of a database URL is determined by whether you are connecting from a client or on the database server.

Note: Starting OneDB JDBC Driver version 8.1.1.3, the use of LDAP to retrieve OneDB server connectivity information from a stored SQLHost files inside of an LDAP server has been removed.

For connections from a client, use the following format:

```
jdbc:onedb:// hostname:portnum /database_name; [ USER=userid; PASSWORD=password ] [ ONEDB_SERVER=servername; ] [
;name=value ]
```

```
[ user=userid; password=password ] [ ;name=value ]
```

hostname

This required parameter specifies the host name of the computer that is running the HCL OneDB™ database server.

This parameter is required for client-side JDBC, unless the SQLH_TYPE property is defined or the IFXHOST property is used. This parameter is optional for server-side JDBC.

portnum

This required parameter specifies the port number of the HCL OneDB™ database server.

This parameter is required for client-side JDBC unless the SQLH_TYPE property is defined.

database_name

This required parameter specifies the name of the HCL OneDB™ database to connect to. If you do not specify the name of a database, a connection is made to the HCL OneDB™ database server.

This parameter is not required but highly recommended that the connection is made to the database the application is going to use. Connection pool software presumes you connect to a particular database and may not function correctly if the database name is omitted.

USER=*userid*

This optional parameter specifies the user ID that is used in connections to the HCL OneDB™ database server.

This parameter is optional, however, if you specify *USER* then you must also specify the PASSWORD. If you do not specify the USER and PASSWORD, the driver calls System.getProperty() to obtain the name of the user currently running the application, and the client is assumed to be trusted. Trusted connections without a username/password can only be established when the JDBC client application is running on the same host as the database server.

PASSWORD=*password*

This optional parameter specifies the password for the specified user ID.

This parameter is optional, however, if you specify *password* then you must also specify the USER.

name*=*value

This optional parameter specifies the name-value pair that specifies a value for the HCL OneDB™ properties that is contained in the *name* variable, which is recognized by either HCL OneDB™ JDBC Driver or by HCL OneDB™ database servers. The *name* variable is not case-sensitive.

For more information, see Specify Connection Properties on page 14 and HCL OneDB JDBC Driver properties on page 15.

If an LDAP server or `sqlhosts` file provides the IP address, host name, or port number through the SQLH_TYPE property, you do not have to specify them in the database URL. For more information, see Dynamically reading the HCL OneDB sqlhosts file on page 23.

Example

In the following example, the connection syntax for a client-side connection is shown:

```
jdbc:onedb://123.45.67.89:1533/testDB;
   user=rdtest;password=test
```

IP address in connection URLs

The HCL OneDB™ JDBC Driver, Version 3.0 and later is IPv6 aware.

That is, the code that parses the connection URL can handle the longer (128-bit mode) IPv6 addresses (as well as IPv4 format). This IP address can be a IPv6 literal, for example:

```
3ffe:ffff:ffff:ffff:0:0:0:12
```

To connect to the IPv6 port with the HCL OneDB™ server, use the system property, for example:

```
java -Djava.net.preferIPv6Addresses=true ...
```

You must create a well-formed URL for the driver to recognize an IPv6 literal address. Note, in the following example:

- The `jdbc:onedb://` is required.
- The port number is required.
- The `3ffe:ffff:ffff:ffff:0::12` is not validated by the driver. It is passed directly into the Java networking classes
- The `8088` must be a valid number < 32k.

```
jdbc:onedb://3ffe:ffff:ffff:ffff:0::12:8088/your_database;USER=onedbsa...
```

Specify Connection Properties

When you use the DriverManager.getConnection() method to create a connection, HCL OneDB™ JDBC Driver reads HCL OneDB™ properties only from the name-value pairs in the connection database URL or from a connection property list. The driver does not consult the user's environment for any properties.

To specify HCL OneDB™ properties in the name-value pairs of the connection database URL, see Format of database URLs on page 12.

To specify HCL OneDB™ properties via a property list, use the **java.util.Properties** class to build the list of properties. The list of properties might include HCL OneDB™ properties, such as **OPTOFC**, as well as **USER** and **PASSWORD**.

After you have built the property list, pass it to the DriverManager.getConnection() method as a second parameter. You still need to include a database URL as the first parameter, although in this case you do not need to include the list of properties in the URL.

The following code shows how to use the **java.util.Properties** class to set connection properties. It first uses the Properties.put() method to set the environment variable **OPTOFC** to `1` in the connection property list; then it connects to the database.

The DriverManager.getConnection() method in this example takes two parameters: the database URL and the property list. The example creates a connection similar to the example given in The DriverManager.getConnection() method on page 11.

The following database URL is passed in as a parameter to the example program when the program is run at the command line:

```
jdbc:onedb://myhost:1533;
   USER=rdtest;PASSWORD=test
```

The code is:

```
try {
   Properties pr = new Properties();
   pr.put("OPTOFC","1");
   conn = DriverManager.getConnection(newUrl, pr);
}
catch (SQLException e) {
   System.out.println("ERROR: failed to connect!");
   e.printStackTrace();
}
```

HCL OneDB™ JDBC Driver properties

The following table lists most of the HCL OneDB™ properties supported by the client JDBC driver. For server-side JDBC, use property settings in the database URL rather than setting properties, because the properties would apply to all programs running in the database server. For more information about properties, see Specify Connection Properties on page 14.

For a list of properties that provide globalization features, see Globalization and date formats on page 178. For a list of properties useful for troubleshooting, see Tuning and troubleshooting on page 193

HCL OneDB™ JDBC properties	Default Value	Description

appendIsamCodeToSqlException	`false`	When set to `true`, the **APPENDISAM** property appends the ISAM Error code and message (if present) to the SQL Exception message, which is shown when .toString() or .getMessage() of an SQL Exception is called. The exception message is shown in the following format:
		`<SQL ERROR MESSAGE> (<SQLCODE>)`
		`ISAM error: <ISAM MESSAGE>(<ISAM CODE>)`

autoCaseSchema	`false`	
autoFreeCursors	`false`	When set to `true`, specifies that the Statement.close() method does not require a network round trip to free the database server cursor resources if the cursor has already been closed in the database server. The database server automatically frees the cursor resources after the cursor is closed, either explicitly by the ResultSet.close() method or implicitly through the **optOFC** property. After the cursor resources have been freed, the cursor can no longer be referenced. For more information, see The Auto Free feature on page 67.
batchInsertPreprocessing	`false`	When set to `true`, enables more efficient bulk inserts on data inserted with JDBC API calls for batched inserts. For more information, see Perform bulk inserts on page 44.
certificateVerification	`true`	Validate the certificates used for the encrypted connection

HCL OneDB™ JDBC properties	Default Value	Description
CLIENT_LOCALE		The locale + encoding of the characters the client application wants to receive from the JDBC driver.
commitBeforeIsolationChange	`false`	Whether you want the driver to automatically commit the current transaction if it detects you are trying to change the transaction isolation level for the session.
connectionCleanerDelay	`15000`	Number of milliseconds for the cleaner thread to wait until it looks for more JDBC resources to clean up. Set to 0 or -1 to disable the cleaner thread
customNLSMap		Allows new mappings to be defined between NLS and Java development kit locales and code sets. For more information, see User-defined locales on page 190.
database		The database the connection should be established against.
DB_LOCALE		The locale + encoding of the database you are connecting to.
DBANSIWARN	`false`	When set to `true`, checks for HCL OneDB™ extensions to ANSI-standard syntax
defaultCursorHoldability	`2`	Indicate the default cursor holdability See {@link ResultSet#HOLD_CURSORS_OVER_COMMIT}.
delimident	`false`	When set to `true`, specifies that strings set off by double quotation marks are delimited identifiers
udtCache	`true`	When set to `true`, caches the data type information for opaque, distinct, or row data types.

HCL OneDB™ JDBC properties	Default Value	Description
		When a **Struct** or **SQLData** object inserts data into a column and getSQLTypeName() returns the type name, the driver uses the cached information instead of querying the database server.
encrypt	`false`	When set to `true`, enables the connection to use SSL/TLS encryption for communication to the server.
encryptionProtocols	`TLSv1.2,TLSv1.1,TLSv1`	Override the encryption protocols presented to the server using a comma separated list of valid JDK protocols that are also supported by your database server
GL_DATETIME		
host		Specifies the host name or IP address to connect to.
invalidAutoCommitThrowError		Throws an exception if you disable autocommit (enabling transactions) on a non-logged database

HCL OneDB™ JDBC properties	Default Value	Description
lobBufferSize	`16384`	Size of buffer used to retrieve large objects from the server
lobCodesetConversionMemory	`-1`	The amount of memory used for conversion of character codesets when processing large objects before using temporary files for caching. If set to a number greater than or equal to 0, automates code-set conversion for TEXT and CLOB data types between client and database locales. The value of this variable determines whether code-set conversion is done in memory in or in temporary files. If set to 0, code-set conversion uses temporary files. If set to a value greater than 0, code-set conversion occurs in the memory of the client computer, and the value represents the number of bytes of memory allocated for the conversion. For more information, see Convert with the IFX_CODESETLOB environment variable on page 188.
lobReadonly	`false`	Whether BLOB/CLOB objects are forced to be readonly
lockTimeout	`-1`	How long (in seconds) to wait on a lock on a server. -1: Wait Forever 0: Do not wait > 0: Wait X seconds
loginRetries	`0`	Number of times retry establishing a connection to the server
loginTimeout	`15`	Initial wait time in seconds to connect to the server
metadataReplicationColumn	`false`	Indicate to the server and DatabaseMetaData queries to use the ifx_replcheck column.

HCL OneDB™ JDBC properties	Default Value	Description
metadataUppercaseValues	`false`	Uppercase values from ResultSetMetaData queries
optOFC	`false`	When set to `true`, the ResultSet.close() method does not require a network round trip if all the qualifying rows have already been retrieved in the clients tuple buffer. The database server automatically closes the cursor after all the rows have been retrieved. HCL OneDB™ JDBC Driver might not have additional rows in the clients tuple buffer before the next ResultSet.next() method is called. Therefore, unless HCL OneDB™ JDBC Driver has received all the rows from the database server, the ResultSet.close() method might still require a network round trip when **OPTOFC** is set to `true`.
padVarchar	`false`	Simulate a CHAR column from a VARCHAR by padding the end of VARCHAR columns to the size of the column.
password		Specifies the password that corresponds to the USER value set.
port	`9088`	Specifies the port number to connect to the database server with
preparedStatementCacheSize	`0`	
protocolTraceFile		File path to generate a protocol level trace file for support teams. Only enable the trace file when directed by a technical support representative.
removeLobTempFilesOnRSClose	`false`	Remove temporary files used with large objects when the ResultSet is closed. If true when a ResultSet is closed, the temporary files are removed, and any references to BLOB/CLOB objects that reference those files will no longer function. If false, then the temporary files can persist until the connection is closed.

HCL OneDB™ JDBC properties	Default Value	Description
replaceUnmappableCharacterSequences	`false`	What to do if a character is not mappable from the database encoding to the client encoding. `true` - replace the character with the charsets default replacement string `false` - throw an error to indicate unmappable characters are present
resultsBufferSize	`4096`	Overrides the default setting for the size of the fetch buffer for all data except large objects.
secondaryServerName		Server name for looking up a secondary server from a SQLHOST file
secondarySwitch	`false`	When set to `true`, secondary server properties are used to connect to the secondary server if the primary server is unavailable.
secondaryHost		Host or IP address of the secondary server
secondaryPort		Port of the secondary server
serverName		Specifies which database server a connection is made to by a client application when looking up via a SQLHOSTS file
sessionVariables		HCL OneDB™ server allows the setting of many variables at the session (Connection) level. Instead of executing a SET ENVIRONMENT SQL statement for each settion variable that needs set, you can specify a comma separated list of session variables. You end the list with a semi-colon as you would any other connection property Below is an example of mixing in a number of session variables along with normal connection properties. `user=myuser;sessionVariables=AUTOLOCATE = '1',EXTDIRECTIVES=OFF , force_ddl_exec='OFF';password=mypassword` See SET ENVIRONMENT statement for the list of session variables you can set.

HCL OneDB™ JDBC properties	Default Value	Description
SQLH_LOC		Path to a client SQLHOST file which contains entries on servers the driver can connect to.
SQLH_TYPE		When set to FILE, specifies that database information (such as *host-name*, *port-number*, *user*, and *password*) is specified in an `sqlhosts` file. For more information, see Dynamically reading the HCL OneDB sqlhosts file on page 23.
socketTimeout	`0` - Wait forever	How long to wait in milliseconds for a response on the TCP socket
socketKeepAlive	`false`	Enable keep alive on the TCP socket connection
serverName	`0`	
tempDir		Specifies where temporary files for handling smart large objects are created. You must supply an absolute path name.
transactionIsolationLevel		Defines the degree of concurrency among processes that attempt to access the same rows simultaneously. Possible values: 0 — Equivalent to `TRANSACTION_NONE` 1 — Dirty Read (equivalent to `TRANSACTION_READ_UNCOMMITTED`) 2 — Committed Read (equivalent to `TRANSACTION_READ_COMMITTED`

HCL OneDB™ JDBC properties	Default Value	Description
		3 — Cursor Stability (equivalent to `TRANSACTION_READ_COMMITTED`) 4 — Repeatable Read (equivalent to `TRANSACTION_REPEATABLE_READ`) 5 — Committed Read LAST COMMITTED (equivalent to `TRANSACTION_LAST_COMMITTED`) 8 — Equivalent to `TRANSACTION_SERIALIZABLE` Specifying U after the mode means retain update locks. For example, a value could be: `2U` (equivalent to `SET ISOLATION TO COMMITTED READ RETAIN UPDATE LOCKS`
trimTrailingSpaces	`false`	Removes trailing spaces from character columns queried from the database server
trustStore		Specifies the location of the truststore to load by the JDBC driver.
trustStorePassword		Specifies the password to the truststore that is being loaded by the JDBC driver.
trustedContext	`false`	When set to `true`, a trusted connection request is sent from client. Either a successful trusted connection is established or the following error is returned from the server: `SQL Exception : -28021(Trusted Connection request rejected.)`
uppercaseMetaDataRSColumnNames	`false`	Return UPPERCASE column names in the link DatabaseMetaData ResultSet column names.
user		The user which you want to authenticate to the database server with.

For a detailed description of a particular property, see *HCL OneDB™ Guide to SQL: Reference*.

Code example lockTimeout property

```
Connection conn = DriverManager.getConnection
 ( "jdbc:onedb://localhost:9080/stores_demo;user=rdtest;password=my_passwd;lockTimeout=15");
```

Code example transactionIsolationLevel property

```
Connection conn = DriverManager.getConnection( "jdbc:onedb://localhost:9088;
user=rdtest;password=my_passwd;transactionIsolationLevel=1U");
```

Important: The isolation property can be set in the URL only when it is an explicit connection to a database.

Dynamically reading the HCL OneDB™ sqlhosts file

HCL OneDB™ JDBC Driver supports the JNDI (Java™ naming and directory interface). This support enables JDBC programs to access the HCL OneDB™ `sqlhosts` file. The `sqlhosts` file lets a client application find and connect to the HCL OneDB™ database server anywhere on the network. For more information about this file, see the *HCL OneDB™ Administrator's Guide* for your database server.

You can access `sqlhosts` data from a local file or from an LDAP server. The system administrator must load the `sqlhosts` data into the LDAP server using the HCL OneDB™ utility.

Your **CLASSPATH** variable must reference the JNDI JAR (Java™ archive) files and the LDAP SPI (service provider interface) JAR files. You must use LDAP Version 3.0 or later, which supports the object class **extensibleObject**.

You can use the `sqlhosts` file **group** option to specify the name of a database server group for the value of `ONEDB_SERVER`. The **group** option is useful with High-Availability Data Replication (HDR); list the primary and secondary database servers in the HDR pair sequentially. For more information on about how to set or use groups in `sqlhosts` file, see the *HCL OneDB™ Administrator's Guide*. For more information about HDR, see Connections to the servers of a high-availability cluster on page 25.

Connection property syntax

Note: Starting OneDB JDBC Driver version 8.1.1.3, the use of LDAP to retrieve OneDB server connectivity information from a stored SQLHost files inside of an LDAP server has been removed.

You can let HCL OneDB™ JDBC Driver look up the host name or port number in an LDAP server instead of specifying them in a database URL or **DataSource** object directly. You must specify the following properties in the database URL or **DataSource** object for the LDAP server:

- **SQLH_TYPE**=LDAP
- **LDAP_URL**=ldap://*host-name*:*port-number*

  host-name and *port-number* are those of the LDAP server, not the database server.
- **LDAP_IFXBASE**=*Informix-base-DN*
- **LDAP_USER**=*user*
- **LDAP_PASSWD**=*password*

If **LDAP_USER** and **LDAP_PASSWD** are not specified, HCL OneDB™ JDBC Driver uses an anonymous search to search the LDAP server. The LDAP administrator must make sure that an anonymous search is allowed on the `sqlhosts` entry. For more information, see your LDAP server documentation.

Informix-base-DN has the following basic format:

```
cn=common-name,o=organization,c=country
```

If *common-name*, *organization*, or *country* consists of more than one word, you can use one entry for each word. For example:

```
cn=informix,cn=software
```

Here is an example database URL:

```
jdbc:onedb:ONEDB_SERVER=value;SQLH_TYPE=LDAP;
   LDAP_URL=ldap://davinci:329;LDAP_IFXBASE=cn=informix,
   cn=software,o=kmart,c=US;LDAP_USER=abcd;LDAP_PASSWD=secret
```

You can also specify the `sqlhosts` file in the database URL or **DataSource** object. The host name and port number or the service name of the HCL OneDB™ database server as specified in the `/etc/services` file are read from the `sqlhosts` file. You must specify the following properties for the file:

- **SQLH_TYPE**=FILE
- **SQLH_FILE**=*sqlhosts-filename*

The `sqlhosts` file can be local or remote, so you can refer to it in the local file system format or URL format. Here are some examples:

- `SQLH_FILE=http://host-name:port-number/sqlhosts.iusSQLH_FILE=http://host-name:service-name/sqlhosts.ius`

  The *host-name* and *port-number* or *service-name* of the HCL OneDB™ database server (from the `etc/services` file) elements are those of the server on which the `sqlhosts` file resides.

- `SQLH_FILE=file://D:/local/myown/sqlhosts.ius`
- `SQLH_FILE=/u/local/sqlhosts.ius`

Here is an example database URL:

```
jdbc:informix-sqli:ONEDB_SERVER=value;SQLH_TYPE=FILE;
   SQLH_FILE=/u/local/sqlhosts.ius
```

If the database URL or **DataSource** object references the LDAP server or `sqlhosts` file but also directly specifies the IP address, host name, and port number, then the IP address, host name, and port number specified in the database URL or **DataSource** object take precedence. For information about how to set these connection properties by using a **DataSource** object, see DataSource extensions on page 213.

Administration requirements

Note: Starting OneDB JDBC Driver version 8.1.1.3, the use of LDAP to retrieve OneDB server connectivity information from a stored SQLHost files inside of an LDAP server has been removed.

If you want the LDAP server to store `sqlhosts` information that a JDBC program can look up, the following requirements must be met:

- The LDAP server must be installed on a computer that is accessible to the client. The LDAP administrator must create an **IFXBASE** entry in the LDAP server.

  For more information about LDAP directory servers, see:
    - www.oracle.com
    - www.openldap.org
- The LDAP administrator must make sure that anonymous search is allowed on the `sqlhosts` entry. For more information, see the LDAP server documentation.

Connections to the servers of a high-availability cluster

Using the JDBC driver, Java™ applications can connect to HCL OneDB™ database servers in a high-availability cluster. Java™ applications can also connect to HCL OneDB™ Connection Managers, which can handle failover for high-availability clusters and redirect connections to cluster servers.

To connect your Java™ application to the servers of a high-availability cluster, you must set properties in the connection URL or DataSource. If the application performs update operations on secondary servers, configure the application to initially check for read-only server status.

When you configure HCL OneDB™ Connection Managers to handle connections between your Java™ application server and high-availability cluster, you get the following benefits:

- You can direct connection requests to the most appropriate secondary server through rule-based redirection policies.
- You can manage failover for your high-availability clusters, automatically promoting a secondary server to the role of primary server if the primary server fails.
- You can prioritize connections between a specific application server and the primary server of your high-availability cluster when you install and configure HCL OneDB™ Connection Managers on the same hosts as your Java™ application servers.
- When database servers are behind a firewall, HCL OneDB™ Connection Managers can act as proxy servers, and handle client/server communication.

You can use high-availability secondary servers with connection pooling. For more information, see High-Availability Data Replication with connection pooling on page 202.

Demonstration programs are available in the `hdr` directory within the `demo` directory where HCL OneDB™ JDBC Driver is installed. For details about the files, see Sample code files on page 204.

Properties for connecting to high-availability cluster servers through HCL OneDB™ Connection Managers

A JDBC application can connect to Connection Manager, just as the application might connect to a database server. Application connection requests are then redirected to the most appropriate server in a high-availability cluster.

You can configure multiple Connection Managers, and then create a Connection Manager group entry in `sqlhost` file that is used by the Java™ application server. If one Connection Manager fails, connection requests can be directed to working Connection Managers. The SQLH_FILE connection property directs the JDBC driver to search for group entries.

To connect to the HCL OneDB™ Connection Manager that then connects to the servers of a high-availability cluster, you must include the following properties in the connection URL or DataSource:

```
ONEDB_SERVER=CM_or_group_name
SQLH_TYPE=FILE
SQLH_FILE=sqlhosts
USER=user_name
PASSWORD=password
```

Include the following properties in the connection URL to prevent your Java™ applications from waiting indefinitely if a Connection Manager is running, but has a hung connection.

```
CONNECT_RETRIES=value
CONNECT_TIMEOUT=value
LOGINTIMEOUT=value
```

The values are set based on the network environment.

Example

Example 1: Connecting to a high-availability cluster through the HCL OneDB™ Connection Manager

In this example, you have the following system setup:

- You have a high-availability cluster (**my_cluster**) that is composed of four servers.
- The user name on all cluster servers is **my_user**.
- The password on all cluster servers is **my_password**.
- **connection_manager**, on **cmhost1.example.com** uses the following configuration file:

```
NAME connection_manager

CLUSTER my_cluster
{
   ONEDB_SERVER my_servers
   SLA sla_primary     DBSERVERS=PRI
   SLA sla_secondaries DBSERVERS=SDS,HDR,RSS
   FOC ORDER=ENABLED \
       PRIORITY=1
}
```

- You have a Java™ application server on **host1.example.com**, and the Java™ application server uses the following `sqlhost` file entries:

```
#dbservername       nettype    hostname             servicename  options
 sla_primary      onsoctcp   cmhost1.example.com  cm_port_1
 sla_secondaries  onsoctcp   cmhost1.example.com  cm_port_1
```

- If the initial connection attempt by the client fails, you want it to retry two times.
- You want the CONNECT statement to wait 10 seconds to establish a connection.
- You want the connection to fail if the server port is polled and does not connect within 10 milliseconds.

To connect the Java™ application client to the primary server of **my_cluster**, use the following URL:

```
jdbc:onedb://ONEDB_SERVER=sla_primary;
   SQLH_TYPE=FILE;SQLH_FILE=sqlhosts;
   USER=my_user_name;PASSWORD=my_password;
   CONNECT_RETRIES=2;CONNECT_TIMEOUT=10;LOGINTIMEOUT=10
```

To connect the Java™ application client to a secondary server of **my_cluster**, use the following URL:

```
jdbc:onedb://ONEDB_SERVER=sla_secondaries;
   SQLH_TYPE=FILE;SQLH_FILE=sqlhosts;
   USER=my_user_name;PASSWORD=my_password;
   CONNECT_RETRIES=2;CONNECT_TIMEOUT=10;LOGINTIMEOUT=10
```

Example

Example 2: Connecting to a high-availability cluster through HCL OneDB™ Connection Managers

In this example, you have the following system setup:

- You have a high-availability cluster (**my_cluster**) that is composed of four servers.
- The user name on all cluster servers is **my_user**.
- The password on all cluster servers is **my_password**.
- **connection_manager_1**, on **cmhost1.example.com** uses the following configuration file for client redirection and failover:

```
NAME connection_manager_1

CLUSTER my_cluster
{
   ONEDB_SERVER my_servers
   SLA sla_primary_1 DBSERVERS=PRI
   FOC ORDER=ENABLED \
       PRIORITY=1
   CMALARMPROGRAM $ONEDB_HOME/etc/CMALARMPROGRAM.sh
}
```

- **connection_manager_2**, on **cmhost2.example.com** uses the following configuration file for client redirection and failover:

```
NAME connection_manager_2

CLUSTER my_cluster
{
   ONEDB_SERVER my_servers
   SLA sla_primary_1 DBSERVERS=PRI
   FOC ORDER=ENABLED \
       PRIORITY=2
   CMALARMPROGRAM $ONEDB_HOME/etc/CMALARMPROGRAM.sh
}
```

- You have a Java™ application server on **host1.example.com**, and the Java™ application server uses the following `sqlhost` file entries:

```
#dbservername       nettype    hostname              servicename  options
 g_primary          group      -                     -            c=1,e=sla_primary_2
 sla_primary_1      onsoctcp   cmhost1.example.com   cm_port_1    g=g_primary
 sla_primary_2      onsoctcp   cmhost2.example.com   cm_port_2    g=g_primary
```

- If the initial connection attempt by the client fails, you want it to retry two times.
- You want the CONNECT statement to wait 10 seconds to establish a connection.
- You want the connection to fail if the server port is polled and does not connect within 10 milliseconds.

To connect the Java™ application client to the primary server of **my_cluster** through either **connection_manager_1** or **connection_manager_2**, use the following URL:

```
jdbc:onedb://ONEDB_SERVER=g_primary;
   SQLH_TYPE=FILE;SQLH_FILE=sqlhosts;
   USER=my_user_name;PASSWORD=my_password;
   CONNECT_RETRIES=2;CONNECT_TIMEOUT=10;LOGINTIMEOUT=10
```

Properties for connecting to high-availability cluster servers through SQLHOST file group entries

You can define `sqlhost` group entries, so that your application connection attempt is always directed to the primary server of a high-availability cluster, even if failover occurs.

To connect to the primary server of a high-availability cluster, include the following properties in the connection URL or DataSource:

```
ONEDB_SERVER=group_name
SQLH_TYPE=FILE
SQLH_FILE=sqlhosts
USER=user_name
PASSWORD=password
```

An exception is thrown if the JDBC driver cannot find a primary server in the group.

Enforcing connections to the primary server is enabled for HCL OneDB™, Version 9.40.xC6 and later only.

Example

Example: Connecting to the primary server of a high-availability cluster through SQLHOST file group entries

In this example, you have the following system setup:

- You have a high-availability cluster (**my_cluster**) that is composed of four servers:
    - **server_1** (primary), on **host1.example.com**
    - **server_2** (shared-disk secondary), on **host1.example.com**
    - **server_3** (HDR), on **host2.example.com**
    - **server_4** (Remote-standalone secondary), on **host3.example.com**
- The user name on all cluster servers is **my_user**.
- The password on all cluster servers is **my_password**.
- You have a Java™ application server on **host4.example.com**. The server uses the following `sqlhost` file entries:

```
#dbservername   nettype    hostname           servicename   options
 my_servers     -          -                                c=1,e=server_4
 server_1       onsoctcp   host1.example.com  port_1        g=my_servers
 server_2       onsoctcp   host1.example.com  port_2        g=my_servers
 server_3       onsoctcp   host2.example.com  port_3        g=my_servers
 server_4       onsoctcp   host3.example.com  port_4        g=my_servers
```

To connect the Java™ application client to the primary server of **my_cluster**, use the following URL:

```
jdbc:onedb://ONEDB_SERVER=my_servers;
   SQLH_TYPE=FILE;SQLH_FILE=sqlhosts;
   USER=my_user_name;PASSWORD=my_password
```

Properties for connecting directly to an HDR pair of servers

You can define your client application's connection URL or DataSource so that your application connects directly to an HDR pair of servers. If a connection attempt to the primary server fails, the client application can attempt to connect to the HDR secondary server.

To connect directly to a primary server and HDR secondary server, include the following properties in the connection URL or DataSource:

```
ONEDB_SERVER=primary_server_name
INFORMIXSERVER_SECONDARY=secondary_server_name
IFXHOST_SECONDARY=secondary_host_name
PORTNO_SECONDARY=secondary_port_number
USER=user_name
PASSWORD=password
ENABLE_HDRSWITCH=true
```

If you are setting values in the DataSource, you must also include the following values:

```
IFXHOST=primary_host_name
PORTNO=primary_port_number
```

When you are using a **DataSource** object, you can set and get the secondary server connection properties with setXXX() and getXXX() methods. These methods are listed with their corresponding connection property in Read and write properties on page 213.

You can manually redirect a connection to the secondary server in an HDR pair by editing the ONEDB_SERVER, PORTNO, and IFXHOST properties in the DataSource or by editing the ONEDB_SERVER property in the URL. Manual redirection requires editing the application code and then restarting the application.

Example

Example: Connecting to an HDR pair of servers

The following example shows a connection URL for a primary server that is named **server_1** and an HDR secondary server that is named **server_2**:

```
jdbc:onedb://my_host:my_port/my_database;
   ONEDB_SERVER=server_1;INFORMIXSERVER_SECONDARY=server_2;
   IFXHOST_SECONDARY=host2.example.com;PORTNO_SECONDARY=port_2;
   user=my_name;password=my_password;
   ENABLE_HDRSWITCH=true
```

Checks for read-only status of high-availability secondary servers

You can write applications to check for read-only server status, so that update operations are not attempted on read-only secondary servers.

The HCL OneDB™ JDBC driver has extension methods to the java.sql.Connection class that provide a way to check the HDR secondary server's status. Users can type cast connection objects to 'com.informix.jdbc.IfmxConnection' to access the following extension methods.

Information obtained	Method signature	Additional information
Whether the server is read-only (a secondary server)	public boolean is ReadOnly() throws SQLException	Returns true if the active server is a secondary server Returns an exception if a database access error occurs If ENABLE_HDRSWITCH is set to false, isReadOnly() returns the value that is initially set after the last successful HDR connection was obtained.
Whether HDR is enabled	public boolean is HDREnabled()	Returns true if both servers in the HDR pair are available Returns false if one of the servers is unavailable
The type of the server (primary, secondary, or standard)	public string getHDRtype()	Returns primary or standard for a primary server, secondary for a secondary server

Information obtained	Method signature	Additional information
		The database administrator can manually reset the type of the server.

For example, you can use one of the following strategies:

- Use the isReadOnly() method before each SQL statement that might contain an update operation. If the value of isReadOnly() is `true`, perform an appropriate action, such as sending an error message to the user or notifying the server administrator.
- You call the isReadOnly() method after you establish a connection and then set a flag, like READ_ONLY, and then perform operations that are based on the flag value.

An administrator can manually switch a secondary server to a primary server to allow update operations. However, the server must be shut down in the process, which can cause uncommitted transactions to be lost.

Connection retry attempts to HDR secondary servers

You can write applications so that if a connection is lost during query operations, HCL OneDB™ JDBC Driver returns a new connection to the secondary database server and the application reruns the queries.

The following example shows how to retry a connection with the secondary server information, and then rerun an SQL statement that received an error because the primary server connection failed:

```
public class HDRConnect {
  static IfmxConnection conn;

  public static void main(String[] args)
  {
     getConnection(args[0]);
     doQuery( conn );
     closeConnection();
  }

  static void getConnection( String url )
  {
        ..
     Class.forName("com.informix.jdbc.IfxDriver");
     conn = (IfmxConnection )DriverManager.getConnection(url);

  }
  static void closeConnection()
  {
     try
     {
         conn.close();
     }
     catch (SQLException e)
     {
         System.out.println("ERROR: failed to close the connection!");
         return;
     }
  }
  static void doQuery( Connection con )
  {
     int rc=0;
     String cmd=null;
     Statement stmt = null;

     try
      {
         // execute some sql statement
      }
     catch (SQLException e)
       {
         if (e.getErrorCode() == -79716 ) || (e.getErrorCode() == -79735)
         // system or internal error
       {
         // This is expected behavior when primary server is down
         getConnection(url);
         doQuery(conn);
       }
       else
         System.out.println("ERROR: execution failed - statement: " + cmd);
       return;
       }
  }
```

Specify where LDAP lookup occurs

Note: Starting OneDB JDBC Driver version 8.1.1.3, the use of LDAP to retrieve OneDB server connectivity information from a stored SQLHost files inside of an LDAP server has been removed.

When used with other LDAP keywords, the SQLH_LOC keyword indicates where an LDAP lookup occurs.

SQLH_LOC can have a value of either `CLIENT` or `PROXY`. If the value is `CLIENT`, the driver performs the LDAP lookup on the client side. If the value is `PROXY`, the proxy performs the lookup on the server side. If no value is specified, the driver uses `CLIENT` as the default value.

Here is the format for an applet or application URL with LDAP keywords that specifies a server-side LDAP lookup:

```
jdbc:informix-sqli:ONEDB_SERVER=informix-server-name;
PROXY=proxy-hostname-or-ip-address:proxy-port-no?
PROXYTIMEOUT=60;SQLH_TYPE=LDAP;LDAP_URL=ldap:
//ldap-hostname-or-ip-address:ldap-port-no;LDAP_IFXBASE=dc=mydomain,dc=com;
SQLH_LOC=PROXY;
```

This example obtains the database server host name and port from an LDAP server:

```
jdbc:informix-sqli:ONEDB_SERVER=samsara;SQLH_TYPE=LDAP;
LDAP_URL=ldap://davinci:329;LDAP_IFXBASE=cn=informix,
o=kmart,c=US;LDAP_USER=abcd;LDAP_PASSWD=secret;SQLH_LOC=PROXY;
PROXY=webserver:1462
```

For a complete example of using an LDAP server with the proxy, see the `proxy` applet and application in the demo directory where your JDBC driver is installed.

Specify sqlhosts file lookup

The SQLH_LOC keyword also applies to `sqlhosts` file lookups when you are using the proxy. If the URL includes SQLH_LOC =PROXY, the driver reads the `sqlhosts` file on the server. If SQLH_LOC =PROXY is not specified, the driver reads the file on the client.

This example obtains the information from an `sqlhosts` file on the server:

```
jdbc:informix-sqli:ONEDB_SERVER=samsara;SQLH_TYPE=FILE;
   SQLH_FILE=/work/9.x/etc/sqlhosts;SQLH_LOC=PROXY;
   PROXY=webserver:1462
```

Encryption options

You can use either password (SECURITY=PASSWORD) or network encryption to establish the security of your connection. To use either the password option or to use network encryption, you must have a Java™ Cryptography Extension (JCE)-compliant encryption services provider installed in your Java™ runtime environment.

It is recommended that you do not mix security packages on the same client. The following topics describe how to configure each package.

Connecting JDBC applications with SSL

You can configure database connections for the HCL OneDB™ JDBC Driver to use the Secure Sockets Layer (SSL) protocol.

Before you begin
The client must use the same public key certificate file as the server.

1. **Create a truststore:** Use the **keytool** utility that comes with your Java™ runtime environment to import a client-side keystore database and add the public key certificate to the keystore.

   ```
   C:\work>keytool -importcert -file filename.extension -keystore .keystore
   ```

   Follow the prompts to enter a new keystore password and to trust the certificate.
2. **Define the truststore location:** Configure an SSL/TLS connection to the database from your Java™ application by using the following options:

   Option 1: Use system properties

   Set the location and password of the truststore using Java system properties.

Note: These settings apply to all the SSL connections made from this application.

```
C:\work>java -Djavax.net.ssl.trustStore=/opt/ids/.keystore
 -Djavax.net.ssl.trustStorePassword=password -jar yourapplication.jar
```

or set the location and password inside the java code using the System.setProperty API.

```
System.setProperty("javax.net.ssl.trustStore", "/opt/ids/.keystore");
 System.setProperty("javax.net.ssl.trustStorePassword", "password");
```

Option 2: Use a DataSource object

Define "per connection" the truststore location and password using a DataSource object by using the setTrustStore and setTrustStorePassword methods on the IfxDataSource object.

```
OneDBDataSource ds = new OneDBDataSource();
ds.setTrustStore("/opt/keystore");
ds.setTrustStorePassword("password");
//Add your additional connection details
```

Option 3: Pass in through the connection URL

If you do not use a DataSource object you can pass in the truststore and password via URL properties using SSL_TRUSTSTORE=/opt/ids/.keystore and SSL_TRUSTSTORE_PASSWORD=password

```
Connection c = DriverManager.getConnection("jdbc:onedb://localhost:9089/mydatabase;
SSL_TRUSTSTORE=/opt/keystore;SSL_TRUSTSTORE_PASSWORD=password
```

3. **Declare the connection for SSL**: This is set per connection and can be done through the DataSource or the URL.

Option 1: Use a DataSource object

```
OneDBDataSource ds = new OneDBDataSource();
ds.setEncrypt(true);
```

Option 2: Pass in through the connection URL

```
Connection c = DriverManager.getConnection("jdbc:onedb://localhost:9089/mydatabase;
 encrypt=true;
```

Example

JDBC sample for SSL connection

This sample Java™ program highlights the operations that are required to connect to the stores_demo database by using SSL.

```
import java.sql.Connection;
import java.sql.SQLException;

import com.onedb.jdbcx.OneDBDataSource;

public class SSLConnectionExample {
 public static void main(String[] args) {

  /* System properties for keystore */
  /* you can set this here for your whole system or you can set on */
  /* the data source (show below) or directly on your connection */
  /* properties using SSL_TRUSTSTORE and SSL_TRUSTSTORE_PASSWORD */
  System.setProperty("javax.net.ssl.trustStore", "/path/to/keystore");
  System.setProperty("javax.net.ssl.trustStorePassword", "password");

  /* Instantiate OneDB data source */
  OneDBDataSource ds = new OneDBDataSource();


  ds.setUser("dbuser");
  ds.setPassword("password");
  ds.setDatabase("stores_demo");
  ds.setPort(9888);

  /* Enable SSL/TLS (required when using SSL/TLS) */
  cds.setEncrypt(true);

  /* Optional if you don't set a system property */
  /* You can set the trust store and password in the data source */
  cds.setTrustStore("/opt/keystore");
  cds.setTrustStorePassword("password");

  try (Connection conn = ds.getConnection()) {
   System.out.println(" Successfully connected to database using SSL Connection");
   System.out.println(" Database version  ...: " + conn.getMetaData().getDatabaseProductVersion());
  } catch (SQLException e) {
   System.err.println("Error Message : " + e.getMessage());
   System.err.println("Error Code    : " + e.getErrorCode());
  }
 }
}
```

PAM authentication method

The HCL OneDB™ JDBC Driver, Version 2.21. JC5 and later, implements support for handling PAM (Pluggable Authentication Module)-enabled HCL OneDB™ server 9.40 and later servers. This implementation supports a challenge-response dialog between PAM and the end user. To facilitate this dialog, the JDBC developer must implement the **com.informix.jdbc.IfmxPAM** interface. The IfxPAM() method in the **IfmxPAM** interface acts as the gateway between PAM and the user.

The IfxPAM() method is called when the JDBC server encounters a PAM challenge method. The return value from the IfxPAM() method acts as the response to the challenge message and is sent to PAM.

The signature for the IfxPAM() method is:

```
public IfxPAMResponse IfxPAM(IfxPAMChallenge challengeMessage)
```

Two classes, **IfxPAMChallenge** and **IfxPAMResponse**, usher messages between the JDBC driver and PAM. The **IfxPAMChallenge** class contains the information that has been sent from PAM to the user.

The challenge message is obtained from the **IfxPAMChallenge** class by using the getChallenge() method. This message is what is sent directly from PAM running on HCL OneDB™ server to be routed to the end user. The challenge messages are listed in the following table.

Table 1. Types of challenge messages

Message	Description
PAM_PROMPT_ECHO_ON	The message is displayed to the user and the users response can be echoed back.
PAM_PROMPT_ECHO_OFF	The message is displayed to the user and the users response is hidden or masked (that is, when the user enters a password, asterisks are displayed instead of the exact characters the user types).
PAM_PROMPT_ERROR_MSG	The message is displayed to the user as an error, with no response required.
PAM_TEXT_INFO_MSG	The message is displayed to the user as an informational message, with no response required.

The challenge message type is governed by the PAM standard and can have vendor-specific values. See the PAM standard and vendor-specific information for possible values and interpretations.

The PAM standard defines the maximum size of a PAM message to be 512 bytes (**IfxPAMChallenge.PAM_MAX_MESSAGE_SIZE**).

The **IfxPAMResponse** class is similar to **IfxPAMChallenge**, but instead of being used by PAM to send a message to the user, the **IfxPAMResponse** class is used to send a message from the user to PAM. Use the IfxPAMResponse.setResponse() method to send the challenge-response string to PAM. However, set the response type (which is set by using the IfxPAMResponse.setResponseType() method) to zero, the default, as the response type is currently reserved for future use.

The challenge-response string is limited to the size of the challenge message: **IfxPAMResponse.PAM_MAX_MESSAGE_SIZE** or 512 bytes. If the response string exceeds this limit, an SQL exception is thrown.

Additionally, when the challenge message is of type PAM_INFO_TEXT or PAM_PROMPT_ERR_MSG (see PAM standards for meaning and integer values), PAM expects no user response. Thus, a null **IfxPAMResponse** object or one that has not been set with specific values can be returned to JDBC. The **IfxPAMResponse** class provides the following method to allow the JDBC developer to stop the connection attempt during a PAM session:

```
public void setTerminateConnection(boolean flag)
```

The value of the *flag* can be TRUE or FALSE. If the value of the parameter passed to **setTerminateConnection** is TRUE, then the connection to the PAM-enabled HCL OneDB™ server immediately terminates upon returning from IfxPAM(). If the value is set to FALSE, then the connection attempt to the PAM-enabled server continues as usual.

PAM in JDBC

JDBC developers using PAM to communicate with a PAM-enabled HCL OneDB™ server must implement the **com.informix.jdbc.IfmxPAM** interface. To do so, put the following on the class declaration line in a Java™ class file:

```
implements IfmxPAM
```

That Java™ class must then implement the **IfmxPAM** interface conforming to Java™ standards and the details provided previously. The next step is to inform the JDBC driver what Java™ class has implemented the **IfmxPAM** interface. There are two ways to do this:

- Add the key-value pair **IFX_PAM_CLASS**=*your.class.name* to the connection URL, where the value *your.class.name* is the path to the class that has implemented the **IfmxPAM** interface.

  This method is typically used when connecting to the HCL OneDB™ server by using the **DriverManager.getConnection** (URL) approach.
- Add the property **IFX_PAM_CLASS** with the value *your.class.name* to your properties list before attempting the connection to the PAM-enabled server.

  This method is used when connecting to the HCL OneDB™ server by using the DataSource.getConnection() approach.

JDBC developers have a wide latitude in implementing the **IfmxPAM** interface. The following actions happen during authentication that uses PAM:

1. The JDBC driver, when detecting communication with a PAM-enabled server, contacts the IfxPAM() method and passes it a **IfxPAMChallenge** object containing the PAM challenge question.
2. A dialog box you create appears with a text question containing the challenge message that was sent by PAM.
3. When the user furnishes the response, it is packaged into an **IfxPAMResponse** object, and it is returned to the JDBC driver by exiting the IfxPAM() method returning the **IfxPAMResponse** object.
4. When PAM receives the response from the challenge question, it can authorize the user, deny access to the user, or issue another challenge question, in which case the previous process is repeated.

This process continues until either the user is authorized or the user is denied access. The Java™ developer or user can terminate the PAM authorization sequence by calling the IfxPAMResponse.setTerminateConnection() method with a value of TRUE.

Perform database operations

These topics explain what you need to use HCL OneDB™ JDBC Driver to perform operations against the HCL OneDB™ database.

Query the database

HCL OneDB™ JDBC Driver complies with the JDBC API specification for sending queries to a database and retrieving the results. The driver supports most of the methods of the **Statement**, **PreparedStatement**, **CallableStatement**, **ResultSet**, and **ResultSetMetaData** interfaces.

Example of sending a query to the HCL OneDB™ database

The following example shows how to use the **PreparedStatement** interface to execute a SELECT statement that has one input parameter:

```
try(PreparedStatement pstmt = conn.prepareStatement("SELECT tabid FROM systables WHERE tablid = ?")
 {
   pstmt.setInt(1, 11);
   try(ResultSet r = pstmt.executeQuery()) {
      while(r.next()) {
         int i = r.getInt(1);
         System.out.println("Select: column tabid = " + i);
      }
   }
}
catch (SQLException e) {
   System.out.println("ERROR: Fetch statement failed: " +
      e.getMessage());
}
```

The program first uses the Connection.prepareStatement() method to prepare the SELECT statement with its single input parameter. It then assigns a value to the parameter by using the PreparedStatement.setInt() method and executes the query with the PreparedStatement.executeQuery() method.

The program returns resulting rows in a **ResultSet** object, through which the program iterates with the ResultSet.next() method. The program retrieves individual column values with the ResultSet.getInt() method, since the data type of the selected column is INTEGER.

Finally, both the **ResultSet** and **PreparedStatement** objects are implicitly closed with the appropriate using Java's try-with-resources block to close any object that implements java.lang.AutoCloseable

For more information about which getXXX() methods retrieve individual column values, see Data type mapping for ResultSet.getXXX() methods on page 229.

Reoptimize queries

When you prepare SELECT, EXECUTE FUNCTION, or EXECUTE PROCEDURE statements, the database server uses a query plan to optimize the query. If you later modify the data that is associated with the prepared statement, you can compromise the effectiveness of the query plan for that statement. However, when you change the data, you can reoptimize your query.

You can reoptimize a query by setting the OneDB® JDBC Driver extension method to reuse the **PreparedStatement** object but reoptimize the previously prepared query plan. Alternatively, you can create a new **PreparedStatement** object. Reoptimizing an existing **PreparedStatement** object, which rebuilds only the query plan, has the following advantages over creating a new **PreparedStatement** object, which rebuilds the whole statement:

- Uses fewer resources
- Reduces overhead
- Requires less time

To enable reoptimization, set the **withReoptimization** argument to the IfmxPreparedStatement.executeQuery() method to `true`. The executeQuery() method has the following format:

```
com.informix.jdbc.IfmxPreparedStatement.executeQuery(boolean withHold,
                              boolean withReOptimization)
```

The following query uses the IfmxPreparedStatement.executeQuery() method to enable reoptimization:

```
Connection conn = DriverManager.getConnection(URL);
com.informix.jdbc.IfmxPreparedStatement pStmt =
         (com.informix.jdbc.IfmxPreparedStatement)
         conn.prepareStatement("SELECT * FROM customer");
ResultSet rs =  pStmt.executeQuery(false, true);
```

Returning Query Results as Java Streams with BSON

The HCL OneDB™ JDBC Driver can simplify converting trasitional ResultSet objects into JSON/BSON structures using Java Streams via Statement or PreparedStatement objects. After creating a Statement or PreparedStatement you can use the extended classes to access a set of methods for streaming the rows of the database as BSON records.

Java applications can access the stream(...) methods by casting the Statement or PreparedStatement to the HCL OneDB™ JDBC Driver implementation classes. By default each row is streamed from the Driver (using the normal fetch buffers), but you can override this to prefetch all rows BEFORE the streams API starts processing.

Once you have a java.util.Stream object (Seehttps://docs.oracle.com/javase/8/docs/api/java/util/stream/Stream.html), you can use the Java Streams API to process each row.

Each row of a database table is represented by a BSON object represented by the IfxBSONObject class. See the Javadocs for the list of methods for IfxBSONObject.

The example below shows how to cast the Statement object from the connection and issue a query that returns a Stream.

```
try(IfxStatement s = connection.createStatement().unwrap(IfxStatement.class)) {
   String sql = "SELECT tabname, tabid from systables where tabid < 10";
   System.out.println(s.stream(sql)
      .count()); // Prints 9
   System.out.println(s.stream(sql, IfxStatement.STREAMS_FETCHING.PREFETCH) //Prefetch all rows.
 Optional
      .count()); // Prints 9
   s.stream(sql).forEach(System.out::println);  //prints each row as a JSON object
}
```

Data types supported

The streaming of results only works with a subset of datatypes that can be mapped into a BSON object. See the documentation on BSON objects to understand the mappings.

Supported Types	Description
CHAR/VARCHAR/LVARCHAR	
int/smallint/decimal/double/real	

Supported Types	Description
BLOB/CLOB	Yout get the large object reference ID, which can be used to query the entire large object separately.
SET/MULTISET/LIST	
DATE/DATETIME	

Result sets

The HCL OneDB™ JDBC Driver implementation of the Statement.execute() method returns a single **ResultSet** object. Because the server does not support multiple **ResultSet** objects, this implementation differs from the JDBC API specification, which states that the Statement.execute() method can return multiple **ResultSet** objects.

Returning multiple Result Sets is not supported by the HCL OneDB™ JDBC Driver.

Scrollable result set for multiple rows

The Scrollable ResultSet fetches one row at a time from the server. A performance enhancement for Scrollable ResultSet allows multiple rows to be fetched at one time. In the following example, where the rows *m* through *n* are desired, the following fetches the rows into a ResultSet. As long as only rows between *m* and *n* inclusive are accessed, no further fetches occur. In this example, the rows 50 through 100 are desired and the ResultSet is SCROLL_INSENSITIVE:

```
rs.setFetchSize(51);
        rs.absolute(49); // one row will be fetched
        rs.next() // rs will contain 51 rows
```

HCL OneDB™ only fetches in the forward direction and only fetches one row, except when a DIR_NEXT fetch is used to fetch rows. For a DIR_NEXT operation, the server sends rows until the fetch buffer is filled or until the last row is sent. Only ResultSet.next() can generate a DIR_NEXT operation.

This performance enhancement does not change the behavior of FORWARD_ONLY ResultSets. The calculation of the size of the fetch buffer is unchanged.

For SCROLL_INSENTIVE ResultSets, the size of the fetch buffer is determined by the fetch size and row size. Statement.setFetchSize() and ResultSet.setFetchSize() can be used to set the fetch size. If fetch size is zero, the default fetch buffer size is used. The fetch buffer size is limited to 32 K.

Certain ResultSet methods require information about the number of rows generated by the query. The methods might result in fetching a row to obtain the information and then refetching the current row. The methods are isBeforeFirst(), isLast(), and absolute(-row).

Additionally, setMaxRows() can change the fetch buffer size for SCROLL_INSENSITIVE ResultsSets. Because additional server support is required to ensure efficient use of setMaxRows(), it is recommended that ResultSet.setMaxRows() is not used as this time.

Deallocate resources

Close a **Statement**, **PreparedStatement**, and **CallableStatement** object by calling the appropriate close() method in your Java™ program when you have finished processing the results of an SQL statement. This closure immediately deallocates the resources that have been allocated to execute your SQL statement. Although the ResultSet.close() method closes the **ResultSet** object, it does not deallocate the resources allocated to the **Statement**, **PreparedStatement**, or **CallableStatement** objects.

It is good practice to call ResultSet.close() and Statement.close() methods when you have finished processing the results of an SQL statement, to indicate to HCL OneDB™ JDBC Driver that you are done with the statement or result set. When you do so, your program releases all its resources on the database server. It is, however, not required to call ResultSet.close() and Statement.close() specifically, as long as you call to Connection.close(), which takes care of releasing these resources.

Execute across threads

The same **Statement** or **ResultSet** instance cannot be accessed concurrently across threads. You can, however, share a **Connection** object between multiple threads.

For example, if one thread executes the Statement.executeQuery() method on a **Statement** object, and another thread executes the Statement.executeUpdate() method on the same **Statement** object, the results of both methods are unexpected and depend on which method was executed last.

Similarly, if one thread executes the method ResultSet.next() and another thread executes the same method on the same **ResultSet** object, the results of both methods are unexpected and depend on which method was executed last.

Scroll cursors

The scroll cursors feature of HCL OneDB™ JDBC Driver follows the JDBC 3.0 specification, with these exceptions:

Scroll sensitivity

The HCL OneDB™ database server implementation of scroll cursors places the rows fetched in a temporary table. If another process changes a row in the original table (assuming the row is not locked) and the row is fetched again, the changes are not visible to the client.

This behavior is similar to the SCROLL_INSENSITIVE description in the JDBC 3.0 specification. HCL OneDB™ JDBC Driver does not support SCROLL_SENSITIVE cursors. To see updated rows, your client application must close and reopen the cursor.

Client-side scrolling

The JDBC specification implies that the scrolling can happen on the client-side result set. HCL OneDB™ JDBC Driver supports the scrolling of the result set only to the extent that the database server supports scrolling.

Result set updatability

The JDBC 3.0 API does not provide exact specifications for SQL queries that yield result sets that can be updated. Generally, queries that meet the following criteria can produce result sets that can be updated:

- The query references only a single table in the database.
- The query does not contain any JOIN operations.
- The query selects the primary key of the table it references.
- Every value expression in the select list must consist of a column specification, and no column specification can appear more than once.
- The WHERE clause of the table expression cannot include a subquery.

HCL OneDB™ JDBC Driver relaxes the primary key requirement, because the driver performs the following operations:

1. The driver looks for a column called ROWID.
2. The driver looks for a SERIAL, SERIAL8, or BIGSERIAL column in the table.
3. The driver looks for the tables primary key in the system catalogs.

If none of these is provided, the driver returns an error.

When you delete a row in a result set, the ResultSet.absolute() method is affected, because the positions of the rows change after the delete.

When the query contains a SERIAL column and the data is duplicated in more than one row, execution of updateRow() or deleteRow() affects all the rows containing that data.

The `ScrollCursor.java` example file shows how to retrieve a result set with a scroll cursor. For examples of how to use a scrollable cursor that can be updated, see the `UpdateCursor1.java`, `UpdateCursor2.java`, and `UpdateCursor3.java` files.

Hold cursors

When transaction logging is used, HCL OneDB™ generally closes all cursors and releases all locks when a transaction ends. In a multiuser environment, this behavior is not always desirable.

HCL OneDB™ JDBC Driver had already implemented holdable cursor support with HCL OneDB™ extensions. HCL OneDB™ database servers (5.x, 7.x, SE, 8.x, 9.x, and 10.x, or later) support adding keywords WITH HOLD in the declaration of the cursor. Such a cursor is referred to as a hold cursor and is not closed at the end of a transaction.

HCL OneDB™ JDBC Driver, in compliance with the JDBC 3.0 specifications, adds methods to JDBC interfaces to support holdable cursors.

For more information about hold cursors, see the *HCL OneDB™ Guide to SQL: Syntax*.

Update the database

You can issue batch update statements or perform bulk inserts to update the database.

Perform batch updates

The batch update feature is similar to multiple HCL OneDB™ SQL PREPARE statements. You can issue batch update statements as in the following example:

```
PREPARE stmt FROM "insert into tab values (1);
   insert into tab values (2);
   update table tab set col = 3 where col = 2";
```

The batch update feature in HCL OneDB™ JDBC Driver follows the JDBC 3.0 specification, with these exceptions:

- SQL statements
- Return value from Statement.executeBatch()

SQL statements and batch updates

The following commands cannot be put into multistatement PREPARE statements:

- SELECT (except SELECT INTO TEMP) statement
- DATABASE statements
- CONNECTION statements

For more details, see *HCL OneDB™ Guide to SQL: Syntax*.

Return value from Statement.executeBatch() method

The return value differs from the JDBC 3.0 specification in the following ways:

- If the **IFX_BATCHUPDATE_PER_SPEC** environment variable is set to `0`, only the update count of the first statement executed in the batch is returned. If the **IFX_BATCHUPDATE_PER_SPEC** environment variable is set to `1` (the default), the return value equals the number of rows affected by all SQL statements executed by Statement.executeBatch(). For more information, see HCL OneDB JDBC Driver properties on page 15.
- When errors occur in a batch update executed in a **Statement** object, no rows are affected by the statement; the statement is not executed. Calling BatchUpdateException.getUpdateCounts() returns `0` in this case.
- When errors occur in a batch update executed in a **PreparedStatement** object, rows that were successfully inserted or updated on the database server do not revert to their pre-updated state. However, the statements are not always committed; they are still subject to the underlying autocommit mode.

The `BatchUpdate.java` example file shows how to send batch updates to the database server.

Perform bulk inserts

A bulk insert is the HCL OneDB™ extension to the JDBC 3.0 batch update feature. The bulk insert feature improves the performance of single INSERT statements that are executed multiple times, with multiple value settings. To enable this feature, set the **IFX_USEPUT** environment variable to `1`. (The default value is `0`.)

This feature does not work for multiple statements passed in the same **PreparedStatement** instance or for statements other than INSERT. If this feature is enabled and you pass in an INSERT statement followed by a statement with no parameters, the statement with no parameters is ignored.

The bulk insert feature requires the client to convert the Java™ type to match the target column type on the server for all data types except opaque types or complex types.

The `BulkInsert.java` example, which is installed in the `demo` directory where your JDBC driver is installed, shows how to perform a bulk insert.

Parameters, escape syntax, and unsupported methods

This section contains the following information:

- How to use OUT parameters
- How to use named parameters in a CallableStatement
- Support for the DESCRIBE INPUT statement
- How to use escape syntax to translate from JDBC to HCL OneDB™

It also lists unsupported methods and methods that behave differently from the standard.

The CallableStatement OUT parameters

The **CallableStatement** methods handle OUT parameters in C function and Java™ user-defined routines (UDRs). Two registerOutParameter() methods specify the data type of OUT parameters to the driver. A series of getXXX() methods retrieves OUT parameters.

The OUT parameter routine makes available a valid blob descriptor and data to the JDBC client for a BINARY OUT parameter. Using receive methods, you can use these OUT parameter descriptors and data provided by the server.

Exchange of descriptor and data between HCL OneDB™ and JDBC is consistent with the existing mechanism by which data is exchanged for the result set methods of JDBC, such as passing the blob descriptor and data through SQLI protocol methods. (SPL UDRs are the only type of UDRs supporting BINARY OUT parameters.)

For background information, see the following documentation:

- *HCL OneDB™ User-Defined Routines and Data Types Developer's Guide* provides introductory and background information about opaque types and user-defined routines (UDRs) for use in the HCL OneDB™ database.
- *HCL® J/Foundation Developer's Guide* describes how to write Java™ UDRs for use in the database server.

- The *HCL OneDB™ Guide to SQL: Tutorial* describes how to write stored procedure language (SPL) routines.
- The *HCL OneDB™ DataBlade® API Programmer's Guide* describes how to write external C routines.

HCL OneDB™ database servers return one or multiple OUT parameter to HCL OneDB™ JDBC Driver.

For examples of how to use OUT parameters, see the `CallOut1.java`, `CallOut2.java`, `CallOut3.java`, and `CallOut4.java` example programs in the `basic` subdirectory of the `demo` directory where your HCL OneDB™ JDBC Driver is installed.

Server and driver restrictions and limitations

Server restrictions

This topic describes the restrictions imposed by different versions of the 9.x and later HCL OneDB™ server. It also describes enhancements made to the JDBC driver and the restrictions imposed by it.

Versions 9.2x and 9.3x of have the following requirements and limitations concerning OUT parameters:

- Only a function can have an OUT parameter. A function is defined as a UDR that returns a value. A procedure is defined as a UDR that does not return a value.
- There can be only one OUT parameter per function.
- The OUT parameter has to be the last parameter.
- You cannot specify INOUT parameters.

  HCL OneDB™, Version 10.0, or later allows you to specify INOUT parameters (C, SPL, or Java™ UDRs).
- The server does not correctly return the value `NULL` for external functions.
- You cannot specify OUT parameters that are complex types.
- You cannot specify C and SPL routines that use the RETURN WITH RESUME syntax.

These restrictions, for server versions 9.2x and 9.3x, are imposed whether users create C, SPL, or Java™ UDRs.

The functionality of the , Version 9.4 allows:

- Any parameters to be OUT parameters for C, SPL, or Java™ UDRs
- User-defined procedures with no return value to have OUT parameters
- Multiple OUT parameters

You cannot specify INOUT parameters.

For more information about UDRs, see *HCL OneDB™ User-Defined Routines and Data Types Developer's Guide* and *HCL® J/Foundation Developer's Guide*.

Driver enhancement

The **CallableStatement** object provides a way to call or execute UDRs in a standard way for all database servers. Results from the execution of these UDRs are returned as a result set or as an OUT parameter.

The following is a program that creates a user-defined function, myudr, with two OUT parameters and one IN parameter, and then executes the myudr() function. The example requires server-side support for multiple OUT parameters; hence it only works for , Version 9.4 or above. For more information about UDRs, see *HCL OneDB™ User-Defined Routines and Data Types Developer's Guide* and *HCL® J/Foundation Developer's Guide*.

```
import java.sql.*;
public class myudr {

  public myudr() {
  }

  public static void main(String args[]) {
    Connection myConn = null;
    try {
      myConn = DriverManager.getConnection(
          "jdbc:onedb://MYSYSTEM:18551/testDB;"
          +"user=USERID;"
          +"password=MYPASSWORD");
    }
    catch (ClassNotFoundException e) {
      System.out.println(
       "problem with loading Ifx Driver\n" + e.getMessage());
    }
    catch (SQLException e) {
      System.out.println(
        "problem with connecting to db\n" + e.getMessage());
    }
    try {
      Statement stmt = myConn.createStatement();
      stmt.execute("DROP FUNCTION myudr");
    }
    catch (SQLException e){
    }
    try
    {
      Statement stmt = myConn.createStatement();

      stmt.execute(
        "CREATE FUNCTION myudr(OUT arg1 int, arg2 int, OUT arg3 int)"
        +" RETURNS boolean; LET arg1 = arg2; LET arg3 = arg2 * 2;"
        +"RETURN 't'; END FUNCTION;");
    }
    catch (SQLException e) {
      System.out.println(
        "problem with creating function\n" + e.getMessage());
    }
    Connection conn = myConn;

    try
    {
      String command = "{? = call myudr(?, ?, ?)}";
      CallableStatement cstmt = conn.prepareCall (command);

      // Register arg1 OUT parameter
      cstmt.registerOutParameter(1, Types.INTEGER);

      // Pass in value for IN parameter
      cstmt.setInt(2, 4);

      // Register arg3 OUT parameter
      cstmt.registerOutParameter(3, Types.INTEGER);

      // Execute myudr
      ResultSet rs = cstmt.executeQuery();

      // executeQuery returns values via a resultSet
      while (rs.next())
      {
        // get value returned by myudr
        boolean b = rs.getBoolean(1);
        System.out.println("return value from myudr = " + b);
      }

      // Retrieve OUT parameters from myudr
      int i = cstmt.getInt(1);
      System.out.println("arg1 OUT parameter value = " + i);

      int k = cstmt.getInt(3);
      System.out.println("arg3 OUT parameter value = " + k);

      rs.close();
      cstmt.close();
      conn.close();
    }
    catch (SQLException e)
    {
      System.out.println("SQLException: " + e.getMessage());
      System.out.println("ErrorCode: " + e.getErrorCode());
      e.printStackTrace();
    }
  }
}
- - -
$> java ... myudr
return value from myudr = true
arg1 OUT parameter value = 4
arg3 OUT parameter value = 8
```

Driver restrictions and limitations

HCL OneDB™ JDBC Driver has the following requirements and limitations concerning OUT parameters:

- With , Version 9.2, the driver always returns a -9752 error if a function contains an OUT parameter. The driver creates an **SQLWarning** object and chains this to the **CallableStatement** object.

  You can determine if a function contains an OUT parameter by calling the CallableStatement.getWarnings() method or by calling the IfmxCallableStatement.hasOutParameter() method, which return `TRUE` if the function has an OUT parameter.

  If a function contains an OUT parameter, you must use the CallableStatement.registerOutParameter() method to register the OUT parameter, the setXXX() methods to register the IN and OUT parameter values, and the getXXX() method to retrieve the OUT parameter value.
- The CallableStatement.getMetaData() method returns `NULL` until the executeQuery() method has been executed. After executeQuery() has been called, the **ResultSetMetaData** object contains information only for the return value, not the OUT parameter.
- You must specify all IN parameters by using setXXX() methods. You cannot use literals in the SQL statement. For example, the following statement produces unreliable results:

  ```
  CallableStatement cstmt = myConn.prepareCall("{call
     myFunction(25, ?)}");
  ```

  Instead, use a statement that does not specify literal parameters:

  ```
  CallableStatement cstmt = myConn.prepareCall("{call
     myFunction(?, ?)}");
  ```

  Call the setXXX() methods for both parameters.
- Do not close the **ResultSet** returned by the CallableStatement.executeQuery() method until you have retrieved the OUT parameter value by using a getXXX() method.
- You cannot cast the OUT parameter to a different type in the SQL statement. For example, the following cast is ignored:

  ```
  CallableStatement cstmt = myConn.prepareCall("{call
     foo(?::lvarchar, ?)}";
  ```
- The setMaxRows() and registerOutParameter() methods both take **java.sql.Types** values as parameters. There are some one-to-many mappings from **java.sql.Types** values to HCL OneDB™ types.

  In addition, some HCL OneDB™ types do not map to **java.sql.Types** values. Extensions for setMaxRows() and registerOutParameter() fix these problems. See IN and OUT parameter type mapping on page 49.

These restrictions apply to a JDBC application that handles C, SPL, or Java™ UDRs.

IN and OUT parameter type mapping

An exception is thrown by the registerOutParameter(int, int), registerOutParameter(int, int, int), or setNull(int, int) method if the driver cannot find a matching HCL OneDB™ type or finds a mapping ambiguity (more than one matching HCL OneDB™ type). The table that follows shows the mappings the **CallableStatement** interface uses. Asterisks (*) indicate mapping ambiguities.

java.sql.Types	com.informix.lang.IfxTypes
Array*	IFX_TYPE_LIST IFX_TYPE_MULTISET IFX_TYPE_SET
Bigint	IFX_TYPE_INT8
Binary	IFX_TYPE_BYTE
Bit	Not supported
Blob	IFX_TYPE_BLOB
Char	IFX_TYPE_CHAR (*n*)
Clob	IFX_TYPE_CLOB
Date	IFX_TYPE_DATE
Decimal	IFX_TYPE_DECIMAL
Distinct*	Depends on base type
Double	IFX_TYPE_FLOAT
Float	IFX_TYPE_FLOAT[1]
Integer	IFX_TYPE_INT
Java_Object*	IFX_TYPE_UDTVAR IFX_TYPE_UDTFIX
Long	IFX_TYPE_BIGINT IFX_TYPE_BIGSERIAL
Longvarbinary*	IFX_TYPE_BYTE IFX_TYPE_BLOB
Longvarchar*	IFX_TYPE_TEXT IFX_TYPE_CLOB

java.sql.Types	com.informix.lang.IfxTypes
	IFX_TYPE_LVARCHAR
Null	Not supported
Numeric	IFX_TYPE_DECMIAL
Other	Not supported
Real	IFX_TYPE_SMFLOAT
Ref	Not supported
Smallint	IFX_TYPE_SMINT
Struct	IFX_TYPE_ROW
Time	IFX_TYPE_DTIME (hour to second)
Timestamp	IFX_TYPE_DTIME (year to fraction(5))
Tinyint	IFX_TYPE_SMINT
Varbinary	IFX_TYPE_BYTE
Varchar	IFX_TYPE_VCHAR (*n*)
Nothing*	IFX_TYPE_BOOL

[1] This mapping is JDBC compliant. You can map the JDBC FLOAT data type to the HCL OneDB™ SMALLFLOAT data type for compatibility with earlier versions by setting the IFX_SET_FLOAT_AS_SMFLOAT connection property to 1.

To avoid mapping ambiguities, use the following extensions to **CallableStatement**, defined in the **IfmxCallableStatement** interface:

```
public void IfxRegisterOutParameter(int parameterIndex,
   int ifxType) throws SQLException;

public void IfxRegisterOutParameter(int parameterIndex,
   int ifxType, String name) throws SQLException;

public void IfxRegisterOutParameter(int parameterIndex,
   int ifxType, int scale) throws SQLException;

public void IfxSetNull(int i, int ifxType) throws SQLException;

public void IfxSetNull(int i, int ifxType, String name) throws
   SQLException;
```

Possible values for the *ifxType* parameter are listed in The IfxTypes class on page 223.

HCL OneDB™, Version 10.0, or later makes available to the JDBC client valid BLOB descriptors and data to support binary OUT parameters for SPL UDRs.

HCL OneDB™ JDBC Driver, Version 3.0, or later can receive the OUT parameter descriptor and data provided by the server and use it in Java™ applications.

The single correct return value for any JDBC binary type (BINARY, VARBINARY, LONGVARBINARY) retrieved via method getParameterType (ParameterMetaData) is -4, which is associated with **java.sql.Type.LONGVARBINARY** data type. This reflects the fact that all the JDBC binary types are mapped to the same HCL OneDB™ SQL data type, BYTE.

Named parameters in a CallableStatement

A CallableStatement provides a way to call a stored procedure on the server from a Java™ program. You can use named parameters in a CallableStatement to identify the parameters by name instead of by ordinal position. This enhancement was introduced in the JDBC 3.0 specification. If the procedure is unique, you can omit parameters that have default values and you can enter the parameters in any order. Named parameters are especially useful for calling stored procedures that have many arguments and some of those arguments have default values.

The JDBC driver ignores case for parameter names. If the stored procedure does not have names for all the arguments, the server passes an empty string for missing names.

Requirements and restrictions for named parameters in a CallableStatement

HCL OneDB™ JDBC Driver has the following requirements and restrictions for named parameters in a CallableStatement:

- Parameters for the CallableStatement must be specified by either name or by the ordinal format within a single invocation of a routine. If you name a parameter for one argument, for example, you must use parameter names for all of the arguments.
- Named parameters are not supported for a remote CallableStatement.
- Support for named parameters is subject to existing limitations for calling stored procedures.

Verify support for named parameters in a CallableStatement

The JDBC specification provides the DatabaseMetaData.supportsNamedParameters() method to determine if the driver and the RDMS support named parameters in a CallableStatement. For example:

```
Connection myConn = . . .   // connection to the RDBMS for Database
. . .
DatabaseMetaData dbmd = myConn.getMetaData();
if (dbmd.supportsNamedParameters() == true)
{
    System.out.println("NAMED PARAMETERS FOR CALLABLE"
                       + "STATEMENTS IS SUPPORTED");
    . . .
}
```

The system returns `true` if named parameters are supported.

Retrieve parameter names for stored procedures

To retrieve the names of parameters for stored procedures, use **DatabaseMetaData** methods defined by the JDBC specification as shown in the following example.

```
Connection myConn = ...   // connection to the RDBMS for Database
. . .
      DatabaseMetaData dbmd = myConn.getMetaData();
      ResultSet rs = dbmd.getProcedureColumns(
       "myDB", schemaPattern, procedureNamePattern, columnNamePattern);
      rs.next() {
          String parameterName = rs.getString(4);
 - - - or - - -
 String parameterName = rs.getString("COLUMN_NAME");
 - - -
          System.out.println("Column Name: " + parameterName);
```

The names of all columns that match the parameters of the getProcedureColumns() method are displayed.

Parameter names are not part of the **ParameterMetaData** interface and cannot be retrieved from a **ParameterMetaData** object.

When you use the getProcedureColumns() method, the query retrieves all procedures owned by **informix** (including system-generated routines) from the **sysprocedures** system catalog table. To prevent errors, verify that the stored procedures you are using have been configured with correct permissions on the server.

See Unsupported methods and methods that behave differently on page 56 for important differences in JDBC API behavior for the getProcedureColumns() method.

Named parameters and unique stored procedures

A unique stored procedure has a unique name and a unique number of arguments. Named parameters are supported for unique stored procedures when the number of parameters in the CallableStatement is equal to or less than the number of arguments in the stored procedure.

Example of number of named parameters equals the number of arguments

The following stored procedure has five arguments

```
create procedure createProductDef(productname   varchar(64),
                 productdesc  varchar(64),
                 listprice    float,
                 minprice     float,
             out prod_id      float);
. . .
  let prod_id = <value for prod_id>;
end procedure;
```

The following Java™ code with five parameters corresponds to the stored procedure. The question mark characters (?) within the parentheses of a JDBC call refer to the parameters. (In this case five parameters for five arguments.) Set or register all the parameters. Name the parameters by using the format `cstmt.setString("arg", name);`, where *arg* is the name of the argument in the corresponding stored procedure. You do not need to name parameters in the same order as the arguments in the stored procedure.

```
String sqlCall = "{call CreateProductDef(?,?,?,?,?)}";
      CallableStatement cstmt = conn.prepareCall(sqlCall);

      cstmt.setString("productname", name);     // Set Product Name.
      cstmt.setString("productdesc", desc);     // Set Product Description.
      cstmt.setFloat("listprice", listprice);   // Set Product ListPrice.
      cstmt.setFloat("minprice", minprice);     // Set Product MinPrice.

      // Register out parameter which should return the product is created.

      cstmt.registerOutParameter("prod_id", Types.FLOAT);

      // Execute the call.
      cstmt.execute();

      // Get the value of the id from the OUT parameter: prod_id
      float id = cstmt.getFloat("prod_id");
```

The Java™ code and the stored procedure show the following course of events:

1. A call to the stored procedure is prepared.
2. Parameter names indicate which arguments correspond to which parameter value or type.
3. The values for the input parameters are set and the type of the output parameter is registered.
4. The stored procedure executes with the input parameters as arguments.
5. The stored procedure returns the value of an argument as an output parameter and the value of the output parameter is retrieved.

Example of number of named parameters Is less than the number of arguments

If the number of parameters in CallableStatement is less than the number of arguments in the stored procedure, the remaining arguments must have default values. You do not need to set values for arguments that have default values because the server automatically uses the default values. You must, however, indicate the arguments that have non-default values or override default values with a question mark character (?) in the CallableStatement.

For example, if a stored procedure has 10 arguments of which 4 have non-default values and 6 have default values, you must have at least four question marks in the CallableStatement. Alternatively, you can use 5, 6, or up to 10 question marks.

If the CallableStatement is prepared with more parameters than non-default values, but less than the number of stored procedure arguments, it must set the values for non-default arguments. The remaining parameters can be any of the other arguments and they can be changed with each execution.

In the following unique stored procedure, the arguments `listprice` and `minprice` have default values:

```
create procedure createProductDef(productname   varchar(64),
                 productdesc  varchar(64),
                 listprice    float default 100.00,
                 minprice     float default  90.00,
             out prod_id      float);
. . .
  let prod_id = <value for prod_id>;
end procedure;
```

The following Java™ code calls the stored procedure with fewer parameters than arguments in the stored procedure (four parameters for five arguments). Because `listprice` has a default value, it can be omitted from the CallableStatement.

```
String sqlCall = "{call CreateProductDef(?,?,?,?)}";
                                              // 4 params for 5 args
      CallableStatement cstmt = conn.prepareCall(sqlCall);

      cstmt.setString("productname", name);   // Set Product Name.
      cstmt.setString("productdesc", desc);   // Set Product Description.

      cstmt.setFloat("minprice", minprice);   // Set Product MinPrice.

      // Register out parameter which should return the product id created.

      cstmt.registerOutParameter("prod_id", Types.FLOAT);

      // Execute the call.
      cstmt.execute();

      // Get the value of the id from the OUT parameter: prod_id
      float id = cstmt.getFloat("prod_id");
```

Alternatively, for the same stored procedure you can omit the parameter for the `minprice` argument. You do not need to prepare the CallableStatement again.

```
      cstmt.setString("productname", name); // Set Product Name.
      cstmt.setString("productdesc", desc); // Set Product Description.

      cstmt.setFloat("listprice", listprice); // Set Product ListPrice.

      // Register out parameter which should return the product id created.

     cstmt.registerOutParameter("prod_id", Types.FLOAT);

     // Execute the call.
     cstmt.execute();

     // Get the value of the id from the OUT parameter: prod_id
     float id = cstmt.getFloat("prod_id");
```

Or you can omit the parameters for both of the default arguments:

```
cstmt.setString("productname", name);
cstmt.setString("productdesc", desc);
cstmt.registerOutParameter("prod_id", Types.FLOAT);
cstmt.execute();
float id = cstmt.getFloat("prod_id");
```

Named parameters and overloaded stored procedures

If multiple stored procedures have the same name and the same number of arguments, the procedures are overloaded (also known as overloaded UDRs).

The JDBC driver throws an SQLException for overloaded stored procedures because the call cannot resolve to a single stored procedure. To prevent an SQLException, specify the HCL OneDB™ server data type of the named parameters in the parameter list by appending `::data_type` to the question mark characters where *data_type* is the HCL OneDB™ server data type. For example `?::varchar` or `?::float`. You must also enter the named parameters for all the arguments and in the same order as the overloaded stored arguments of procedure.

For example, the following two procedures have the same name (**createProductDef**) and the same number of arguments. The data type for the **prod_id** argument is a different data type in each procedure.

Procedure 1

```
create procedure createProductDef(productname   varchar(64),
          productdesc  varchar(64),
          listprice    float default 100.00,
          minprice     float default  90.00,
          prod_id      float);
 ...
 let prod_id = <value for prod_id>;
end procedure;
```

Procedure 2

```
create procedure createProductDef(productname   varchar(64),
          productdesc  varchar(64),
          listprice    float default 100.00,
          minprice     float default  90.00,
          prod_id      int);
 ...
 let prod_id = <value for prod_id>;
end procedure;
```

If you use the following Java™ code, it returns an SQLException because it cannot resolve to only one procedure:

```
String sqlCall = "{call CreateProductDef(?,?,?,?,?)}";
CallableStatement cstmt = con.prepareCall(sqlCall);
cstmt.setString("productname", name);   // Set Product Name.
```

If you specify the HCL OneDB™ data type for the argument that has a different data type, the Java™ code resolves to one procedure. The following Java™ code resolves to Stored Procedure 1 because the code specifies the FLOAT data type for the **prod_id** argument:

```
String sqlCall = "{call CreateProductDef(?,?,?,?,?::float)}";
CallableStatement cstmt = con.prepareCall(sqlCall);
cstmt.setString("productname", name);   // Set Product Name
```

The escape syntax

Escape syntax indicates information that must be translated from JDBC format to HCL OneDB™ native format. Valid escape syntax for SQL statements is as follows.

Type of statement	Escape syntax
Procedure	{call *procedure*}
Function	{*var* = call *function*}
Date	{d '*yyyy-mm-dd*'}
Time	{t '*hh:mm:ss*'}
Timestamp (Datetime)	{ts '*yyyy-mm-dd hh:mm:ss*[.*fffff*]'}
Function call	{fn *func*[(*args*)]}
Escape character	{escape '*escape-char*'}
Outer join	{oj *outer-join-statement*}
Limit	{limit *number-to-limit*}
Skip	{limit *number-to-limit number-to-skip*}

You can put any of this syntax in an SQL statement, as follows:

```
executeUpdate("insert into tab1 values( {d '1999-01-01'} )");
```

Everything inside the brackets is converted into a valid HCL OneDB™ SQL statement and returned to the calling function.

Unsupported methods and methods that behave differently

The following JDBC API methods are not supported by HCL OneDB™ JDBC Driver and cannot be used in a Java™ program that connects to HCL OneDB™ databases:

- CallableStatement.getRef(int)
- Connection.setCatalog()
- Connection.setReadOnly()
- PreparedStatement.addBatch(String)
- PreparedStatement.setRef(int, Ref)
- PreparedStatement.setUnicodeStream(int, java.io.InputStream, int)
- ResultSet.getRef(int)
- ResultSet.getRef(String)
- ResultSet.getUnicodeStream(int)

- ResultSet.getUnicodeStream(String)
- ResultSet.refreshRow()
- ResultSet.rowDeleted()
- ResultSet.rowInserted()
- ResultSet.rowUpdated()
- ResultSet.setFetchSize()
- Statement.setMaxFieldSize()

The Connection.setCatalog() and Connection.setReadOnly() methods return with no error. The other methods throw the exception: `Method not Supported`.

The following JDBC API methods behave other than specified by the JavaSoft specification:

- CallableStatement.execute()

  Returns a single result set
- DatabaseMetaData.getProcedureColumns()

  Example:

  ```
  DBMD.getProcedureColumns(String catalog,
              String schemaPattern,
              String procedureNamePattern,
              String columnNamePattern)
  ```

  Ignores the **columnNamePattern** field; returns `NULL` when used with any server version older than 9.x.

  When you use the getProcedureColumns() method, the query retrieves all procedures owned by **informix** (including system-generated routines) from the **sysprocedures** system catalog table. To prevent errors, verify that the stored procedures you are using have been configured with correct permissions on the server.

  For example, if you use one of the following statements:

  ```
  getProcedureColumns("","","","")
  ```

  ```
  getProcedureColumns("",informix,"","")
  ```

  The DatabaseMetaData.getProcedureColumns() method loads all server UDRs or all UDRs owned by user **informix**. If you chose not to install J/Foundation, or if the configuration parameters for J/Foundation are not set to valid values in your `onconfig` file, the method fails. Also, if any one UDR is not set up correctly on the server, the method fails.

  For information about how to set up J/Foundation on HCL OneDB™ servers and how to run Java™ UDRs on HCL OneDB™ servers, see the *HCL® J/Foundation Developer's Guide*. For information about how to set up and run C UDRs, see the *HCL OneDB™ User-Defined Routines and Data Types Developer's Guide*.
- DatabaseMetaData.othersUpdatesAreVisible()

  Always returns `FALSE`
- DatabaseMetaData.othersDeletesAreVisible()

Always returns `FALSE`

- DatabaseMetaData.othersInsertsAreVisible()

  Always returns `FALSE`
- DatabaseMetaData.ownUpdatesAreVisible()

  Always returns `FALSE`
- DatabaseMetaData.ownDeletesAreVisible()

  Always returns `FALSE`
- DatabaseMetaData.ownInsertsAreVisible()

  Always returns `FALSE`
- DatabaseMetaData.deletesAreDetected()

  Always returns `FALSE`
- DatabaseMetaData.updatesAreDetected()

  Always returns `FALSE`
- DatabaseMetaData.insertsAreDetected()

  Always returns `FALSE`
- PreparedStatement.execute()

  Returns a single result set
- ResultSet.getFetchSize()

  Always returns `0`
- ResultSetMetaData.getCatalogName()

  Always returns a **String** object containing one blank space
- ResultSetMetaData.getTableName()

  Returns the table name for SELECT, INSERT, and UPDATE statements

  SELECT statements with more than one table name and all other statements return a **String** object containing one blank space.
- ResultSetMetaData.getSchemaName()

  Always returns a **String** object containing one blank space
- ResultSetMetaData.isDefinitelyWriteable()

  Always returns `TRUE`

- ResultSetMetaData.isReadOnly()

  Always returns `FALSE`
- ResultSetMetaData.isWriteable()

  Always returns `TRUE`
- Statement.execute()

  Returns a single result set
- Connection.isReadOnly()

  Returns `TRUE` only when connecting to a secondary server in HDR scenario (see the following **Important** note)

Important: HCL® OneDB® servers do not currently support read-only connections. For the HCL OneDB™ JDBC Driver, Version 2.21.JC4, the implementation of the setReadOnly() method from the **java.sql.Connection** interface has been changed to accept the value passed to it by the calling process. The setReadOnly() method simply returns to the calling process without any interaction to the HCL OneDB™ database server. (Previous versions of the JDBC driver threw an unsupported method exception.) This change has been made to synchronize the functionality present in the HCL OneDB™ JDBC Driver to the .NET Core Provider JDBC driver and also to achieve a higher level of compliance in the Sun Conformance Test (CTS).

Handle transactions

By default, all new **Connection** objects are in autocommit mode. When autocommit mode is on, a COMMIT statement is automatically executed after each statement that is sent to the database server. To turn off autocommit mode , explicitly call Connection.setAutoCommit(false).

When autocommit mode is off, HCL OneDB™ JDBC Driver implicitly starts a new transaction when the next statement is sent to the database server. This transaction lasts until the user issues a COMMIT or ROLLBACK statement. If the user has already started a transaction by executing setAutoCommit(false) and then calls setAutoCommit(false) again, the existing transaction continues unchanged. The Java™ program must explicitly terminate the transaction by issuing either a COMMIT or a ROLLBACK statement before it drops the connection to the database or the database server.

In a database that has been created with logging, if a COMMIT statement is sent to the database server and autocommit mode is on, the error `-255: Not in transaction` is returned by the database server because there is currently no user transaction started. This occurs whether the COMMIT statement was sent with the Connection.commit() method or directly with an SQL statement.

In a database created in ANSI mode, explicitly sending a COMMIT statement to the database server commits an empty transaction. No error is returned because the database server automatically starts a transaction before it executes the statement if there is no user transaction currently open.

For an **XAConnection** object, autocommit mode is off by default and must remain off while a distributed transaction is occurring. The transaction manager performs commit and rollback operations; therefore, you avoid performing these operations directly.

For HCL OneDB™ releases later than 11.50.xC2, two JDBC classes support SQL transactions that can be rolled back to a savepoint (rather than canceled in its entirety) after an adverse event is encountered:

- **IfmxSavepoint** (Interface)
- **IfxSavepoint** (Savepoint class)

JDBC applications can create, destroy, or rollback to savepoint objects through the following standard JDBC methods:

Table 2. JDBC savepoint classes and methods

Class	Method

IfxConnection	setSavepoint()
	releaseSavepoint()
	rollback(*savepoint*)

IfxSavepoint	getSavepointId()
	getSavepointName()
	
	These two methods are not interchangeable. A call to getSavepointName() fails with an error unless the savepoint object is declared with a string argument to the setSavepoint() method or to the setSavepointUnique() method. Similarly, an error is returned if you call getSavepointId() for a named savepoint object.

In addition, the setSavepointUnique() method can set a named savepoint whose identifier is unique. While the unique savepoint is active,HCL OneDB™ issues an exception if the application attempts to reuse its name within the same connection.

The following restrictions apply to savepoint objects in JDBC:

- Savepoints are not valid within XA transactions.
- Savepoints cannot be used unless the current connection sets autocommit mode off.
- Savepoints are not valid in connections to unlogged databases.
- Savepoints cannot be referenced in a triggered action.
- In cross-server distributed queries in which any participating subordinate server does not support savepoint objects, a warning is issued if you set a savepoint after connecting to a server that does not support savepoints, and any call to **rollback***savepoint* fails with an error.

See the descriptions of the SAVEPOINT, RELEASE SAVEPOINT, and ROLLBACK WORK TO SAVEPOINT statements in *HCL OneDB™ Guide to SQL: Syntax* for more information about using savepoint objects in SQL transactions.

Autocommit

By default, all new **Connection** objects are in autocommit mode. When autocommit mode is on, a COMMIT statement is automatically executed after each statement that is sent to the database server. To turn off autocommit mode, explicitly call Connection.setAutoCommit(false).

When autocommit mode is off the JDBC Driver implicitly starts a new transaction when the next statement is sent to the database server. This transaction lasts until the user issues a COMMIT or ROLLBACK statement. If the user has already started a transaction by executing setAutoCommit(false) and then calls setAutoCommit(false) again, the existing transaction continues unchanged. The Java™ program must explicitly terminate the transaction by issuing either a COMMIT or a ROLLBACK statement before it drops the connection to the database or the database server.

Logged Database

In a database that has been created with logging, if a COMMIT statement is sent to the database server and autocommit mode is enabled, the error -255: Not in transaction is returned by the database server because there is currently no user transaction started. This occurs whether the COMMIT statement was sent with the Connection.commit() method or directly with an SQL statement.

ANSI Databases

In a database created in ANSI mode, explicitly sending a COMMIT statement to the database server commits an empty transaction. No error is returned because the database server automatically starts a transaction before it executes the statement if there is no user transaction currently open.

Non-logged Databases

You cannot turn off autocommit on non-logged databases. Because NONLOGGED databases do not support transactions you cannot disable auto-commit which forces JDBC to attempt to start a transaction.

Transactions with Large Objects

Large objects are a special consideration when dealing with database transactions. Manipulating a large object (BLOB/CLOB) is considered a distinct step in a transaction. This has the following implications:

Autocommit is enabled

When autocommit is enabled, creating and inserting a large object is considered two steps. Consider the following example:

```
ByteArrayInputStream byteStream = new ByteArrayInputStream(buffer);
PreparedStatement p = c.prepareStatement("INSERT INTO blobTestValues(?)")) {
   p.setBinaryStream(1, byteStream);
   p.execute();
}
```

In this example we are inserting a single row into the table. Since the column we are inserting is a BLOB, this is two operations. First, JDBC needs to create the BLOB object on the server. This is a single operation and with auto-commit enabled, this is commited and the BLOB is now present on the server. Second, we insert the BLOB pointer into the table row. This operation is then committed. Any error on the INSERT does **NOT** rollback or dispose of the BLOB object that was created. Since the BLOB was dynamically created by the JDBC driver, you will lose all references to the object in the system. It can be cleaned up by a DBA running on the database system, but not by the JDBC application.

If you want to ensure the BLOB is not lost in this scenario you **MUST** using an explicit transaction like the following example shows:

```
ByteArrayInputStream byteStream = new ByteArrayInputStream(buffer);
c.setAutoCommit(false);
PreparedStatement p = c.prepareStatement("INSERT INTO blobTestValues(?)")) {
   p.setBinaryStream(1, byteStream);
   p.execute();
}
c.commit();
```

Autocommit is disabled

If autocommit is disabled then you are using explicit transactions and most large object operations will work as expected in between your transaction boundaries. However, you are free to commit/rollback the intermediate large object operations if you use an explicit Blob/Clob object.

```
c.setAutoCommit(false);
PreparedStatement p = c.prepareStatement("INSERT INTO blobTestValues(?)")) {
   Blob blob = c.createBlob();
   c.commit(); //Commits the blob creation
   p.setBlob(1, blob);
   p.execute();
}
c.rollback(); //rollback the insert, the blob survives
```

Transactions with XA

For a **XAConnection** object, autocommit mode is off by default and must remain off while a distributed transaction is occurring. The transaction manager performs commit and rollback operations; therefore, you avoid performing these operations directly.

Transactions with Savepoints

Since JDBC 3.00.JC2 and Informix server 11.50.xC2, Informix supports SQL transactions that can be rolled back to a Savepoint. A Savepoint is a marker created at any point during a transaction that you can rollback to rather than completely rolling back the entire transaction.

JDBC applications can create, destroy, or rollback to Savepoint objects through the following standard JDBC methods:

Table 3. JDBC Savepoint classes and methods

Class	Method
Connection	**setSavepoint()** **setSavepoint**(*String name*) **releaseSavepoint**(*Savepoint*) **rollback**(*Savepoint*)

Savepoint	**getSavepointId()**
	getSavepointName()
	These two methods are not interchangeable. A call to **getSavepointName()** fails with an error unless the savepoint object is declared with a string argument to the **setSavepoint()** method or to the **setSavepointUnique()** method. Similarly, an error is returned if you call **getSavepointId()** for a named savepoint object.

In addition, the **setSavepointUnique(***String name***)** method can set a named savepoint whose identifier is unique. If the application attempts to reuse its name within the same connection JDBC will throw a SQLException.

The following restrictions apply to Savepoint objects in JDBC:

- Savepoints are not valid within XA transactions.
- Savepoints cannot be used unless the current connection sets autocommit mode off.
- Savepoints are not valid in connections to unlogged databases.
- Savepoints cannot be referenced in a triggered action.
- In cross-server distributed queries in which any participating subordinate server does not support savepoint objects, a warning is issued if you set a savepoint after connecting to a server that does not support savepoints, and any call to **rollback***savepoint* fails with an error.

Form more information, see *IBM Informix Guide to SQL: Syntax*.

Handle errors

Use the JDBC API **SQLException** class to handle errors in your Java™ program. The HCL OneDB™-specific **com.informix.jdbc.Message** class can also be used outside a Java™ program to retrieve the HCL OneDB™ error text for a given error number.

Handle errors with the SQLException class

Whenever an error occurs from either HCL OneDB™ JDBC Driver or the database server, an **SQLException** is raised. Use the following methods of the **SQLException** class to retrieve the text of the error message, the error code, and the **SQLSTATE** value:

getMessage()

Returns a description of the error

SQLException inherits this method from the **java.util.Throwable** class.

getErrorCode()

Returns an integer value that corresponds to the HCL OneDB™ database server or HCL OneDB™ JDBC Driver error code

getSQLState()

Returns a string that describes the **SQLSTATE** value

The string follows the X/Open **SQLSTATE** conventions.

All HCL OneDB™ JDBC Driver errors have error codes of the form `-79xxx`, such as `-79708: Can't take null input`.

For a list of HCL OneDB™ database server errors, see *HCL OneDB™ Error Messages*. For a list of HCL OneDB™ JDBC Driver errors, see Error messages on page 245.

The following example from the `SimpleSelect.java` program shows how to use the **SQLException** class to catch HCL OneDB™ JDBC Driver or database server errors by using a try-catch block:

```
try
   {
   PreparedStatement pstmt = conn.prepareStatement("Select *
      from x "
      + "where a = ?;");
   pstmt.setInt(1, 11);
   ResultSet r = pstmt.executeQuery();
   while(r.next())
      {
      short i = r.getShort(1);
      System.out.println("Select: column a = " + i);
      }
   r.close();
   pstmt.close();
   }
catch (SQLException e)
   {
   System.out.println("ERROR: Fetch statement failed: " +
      e.getMessage());
   }
```

Retrieve the syntax error offset

If there is an incorrect SQL statement executed which results in a syntax error, the driver will throw a java.sql.SQLSyntaxErrorException.

As part of the messasge in that exception will be the offset (if provided by the server) in characters to where the syntax error was detected.

An example would be:

```
java.sql.SQLSyntaxErrorException: A syntax error has occurred near position: 10
```

To programatically retrieve the exact location of a syntax error, use the getSQLStatementOffset() method to return the syntax error offset.

The following example shows how to retrieve the syntax error offset from an SQL statement (which is `10` in this example):

```
try {
  Statement stmt = conn.createStatement();
  String command = "select * fom tt";
  stmt.execute( command );
}
catch(Exception e)
{
  System.out.println
  ("Error Offset :" + ((com.onedb.jdbc.OneDBConnection) conn).getSQLStatementOffset());
  System.out.println(e.getMessage());
}
```

Catch RSAM error messages

RSAM messages are attached to SQLCODE messages. For example, if an SQLCODE message says that a table cannot be created, the RSAM message states the reason, which might be insufficient disk space.

You can use the SQLException.getNextException() method to catch RSAM error messages. For an example of how to catch these messages, see the `ErrorHandling.java` program, which is included in HCL OneDB™ JDBC Driver.

Handle errors with the com.informix.jdbc.Message class

HCL OneDB™ provides the class **com.informix.jdbc.Message** for retrieving HCL OneDB™ error message text based on the HCL OneDB™ error number. To use this class, call the Java™ interpreter **java** directly, passing it the HCL OneDB™ error number, as shown in the following example:

```
java com.informix.jdbc.Message 100
```

The example returns the message text for HCL OneDB™ error 100:

```
100: ISAM error: duplicate value for a record with unique key.
```

A positive error number is returned if you specify an unsigned number when using the **com.informix.jdbc.Message** class. This differs from the finderr utility, which returns a negative error number for an unsigned number.

Access database metadata

To access information about the HCL OneDB™ database, use the JDBC API **DatabaseMetaData** interface.

HCL OneDB™ JDBC Driver implements all the JDBC 3.0 specifications for **DatabaseMetaData** methods.

The following methods in **DatabaseMetaData** are included in HCL OneDB™ JDBC Driver for JDBC 3.0 compliance:

- getSuperTypes()
- getSuperTables()
- getAttributes()
- getResultSetHoldability()
- getDatabaseMajorVersion()
- getDatabaseMinorVersion()
- getJDBCMajorVersion()
- getJDBCMinorVersion()
- getSQLStateType()
- locatorsUpdateCopy()
- supportsGetGeneratedKeys()
- supportsMultipleOpenResults()
- supportsNamedParameters()
- supportsGetGeneratedKeys()
- supportsMultipleOpenResults()

Methods retrieve server-generated keys. Retrieving autogenerated keys involves the following actions:

1. The JDBC application programmer provides an SQL statement to be executed.
2. The server executes the SQL statement and an indication that autogenerated keys can be retrieved is returned.
3. Before the server executes the SQL statement, **columnNames** or **columnIndexes** (if provided) are validated. An **SQLException** is thrown if they are invalid.
4. If requested, the JDBC driver and server returns a **resultSet** object. If no keys were generated, the **resultSet** is empty, containing no rows or columns.
5. The user can request metadata for the **resultSet** object, and the JDBC driver and server returns a **resultSetMetaData** Object.

For more information about retrieving autogenerated keys, see the JDBC 3.0 Specification, Section 13.6, “Retrieving Auto Generated Keys."

HCL OneDB™ JDBC Driver uses the **sysmaster** database to get database metadata. If you want to use the **DatabaseMetaData** interface in your Java™ program, the **sysmaster** database must exist in the HCL OneDB™ database server to which your Java™ program is connected.

HCL OneDB™ JDBC Driver interprets the JDBC API term *schemas* to mean the names of HCL OneDB™ users who own tables. The DatabaseMetaData.getSchemas() method returns all the users found in the **owner** column of the **systables** system catalog.

Similarly, HCL OneDB™ JDBC Driver interprets the JDBC API term *catalogs* to mean the names of HCL OneDB™ databases. The DatabaseMetaData.getCatalogs() method returns the names of all the databases that currently exist in the HCL OneDB™ database server to which your Java™ program is connected.

The example `DBMetaData.java` shows how to use the **DatabaseMetaData** and **ResultSetMetaData** interfaces to gather information about a new procedure. Refer to Sample code files on page 204 for more information about this example.

Other HCL OneDB™ extensions to the JDBC API

This section describes the HCL OneDB™-specific extensions to the JDBC API not already discussed in this guide. These extensions handle information that is specific to HCL OneDB™ databases.

Another HCL OneDB™ extension, the **com.informix.jdbc.Message** class, is fully described in Handle errors on page 63.

The Auto Free feature

If you enable the HCL OneDB™ Auto Free feature, the database server automatically frees the cursor when it closes the cursor. Therefore, your application does not have to send two separate requests to close and then free the cursor—closing the cursor is sufficient.

You can enable the Auto Free feature by setting the **IFX_AUTOFREE** property to `TRUE` in the database URL, as in this example:

```
jdbc:onedb://123.45.67.89:1533;user=rdtest;password=test;ifx_autofree=true;
```

You can also use one of the following methods:

```
public void setAutoFree (boolean flag)
public boolean getAutoFree()
```

The setAutoFree() method should be called before the executeQuery() method, but the getAutoFree() method can be called before or after the executeQuery() method.

To use these methods, your applications must import classes from the HCL OneDB™ package `com.informix.jdbc` and cast the **Statement** class to the **IfmxStatement** class, as shown here:

```
import com.informix.jdbc.*;
...
(IfmxStatement)stmt.setAutoFree(true);
```

The Auto Free feature is available for the following database server versions:

- Version 7.23 and later
- Version 9.0 and later

Obtaining driver version information

About this task

There are two ways to obtain version information about HCL OneDB™ JDBC Driver: from your Java™ program or from the UNIX™ or MS-DOS command prompt.

To get version information from your Java™ program:

1. Import the HCL OneDB™ package `com.informix.jdbc.*` into your Java™ program by adding the following line to the import section:

   ```
   import com.informix.jdbc.*;
   ```

2. Invoke the static method IfxDriver.getJDBCVersion().
   This method returns a **String** object that contains the complete version of the current HCL OneDB™ JDBC Driver.

   An example of a version of HCL OneDB™ JDBC Driver is 2.00.JC1.

   The IfxDriver.getJDBCVersion() method returns only the version, not the serial number you provided during installation of the driver.

Results

Important: For version X.Y of HCL OneDB™ JDBC Driver, the JDBC API methods Driver.getMajorVersion() and DatabaseMetaData.getDriverMajorVersion() always return the value X. Similarly, the methods Driver.getMinorVersion() and DatabaseMetaData.getDriverMinorVersion() always return the value Y.

To get the version of HCL OneDB™ JDBC Driver from the command line, enter the following command at the UNIX™ shell prompt or the Windows™ command prompt:

```
java com.informix.jdbc.Version
```

The command also returns the serial number you provided when you installed the driver.

Store and retrieve XML documents

Extensible Markup Language (XML), as defined by the World Wide Web Consortium (W3C) provides rules, guidelines, and conventions for describing structured data in a plain text, editable file (called an *XML document*). XML uses tags only to delimit pieces of data, leaving the interpretation of the data to the application that uses it. XML is an method of representing data in an open, platform-independent format.

The currently available API for accessing XML documents is called JAXP (Java™ API for XML Parsing). The API has the following two subsets:

- **Simple API for XML** (SAX) is an event-driven protocol, with the programmer providing the callback methods that the XML parser invokes when it analyzes a document.
- **Document Object Model** (DOM) is a random-access protocol, which converts an XML document into a collection of objects in memory that can be manipulated at the programmers discretion. DOM objects have the data type Document.

JAXP also contains a *plugability layer* that standardizes programmatic access to SAX and DOM by providing standard factory methods for creating and configuring SAX parsers and creating DOM objects.

HCL OneDB™ extensions to the JDBC API facilitate storage and retrieval of XML data in database columns. The methods used during data storage assist in parsing the XML data, verify that well-formed and valid XML data is stored, and ensure that invalid XML data is rejected. The methods used during data retrieval assist in converting the XML data to DOM objects and to type **InputSource**, which is the standard input type to both SAX and DOM methods. The HCL OneDB™ extensions are designed to support XML programmers while still providing flexibility regarding which JAXP package the programmer is using.

Set up your environment to use XML methods

This section contains information you need to know to prepare your system to use the JDBC driver XML methods.

Set your CLASSPATH

To use the XML methods, add the path names of the following files to your CLASSPATH setting:

- `ifxtools.jar`
- `xerces.jar`

All of these files are located in the `lib` directory where you installed your driver.

The Xerces XML library `xerces.jar` has been removed from distribution with the HCL OneDB™ JDBC Driver, Version 3.00.

The XML methods are not part of the `ifxjdbc.jar` file. Instead, they are released in a separate `.jar` file named `ifxtools.jar`. To use the methods, you must add this file to your CLASSPATH setting along with `ifxjdbc.jar`.

In addition, building `ifxtools.jar` requires that you use code from a `.jar` file that supports the SAX, DOM, and JAXP methods. To use `ifxtools.jar`, you must add these `.jar` files to your CLASSPATH setting.

The Java development kit uses the default XML parser even if the xml4j parser is in the CLASSPATH. To use the xml4j implementation of the SAX parser, set the following system properties in the application code or use the **-D** command-line option:

- The property **javax.xml.parsers.SAXParserFactory** must be set to **org.apache.xerces.jaxp.SAXParserFactoryImpl**.
- For the Document Object Model, the property **javax.xml.parsers.DocumentBuilderFactory** must be set to **org.apache.xerces.jaxp.DocumentBuilderFactoryImpl**.

For more info about how to set the properties, see Specify a parser factory on page 70.

Specify a parser factory

By default, the xml4j xerces parser (and as a result, `ifxtools.jar`) uses the non-validating XML parser. To use an alternative SAX parser factory, run your application from the command line as follows:

```
% java -Djavax.xml.parsers.SAXParserFactory=new-factory
```

If you are not running from the command line, the factory name must be enclosed in double quotation marks:

```
% java -Djavax.xml.parsers.SAXParserFactory="new-factory"
```

You can also set a system property in your code:

```
System.setProperty("javax.xml.parsers.SAXParserFactory",
   "new-factory")
```

In this code, *new-factory* is the alternative parser factory. For example, if you are using the xerces parser, then *new-factory* is replaced by **org.apache.xerces.jaxp.SAXParserFactoryImpl**.

It is also possible to use an alternative document factory for DOM methods. Run your application from the command line as follows:

```
% java -Djavax.xml.parsers.DocumentBuilderFactory=new-factory
```

If you are not running from the command line, the factory name must be enclosed in double quotation marks:

```
% java -Djavax.xml.parsers.DocumentBuilderFactory="new-factory"
```

You can also set a system property in your code:

```
System.setProperty("javax.xml.parsers.DocumentBuilderFactory",
   "new-factory")
```

For example, if you are using the xerces parser, then *new-factory* is replaced by **jorg.apache.xerces.jaxp.DocumentBuilderFactoryImpl**.

Insert data

You can use the methods in this section to insert XML data into a database column.

The parameters in method declarations in this section have the following meanings:

- The *file* parameter is an XML document. The document can be referenced by a URL (such as **http://server/file.xml** or **file:///path/file.xml**) or a path name (such as `/tmp/file.xml` or `c:\\work\\file.xml`).
- The *handler* parameter is an optional class you supply, containing callback routines that the SAX parser invokes as it is parsing the file. If no value is specified, or if *handler* is set to `NULL`, the driver uses empty callback routines that echo success or failure (the driver reports failure in the form of an **SQLException**).
- The *validating* parameter tells the SAX parser factory to use a validating parser instead of a parser that only checks form.

If you do not specify *nsa* or *validating*, the driver uses the xml4j nonvalidating XML parser. To change the default, see Specify a parser factory on page 70.

- The *nsa* parameter tells the SAX parser factory whether it can use a parser that can handle namespaces.

The following methods parse a file by using SAX and convert it to a string. You can then use the string returned by these methods as input to the PreparedStatement.setString() method to insert the data into a database column.

```
public String XMLtoString(String file, String handler, boolean
   validating,boolean nsa) throws SQLException

public String XMLtoString(String file, String handler) throws
   SQLException

public String XMLtoString(String file) throws SQLException
```

The following methods parse a file by using SAX and convert it to an object of class **InputStream**. You can then use the **InputStream** object as input to the PreparedStatement.setAsciiStream(), PreparedStatement.setBinaryStream(), or PreparedStatement.setObject() methods to insert the data into a database column.

```
public InputStream XMLtoInputStream(String file, String handler,
   boolean validating,boolean nsa) throws SQLException;

public InputStream XMLtoInputStream(String file, String handler)
   throws SQLException;

public InputStream XMLtoInputStream(String file) throws
   SQLException;
```

For examples of using these methods, see Insert data examples on page 72.

If no value is specified, or if *handler* is set to `NULL`, the driver uses the default HCL OneDB™ handler.

Important: The driver truncates any input data that is too large for a column. For example, if you insert the `x.xml` file into a column of type char (55) instead of a column of type char (255), the driver inserts the truncated file with no errors (the driver throws an SQLWarn exception, however). When the truncated row is selected, the parser throws a SAXParseException because the row contains invalid XML.

Retrieve data

You can use the methods in this section to convert XML data that has been fetched from a database column. These methods help you either convert selected XML text to DOM or parse the data with SAX. The **InputSource** class is the input type to JAXP parsing methods.

For information about the *file*, *handler*, *nsa*, and *validating* parameters, see Insert data on page 70.

The following methods convert objects of type String or InputStream to objects of type InputSource. You can use the ResultSet.getString(), ResultSet.getAsciiStream(), or ResultSet.getBinaryInputStream() methods to retrieve the data from the database column and then pass the retrieved data to getInputSource() for use with any of the SAX or DOM parsing methods. (For an example, see Retrieve data examples on page 73.)

```
public InputSource getInputSource(String s) throws SQLException;

public InputSource getInputSource(InputStream is) throws
   SQLException;
```

The following methods convert objects of type String or InputStream to objects of type Document:

```
public Document StringtoDOM(String s, String handler, boolean
   validating,boolean nsa) throws SQLException

public Document StringtoDOM(String s, String handler) throws
   SQLException

public Document StringtoDOM(String s) throws SQLException

public Document InputStreamtoDOM(String s, String handler, boolean
   validating,boolean nsa) throws SQLException

public Document InputStreamtoDOM(String file, String handler)
   throws SQLException

public Document InputStreamtoDOM(String file) throws SQLException
```

For examples of using these methods, see Retrieve data examples on page 73.

Insert data examples

The examples in this section illustrate converting XML documents to formats acceptable for insertion into HCL OneDB™ database columns.

The XMLtoString() examples

The following example converts three XML documents to character strings and then uses the strings as parameter values in an SQL INSERT statement:

```
PreparedStatement p = conn.prepareStatement("insert into tab
   values(?,?,?)");
p.setString(1, UtilXML.XMLtoString("/home/file1.xml"));
p.setString(2, UtilXML.XMLtoString("http://server/file2.xml");
p.setString(3, UtilXML.XMLtoString("file3.xml");
```

The following example inserts an XML file into an LVARCHAR column. In this example, **tab1** is a table created with the SQL statement:

```
create table tab1 (col1 lvarchar);
```

The code is:

```
try
   {
```

```
   String cmd = "insert into tab1 values (?)";
   PreparedStatement pstmt = conn.prepareStatement(cmd);
   pstmt.setString(1, UtilXML.XMLtoString("/tmp/x.xml"));
   pstmt.execute();
   pstmt.close();
   }
    catch (SQLException e)
   {
   // Error handling
   }
```

The XMLtoInputStream() example

The following example inserts an XML file into a text column. In this example, table **tab2** is created with the SQL statement:

```
create table tab2 (col1 text);
```

The code is:

```
try
   {
   String cmd = "insert into tab2 values (?)";
   PreparedStatement pstmt = conn.prepareStatement(cmd);
   pstmt.setAsciiStream(1, UtilXML.XMLtoInputStream("/tmp/x.xml"),
      (int)(new File("/tmp/x.xml").length()));
    pstmt.execute();
    pstmt.close();
    }
    catch (SQLException e)
    {
    // Error handling
    }
```

Retrieve data examples

The following examples illustrate retrieving data from HCL OneDB™ database columns and converting the data to formats acceptable to XML parsers.

The StringtoDOM() example

This example operates under the assumption that **xmlcol** is a column of type **lvarchar** that contains XML data. The data could be fetched and converted to DOM with the following code:

```
ResultSet r = stmt.executeQuery("select xmlcol from table where
      ...");
while (r.next()
    {
    Document doc= UtilXML.StringtoDOM(r.getString("xmlcol"));
    // Process ‘doc'
    }
```

The InputStreamtoDOM() example

The following example fetches XML data from a text column into a DOM object:

```
try
    {
    String sql = "select col1 from tab2";
    Statement stmt = conn.createStatement();
    ResultSet r = stmt.executeQuery(sql);
     while(r.next())
        {
        Document doc = UtilXML.InputStreamtoDOM(r.getAsciiStream(1));
        }
    r.close();
    }
    catch (Exception e)
    {
    // Error handling
    }
```

The getInputSource() examples

This example retrieves the XML data stored in column **xmlcol** and converts it to an object of type InputSource; the InputSource object `i` can then be used with any SAX or DOM parsing methods:

```
InputSource i = UtilXML.getInputSource
   (resultset.getString("xmlcol"));
```

This example uses the implementation of JAXP API, in `xerces.jar`, to parse fetched XML data in column **xmlcol**:

```
InputSource input = UtilXML.getInputSource(resultset.getString("xmlcol"));
SAXParserFactory f = SAXParserFactory.newInstance();
SAXParser parser = f.newSAXParser();
parser.parse(input);
```

In the examples that follow, **tab1** is a table created with the SQL statement:

```
create table tab1 (col1 lvarchar);
```

The following example fetches XML data from an LVARCHAR column into an **InputSource** object for parsing. This example uses SAX parsing by invoking the parser at **org.apache.xerces.parsers.SAXParser**.

```
try
    {
    String sql = "select col1 from tab1";
    Statement stmt = conn.createStatement();
    ResultSet r = stmt.executeQuery(sql);
    Parser p = ParserFactory.makeParser("org.apache.xerces.parsers.SAXParser");
    while(r.next())
        {
        InputSource i = UtilXML.getInputSource(r.getString(1));
        p.parse(i);
        }
    r.close();
    }
    catch (SQLException e)
    {
    // Error handling
    }
```

The following example fetches XML data from a text column into an **InputSource** object for parsing. This example is the same example as the previous one, but it uses JAXP factory methods instead of the SAX parser to analyze the data.

```
try
    {
    String sql = "select col1 from tab2";
    Statement stmt = conn.createStatement();
    ResultSet r = stmt.executeQuery(sql);
    SAXParserFactory factory = SAXParserFactory.newInstance();
    Parser p = factory.newSAXParser();
    while(r.next())
        {
        InputSource i = UtilXML.getInputSource(r.getAsciiStream(1));
        p.parse(i);
        }
    r.close();
    }
    catch (Exception e)
    {
    // Error handling
    }
```

Work with HCL OneDB™ types

These topics explain the data types that are specific to HCL OneDB™ (other than opaque types) supported in HCL OneDB™ JDBC Driver. For information about opaque types, see Work with opaque types on page 135.

Distinct data types

A distinct type can map to the underlying base type or to a user-defined Java™ object. For example, a distinct type of INT can map to int or to a Java™ object that encapsulates the data representation. This Java™ object must implement the java.sql.SQLData interface. You must provide a custom type map as described in Mapping data types on page 215, to map this Java™ object to the corresponding SQL type name.

Insert data examples

The following example shows an SQL statement that defines a distinct type:

```
CREATE DISTINCT TYPE mymoney AS NUMERIC(10, 2);
CREATE TABLE distinct_tab (mymoney_col mymoney);
```

The following is an example of mapping to the base type:

```
String s = "insert into distinct_tab (mymoney_col) values (?)";
System.out.println(s);
```

```
pstmt = conn.prepareStatement(s);

...
BigDecimal bigDecObj = new BigDecimal(123.45);
pstmt.setBigDecimal(1, bigDecObj);
System.out.println("setBigDecimal...ok");
pstmt.executeUpdate();
```

When you map to the underlying type, HCL OneDB™ JDBC Driver performs the mapping on the client side because the database server provides implicit casting between the underlying type and the distinct type.

You can also map distinct types to Java™ objects that implement the **SQLData** interface. The following example shows an SQL statement that defines a distinct type:

```
CREATE DISTINCT TYPE mymoney AS NUMERIC(10,2)
```

The following code maps the distinct type to a Java™ object named **MyMoney**:

```
import java.sql.*;
import com.informix.jdbc.*;
public class myMoney implements SQLData
{
     private String sql_type = "mymoney";
     public java.math.BigDecimal value;
     public myMoney() { }

     public myMoney(java.math.BigDecimal value)

         this.value = value;

     public String getSQLTypeName()
     {
         return sql_type;
     {

     public void readSQL(SQLInput stream, String type) throws
   SQLException
     {
         sql_type = type;
         value = stream.readBigDecimal();
     {

     public void writeSQL(SQLOutput stream) throws SQLException
     {
         stream.writeBigDecimal(value);
     }
     // overides Object.equals()
     public boolean equals(Object b)

         return value.equals(((myMoney)b).value);
     }
     public String toString()
     {
         return "value=" + value;
     }
}
...
String s - "insert into distinct_tab (mymoney_col) values (?)";
pstmt = conn.prepareStatement(s);
myMoney mymoney = new myMoney();
mymoney.value = new java.math.BigDecimal(123.45);
pstmt.setObject(1, mymoney);
System.out.println("setObject(myMoney)...ok");
pstmt.executeUpdate();
```

In this case, you use the setObject() method instead of the setBigDecimal() method to insert data.

Retrieve data example

You can fetch a distinct type as its underlying base type or as a Java™ object, if the mapping is defined in a custom type map. Using the previous example, you can fetch the data as a Java™ object, as shown in the following example:

```
java.util.Map customtypemap = conn.getTypeMap();
System.out.println("getTypeMap...ok");
if (customtypemap == null)
{
   System.out.println("\n***ERROR: typemap is null!");
   return;
}
customtypemap.put("mymoney", Class.forName("myMoney"));

...
String s = "select mymoney_col from distinct_tab order by 1";
try
{
   Statement stmt = conn.createStatement();
   ResultSet rs = stmt.executeQuery(s);
   System.out.println("Fetching data ...");
   int curRow = 0;
   while (rs.next())
   {
      curRow++;
      myMoney mymoneyret = (myMoney)rs.getObject("mymoney_col");
   }
   System.out.println("total rows expected: " + curRow);
   stmt.close();
}
catch (SQLException e)
{
   System.out.println("***ERROR: " +   e.getErrorCode() + " " +
                                 e.getMessage());
   e.printStackTrace();
}
```

In this case, you use the getObject() method instead of the getBigDecimal() method to retrieve data.

Unsupported methods

The following methods of the **SQLInput** and **SQLOutput** interfaces are not supported for distinct types:

- **java.sql.SQLInput**
  - readArray()
  - readCharacterStream()
  - readRef()
- **java.sql.SQLOutput**
  - writeArray()
  - writeCharacterStream(Reader x)
  - writeRef(Ref x)

BYTE and TEXT data types

This section describes the HCL OneDB™ BYTE and TEXT data types and how to manipulate columns of these data types with the JDBC API.

The BYTE data type is a data type for a simple large object that stores any data in an undifferentiated byte stream. Examples of this binary data include spreadsheets, digitized voice patterns, and video clips. The TEXT data type is a data type for a simple large object that stores any text data. It can contain both single and multibyte characters.

Columns of either data type have a theoretical limit of 2^{31} bytes and a practical limit determined by your disk capacity.

For more detailed information about the HCL OneDB™ BYTE and TEXT data types, see *HCL OneDB™ Guide to SQL: Reference* and *HCL OneDB™ Guide to SQL: Syntax*.

Cache large objects

Whenever an object of type BLOB, CLOB, text, or byte is fetched from the database server, the data is cached in client memory. If the size of the large object is bigger than the value in the **LOBCACHE** environment variable, the large object data is stored in a temporary file. For more information about the **LOBCACHE** variable, see Manage memory for large objects on page 196.

Example: Inserting or updating data

To insert into or update BYTE and TEXT columns, read a stream of data from a source, such as an operating system file, and transmit it to the database as a **java.io.InputStream** object. The **PreparedStatement** interface provides methods for setting an input parameter to this Java™ input stream. When the statement is executed, HCL OneDB™ JDBC Driver makes repeated calls to the input stream, reading its contents and transmitting those contents as the actual parameter data to the database.

For BYTE data types, use the PreparedStatement.setBinaryStream() method to set the input parameter to the **InputStream** object. For TEXT data types, use the PreparedStatement.setAsciiStream() method.

The following example from the `ByteType.java` program shows how to insert the contents of the operating system file `data.dat` into a column of data type BYTE:

```
try
{
        stmt = conn.createStatement();
        stmt.executeUpdate("create table tab1(col1 byte)");
}
catch (SQLException e)
{
        System.out.println("Failed to create table ..." + e.getMessage());
}

try
{
        pstmt = conn.prepareStatement("insert into tab1 values (?)");
}
catch (SQLException e)
{
        System.out.println("Failed to Insert into tab: " + e.toString());
}

File file = new File("data.dat");
int fileLength = (int) file.length();
InputStream value = null;
FileInputStream fileinp = null;
int row = 0;
String str = null;
int        rc = 0;
ResultSet rs = null;

System.out.println("Inserting data ...\n");

try
{
        fileinp =  new FileInputStream(file);
        value = (InputStream)fileinp;
}
catch (Exception e) {}

try
{
        pstmt.setBinaryStream(1,value,10); //set 1st column
}
catch (SQLException e)
{
        System.out.println("Unable to set parameter");
}

set_execute();



...
public static void set_execute()
```

```
{
try
{
        pstmt.executeUpdate();
}
catch (SQLException e)
{
   System.out.println("Failed to Insert into tab: " + e.toString());
   e.printStackTrace();
}
}
```

The example first creates a **java.io.File** object that represents the operating system file `data.dat`. The example then creates a **FileInputStream** object to read from the object of type **File**. The object of type **FileInputStream** is cast to its superclass **InputStream**, which is the expected data type of the second parameter to the PreparedStatement.setBinaryStream() method. The setBinaryStream() method executes on the already prepared INSERT statement, which sets the input stream parameter. Finally, the PreparedStatement.executeUpdate() method executes, which inserts the contents of the `data.dat` operating system file into the column of type BYTE.

The `TextType.java` program shows how to insert data into a column of type TEXT. It is similar to inserting into a column of type BYTE, except the method setAsciiStream() is used to set the input parameter instead of setBinaryStream().

Example: Selecting data

After you select from a table into a **ResultSet** object, you can use the ResultSet.getBinaryStream() method to retrieve a stream of binary or ASCII data from the columns of type BYTE. You can also use the ResultSet.getAsciiStream() method to retrieve a stream of binary or ASCII data from the columns of type TEXT. Both methods return an **InputStream** object, which can be used to read the data in chunks.

All the data in the returned stream in the current row must be read before you call the next() method to retrieve the next row.

The following example from the `ByteType.java` program shows how to select data from a column of type BYTE and print out the data to the standard output device:

```
try
{
        stmt = conn.createStatement();
        rs =  stmt.executeQuery("Select * from tab1");
        while( rs.next() )
       {
            row++;
            value = rs.getBinaryStream(1);
            dispValue(value);
       }
}
catch (Exception e) { }

...

public static void dispValue(InputStream in)
```

```
{
        int size;
        byte buf;
        int count = 0;
        try
        {
             size = in.available();
             byte ary[] = new byte[size];
             buf = (byte) in.read();
             while(buf!=-1)
            {
                  ary[count] = buf;
                  count++;
                  buf = (byte) in.read();
            }
        }
        catch (Exception e)
        {
             System.out.println("Error occured while reading stream ... \n");
        }
}
```

The example first puts the result of a SELECT statement into a **ResultSet** object. It then executes the method ResultSet.getBinaryStream() to retrieve the BYTE data into a Java™ **InputStream** object.

The method dispValue(), whose Java™ code is also included in the example, is used to print out the contents of the column to the standard output device. The dispValue() method uses byte arrays and the InputStream.read() method to systematically read the contents of the column of type BYTE.

The `TextType.java` program shows how to select data from a column of type TEXT. It is similar to selecting from a column of type BYTE, except the getAsciiStream() method is used instead of getBinaryStream().

SERIAL and SERIAL8 data types

HCL OneDB™ JDBC Driver provides support for the HCL OneDB™ SERIAL and SERIAL8 data types through the methods getSerial() and getSerial8(), which are part of the implementation of the **java.sql.Statement** interface.

Because the SERIAL and SERIAL8 data types do not have an obvious mapping to any JDBC API data types from the **java.sql.Types** class, you must import classes that are specific to HCL OneDB™ into your Java™ program to handle SERIAL and SERIAL8 columns. To do this, add the following import line to your Java™ program:

```
import com.informix.jdbc.*;
```

Use the getSerial() method after an INSERT statement to return the serial value that was automatically inserted into the SERIAL column of a table. Use the getSerial8() method after an INSERT statement to return the serial value that was automatically inserted into the SERIAL8 column of a table. The methods return `0` if any of the following conditions are true:

- The last statement was not an INSERT statement.
- The table being inserted into does not contain a SERIAL or SERIAL8 column.
- The INSERT statement has not executed yet.

If you execute the getSerial() or getSerial8() method after a CREATE TABLE statement, the method returns `1` by default (assuming the new table includes a SERIAL or SERIAL8 column). If the table does not contain a SERIAL or SERIAL8 column, the method returns `0`. If you assign a new serial starting number, the method returns that number.

If you want to use the getSerial() and getSerial8() methods, you must cast the **Statement** or **PreparedStatement** object to **IfmxStatement**, the implementation of the **Statement** interface, which is specific to HCL OneDB™. The following example shows how to perform the cast:

```
cmd = "insert into serialTable(i) values (100)";
stmt.executeUpdate(cmd);
System.out.println(cmd+"...okay");
int serialValue = ((IfmxStatement)stmt).getSerial();
System.out.println("serial value: " + serialValue);
```

If you want to insert consecutive serial values into a column of data type SERIAL or SERIAL8, specify a value of `0` for the SERIAL or SERIAL8 column in the INSERT statement. When the column is set to `0`, the database server assigns the next-highest value.

For more detailed information about the HCL OneDB™ SERIAL and SERIAL8 data types, see the *HCL OneDB™ Guide to SQL: Reference* and the *HCL OneDB™ Guide to SQL: Syntax*.

BIGINT and BIGSERIAL data types

The BIGINT and BIGSERIAL data types have the same range of values as INT8 and SERIAL8 data types. However, BIGINT and BIGSERIAL have advantages for storage and computation over INT8 and SERIAL8.

Both the BIGINT and BIGSERIAL data types map to the to BIGINT Java™ type in the class **java.sql.Types**. When data is retrieved from the database, the BIGINT and BIGSERIAL data types map to long Java™ Type.

The OneDB® JDBC Driver provides support for the HCL OneDB™ BIGSERIAL and BIGINT data types through the getBigSerial() method, which is a part of the **java.sql.Statement** interface

Because the BIGSERIAL and BIGINT data types do not have an obvious mapping to any JDBC API data types from the **java.sql.Types** class, you must import classes that are specific to HCL OneDB™ into your Java™ program to handle BIGSERIAL and BIGINT columns. To do this, add the following import line to your Java™ program:

```
import com.informix.jdbc.*;
```

Use the getBigSerial() method after an INSERT statement to return the value that was inserted into the BIGSERIAL or BIGINT column of a table.

If you want to use the getBigSerial() method, you must cast the **Statement** or **PreparedStatement** object to **IfmxStatement**, the implementation of the **Statement** interface, which is specific to HCL OneDB™. The following example shows how to perform the cast:

```
cmd = "insert into bigserialTable(i) values (100)";
stmt.executeUpdate(cmd);
System.out.println(cmd+"...okay");
long serialValue = ((IfmxStatement)stmt).getBigSerial();
System.out.println("serial value: " + serialValue);
```

These types are part of the **com.informix.lang.IfxTypes** class. See the The IfxTypes class on page 223 table for the IfxTypes constants and the corresponding HCL OneDB™ data types.

INTERVAL data type

The HCL OneDB™ INTERVAL data type stores a value that represents a span of time. INTERVAL data types comprise two types: year-month intervals and day-time intervals. A year-month interval can represent a span of years and months, and a day-time interval can represent a span of days, hours, minutes, seconds, and fractions of a second. For more information about the INTERVAL data type and definitions of *qualifier*, *precision*, and *fraction*, see the following publications:

- *HCL OneDB™ Guide to SQL: Tutorial*
- *HCL OneDB™ Guide to SQL: Reference*
- *HCL OneDB™ Guide to SQL: Syntax*

The Interval class

The **com.informix.lang.Interval** class is the HCL OneDB™-specific extension to the JDBC specification. Interval is the base class for the INTERVAL data type. Interval has two subclasses: IntervalYM (for year-month qualifiers) and IntervalDF (for day-time qualifiers). You use these subclasses to create and manipulate INTERVAL data types.

Tip: Many of the **Interval**, **IntervalYM**, and **IntervalDF** constructors take a **Connection** object as a parameter. This passes the value of the **CLIENT_LOCALE** environment variable to the **Interval**, **IntervalYM**, or **IntervalDF** object, which allows the display of localized error messages if an exception is thrown. For more information, see Support for globalized error messages on page 191.

For information about the string INTERVAL formats in this section, see the *HCL OneDB™ Guide to SQL: Syntax*.

This section discusses many of the methods you can use with the INTERVAL data types. For complete reference information, see the online reference documentation in the directory `doc/javadoc/*` after you install your software. (The `doc` directory is a subdirectory of the directory where you installed HCL OneDB™ JDBC Driver.)

Variables for binary qualifiers

You can use string qualifiers to manipulate INTERVAL data types, but using binary qualifiers results in faster performance. The following variables are defined in the **Interval** base class and represent the time unit (start and end code) of a field in the binary qualifier. To use these variables, instantiate objects of the **IntervalYM** and **IntervalDF** classes, which inherit these variables from the **Interval** base class.

TU_YEAR

Time unit for the YEAR qualifier field

TU_MONTH

Time unit for the MONTH qualifier field

TU_DAY

Time unit for the DAY qualifier field

TU_HOUR

Time unit for the HOUR qualifier field

TU_MINUTE

Time unit for the MINUTE qualifier field

TU_SECOND

Time unit for the SECOND qualifier field

TU_FRAC

Time unit for the leading FRACTION qualifier field

TU_F1

Time unit for the ending field of the first position of FRACTION

TU_F2

Time unit for the ending field of the second position of FRACTION

TU_F3

Time unit for the ending field of the third position of FRACTION

TU_F4

Time unit for the ending field of the fourth position of FRACTION

TU_F5

Time unit for the ending field of the fifth position of FRACTION

Interval methods

You can use the **Interval** methods to extract information about binary qualifiers. To use these methods, instantiate objects of the **IntervalYM** and **IntervalDF** classes, which inherit these variables from the **Interval** base class.

Some of the tasks you can perform and the methods you can use follow:

- Extracting the length of a qualifier:

  ```
  public static byte getLength(short qualifier)
  ```

- Extracting the starting field code (one of the TU_*XXX* variables) from a qualifier:

  ```
  public static byte getStartCode(short qualifier)
  ```

- Extracting the ending field code (one of the TU_*XXX* variables) from a qualifier:

```
public static byte getEndCode(short qualifier)
```

- Obtaining the string value that corresponds to the TU_*XXX* value of part of an interval (for example, `getFieldName(TU_YEAR)` returns the string `year`):

  ```
  public static String getFieldName(byte code)
  ```

- Obtaining the entire name of the interval as a character string, taking a qualifier as input:

  ```
  public static String getIfxTypeName(int type,
     short qualifier)
  ```

- Obtaining the number of digits in the FRACTION part of the INTERVAL data type:

  ```
  public static byte getScale(short qualifier)
  ```

- Creating a binary qualifier from a length, start code (TU_*XXX*), and end code (TU_*XXX*):

  ```
  public static short getQualifier(byte length, byte
     startCode, byte endCode) throws SQLException
  ```

  For example, `getQualifier(4, TU_YEAR, TU_MONTH)` creates a binary representation of the YEAR TO MONTH qualifier.

The IntervalYM class

The **com.informix.lang.IntervalYM** class allows you to manipulate year-month intervals.

The IntervalYM constructors

The default constructor is defined as follows:

```
public IntervalYM() throws SQLException
```

Use this second version of the constructor to display localized error messages if an exception is thrown:

```
public IntervalYM(Connection conn) throws SQLException
```

Use the following constructors to create year-month intervals from specific input values:

- Two time stamps, returning the IntervalYM value that equals *Timestamp1 - Timestamp2*:

  ```
  public IntervalYM(Timestamp t1, Timestamp t2) throws
     SQLException
  public IntervalYM (Timestamp t1, Timestamp t2, Connection
     conn) throws SQLException
  ```

  The second version allows you to support localized error messages.

- Year and month values (large month values are converted to year):

  ```
  public IntervalYM(int years, int months) throws
     SQLException

  public IntervalYM(int years, int months,
     Connection conn) throws SQLException
  ```

The second version allows you to support localized error messages.

- A month value and the encoded qualifier:

  ```
  public IntervalYM(int months, short qualifier,
     Connection conn) throws SQLException
  ```

  To specify the qualifier, you can use the getQualifier() method described in Interval methods on page 84. This constructor supports localized error messages.

- A string:

  ```
  public IntervalYM(String string) throws SQLException
  public IntervalYM(String string, Connection conn) throws
     SQLException
  ```

  The second version allows you to support localized error messages.

- A string and qualifier:

  ```
  public IntervalYM(String string, short qualifier,
     Connection conn) throws SQLException
  ```

  To specify the qualifier, you can use the getQualifier() method described in Interval methods on page 84. This constructor supports localized error messages.

- A string and qualifier information:

  ```
  public IntervalYM(String string, int length,
     byte startCode, byte endCode) throws SQLException

  public IntervalYM(String string, int length,
     byte startCode, byte endCode, Connection conn) throws
     SQLException
  ```

  The second version allows you to support localized error messages.

The IntervalYM methods

The following methods allow you to manipulate year-month intervals. (You can also use the **Interval** methods, described previously.) Some of the tasks you can perform with **IntervalYM** methods include the following:

- Comparing two intervals:

  ```
  boolean equals(Object other)
  boolean greaterThan(IntervalYM other)
  boolean lessThan(IntervalYM other)
  ```

- Setting a value for an interval from:
  - A string:

    ```
    void fromString(String other)
    void set(String string)
    ```

  - Year and month values (large month values are converted to years):

```
void set(int years, int months)
```

  - Two time stamps:

```
void set(Timestamp t1, Timestamp t2)
```

- Setting the qualifier for an interval:
  - From the length, start code, and end code:

```
void setQualifier(int length, byte startcode, byte
      endcode)
```

  - Using an existing qualifier:

```
void setQualifier(short qualifier)
```

- Obtaining the number of months in the interval:

```
long getMonths()
```

- Creating a string representation of the interval in the format `yyyy-mm`:

```
String toString()
```

  The fields present depend on the qualifier. Blanks replace leading zeros.

The IntervalDF class

The **com.informix.lang.IntervalDF** class allows you to manipulate intervals.

The IntervalDF constructors

The default constructor is defined as follows:

```
public IntervalDF() throws SQLException
```

Use this second version of the default constructor to display localized error messages if an exception is thrown:

```
public IntervalDF(Connection conn) throws SQLException
```

Use the following constructors to create intervals from specific input values:

- Two time stamps *t1* and *t2*, returning the IntervalDF value that equals *t1* - *t2*:

```
public IntervalDF(Timestamp t1, Timestamp t2)
                      throws SQLException

public IntervalDF(Timestamp t1, Timestamp t2, Connection conn)
                      throws SQLException
```

  The second version allows you to support localized error messages.

- A number of seconds and nanoseconds (large second values are converted to minutes, hours, or days):

```
public IntervalDF(long seconds, long nanos)
                      throws SQLException
```

```
public IntervalDF(long seconds, long nanos, Connection conn)
                      throws SQLException
```

The second version allows you to support localized error messages.

- A number of seconds, a number of nanoseconds, and qualifier:

```
public IntervalDF(long seconds, long nanos, short qualifier)
                      throws SQLException

public IntervalDF(long seconds, long nanos, short qualifier, Connection conn)
                      throws SQLException
```

To specify the qualifier, you can use the getQualifier() method described in Interval methods on page 84. The second version allows you to support localized error messages.

- A string:

```
public IntervalDF(String string)
                      throws SQLException
public IntervalDF(String string, Connection conn)
                      throws SQLException
```

The second version allows you to support localized error messages.

When you use these constructors, the default qualifier is set to the following values:

leading field precision: `2` start code: `TU_DAY` end code: `TU_F5`

For information about string INTERVAL formats, see the *HCL OneDB™ Guide to SQL: Syntax*.

- A string and a qualifier:

```
public IntervalDF(String string, short qualifier)
                      throws SQLException

public IntervalDF(String string, short qualifier, Connection conn)
                      throws SQLException
```

To specify the qualifier, you can use the getQualifier() method described in Interval methods on page 84. The second version allows you to support localized error messages.

- A string and qualifier information:

```
public IntervalDF(String string, int length, byte startcode, byte endcode)
                        throws SQLException

public IntervalDF(String string, int length, byte startcode,
byte endcode, Connection conn) throws SQLException
```

The second version allows you to support localized error messages.

The IntervalDF methods

The following methods allow you to manipulate intervals. (You can also use the **Interval** methods, described previously.) The tasks you can perform, and the methods you can use, are as follows:

- Comparing two intervals:

  ```
  boolean equals(Object other)
  boolean greaterThan(IntervalDF other)
  boolean lessThan(IntervalDF other)
  ```

- Setting a value for an interval from:
  - A string:

    ```
    void fromString(String other)
    void set(String string)
    ```

  - Second and nanosecond values (large second values are converted to minutes, hours, or days):

    ```
    void set(long seconds, long nanos)
    ```

  - Two time stamps:

    ```
    void set(Timestamp t1, Timestamp t2)
    ```

- Setting the qualifier from the length, start code, and end code:

  ```
  void setQualifier(int length, byte startcode, byte endcode)
  ```

- Obtaining the number of nanoseconds in the interval:

  ```
  long getNanoSeconds()
  ```

- Obtaining the number of seconds in the interval:

  ```
  long getSeconds()
  ```

- Creating a string representation of the interval in the format `ddddd hh:mm:ss.nano`:

  ```
  String toString()
  ```

  The fields present depend on the qualifier. Blanks replace leading zeros.

Interval example

The `Intervaldemo.java` program, which is included in HCL OneDB™ JDBC Driver, shows how to insert into and select from the two types of INTERVAL data types.

Collections and arrays

The JDBC 3.0 specification describes only one method to exchange collection data between a Java™ client and a relational database: an array.

Because the array interface does not include a constructor, HCL OneDB™ JDBC Driver includes an extension that allows a **java.util.Collection** object to be used in the PreparedStatement.setObject() and ResultSet.getObject() methods.

If you prefer to use an **Array** object, use the PreparedStatement.setArray() and ResultSet.getArray() methods. A **Collection** object is easier to use, but an **Array** object conforms to JDBC 3.0 standards.

By default, the driver maps LIST columns to **java.util.ArrayList** objects and SET and MULTISET columns to **java.util.HashSet** objects during a fetch. You can override these defaults, but the class you use must implement the **java.util.Collection** interface.

To override this default mapping, you can use other classes in the **java.util.Collection** interface, such as the **TreeSet** class. You can also create your own classes that implement the **java.util.Collection** interface. In either case, you must provide a customized type map using the Connection.setTypeMap() method.

During an INSERT operation, any **java.util.Collection** object that is an instance of the **java.util.Set** interface is mapped to the HCL OneDB™ MULTISET data type. An instance of the **java.util.List** interface is mapped to the HCL OneDB™ LIST data type. You can override these defaults by creating a customized type mapping.

For information about customized type mappings, see Mapping data types on page 215.

Important: Sets are by definition unordered. If you select collection data using a **HashSet** object, the order of the elements in the **HashSet** object might not be the same as the order specified when the set was inserted. For example, if the data on the database server is the **set** {1, 2, 3}, it might be retrieved into the **HashSet** object as {3, 2, 1} or any other order.

The complete versions of all of the examples in the following sections are in the `complex-types` directory where you installed the driver. For more information, see Sample code files on page 204.

Collection examples

Following is a sample database schema:

```
create table tab ( a set(integer not null), b integer);
insert into tab values ("set{1, 2, 3}", 10);
```

The following is a fetch example using a **java.util.HashSet** object:

```
java.util.HashSet set;

PreparedStatement pstmt;
ResultSet rs;
pstmt = conn.prepareStatement("select * from tab");
System.out.println("prepare ... ok");
rs = pstmt.executeQuery();
System.out.println("executeQuery ... ok");

rs.next();
set = (HashSet) rs.getObject(1);
System.out.println("getObject() ... ok");

/* The user can now use HashSet.iterator() to extract
 * each element in the collection.
 */
Iterator it = set.iterator();
Object obj;
Class cls = null;
int i = 0;
while (it.hasNext())
   {
   obj = it.next();
   if (cls == null)
      {
      cls = obj.getClass();
      System.out.println("    Collection class: " + cls.getName());
      }
   System.out.println("    element[" + i + "] = " +
   obj.toString());
   i++;
   }
pstmt.close();
```

In the `set = (HashSet) rs.getObject(1)` statement of this example, HCL OneDB™ JDBC Driver gets the type for column 1. Because it is a SET type, a **HashSet** object is instantiated. Next, each collection element is converted into a Java™ object and inserted into the collection.

The following fetch example uses a **java.util.TreeSet** object:

```
java.util.TreeSet set;

PreparedStatement pstmt;
ResultSet rs;

/*
 * Fetch a SET as a TreeSet instead of the default
 * HashSet. In this example a new java.util.Map object has
 * been allocated and passed in as a parameter to getObject().
 * Connection.getTypeMap() could have been used as well.
 */
java.util.Map map = new HashMap();
map.put("set", Class.forName("java.util.TreeSet"));
System.out.println("mapping ... ok");

pstmt = conn.prepareStatement("select * from tab");
System.out.println("prepare ... ok");
rs = pstmt.executeQuery();
System.out.println("executeQuery ... ok");

rs.next();
set = (TreeSet) rs.getObject(1, map);
System.out.println("getObject(Map) ... ok");

/* The user can now use HashSet.iterator() to extract
 * each element in the collection.
 */
```

```
Iterator it = set.iterator();
Object obj;
Class cls = null;
int i = 0;
while (it.hasNext())
   {
   obj = it.next();
   if (cls == null)
      {
      cls = obj.getClass();
      System.out.println("    Collection class: " + cls.getName());
      }
   System.out.println("    element[" + i + "] = " +
   obj.toString());
   i++;
   }
pstmt.close();
```

In the `map.put("set", Class.forName( "java.util.TreeSet" ));` statement, the default mapping of **set = HashSet** is overridden.

In the `set = (TreeSet) rs.getObject(1, map)` statement, HCL OneDB™ JDBC Driver gets the type for column 1 and finds that it is a SET object. Then the driver looks up the type mapping information, finds **TreeSet**, and instantiates a **TreeSet** object. Next, each collection element is converted into a Java™ object and inserted into the collection.

The following example shows an insert. This example inserts the set (0, 1, 2, 3, 4) into a SET column:

```
java.util.HashSet set = new HashSet();
Integer intObject;
int i;

/* Populate the Java collection */
for (i=0; i < 5; i++)
   {
   intObject = new Integer(i);
   set.add(intObject);
   }
System.out.println("populate java.util.HashSet...ok");

PreparedStatement pstmt = conn.prepareStatement
   ("insert into tab values (?, 20)");
System.out.println("prepare...ok");

pstmt.setObject(1, set);
System.out.println("setObject()...ok");
pstmt.executeUpdate();
System.out.println("executeUpdate()...ok");
pstmt.close();
```

The `pstmt.setObject(1, set)` statement in this example first serializes each element of the collection. Next, the type information is constructed as each element is converted into a Java™ object. If the types of any elements in the collection do not match the type of the first element, an exception is thrown. The type information is sent to the database server.

Array example

Following is a sample database schema:

```
CREATE TABLE tab (a set(integer not null), b integer);
INSERT INTO tab VALUES ("set{1,2,3}", 10);
```

The following example fetches data using a **java.sql.Array** object:

```
PreparedStatement pstmt = conn.prepareStatement("select a from tab");
System.out.println("prepare ... ok");
ResultSet rs = pstmt.executeQuery();
System.out.println("executeQuery ... ok");

rs.next();
java.sql.Array array = rs.getArray(1);
System.out.println("getArray() ... ok");
pstmt.close();

/*
 * The user can now materialize the data into either
 * an array or else a ResultSet. If the collection elements
 * are primitives then the array should be an array of primitives,
 * not Objects. Mapping data can be provided at this point.
 */

Object obj = array.getArray((long) 1, 2);

int [] intArray = (int []) obj;   // cast it to an array of ints
int i;
for (i=0; i < intArray.length; i++)
   {
   System.out.println("integer element = " + intArray[i]);
   }
pstmt.close();
```

The `java.sql.Array array = rs.getArray(1)` statement instantiates a **java.sql.Array** object. Data is not converted at this point.

The `Object obj = array.getArray((long) 1, 2)` statement converts data into an array of integers (**int** types, not **Integer** objects). Because the getArray() method has been called with index and count values, only a subset of data is returned.

Named and unnamed rows

The JDBC 3.0 specification refers to an SQL type called a *structured type* or *struct*, which is equivalent to the HCL OneDB™ named row. The specification defines two approaches to exchange structured-type data between a Java™ client and a relational database:

- **Using the SQLData interface**. A single Java™ class per named row type implements the **SQLData** interface. The class has a member for each element in the named row.
- **Using the Struct interface**. This interface instantiates the necessary Java™ object for each element in the named row and constructs an array of **java.util.Object** Java™ objects.

Whether HCL OneDB™ JDBC Driver instantiates a Java™ object or a **Struct** object for a fetched named row depends on whether there is a customized type-mapping entry or not, as follows:

- If there is an entry for a named row in the Connection.getTypeMap() map, or if you provided a type mapping using the getObject() method, a single Java™ object is instantiated.
- If there is no entry for a named row in the Connection.getTypeMap() map, and if you have not provided a type mapping using the getObject() method, a **Struct** object is instantiated.

Unnamed rows are always fetched into **Struct** objects.

Important: Regardless of whether you use the **SQLData** or **Struct** interface, if a named or unnamed row contains an opaque data type column, there must be a type-mapping entry for it. If you are using the **Struct** interface to access a row that contains an opaque data type column, you need a customized type map for the opaque data type column, but not for the row as a whole.

For more information about custom type mapping, see Mapping data types on page 215.

Interval and collection support

The java.sql.SQLOutput and java.sql.SQLInput methods are extended to support **Collection** and **Interval** objects in named and unnamed rows. These extensions include the following methods:

- The com.informix.jdbc.IfmxComplexSQLInput.readObject() method returns the appropriate **java.util.Collection** object if the data is a set, list, or multiset data type.
- The com.informix.jdbc.IfmxComplexSQLInput.readInterval() method returns the appropriate **IntervalYM** or **IntervalDF** object for an interval data type, depending on the qualifier.
- The com.informix.jdbc.IfmxComplexSQLOutput.writeObject() method accepts objects derived from the **java.util.Collection** interface or from **IntervalYM** and **IntervalDF** objects.

Unsupported methods

The following **SQLInput** methods are not supported for selecting a ROW column into a Java™ object that implements **SQLData**:

- readByte()
- readCharacterStream()
- readRef()

The following **SQLOutput** methods are not supported for inserting a Java™ object that implements **SQLData** into a ROW column:

- writeByte(byte)
- writeCharacterStream(java.io.Reader x)
- writeRef(Ref x)

The SQLData interface

The Java™ class for the named row must implement the **SQLData** interface. The class must have a member for each element in the named row but can have other members in addition to these. The members can be in any order and need not be public.

The Java™ class must implement the writeSQL(), readSQL(), and getSQLTypeName() methods for the named row as defined in the **SQLData** interface, but can implement additional methods. You can use the ClassGenerator utility to create the class; for more information, see The ClassGenerator utility on page 103.

To link this Java™ class with the named row, create a customized type mapping using the Connection.setTypeMap() method or the getObject() method. For more information about type mapping, see Mapping data types on page 215.

You cannot use the **SQLData** interface to access unnamed rows.

SQLData examples

The complete versions of all of the examples in this section are in the `demo/complex-types` directory where you installed the driver. For more information, see Sample code files on page 204.

The following example includes a Java™ class that implements the **java.sql.SQLData** interface.

Here is a sample database schema:

```
CREATE ROW TYPE fullname_t (first char(20), last char(20));
CREATE ROW TYPE person_t (id int, name fullname_t, age int);
CREATE TABLE teachers (person person_t, dept char (20));
INSERT INTO teachers VALUES ("row(100, row(‘Bill', 'Smith'), 27)", "physics");
```

This is the **fullname** Java™ class:

```
import java.sql.*;
public class fullname implements SQLData
{
   public String first;
   public String last;
   private String sql_type = "fullname_t";

   public String getSQLTypeName()
   {
      return sql_type;
   }
   public void readSQL (SQLInput stream, String type) throws
      SQLException
   {
      sql_type = type;
      first = stream.readString();
      last = stream.readString();
   }
   public void writeSQL (SQLOutput stream) throws SQLException
   {
      stream.writeString(first);
      stream.writeString(last);
   }
   /*
     * Function not required by SQLData interface, but makes
     * it easier for displaying results.
     */
   public String toString()
   {
      String s = "fullname: ";
      s += "first: " + first + " last: " + last;
      return s;
   }
}
```

This is the **person** Java™ class:

```
import java.sql.*;
public class person implements SQLData
{
   public int id;
    public fullname name;
    public int age;
    private String sql_type = "person_t";

   public String getSQLTypeName()
   {
      return sql_type;
   }
   public void readSQL (SQLInput stream, String type) throws SQLException
   {
      sql_type = type;
      id = stream.readInt();
      name = (fullname)stream.readObject();
      age = stream.readInt();
   }
   public void writeSQL (SQLOutput stream) throws SQLException
   {
      stream.writeInt(id);
      stream.writeObject(name);
      stream.writeInt(age);
   }
   public String toString()
   {
      String s = "person:";
      s += "id: " + id + "\n";
      s += "     name: " + name.toString() + "\n";
      s += "     age: " + age + "\n";
      return s;
   }
}
```

Here is an example of fetching a named row:

```
java.util.Map map = conn.getTypeMap();
conn.setTypeMap(map);
map.put("fullname_t", Class.forName("fullname"));
map.put("person_t", Class.forName("person"));

...
PreparedStatement pstmt;
ResultSet rs;
pstmt = conn.prepareStatement("select person from teachers");
System.out.println("prepare ...ok");

rs = pstmt.executeQuery();
System.out.println("executetQuery()...ok");

while (rs.next())
   {
   person who = (person) rs.getObject(1);
   System.out.println("getObject()...ok");
   System.out.println("Data fetched:");
   System.out.println("row: " + who.toString());
   }
pstmt.close();
```

The conn.getTypeMap() method returns the named row mapping information from the **java.util.Map** object through the **Connection** object.

The map.put() method registers the mappings between the nested named row on the database server, **fullname_t**, and the Java™ class **fullname**, and between the named row on the database server, **person_t**, and the Java™ class **person**.

The `person who = (person) rs.getObject(1)` statement retrieves the named row into the Java™ object **who**. HCL OneDB™ JDBC Driver recognizes that this object **who** is a named row, a distinct type, or an opaque type, because the information sent by the database server has an extended name of **person_t**.

The driver looks up **person_t** and finds it is a named row. The driver calls the map.get() method with the key **person_t**, which returns the **person** class object. An object of class **person** is instantiated.

The readSQL() method in the **person** class calls methods defined in the **SQLInput** interface to convert each field in the ROW column into a Java™ object and assign each to a member in the **person** class.

The following example shows a method for inserting a Java™ object into a named row column using the setObject() method:

```
java.util.Map map = conn.getTypeMap();
map.put("fullname_t", Class.forName("fullname"));
map.put("person_t", Class.forName("person"));
```

```
...
PreparedStatement pstmt;
System.out.println("Populate person and fullname objects");
person who = new person();
fullname name = new fullname();
name.last = "Jones";
name.first = "Sarah";
who.id = 567;
who.name = name;
who.age = 17;

String s = "insert into teachers values (?, 'physics')";
pstmt = conn.prepareStatement (s);
System.out.println("prepared...ok");

pstmt.setObject(1, who);
System.out.println("setObject()...ok");

int rowcount = pstmt.executeUpdate();
System.out.println("executeUpdate()...ok");
pstmt.close();
```

The conn.getTypeMap() method returns the named row mapping information from the **java.util.Map** object through the **Connection** object.

The map.put() method registers the mappings between the nested named row on the database server, **fullname_t**, and the Java™ class **fullname** and between the named row on the database server, **person_t**, and the Java™ class **person**.

HCL OneDB™ JDBC Driver recognizes that the object **who** implements the **SQLData** interface, so it is either a named row, a distinct type, or an opaque type. HCL OneDB™ JDBC Driver calls the getSQLTypeName() method for this object (required for classes implementing the **SQLData** interface), which returns **person_t**. The driver looks up **person_t** and finds it is a named row.

The writeSQL() method in the **person** class calls the corresponding SQLOutput.writeXXX() method for each member in the class, each of which maps to one field in the named row **person_t**. The writeSQL() method in the class contains calls to the SQLOutput.writeObject(name) and SQLOutput.writeInt(id) methods. Each member of the class **person** is serialized and written into a stream.

The Struct interface

The JDBC documentation does not specify that **Struct** objects can be parameters to the PreparedStatement.setObject() method. However, HCL OneDB™ JDBC Driver can handle any object passed by the PreparedStatement.setObject() or ResultSet.getObject() method that implements the **java.sql.Struct** interface.

You must use the **Struct** interface to access unnamed rows.

You do not need to create your own class to implement the **java.sql.Struct** interface. However, you must perform a fetch to retrieve the ROW data and type information before you can insert or update the ROW data. HCL OneDB™ JDBC Driver automatically calls the getSQLTypeName() method, which returns the type name for a named row or the row definition for an unnamed row.

If you create your own class to implement the **Struct** interface, the class you create must implement all the **java.sql.Struct** methods, including the getSQLTypeName() method. You can choose what the getSQLTypeName() method returns.

Although you must return the row definition for unnamed rows, you can return either the row name or the row definition for named rows. Each has advantages:

- **Row definition**. The driver does not need to query the database server for the type information. In addition, the row definition returned does not have to match the named row definition exactly, because the database server provides casting, if needed. This is useful if you want to use strings to insert into an opaque type in a row, for example.
- **Row name**. If a user-defined routine takes a named row as a parameter, the signature has to match, so you must pass in a named row.

  For more information about user-defined routines, see the following publications: *HCL® J/Foundation Developer's Guide* (for information specific to Java™); *HCL OneDB™ User-Defined Routines and Data Types Developer's Guide* and *HCL OneDB™ Guide to SQL: Reference* (both for general information about user-defined routines); and *HCL OneDB™ Guide to SQL: Syntax* (for the syntax to create and invoke user-defined routines).

Important: If you use the **Struct** interface for a named row and provide type-mapping information for the named row, a **ClassCastException** message is generated when the ResultSet.getObject() method is called, because Java™ cannot cast between an **SQLData** object and a **Struct** object.

Struct examples

The complete versions of all of the examples in this section are in the `demo/complex-types` directory where you installed the driver. For more information, see Sample code files on page 204.

This example fetches an unnamed ROW column. Here is a sample database schema:

```
CREATE TABLE teachers
   (
   person row(
      id int,
      name row(first char(20), last char(20)),
      age int
      ),
   dept char(20)
   );
INSERT INTO teachers VALUES ("row(100, row('Bill', 'Smith'), 27)", "physics");
```

This is the rest of the example:

```
PreparedStatement pstmt;
ResultSet rs;
pstmt = conn.prepareStatement("select person from teachers");
System.out.println("prepare ...ok");
```

```
rs = pstmt.executeQuery();
System.out.println("executetQuery()...ok");

rs.next();
Struct person = (Struct) rs.getObject(1);
System.out.println("getObject()...ok");
System.out.println("\nData fetched:");

Integer id;
Struct name;
Integer age;
Object[] elements;

/* Get the row description */
String personRowType = person.getSQLTypeName();
System.out.println("person row description: " + personRowType);
System.out.println("");

/* Convert each element into a Java object */
elements = person.getAttributes();

/*
 * Run through the array of objects in 'person' getting out each structure
 * field. Use the class Integer instead of int, because int is not an object.
 */
id = (Integer) elements[0];
name = (Struct) elements[1];
age = (Integer) elements[2];
System.out.println("person.id: " + id);
System.out.println("person.age: " + age);
System.out.println("");

/* Convert 'name' as well. */
/* get the row definition for 'name' */
String nameRowType = name.getSQLTypeName();
System.out.println("name row description: " + nameRowType);

/* Convert each element into a Java object */
elements = name.getAttributes();

/*
 * run through the array of objects in 'name' getting out each structure
 * field.
 */
String first = (String) elements[0];
String last = (String) elements[1];
System.out.println("name.first: " + first);
System.out.println("name.last: " + last);
pstmt.close();
```

The `Struct person = (Struct) rs.getObject(1)` statement instantiates a **Struct** object if column 1 is a ROW type and there is no extended data type name (if it is a named row).

The `elements = person.getAttributes();` statement performs the following actions:

- Allocates an array of **java.lang.Object** objects with the correct number of elements
- Converts each element in the row into a Java™ object

  If the element is an opaque type, you must provide type mapping in the **Connection** object or pass in a **java.util.Map** object in the call to the getAttributes() method.

The `String personrowType = person.getSQLTypeName();` statement returns the row type information. If this type is a named row, the statement returns the name. Because the type is not a named row, the statement returns the row definition: **row(int id, row(first char(20), last char(20)) name, int age)**.

The example then goes through the same steps for the unnamed row **name** as it did for the unnamed row **person**.

The following example uses a user-created class, **GenericStruct**, which implements the **java.sql.Struct** interface. As an alternative, you can use a **Struct** object returned from the ResultSet.getObject() method instead of the **GenericStruct** class.

```
import java.sql.*;
import java.util.*;
public class GenericStruct implements java.sql.Struct
{
   private Object [] attributes = null;
   private String typeName = null;

   /*
    * Constructor
    */
   GenericStruct() { }

   GenericStruct(String name, Object [] obj)
   {
      typeName = name;
      attributes = obj;
   }
   public String getSQLTypeName()
   {
      return typeName;
   }
   public Object [] getAttributes()
   {
      return attributes;
   }
   public Object [] getAttributes(Map map) throws SQLException
   {
      // this class shouldn't be used if there are elements
      // that need customized type mapping.
      return attributes;
   }
   public void setAttributes(Object [] objArray)
   {
      attributes = objArray;
   }
   public void setSQLTypeName(String name)
   {
      typeName = name;
   }
}
```

The following Java™ program inserts a ROW column:

```
PreparedStatement pstmt;
ResultSet rs;
GenericStruct gs;
String rowType;

pstmt = conn.prepareStatement("insert into teachers values (?, 'Math')");
System.out.println("prepare insert...ok\n");

System.out.println("Populate name struct...");
Object[] name = new Object[2];

// populate inner row first
name[0] = new String("Jane");
name[1] = new String("Smith");

rowType = "row(first char(20), last char(20))";
gs = new GenericStruct(rowType, name);
System.out.println("Instantiate GenericStructObject...okay\n");

System.out.println("Populate person struct...");
// populate outer row next
Object[] person = new Object[3];
person[0] = new Integer(99);
person[1] = gs;
person[2] = new Integer(56);

rowType = "row(id int, " +
   "name row(first char(20), last char(20)), " +
   "age int)";
gs = new GenericStruct(rowType, person);
System.out.println("Instantiate GenericStructObject...okay\n");

pstmt.setObject(1, gs);
System.out.println("setObject()...okay");
pstmt.executeUpdate();
System.out.println("executeUpdate()...okay");
pstmt.close();
```

At the `pstmt.setObject(1, gs)` statement in this example, HCL OneDB™ JDBC Driver determines that the information is to be transported from the client to the database server as a ROW column, because the **GenericStruct** object is an instance of the **java.sql.Struct** interface.

Each element in the array is serialized, verifying that each element matches the type as defined by the getSQLTypeName() method.

The ClassGenerator utility

The ClassGenerator utility generates a Java™ class for a named row type defined in the system catalog. The utility is the HCL OneDB™ extension to the JDBC specification.

The created Java™ class implements the **java.sql.SQLData** interface. The class has members for each field in the named row. The readSQL(), writeSQL(), and SQLData.readSQL() methods read the attributes in the order in which they appear in the definition of the named row type in the database. Similarly, writeSQL() writes the data to the stream in that order.

ClassGenerator is packaged in the `ifxtools.jar` file, so the **CLASSPATH** environment variable must point to `ifxtools.jar`.

The syntax for using ClassGenerator is as follows:

```
java ClassGenerator rowtypename [-u URL] [-c classname]
```

The default value for *classname* is the value for *rowtypename*.

If the *URL* parameter is not specified, the required information is retrieved from the `setup.std` file in the home directory.

The structure of `setup.std` is as follows:

```
URL jdbc:host-name:port-number
ONEDB_SERVER informixservername
database database
user user
passwd password
```

Simple named row example

To use ClassGenerator, you first create the named row on the database server as shown in this example:

```
create row type employee (name char (20), age int);
```

Next, run ClassGenerator:

```
java ClassGenerator employee
```

The class generator generates `employee.java`, as shown next, and retrieves the database URL information from `setup.std`, which has the following contents:

```
URL jdbc:davinci:1528
database test
user scott
passwd tiger
ONEDB_SERVER picasso_ius
```

Following is the generated `.java` file:

```
import java.sql.*;
import java.math.*;
public class employee implements SQLData
{
   public String name;
   public int age;
   private String sql_type;

   public String getSQLTypeName() { return "employee"; }

   public void readSQL (SQLInput stream, String type) throws
      SQLException
   {
      sql_type = type;
      name = stream.readString();
      age = stream.readInt();
   }

   public void writeSQL (SQLOutput stream) throws SQLException
   {
      stream.writeString(name);
      stream.writeInt(age);
   }
}
```

Nested named row example

To use ClassGenerator for a nested row, you first create the named row on the database server:

```
create row type manager (emp employee, salary int);
```

Next, run ClassGenerator. In this case, the `setup.std` file is not consulted, because you provide all the needed information at the command line:

```
java ClassGenerator manager -c Manager -u "jdbc:davinci:1528/test:user=scott;
password=tiger;ONEDB_SERVER=picasso_ius"
```

The **-c** option defines the Java™ class you are creating, which is **Manager** (with uppercase M).

The preceding command generates the following Java™ class:

```
import java.sql.*;
import java.math.*;
public class Manager implements SQLData
{
   public employee emp;
   public int salary;
   private String sql_type;

   public String getSQLTypeName() { return "manager"; }

   public void readSQL (SQLInput stream, String type) throws
      SQLException
   {
      sql_type = type;
      emp = (employee)stream.readObject();
      salary = stream.readInt();
   }

   public void writeSQL (SQLOutput stream) throws SQLException
   {
      stream.writeObject(emp);
      stream.writeInt(salary);
   }
}
```

Type cache information

When objects of some data types insert data into columns of certain other data types, HCL OneDB™ JDBC Driver verifies that the data provided matches the data the database server expects by calling the SQLData.getSQLTypeName() method. The driver asks the database server for the type information with each insertion.

This occurs in the following cases:

- When an **SQLData** object inserts data into an opaque type column and getSQLTypeName() returns the name of the opaque type
- When a **Struct** or **SQLData** object inserts data into a row column and getSQLTypeName() returns the name of a named row
- When an **SQLData** object inserts data into a DISTINCT type column.

By default the driver will cache the data type information the first time it is retrieved. The driver then asks the cache for the type information before requesting the data from the database server.

In the database URL, you can set the property **udtCache**`=false` to disable the cache.

Smart large object data types

A smart large object is a large object with the following features:

- A smart large object can hold a very large amount of data.

  Currently, a single smart large object can hold up to four terabytes of data. This data is stored in a separate disk space called an sbspace.
- A smart large object is recoverable.

  The database server can log changes to smart large objects and therefore can recover smart-large-object data in the event of a system or hardware failure. Logging of smart large objects is not the default behavior.
- A smart large object supports random access to its data.

Access to a simple large object (BYTE or TEXT) is on an “all or nothing basis; that is, the database server returns all of the simple large-object data that you request at one time. With smart large objects, you can seek to a desired location and read or write the desired number of bytes.

- You can customize storage characteristics of a smart large object.

  When you create a smart large object, you can specify storage characteristics for the smart large object such as:
    - Whether the database server logs the smart large object in accordance with the current database log mode
    - Whether the database server keeps track of the last time the smart large object was accessed
    - Whether the database server uses page headers to detect data corruption

Smart large objects are stored in the database as BLOB and CLOB data types, which you can access in two ways:

- In HCL OneDB™ JDBC Driver 3.0, and later, and HCL OneDB™ servers that support smart large object data types, you can use the standard JDBC API methods described in the JDBC 3.0 specifications. This is the simpler approach.

  The following JDBC 3.0 methods for BLOB and CLOB internal update have already been implemented in previous releases:

  ```
  int setBytes(long, byte[]) throws SQLException
  ```

  ```
  void truncate(long) throws SQLException
  ```

  The following JDBC 3.0 methods from the BLOB interface are implemented in HCL OneDB™ JDBC Driver, Version 3.0, or later:

  ```
  OutputStream setBinaryStream(long) throws SQLException
  ```

  ```
  int setBytes(long, byte[], int, int) throws SQLException
  ```

  The following JDBC 3.0 methods from the CLOB interface are implemented in HCL OneDB™ JDBC Driver, Version 3.0, or later:

  ```
  OutputStream setAsciiStream(long) throws SQLException
  Writer setCharacterStream(long) throws SQLException
  ```

  ```
  int setString(long, String) throws SQLException
  ```

  ```
  int setString(long, String, int, int) throws SQLException
  ```

- You can use HCL OneDB™ extensions that are based on smart-large-object support within . This approach offers more options.

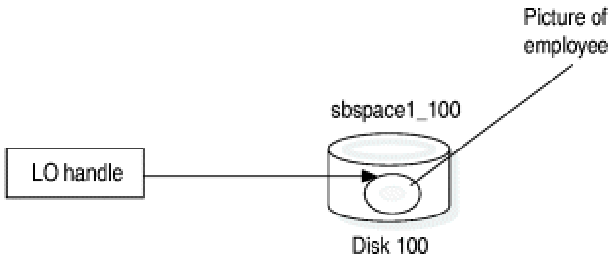
Smart large objects in the database server

In the database server, a smart large object has two parts:

- The data, which is stored in an *sbspace*
- A *large-object handle*, known as an *LO handle*, which identifies the location of the smart-large-object data in its sbspace

Suppose you store the picture of an employee as a smart large object. The following figure shows how the LO handle contains information about the location of the actual employee picture in the **sbspace1_100** sbspace.

Figure 1. Smart large object in the database server



In the figure, the sbspace holds the actual employee image that the LO handle identifies. For more information about the structure of an sbspace, and the onspaces database utility that creates and drops sbspaces, see the *HCL OneDB™ Administrator's Guide*.

Important: Smart large objects can only be stored in sbspaces. You must create an sbspace before you attempt to insert smart large objects into the database.

Because a smart large object is potentially very large, the database server stores only its LO handle in a database table; it can then use this handle to find the actual data of the smart large object in the sbspace. This arrangement minimizes the table size.

Applications obtain the LO handle from the database and use it to locate the smart-large-object data and to open the smart large object for read and write operations.

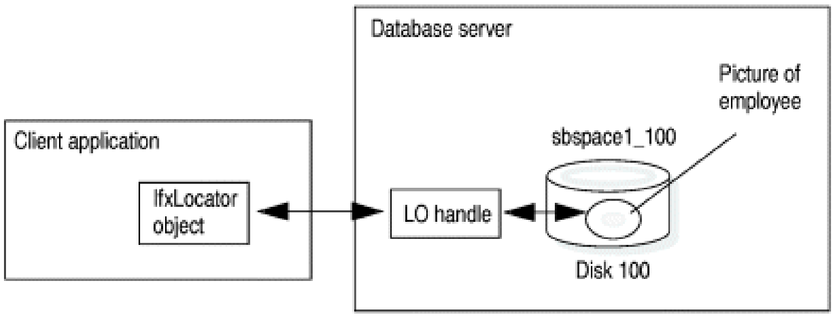
Smart large objects in a client application

On the client, your JDBC application can use **ResultSet** methods to access smart-large-object data, such as:

- getClob() and getAsciiStream() for CLOB data
- getBlob() and getBinaryStream() for BLOB data
- getString() for both CLOB and BLOB data

On the client side, the JDBC driver references the LO handle through an **IfxLocator** object. Your JDBC application obtains an instance of the **IfxLocator** class to contain the smart-large-object locator handle, as shown in the following figure. Your application creates a smart large object independently and then inserts the smart large object into different columns, even in multiple tables. Using multiple threads, an application can write or read data from various portions of the smart large object in parallel, which is very efficient.

Figure 2. Locating a smart large object In a client application



In , support for HCL OneDB™ smart large object data types is available only with 9.x and later versions of the database server.

Creating smart large objects

About this task

The smart large object implementation is based on the following classes:

- **IfxLobDescriptor** stores attributes for the large object.
- **IfxLocator** contains the handle to the large object in the database server.
- **IfxSmartBlob** contains methods for working with the smart large object, such as positioning within the object, reading data from the object, and writing data to the object.
- **IfxBblob** and **IfxCblob** implement the **java.sql.Blob** and **java.sql.Clob** interfaces from the JDBC 3.0 specification.
- **IfxLoStat** stores status information about the large object.

Tip: This section describes how to use the HCL OneDB™ smart-large-object interface, but it does not currently document every method and parameter in the interface. For a comprehensive reference to all the methods in the interface and their parameters, see the javadoc files for HCL OneDB™ JDBC Driver, located in the `doc/javadoc` directory where your driver is installed.

To create a smart large object:

1. For a new smart large object, ensure that the smart large object has an sbspace specified for its data.

   For detailed documentation about the onspaces utility that creates sbspaces, see the *HCL OneDB™ Administrator's Guide*. For an example of creating an sbspace, see Example of setting sbspace characteristics on page 122.
2. Create an **IfxLobDescriptor** object.

   This allows you to set storage characteristics for the smart large object. The driver passes the **IfxLobDescriptor** object to the database server when the IfxSmartBlob.IfxLoCreate() method creates the large object.
3. If desired, call methods in the **IfxLobDescriptor** object to specify storage characteristics.

   For most smart large objects, the sbspace name is the only storage characteristic that you need to specify. The database server can calculate values for all other storage characteristics. You can set particular storage characteristics to override these calculated values. However, most applications do not need to set storage characteristics at this level of detail. For more information, see Work with storage characteristics on page 119.

4. Create an **IfxLocator** object.

   This is the pointer to the smart large object on the client.

5. Create an **IfxSmartBlob** object.

   This lets you perform various common operations on the smart large object.

6. Execute the IfxSmartBlob.IfxLoCreate() method to create the large object in the database server.

   IfxLoCreate() takes the **IfxLocator** and **IfxLobDescriptor** objects as parameters to identify the smart large object in the database server.

7. Execute IfxSmartBlob.IfxLoWrite() to write data to the smart large object in the database server.
8. Execute additional **IfxSmartBlob** methods to position within the object, read from the object, and so forth.
9. Execute IfxSmartBlob.IfxLoClose() to close the large object.
10. Insert the smart large object into the database (see Inserting a smart large object into a column on page 113).
11. Execute IfxSmartBlob.IfxLoRelease() to release the locator pointer.

Create an IfxLobDescriptor object

The **IfxLobDescriptor** class stores the internal storage characteristics for a smart large object. Before you can create a smart large object on the database server, you must create an **IfxLobDescriptor** object, as follows:

```
IfxLobDescriptor loDesc = new IfxLobDescriptor(conn);
```

The *conn* parameter is a **java.sql.Connection** object. The IfxLobDescriptor() constructor sets all the default values for the object.

For more information about the internal storage characteristics, see Work with storage characteristics on page 119.

Create an IfxLocator object

The **IfxLocator** object (usually known as the *locator pointer* or *large object locator*) identifies the location of the smart large object, as shown in Figure 2: Locating a smart large object In a client application on page 108; the locator pointer is the communication link between the database server and the client for a particular large object. Before it creates a large object or opens a large object for reading or writing, an application must create an **IfxLocator** object:

```
IfxLocator loPtr = new IfxLocator();
IfxLocator loPtr = new IfxLocator(Connection conn);
```

Use the second of these constructors to display localized error messages if an exception is thrown. For more information, see Support for globalized error messages on page 191.

Create an IfxSmartBlob object

To create a smart large object and obtain access to the methods for performing operations on the object, call the **IfxSmartBlob** constructor, passing a reference to the JDBC connection:

```
IfxSmartBlob smb = new IfxSmartBlob(myConn)
```

Once you have written all the methods that perform operations you need in the smart large object, you can then use the IfxSmartBlob.IfxLoCreate() method to create the large object in the database server and open it for access within your application. The method signature is as follows:

```
public int  IfxLoCreate(IfxLobDescriptor loDesc, int flag,
   IfxLocator loPtr) throws SQLException
public int  IfxLoCreate(IfxLobDescriptor loDesc, int flag,
   IfxBblob blob)throws SQLException
public int  IfxLoCreate(IfxLobDescriptor loDesc, int flag,
   IfxCblob clob throws SQLException
```

The return value is the locator handle, which you can use in subsequent read, write, seek, and close methods (you can pass it as the locator file descriptor (*lofd)* parameter to the methods that operate on open smart large objects; these methods are described beginning with Position within a smart large object on page 115).

The *flag* parameter is an integer value that specifies the access mode in which the new smart large object is opened in the server. The access mode determines which read and write operations are valid on the open smart large object. If you do not specify a value, the object is opened in read-only mode.

Use the access mode *flag* values in the following table with the IfxLoCreate() and IfxLoOpen() methods to open or create smart large objects with specific access modes.

Access mode	**Purpose**	**Flag value in IfxSmartBlob**
Read only	Allows read operations only	LO_RDONLY
Write only	Allows write operations only	LO_WRONLY
Write/Append	Appends data you write to the end of the smart large object By itself, it is equivalent to write-only mode followed by a seek to the end of the smart large object. Read operations fail. When you open a smart large object in write/append mode only, the smart large object is opened in write-only mode. Seek operations move the seek position, but read operations to the smart large object fail, and the seek position remains unchanged from its position just before the write. Write operations occur at the seek position, and then the seek position is moved.	LO_APPEND
Read/Write	Allows read and write operations	LO_RDWR

The following example shows how to use a LO_RDWR *flag* value:

```
IfxSmartBlob smb = new IfxSmartBlob(myConn);
int loFd = smb.IfxLoCreate(loDesc, smb.LO_RDWR, loPtr);
```

The **loDesc** and **loPtr** objects are previously created **IfxLobDescriptor** and **IfxLocator** objects, respectively.

The database server uses the following system defaults when it opens a smart large object.

Open-mode information

Default open mode

Access mode

Read-only

Access method

Random

Buffering

Buffered access

Locking

Whole-object locks

For more information about locking, see Work with locks on page 130.

The following table provides the full set of open-mode flags:

Open-mode flag	Description
LO_APPEND	Appends data you write to the end of the smart large object By itself, it is equivalent to write-only mode followed by a seek to the end of the smart large object. Read operations fail. When you open a smart large object in write/append mode only, the smart large object is opened in write-only mode. Seek operations move the seek position, but read operations to the smart large object fail, and the seek position remains unchanged from its position just before the write. Write operations occur at the seek position, and then the seek position is moved.
LO_WRONLY	Allows write operations only
LO_RDONLY	Allows read operations only

Open-mode flag	Description
LO_RDWR	Allows read and write operations
LO_DIRTY_READ	For open only Allows you to read uncommitted data pages for the smart large object You cannot write to a smart large object after you set the mode to LO_DIRTY_READ. When you set this flag, you reset the current transaction isolation mode to Dirty Read for the smart large object. Do not base updates on data that you obtain from a smart large object in Dirty Read mode.
LO_RANDOM	Overrides optimizer decision Indicates that I/O is random and that the database server should not read ahead. Default open mode.
LO_SEQUENTIAL	Overrides optimizer decision Indicates that reads are sequential in either forward or reverse direction.
LO_FORWARD	Used only for sequential access to indicate forward direction
LO_REVERSE	Used only for sequential access to indicate reverse direction
LO_BUFFER	Use standard database server buffer pool.
LO_NOBUFFER	Do not use the standard database server buffer pool. Use private buffers from the session pool of the database server.
LO_NODIRTY_READ	Do not allow dirty reads on smart large object. See LO_DIRTY_READ flag for more information.

Open-mode flag	Description
LO_LOCKALL	Specifies that locking will occur on entire smart large object
LO_LOCKRANGE	Specifies that locking will occur for a range of bytes You specify the range of bytes through the IfxSmartBlob.IfxLoLock() method when you place the lock.

Inserting a smart large object into a column

About this task

After creating a smart large object, you must insert it into a BLOB or CLOB column to save it in the database. To do this, you must convert the **IfxLocator** object to an **IfxBblob** or **IfxCblob** object, depending upon the column type.

To insert a smart large object into a BLOB or CLOB column:

1. Create an **IfxBblob** or **IfxCblob** object, as follows:

   ```
   IfxBblob blb = new IfxBblob(loPtr);
   ```

   The *loPtr* parameter is an **IfxLocator** object obtained from one of the previous sets of steps.
2. Use the PreparedStatement.setBlob() or setClob() method to insert the object into the column.

Results

Important: The sbspace for the smart large object must exist in the database server before the insertion executes.

Accessing smart large objects

About this task

Follow these steps to use the HCL OneDB™ extensions to select a smart large object from a database column.

To access a smart large object:

1. Cast the **java.sql.Blob** or **java.sql.Clob** object to an **IfxBblob** or **IfxCblob** object.
2. Use the IfxBblob.getLocator() or IfxCblob.getLocator() method to extract an **IfxLocator** object.
3. Create an **IfxSmartBlob** object.
4. Use the IfxSmartBlob.IfxLoOpen() method to open the smart large object.

5. Use the IfxSmartBlob.IfxLoRead() method to read the data from the smart large object.
6. Close the smart large object using the IfxSmartBlob.IfxLoClose() method.
7. Release the locator pointer in the server by calling the IfxSmartBlob.IfxLoRelease() method.

Results

Standard JDBC ResultSet methods such as ResultSet.getBinaryStream(), getAsciiStream(), getString(), getBytes(), getBlob(), and getClob() can fetch BLOB or CLOB data from a table. The HCL OneDB™ extension classes can then access the data.

Perform operations on smart large objects

In the database server, you can store a smart large object directly in a column that has one of the following data types:

- The CLOB data type holds text data.
- The BLOB data type can store any kind of binary data in an undifferentiated byte stream.

The CLOB or BLOB column holds an LO handle for the smart large object. Therefore, when you select a CLOB or BLOB column, you do not obtain the actual data of the smart large object, but the LO handle that identifies this data. Columns for smart large objects have a theoretical limit of 4 terabytes and a practical limit determined by your disk capacity.

You can use either of the following ways to store a smart large object in a column:

- For direct access to the smart large object, create a column of the CLOB or BLOB data type.
- To hide the smart large object within an atomic data type, create an opaque type that holds a smart large object.

In a client application, the **IfxBblob** and **IfxCblob** classes are bridges between the way of handling smart large object data described in the JDBC 3.0 specification and the HCL OneDB™ extensions. The **IfxBblob** class implements the **java.sql.Blob** interface, and the **IfxCblob** class implements the **java.sql.Clob** interface. The HCL OneDB™ extensions require an **IfxLocator** object to identify the smart large object in the database server.

When you query a table containing a column of type BLOB or CLOB, an object of type Blob or Clob is returned, depending upon the column type. You can then use the JDBC 3.0 supporting methods for objects of type Blob or Clob to access the smart large object.

The constructors create an **IfxBblob** or **IfxCblob** object from the **IfxLocator** object *loPtr*:

```
public IfxBblob(IfxLocator loPtr)
public IfxCblob(IfxLocator loPtr)
```

The following locator method returns an **IfxLocator** object from an **IfxBblob** or **IfxCblob** object. You can then open, read, and write to the smart large object using the IfxSmartBlob.IfxLoOpen(), IfxLoRead(), and IfxLoWrite() methods:

```
public IfxLocator getLocator() throws SQLException
```

Open a smart large object

The following methods in the **IfxSmartBlob** class open an existing smart large object in the database server:

```
public int IfxLoOpen(IfxLocator loPtr, int flag) throws
   SQLException
public int IfxLoOpen(IfxBblob blob, int flag) throws SQLException
public int IfxLoOpen(IfxCblob clob, int flag) throws SQLException
```

The first version opens the smart large object that is referenced by the locator pointer *loPtr*. The second and third versions open the smart large objects that are referenced by the specified **IfxBblob** and **IfxCblob** objects, respectively. The *flag* parameter is a value from the table in Create an IfxSmartBlob object on page 110.

Position within a smart large object

The IfxLoTell() method in the **IfxSmartBlob** class returns the current seek position, which is the offset for the next read or write operation on the smart large object. The IfxLoSeek() method in the **IfxSmartBlob** class sets the read or write position within an already opened large object.

```
public long       IfxLoTell(int lofd)
public long IfxLoSeek(int lofd, long offset, int whence) throws
   SQLException
```

The absolute position depends on the value of the second parameter, *offset*, and the value of the third parameter, *whence*.

The *lofd* parameter is the locator file descriptor returned by the IfxLoCreate() or IfxLoOpen() method. The *offset* parameter is an offset from the starting seek position.

The *whence* parameter identifies the starting seek position. Use the *whence* values in the following table to define the position within a smart large object to start a seek operation.

Starting seek position	Whence value
Beginning of the smart large object	IfxSmartBlob.LO_SEEK_SET
Current® location in the smart large object	IfxSmartBlob.LO_SEEK_CUR
End of the smart large object	IfxSmartBlob.LO_SEEK_END

The return value is a long integer representing the absolute position within the smart large object.

The following example shows how to use a LO_SEEK_SET *whence* value:

```
IfxLobDescriptor loDesc = new IfxLobDescriptor(myConn);
IfxLocator loPtr = new IfxLocator();
IfxSmartBlob smb = new IfxSmartBlob(myConn);
int loFd = smb.IfxLoCreate(loDesc, smb.LO_RDWR, loPtr);
int n = smb.IfxLoWrite(loFd, fin, fileLength);
smb.IfxLoClose(loFd);
loFd = smb.IfxLoOpen(loPtr, smb.LO_RDWR);
long m = smb.IfxLoSeek(loFd, 200, smb.LO_SEEK_SET);
```

The writing position is set at an offset of 200 bytes from the beginning of the smart large object.

Read data from a smart large object

You can read data from a smart large object in the following ways:

- Read the data from the object into a **byte[ ]** buffer.
- Read the data from the object into a file output stream.
- Read the data from the object into a file.

Use the IfxLoRead() method in the **IfxSmartBlob** class, which has the following signatures, to read from a smart large object into a buffer or file output stream:

```
public byte[] IfxLoRead(int lofd, int nbytes) throws SQLException
public int IfxLoRead(int lofd, byte[] buffer, int nbytes) throws
   SQLException
public int IfxLoRead(int lofd, FileOutputStream fout, int nbytes
   throws SQLException
public int IfxLoRead(int lofd, byte[] buffer, int nbytes, int
   offset throws SQLException
```

The *lofd* parameter is a locator file descriptor returned by the IfxLoRead() or IfxLoOpen() method.

The first version returns *nbytes* bytes of data into a byte buffer. This version of the method allocates the memory for the buffer. The second version reads *nbytes* bytes of data into an already allocated buffer. The third version reads *nbytes* bytes of data into a file output stream. The fourth version reads *nbytes* bytes of data into a byte buffer starting at the *current seek position plus offset* into the smart large object. The return values for the last three versions indicate the number of bytes read.

Use the IfxLoToFile() method in the **IfxSmartBlob** class, which has the following signatures, to read from a smart large object into a file:

```
public int IfxLoToFile(IfxLocator loPtr, String filename, int flag
   , int whence) throws SQLException
public int IfxLoToFile(IfxBblob blob, String filename, int flag ,
   int whence) throws SQLException
public int IfxLoToFile(IfxCblob clob, String filename, int flag ,
   int whence) throws SQLException
```

The first version reads the smart large object that is referenced by the locator pointer *loPtr*. The second and third versions read the smart large objects that are referenced by the specified **IfxBblob** and **IfxCblob** objects, respectively.

The *flag* parameter indicates whether the file is on the client or the server. The value is either `IfxSmartBlob.LO_CLIENT_FILE` or `IfxSmartBlob.LO_SERVER_FILE`. The *whence* parameter identifies the starting seek position. For the values, see Position within a smart large object on page 115.

Tip: There has been a change in the signature of the following function:

```
IfxSmartBlob.IfxLoToFile().
```

This function used to accept four parameters, but now only accepts three parameters. All three overloaded functions for IfxLoToFile() accept three parameters.

Write data to a smart large object

You can write data to a smart large object in the following ways:

- Write the data from a **byte[ ]** buffer to the object.
- Write the data from a file input stream to the object.
- Write the data from a file to the object.

Use the IfxLoWrite() methods in the **IfxSmartBlob** class to write to a smart large object from a **byte[ ]** buffer or file input stream:

```
public int IfxLoWrite(int lofd, byte[] buffer) throws SQLException
public int IfxLoWrite(int lofd, InputStream fin, int length)
   throws SQLException
```

The first version of the method writes *buffer.length* bytes of data from the buffer into the smart large object. The second version writes *length* bytes of data from an **InputStream** object into the smart large object.

The *lofd* parameter is a locator file descriptor returned by the IfxLoCreate() or IfxLoOpen() method. The *buffer* parameter is the **byte[]** buffer where the data is read. The *fin* parameter is the **InputStream** object from which data is written into the smart large object. The *length* parameter is the number of bytes written into the smart large object. The driver returns the number of bytes written.

Use the IfxLoFromFile() method in the **IfxSmartBlob** class to write data to a smart large object from a file:

```
public int IfxLoFromFile (int lofd, String filename, int flag, int
   offset, int amount) throws SQLException
```

The *lofd* parameter is a locator file descriptor returned by the IfxLoCreate() or IfxLoOpen() method. The *flag* parameter indicates whether the file is on the client or the server. The value is either `IfxSmartBlob.LO_CLIENT_FILE` or `IfxSmartBlob.LO_SERVER_FILE`.

The driver returns the number of bytes written.

Truncate a smart large object

Use the IfxLoTruncate() method in the **IfxSmartBlob** class to truncate a large object at an offset you specify. The method signature is as follows:

```
public void IfxLoTruncate(int lofd, long offset) throws
   SQLException
```

The *offset* parameter is the absolute position at which the smart large object is truncated.

Measure a smart large object

Use the IfxLoSize() method in the **IfxSmartBlob** class to return the size of a smart large object. This method returns a long integer representing the size of the large object.

The method signature is as follows:

```
public long IfxLoSize(int lofd) throws SQLException
```

Close and release a smart large object

After you have performed all the operations your application needs, you must close the object and then release the resources in the server. The methods in the **IfxSmartBlob** class that perform these tasks are as follows:

```
public void IfxLoClose(int lofd) throws SQLException
public void IfxLoRelease(IfxLocator loPtr) throws SQLException
public void IfxLoRelease(IfxBblob blob) throws SQLException
public void IfxLoRelease(IfxCblob clob) throws SQLException
```

For any further access to the same large object, you must reopen it with the IfxLoOpen() method.

Convert IfxLocator to a hexadecimal string

Some applications, for example, web browsers, can only process ASCII data; they require IfxLocator to be converted to hexadecimal string format. In a typical web-based application, the web server queries the database table and sends the results to the browser. Instead of sending the entire smart large object, the web server converts the locator into hexadecimal string format and sends it to the browser. If the user requests the browser to display the smart large object, the browser sends the locator in hexadecimal format back to the web server. The web server then reconstructs the binary locator from the hexadecimal string and sends the corresponding smart large object data to the browser.

To convert between the IfxLocator byte array and a hexadecimal number, use the methods listed in the following table.

Task performed	Method signature	Additional information
Converts a byte array to a hexadecimal character string	public static String toHexString(byte[] *byteBuf*);	Works on data other than IfxLocator Provided in the **com.informix.util.stringUtil** class
Converts a hexadecimal character string to a byte array	public static byte[] fromHexString(String *str*) throws NumberFormatException;	Works on data other than IfxLocator Provided in the **com.informix.util.stringUtil** class
Constructs an IfxLocator object using a byte array	public IfxLocator(byte[] *byteBuf*) throws SQLException;	Provided in the **IfxLocator** class
Converts an IfxLocator byte array to a hexadecimal character string	public String toString();	Provided in the **IfxLocator** class

Task performed	Method signature	Additional information
Converts a hexadecimal character string to an IfxLocator byte array	public byte[] toBytes();	Provided in the **IfxLocator** class

The following example uses the toString() and toBytes() methods to fetch the locator from a smart large object and then convert it into a hexadecimal string:

```
...

String hexLoc = "";
byte[] blobBytes;
byte[] rawLocA = null;
IfxLocator loc;
try
{
     ResultSet rs = stmt.executeQuery("select b1 from btab");
     while(rs.next())
     {
         IfxBblob b=(IfxBblob)rs.getBlob(1);
         loc =b.getLocator();
         hexLoc = loc.toString();
         rawLocA = loc.toBytes();
     }
}
catch(SQLException e)
{}
```

The following example uses the IfxLocator() method to construct an IfxLocator, which is then used to read a smart large object:

```
...

try
{
     IfxLocator loc2 = new IfxLocator(rawLoc);
     IfxSmartBlob b2 = new IfxSmartBlob((IfxConnection)myConn);
     int lofd = b2.IfxLoOpen(loc2, b2.LO_RDWR);
     blobBytes = b2.IfxLoRead(lofd, fileLength);
}
catch(SQLException e)
  {}
```

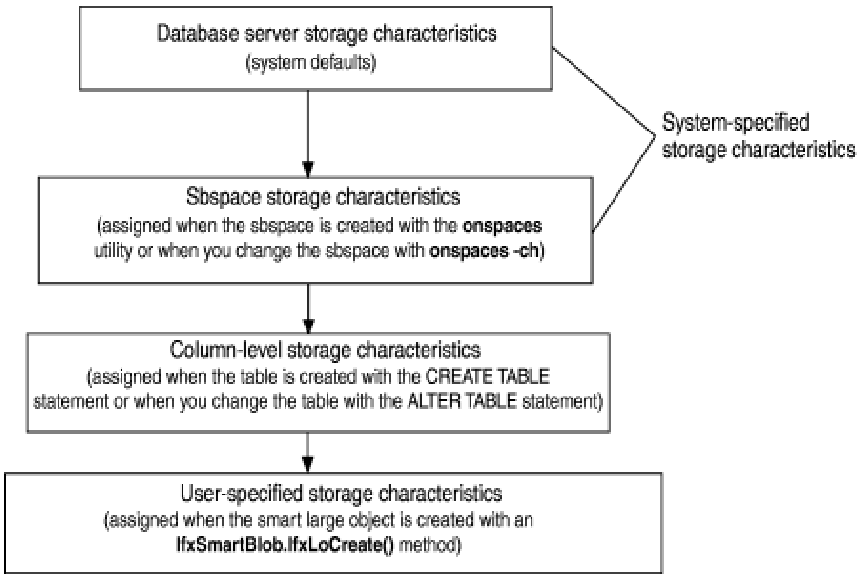
Work with storage characteristics

Storage characteristics tell the database server how to manage a smart large object. These characteristics include such areas as sizing, logging, locking, and open modes. You have the following options with respect to storage characteristics:

- Use the system-specified storage characteristics as a basis for obtaining the storage characteristics of a smart large object.
- Override the system defaults with one of the following:
    - Storage characteristics defined for a particular CLOB or BLOB column in which you want to store the smart large object
    - Storage characteristics that are unique to a particular CLOB or BLOB column called *column-level storage characteristics*
    - Special storage characteristics that you define for this smart large object only called *user-specified storage characteristics*

The database server uses a hierarchy, which the following figure shows, to obtain the storage characteristics for a new smart large object.

Figure 3. Storage-characteristics hierarchy


Database server storage characteristics
(system defaults)
System-specified storage characteristics
Sbspace storage characteristics
(assigned when the sbspace is created with the onspaces utility or when you change the sbspace with onspaces -ch)
Column-level storage characteristics
(assigned when the table is created with the CREATE TABLE statement or when you change the table with the ALTER TABLE statement)
User-specified storage characteristics
(assigned when the smart large object is created with an IfxSmartBlob.IfxLoCreate() method)

For a given storage characteristic, any value defined at the column level overrides the system-specified value, and any user-level value overrides the column-level value. You can specify storage characteristics at the three points shown in the following table.

When specified	How specified	For more information
When an sbspace is created	Options of onspaces utility	System-specified storage characteristics on page 121 *HCL OneDB™ Administrator's Guide*
When a database table is created	Keywords in PUT clause of CREATE TABLE statement	*HCL OneDB™ Guide to SQL: Syntax*
When a smart large object is created	Create flags and methods in the **ifxLobDescriptor** class	Set create flags on page 128

System-specified storage characteristics

The database administrator establishes system-specified storage characteristics when he or she initializes the database server and creates an sbspace with the onspaces utility, as follows:

- If the onspaces utility has specified a value for a particular storage characteristic, the database server uses the onspaces value as the system-specified storage characteristic.
- If the onspaces utility has not specified a value for a particular storage characteristic, the database server uses the system default as the system-specified storage characteristic.

The system-specified storage characteristics apply to all smart large objects that are stored in the sbspace, unless a smart large object specifically overrides them with column-level or user-specified storage characteristics.

For the storage characteristics that onspaces can set, as well as the system defaults, see Table 5: Specifying disk-storage information on page 124 and Table 6: Specifying attribute information on page 125.

For most applications, it is recommended that you use the system-specified default values for the storage characteristics. Note the following exceptions:

- Your application needs to obtain extra performance.

  You can use setXXX() methods in **ifxLobDescriptor** to change the disk-storage information of a new smart large object. For more information, see Set create flags on page 128.
- You want to use the storage characteristics of an existing smart large object.

  The IfxLoStat.getLobDescriptor() method can obtain the large-object descriptor of an open smart large object. You can then create a new object and use the IfxSmartBlob.ifxLoAlter() method to set its characteristics to the new descriptor. For more information, see Changing the storage characteristics on page 127.
- You are working with more than one smart large object and do not want to use the default sbspace.

  The DBA can specify a default sbspace name with the SBSPACENAME configuration parameter in the `onconfig` file. However, you must ensure that the location (the name of the sbspace) is correct for the smart large object that you create. If you do not specify an sbspace name for a new smart large object, the database server stores it in this default sbspace. This arrangement can lead to space constraints.
- If you know the size of the smart large object, specify this size in your application using the IfxLobDescriptor.setEstBytes() method instead of in the onspaces utility (system level) or the CREATE TABLE or the ALTER TABLE statement (column level).

Obtain information about storage characteristics

To obtain the column-level storage characteristics of a smart large object, your application can call the following method in the **IfxSmartBlob** class, passing the name of the column for the *colname* parameter:

```
IfxLobDescriptor IfxLoColInfo(java.lang.String colname) throws
   SQLException
```

Most applications only need to ensure correct storage characteristics for an sbspace name (the location of the smart large object). You can get information for this and other storage characteristics by calling the various getXXX() methods in the **ifxLobDescriptor** class before creating the **IfxSmartBlob** object. The following table summarizes the getXXX() methods.

Method signature in ifxLobDescriptor	Purpose
int getCreateFlags()	Obtains the create flags for the object
long getEstSize()	Obtains the estimated size, in bytes, of the object
int getExtSize()	Obtains the extent size of the object
long getMaxBytes()	Obtains the maximum size, in bytes, of the object
java.lang.String getSbspace()	Obtains the name of the sbspace in the database server in which the object is stored

Example of setting sbspace characteristics

The following call to the onspaces utility creates an sbspace called **sb1** in the **/dev/sbspace1** partition:

```
onspaces -c -S sb1 -p /dev/sbspace1 -o 500 -s 2000
   -Df "AVG_LO_SIZE=32"
```

The following table shows the resulting system-specified storage characteristics for all smart large objects in the **sb1** sbspace.

Table 4. System-specified storage characteristics for the sb1 sbspace

Disk-storage information	System-specified value	Specified by onspaces utility
Size of extent	Calculated by database server	System default
Size of next extent	Calculated by database server	System default
Minimum extent size	Calculated by database server	System default
Size of smart large object	32 kilobytes (database server uses as size estimate)	AVG_LO_SIZE
Maximum size of I/O block	Calculated by database server	System default
Name of sbspace	**sb1**	-S option
Logging	OFF	System default
Last-access time	OFF	System default

Work with disk-storage information

Disk-storage information helps the database server determine how to manage the smart large object most efficiently on disk.

Important: For most applications, use the values that the database server calculates for the disk-storage information. Methods provided in HCL OneDB™ JDBC Driver are intended for special situations.

This disk-storage information includes:

- Allocation-extent information:
    - Extent size:

      An *allocation extent* is a collection of contiguous bytes within an sbspace that the database server allocates to a smart large object at one time. The database server performs storage allocations for smart large objects in increments of the extent size.

      You can specify an extent size by calling the ifxLobDescriptor.setExtSize() method.
    - Next-extent size:

      The database server tries to allocate an extent as a single, contiguous region in a chunk. However, if no single extent is large enough, the database server must use multiple extents as necessary to satisfy the current write request. After the initial extent fills, the database server attempts to allocate another extent of contiguous disk space. This process is called *next-extent allocation*.

  For more information about extents, see the topics on disk structure and storage in the *HCL OneDB™ Administrator's Guide*.
- Sizing information:
    - Estimated number of bytes in a new smart large object
    - Maximum number of bytes to which the smart large object can grow

  To specify sizing information, you can use the setMaxBytes() and setEstBytes() methods in the **ifxLobDescriptor** class.

  If you know the size of the smart large object, specify this size using the setEstBytes() method. This is the best way to set the extent size because the database server can allocate the entire smart large object as one extent.
- Location:

  The name of the sbspace identifies the location at which to store the smart large object. To set this name, you can use the vifxLobDescriptor.setSbSpace() method.

The database server uses the disk-storage information to determine how best to size, allocate, and manage the extents of the sbspace. It can calculate all disk-storage information for a smart large object except the sbspace name.

The following table summarizes the ways to specify disk-storage information for a smart large object.

Table 5. Specifying disk-storage information

Disk-storage information	**System-specified storage characteristics**		**Column-level storage characteristics**	**User-specified storage characteristics**
	System default value	**Specified by onspaces utility**	**Specified by PUT clause of CREATE TABLE**	**Specified by the HCL OneDB™ JDBC Driver method**
Size of extent	Calculated by database server	EXTENT_SIZE	EXTENT SIZE	Yes
Size of next extent	Calculated by database server	NEXT_SIZE	No	No
Minimum extent size	4 kilobytes	MIN_EXT_SIZE	No	No
Size of smart large object	Calculated by database server	Average size of all smart large objects in sbspace: AVG_LO_SIZE	No	Estimated size of a particular smart large object Maximum size of a particular smart large object
Maximum size of I/O block	Calculated by database server	MAX_IO_SIZE	No	No
Name of sbspace	SBSPACENAME	-S *option*	Name of an existing sbspace in which a smart large object: IN clause	Yes

Work with logging, last-access time, and data integrity

Database administrators and applications can affect some additional smart-large-object attributes:

- Whether to log changes to the smart large object in the system log file
- Whether to save the last-access time for a smart large object
- How to format the pages in the sbspace of the smart large object

The following table summarizes how you can alter these attributes at the system, column, and application levels.

Table 6. Specifying attribute information

Attribute information	**System-specified storage characteristics default value**	**System-specified storage characteristics, specified by onspaces utility**	**Column-level storage characteristics, specified by PUT clause of CREATE TABLE**	**User-specified storage characteristics, specified by a JDBC driver method**
Logging	OFF	LOGGING	LOG, NO LOG	Yes
Last-access time	OFF	ACCESSTIME	KEEP ACCESS TIME, NO KEEP ACCESS TIME	Yes
Buffering mode	OFF	BUFFERING	No	No
Lock mode	Lock entire smart large object	LOCK_MODE	No	Yes
Data integrity	High integrity	No	HIGH INTEG, MODERATE INTEG	Yes

Logging

By default, the database server does not log the user data of a smart large object. You can control the logging behavior for a smart large object as part of its create flags. For more information, see Set create flags on page 128.

When a database performs logging, smart large objects might result in long transactions for the following reasons:

- Smart large objects can be very large, even several gigabytes in size.

  The amount of log storage needed to log user data can easily overflow the log.
- Smart large objects might be used in situations where data collection can be quite long.

  For example, if a smart large object holds low-quality audio recording, the amount of data collection might be modest but the recording session might be quite long.

A simple workaround is to divide a long transaction into multiple smaller transactions. However, if this solution is not acceptable, you can control when the database server performs logging of smart large objects. (Table 6: Specifying attribute information on page 125 shows how you can control the logging behavior for a smart large object.)

When logging is enabled, the database server logs changes to the user data of a smart large object. It performs this logging in accordance with the current database log mode.

For a database that is not ANSI compliant, the database server does not guarantee that log records that pertain to smart large object are flushed at transaction commit. However, the metadata is always restorable to an action-consistent state; that is, to a state that ensures no structural inconsistencies exist in the metadata (control information of the smart large object, such as reference counts).

An ANSI-compliant database uses unbuffered logging. When smart-large-object logging is enabled, all log records (metadata and user data) that pertain to smart large objects are flushed to the log at transaction commit. However, user data is not guaranteed to be flushed to its stable storage location at commit time.

When logging is disabled, the database server does not log changes to user data even if the database server logs other database changes. However, the database server always logs changes to the metadata. Therefore, the database server can still restore the metadata to an action-consistent state.

Important: Consider carefully whether to enable logging for a smart large object. The database server incurs considerable overhead to log smart large objects. You must also ensure that the system log file is large enough to hold the value of the smart large object. The logical log size must exceed the total amount of data that the database server logs while the update transaction is active.

Write your application so that any transactions with smart large objects that have potentially long updates do not cause other transactions to wait. Multiple transactions can access the same smart-large-object instance if the following conditions are satisfied:

- The transaction can access the database row that contains an LO handle for the smart large object.

  Multiple references can exist on the same smart large object if more than one column holds an LO handle for the same smart large object.
- Another transaction does not hold a conflicting lock on the smart large object.

  For more information about smart large object locks, see Work with locks on page 130.

The best update performance and fewest logical-log problems result when you disable the logging feature when you load a smart large object and re-enable it after the load operation completes. If logging is turned on, you might want to turn logging off before a bulk load and then perform a level-0 backup.

Last-access time

The last-access time of a smart large object is the system time at which the database server last read or wrote the smart large object. The last-access time records access to the user data and metadata of a smart large object. This system time is stored as number of seconds since January 1, 1970. The database server stores this last-access time in the metadata area of the sbspace.

By default, the database server does not save the last access time. You can specify saving the last-access time by setting the LO_KEEP_LASTACCESS_TIME create flag and calling the IfxLobDescriptor.setCreateFlags() method. For more information, see Set create flags on page 128.

The database server also tracks the last-modification time and the last change in status for a smart large object. For more information, see Work with status characteristics on page 129.

Important: Consider carefully whether to track last-access time for a smart large object. The database server incurs considerable overhead in logging and concurrency to maintain last-access times for smart large objects.

Data integrity

You can specify data integrity with the LO_HIGH_INTEG and LO_MODERATE_INTEG create flags, by calling the IfxLobDescriptor.setCreateFlags() method. For more information, see Set create flags on page 128.

An sbpage is the unit of allocation for smart large object data, which is stored in the user-data area of an sbspace. The structure of an sbpage in the sbspace determines how much data integrity the database server can provide. The database server uses the page header and trailer to detect incomplete writes and data corruption.

The database server supports the following levels of data integrity:

- High integrity tells the database server to use both a page header and a page trailer in each sbpage.
- Moderate integrity tells the database server to use only a page header in each sbpage.

Moderate integrity provides the following benefits:

- It eliminates an additional data copy operation that is necessary when an sbpage has page headers and page trailers.
- It preserves the user data alignments on pages because no page header and page trailer are present.

Moderate integrity might be useful for smart large objects that contain large amounts of audio or video data that is moved through the database server and that do not require a high data integrity. By default, the database server uses high integrity (page headers and page trailers) for sbspace pages. You can control the data integrity for a smart large object as part of its storage characteristics.

Important: Consider carefully whether to use moderate integrity for sbpages of a smart large object. Although moderate integrity takes less disk space per page, it also reduces the ability of the database server to recover information if disk errors occur.

For information about the structure of sbspace pages, see the *HCL OneDB™ Administrator's Guide*.

Changing the storage characteristics

About this task

The IfxLoAlter() methods in the **IfxSmartBlob** class let you change the storage characteristics of a smart large object.

To change smart-large-object characteristics:

1. Create a new large-object descriptor.
   Example
   For example:

```
IfxLobDescriptor loDesc = new IfxLobDescriptor(conn);
```

2. Call IfxLobDescriptor.setCreateFlags(), setEstBytes(), IfxLobDescriptor.setMaxBytes(), **setExtSize**, and setSbspace() to specify the new characteristics:

   ```
   public void setCreateFlags( int flags )
   public void setEstBytes(long estSize)
   public void setMaxBytes (long maxSize)
   public void setExtSize (long extSize)
   public void setSbspace(java.lang.String sbspacename)
   ```

   The *flag* parameter is a constant from Set create flags on page 128.

3. Call IfxLoAlter() to alter the existing smart large object to contain the new descriptor:

   ```
   public int IfxLoAlter(IfxLocator loPtr, IfxLobDescriptor loDesc)
      throws SQLException
   public int IfxLoAlter(IfxBblob blob, IfxLobDescriptor loDesc)
      throws SQLException
   public int IfxLoAlter(IfxCblob clob, IfxLobDescriptor loDesc)
      throws SQLException
   ```

Results

IfxLoAlter() obtains an exclusive lock in the server for the entire smart large object before it proceeds with the update. It holds this lock until the update completes.

Set create flags

You can change the following characteristics by calling the IfxLobDescriptor.setCreateFlags() method:

- Logging characteristics

  You can specify the LO_LOG or LO_ NOLOG constant.

  LO_LOG causes the server to follow the logging procedure used with the current database log for the corresponding smart large object. This option can generate large amounts of log traffic and increase the risk that the logical log fills up.

  Instead of full logging, you might turn off logging when you load the smart large object initially and then turn logging back on once the smart large object is loaded. If you use NO LOG, you can restore the smart-large-object metadata later to a state in which no structural inconsistencies exist. In most cases, no transaction inconsistencies will exist either, but that result is not guaranteed.

  For more usage details on logging, see Logging on page 125.

- Last-access time characteristics

  You can specify the LO_ KEEP_LASTACCESS_TIME or LO NOKEEP_LASTACCESS_TIME constant. LO_ KEEP_LASTACCESS_TIME records, in the smart-large-object metadata, the system time at which the corresponding smart large object was last read or written.

For more usage details on last-access time, see Last-access time on page 126.

- Whether to detect incomplete writes and data corruption by producing user-data pages with a page header and page trailer

  You can specify the LO_ HIGH_INTEG or LO_moderate_integ constant. LO_ HIGH_INTEG is the default data-integrity behavior.

  For more usage details on data integrity, see Data integrity on page 127.

The following example sets multiple flags:

```
loDesc.setCreateFlags
   (IfxSmartBlob.LO_LOG+IfxSmartBlob.LO_TEMP+...)
```

A parallel getXXX() method lets you obtain the current storage characteristics for the large object:

```
public int getCreateFlags()
```

For more detailed information about all of the characteristics, see the section describing the PUT clause for the CREATE TABLE statement, in the *HCL OneDB™ Guide to SQL: Syntax*.

Work with status characteristics

The **IfxLoStat** class stores some statistical information about a smart large object such as the size, last access time, last modified time, last status change, and so on. The following table shows the status information that you can obtain.

Table 7. Status information for a smart large object

Status information	Description
Last-access time	The time, in seconds, that the smart large object was last accessed This value is available only if the last-access time attribute is enabled for the smart large object. For more information, see Last-access time on page 126.
Last-change time	The time, in seconds, of the last change in status for the smart large object A change in status includes changes to metadata and user data (data updates and changes to the number of references). This system time is stored as number of seconds since January 1, 1970.
Last-modifi cation time	The time, in seconds, that the smart large object was last modified A modification includes only changes to user data (data updates). This system time is stored as the number of seconds since January 1, 1970. On some platforms, the last-modification time might also have a microseconds component, which can be obtained separately from the seconds component.

Table 7. Status information for a smart large object (continued)

Status information	Description
Size	The size, in bytes, of the smart large object
Storage characteristics	See Work with storage characteristics on page 119.

To obtain a reference to the status structure, call the following method in the **IfxSmartBlob** class:

```
IfxLoStat IfxLoGetStat(int lofd)
```

To obtain particular categories of status information, call the methods shown in the following table.

Table 8. Methods for obtaining status information

Status information	Method signature in ifxLoStat class
Last-access time	int getLastAccessTime()
Last-change time	int getLastStatusTime()
Last-modification time	int getLastModifyTimeM() - time in microseconds
	int getLastModifyTimeS() - time rounded to seconds
Size	int getSize()
Storage characteristics	ifxLobDescriptor getLobDescriptor()

Work with locks

To prevent simultaneous access to smart-large-object data, the database server obtains a lock on this data when you open the smart large object. This smart-large-object lock is distinct from the following kinds of locks:

- Row locks

  A lock on a smart large object does not lock the row in which the smart large object resides. However, if you retrieve a smart large object from a row and the row is still current, the database server might hold a row lock as well as a smart-large-object lock. Locks are held on the smart large object instead of on the row because many columns could be accessing the same smart-large-object data.
- Locks of different smart large objects in the same row of a table

  A lock on one smart large object does not affect other smart large objects in the row.

The following table shows the lock modes that a smart large object can support.

Table 9. Lock modes for a smart large object

Lock mode	**Purpose**	**Description**
Lock-all	Lock the entire smart large object	Indicates that lock requests apply to all data for the smart large object
Byte-range	Lock only specified portions of the smart large object	Indicates that lock requests apply only to the specified number of bytes of smart-large-object data

When the server opens a smart large object, it uses the following information to determine the lock mode of the smart large object:

- The access mode of the smart large object

  The database server obtains a lock as follows:

  - In *share mode*, when you open a smart large object for reading (read-only)
  - In *update mode*, when you open a smart large object for writing (write-only, read/write, write/append)

    When a write operation (or some other update) is actually performed on the smart large object, the server upgrades this lock to an *exclusive lock*.
- The isolation level of the current transaction

  If the database table has an isolation mode of Repeatable Read, the server does not release any locks that it obtains on a smart large object until the end of the transaction.

By default, the server chooses the lock-all lock mode.

The server retains the lock as follows:

- It holds share-mode locks and update locks (which have not yet been upgraded to exclusive locks) until one of the following events occurs:
  - The close of the smart large object
  - The end of the transaction
  - An explicit request to release the lock (for a byte-range lock only)
- It holds exclusive locks until the end of the transaction even if you close the smart large object.

When one of the preceding conditions occurs, the server releases the lock on the smart large object.

Important: You lose the lock at the end of a transaction even if the smart large object remains open. When the server detects that a smart large object has no active lock, it automatically obtains a new lock when the first access occurs to the smart large object. The lock that it obtains is based on the original access mode of the smart large object.

The server releases the lock when the current transaction terminates. However, the server obtains the lock again when the next function that needs a lock executes. If this behavior is undesirable, the server-side SQL application can use BEGIN WORK transaction blocks and place a COMMIT WORK or ROLLBACK WORK statement after the last statement that needs to use the lock.

Byte-range locking

By default, the database server uses whole lock-all locks when it needs to lock a smart large object. Lock-all locks are an "all or nothing" lock; that is, they lock the entire smart large object. When the database server obtains an exclusive lock, no other user can access the data of the smart large object as long as the lock is held.

If this locking is too restrictive for the concurrency requirements of your application, you can use byte-range locking instead of lock-all locking. With byte-range locking, you can specify the range of bytes to lock in the smart-large-object data. If other users access other portions of the data, they can still acquire their own byte-range lock.

Use the IfxLoLock() method in the **IfxSmartBlob** class to specify byte-range locking:

```
public long IfxLoLock(int lofd, long offset, int whence, long
   range, int lockmode) throws SQLException
```

To unlock a range of bytes in the object, use the IfxLoUnLock() method:

```
public long IfxLoUnLock( int lofd, long offset, int whence, long
   range) throws SQLException
```

The *lofd* parameter is the locator file descriptor returned by the IfxLoCreate() or IfxLoOpen() method. The *offset* parameter is an offset from the starting seek position. The *whence* parameter identifies the starting seek position. The values are described in the table in Position within a smart large object on page 115.

The *range* parameter indicates the number of bytes to lock or unlock within the smart large object. The *lockmode* parameter indicates what type of lock to create. The values can be either `IfxSmartBlob.LO_EXCLUSIVE_MODE` or `IfxSmartBlob.LO_SHARED_MODE.`

Cache large objects

Whenever an object of type BLOB, CLOB, text, or byte is fetched from the database server, the data is cached in client memory. If the size of the large object is bigger than the value in the **LOBCACHE** environment variable, the large object data is stored in a temporary file. For more information about the **LOBCACHE** variable, see Manage memory for large objects on page 196.

Avoid errors transferring large objects

The **IFX_LOB_XFERSIZE** environment variable is used to specify the number of bytes in a CLOB or BLOB to transfer from a client application to the database server before checking whether an error has occurred. The error check occurs each time the specified number of bytes is transferred. If an error occurs, the remaining data is not sent and an error is reported. If no error occurs, the file transfer will continue until it finishes.

For example, if the value of **IFX_LOB_XFERSIZE** is set to 10485760 (10 MB), then error checking will occur after every 10485760 bytes of the CLOB or BLOB is sent. If the **IFX_LOB_XFERSIZE** environment variable is not set, the error check occurs after the entire BLOB or CLOB is transferred.

The valid range for the **IFX_LOB_XFERSIZE** environment variable is from 1 to 9223372036854775808 bytes. The **IFX_LOB_XFERSIZE** environment variable is set on the client.

You should adjust the value of **IFX_LOB_XFERSIZE** to suit your environment. Set the **IFX_LOB_XFERSIZE** environment variable low enough so that transmission errors of large BLOB or CLOB data types are detected early, but not so low that excessive network resources are consumed.

Smart large object examples

The following examples illustrate some of the tasks discussed in this section.

Create a smart large object

This example illustrates the steps shown in Creating smart large objects on page 108.

```
file = new File("data.dat");
FileInputStream fin = new FileInputStream(file);

byte[] buffer = new byte[200];;

IfxLobDescriptor loDesc = new IfxLobDescriptor(myConn);
IfxLocator loPtr = new IfxLocator();
IfxSmartBlob smb = new IfxSmartBlob(myConn);

// Now create the large object in server. Read the data from the
   file
// data.dat and write to the large object.
int loFd = smb.IfxLoCreate(loDesc, smb.LO_RDWR, loPtr);
System.out.println("A smart-blob is created ");
int n = fin.read(buffer);
if (n > 0)
n = smb.IfxLoWrite(loFd, buffer);
System.out.println("Wrote: " + n +" bytes into it");

// Close the large object and release the locator.
smb.IfxLoClose(loFd);
System.out.println("Smart-blob is closed " );
smb.IfxLoRelease(loPtr);
System.out.println("Smart Blob Locator is released ");
```

The contents of the file `data.dat` are written to the smart large object.

Insert data into a smart large object

The following code inserts data into a smart large object:

```
String s = "insert into large_tab (col1, col2) values (?,?)";
pstmt = myConn.prepareStatement(s);

file = new File("data.dat");
FileInputStream fin = new FileInputStream(file);

byte[] buffer = new byte[200];;

IfxLobDescriptor loDesc = new IfxLobDescriptor(myConn);
IfxLocator loPtr = new IfxLocator();
IfxSmartBlob smb = new IfxSmartBlob(myConn);

// Create a smart large object in server
int loFd = smb.IfxLoCreate(loDesc, smb.LO_RDWR, loPtr);
System.out.println("A smart-blob has been created ");
int n = fin.read(buffer);
if (n > 0)
n = smb.IfxLoWrite(loFd, buffer);
smb.IfxLoClose(loFd);

System.out.println("Wrote: " + n +" bytes into it");
System.out.println("Smart-blob is closed " );

Blob blb = new IfxBblob(loPtr);
pstmt.setInt(1, 2);  // set the Integer column
pstmt.setBlob(2, blb); // set the blob column
pstmt.executeUpdate();
System.out.println("Binding of smart large object to table is
   done");

pstmt.close();
smb.IfxLoRelease(loPtr);
System.out.println("Smart Blob Locator is released ");
```

The contents of the file `data.dat` are written to the BLOB column of the **large_tab** table.

Retrieve data from a smart large object

The example in this topic illustrates the steps in Accessing smart large objects on page 113.

The following code example shows how to access the smart large object data using HCL OneDB™ extension classes:

```
byte[] buffer  = new byte[200];
System.out.println("Reading data now ...");
try
   {
   int row = 0;
   Statement stmt = myConn.createStatement();
   ResultSet rs =  stmt.executeQuery("Select * from demo_14");
   while( rs.next() )
      {
      row++;
      String str = rs.getString(1);
      InputStream value = rs.getAsciiStream(2);
      IfxBblob b = (IfxBblob) rs.getBlob(2);
      IfxLocator loPtr = b.getLocator();
      IfxSmartBlob smb = new IfxSmartBlob(myConn);
      int loFd = smb.IfxLoOpen(loPtr, smb.LO_RDONLY);

      System.out.println("The Smart Blob is Opened for reading ..");
      int number = smb.IfxLoRead(loFd, buffer, buffer.length);
      System.out.println("Read total " + number  + " bytes");
      smb.IfxLoClose(loFd);
      System.out.println("Closed the Smart Blob ..");
      smb.IfxLoRelease(loPtr);
      System.out.println("Locator is released ..");
      }
   rs.close();
   }
catch(SQLException e)
   {
   System.out.println("Select Failed ...\n" +e.getMessage());
         }
```

First, the ResultSet.getBlob() method gets an object of type BLOB. The casting is required to convert the returned object to an object of type **IfxBblob**. Next, the IfxBblob.getLocator() method gets an **IfxLocator** object from the **IfxBblob** object. After the **IfxLocator** object is available, you can instantiate an **IfxSmartBlob** object and use the IfxLoOpen() and IfxLoRead() methods to read the smart large object data. Fetching **CLOB** data is similar, but it uses the methods ResultSet.getClob(), IfxCblob.getLocator(), and so on.

If you use getBlob() or getClob() to fetch data from a column of type BLOB, you do not need to use the HCL OneDB™ extensions to retrieve the actual BLOB content as outlined in the preceding sample code. You can simply use Java.Blob.getBinaryStream() or Java.Clob.getAsciiStream() to retrieve the content. HCL OneDB™ JDBC Driver implicitly gets the content from the database server for you, using basically the same steps as the sample code. This approach is simpler than the approach of the preceding example but does not provide as many options for reading the contents of the BLOB column.

Work with opaque types

An *opaque data type* is an atomic data type that you define to extend the database server. The database server has no information about the opaque data type until you provide routines that describe it.

Extending the database server also frequently requires that you create *user-defined routines* (UDRs) to support the extensions. A UDR is a routine that you create that can be invoked in an SQL statement, by the database server, or from another UDR. UDRs can be part of opaque types, or they can be separate.

The JDBC 3.0 standard provides the java.sql.SQLInput and java.sql.SQLOutput methods to access opaque types. The definition of these interfaces is extended to fully support HCL OneDB™ fixed binary and variable binary opaque types. This extension includes the following interfaces:

- **IfmxUdtSQLInput**
- **IfmxUdtSQLOutput**

In addition, the following classes simplify creating Java™ opaque types and UDRs in the database server from a JDBC client application:

- **UDTManager**
- **UDTMetaData**
- **UDRManager**
- **UDRMetaData**

The **UDTManager** and **UDRManager** classes provide an infrastructure for mapping client-side Java™ classes as opaque data types and UDRs and storing their instances in the database.

This facility works only in client-side JDBC. For details about the features and limitations of server-side JDBC, see the *HCL® J/Foundation Developer's Guide*.

For detailed information about opaque types and UDRs, see the following publications:

- *HCL OneDB™ User-Defined Routines and Data Types Developer's Guide* discusses the terms and concepts about opaque types and UDRs that you need to use the information in this section, including the internal data structure, support functions, and implicit and explicit casts.
- The *HCL® J/Foundation Developer's Guide* discusses information specific to writing UDRs in Java™.

The IfmxUDTSQLInput interface

The **com.informix.jdbc.IfmxUdtSQLInput** interface extends **java.sql.SQLInput** with several added methods. To use these methods, you must cast the **SQLInput** references to **IfmxUdtSQLInput**. The methods allow you to perform the following functions:

- Read data.
- Position in the data stream.
- Set or obtain attributes of the data.

Read data

The readString() method reads the next attribute in the stream as a Java™ string. The readBytes() method reads the next attribute in the stream as a Java™ byte array. Both methods are similar to the SQLInput.readBytes() method except that a fixed length of data is read in:

```
public String readString(int maxlen) throws SQLException;
public byte[] readBytes(int maxlen) throws SQLException;
```

In both methods, you must supply a length for HCL OneDB™ JDBC Driver to read the next attribute properly, because the characteristics of the opaque type are unknown to the driver. The *maxlen* parameter specifies the maximum length of data to read in.

Position in the data stream

The getCurrentPosition() method retrieves the current position in the input stream. The setCurrentPosition() method changes the position in the input stream to the position specified by the *position* parameter:

```
public int getCurrentPosition();
public void setCurrentPosition(int position) throws SQLException;
public void skipBytes(int len) throws SQLException;
```

The *position* parameter must be a positive integer. The skipBytes() method changes the position in the input stream by the number of bytes specified by the *len* parameter, relative to the current position. The *len* parameter must be a positive integer.

In both setCurrentPosition() and skipBytes(), HCL OneDB™ JDBC Driver generates an **SQLException** if the new position specified is after the end of the input stream.

Set or obtain data attributes

The length() method returns the total length of the entire data stream. The getAutoAlignment() method retrieves the `TRUE` or `FALSE` (on or off) state of the auto alignment feature. The setAutoAlignment() method sets the state to `TRUE` or `FALSE`:

```
public int length();
public boolean getAutoAlignment();
public void setAutoAlignment(boolean value);
```

Important: Setting the auto alignment feature might result in discarded bytes from the input stream if the data is not already aligned. JDBC applications should provide aligned data or set the auto alignment feature to `FALSE`.

The IfmxUDTSQLOutput interface

The **com.informix.jdbc.IfmxUdtSQLOutput** interface extends **java.sql.SQLOutput** with the following added methods:

```
public void writeString(String str, int length) throws
   SQLException;
public void writeBytes(byte[] b, int length) throws SQLException;
```

To use these methods, you must cast the **SQLOutput** references to **IfmxUdtSQLOutput**.

Use the writeString() method to write the next attribute to the stream as a Java™ string. If the string passed in is shorter than the specified length, HCL OneDB™ JDBC Driver pads the string with zeros.

Use the writeBytes() method to write the next attribute to the stream as a Java™ byte array.

Both methods are similar to the SQLOutput.writeBytes() method except that a fixed length of data is written to the stream. If the array or string passed in is shorter than the specified length, HCL OneDB™ JDBC Driver pads the array or string with zeros. In both methods, you must supply a length for HCL OneDB™ JDBC Driver to write the next attribute properly, because the opaque type is unknown to the driver.

Map opaque data types

opaque types map to Java™ objects, which must implement the **java.sql.SQLData** interface. These Java™ objects describe all the data members that make up the opaque type. These Java™ objects are strongly typed; that is, each read or write method in the **readSQL** or **writeSQL** method of the Java™ object must match the corresponding data member in the opaque type definition.HCL OneDB™ JDBC Driver cannot perform any type conversion because the type structure is unknown to it.

HCL OneDB™ JDBC Driver also requires that all opaque data be transported as HCL OneDB™ DataBlade® API data types, as defined in `mitypes.h` (this file is included in all installations). All opaque data is stored in the database server table in a C struct, which is made up of various DataBlade® API types, as defined in the opaque type.

You do not need to handle mapping between Java™ and C if you use the UDT and UDR Manager facility to create opaque types. For more information, see Creating opaque types and UDRs on page 139.

Type cache information

When objects of some data types insert data into columns of certain other data types, HCL OneDB™ JDBC Driver verifies that the data provided matches the data the database server expects by calling the SQLData.getSQLTypeName() method. The driver asks the database server for the type information with each insertion.

This occurs in the following cases:

- When an **SQLData** object inserts data into an opaque type column and getSQLTypeName() returns the name of the opaque type
- When a **Struct** or **SQLData** object inserts data into a row column and getSQLTypeName() returns the name of a named row
- When an **SQLData** object inserts data into a DISTINCT type column,

In the database URL, you can set the environment variable **ENABLE_TYPE_CACHE**`=TRUE` to have the driver cache the data type information the first time it is retrieved. The driver then asks the cache for the type information before requesting the data from the database server.

Unsupported methods

The following methods of the **SQLInput** and **SQLOutput** interfaces are not supported for opaque types:

- **java.sql.SQLInput**
    - readAsciiStream()
    - readBinaryStream()
    - readBytes()
    - readCharacterStream()
    - readObject()

    - readRef()
    - readString()
- **java.sql.SQLOutput**
    - writeAsciiStream(InputStream x)
    - writeBinaryStream(InputStream x)
    - writeBytes(byte[] x)
    - writeCharacterStream(Reader x)
    - writeObject(Object x)
    - writeRef(Ref x)
    - writeString(String x)

Creating opaque types and UDRs

About this task

The **UDTManager** and **UDRManager** classes allow you to easily create and deploy opaque types and user-defined routines (UDRs) in the database server.

Before using the information in this section, read the following two additional publications:

- For information about configuring your system to support Java™ UDRs, see the *HCL® J/Foundation Developer's Guide*.
- For detailed information about developing opaque types, see *HCL OneDB™ User-Defined Routines and Data Types Developer's Guide*.

Overview of creating opaque types and UDRs

In the database server, any Java™ class that implements the **java.sql.SQLData** interface and is accessible to the Java™ Virtual Machine can be stored as an opaque type. The **UDTManager** and **UDRManager** classes, together with their supporting **UDTMetaData** and **UDRMetaData** classes, extend this facility to client applications: your Java™ client application can use these classes to create opaque types and user-defined routines and transfer their class definitions to the database server. The client does not need to be accessible to the database server to use this functionality.

Important: This functionality is tightly coupled with server support for creating and using Java™ opaque types and user-defined routines. Any limitations on using Java™ opaque types and user-defined routines that exist in your version of the database server apply equally to Java™ opaque types and routines you create in your client applications.

When you use the **UDTManager** and **UDTMetaData** classes, HCL OneDB™ JDBC Driver performs all of the following actions for your application:

1. Obtains the JAR file you specify
2. Transports the JAR file from the client local area to the server local area

You define the server local area using the UDTManager.setJarFileTmpPath() method. The default is `/tmp` on UNIX™ systems and `C:\temp` on Windows™ systems.

3. Installs the JAR file in the server
4. Registers the opaque data type in the database with the CREATE OPAQUE TYPE SQL statement, taking input from the **UDTMetaData** class
5. Registers the support functions and casts you provide for the opaque type using the CREATE Function and CREATE CAST SQL statements

   You define support functions and casts using the setSupportUDR() and setXXXCast() methods in the **UDTMetaData** class.

   If you do not provide input and output functions for the opaque type, the driver registers the default functions (see the release notes for any limitations on this feature).
6. Registers any other nonsupport routines or casts (if any) that you specified, taking input from the UDTMetaData.setUDR() and UDTMetaData.setXXXCast() method calls in your application
7. Creates a mapping between an SQL OPAQUE type and a Java™ object (using the sqlj.setUDTExtName() method)

When you use the **UDRManager** and **UDRMetaData** classes, HCL OneDB™ JDBC Driver performs the following actions:

1. Obtains the JAR file you specify
2. Transports the JAR file from the client local area to the server local area
3. Installs the JAR file in the server
4. Registers the UDRs in the database with the CREATE FUNCTION SQL statement, taking input from the UDRMetaData.setUDR() method calls in your application

The methods in the UDT and UDR Manager facility perform the following main functions:

- Creating opaque types in Java™ without preexisting Java™ classes, using the default input and output methods the server provides
- Converting existing Java™ classes on the client to opaque types and UDRs in the database server
- Converting Java™ static methods to UDRs

Preparing to create opaque types and UDRs

Before you begin

Before using the UDT and UDR Manager facility, perform the following setup tasks:

- Make sure your database server supports Java™.

  The UDT and UDR Manager facility does not work in legacy servers that do not include Java™ support.
- Include either the `ifxtools.jar` or `ifxtools_g.jar` file in your CLASSPATH setting.

- Create a directory named `/usr/informix` in the database server, with owner and group set to user **informix** and permissions set to `777`.
- Add the following entry to the `/etc/group` file in the database server:

  ```
  informix::unique-id-number:
  ```
- Check the release notes for the driver and database server for any further limitations in this release.

Creating opaque types

About this task

Using UDT Manager, you can create a Java™ opaque type from an existing Java™ class that implements the **SQLData** interface. UDT Manager can also help you create a Java™ opaque type without requiring that you have the Java™ class ready; you specify the characteristics of the opaque type you want to create, and the UDT Manager facility creates the Java™ class and then the Java™ opaque type.

Follow the steps in this section to use the **UDTManager** classes.

Creating an opaque type from an existing Java™ class

About this task

To create an opaque type from an existing Java™ class:

1. Ensure that the class meets the requirements for conversion to an opaque type.

   For the requirements, see Requirements for the Java class on page 145.
2. If you do not want to use the default input and output routines provided by the server, write support UDRs for input and output.

   For general information about writing support UDRs, see *HCL OneDB™ User-Defined Routines and Data Types Developer's Guide*.
3. Create a default sbspace on the database server to hold the JAR file that contains the code for the opaque type.

   For information about creating an sbspace, see the *HCL OneDB™ Administrator's Guide* for your database server and the *HCL® J/Foundation Developer's Guide*.
4. Open a JDBC connection.

   Make sure a database object is associated with the connection object. The driver cannot create an opaque type without a database object. For details about creating a connection with a database object, see Connect to the database on page 8.
5. Instantiate an **UDTManager** object and an **UDTMetaData** object:

   ```
   UDTManager udtmgr = new UDTManager(connection);
   UDTMetaData mdata = new UDTMetaData();
   ```
6. Set properties for the opaque type by calling methods in the **UDTMetaData** object.

At a minimum, you must specify the SQL name, UDT length, and JAR file SQL name. For an explanation of SQL names, see SQL names on page 146.

You can also specify the alignment, implicit and explicit casts, and any support UDRs:

```
mdata.setSQLName("circle2");
mdata.setLength(24);
mdata.setAlignment(UDTMetaData.EIGHT_BYTE)
mdata.setJarFileSQLName("circle2_jar");
mdata.setUDR(areamethod, "area");
mdata.setSupportUDR(input, "input", UDTMetaData.INPUT)
mdata.setSupportUDR(output, "output",UDTMetaData.OUTPUT)
mdata.SetImplicitCast(com.informix.lang.IfxTypes.IFX_TYPE_
   LVARCHAR, "input");
mdata.SetExplicitCast(com.informix.lang.IfxTypes.IFX_TYPE_
   LVARCHAR, "output");
```

7. If desired, specify a path name where the driver should place the JAR file in the database server file system:

   ```
   String pathname = "/work/srv93/examples";
   udtmgr.setJarFileTmpPath(pathname);
   ```

   Make sure the path exists in the server file system. For more information, see Specify a JAR file temporary path on page 151.

8. Create the opaque type:

   ```
   udtmgr.createUDT(mdata, "Circle2.jar", "Circle2", 0);
   ```

Results

For additional information about creating an opaque type from existing code, see Creating an opaque type from existing code on page 151.

For a complete code example of using the preceding steps to create an opaque type, see Create an opaque type from an existing Java class with UDTManager on page 163.

Creating an opaque type without an existing Java™ class

About this task

To create an opaque type without an existing Java™ class:

1. Create a default sbspace on the database server to hold the JAR file that contains the code for the opaque type.

   For information about creating an sbspace, see the *HCL OneDB™ Administrator's Guide* for your database server and the *HCL® J/Foundation Developer's Guide*.

2. Open a JDBC connection.

   Make sure the connection object has a database object associated with it. For details, see Connect to the database on page 8.

3. Instantiate a **UDTManager** object and a **UDTMetaData** object:

   ```
   UDTManager udtmgr = new UDTManager(connection);
   UDTMetaData mdata = new UDTMetaData();
   ```

4. Specify the characteristics of the opaque type by calling methods in the **UDTMetaData** class:

   ```
   mdata.setSQLName("acircle");
   mdata.setLength(24);
   mdata.setFieldCount(3);
   mdata.setFieldName(1, "x");
   mdata.setFieldName(2, "y");
   mdata.setFieldName(3, "radius");
   mdata.setFieldType
      (1,com.informix.lang.IfxTypes.IFX_TYPE_INT);
   mdata.setFieldType
      (2,com.informix.lang.IfxTypes.IFX_TYPE_INT);
   mdata.setFieldType
      (3,com.informix.lang.IfxTypes.IFX_TYPE_INT);
   mdata.setJarFileSQLName("ACircleJar");
   ```

   For more information about setting characteristics for opaque types, see Specify characteristics for an opaque type on page 146.

5. Create the Java™ file, the class file, and the JAR file:

   ```
   mdata.keepJavaFile(true);
   String classname = udtmgr.createUDTClass(mdata);
   String jarfilename = udtmgr.createJar(mdata, new String[]
      {classname + .class"});
   ```

   For more information, see Creating the JAR and class files on page 149.

6. If desired, specify a path name where the driver should place the JAR file in the database server file system:

   ```
   String pathname = "/work/srv93/examples";
   udtmgr.setJarFileTmpPath(pathname);
   ```

   Make sure the path exists in the server file system. For more information, see Specify a JAR file temporary path on page 151.

7. Send the class definition to the database server:

   ```
   udtmgr.createUDT(mdata, jarfilename, classname, 0);
   ```

   For more information, see Send the class definition to the database server on page 150.

Results

For a complete code example of using the preceding steps to create an opaque type, see Create an opaque type without an existing Java class on page 173.

Creating a UDR

About this task

The following topics shows you how to create a UDR from a Java™ class.

To create a UDR:

1. Write a Java™ class with one or more static method to be registered as UDRs.

   For more information, see Requirements for the Java class on page 145.

2. Create an sbspace on the database server to hold the JAR file that contains the code for the UDR.

   For information about creating an sbspace, see the *HCL OneDB™ Administrator's Guide* for your database server and the *HCL® J/Foundation Developer's Guide*.

3. Open a JDBC connection.

   Make sure the connection object has a database object associated with it. For details, see Connect to the database on page 8.

4. Instantiate a **UDRManager** object and a **UDRMetaData** object:

   ```
   UDRManager udrmgr = new UDRManager(myConn);
   UDRMetaData mdata = new UDRMetaData();
   ```

5. Create **java.lang.Reflect.Method** objects for the static methods to be registered as UDRs.
   Example
   In the following example, **method1** is an instance that represents the udr1(string, string) method in the Group1 java class; **method2** is an instance that represents the udr2(Integer, String, String) method in the **Group1** Java™ class:

   ```
   Class gp1 = Class.forName("Group1");
   Method method1 = gp1.getMethod("udr1",
          new Class[]{String.class, String.class});
   Method method2 = gp1.getMethod("udr2",
          new Class[]{Integer.class, String.class, String.class});
   ```

6. Specify which methods to register as UDRs.

   The second parameter specifies the SQL name of the UDR:

   ```
   mdata.setUDR(method1, "group1_udr1");
   mdata.setUDR(method2, "group1_udr2");
   ```

   For more information, see Create UDRs on page 154.

7. Specify the JAR file SQL name:

   ```
   mdata.setJarFileSQLName("group1_jar");
   ```

8. If desired, specify a path name where the driver should place the JAR file in the database server file system:

   ```
   String pathname = "/work/srv93/examples";
   udrmgr.setJarFileTmpPath(pathname);
   ```

Make sure the path exists in the database server file system. For more information, see Specify a JAR file temporary path on page 151.

9. Install the UDRs in the database server:

```
udrmgr.createUDRs(mdata, "Group1.jar", "Group1", 0);
```

For more information, see Create UDRs on page 154.

Results

For complete code examples of creating UDRs, see Create UDRs with UDRManager on page 176.

Requirements for the Java™ class

To qualify for converting into an opaque type, your Java™ class must meet the following conditions:

- The class must implement the **java.sql.SQLData** interface. For an example, see Examples on page 157.
- If the class contains another opaque type, the additional opaque type must be implemented in a similar way and the additional `.class` file must be packaged as part of the same JAR file as the original opaque type.
- If the class contains DISTINCT types, the class can either implement the **SQLData** interface for the DISTINCT types or let the driver map the DISTINCT types to the base types. For more information, see Distinct data types on page 75.
- The class cannot contain complex types.
- If you are creating an opaque type from an existing Java™ class and using the default support functions in the database server, you must cast the **SQLInput** and **SQLOutput** streams in SQLData.readSQL() and SQLData.writeSQL() to **IfmxUDTSQLInput** and **IfmxUDTSQLOutput**.

  For a code example that shows how to do this, see Create an opaque type using default support functions on page 163.
- All Java™ methods for the opaque type must be in the same `.java` file with the class that defines the opaque type.

Additional requirements for UDRs are as follows:

- All class methods to be registered as UDRs must be static.
- The method argument types and the return types must be valid Java™ data types.
- The methods can use all basic nongraphic Java™ packages that are included in the Java™ development kit, such as `java.util`, `java.io`, `java.net`, `java.rmi`, `java.sql`, and so forth.
- Data types of method arguments and return types must conform to the data type mapping tables shown in Data type mapping for UDT manager and UDR manager on page 233.
- The following SQL argument or return types are not supported:
  - MONEY
  - DATETIME with qualifier other than hour to second or year to fraction(5)
  - INTERVAL with qualifier other than year to month or day to fraction(5)
  - Any data type not shown in the mapping tables for method arguments and return types; for the tables, see Data type mapping for UDT manager and UDR manager on page 233.

SQL names

Some of the methods in the **UDTMetaData** class set an *SQL name* for an opaque type or a JAR file that contains the opaque type or UDR code. The SQL name is the name of the object as referenced in SQL statements. For example, assume your application makes the following call:

```
mdata.setSQLName("circle2");
```

The name as used in an SQL statement is as follows:

```
CREATE TABLE tab (c circle2);
```

Similarly, assume the application sets the JAR file name as follows:

```
mdata.setJarFileSQLname("circle2_jar");
```

The JAR file name as referenced in SQL is as follows:

```
CREATE FUNCTION circle2_output (...)
RETURNS circle2
EXTERNAL NAME
   'circle2_jar: circle2.fromString (...)'
LANGUAGE JAVA
NOT VARIANT
END FUNCTION;
```

Important: There is no default value for an SQL name. Use the setSQLname() or setJarFileSQLName() method to specify a name, otherwise an SQL exception will be thrown.

Specify characteristics for an opaque type

The following topics provide additional information about creating an opaque type without a preexisting Java™ class. Details about creating an opaque type from an existing Java™ class begin with Creating an opaque type from existing code on page 151.

Using the methods in the **UDTMetaData** class, you can specify characteristics for a new opaque type. These settings apply for new opaque types; for opaque types created from existing files, see Creating an opaque type from existing code on page 151.

You can set the following characteristics:

- The number of fields in the internal data structure that defines the opaque type
- Additional characteristics, such as data type, name, and scale, of each field in the internal structure that defines the opaque type
- The length of the opaque type
- The alignment of the opaque type
- The SQL name of the opaque type and the JAR file
- The name of the generated Java™ class
- Whether to keep the generated `.java` file

Specify field count

The setFieldCount() method specifies the number of fields in the internal data structure that defines the opaque type:

```
public void setFieldCount(int fieldCount) throws SQLException
```

Specify additional field characteristics

The following methods set additional characteristics for fields in the internal data structure:

```
public void setFieldName (int field, String name) throws SQLException
public void setFieldType (int field, int ifxtype) throws SQLException
public void setFieldTypeName(int field, String sqltypename) throws SQLException
public void setFieldLength(int field, int length) throws SQLException
```

The *field* parameter indicates the field for which the driver should set or obtain a characteristic. The first field is `1`; the second field is `2`, and so forth.

The name you specify with setFieldName() appears in the Java™ class file. The following example sets the first field name to `IMAGE`.

```
mdata.setFieldName(1, "IMAGE");
```

The setFieldType() method sets the data type of a field using a constant from the file **com.informix.lang.IfxTypes**. For more information, see Mapping for field types on page 235. The following example specifies the CHAR data type for values in the third field:

```
mdata.setFieldType(3, com.informix.lang.IfxTypes.IFX_TYPE_CHAR);
```

The setFieldTypeName() method sets the data type of a field using the SQL data type name:

```
mdata.setFieldTypeName(1, "IMAGE_UDT");
```

This method is valid only for opaque and distinct types; for other types, the driver ignores the information.

The *length* parameter has the following meanings, depending on the data type of the field:

Character types

Maximum length in characters

DATETIME

Encoded length

INTERVAL

Encoded length

Other data type or no type specified

Driver ignores the information

The possible values for encoded length are those in the JDBC 2.20 specification: hour to second; year to second; and year to fraction(`1`), year to fraction(`2`), up through year to fraction(`5`).

The following example specifies that the third (VARCHAR) field in an opaque type cannot store more than 24 characters:

```
mdata.setFieldLength(3, 24);
```

Specify length

The setLength() method specifies the total length of the opaque type:

```
public void setLength(int length) throws SQLException
```

If you are creating an opaque type from an existing Java™ class and do not specify a length, the driver creates a variable-length opaque type. If you are creating an opaque type without an existing Java™ class, you must specify a length; UDT Manager creates only fixed-length opaque types in this case.

Specify alignment

The setAlignment() method specifies the opaque types alignment:

```
public void setAlignment(int alignment)
```

The *alignment* parameter is one of the alignment values shown in the next section. If you do not specify an alignment, the database server aligns the opaque type on 4-byte boundaries.

Alignment values

Alignment values are shown in the following table.

Value	Constant	Structure begins with	Boundary aligned on
1	SINGLE_BYTE	1-byte quantity	single-byte
2	TWO_BYTE	2-byte quantity (such as SMALLINT)	2-byte
4	FOUR_BYTE	4-byte quantity (such as FLOAT or UNSIGNED INT)	4-byte
8	EIGHT_BYTE	8-byte quantity	8-byte

Specify SQL names

Specify SQL names with the setSQLName() and setJarFileSQLName() methods:

```
public void setSQLName(String name) throws SQLException
public void setJarFileSQLName(String name) throws SQLException
```

By default, the driver uses the name you set through the setSQLName() method as the file names of the Java™ class and JAR files generated when you call the UDTManager.createUDTCclass() and UDTManager.createJar() methods. For example, if you called `setSQLName("circle")` and then called createUDTCclass() and createJar(), the class file name generated would be `circle.class` and the JAR file name would be `circle.jar`. You can specify a Java™ class file name other than the default by calling the setClassName() method.

The JAR file SQL name is the name as it will be referenced in the SQL CREATE FUNCTION statement the driver uses to register a UDR.

Important: The JAR file SQL name is the name of the JAR file in SQL statements; it has no relationship to the contents of the JAR file.

Specify the Java™ class name

Use setClassName() to specify the Java™ class name:

```
public void setClassName(String name)throws SQLException
```

If you do not set a class name with setClassName(), the driver uses the SQL name of the opaque type (set through setSQLName()) as the name of the Java™ class and the file name of the `.class` file generated by the createUDTCclass() method.

Specifying Java™ source file retention

Use keepJavaFile() to specify whether to retain the `.java` source file:

```
public void keepJavaFile(boolean value)
```

The *value* parameter indicates whether the createUDTClass() method should retain the `.java` file that it generates when it creates the Java™ class file for the new opaque type. The default is to remove the file. The following example specifies keeping the `.java` file:

```
mdata.keepJavaFile(true);
```

Creating the JAR and class files

About this task

Once you have specified the characteristics of the opaque type through the **UDTMetaData** methods, you can use the methods in the **UDTManager** class to create opaque types and their class and JAR files in the following order:

1. Instantiate the **UDTManager** object.

   The constructor is defined as follows:

   ```
   public UDTManager(Connection conn) throws SQLException
   ```
2. Create the `.class` and `.java` files with the createUDTClass() method.
3. Create the `.jar` file with the createJar() method.
4. Create the opaque type with the createUDT() method.

Create the .class and .java files

The createUDTClass() method has the following signature:

```
public String createUDTClass(UDTMetaData mdata) throws SQLException
```

The createUDTClass() method causes the driver to perform all of the following actions for your application:

1. Creates a Java™ class with the name you specified in the UDTMetaData.setClassName() method

   If no class name was specified, the driver uses the name specified in the UDTMetaData.setSQLName() method.
2. Puts the Java™ class code into a `.java` file and then compile the file to a `.class` file
3. Returns the name of the newly created class to your application

If you specified `TRUE` by calling the UDTMetaData.keepJavaFile() method, the driver retains the generated `.java` file. The default is to delete the `.java` file.

Your application should call the createUDTClass() method only to create new `.class` and `.java` files to define an opaque type, not to generate an opaque type from existing files.

Create the .jar file

The createJar() method compiles the class files you specify in the *classnames* list. The files in the list must have the `.class` extension.

```
public String createJar(UDTMetaData mdata, String[] classnames)
   throws SQLException;
```

The driver creates a JAR file named *`sqlname`*`.jar` (where *sqlname* is the name you specified by calling UDTMetaData.setSQLName()) and returns the file name to your application.

Send the class definition to the database server

After you have created the JAR file, use the UDTManager.createUDT() method to create the opaque type by sending the class definition to the database server:

```
public void createUDT(UDTMetaData mdata, String jarfile, String
   classname, int deploy) throws SQLException;
```

The *jarfile* parameter is the path name of a JAR (`.jar`) file that contains the class definition for the opaque type. By default, the classes in the `java.io` package resolve relative path names against the current user directory as named by the system property **user.dir**; it is typically the directory in which the Java™ Virtual Machine was invoked. The file name must be included in your CLASSPATH setting if you use an absolute path name.

The *classname* parameter is the name of the class that implements the opaque type.

The SQL name of the opaque type defaults to the class name if your application does not call setClassName(). You can specify an SQL name by calling the UDTMetaData.setSQLName() method.

Important: If your application calls createUDT() within a transaction or your database is ANSI or enables logging, some extra guidelines apply. For more information, see Execute in a transaction on page 157.

Specify deployment descriptor actions

In the **UDTManager** and **UDRManager** methods, the *deploy* parameter indicates whether install_actions should be executed if a deployment descriptor is present in the JAR file. The *undeploy* parameter indicates whether remove_actions should be executed.

0

Execute install_actions or remove_actions.

Nonzero

Do not execute install_actions or remove_actions.

A deployment descriptor allows you to include the SQL statements for creating and dropping UDRs in a JAR file. For more information about the deployment descriptor, see the *HCL® J/Foundation Developer's Guide* and the SQLJ specification.

Specify a JAR file temporary path

When the driver ships the JAR file for an opaque type or UDR, it places the file by default in `/tmp` (on UNIX™) or in `C:\temp` (on Windows™). You can specify an alternative path name by calling the setJarTmpPath() method in either the **UDTManager** or **UDRManager** class:

```
public void setJarTmpPath(String path) throws SQLException
```

You can call this method at any point before calling createUDT() or createUDR(), the **UDTManager** or **UDRManager** objects. The *path* parameter must be an absolute path name, and you must ensure that the path exists on the server file system.

Creating an opaque type from existing code

About this task

The preceding topics describe methods you use to create a new opaque type without an existing Java™ class. When you create an opaque type from existing Java™ code, you specify the SQL name, JAR file SQL name, support UDRs (if any), and any additional nonsupport UDRs that are included in the opaque type. (For an explanation of SQL names, see SQL names on page 146.) You can also specify the length, alignment, and implicit and explicit casts.

To create an opaque type from existing code, use the following methods:

- UDTMetaData.setSQLName() to specify the SQL name of the opaque type as referenced in SQL statements
- UDTMetaData.setSupportUDR() for each support UDR in the opaque type

  Support UDRs are input/output, send/receive, and so forth.
- UDTMetaData.setUDR() for each nonsupport UDR in the opaque type
- UDTMetaData.setJarFileSQLName() to specify an SQL name for the JAR file

- UDTMetaData.setImplicitCast() or UDTMetaData.setExplicitCast() to specify each cast
- UDTMetaData.setLength() if the opaque type is fixed length (the driver defaults to variable length)
- UDTMetaData.setAlignment() to specify the byte boundary on which the opaque type is aligned (necessary only if you do not want the database server to default to a 4-byte boundary)
- UDTManager.createJar() to create a JAR (`.jar`) file if you do not already have one
- UDTManager.createUDT() to create the opaque type

In addition, the setXXXCast(), setSupportUDR(), and **setUDR()** methods are used only for creating an opaque type from existing code:

```
public void setImplicitCast(int ifxtype, String methodsqlname)
   throws SQLException

public void setExplicitCast(int ifxtype, String methodsqlname)
   throws SQLException

public void setSupportUDR(Method method, String sqlname, int type)
   throws SQLException
public void setUDR(Method method, String sqlname)
   throws SQLException
```

The setXXXCast() methods

The setXXXCast() methods specify the implicit or explicit cast to convert data from an opaque type to the data type specified.

The *ifxtype* parameter is a type code from the class **com.informix.lang.IfxTypes**. Data type mapping between the *ifxtype* parameter and the SQL type in the database server is detailed in Mapping for casts on page 234. The *methodsqlname* parameter is the SQL name of the Java™ method that implements the cast.

The following example sets an implicit cast implemented by a Java™ method with the SQL name **circle2_input**:

```
setImplicitCast(com.informix.lang.IfxTypes.IFX_TYPE_LVARCHAR,
   "circle2_input");
```

The following example sets an explicit cast implemented by a Java™ method with the SQL name **circle_output**:

```
setExplicitCast(com.informix.lang.IfxTypes.IFX_TYPE_LVARCHAR,
   "circle2_output");
```

The following example sets an explicit cast for converting a **circle2** opaque type to an integer:

```
setExplicitCast(com.informix.lang.IfxTypes.IFX_TYPE_INT,
   "circle2_to_int");
```

The setSupportUDR() and setUDR() methods

The setSupportUDR() method specifies a Java™ method in an existing Java™ class that will be registered as a support UDR for the opaque type.

The *method* parameter specifies an object from **java.lang.reflect.Method** to be registered as a Java™ support UDR for the opaque type in the database server. Support UDRs are Input, Output, Send, Receive, and so forth (for more information, see *HCL OneDB™ User-Defined Routines and Data Types Developer's Guide*.)

The *sqlname* parameter specifies the SQL name of the method. For more information, see SQL names on page 146.

The *type* parameter specifies the kind of support UDR, as follows:

```
UDTMetaData.INPUT
UDTMetaData.OUTPUT
UDTMetaData.SEND
UDTMetaData.RECEIVE
UDTMetaData.IMPORT
UDTMetaData.EXPORT
UDTMetaData.BINARYIMPORT
UDTMetaData.BINARYEXPORT
```

For step-by-step information about creating an opaque type from existing code, see Creating an opaque type from an existing Java class on page 141.

Tip: It is not necessary to register the methods in the SQLData interface. For example, you do not need to register SQLData.getSQLTypeName(), SQLData.readSQL(), or SQLData.writeSQL().

To specify other UDRs, use setUDR() as described in Create UDRs on page 154.

Remove opaque types and JAR files

You can remove opaque types and their JAR files using the following methods:

```
public static void removeUDT(String sqlname) throws SQLException
public static void removeJar(String jarfilesqlname, int undeploy)
   throws SQLException
```

The removeUDT() method removes the opaque type, with all its casts and UDRs, from the database server. It does not remove the JAR file itself because other opaque types or UDRs could be using the same JAR file.

Important: If your application calls removeUDT() within a transaction or if your database is ANSI or enables logging, some extra guidelines apply. For more information, see Execute in a transaction on page 157.

The removeJar() method removes the JAR file from the system catalog. The *jarfilesqlname* parameter is the name you specified with the setJarFileSQLName() method.

For the *undeploy* parameter, see Specify deployment descriptor actions on page 151.

Important: Before calling removeJar(), you must first remove all functions and procedures that depend on the JAR file. Otherwise, the database server fails to remove the file.

Create UDRs

Using UDR Manager to create UDRs in the database server involves:

- Coding the UDRs and packaging the code in a JAR file

  For details about coding UDRs, see the *HCL® J/Foundation Developer's Guide*.
- Creating a default sbspace in the database server to hold the JAR file that contains the code for the UDR

  For information about creating an sbspace, see the *HCL OneDB™ Administrator's Guide* for your database server and the *HCL® J/Foundation Developer's Guide*.
- Calling methods in the **UDRMetaData** class to specify the information necessary for HCL OneDB™ JDBC Driver to register the UDRs in the database server
- If desired, specifying a path name where the driver should place the JAR file in the database server file system
- Installing the UDRs in the server

Creating a UDR for a C-language opaque type is not supported; the opaque type must be in Java™.

To specify a UDR for the driver to register, use this method in **UDRMetaData**:

```
public void setUDR(Method method, String sqlname) throws SQLException
```

The *method* parameter specifies an object from **java.lang.Reflect.Method** to be registered as a Java™ UDR in the database server. The *sqlname* parameter is the name of the method as used in SQL statements.

Once you have specified the UDRs to be registered, you can set the JAR file SQL name using UDRMetaData.setJarFileSQLName() and then use the UDRManager.createUDRs() method to install the UDRs in the database server, as follows:

```
public void createUDRs(UDRMetaData mdata, String jarfile, String
   classname, int deploy) throws SQLException
```

The *jarfile* parameter is the absolute or relative path name of the client-side JAR file that contains the Java™ method definitions. If you use the absolute path name, the JAR file name must be included in your CLASSPATH setting.

The *classname* parameter is the name of a Java™ class that contains the methods you want to register as UDRs in the database server. Requirements for preparing the Java™ methods are described on 1 on page 144.

For the *deploy* parameter, see Specify deployment descriptor actions on page 151.

The createUDRs() method causes the driver to perform all of the following steps for your application:

1. Obtain the JAR file designated by the first parameter.
2. Transport the JAR file from the client local area to the server local area.

3. Register the UDRs specified in the **UDRMetaData** object (set through one or more calls to UDRMetaData.setUDR()).
4. Install the JAR file and create the UDRs in the server.

After createUDRs() executes, your application can use the UDRs in SQL statements.

Important: If your application calls createUDRs() within a transaction, or if your database is ANSI or enables logging, some extra guidelines apply. For more information, see Execute in a transaction on page 157.

Remove UDRs and JAR files

You can remove UDRs using the following methods:

```
public void removeUDR(String sqlname) throws SQLException
public void removeJar(String jarfilesqlname, int undeploy) throws
   SQLException
```

Tip: The removeUDR() method removes the UDR from the server but does not remove the JAR file, because other opaque types or UDRs could be using the same JAR file.

The removeJar() method is described in Remove opaque types and JAR files on page 153.

Remove overloaded UDRs

To remove overloaded UDRs, use the removeUDR() method with an additional parameter:

```
public void removeUDR(String sqlname, Class[] methodparams) throws
   SQLException
```

The *methodparams* parameter specifies the data type of each parameter in the UDR. Specify NULL to indicate no parameters. For example, assume a UDR named print() is overloaded with two additional method signatures.

Java™ method signature	Correspo nding SQL name
void print()	print1
void print(String x, String y, int r)	print2
void print(int a, int b)	print3

The code to remove all three UDRs is:

```
udrmgr.removeUDR("print1", null );
udrmgr.removeUDR("print2",
   new Class[] {String.class, String.class, int.class} );
udrmgr.removeUDR("print3", new Class[] {int.class, int.class} );
```

Obtain information about opaque types and UDRs

Many of the setXXX() methods in the **UDTMetaData** and **UDRMetaData** classes have parallel getXXX() methods for obtaining characteristics of existing opaque types and UDRs.

The getXXX() methods in the UDTMetaData class

The following table summarizes the available getXXX() methods in the **UDTMetaData** class. For the *field* parameter, `1` designates the first field in the internal data structure, `2` is the second, and so forth. For details about SQL names, see SQL names on page 146.

Information obtained	Method signature	Additional information
Number of fields in the internal data structure	public int getFieldCount()	Returns `0` if no fields are present
Name of a field in the internal data structure	public String getFieldName int *field*) throws SQLException	Returns NULL if no name exists
Data type code of a field in the internal data structure	public int getFieldType (int *field*) throws SQLException	Data type codes come from the class **com.informix.lang.IfxTypes**. Returns `-1` if no data type exists
Data type name of a field in the internal data structure	public String getFieldTypeName (int *field*) throws SQLException	Returns NULL if no name exists
For character type: maximum number of characters in the field; for date-time or interval type: encoded qualifier	public int getFieldLength (int *field*) throws SQLException	Returns `-1` if no length was set
SQL name of the opaque type	public String getSQLName()	Returns NULL if no name was set
SQL name of the JAR file	public String getJarFileSQLName()	Returns NULL if no name was set
Name of the Java™ class for the opaque type	public String getClassName()	If no class name was set through setClassName(), *sqlname* is returned (this is the default). If no SQL name was set through setSQLName(), returns NULL
Length of a fixed-length opaque type	public int getLength()	Returns`-1` if no length was set
Alignment of an opaque type	public int getAlignment()	Returns `-1` if no alignment was set For the alignment codes, see Alignment values on page 148.

Information obtained	Method signature	Additional information
An array of Method objects that have been specified as support UDRs through setSupportUDR()	public Method[] getSupportUDRs()	For details about support UDRs, see the description of setSupportUDR() in Creating an opaque type from existing code on page 151. Returns NULL if no support UDRs were specified
SQL name of a Java™ method that was specified as a support UDR through setSupportUDR()	public String getSupportUDRSQLName (Method *method*) throws SQLException	Returns NULL if no name was set

The getXXX() methods in the UDRMetaData class

To obtain information about UDRs, use the methods in the following table.

Information obtained	Method signature	Additional information
An array of **java.lang.Method.Reflect** methods that have been specified as UDRs for an opaque type.	public Method[] getUDRs()	To specify a UDR for an opaque type, call the UDTMetaData.setUDR() method. Returns NULL if no UDRs were specified
SQL name of a Java™ method	public String getUDRSQLName(Method *method*) throws SQLException	Returns NULL if no SQL name was specified for the UDR Method object

Execute in a transaction

If your database is ANSI or has logging enabled, and the application is not already in a transaction, the driver executes the SQL statements to create opaque types and UDRs on the server within a transaction. This means that either all the steps will succeed, or all will fail. If the opaque type or UDR creation fails at any point, the driver rolls back the transaction and throws an SQLException.

If the application is already in a transaction when the UDTManager.createUDT() or UDRManager.createUDRs() method calls are issued, the SQL statements are executed within the existing transaction. This means that if the driver returns an SQLException to your application during the creation of the opaque type or UDR, your application must roll back the transaction to ensure the integrity of the database. Otherwise, the opaque type, parts of its casts, or UDRs could be left in the database.

Examples

The rest of this section contains examples for creating and using opaque types and UDRs.

The first four examples are released with your JDBC driver software in the `demo/udt-distinct` directory; the last two are in the `demo/tools/udtudrmgr` directory. See the `README` file in each directory for a description of the files.

Class definition

The class for the C opaque type, **charattrUDT** in the following example, must implement the **SQLData** interface:

```
import java.sql.*;
import com.informix.jdbc.*;
/*
 * C struct of charattr_udt:
 *
 * typedef struct charattr_type
 * {
 *     char          chr1[4+1];
 *     mi_boolean    bold;       // mi_boolean (1 byte)
 *     mi_smallint   fontsize;   // mi_smallint (2 bytes)
 * }
 * charattr;
 *
 * typedef charattr charattr_udt;
 *
 */
public class charattrUDT implements SQLData
{
        private String sql_type = "charattr_udt";
        // an ASCII character/a multibyte character, and is null-terminated.
        public String chr1;
        // Is the character in boldface?
        public boolean bold;
        // font size of the character
        public short fontsize;

   public charattrUDT() { }

   public charattrUDT(String chr1, boolean bold, short fontsize)
   {
        this.chr1 = chr1;
        this.bold = bold;
        this.fontsize = fontsize;
   }

    public String getSQLTypeName()
   {
                return sql_type;
   }
   // reads a stream of data values and builds a Java object
   public void readSQL(SQLInput stream, String type) throws SQLException
   {
        sql_type = type;
        chr1 = ((IfmxUDTSQLInput)stream).readString(5);
        bold = stream.readBoolean();
        fontsize = stream.readShort();
   }
   // writes a sequence of values from a Java object to a stream
   public void writeSQL(SQLOutput stream) throws SQLException
   {
                ((IfmxUDTSQLOutput)stream).writeString(chr1, 5);
                stream.writeBoolean(bold);
                stream.writeShort(fontsize);
   }
   // overides Object.equals()
   public boolean equals(Object b)
   {
                return (chr1.equals(((charattrUDT)b).chr1) &&
                bold == ((charattrUDT)b).bold &&
                fontsize == ((charattrUDT)b).fontsize);
   }

   public String toString()
   {
                return "chr1=" + chr1 + " bold=" + bold + " fontsize=" + fontsize;
   }
}
```

In your JDBC application, a custom type map must map the SQL-type name **charattr_udt** to the **charattrUDT** class:

```
java.util.Map customtypemap = conn.getTypeMap();
if (customtypemap == null)
        {
        System.out.println("\n***ERROR: typemap is null!");
        return;
        }
customtypemap.put("charattr_udt", Class.forName("charattrUDT"));
```

Insert data

You can insert an opaque type as either its original type or its cast type. The following example shows how to insert opaque data using the original type:

```
String s = "insert into charattr_tab (int_col, charattr_col)
   values (?, ?)";
System.out.println(s);
pstmt = conn.prepareStatement(s);
...
charattrUDT charattr = new charattrUDT();
charattr.chr1 = "a";
charattr.bold = true;
charattr.fontsize = (short)1;

pstmt.setInt(1, 1);
System.out.println("setInt...ok");

pstmt.setObject(2, charattr);
System.out.println("setObject(charattrUDT)...ok");
```

```
pstmt.executeUpdate();
```

If a casting function is defined, and you would like to insert data as the casting type instead of the original type, you must call the setXXX() method that corresponds to the casting type. For example, if you have defined a function casting CHAR or LVARCHAR to a **charattrUDT** column, you can use the setString() method to insert data, as follows:

```
// Insert into UDT column using setString(int,String) and Java
   String object.
String s =
        "insert into charattr_tab " +
        "(decimal_col, date_col, charattr_col, float_col) " +
        "values (?,?,?,?)";
writeOutputFile(s);
PreparedStatement pstmt = myConn.prepareStatement(s);

...
String strObj = "(A, f, 18)";
pstmt.setString(3, strObj);
...
```

Retrieve data

To retrieve HCL OneDB™ opaque types, you must use ResultSet.getObject(). HCL OneDB™ JDBC Driver converts the data to a Java™ object according to the custom type map you provide. Using the previous example of the **charattrUDT** type, you can fetch the opaque data, as in the following example:

```
String s = "select int_col, charattr_col from charattr_tab order by 1";
System.out.println(s);

Statement stmt = conn.createStatement();
ResultSet rs = stmt.executeQuery(s);
System.out.println("execute...ok");

System.out.println("Fetching data ...");
int curRow = 0;
while (rs.next())
        {
        curRow++;
        System.out.println("currentrow=" + curRow + " : ");

        int intret = rs.getInt("int_col");
        System.out.println("   int_col       " + intret);

        charattrUDT charattrret = (charattrUDT)rs.getObject("charattr_col");
        System.out.print("   charattr_col  ");
        if (curRow == 2 || curRow == 6)
                {
                        if (rs.wasNull())
                                System.out.println("<null>");
                        else
                                System.out.println("***ERROR: " + charattrret);
                }
                else
                System.out.println(charattrret+"");
        } //while

System.out.println("total rows expected: " + curRow);
stmt.close();
```

Smart large objects within an opaque type

A smart large object can be a data member within an opaque type, although you are most likely to create a large object on the database server, outside of the opaque type context, using the HCL OneDB™ extension classes.

For more information about smart large objects, see Smart large object data types on page 105.

A large object is stored as an **IfxLocator** object within the opaque type; in the C struct that defines the opaque type internally, the large object is referenced through a locator pointer of type MI_LO_HANDLE. The object is created using the methods provided in the **IfxSmartBlob** class, and the large object handle obtained from these methods becomes the data member within the opaque type. Both BLOB and CLOB objects use the same large object handle, as shown in the following example:

```
import java.sql.*;
import com.informix.jdbc.*;
/*
 * C struct of large_bin_udt:
 *
 * typedef struct LARGE_BIN_TYPE
 * {
 *     MI_LO_HANDLE lb_handle;   // handle to large object (72 bytes)
 * }
 * large_bin_udt;
 *
 */
public class largebinUDT implements SQLData
{
    private String sql_type = "large_bin_udt";
    public Clob lb_handle;

    public largebinUDT() { }

    public largebinUDT(Clob clob)
        {
                lb_handle = clob;
        }

    public String getSQLTypeName()
        {
                return sql_type;
        }
    // reads a stream of data values and builds a Java object
    public void readSQL(SQLInput stream, String type) throws SQLException
        {
                sql_type = type;
                lb_handle = stream.readClob();
        }
        // writes a sequence of values from a Java object to a stream
    public void writeSQL(SQLOutput stream) throws SQLException
        {
                stream.writeClob(lb_handle);
        }
}
```

In a JDBC application, you create the MI_LO_HANDLE object using the methods provided by the **IfxSmartBlob** class:

```
String s = "insert into largebin_tab (int_col, largebin_col, lvc_col) " +
        "values (?,?,?)";
System.out.println(s);
pstmt = conn.prepareStatement(s);

...
// create a large object using IfxSmartBlob's methods
String filename = "lbin_in1.dat";
File file = new File(filename);
int fileLength = (int) file.length();
FileInputStream fin = new FileInputStream(file);

IfxLobDescriptor loDesc = new IfxLobDescriptor(conn);
System.out.println("create large object descriptor...ok");

IfxLocator loPtr = new IfxLocator();
IfxSmartBlob smb = new IfxSmartBlob((IfxConnection)conn);
int loFd = smb.IfxLoCreate(loDesc, 8, loPtr);
System.out.println("create large object...ok");

int n = smb.IfxLoWrite(loFd, fin, fileLength);
System.out.println("write file content into large object...ok");

pstmt.setInt(1, 1);
System.out.println("setInt...ok");

// initialize largebin object using the large object created
// above, before doing setObject for the large_bin_udt column.
largebinUDT largebinObj = new largebinUDT();
largebinObj.lb_handle = new IfxCblob(loPtr);
pstmt.setObject(2, largebinObj);
System.out.println("setObject(largebinUDT)...ok");

pstmt.setString(3, "Sydney");
System.out.println("setString...ok");

pstmt.executeUpdate();
System.out.println("execute...ok");

// close/release large object
smb.IfxLoClose(loFd);
System.out.println("close large object...ok");
```

```
smb.IfxLoRelease(loPtr);
System.out.println("release large object...ok");
```

See Smart large object data types on page 105 for details.

Create an opaque type from an existing Java™ class with UDTManager

The following example shows how an application can use the **UDTManager** and **UDTMetaData** classes to convert an existing Java™ class on the client (inaccessible to the database server) to an SQL opaque type in the database server.

Create an opaque type using default support functions

The following example creates an opaque type named **Circle**, using an existing Java™ class and using the default support functions provided in the database server:

```
*/

import java.sql.*;
import com.informix.jdbc.IfmxUDTSQLInput;
import com.informix.jdbc.IfmxUDTSQLOutput;

public class Circle implements SQLData
{
    private static double PI = 3.14159;

    double x;           // x coordinate
    double y;           // y coordinate
    double radius;

    private String type = "circle";

    public String getSQLTypeName() { return type; }

    public void readSQL(SQLInput stream, String typeName)
        throws SQLException
    {
        // To be able to use the DEFAULT support functions supplied
        // by the server, you must cast the stream to IfmxUDTSQLInput.
        // (Server requirement)

        IfmxUDTSQLInput in = (IfmxUDTSQLInput) stream;
        x = in.readDouble();
        y = in.readDouble();
        radius = in.readDouble();
    }

    public void writeSQL(SQLOutput stream) throws SQLException
    {
        // To be able to use the DEFAULT support functions supplied
        // by the server, have to cast the stream to IfmxUDTSQLOutput.
        // (Server requirement)
        IfmxUDTSQLOutput out = (IfmxUDTSQLOutput) stream;
        out.writeDouble(x);
        out.writeDouble(y);
        out.writeDouble(radius);
    }

    public static double area(Circle c)
    {
        return PI * c.radius * c.radius;
    }

}
```

The opaque type

The following JDBC client application installs the class **Circle** (which is packaged in `Circle.jar`) as an opaque type in the system catalog. Applications can then use the opaque type **Circle** as a data type in SQL statements:

```
import java.sql.*;
import java.lang.reflect.*;


public class PlayWithCircle
{
    String dbname = "test";
    String url = null;
    Connection conn = null;

    public static void main (String args[])
    {
        new PlayWithCircle(args);
    }

    PlayWithCircle(String args[])
    {
        System.out.println("----------------");
        System.out.println("- Start - Demo 1");
        System.out.println("----------------");

        // -----------
        // Getting URL
        // -----------
        if (args.length == 0)
            {
            System.out.println("\n***ERROR: connection URL must be provided " +
                               "in order to run the demo!");
            return;
            }
        url = args[0];

        // --------------
        // Loading driver
        // --------------
        try
            {
            System.out.print("Loading JDBC driver...");
            Class.forName("com.informix.jdbc.IfxDriver");
            System.out.println("ok");
            }
        catch (java.lang.ClassNotFoundException e)
            {
            System.out.println("\n***ERROR: " + e.getMessage());
            e.printStackTrace();
            return;
            }

        // ------------------
        // Getting connection
        // ------------------
        try
            {
            System.out.print("Getting connection...");
            conn = DriverManager.getConnection(url);
            System.out.println("ok");
            }
        catch (SQLException e)
            {
            System.out.println("URL = '" + url + "'");
            System.out.println("\n***ERROR: " + e.getMessage());
            e.printStackTrace();
            return;
            }
        System.out.println();

        // -------------------
        // Setup UDT meta data
        // -------------------
        Method areamethod = null;
        try
            {
            Class c = Class.forName("Circle");
            areamethod = c.getMethod("area", new Class[] {c});
            }
        catch (ClassNotFoundException e)
            {
            System.out.println("Cannot get Class: " + e.toString());
            return;
            }
        catch (NoSuchMethodException e)
            {
            System.out.println("Cannot get Method: " + e.toString());
            return;
            }
        UDTMetaData mdata = null;
        try
            {
            System.out.print("Setting mdata...");
            mdata = new UDTMetaData();
            mdata.setSQLName("circle");
            mdata.setLength(24);
            mdata.setAlignment(UDTMetaData.EIGHT_BYTE);
            mdata.setUDR(areamethod, "area");
            mdata.setJarFileSQLName("circle_jar");
            System.out.println("ok");
            }
        catch (SQLException e)
            {
            System.out.println("\n***ERROR: " + e.getMessage());
            return;
            }

        // -------------------------------
        // Install the UDT in the database
        // -------------------------------
        UDTManager udtmgr = null;
        try
            {
            udtmgr = new UDTManager(conn);

            System.out.println("\ncreateJar()");
            String jarfilename = udtmgr.createJar(mdata,
                new String[] {"Circle.class"}); // jarfilename = circle.jar
            System.out.println("    jarfilename = " + jarfilename);

            System.out.println("\nsetJarTmpPath()");
            udtmgr.setJarTmpPath("/tmp");

            System.out.print("\ncreateUDT()...");
            udtmgr.createUDT(mdata,
            "/vobs/jdbc/demo/tools/udtudrmgr/" + jarfilename, "Circle", 0);
            System.out.println("ok");
            }
        catch (SQLException e)
            {
            System.out.println("\n***ERROR: " + e.getMessage());
            return;
            }
        System.out.println();

        // ---------------
        // Now use the UDT
        // ---------------
        try
        {
            String s = "drop table tab";
            System.out.print(s + "...");
            Statement stmt = conn.createStatement();
            int count = stmt.executeUpdate(s);
            stmt.close();
            System.out.println("ok");
        }
        catch ( SQLException e)
        {
            // -206 The specified table (%s) is not in the database.
            if (e.getErrorCode() != -206)
                {
                System.out.println("\n***ERROR: " + e.getMessage());
                return;
                }
            System.out.println("ok");
        }

        executeUpdate("create table tab (c circle)");

        // test DEFAULT Input function
        executeUpdate("insert into tab values ('10 10 10')");

        // test DEFAULT Output function
        try
            {
            String s = "select c::lvarchar from tab";
            System.out.println(s);
            Statement stmt = conn.createStatement();
            ResultSet rs = stmt.executeQuery(s);
            if (rs.next())
                {
                String c = rs.getString(1);
                System.out.println("   circle = '" + c + "'");
                }
            rs.close();
            stmt.close();
            }
        catch (SQLException e)
            {
            System.out.println("***ERROR: " + e.getMessage());
            }
        System.out.println();

        // test DEFAULT Send function
        try
            {
            // setup type map before using getObject() for UDT data.
            java.util.Map customtypemap = conn.getTypeMap();
            System.out.println("getTypeMap...ok");
            if (customtypemap == null)
                {
                System.out.println("***ERROR: map is null!");
                return;
                }
            customtypemap.put("circle", Class.forName("Circle"));
            System.out.println("put...ok");

            String s = "select c from tab";
            System.out.println(s);
            Statement stmt = conn.createStatement();
            ResultSet rs = stmt.executeQuery(s);
            if (rs.next())
                {
                Circle c = (Circle)rs.getObject(1, customtypemap);
                System.out.println("   c.x = " + c.x);
                System.out.println("   c.y = " + c.y);
                System.out.println("   c.radius = " + c.radius);
                }
            rs.close();
            stmt.close();
            }
        catch (SQLException e)
            {
            System.out.println("***ERROR: " + e.getMessage());
            }
        catch (ClassNotFoundException e)
            {
            System.out.println("***ERROR: " + e.getMessage());
            }
        System.out.println();

        // test user's non-support UDR
        try
            {
            String s = "select area(c) from tab";
            System.out.println(s);
            Statement stmt = conn.createStatement();
            ResultSet rs = stmt.executeQuery(s);
            if (rs.next())
                {
                double a = rs.getDouble(1);
                System.out.println("   area = " + a);
                }
            rs.close();
            stmt.close();
            }
        catch (SQLException e)
            {
            System.out.println("***ERROR: " + e.getMessage());
            }
        System.out.println();

        executeUpdate("drop table tab");
        // ------------------
        // Closing connection
        // ------------------
        try
            {
            System.out.print("Closing connection...");
            conn.close();
            System.out.println("ok");
            }
        catch (SQLException e)
            {
            System.out.println("\n***ERROR: " + e.getMessage());
            }
}
```

Create an opaque type using support functions you supply

In this example, the Java™ class **Circle2** on the client is mapped to an SQL opaque type named **circle2**. The **circle2** opaque type uses support functions provided by the programmer.

```
import java.sql.*;
import java.text.*;
import com.informix.jdbc.IfmxUDTSQLInput;
import com.informix.jdbc.IfmxUDTSQLOutput;

public class Circle2 implements SQLData
{
    private static double PI = 3.14159;

    double x;           // x coordinate
    double y;           // y coordinate
    double radius;

    private String type = "circle2";

    public String getSQLTypeName() { return type; }

    public void readSQL(SQLInput stream, String typeName)
        throws SQLException
    {
/* commented out - because the first release of the UDT/UDR Manager feature
 *                does not support mixing user-supplied support functions
 *                with server DEFAULT support functions.
 * However, once the mix is supported, this code needs to be used to
 * replace the existing code.
 *
        // To be able to use the DEFAULT support functions (other than
        // Input/Output) supplied by the server, you must cast the stream
        // to IfmxUDTSQLInput.

        IfmxUDTSQLInput in = (IfmxUDTSQLInput) stream;
        x = in.readDouble();
        y = in.readDouble();
        radius = in.readDouble();
 */

        x = stream.readDouble();
        y = stream.readDouble();
        radius = stream.readDouble();
    }

    public void writeSQL(SQLOutput stream) throws SQLException
    {
/* commented out - because the 1st release of UDT/UDR Manager feature
 *                 doesn't support the mixing of user support functions
 *                 with server DEFAULT support functions.
 * However, once the mix is supported, this code needs to be used to
 * replace the existing code.
 *
        // To be able to use the DEFAULT support functions (other than
        // Input/Output) supplied by the server, you must cast the stream
        // to IfmxUDTSQLOutput.

        IfmxUDTSQLOutput out = (IfmxUDTSQLOutput) stream;
        out.writeDouble(x);
        out.writeDouble(y);
        out.writeDouble(radius);
 */

        stream.writeDouble(x);
        stream.writeDouble(y);
        stream.writeDouble(radius);
    }

    /**
     * Input function - return the object from the String representation -
     * 'x y radius'.
     */
    public static Circle2 fromString(String text)
    {
        Number a = null;
        Number b = null;
        Number r = null;

        try
            {
            ParsePosition ps = new ParsePosition(0);
            a = NumberFormat.getInstance().parse(text, ps);
            ps.setIndex(ps.getIndex() + 1);
            b = NumberFormat.getInstance().parse(text, ps);
            ps.setIndex(ps.getIndex() + 1);
            r = NumberFormat.getInstance().parse(text, ps);
            }
        catch (Exception e)
```

```
            {
            System.out.println("In exception : " + e.getMessage());
            }

        Circle2 c = new Circle2();
        c.x = a.doubleValue();
        c.y = b.doubleValue();
        c.radius = r.doubleValue();

        return c;
    }

    /**
     * Output function - return the string of the form 'x y radius'.
     */
    public static String makeString(Circle2 c)
    {
        StringBuffer sbuff = new StringBuffer();
        FieldPosition fp = new FieldPosition(NumberFormat.INTEGER_FIELD);
        NumberFormat.getInstance().format(c.x, sbuff, fp);
        sbuff.append(" ");
        NumberFormat.getInstance().format(c.y, sbuff, fp);
        sbuff.append(" ");
        NumberFormat.getInstance().format(c.radius, sbuff, fp);

        return sbuff.toString();
    }

    /**
     * user function - get the area of a circle.
     */
    public static double area(Circle2 c)
    {
        return PI * c.radius * c.radius;
    }

}
```

The opaque type

The following JDBC client application installs the class **Circle2** (which is packaged in `Circle2.jar`) as an opaque type in the system catalog. Applications can then use the opaque type **Circle2** as a data type in SQL statements:

```
import java.sql.*;
import java.lang.reflect.*;


public class PlayWithCircle2
{
    String dbname = "test";
    String url = null;
    Connection conn = null;
    public static void main (String args[])
    {
        new PlayWithCircle2(args);
    }

    PlayWithCircle2(String args[])
    {

        // -----------
        // Getting URL
        // -----------
        if (args.length == 0)
            {
            System.out.println("\n***ERROR: connection URL must be provided " +
                               "in order to run the demo!");
            return;
            }

        url = args[0];

        // --------------
        // Loading driver
        // --------------
        try
            {
            System.out.print("Loading JDBC driver...");
            Class.forName("com.informix.jdbc.IfxDriver");
            }
        catch (java.lang.ClassNotFoundException e)
            {
            System.out.println("\n***ERROR: " + e.getMessage());
            e.printStackTrace();
            return;
            }


        try
            {
            conn = DriverManager.getConnection(url);
            }
        catch (SQLException e)
            {
            System.out.println("URL = '" + url + "'");
            System.out.println("\n***ERROR: " + e.getMessage());
            e.printStackTrace();
            return;
            }
        System.out.println();
```

Create an opaque type without an existing Java™ class

In this example, the Java™ class **MyCircle** on the client is used to create a fixed-length opaque type in the database server named **ACircle**. The **ACircle** opaque type uses the default support functions provided by the database server:

```
import java.sql.*;

public class MyCircle
{
    String dbname = "test";
    String url = null;
    Connection conn = null;

    public static void main (String args[])
    {
        new MyCircle(args);
    }

    MyCircle(String args[])
    {
        System.out.println("----------------");
        System.out.println("- Start - Demo 3");
        System.out.println("----------------");

        // -----------
        // Getting URL
        // -----------
        if (args.length == 0)
            {
            System.out.println("\n***ERROR: connection URL must be provided " +
                               "in order to run the demo!");
            return;
            }
        url = args[0];

        // --------------
        // Loading driver
        // --------------
        try
            {
            System.out.print("Loading JDBC driver...");
            Class.forName("com.informix.jdbc.IfxDriver");
            System.out.println("ok");
            }
        catch (java.lang.ClassNotFoundException e)
            {
            System.out.println("\n***ERROR: " + e.getMessage());
            e.printStackTrace();
            return;
            }

        // ------------------
        // Getting connection
        // ------------------
        try
            {
            System.out.print("Getting connection...");
            conn = DriverManager.getConnection(url);
            System.out.println("ok");
            }
        catch (SQLException e)
            {
            System.out.println("URL = '" + url + "'");
            System.out.println("\n***ERROR: " + e.getMessage());
            e.printStackTrace();
            return;
            }
         // -------------------
        // Setup UDT meta data
        // -------------------
        UDTMetaData mdata = null;
        try
            {
            mdata = new UDTMetaData();
            System.out.print("Setting fields in mdata...");
            mdata.setSQLName("acircle");
            mdata.setLength(24);
            mdata.setFieldCount(3);
            mdata.setFieldName(1, "x");
            mdata.setFieldName(2, "y");
            mdata.setFieldName(3, "radius");
            mdata.setFieldType(1, com.informix.lang.IfxTypes.IFX_TYPE_INT);
            mdata.setFieldType(2, com.informix.lang.IfxTypes.IFX_TYPE_INT);
            mdata.setFieldType(3, com.informix.lang.IfxTypes.IFX_TYPE_INT);
            // set class name if don't want to use the default name
            // <udtsqlname>.class
            mdata.setClassName("ACircle");
            mdata.setJarFileSQLName("ACircleJar");
            mdata.keepJavaFile(true);
            System.out.println("ok");
            }
        catch (SQLException e)
            {
            System.out.println("***ERROR: " + e.getMessage());
            return;
            }

        // -------------------------------------------------------
        // create java file for UDT and install UDT in the database
        // -------------------------------------------------------
        UDTManager udtmgr = null;
        try
            {
            udtmgr = new UDTManager(conn);
            System.out.println("Creating .class/.java files - " +
                                "createUDTClass()");
            String classname = udtmgr.createUDTClass(mdata); // generated
                                //java file is kept
            System.out.println("   classname = " + classname);

            System.out.println("\nCreating .jar file - createJar()");
            String jarfilename = udtmgr.createJar(mdata,
                new String[]{"ACircle.class"}); // jarfilename is
                                                // <udtsqlname>.jar
                                                // ie. acircle.jar

            System.out.println("\nsetJarTmpPath()");
            udtmgr.setJarTmpPath("/tmp");

            System.out.print("\ncreateUDT()...");
            udtmgr.createUDT(mdata,
                "/vobs/jdbc/demo/tools/udtudrmgr/" + jarfilename, "ACircle", 0);
            System.out.println("ok");
            }
        catch (SQLException e)
            {
            System.out.println("\n***ERROR: " + e.getMessage());
            return;
            }
        System.out.println();


        // ---------------
        // Now use the UDT
        // ---------------
        try
        {
            String s = "drop table tab";
            System.out.print(s + "...");
            Statement stmt = conn.createStatement();
            int count = stmt.executeUpdate(s);
            stmt.close();
            System.out.println("ok");
        }
        catch ( SQLException e)
        {
            // -206 The specified table (%s) is not in the database.
            if (e.getErrorCode() != -206)
                {
                System.out.println("\n***ERROR: " + e.getMessage());
                return;
                }
            System.out.println("ok");
        }
        executeUpdate("create table tab (c acircle)");

        // test DEFAULT Input function
        executeUpdate("insert into tab values ('10 10 10')");

        // test DEFAULT Output function
        try
            {
            String s = "select c::lvarchar from tab";
            System.out.println(s);
            Statement stmt = conn.createStatement();
            ResultSet rs = stmt.executeQuery(s);
            if (rs.next())
                {
                String c = rs.getString(1);
                System.out.println("   acircle = '" + c + "'");
                }
            rs.close();
            stmt.close();
            }
        catch (SQLException e)
            {
            System.out.println("***ERROR: " + e.getMessage());
            }
        System.out.println();

        executeUpdate("drop table tab");

        // ------------------
        // Closing connection
        // ------------------
        try
            {
            System.out.print("Closing connection...");
            conn.close();
            System.out.println("ok");
            }
        catch (SQLException e)
            {
            System.out.println("\n***ERROR: " + e.getMessage());
            }

        System.out.println("------------------");
        System.out.println("- End - UDT Demo 3");
        System.out.println("------------------");

    }
```

Create UDRs with UDRManager

The following code shows how an application can use the **UDRManager** and **UDRMetaData** classes to convert methods in a Java™ class on the client (inaccessible to the database server) to Java™ UDRs in the database server. Applications can later reference the UDRs in SQL statements. In this example, the Java™ class on the client is named **Group1**. The class has two routines, **udr1** and **udr2**.

The following code creates methods in the **Group1** class to be registered as UDRs in the database server:

```
import java.sql.*;

public class Group1
{
   public static String udr1 (String s1, String s2)
        throws SQLException
   {
   return s1 + s2;
   }
    // Return a formatted string with all inputs
   public static String udr2 (Integer i, String s1,
                  String s2) throws SQLException
   {
   return "{" + i + "," + s1 + "," + s2 +"}";
   }
}
```

The following code creates Java™ methods **udr1** and **udr2** as UDRs **group1_udr1** and **group1_udr2** in the database server and then uses the UDRs:

```
import java.sql.*;
import java.lang.reflect.*;

public class PlayWithGroup1
{
// Open a connection...
url = "jdbc:onedb://hostname:portnum:db;user=scott;password=tiger;
myConn = DriverManager.getConnection(url);

//Install the routines in the database.
UDRManager udtmgr = new UDRManager(myConn);
UDRMetaData mdata = new UDRMetaData();
Class gp1 = Class.forName("Group1");
Method method1 = gp1.getMethod("udr1",
   new Class[]{String.class, String.class});
Method method2 = gp1.getMethod("udr2",
   new Class[]{Integer.class, String.class, String.class});
mdata.setUDR(method1, "group1_udr1");
mdata.setUDR(method2, "group1_udr2");
mdata.setJarFileSQLName("group1_jar");
udtmgr.createUDRs(mdata, "Group1.jar", "Group1", 0);

// Use the UDRs in SQL statements:
Statement stmt = myConn.createStatement();
stmt.executeUpdate("create table tab (c1 varchar(10),
   c2 char(20)", c3 int);
stmt.close();
Statement stmt = myConn.createStatement();
stmt.executeUpdate("insert into tab values ('hello', 'world',
   222)");
stmt.close();

Statement stmt = myConn.createStatement();
ResultSet r = stmt.executeQuery("select c3, group1_udr2(c3, c1, c2)
   from tab where group1_udr1(c1, c2) = 'hello world'");

...

}
```

Globalization and date formats

HCL OneDB™ JDBC Driver extends the Java™ globalization features by providing access to HCL OneDB™ databases that are based on different locales and code sets.

Globalization allows you to develop software independently of the countries or languages of its users and then to localize your software for multiple countries or regions.

For general information about setting up Global Language Support (GLS), see the *HCL OneDB™ GLS User's Guide*.

Support for Java™ and globalization

The Java™ development kit provides a rich set of APIs for developing global applications. These globalization APIs are based on the Unicode 2.0 code set and can adapt text, numbers, dates, currency, and user-defined objects to any country conventions.

The globalization APIs are concentrated in three packages:

- The `java.text` package contains classes and interfaces for handling text in a locale-sensitive way.
- The `java.io` package contains new classes for importing and exporting non-Unicode character data.
- The `java.util` package contains the **Locale** class, the globalization support classes, and new classes for date and time handling.

Important: There is no connection between Java™ development kit locales and code sets; you must keep these code sets in agreement.

Support for HCL OneDB™ GLS variables

Globalization adds several environment variables to HCL OneDB™ JDBC Driver, which are summarized in the following table.

Supported HCL OneDB™ environment variables	Description
CLIENT_LOCALE	Specifies the locale of the client that is accessing the database. Provides defaults for user-defined formats such as the **GL_DATE** format. User-defined data types can use it

Supported HCL OneDB™ environment variables	Description
	for code-set conversion. Together with the **DB_LOCALE** variable, the database server uses this variable to establish the server processing locale. The **DB_LOCALE** and **CLIENT_LOCALE** values must be the same, or their code sets must be convertible.
DBCENTURY	Enables you to specify the appropriate expansion for one- or two-digit year DATE values
DBDATE	Specifies the end-user formats of values in DATE columns. Supported for compatibility with earlier versions; **GL_DATE** is preferred.
DB_LOCALE	Specifies the locale of the database. HCL OneDB™ JDBC Driver uses this variable to perform code-set conversion between Unicode and the database locale. Together with the **CLIENT_LOCALE** variable, the database server uses this variable to establish the server processing locale. The **DB_LOCALE** and **CLIENT_LOCALE** values must be the same, or their code sets must be convertible.
GL_DATE	Specifies the end-user formats of values in DATE columns
GL_USEGLU	To enable Unicode collation by Java/JDBC client applications with the International Components for Unicode (ICU), specify GL_USEGLU=1 in the connection string before connecting to the HCL OneDB™ instance. This enables the server to use advanced Unicode converters that are required to work with Java™. The GL_USEGLU environment variable must be set to a value of 1 (one) in the database server environment before the server is started, and before the database is created.
NEWCODESET	Allows new code sets to be defined between releases of HCL OneDB™ JDBC Driver.
NEWLOCALE	Allows new locales to be defined between releases of HCL OneDB™ JDBC Driver.

The HCL OneDB™ JDBC Driver does not change the decimal format, even if there is a **CLIENT_LOCALE** setting available. Globalization should be done within the Java™ application with the **DecimalFormat** class.

Important: The **DB_LOCALE**, **CLIENT_LOCALE**, and **GL_DATE** variables are supported only if the database server supports the feature.

Support for DATE end-user formats

The end-user format is the format in which a DATE value appears in a string variable. This section describes the **GL_DATE**, **DBDATE**, and **DBCENTURY** variables, which specify DATE end-user formats. These variables are optional.

Important: HCL OneDB™ JDBC Driver does not support ALS 6.0, 5.0, or 4.0 formats for the **DBDATE** or **GL_DATE** environment variables.

For more information about **GL_DATE**, see *HCL OneDB™ GLS User's Guide*.

The GL_DATE variable

The **GL_DATE** environment variable specifies the end-user formats of values in DATE columns. A **GL_DATE** format string can contain the following characters:

- One or more white space characters
- An ordinary character (other than the percent symbol (%) or a white space character)
- A formatting directive, which is composed of the percent symbol (%) followed by one or two conversion characters that specify the required replacement

Date formatting directives are defined in the following table.

Directive	Replaced by
%a	The abbreviated weekday name as defined in the locale
%A	The full weekday name as defined in the locale
%b	The abbreviated month name as defined in the locale
%B	The full month name as defined in the locale
%C	The century number (the year divided by 100 and truncated to an integer) as a decimal number (00 through 99)
%d	The day of the month as a decimal number (01 through 31) A single digit is preceded by a zero (0).
%D	Same as the %m/%d/%y format
%e	The day of the month as a decimal number (1 through 31) A single digit is preceded by a space.
%h	Same as the %b formatting directive
%iy	The year as a two-digit decade (00 through 99) It is the formatting directive that is specific to HCL OneDB™ for %y.
%iY	The year as a four-digit decade (0000 through 9999) It is the formatting directive that is specific to HCL OneDB™ for %Y.
%m	The month as a decimal number (01 through 12)
%n	A `newline` character
%t	The `TAB` character
%w	The weekday as a decimal number (0 - 6)

Directive	Replaced by
	The 0 represents the locale equivalent of Sunday.
%x	A special date representation that the locale defines
%y	The year as a two-digit decade (00 - 99)
%Y	The year as a four-digit decade (0000 - 9999)
%%	% (to allow % in the format string)

Important: GL_DATE optional date format qualifiers for field specifications are not supported.

For example, by using *%4m* to display a month as a decimal number with a maximum field width of 4 is not supported.

The **GL_DATE** conversion modifier O, which indicates use of alternative digits for alternative date formats, is not supported.

White space or other nonalphanumeric characters must appear between any two formatting directives. If a **GL_DATE** variable format does not correspond to any of the valid formatting directives, errors can result when the database server attempts to format the date.

For example, for a U.S. English locale, you can format an internal DATE value for 09/29/1998 using the following format:

```
* Sep 29, 1998 this day is:(Tuesday), a fine day *
```

To create this format, set the **GL_DATE** environment variable to this value:

```
* %b %d, %Y this day is:(%A), a fine day *
```

To insert this date value into a database table that has a date column, you can perform the following types of inserts:

- Nonnative SQL, in which SQL statements are sent to the database server unchanged

  Enter the date value exactly as expected by the **GL_DATE** setting.
- Native SQL, in which escape syntax is converted to a format that is specific to HCL OneDB™

  Enter the date value in the JDBC escape format `yyyy-mm-dd`; the value is converted to the **GL_DATE** format automatically.

The following example shows both types of inserts:

To retrieve the formatted **GL_DATE** DATE value from the database, call the getString() method of the **ResultSet** class.

To enter strings that represent dates into database table columns of char, varchar, or lvarchar type, you can also build date objects that represent the date string value. The date string value must be in **GL_DATE** format.

The following example shows both ways of selecting DATE values:

```
PreparedStatement pstmt = conn.prepareStatement("Select * from
   tablename "
   + "where col2 like ?;");
pstmt.setString(1, "%Tue%");
ResultSet r = pstmt.executeQuery();
while(r.next())
   {
   String s = r.getString(1);
   java.sql.Date d = r.getDate(2);
   System.out.println("Select: column col1 (GL_DATE format) = <"
      + s + ">");
   System.out.println("Select: column col2 (JDBC Escape format) = <"
      + d + ">");
   }
r.close();
pstmt.close();
```

The DBDATE variable (deprecated)

Support for the **DBDATE** environment variable provides compatibility with earlier versions for client applications that are based on HCL OneDB™ database server versions before 7.2x, 8.x, or 9.x. Use the **GL_DATE** environment variable for new applications.

The **DBDATE** environment variable specifies the end-user formats of values in DATE columns. End-user formats are used in the following ways:

- When you input DATE values, HCL® OneDB® products use the **DBDATE** environment variable to interpret the input. For example, if you specify a literal DATE value in an INSERT statement, HCL OneDB™ database servers require this literal value to be compatible with the format specified by the **DBDATE** variable.
- When you display DATE values, HCL® OneDB® products use the **DBDATE** environment variable to format the output.

With standard formats, you can specify the following attributes:

- The order of the month, day, and year in a date
- Whether the year is printed with two digits (Y2) or four digits (Y4)
- The separator between the month, day, and year

The format string can include the following characters:

- Hyphen (-), dot (.), and slash (/) are separator characters in a date format. A separator appears at the end of a format string (for example `Y4MD-`).
- A 0 indicates that no separator is displayed.
- D and M are characters that represent the day and the month.
- Y2 and Y4 are characters that represent the year and the number of digits in the year.

The following format strings are valid standard **DBDATE** formats:

- DMY2
- DMY4
- MDY4
- MDY2
- Y4MD
- Y4DM
- Y2MD
- Y2DM

The separator always goes at the end of the format string (for example, `DMY2/`). If no separator or an invalid character is specified, the slash (/) character is the default.

For the U.S. ASCII English locale, the default setting for **DBDATE** is `Y4MD-`, where Y4 represents a four-digit year, M represents the month, D represents the day, and hyphen (-) is the separator (for example, 1998-10-08).

To insert a date value into a database table with a date column, you can perform the following types of inserts:

- **Nonnative SQL**. SQL statements are sent to the database server unchanged. Enter the date value exactly as expected by the **DBDATE** setting.
- **Native SQL**. Escape syntax is converted to a format that is specific to HCL OneDB™. Enter the date value in the JDBC escape format `yyyy-mm-dd`; the value is converted to the **DBDATE** format automatically.

The following example shows both types of inserts (the **DBDATE** value is `MDY2-`):

```
stmt = conn.createStatement();
cmd = "create table tablename (col1 date, col2 varchar(20));";
rc = stmt.executeUpdate(cmd);..
.String[] dateVals = {"'08-10-98'", "{d '1998-08-11'}" };
String[] charVals = {"'08-10-98'", "'08-11-98'" };
int numRows = dateVals.length;
for (int i = 0; i < numRows; i++)
    {
    cmd = "insert into tablename values(" + dateVals[i] + ", " +
        charVals[i] + ")";
    rc = stmt.executeUpdate(cmd);
    System.out.println("Insert: column col1 (date) = " + dateVals[i]);
    System.out.println("Insert: column col2 (varchar) = " + charVals[i]);
    }
```

To retrieve the formatted **DBDATE** DATE value from the database, call the **getString** method of the **ResultSet** class.

To enter strings that represent dates into database table columns of char, varchar, or lvarchar type, you can build date objects that represent the date string value. The date string value needs to be in **DBDATE** format.

The following example shows both ways to select DATE values:

```
PreparedStatement pstmt = conn.prepareStatement("Select * from tablename "
    + "where col1 = ?;");
GregorianCalendar gc = new GregorianCalendar(1998, 7, 10);
```

```
java.sql.Date dateObj = new java.sql.Date(gc.getTime().getTime());
pstmt.setDate(1, dateObj);
ResultSet r = pstmt.executeQuery();
while(r.next())
    {
    String s = r.getString(1);
    java.sql.Date d = r.getDate(2);
    System.out.println("Select: column col1 (DBDATE format) = <"
        + s + ">");
    System.out.println("Select: column col2 (JDBC Escape format) = <"
        + d + ">");
    }
r.close();
pstmt.close();
```

The DBCENTURY variable

If a **String** value represents a DATE value that has less than a three-digit year and **DBCENTURY** is set, HCL OneDB™ JDBC Driver converts the **String** value to a DATE value and uses the **DBCENTURY** property to determine the correct four-digit expansion of the year.

The methods affected and the conditions under which they are affected are summarized in the following table.

Method	Condition
PreparedStatement.setString(int, String)	The target column is DATE.
PreparedStatement.setObject(int, String)	The target column is DATE.
IfxPreparedStatement.IfxSetObject(String)	The target column is DATE.

ResultSet.getDate(int)
ResultSet.getDate(int, Calendar)
ResultSet.getDate(String)
ResultSet.getDate(String, Calendar)
	The source column is a **String** type.

ResultSet.getTimestamp(int)
ResultSet. getTimestamp(int, Calendar)
ResultSet.getTimestamp(String)
ResultSet.getTimestamp(String, Calendar)
	The source column is a **String** type.

ResultSet.updateString(int, String)
ResultSet.updateString(String, String)
	The target column is DATE.

ResultSet.updateObject(int, String)
ResultSet.updateObject(int, String, int)
	The target column is DATE.

Method	Condition

ResultSet.updateObject(String, String)
ResultSet.updateObject(String, String, int)	

The following table describes the four possible settings for the **DBCENTURY** environment variable.

Setting	Meaning	Description
P	Past	Uses past and present centuries to expand the year value.
F	Future	Uses present and next centuries to expand the year value.
C	Closest	Uses past, present, and next centuries to expand the year value.
R	Present	Uses present century to expand the year value.

See the "Environment Variables" section in the *HCL OneDB™ Guide to SQL: Reference* for a discussion of the algorithms used for each setting and examples of each setting.

Here is an example of a URL that sets the **DBCENTURY** value:

```
jdbc:onedb://myhost:1533;user=myname;password=mypasswd;DBCENTURY=F;
```

A URL must not have a line break.

HCL OneDB™ JDBC Driver always includes four-digit years when it sends **java.sql.Date** and **java.sql.Timestamp** values to the server. Similarly, the server always includes four-digit years when it sends HCL OneDB™ date values to HCL OneDB™ JDBC Driver.

For examples of how to use **DBCENTURY** with HCL OneDB™ JDBC Driver, see the `DBCENTURYSelect.java`, `DBCENTURYSelect2.java`, `DBCENTURYSelect3.java`, `DBCENTURYSelect4.java`, and `DBCENTURYSelect5.java` example programs.

Precedence rules for end-user formats

The precedence rules that define how to determine an end-user format for an internal DATE value are listed here:

- If a **DBDATE** format is specified, this format is used.
- If a **GL_DATE** format is specified, a locale must be determined:
  - If a **CLIENT_LOCALE** value is specified, it is used with the **GL_DATE** format string to display DATE values.
  - If a **DB_LOCALE** value is specified but a **CLIENT_LOCALE** value is not, the **DB_LOCALE** value is compared with the database locale (read from the **systables** table of the user database) to verify that the **DB_LOCALE** value is valid. If the **DB_LOCALE** value is valid, it is used with the **GL_DATE** format string to display DATE values. If the **DB_LOCALE** value is not valid, the database locale is used with the **GL_DATE** format string.
  - If the **CLIENT_LOCALE** or **DB_LOCALE** values are not specified, the database locale is used with the **GL_DATE** format string to display DATE values.
- If a **CLIENT_LOCALE** value is specified, the DATE formats conform to the default formats associated with this locale.

- If a **DB_LOCALE** value is specified but no **CLIENT_LOCALE** value is specified, the **DB_LOCALE** value is compared with the database locale to verify that the **DB_LOCALE** value is valid.

  If the **DB_LOCALE** value is valid, the **DB_LOCALE** default formats are used. If the **DB_LOCALE** value is not valid, the default formats for dates associated with the database locale are used.
- If the **CLIENT_LOCALE** or **DB_LOCALE** values are not specified, all DATE values are formatted in U.S. English format, `Y4MD-`.

Support for code-set conversion

Code-set conversion converts character data from one code set to another. In a client/server environment, character data might need to be converted from one code set to another if the client and database server computers use different code sets to represent the same characters. For detailed information about code-set conversion, see the *HCL OneDB™ GLS User's Guide*.

You must specify code-set conversion for the following types of character data:

- SQL data types (char, varchar, nchar, nvarchar)
- SQL statements
- Database objects such as database names, column names, table names, statement identifier names, and cursor names
- Stored procedure text
- Command text
- Environment variables

HCL OneDB™ JDBC Driver converts character data as it is sent between client and database server. The code set (encoding) used for the conversion is specified in the **systables** catalog for the opened database. You set the **DB_LOCALE** and **CLIENT_LOCALE** values in the connection properties or database URL.

Unicode to database code set

Java™ is Unicode based, so HCL OneDB™ JDBC Driver converts data between Unicode and the HCL OneDB™ database code set. The code-set conversion value is extracted from the **DB_LOCALE** value specified at the time the connection is made. If the **DB_LOCALE** value is incorrect, a `Database Locale information mismatch` error occurs.

The **DB_LOCALE** value must be a valid HCL OneDB™ locale, with a valid HCL OneDB™ code-set name or number as shown in the compatibility table that follows. The following table maps the supported Java™ development kit encodings to HCL OneDB™ code sets.

HCL OneDB™ code set name	**HCL OneDB™ code set number**	**JDK code set**
8859-1	819	8859_1
GB18030-2000	5488	GB18030

You cannot use the HCL OneDB™ locale with a code set for which there is no JDK-supported encoding. This incorrect usage results in an `Encoding or code set not supported` error message.

The supported locales are **en_us** and **zh_cn**.

Unicode to client code set

Because the Unicode code set includes all existing code sets, the Java™ virtual machine (JVM) must render the character with the platforms local code set. Inside the Java™ program, you must always use Unicode characters. The JVM on that platform converts input and output between Unicode and the local code set.

For example, you specify button labels in Unicode, and the JVM converts the text to display the label correctly. Similarly, when the getText() method gets user input from a text box, the client program gets the string in Unicode, no matter how the user entered it.

Never read a text file one byte at a time. Always use the InputStreamReader() or OutputStreamWriter() methods to manipulate text files. By default, these methods use the local encoding, but you can specify an encoding in the constructor of the class, as follows:

```
InputStreamReader = new InputStreamReader (in, "SJIS");
```

You and the JVM are responsible for getting external input into the correct Java™ Unicode string. Thereafter, the database locale encoding is used to send the data to and from the database server.

Connect to a database with non-ASCII characters

If you do not specify the database name at connection time, the connection must be opened with the correct **DB_LOCALE** value for the specified database.

If close database and database *dbname* statements are issued, the connection continues to use the original **DB_LOCALE** value to interpret the database name. If the **DB_LOCALE** value of the new database does not match, an error is returned. In this case, the client program must close and reopen the connection with the correct **DB_LOCALE** value for the new database.

If you supply the database name at connection time, the **DB_LOCALE** value must be set to the correct database locale.

You can connect to an NLS database by defining a locale with **NEWCODESET** and **NEWLOCALE** connection properties. For information about their formats, see Connecting with the NEWLOCALE and NEWCODESET Environment Variables on page 190.

Code-set conversion for TEXT and CLOB data types

HCL OneDB™ JDBC Driver does not automatically convert between code sets for TEXT, BYTE, CLOB, and BLOB data types.

You can convert between code sets for TEXT and CLOB data types in one of the following ways:

- You can automate code-set conversion for TEXT or CLOB data between the client and database locales by using the **IFX_CODESETLOB** environment variable.
- You can convert between code sets for TEXT data by using the getBytes(), getString(), InputStreamReader(), and OutputStreamWriter() methods.

Convert with the IFX_CODESETLOB environment variable

You can automate the following pair of code-set conversions for TEXT and CLOB data types:

- Convert from client locale to database locale before the data is sent to the database server.
- Convert from database locale to client locale before the data is retrieved by the client.

To automate code-set conversion for TEXT and CLOB data types, set the **IFX_CODESETLOB** environment variable in the connection URL. For example: `IFX_CODESETLOB = 4096`. You can also use the following methods of the **IfxDataSource** class to set and get the value of **IFX_CODESETLOB**:

```
public void setIfxIFX_CODESETLOB(int codesetlobFlag);
public int getIfxIFX_CODESETLOB();
```

IFX_CODESETLOB can have the following values:

none

Default

Automatic code-set conversion is not enabled.

0

Automatic code-set conversion takes place in internal temporary files.

> 0

Automatic code-set conversion takes place in the memory of the client computer. The value indicates the number of bytes allocated for the conversion.

If the number of allocated bytes is less than the size of the large object, an error is returned.

To perform conversion in memory, you must specify an amount that is smaller than the memory limits of the client machines and larger than the possible size of any converted large object.

When you are using any of the following java.sql.Clob interface methods or HCL OneDB™ extensions to the Clob interface, no code-set conversion is performed, even if the **IFX_CODESETLOB** environment variable is set. These methods include:

```
IfxCblob::setAsciiStream(long)
Clob::setAsciiStream(long position, InputStream fin, int length)
```

IFX_CODESETLOB takes effect only for methods from the java.sql.PreparedStatement interface.

However when using any of following java.sql.Clob interface methods or HCL OneDB™ extensions to Clob interface, Unicode characters are always converted automatically to the database locale code set. Here is a list of those methods:

```
Clob::setCharacterStream(long) throws SQLException
Clob::setString(long, String) throws SQLException
Clob:: setString(long pos, String str, int offset, int len)
IfxCblob::setSubString(long position, String str, int length)
```

Convert with Java™ methods

The Java™ methods getBytes(), getString(), InputStreamReader(), and OutputStreamWriter() take a code-set parameter that converts to and from Unicode and the specified code set.

Here is sample code that shows how to convert a file from the client code set to Unicode and then from Unicode to the database code set:

```
File infile = new File("data_jpn.dat");
File outfile = new File ("data_conv.dat");..
.pstmt = conn.prepareStatement("insert into t_text values (?)");..
.// Convert data from client encoding to database encoding
System.out.println("Converting data ...\n");
try
    {
    String from = "SJIS";
    String to = "8859_1";
    convert(infile, outfile, from, to);
    }
catch (Exception e)
    {
    System.out.println("Failed to convert file");
    }

System.out.println("Inserting data ...\n");
try
    {
    int fileLength = (int) outfile.length();
    fin = new FileInputStream(outfile);
    pstmt.setAsciiStream(1 , fin, fileLength);
    pstmt.executeUpdate();
    }
catch (Exception e)
    {
    System.out.println("Failed to setAsciiStream");
    }..
.public static void convert(File infile, File outfile, String from, String to)
    throws IOException
    {
    InputStream in = new FileInputStream(infile);
    OutputStream out = new FileOutputStream(outfile);

    Reader r = new BufferedReader( new InputStreamReader( in, from));
    Writer w = new BufferedWriter( new OutputStreamWriter( out, to));

    //Copy characters from input to output. The InputStreamReader converts
    // from the input encoding to Unicode, and the OutputStreamWriter
    // converts from Unicode to the output encoding.  Characters that can
    // not be represented in the output encoding are output as '?'

    char[] buffer = new char[4096];
    int len;
    while ((len = r.read(buffer)) != -1)
        w.write(buffer, 0, len);
    r.close();
    w.flush();
    w.close();
    }
```

When you retrieve data from the database, you can use the same approach to convert the data from the database code set to the client code set.

Code-set conversion for BLOB and BYTE data types

When you use java.sql.PreparedStatement::setCharacterStream() to insert in a CLOB column, Java™ Unicode characters are converted automatically to the database locale code set. If the environment variable **IFX_CODESETLOB** is set, its value determine whether to perform code set conversion using temporary files or to perform the code set conversion in memory. If **IFX_CODESETLOB** is not set, the **LOBCACHE** environment variable determines whether the code set conversion takes place in temporary files or in memory.

However, you are discouraged from using java.sql.PreparedStatement::setCharacterStream() to insert BLOB or BYTE columns. The JDBC driver cannot insert Java™ characters in a database and consequently attempts code set conversion of the characters. Using java.sql.PreparedStatement::setBinaryStream() is the preferred way to insert BLOB or BYTE columns.

User-defined locales

HCL OneDB™ JDBC Driver uses the Java™ globalization API to manipulate international data.

The classes and methods in that API take a Java™ development kit locale or encoding as a parameter, but because the HCL OneDB™ **DB_LOCALE** and **CLIENT_LOCALE** properties specify the locale and code set based on HCL OneDB™ names, these HCL OneDB™ names are mapped to the Java™ development kit names. These mappings are kept in internal tables, which are updated periodically.

For example, the HCL OneDB™ and Java™ development kit names for the ASCII code set are 8859-1 and 8859_1, respectively. HCL OneDB™ JDBC Driver maps 8859-1 to 8859_1 in its internal tables and uses the appropriate name in the Java™ development kit classes and methods.

Connect with the NEWLOCALE and NEWCODESET properties

Because new locales may be created between updates of these tables, two connection properties, **NEWLOCALE** and **NEWCODESET**, let you specify a locale or code set that is not specified in the tables. Here is an example URL using these properties:

```
jdbc:onedb://myhost:1533;
   user=myname; password=mypasswd;NEWLOCALE=en_us,en_us;
   NEWCODESET=8859_1,8859-1,819;
```

A URL must be on one line.

The **NEWLOCALE** and **NEWCODESET** properties have the following formats:

```
NEWLOCALE=JDK-locale,Ifx-locale:JDK-locale,Ifx-locale...

NEWCODESET=JDK-encoding,Ifx-codeset,Ifx-codeset-number:JDK-
   encoding, Ifx-codeset,Ifx-codeset-number...
```

There is no limit to the number of locale or code-set mappings you can specify.

You can connect to an NLS database by defining a locale using **NEWCODESET** and **NEWLOCALE** connection properties.

If you specify an incorrect number of parameters or values, you get a `Locale Not Supported` or `Encoding or Code Set Not Supported` message.

If these properties are set in the URL or a **DataSource** object, the new values in **NEWLOCALE** and **NEWCODESET** override the values in the JDBC internal tables. For example, if JDBC already maps 8859-1 to 8859_1 internally, but you specify `NEWCODESET=8888,8859-1,819` instead, the new value `8888` is used for the code-set conversion.

Connect with the NEWNLSMAP property

To support connecting to NLS databases, HCL OneDB™ JDBC Driver maintains a table for mapping NLS locale to the corresponding Java™ development kit locale and code set. Locales and code sets that are not supported in a particular version of the development kit might be supported in later versions of the development kit. Use the **NEWNLSMAP** connection property to specify mappings for an NLS locale that is not specified in the table.

The **NEWNLSMAP** property has the following format:

```
NEWNLSMAP=NLS-locale,JDK-locale,JDK-codeset:NLS-locale,JDK-locale,
JDK-codeset,....
```

Here is an example URL using these properties:

```
jdbc:onedb://
myhost:9088/mydatabase;user=myname;password=mypasswd;NEWNLSMAP=rumanian,ro_RO,ISO8859_2;
```

There is no limit to the number of mappings you can specify. If you specify an incorrect number of parameters or values, you get a `Locale Not Supported` or `Encoding or Code Set Not Supported` message.

Support for globalized error messages

Message text is usually the text of an **SQLException** object, but can also be an **SQLWarn** object or any other text output from the driver.

There are two requirements to enable globalized message text output, as follows:

- You must add the full path of the `ifxlang.jar` file to the **$CLASSPATH** (UNIX™) or **%CLASSPATH%** (Windows™) environment variable. This JAR file contains globalized versions of all message text supported by HCL OneDB™ JDBC Driver. Supported languages are English and Chinese.
- The **CLIENT_LOCALE** environment variable value must be passed through the property list to the connection object at connection time if you are using a nondefault locale. For more information about **CLIENT_LOCALE** and GLS features in general, see Support for HCL OneDB GLS variables on page 178.

Several public classes have constructors that take the current connection object as a parameter so they have access to the **CLIENT_LOCALE** value. If you want access to non-English error messages, you must use the constructors that include the connection object. Otherwise, any error message text from those classes is in English only. Affected public classes are Interval, IntervalYM, IntervalDF, and IfxLocator. For more information about the constructors to use for these classes, see Work with HCL OneDB types on page 75.

For an example of how to use the globalized error message support feature, see the `locmsg.java` program, which is included with HCL OneDB™ JDBC Driver.

Smart trigger feature

Smart Triggers in JDBC are a set of classes/interfaces that provide an ease of use capability to the Push data feature.

A smart trigger is a set of commands issued to the database that sets up a push notification when certain changes happen to data in a table. These changes are detected by a SQL query that is run after INSERT, UPDATE, or DELETE commands are executed.

Using the smart trigger feature, you can quickly watch one or more tables for changes and receive callbacks when a change is detected. Using the following JDBC API, if you make any change to the customer's table (insert/update/delete) the notify() method that you specified will get called, allowing you to see the effects of the change and take action.

```
/* Create a new smart trigger */
IfmxThreadedSmartTrigger push = new IfxSmartTrigger("JDBC URL to sysadmin database here");
/* Create your own callback class */
IfmxSmartTriggerCallback callback = new IfmxSmartTriggerCallback() {
    @Override
    public void notify(String json) {
        /*Here you can process the json from the trigger event*/
        System.out.println("Trigger received! Data: " + json);
    }
};
/* Set additional properties like the timeout or a default label */
push.label("test-label").timeout(60);
/* Add one or more triggers against the table/owner/database using a SQL query */
push.addTrigger("customers", "informix", "stores_demo", "SELECT * FROM
 customers", "test-label-pushtest", callback);
/* IfmxThreadedSmartTrigger is runnable so you can easily start it in a background thread*/
Thread t = new Thread(push);
t.start();
/* you can wait on that thread or go and do other work */
j.join();
```

A dedicated server connection is required for using the smart trigger feature. Because of this, the **IfmxSmartTrigger** class uses a URL or a DataSource object for creating a new JDBC connection.

You can close or shut down the smart trigger by executing a close() method on the **IfmxSmartTrigger** object. This will queue-up a smooth shutdown of the session. You can also add or remove triggers anytime, as required. If the application has not started either the run() or watch() method, then the changes occur immediately. Otherwise, changes are queued until the driver receives data from the server. This will occur when any trigger is fired or when the timeout is reached.

If you want to manage the smart trigger without creating another thread, you can directly call the watch() method.

Warning: The watch() method is a blocking call and will never return unless another thread interrupts it or calls a close().

For details on all of the API's added, see the Javadoc documentation on the **IfmxThreadedSmartTrigger** interface.

Related links:

Push data feature

Detach trigger

Using the detach trigger methods in IfmxThreadedSmartTrigger, you can declare a Smart Trigger to be 'detachable'. A detachable trigger has an unique identifier which allows you to reconnect to the session on the server.

```
/* Detach a trigger */
IfxSmartTrigger push = new IfxSmartTrigger("jdbc-url-here");
push.detachable(true); //Set the trigger as detachable
push.open();
String session1 = push.getDetachableSessionID(); //Get the session id
//Closes the JDBC connection and returns the session ID
//This is the same session id as you get from the call above
Session1 = push.detach();
```

On detaching from the session, you can create a new Smart Trigger object and pass in the session ID.

```
push = new IfxSmartTrigger(“jdbc-url-here");
//Assign the session ID before you start the smart trigger
push.sessionID(sessionID);
TestPushCallback callback1 = new TestPushCallback();
push.registerCallback("test-label-pushtest", callback1);
push.start();
//You pick up where you left off, retrieving any messages you missed from the server
```

Tuning and troubleshooting

These topics provides tuning and troubleshooting information for HCL OneDB™ JDBC Driver.

Debug your JDBC API program

There are two mechanisms to generate trace outputs in JDBC. A legacy mechanism SQLDEBUG and a more modern use of a logging framework.

Note: Enabling tracing can have a noticeable impact on driver performance. Enable only logging to assist in diagnosing a problem with the driver.

JDBC Tracing Using Logging

You can enable tracing of the JDBC driver via the logging API Log4j. For JDBC versions 8.1.1.2 and above you will need to include the optional logging library which is found at https://search.maven.org/artifact/org.apache.logging.log4j/log4j-core/2.17.1/jar alongside the JDBC jar file in yoru CLASSPATH.

Important: The JDBC trace feature should only be used when directed by the HCL technical support representative.

You will need to provide to your application an XML configuration file that specifies what and where to log JDBC tracing information. You can take the example XML configuration file for Log4j2 below and save it where you application is running. Notice you can adjust modify the file path as well as the trace level. JDBC will only print events on 'trace' and 'debug' levels to avoid inadvertant printing of trace messages when the driver is used in applications already using Log4j.

This file must exist in the CLASSPATH of the running application or be specified using the Java system property `log4j2.configurationFile=/path/to/log4j2.xml`

```
<?xml version="1.0" encoding="UTF-8"?>
<Configuration monitorInterval="30" status="WARN">
  <Property name="pattern">%d{yyyy-MM-dd HH:mm:ss.SSS} | %-5level | %t | %c{1} | %method | %marker |
 %msg%n</Property>
  <Appenders>
    <File name="console" fileName="/tmp/onedb-jdbc.log">
      <PatternLayout pattern="${pattern}" />
    </File>
  </Appenders>
  <Loggers>
    <!-- Change this to 'trace' to print out driver events -->
    <Root level="trace" additivity="false">
      <AppenderRef ref="console" />
    </Root>
  </Loggers>
</Configuration>
```

If you already using Log4j or another logger you can enable JDBC logging by enabling trace events on the JDBC packages.

For more information on the customization and options available using Log4j refer to the Log4j configuration guide at https://logging.apache.org/log4j/2.x/manual/configuration.html

Package Name
com.onedb.jdbc
com.onedb.jdbcx
com.informix

SQLIDEBUG

You can set the SQLIDEBUG connection property to generate binary protocol trace. You set the connection property SQLIDEBUG to specify a file. For example:

```
SQLIDEBUG=/tmp/jdbctrace.log
```

A new trace file is generated for every connection and is suffixed with a timestamp. If you are using the **OneDBDataSource** class, you can use the OneDBDataSource.setPropery("SQLIDEBUG", "/tmp/jdbctrace.log") method.

Important: The binary SQLI protocol trace feature (SQLIDEBUG) should only be used when directed by the HCL technical support representative.

Manage performance

This section describes issues that might affect the performance of your queries:

- The **FET_BUF_SIZE** and **BIG_FET_BUF_SIZE** environment variables
- Memory management of large objects
- Reducing network traffic
- Using bulk inserts
- Tuning the connection pool.

Manage the fetch buffer size

Use the **FET_BUF_SIZE** and **SRV_FET_BUF_SIZE** environment variables to set the size of the fetch buffer.

When a SELECT statement is sent from a Java™ program to the HCL OneDB™ database, the returned rows, or *tuples*, are stored in a tuple buffer in HCL OneDB™ JDBC Driver. The default size of the tuple buffer is the larger of the returned tuple size or 4096 bytes.

You can use the HCL OneDB™ **FET_BUF_SIZE** environment variable to override the default size of the tuple buffer. **FET_BUF_SIZE** can be set to any positive integer less than or equal to 2 GiB (2147483648). If the **FET_BUF_SIZE** environment variable is set, and its value is larger than the default tuple buffer size, the tuple buffer size is set to the value of **FET_BUF_SIZE**.

Similarly, you can use the **SRV_FET_BUF_SIZE** environment variable to set the fetch buffer size for the local database server to use when it participates in cross-server distributed DML transactions. For 11.70.xC5 and newer versions, the maximum size to which **SRV_FET_BUF_SIZE** can be set is 1048576 (= 1 MiB).

Increasing the size of the tuple buffer can reduce network traffic between your Java™ program and the database, often resulting in better performance of queries. There are times, however, when increasing the size of the tuple buffer can actually degrade the performance of queries. This could happen if your Java™ program has many active connections to a database or if the swap space on your computer is limited. If this is true for your Java™ program or computer, you might not want to use the **FET_BUF_SIZE** or **SRV_FET_BUF_SIZE** environment variables to increase the size of the tuple buffer.

For more information about setting HCL OneDB™ environment variables, see Connect to the database on page 8. For more information about increasing the fetch buffer size, see the *HCL OneDB™ Guide to SQL: Reference*.

Manage memory for large objects

Whenever a large object (a BYTE, TEXT, BLOB, or CLOB data type) is fetched from the database server, the data is either cached into memory or stored in a temporary file (if it exceeds the memory buffer).

You can specify how large object data is stored by using an environment variable, **LOBCACHE**, that you include in the connection property list, as follows:

- To set the maximum number of bytes allocated in memory to hold the data, set the **LOBCACHE** value to that number of bytes.

  If the data size exceeds the **LOBCACHE** value, the data is stored in a temporary file. If a security violation occurs during creation of this file, the data is stored in memory.
- To always store the data in a file, set the **LOBCACHE** value to `0`.

  In this case, if a security violation occurs, HCL OneDB™ JDBC Driver makes no attempt to store the data in memory.
- To always store the data in memory, set the **LOBCACHE** value to a negative number.

  If the required amount of memory is not available, HCL OneDB™ JDBC Driver throws the **SQLException** message `Out of Memory`.

If the **LOBCACHE** size is invalid or not defined, the default size is 4096.

You can set the **LOBCACHE** value through the database URL, as follows:

```
URL = jdbc:onedb://158.58.9.37:9088/test;user=guest;password=iamaguest;lobcache=4096";
```

The preceding example stores the large object in memory if the size is 4096 bytes or fewer. If the large object exceeds 4096 bytes, HCL OneDB™ JDBC Driver tries to create a temporary file. If a security violation occurs, memory is allocated for the entire large object. If that fails, the driver throws an **SQLException** message.

Here is another example:

```
URL = "jdbc:onedb://hostname:9088/testdb;user=guest;passwd=whoknows;lobcache=0";
```

The preceding example uses a temporary file for storing the fetched large object.

Here is a third example:

```
URL = "jdbc:onedb://icarus:7110/testdb;user=guest;passwd=whoknows;lobcache=-1";
```

The preceding example always uses memory to store the fetched large object.

For programming information about how to use the TEXT and BYTE data types in a Java™ program, see BYTE and TEXT data types on page 78. For programming information about how to use the BLOB and CLOB data types in a Java™ program, see Smart large object data types on page 105.

Reduce network traffic

The two environment variables **OPTOFC** and **IFX_AUTOFREE** can be used to reduce network traffic when you close **Statement** and **ResultSet** objects.

Set **OPTOFC** to `1` to specify that the ResultSet.close() method does not require a network round trip if all the qualifying rows have already been retrieved in the clients tuple buffer. The database server automatically closes the cursor after all the rows have been retrieved.

HCL OneDB™ JDBC Driver might or might not have additional rows in the clients tuple buffer before the next ResultSet.next() method is called. Therefore, unless HCL OneDB™ JDBC Driver has received all rows from the database server, the ResultSet.close() method might still require a network round trip when **OPTOFC** is set to 1.

Set **IFX_AUTOFREE** to `1` to specify that the Statement.close() method does not require a network round trip to free the database server cursor resources if the cursor has already been closed in the database server.

You can also use the setAutoFree(boolean flag) and getAutoFree() methods to free database server cursor resources. For more information, see The Auto Free feature on page 67.

The database server automatically frees the cursor resources after the cursor is closed, either explicitly by the ResultSet.close() method or implicitly by the **OPTOFC** environment variable.

When the cursor resources have been freed, the cursor can no longer be referenced.

For examples of how to use the **OPTOFC** and **IFX_AUTOFREE** environment variables, see the `autofree.java` and `optofc.java` demonstration examples described in Sample code files on page 204. In these examples, the variables are set with the Properties.put() method.

For more information about setting HCL OneDB™ environment variables, see HCL OneDB JDBC Driver properties on page 15.

Bulk inserts

The bulk insert feature improves the performance of single INSERT statements that are executed multiple times with multiple value settings. For more information, see Perform bulk inserts on page 44.

Statement Caching

Statement caching is a way to improve client performance by caching and reusing **PreparedStatement** and **CallableStatement** objects. When you re-use a PreparedStatement or CallableStatement, you avoid the overhead of statement preparation which involves work in both the driver as well as the server to prepare the query for execution. As a result, you can get a performance benefit when re-using statements.

Note: Statement caching only works for PreparedStatement and CallableStatement objects. A basic Statement object cannot be cached as it does not have a set SQL string which is saved on the server.

Each physical connection to the server will have its own Statement cache. Statements are cached with a key. For implicit caching the key used is the SQL string used for the Statement. For an explicit cache, you can specific the key you want to save the Statement with.

Enabling Statement Caching

You can enable Statement caching in two ways. You can enable it by setting the statement cache size by calling the method **IfxConnection.setStatementCacheSize** or you can use the connection parameter **IFX_PREPAREDSTATEMENT_CACHE_SIZE** to the size you want set. A size of 0 disables the cache for this connection. By default, the statement cache is disabled (size is 0).

```
Connection conn =
 Driver.getConnection("jdbc:onedb://localhost:9889/testdb;user=onedbsa;password=password;
 IFX_PREPAREDSTATEMENT_CACHE_SIZE=20");
((IfxConnection)conn).setStatementCacheSize(20); // Can set the cache size at any time on the
 connection
```

Explicitly Statement Caching

You can explicitly save a statement into the case with a specified key. You must have already enabled the cache on the parent Connection object. You can then close any PreparedStatement or CallableStatement with **closeWithKey(String uniqueKey)**. This caches the statement with your key instead of the SQL statement.

You can retrieve a statement using the **IfxConnection.getStatementWithKey(String key)** or **IfxConnection.getCallWithKey(String key)** depending on if you are retrieving a PreparedStatement or a CallableStatement.

```
PreparedStatment p = conn.prepareStatement("SELECT * FROM systables");
((IfxPreparedStatement)p).closeWithKey("sample-key");

p = ((IfxConnection)conn).getStatementWithKey("sample-key");
```

Disabling Caching for a single Statement

Sometimes you do not want a Statement to be cached. In this case, you can use the JDBC Statement API to turn off the pool setting before you close the connection.

```
stmt.setPoolable(false);
stmt.close();
```

Example

```
Properties prop = new Properties();
prop.setProperty("IFX_PREPAREDSTATEMENT_CACHE_SIZE", "20"); //save 20 prepared statements
try(Connection con = DriverManager.getConnection(“JDBC-url-here", prop)) {
 try(PreparedStatement p = con.prepareStatement("INSERT INTO mytable VALUES(?)")) {
   //do work
 } //prepared statement closed/cached
 //SQL matches, so we get back the prepared statement handle to reuse
 try(PreparedStatement p = con.prepareStatement("INSERT INTO mytable VALUES(?)")) {
   //do work
 } //prepared statement closed/cached
}
```

A connection pool

To improve the performance and scalability of your application, you can obtain your connection to the database server through a **DataSource** object that references a **ConnectionPoolDataSource** object. HCL OneDB™ JDBC Driver provides a Connection Pool Manager as a transparent component of the **ConnectionPoolDataSource** object. The Connection Pool Manager keeps a closed connection in a pool instead of returning the connection to the database server as closed. Whenever a user requests a new connection, the Connection Pool Manager gets the connection from the pool, avoiding the overhead of having the server close and re-open the connection.

Using the **ConnectionPoolDataSource** object can significantly improve performance in cases where your application receives frequent, periodic connection requests.

For complete information about how and why to use a **DataSource** or **ConnectionPoolDataSource** object, see the JDBC 3.0 API.

Important: This feature does not affect IfxXAConnectionPoolDataSource, which operates under the assumption that connection pooling is handled by the transaction manager.

Deploying a ConnectionPoolDataSource object

About this task

In the following steps:

- The variable **cpds** refers to a **ConnectionPoolDataSource** object.
- The JNDI logical name for the **ConnectionPoolDataSource** object is **myCPDS**.
- The variable **ds** refers to a **DataSource** object.
- The logical name for the **DataSource** object is **DS_Pool**.

To deploy a ConnectionPoolDataSource object:

1. Instantiate an **IfxConnectionPoolDataSource** object.
2. Set any desired tuning properties for the object:

   ```
   cpds.setIfxCPMInitPoolSize(15);
   cpds.setIfxCPMMinPoolSize(2);
   cpds.setIfxCPMMaxPoolSize(20);
   cpds.setIfxCPMServiceInterval(30);
   ```
3. Register the **ConnectionPoolDataSource** object using JNDI to map a logical name to the object:

```
Context ctx = new InitialContext();
ctx.bind("myCPDS",cpds);
```

4. Instantiate an **IfxDataSource** object.
5. Associate the **DataSource** object with the logical name you registered for the **ConnectionPoolDataSource** object:

   ```
   ds.setDataSourceName("myCPDS",ds);
   ```

6. Register the **DataSource** object using JNDI:

   ```
   Context ctx = new InitialContext();
   ctx.bind("DS_Pool",ds);
   ```

Tune the Connection Pool Manager

During the deployment phase, you or your database administrator can control how connection pooling works in your applications by setting values for any of these Connection Pool Manager properties:

- IFMX_CPM_INIT_POOLSIZE lets you specify the initial number of connections to be allocated for the pool when the **ConnectionPoolDataSource** object is first instantiated and the pool is initialized. The default is `0`.

  Set this property if your application will need many connections when the **ConnectionPoolDataSource** object is first instantiated.

  To obtain the value, call getIfxCPMInitPoolSize().

  To set the value, call **setIfxCPMInitPoolSize (int *init*)**.

- IFMX_CPM_MAX_CONNECTIONS lets you specify the maximum number of simultaneous physical connections that the DataSource object can have with the server.

  `The value -1` specifies an unlimited number. The default is `-1`.

  To obtain the value, call getIfxCPMMaxConnections().

  To set the value, call **setIfxCPMMaxConnections(int *limit*)**.

- IFMX_CPM_MIN_POOLSIZE lets you specify the minimum number of connections to maintain in the pool. See the IFMX_CPM_MIN_AGELIMIT parameter for what to do when this minimum number of connections kept in the pool exceeds the age limit. The default is `0`.

  To obtain the value, call getIfxCPMMinPoolSize().

  To set the value, call **setIfxCPMMinPoolSize(int *min*)**.

- IFMX_CPM_MAX_POOLSIZE lets you specify the maximum number of connections to maintain in the pool. When the pool reaches this size, all connections return to the server. The default is `50`.

  To obtain the value, call getIfxCPMMaxPoolSize().

  To set the value, call **setIfxCPMMaxPoolSize(int *max*)**.

- IFMX_CPM_AGELIMIT lets you specify the time, in seconds, that a free connection is kept in the free connection pool.

  The default is `-1`, which means that the free connections are retained until the client terminates.

  To obtain the value, call getIfxCPMAgeLimit().

  To set the value, call **setIfxCPMAgeLimit(long *limit*)**.

- IFMX_CPM_MIN_AGELIMIT lets you specify the additional time, in seconds, that a connection in the free connection pool is retained when no connection requests have been received.

  Use this setting to reduce resources held in the pool when there are expected periods in which no connection requests will be made. A value of `0` indicates that no additional time is given to a connection in the minimum pool: the connection is released to the server whenever it exceeds IFMX_CPM_AGELIMIT.

  The default is `-1`, which means that a minimum number of free connections is retained until the client terminates.

  To obtain the value, call getIfxCPMMinAgeLimit().

  To set the value, call **setIfxCPMAgeMinLimit(long *limit*)**.

- IFMX_CPM_SERVICE_INTERVAL lets you specify the pool service frequency, in milliseconds.

  Pool service activity includes adding free connections (if the number of free connections falls below the minimum value) and removing free connections. The default is `50`.

  To obtain the value, call getIfxCPMServiceInterval().

  To set the value, call **setIfxCPMServiceInterval (long *interval*)**.

- IFMX_CPM_ENABLE_SWITCH_HDRPOOL lets you specify whether to allow automatic switching between the primary and secondary connection pools of an HDR database server pair.

  Set this property if your application relies on High-Availability Data Replication with connection pooling. The default is `false`.

  To obtain the value, call getIfxCPMSwitchHDRPool().

  To set the value, call **setIfxCPMSwitchHDRPool(boolean *flag*)**.

A demonstration program is available in the **connection-pool** directory within the `demo` directory where your JDBC driver is installed. For connection pooling with HDR, a demonstration program is available in the `hdr` directory within the `demo` directory. For details about the files, see Sample code files on page 204.

Some of these properties overlap Sun JDBC 3.0 properties. The following table lists the Sun JDBC 3.0 properties and their HCL OneDB™ equivalents.

Sun JDBC property name	HCL OneDB™ property name	Additional information
initialPoolSize	IFMX_CPM_INIT_POOLSIZE	

Sun JDBC property name	HCL OneDB™ property name	Additional information
maxPoolSize	IFMX_CPM_MAX_POOLSIZE	For maxPoolSize, 0 indicates no maximum size. For IFMX_CPM_MAX_POOLSIZE, you must specify a value.
minPoolSize	IFMX_CPM_MIN_POOLSIZE	
maxIdleTime	IFMX_CPM_AGELIMIT	For maxIdleTime, 0 indicates no time limit. For IFMX_CPM_AGELIMIT, -1 indicates no time limit.

The following Sun JDBC 3.0 properties are not supported:

- maxStatements
- propertyCycle

High-Availability Data Replication with connection pooling

HCL OneDB™ JDBC Driver implementation of connection pooling provides the ability to pool connections with database servers in an HDR pair:

- The primary pool contains connections to the primary server in an HDR pair.
- The secondary pool contains connections to the secondary server in an HDR pair.

You do not have to change application code to take advantage of connection pooling with HDR. Set the IFMX_CPM_ENABLE_SWITCH_HDRPOOL property to `TRUE` to allow switching between the two pools. When switching is allowed, the Connection Pool Manager validates and activates the appropriate connection pool.

When the primary server fails, the Connection Pool Manager activates the secondary pool. When the secondary pool is active, the Connection Pool Manager validates the state of the pool to check if the primary server is running. If the primary server is running, the Connection Pool Manager switches new connections to the primary server and sets the active pool to the primary pool.

If IFMX_CPM_ENABLE_SWITCH_HDRPOOL is set to `FALSE`, you can force switching to the other connection pool by calling the activateHDRPool_Primary() or activateHDRPool_Secondary() methods:

```
public void activateHDRPool_Primary(void) throws SQLException
public void activateHDRPool_Secondary(void) throws SQLException
```

The activateHDRPool_Primary() method switches the primary connection pool to be the active connection pool. The activateHDRPool_Secondary() method switches the secondary connection pool to be the active pool.

You can use the isReadOnly(), isHDREnabled(), and getHDRtype() methods with connection pooling (see Checks for read-only status of high-availability secondary servers on page 30).

A demonstration program is available in the `hdr` directory within the `demo` directory where HCL OneDB™ JDBC Driver is installed. For details about the files, see Sample code files on page 204.

Clean pooled connections

You can alter connections from their original, default properties by setting database properties, such as AUTOCOMMIT and TRANSACTION ISOLATION. When a connection is closed, these properties revert to their default values. However, a *pooled* connection does not automatically revert to default properties when it is returned to the pool.

In HCL OneDB™ JDBC Driver, you can call the scrubConnection() method to:

- Reset the database properties and connection level properties to the default values.
- Close open cursors and transactions.
- Retain all statements.

This now enables the application server to cache the statements, and it can be used across applications and sessions to provide better performance for end-user applications.

The signature of the scrubConnection() method is:

```
public void scrubConnection() throws SQLException
```

The following example demonstrates how to call scrubConnection():

```
try
  {
  IfmxConnection conn = (IfmxConnection)myConn;
  conn.scrubConnection();
  }
catch (SQLException e)
  {
  e.printStackTrace();
  }
```

The following method verifies whether a call to scrubConnection() has released all statements:

```
public boolean scrubConnectionReleasesAllStatements()
```

Manage connections

The following table contrasts different implementations of the connection.close() and scrubConnection() methods when they are in connection pool setup or not.

Connection pooling status	Behavior with connection.close() method	Behavior with scrubconnection() method
Non-connection pool setup	Closes database connection, all associated statement objects, and their result sets Connection is no longer valid.	Returns connection to default state, keeps opened statements, but closes result sets Connection is still valid. Releases resources associated with result sets only.

Connection pooling status	Behavior with connection.close() method	Behavior with scrubconnection() method
Connection Pool with HCL OneDB™ Implementation	Closes connection to the database and reopens it to close any statements associated with the connection object and reset the connection to its original state Connection object is then returned to the connection pool and is available when requested by a new application connection.	Returns a connection to the default state and keeps all open statements, but closes all result sets. Calling this method is not recommended here.
Connection Pool with AppServer Implementation	Defined by users connection pooling implementation	Returns connection to default state and retains opened statements, but closes result sets

Avoid application hanging problems (HP-UX only)

If your JDBC application hangs on your HP-UX server, check the setting for the PTHREAD_COMPAT_MODE environment variable on the HP-UX server. The **PTHREAD_COMPAT_MODE** environment variable should be set to 1. This variable tells the pthread library (libpthread) to run in 1 X 1 mode instead of MxN mode. 1 X 1 is the default mode now on HP-UX. Setting this environment variable should resolve the hang problem.

Appendixes

Sample code files

This section contains tables that list and briefly describe the code examples provided with the client-side version of HCL OneDB™ JDBC Driver.

Most of these examples can be adapted to work with server-side JDBC by changing the syntax of the connection URL. For more information, see Format of database URLs on page 12.

The examples in the `tools/udtudrmgr` directory and the `demo/xml` directory are for client-side JDBC only in the 2.2 release.

Summary of available examples

The examples are provided in two directories:

- The `demo` directory where your HCL OneDB™ JDBC Driver software is installed
- The `tools` directory beneath the `demo` directory

Examples in the demo directory

Each example has its own subdirectory. Most of the directories include a README file that describes the examples and how to run them.

Directory	Type of examples
`basic`	Examples that show common database operations
`bson`	Examples that show the usage of the IfxBSONObject extension class, which is used to access the HCL OneDB™ BSON data type.
`clob-blob`	Examples that use smart large objects
`udt-distinct`	Examples that use opaque and DISTINCT data types (there are additional examples using opaque types in Examples in the udtudrmgr directory on page 213)
`complex-types`	Examples that use row and collection types
`rmi`	An example using Remote Method Invocation
`stores7`	The **stores7** demonstration database
`pickaseat`	An example using **DataSource** objects
`connection-pool`	Examples that illustrate using a connection pool
`proxy`	Examples that illustrate using an HTTP proxy server
`xml`	Examples that illustrate storing and retrieving XML documents
`hdr`	Examples that illustrate using High-Availability Data Replication

Examples in the basic directory

The following table lists the files in the `basic` directory.

Demo program name	Description
`autofree.java`	Shows how to use the **IFX_AUTOFREE** environment variable
`BatchUpdate.java`	Shows how to send batch updates to the server
`ByteType.java`	Shows how to insert into and select from a table that contains a column of data type BYTE
`CallOut1.java`	Executes a C function that has an OUT parameter using **CallableStatement** methods
`CallOut2.java`	Executes an SPL function that has an OUT parameter using **CallableStatement** methods

Demo program name	Description
`CallOut3.java`	Executes a C function that has a Boolean OUT parameter using the IfmxCallableStatement.IfxRegisterOut Parameter() method
`CallOut4.java`	Executes a C function that has a CLOB type OUT parameter and uses the IfmxCallableStatement.hasOutParameter() method
`CreateDB.java`	Creates a database called **testDB**
`DBCENTURYSelect.java`	Uses the getString() method to retrieve a date string representation in which the four-digit year expansion is based on the **DBCENTURY** property value
`DBCENTURYSelect2.java`	Retrieves a date string representation in which the four-digit year expansion is based on the **DBCENTURY** property value using string-to-binary conversion Uses the getDate() method to build a **java.sql.Date** object upon which the date string representation is based
`DBCENTURYSelect3.java`	Retrieves a date string representation in which the four-digit year expansion is based on the **DBCENTURY** property value using string-to-binary conversion Uses the getTimestamp() method to build a **java.sql.Timestamp** object upon which the date string representation is based
`DBCENTURYSelect4.java`	Retrieves a date string representation in which the four-digit year expansion is based on the **DBCENTURY** property value using binary-to-string conversion Uses the getDate() method to build a **java.sql.Date** object upon which the date string representation is based
`DBCENTURYSelect5.java`	Retrieves a date string representation in which the four-digit year expansion is based on the **DBCENTURY** property value using binary-to-string conversion Uses the getTimestamp() method to build a **java.sql.Timestamp** object upon which the date string representation is based
`DBConnection.java`	Creates connections to both a database and a database server
`DBDATESelect.java`	Shows how to retrieve a date object and a date string representation from the database based on the **DBDATE** property value from the URL string
`DBMetaData.java`	Shows how to retrieve information about a database with the **DatabaseMetaData** interface
`DropDB.java`	Drops a database called **testDB**
`ErrorHandling.java`	Shows how to retrieve RSAM error messages

Demo program name	Description
`GLDATESelect.java`	Shows how to retrieve a date object and a date string representation from the database based on the **GL_DATE** property value from the URL string
`Intervaldemo.java`	Shows how to insert and select HCL OneDB™ interval data
`LOCALESelect.java`	Shows how to retrieve a date object and a date string representation from the database based on the **CLIENT_LOCALE** property value from the URL string
`locmsg.java`	Shows how to use HCL OneDB™ extension methods that support localized error messages
`MultiRowCall.java`	Shows how to return multiple rows in a stored procedure call
`OptimizedSelect.java`	Shows how to use the **FET_BUF_SIZE** environment variable to adjust the HCL OneDB™ JDBC Driver tuple buffer size
`optofc.java`	Shows how to use the **OPTOFC** environment variable
`PropertyConnection.java`	Shows how to specify connection environment variables via a property list
`RSMetaData.java`	Shows how to retrieve information about a result set with the **ResultSetMetaData** interface
`ScrollCursor.java`	Shows how to retrieve a result set with a scroll cursor
`Serial.java`	Shows how to insert and select HCL OneDB™ SERIal and SERIal8 data
`SimpleCall.java`	Shows how to call a stored procedure
`SimpleConnection.java`	Shows how to connect to a database or database server
`SimpleSelect.java`	Shows how to send a simple SELECT query to the database server
`TextConv.java`	Shows how to convert a file from the client code set to Unicode and then from Unicode to the database code set
`TextType.java`	Shows how to insert into and select from a table that contains a column of data type TEXT
`UpdateCursor1.java`	Shows how to create an updatable scroll cursor using a ROWID column in the query
`UpdateCursor2.java`	Shows how to create an updatable scroll cursor using a SERIAL column in the query
`UpdateCursor3.java`	Shows how to create an updatable scroll cursor using a primary key column in the query

Examples in the bson directory

The following table lists the files in the `bson` directory.

Demo program name	Description
`IfxBSONObjectDemo.java`	Shows the usage of BSON and JSON data types.

Examples in the clob-blob directory

The following table lists the files in the `clob-blob` directory.

Demo program name	Description
`demo1.java`	Shows how to create two tables with BLOB and CLOB columns and compare the data
`demo2.java`	Shows how to create one table with BYTE and TEXT columns and a second table with BLOB and CLOB columns and how to compare the data
`demo3.java`	Shows how to create one table with BLOB and CLOB columns and a second table with BYTE and TEXT columns and how to compare the data
`demo4.java`	Shows how to create two tables with BYTE and TEXT columns and compare the data
`demo5.java`	Shows how to store data from a file into a BLOB table column
`demo6.java`	Shows how to read a portion of the data in a smart large object
`demo_11.java`	Shows how to read data from a file into a buffer and write the contents of the buffer into a smart large object
`demo_13.java`	Shows how to write data into a smart large object and then insert the smart large object into a table
`demo_14.java`	Shows how to fetch smart large object data from a table

Examples in the udt-distinct directory

The following table lists the files in the `udt-distinct` directory (there are additional examples using opaque types in Examples in the udtudrmgr directory on page 213.)

Demo program name	Description
`charattrUDT.java`	Shows how to implement an opaque fixed-length type using **SQLData**
`createDB.java`	Creates a database that the other `udt-distinct` demonstration files use
`createTypes.java`	Shows how to create opaque and distinct types in the database
`distinct_d1.java`	Shows how to create a distinct type without using **SQLData**

Demo program name	Description
`distinct_d2.java`	Shows how to create a second distinct type without using **SQLData**
`dropDB.java`	Drops the database that the other `udt-distinct` demonstration files use
`largebinUDT.java`	Shows how to implement an opaque type (smart large object embedded) using **SQLData**
`manualUDT.java`	Shows how to implement an opaque type that allows you to change the position in the input stream
`myMoney.java`	Shows how to implement a distinct type using **SQLData**
`udt_d1.java`	Shows how to create a fixed-length opaque type
`udt_d2.java`	Shows how to create an opaque type with an embedded smart large object
`udt_d3.java`	Shows how to create an opaque type that allows you to change the position in the input stream

Examples in the complex-types directory

The following table lists the files in the `complex-types` directory.

Demo program name	Description
`createDB.java`	Creates a database with named rows
`list1.java`	Inserts and selects a simple collection using both the **java.sql.Array** and **java.util.Collection** classes
`list2.java`	Inserts and selects a collection with a nested row element Uses both the **java.sql.Array** and **java.util.Collection** classes for the collection and both the **SQLData** and **Struct** interfaces for the nested row
`r1_t.java`	Defines the **SQLData** class for named row **r1_t**
`r2_t.java`	Defines the **SQLData** class for named row **r2_t**
`GenericStruct.java`	Instantiates a **java.sql.Struct** object for inserting into named or unnamed rows
`row1.java`	Inserts and selects a simple named row using both the **SQLData** and **Struct** interfaces
`row2.java`	Inserts and selects a named row with a nested collection using both the **SQLData** and **Struct** interfaces The **SQLData** interface uses the HCL OneDB™ IfmxComplexSQLOutput. writeObject() and IfmxComplexSQLOutput.readObject() extension methods to write and read the nested collection.
`row3.java`	Inserts and selects an unnamed row with a nested collection
`fullname.java`	Contains the **SQLData** class for the named row **fullname_t**

Demo program name	Description
	Used by the **demo1.java** and **demo2.java** files
`person.java`	Contains the **SQLData** class for the named row **person_t** Used by the `demo1.java` and `demo2.java` files
`demo1.java`	Fetches a named row into an **SQLData** object
`demo2.java`	Inserts an **SQLData** object into a named row column
`demo3.java`	Fetches an unnamed row column into a **Struct** object
`demo4.java`	Inserts a **Struct** object into a named row column
`demo5.java`	Fetches the HCL OneDB™ SET column into a **java.util.HashSet** object
`demo6.java`	Fetches the HCL OneDB™ SET column into a **java.util.TreeSet** object A customized type mapping is provided to override the default.
`demo7.java`	Inserts a **java.util.HashSet** object into the HCL OneDB™ SET column
`demo8.java`	Fetches the HCL OneDB™ SET column into a **java.sql.Array** object
`dropDB.java`	Drops the database

Examples in the proxy directory

The following table lists the files in the `proxy` directory. A `README` file in the directory contains setup information.

Demo program name	Description
`ProxySelect.java`	(application) Creates a sample database and connects to it using four scenarios: • Connection with a proxy server and no LDAP server • Connection with an LDAP server and no proxy server • Connection using an `sqlhosts` file • Direct connection (no proxy servlet, `sqlhosts` file, or LDAP server)
`proxy.sh`	(shell script) Launches `ProxySelect.java`. To run the script (and the demo), type: `proxy.sh -d ProxySelect -s 2`
`proxy.java`	(applet) Performs the same operations as `ProxySelect.java` from an applet. To run the applet, type: `appletviewer proxy.html`

Demo program name	Description
`proxy.html`	HTML file for `proxy.java`
`ifmx.conf`	Sample LDAP configuration file
`ifmx.ldif`	Sample LDAP `ldif` file

Examples in the connection-pool directory

The following table lists the files in the `connection-pool` directory. A `README` file in the directory contains setup information.

Demo program name	Description
`AppSimulator.java`	Simulates multiple client threads making DataSource connections
`SetupDB.java`	Creates and populates a sample database. See the comments at the beginning of the code for a sample run command
`DS_Pool.prop`	Lists properties for a connection-pooling application
`myCPDS.prop`	Lists properties for a connection-pooling application, with the optional tuning parameters included
`DS_no_Pool.prop`	Lists properties for an application without connection pooling
`Register.java`	Registers a **DataSource** object with a JNDI Name registry A sample run command is: `java Register DS_no_Pool /tmp`
`runDemo`	(Shell script) Creates and populates a sample database; registers the data sources DS_no_Pool and DS_Pool; and runs an application to simulate multiple client threads that connect to the sample database

Examples in the xml directory

The following table lists the files in the `xml` directory.

Demo program name	Description
`CreateDB.java`	Creates a sample database
`makefile`	Compiles the examples
`myHandler.java`	Sample class of callback routines for the SAX parser
`sample1.xml`	Simple XML slide
`sample2.xml`	Sample set of XML slides
`sample2.dtd`	Document-type definition for `sample1.xml`
`xmldemo1.java`	Uses XMLtoString(), getInputSource(), and `myHandler.java` to convert the XML in `sample1.xml` to an InputSource object and then parses it using the SAX parser

Examples in the hdr directory

The following table lists the files in the `hdr` directory. A README file in the directory contains setup information.

Demo program name	Description
`SetupDB.java`	Creates a sample database and table
`Register.java`	Registers the DS_no_Pool and DS_Pool **DataSource** objects with a JNDI Name registry. A sample run command is: `java Register DS_no_Pool /tmp`
`AppSimulator.java`	Simulates High-Availability Data Replication redirection for pooled and nonpooled connections made with the DataSource.getConnection() method
`HdrSimpleConnect.java`	Shows how to implement HDR redirection with the DriverManager.getConnection() method

Examples in the tools directory

The `tools` directory includes the following subdirectories:

- The `udtudrmgr` directory contains examples that use UDT and UDR Manager to create opaque types and UDRs.
- The `classgenerator` directory contains sample output files of the ClassGenerator utility.

Examples in the udtudrmgr directory

The following table lists the files in the `udtudrmgr` directory. A `README` file in the directory contains setup information.

Demo program name	Description
`createDB.java`	Creates a sample database
`dropDB.java`	Drops the sample database
`Circle.java`	(Demo application 1) Implements a Java™ class, using the default **Input** and **Output** functions, to be converted to a Java™ opaque type
`PlayWithCircle.java`	(Demo application 1) Uses the Circle opaque type in a client application
`Circle2.java`	(Demo application 2) Implements a Java™ class, with user-supplied **Input** and **Output** functions, to be converted to a Java™ opaque type
`PlayWithCircle2.java`	(Demo application 2) Uses the Circle2 opaque type in a client application
`MyCircle.java`	(Demo application 3) Creates a fixed-length opaque type without a preexisting Java™ class
`Group1.java`	(Demo application 4) Maps methods in an existing Java™ class to Java™ UDRs
`PlayWithGroup1.java`	(Demo application 4) Uses the UDRs from `Group1.java` in a client application

DataSource extensions

This section lists the HCL OneDB™ extensions to standard JDBC classes:

- The **OneDBDataSource** class, which implements the javax.sql.DataSource interface.

For information about how and why to use a **DataSource** object, see the JDBC 3.0 API.

HCL OneDB™ JDBC Driver provides extensions for the following purposes:

- Reading and writing properties
- Getting and setting standard properties
- Getting and setting HCL OneDB™ connection properties

Read and write properties

The com.onedb.jdbcx.OneDBDataSource extends the commonly used java.util.Properties class and as such all of the methods of a Properties object can be used to set and get any property from the datasource as a String.

Example adding and getting a property using the Properties methods. You can use a String as the key, or use the com.onedb.jdbcx.OneDBParams constants.

```
OneDBDataSource ds = new OneDBDataSource();
//both of these set the same property
ds.setProperty("preparedStatementCacheSize", 20);
ds.setProperty(com.onedb.jdbc.OneDBParams.PREPAREDSTATEMENT_CACHE_SIZE, 20);

//example getting the parameter value back, including a default if it is not set.
String cacheSize = ds.getProperty("preparedStatementCacheSize");key, Object value);
```

Each property supported by the driver also has it's own set/get methods. These methods match the name of the property. The example below shows setting and getting the PreparedStatement cache size property.

```
// for preparedStatementCacheSize
ds.setPreparedStatementCacheSize(20); //uses int, not String
int cacheSize = ds.getPreparedStatementCacheSize();key);
```

Get and set standard properties

The following methods are defined in the extended **DataSource** interface for getting and setting properties defined in the JDBC 3.0 API.

Property	getXXX() and setXXX() method signatures

portNumber	public int getPortNumber();
	public void setPortNumber(int *value*);

databaseName	public String getDatabaseName();
	public void setDatabaseName(String *value*);

serverName	public String getServerName();
	public void setServerName(String *value*);

user	public String getUser();
	public void setUser(String *value*);

password	public String getPassword();
	public void setPassword(String *value*);

description	public String getDescription();
	public void setDescription(String *value*);

dataSourceName	public String getDataSourceName();
	public void setDataSourceName(String *value*);

The **networkProtocol** and **roleName** properties are not supported by HCL OneDB™ JDBC Driver.

Mapping data types

This section discusses mapping issues between data types defined in a Java™ program and the data types supported by the HCL OneDB™ database server.

Data type mapping between HCL OneDB™ and JDBC data types

Because there are variations between the SQL data types supported by each database vendor, the JDBC API defines a set of generic SQL data types in the class **java.sql.Types**. Use these JDBC API data types to reference generic SQL types in your Java™ programs that use the JDBC API to connect to HCL OneDB™ databases.

The following table shows the HCL OneDB™ data type to which each JDBC API data type maps.

JDBC API data type	HCL OneDB™ data type
BIGINT	INT8, BIGINT, BIGSERIAL
BINARY	BYTE
BIT [1]	BOOLEAN
REF	Not supported
CHAR	CHAR(*n*)
DATE	DATE
DECIMAL	DECIMAL
DOUBLE	FLOAT
FLOAT	FLOAT[2]
INTEGER	INTEGER
LONGVARBINARY	BYTE or BLOB
LONGVARCHAR	TEXT or CLOB
NUMERIC	DECIMAL
NUMERIC	MONEY
REAL	SMALLFLOAT
SMALLINT	SMALLINT
TIME	DATETIME HOUR TO SECOND[2]
TIMESTAMP	DATETIME YEAR TO FRACTION(5)[3]
TINYINT	SMALLINT

JDBC API data type	HCL OneDB™ data type
VARBINARY	BYTE
VARCHAR	VARCHAR(*m*,*r*)
BOOLEAN	BOOLEAN
SMALLINT	SMALLINT

[1] With Java™ 1.4 is , java.sql.Types.BOOLEAN maps to BOOLEAN.

[2] This mapping is JDBC compliant. You can map the JDBC FLOAT data type to the HCL OneDB™ SMALLFLOAT data type for backward compatibility by setting the **IFX_SET_FLOAT_AS_SMFLOAT** environment variable to 1.

[3] HCL OneDB™ DATETIME types are very restrictive and are not interchangeable. For more information, see Field lengths and date-time data on page 236.

Data type mapping between extended types and Java™ and JDBC types

The following table lists mappings between the extended data types supported in and the corresponding Java™ and JDBC types.

JDBC type	Java™ object type	HCL OneDB™ type
java.sql.Types.LONGVARCHAR	java.sql.String java.io.inputStream	LVARCHAR IfxTypes.IFX_TYPE_LVARCHAR
java.sql.Types.JAVA_OBJECT	java.sql.SQLData	Opaque type IfxTypes.IFX_TYPE_UDTFIXED IfxTypes.IFX_TYPE_UDTVAR
java.sql.Types.LONGVARBINARY java.sql.Types.BLOB	java.sql.Blob java.io.inputStream byte[]	BLOB IfxTypes.IFX_TYPE_BLOB
java.sql.Types.LONGVARCHAR java.sql.Types.CLOB	java.sql.Clob java.io.inputStream java.lang.String	CLOB IfxTypes.IFX_TYPE_CLOB
java.sql.Types.LONGVARBINARY java.sql.Types.BLOB	java.io.inputStream java.sql.Blob byte[]	BYTE IfxTypes.IFX_TYPE_BYTE
java.sql.Types.LONGVARCHAR java.sql.Types.CLOB	java.io.InputStream java.sql.Clob java.sql.String	TEXT IfxTypes.IFX_TYPE_TEXT

JDBC type	Java™ object type	HCL OneDB™ type
java.sql.Types.JAVA_OBJECT java.sql.Types.STRUCT	java.sql.SQLData java.sql.Struct	Named row IfxTypes.IFX_TYPE_ROW
java.sql.Types.STRUCT	java.sql.Struct	Unnamed row IfxTypes.IFX_TYPE_ROW
java.sql.Types.ARRAY java.sql.Types.OTHER	java.sql.Array java.util.LinkedList java.util.HashSet java.util.TreeSet	set, multiset IfxTypes.IFX_TYPE_SET IfxTypes.IFX_TYPE_MULTISET
java.sql.Types.ARRAY java.sql.Types.OTHER	java.sql.Array java.util.ArrayList java.util.LinkedList	LIST IfxTypes.IFX_TYPE_LIST

A Java™ boolean object can map to the HCL OneDB™ smallint data type or the HCL OneDB™ boolean data type. HCL OneDB™ JDBC Driver attempts to map it according to the column type. However, in cases such as **PreparedStatement** host variables, HCL OneDB™ JDBC Driver cannot access the column types, so the mapping is somewhat limited. For more details on data type mapping, see Data type mapping for PreparedStatement.setXXX() extensions on page 218.

Data type mapping between C opaque types and Java™

To create an opaque type using Java™, you can use the UDT and UDR Manager facility. For more information, see Work with opaque types on page 135.

All opaque data is stored in the database server table in a C struct, which is made up of various DataBlade® API types, as defined in the opaque type. (For more information, see the *HCL OneDB™ DataBlade® API Programmer's Guide*.)

The following table lists the mapping of DataBlade® API types to their corresponding Java™ types.

DataBlade® API type	Java™ type
MI_LO_HANDLE	BLOB or CLOB
gl_wchar_t	String
mi_boolean	boolean
mi_char	String
mi_char1	String
mi_date	Date
mi_datetime	TimeStamp

DataBlade® API type	Java™ type
mi_decimal	BigDecimal
mi_double_precision	double
mi_int1	byte
mi_int8	long
mi_integer	int
mi_interval	Not supported
mi_money	BigDecimal
mi_numeric	BigDecimal
mi_real	float
mi_smallint	short
mi_string	String
mi_unsigned_char1	String
mi_unsigned_int8	long
mi_unsigned_integer	int
mi_unsigned_smallint	short
mi_wchar	String

The C struct may contain padding bytes. HCL OneDB™ JDBC Driver automatically skips these padding bytes to make sure the next data member is properly aligned. Therefore, your Java™ objects do not have to take care of alignment themselves.

Data type mapping for PreparedStatement.setXXX() extensions

introduces many extended data types. As a result, there can be multiple mappings between a JDBC or Java™ data type and the corresponding HCL OneDB™ data type.

For example, you can use PreparedStatement.setAsciiStream() to insert into either a text column or a CLOB column. Similarly, you can also use PreparedStatement.setBinaryStream() to insert into a byte column or a BLOB column. Because the actual column information is not available to HCL OneDB™ JDBC Driver at all times, there can be ambiguity for the driver when it maps data types.

Normally, with INSERT, SELECT, or DELETE statements, the column information is available to the driver, so the driver can determine how the data can be sent to the database server.

However, when the data is referenced in an UPDATE statement or inside a WHERE clause, HCL OneDB™ JDBC Driver does not have access to the column information. In those cases, unless you use the HCL OneDB™ extensions, the driver maps those columns using the corresponding HCL OneDB™ data types listed in the first table in Data type mapping between HCL OneDB and JDBC data types on page 215. For the PreparedStatement.setAsciiStream() method, the driver tries to map to a text data type, and for the PreparedStatement.setBinaryStream() method, it tries to map to a byte data type.

The mapping extensions

To direct the driver to map to a certain data type (so there is no ambiguity in UPDATE statements and WHERE clauses), you can use extensions to the PreparedStatement.setXXX() methods. The only data types that might have ambiguity are boolean, lvarchar, text, byte, BLOB, and CLOB.

To use these extended methods, you must cast your **PreparedStatement** references to **IfmxPreparedStatement**. For example, the following code casts the statement variable **p_stmt** to **IfmxPreparedStatement** to call the IfxSetObject() method and insert the contents of a file as a large object of type CLOB. IfxSetObject() is defined as **I**:

```
public void IfxSetObject(int i, Object x, int scale, int ifxType)
   throws SQLException
public void IfxSetObject(int i, Object x, int ifxType) throws
   SQLexception
```

The code is:

```
File file = new File("sblob_06.dat");
int fileLength = (int)file.length();
byte[] buffer = new byte[fileLength];
FileInputStream fin = new FileInputStream(file);
fin.read(buffer,0,fileLength);
String str = new String(buffer);

writeOutputFile("Prepare");
PreparedStatement p_stmt = myConn.prepareStatement
   ("insert into sblob_t20(c1) values(?)");

writeOutputFile("IfxSetObject");
((IfmxPreparedStatement)p_stmt).IfxSetObject(1,str,30,IfxTypes.IFX
   _TYPE_CLOB);
```

For the **IfmxPreparedStatement.IfxSetObject** extension, you cannot simply overload the method signature with an added **ifxType** parameter, because such overloading creates method ambiguity. You must name the method to **IfxSetObject** instead.

The extensions for opaque types

The extensions for processing opaque types allow your application to specify the return type to which the database server should cast the opaque type before returning it to the client. This is known as *prebinding* the return value. The methods are:

- setBindColType(), which allows applications to specify the output type of result-set values using standard JDBC data types from **java.sql.Types**
- setBindColIfxType(), which allows applications to specify the output type of result-set values using HCL OneDB™ data types from **com.informix.lang.IfxTypes**

For more information about the available types, see The IfxTypes class on page 223.

- clearBindColType(), which resets values set through the previous two methods

In the following topics:

- The *colIndex* parameter specifies the column: 1 is the first column, 2 the second, and so forth
- The *sqltype* parameter is a value from **java.sql.Types**: for example, `Types.INTEGER`.
- The *ifxtype* parameter is a value from **IfxTypes**: for example, `IfxTypes.IFX_TYPE_DECIMAL`.

The setBindColType() methods

The methods are as follows:

```
public void setBindColType(int colIndex, int sqltype) throws SQLException;
public void setBindColType(int colIndex, int sqltype, int scale)
   throws SQLException;
public void setBindColType(int colIndex, int sqltype, String name)
   throws SQLException;
```

The first overloaded method allows applications to specify the output type to be `java.sql.DECIMAL` or `java.sql.NUMERIC`; the *scale* parameter specifies the number of digits to the right of the decimal point. The second overloaded method allows applications to specify the output type to be `java.sql.STRUCT`, `java.sql.ARRAY`, `java.sql.DISTINCT`, or `java.sql.JAVA_OBJECT` by assigning one of these values to the *name* parameter.

The setBindColIfxType() methods

The methods are as follows:

```
public void setBindColIfxType(int colIndex, int ifxtype) throws SQLException;
public void setBindColIfxType(int colIndex, int ifxtype, int scale)
   throws SQLException;
public void setBindColIfxType(int colIndex, int ifxtype, String name)
   throws SQLException;
```

The first overloaded method allows applications to specify the output type to be `IFX_TYPE_DECIMAL` or `IFX_TYPE_NUMERIC`; the *scale* parameter specifies the number of digits to the right of the decimal point. The second overloaded method allows applications to specify the output type to be `IFX_TYPE_LIST`, `IFX_TYPE_ROW`, `IFX_TYPE_MULTISET`, `IFX_TYPE_SET`, `IFX_TYPE_UDTVAR`, or `IFX_TYPE_UDTFIXED` by assigning one of these values to the *name* parameter.

The clearBindColType() method

The method is as follows:

```
public void clearBindColType() throws SQLException;
```

Prebinding example

The following code from the `udt_bindCol.java` sample program prebinds an opaque type to the HCL OneDB™ VARCHAR and then to a standard Java™ Integer type. The table used in this example has one **int** column and one opaque type column and is defined as follows:

```
create table charattr_tab (int_col int, charattr_col charattr_udt)
```

The code to select and prebind the opaque type in the **charattr_col** column is as follows:

```
String s = "select int_col, charattr_col as cast_udt_to_lvc, " +
    "charattr_col as cast_udt_to_int from charattr_tab order by 1";

pstmt = conn.prepareStatement(s);
    ((IfxPreparedStatement)pstmt).setBindColIfxType(2,IfxTypes.IFX_TYPE_LVARCHAR);
    ((IfxPreparedStatement)pstmt).setBindColType(3,Types.INTEGER);

ResultSet rs = pstmt.executeQuery();

System.out.println("Fetching data ...");
int curRow = 0;
while (rs.next())
{
     curRow++;
     int intret = rs.getInt("int_col");
     String strret = rs.getString("cast_udt_to_lvc");
     int intret2 = rs.getInt("cast_udt_to_int");
} // end while
```

Other mapping extensions

The remaining method signatures are listed next, along with any additional considerations that apply. In each case, the HCL OneDB™ type must be the last parameter to the standard JDBC PreparedStatement.setXXX() interface.

IfmxPreparedStatement.setArray()

```
public void setArray(int parameterIndex, Array x, int ifxType)
   throws SQLException
```

IfmxPreparedStatement.setAsciiStream()

```
public void setAsciiStream(int i, InputStream x, int length, int
   ifxType) throws SQLException
```

When your application is inserting a very large ASCII value into a LONGVARCHAR column, it is sometimes more efficient to send the ASCII value to the server using **java.io.InputStream**.

IfmxPreparedStatement.setBigDecimal()

```
public void setBigDecimal(int i, BigDecimal x, int ifxType)
   throws SQLException
```

IfmxPreparedStatement.setBinaryStream()

```
public void setBinaryStream(int i, InputStream x, int length, int
   ifxType) throws SQLException
```

When your application is inserting a very large binary value into a LONGVARbinary column, it is sometimes more efficient to send the binary value to the server using **java.io.InputStream**.

IfmxPreparedStatement.setBlob()

```
public void setBlob(int parameterIndex, Blob x, int ifxType)
   throws SQLException
```

IfmxPreparedStatement.setBoolean()

```
public void setBoolean(int i, boolean x, int ifxType) throws
   SQLException
```

IfmxPreparedStatement.setByte()

```
public void setByte(int i, byte x, int ifxType) throws
   SQLException
```

IfmxPreparedStatement.setBytes()

```
public void setBytes(int i, byte x[], int ifxType) throws
   SQLException
```

IfmxPreparedStatement.setCharacterStream()

```
public void setCharacterStream(int parameterIndex, Reader reader,
   int length, int ifxType) throws SQLException
```

When your application is setting a LONGVARCHAR parameter to a very large UNICODE value, it is sometimes more efficient to send the UNICODE value to the server using **java.io.Reader**.

IfmxPreparedStatement.setClob()

```
public void setClob(int parameterIndex, Clob x, int ifxType)
   throws SQLException
```

IfmxPreparedStatement.setDate()

```
public void setDate(int i, Date x, int ifxType) throws
   SQLException
public void setDate(int parameterIndex, Date x, Calendar Cal,
   int ifxType) throws SQLException
```

IfmxPreparedStatement.setDouble()

```
public void setDouble(int i, double x, int ifxType) throws SQ
   LException
```

IfmxPreparedStatement.setFloat()

```
public void setFloat(int i, float x, int ifxType) throws
   SQLException
```

IfmxPreparedStatement.setInt()

```
public void setInt(int i, int x, int ifxType) throws SQLException
```

IfmxPreparedStatement.setLong()

```
public void setLong(int i, long x, int ifxType) throws
   SQLException
```

IfmxPreparedStatement.setNull()

```
public void setNull(int i, int sqlType, int ifxType) throws
   SQLException
```

IfmxPreparedStatement.setShort()

```
public void setShort(int i, short x, int ifxType) throws
SQLException
```

IfmxPreparedStatement.setString()

```
public void setString(int i, String x, int ifxType) throws
   SQLException
```

IfmxPreparedStatement.setTime()

```
public void setTime(int i, Time x, int ifxType) throws
   SQLException
public void setTime(int parameterIndex, Time time, Calendar Cal,
   int ifxType) throws SQLException
```

IfmxPreparedStatement.setTimestamp()

```
public void setTimestamp(int i, Timestamp x, int ifxType) throws
   SQLException
public void setTimestamp(int parameterIndex, Timestamp x, Calendar
   Cal) throws SQLException
```

The IfxTypes class

The extended **IfmxPreparedStatement** methods require you to pass in the HCL OneDB™ data type to which you want to map. These types are part of the **com.informix.lang.IfxTypes** class.

The following table shows the **IfxTypes** constants and the corresponding HCL OneDB™ data types.

IfxTypes constant	HCL OneDB™ data type
IfxTypes.IFX_TYPE_BIGINT	BIGINT
IfxTypes.IFX_TYPE_BIGSERIAL	BIGSERIAL
IfxTypes.IFX_TYPE_CHAR	CHAR
IfxTypes.IFX_TYPE_SMALLINT	SMALLINT

IfxTypes constant	HCL OneDB™ data type
IfxTypes.IFX_TYPE_INT	INT
IfxTypes.IFX_TYPE_FLOAT	FLOAT
IfxTypes.IFX_TYPE_SMFLOAT	SMALLFLOAT
IfxTypes.IFX_TYPE_DECIMAL	DECIMAL
IfxTypes.IFX_TYPE_SERIAL	SERIAL
IfxTypes.IFX_TYPE_DATE	DATE
IfxTypes.IFX_TYPE_MONEY	MONEY
IfxTypes.IFX_TYPE_NULL	NULL
IfxTypes.IFX_TYPE_DATETIME	DATETIME
IfxTypes.IFX_TYPE_BYTE	BYTE
IfxTypes.IFX_TYPE_TEXT	TEXT
IfxTypes.IFX_TYPE_VARCHAR	VARCHAR
IfxTypes.IFX_TYPE_INTERVAL	INTERVAL
IfxTypes.IFX_TYPE_NCHAR	NCHAR
IfxTypes.IFX_TYPE_NVARCHAR	NVARCHAR
IfxTypes.IFX_TYPE_INT8	INT8
IfxTypes.IFX_TYPE_SERIAL8	SERIAL8
IfxTypes.IFX_TYPE_SET	SQLSET
IfxTypes.IFX_TYPE_MULTISET	SQLMULTISET
IfxTypes.IFX_TYPE_LIST	SQLLIST
IfxTypes.IFX_TYPE_ROW	SQLROW
IfxTypes.IFX_TYPE_COLLECTION	COLLECTION
IfxTypes.IFX_TYPE_UDTVAR	UDTVAR
IfxTypes.IFX_TYPE_UDTFIXED	UDTFIXED
IfxTypes.IFX_TYPE_REFSER8	REFSER8
IfxTypes.IFX_TYPE_LVARCHAR	LVARCHAR
IfxTypes.IFX_TYPE_SENDRECV	SENDRECV
IfxTypes.IFX_TYPE_BOOL	BOOLEAN

IfxTypes constant	HCL OneDB™ data type
IfxTypes.IFX_TYPE_IMPEXP	IMPEXP
IfxTypes.IFX_TYPE_IMPEXPBIN	IMPEXPBIN
IfxTypes.IFX_TYPE_CLOB	CLOB
IfxTypes.IFX_TYPE_BLOB	BLOB

Extension summary

The tables in this section list the PreparedStatement.setXXX() methods that HCL OneDB™ JDBC Driver supports for nonextended data types and HCL OneDB™ extended data types.

Nonextended data types

The following tables list the PreparedStatement.setXXX() methods that HCL OneDB™ JDBC Driver supports for nonextended data types. The top heading lists the standard JDBC API data types defined in the **java.sql.Types** class. These translate to specific HCL OneDB™ data types, as shown in the table in Data type mapping between extended types and Java and JDBC types on page 216. The tables below list the setXXX() methods you can use to write data of a particular JDBC API data type. An uppercase and bold **X** indicates the setXXX() method that it is recommended you use with HCL OneDB™ JDBC Driver; a lowercase x indicates other setXXX() methods that HCL OneDB™ JDBC Driver supports.

Numeric JDBC API data types

Table 10. Numeric JDBC API data types from java.sql.Types

setXXX() method	TINYINT	SMALLINT	INTEGER	BIGINT
setByte()	**X**	x	x	x
setShort()	x	**X**	x	x
setInt()	x	x	**X**	x
setLong()	x	x	x	**X**
setFloat()	x	x	x	x
setDouble()	x	x	x	x
setBigDecimal()	x	x	x	x
setBoolean()	x	x	x	x
setString()	x	x	x	x
setObject()	x	x	x	x

Table 11. Numeric JDBC API data types from java.sql.Types (continued)

setXXX() method	REAL	FLOAT	DOUBLE	DECIMAL	NUMERIC
setByte()	x	x	x	x	x
setShort()	x	x	x	x	x
setInt()	x	x	x	x	x
setLong()	x	x	x	x	x
setFloat()	**X**	x	x	x	x
setDouble()	x	**X**	**X**	x	x
setBigDecimal()	x	x	x	**X**	**X**
setBoolean()	x	x	x	x	x
setString()	x	x	x	x	x
setObject()	x	x	x	x	x

Character and chronological JDBC API data types

Table 12. Character and chronological JDBC API data types from java.sql.Types

setXXX() method	CHAR	VARCHAR	LONGVARCHAR	BINARY
setByte()	x[1 on page 227]	x[1 on page 227]		
setShort()	x[1 on page 227]	x[1 on page 227]		
setInt()	x[1 on page 227]	x[1 on page 227]		
setLong()	x[1 on page 227]	x[1 on page 227]		
setFloat()	x[1 on page 227]	x[1 on page 227]		
setDouble()	x[1 on page 227]	x[1 on page 227]		
setBigDecimal()	x	x		
setBoolean()	x	x		
setString()	**X**	**X**	x	x
setBytes()			x	**X**
setDate()	x	x		
setTime()	x	x		
setTimestamp()	x	x		

Table 12. Character and chronological JDBC API data types from java.sql.Types (continued)

setXXX() method	CHAR	VARCHAR	LONGVARCHAR	BINARY
setAsciiStream()			**X**	x
setCharacterStream()			**X**	x
setBinaryStream()			x	x
setObject()	x	x	x[2 on page 227]	x

Notes:

1. The column value must match the type of setXXX() exactly, or an **SQLException** is raised. If the column value is not within the allowed value range, the setXXX() method raises an exception instead of converting the data type. For example, setByte(1) raises an **SQLException** if the value being written is `1000`.
2. A byte array is written.

Table 13. Character and chronological JDBC API data types from java.sql.Types (continued)

setXXX() method	VARBINARY	LONGVARBINARY	DATE	TIME	TIMESTAMP
setString()	x	x	x	x	x
setBytes()	**X**	x			
setDate()			**X**		x
setTime()				**X**	x
setTimestamp()			x		**X**
setAsciiStream()	x	x			
setCharacterStream()	x	x			
setBinaryStream()	x	**X**			
setObject()	x	x[1 on page 227]	x	x[2 on page 227]	x

Notes:

1. A byte array is written.
2. A **Timestamp** object is written instead of a **Time** object.

The setMaxRows() method writes an SQL null value.

HCL OneDB™ extended data types

The following table lists the PreparedStatement.setXXX() methods that HCL OneDB™ JDBC Driver supports for the HCL OneDB™ extended data types, the mappings for which are shown in the table Data type mapping between extended types and Java and JDBC types on page 216. The table lists the setXXX() methods you can use to write data of a particular extended data type.

An uppercase and bold **X** indicates the recommended setXXX() method to use; a lowercase `x` indicates other setXXX() methods supported by HCL OneDB™ JDBC Driver. The table does not include setXXX() methods that you cannot use with any of the HCL OneDB™ extended data types.

Table 14. HCL OneDB™ extended data types

setXXX() method	BOOLEAN	LVARCHAR	Opaque types	BLOB	CLOB	BYTE	TEXT
setByte()	x	x					
setShort()	x						
setInt()	x						
setBoolean()	**X**						
setString()		**X**			x		x
setBytes()				x		x	
setAsciiStream()		x			x		**X**
setCharacterStream()		x			x		**X**
setBinaryStream()	x			x		**X**	
setObject()	x	x	**X**	x	x	x	x
setArray()							
setBlob()				**X**			
setClob()					**X**		

Table 15. HCL OneDB™ extended data types (continued)

setXXX() method	NAMED ROW	UNNAMED ROW	SET or MULTISET	LIST
setObject()	**X**	**X**	x	x
setArray()			x	x

The setMaxRows() method writes an SQL null value.

Data type mapping for ResultSet.getXXX() methods

Use the ResultSet.getXXX() methods to transfer data from the HCL OneDB™ database to a Java™ program that uses the JDBC API to connect to the HCL OneDB™ database. For example, use the ResultSet.getString() method to get the data stored in a column of data type LVARCHAR.

Important: If you use an expression within an SQL statement—for example, `SELECT mytype::LVARCHAR FROM mytab`—you might not be able to use ResultSet.getXXX(columnName) to retrieve the value. Use ResultSet.getXXX(columnIndex) to retrieve the value instead.

The getXXX() methods return a null value if the retrieved column value is an SQL null value.

The tables in this section list the ResultSet.getXXX() methods that HCL OneDB™ JDBC Driver supports for nonextended data types and HCL OneDB™ extended data types.

Nonextended data types

The following tables list the ResultSet.getXXX() methods that HCL OneDB™ JDBC Driver supports for nonextended data types. The top heading lists the standard JDBC API data types defined in the **java.sql.Types** class. These translate to specific HCL OneDB™ data types, as shown in the first table in Data type mapping between HCL OneDB and JDBC data types on page 215. The tables list the getXXX() methods you can use to retrieve data of a particular JDBC API data type.

An uppercase and bold **X** indicates the recommended getXXX() method to use; a lowercase `x` indicates other getXXX() methods supported by HCL OneDB™ JDBC Driver.

Numeric JDBC API data types

Table 16. Numeric JDBC API data types from java.sql.Types

getXXX() method	TINYINT	SMALLINT	INTEGER	BIGINT
getByte()	**X**	x	x	x
getShort()	x	**X**	x	x
getInt()	x	x	**X**	x
getLong()	x	x	x	**X**
getFloat()	x	x	x	x
getDouble()	x	x	x	x
getBigDecimal()	x	x	x	x
getBoolean()	x	x	x	x
getString()	x	x	x	x
getObject()	x	x	x	x

Table 17. Numeric JDBC API data types from java.sql.Types (continued)

getXXX() method	REAL	FLOAT	DOUBLE	DECIMAL	NUMERIC
getByte()	x	x	x	x	x
getShort()	x	x	x	x	x
getInt()	x	x	x	x	x
getLong()	x	x	x	x	x
getFloat()	**X**	x	x	x	x
getDouble()	x	**X**	**X**	x	x
getBigDecimal()	x	x	x	**X**	**X**
getBoolean()	x	x	x	x	x
getString()	x	x	x	x	x
getObject()	x	x	x	x	x

Character and chronological JDBC API data types

Table 18. Character and chronological JDBC API data types from java.sql.Types

getXXX() method	CHAR	VARCHAR	LONGVARCHAR	BINARY
getByte()	x[1 on page 231]	x[1 on page 231]		
getShort()	x[1 on page 231]	x[1 on page 231]		
getInt()	x[1 on page 231]	x[1 on page 231]		
getLong()	x[1 on page 231]	x[1 on page 231]		
getFloat()	x[1 on page 231]	x[1 on page 231]		
getDouble()	x[1 on page 231]	x[1 on page 231]		
getBigDecimal()	x	x		
getBoolean()	x	x		
getString()	**X**	**X**	x	x
getBytes()	x	x	x	**X**
getDate()	x	x		
getTime()	x	x		
getTimestamp()	x	x		

Table 18. Character and chronological JDBC API data types from java.sql.Types (continued)

getXXX() method	CHAR	VARCHAR	LONGVARCHAR	BINARY
getAsciiStream()			**X**	x
getCharacterStream()			**X**	x
getBinaryStream()			x	x
getObject()	x	x	x[2 on page 231]	x

Notes:

1. The column value must match the type of getXXX() exactly, or an **SQLException** is raised. If the column value is not within the allowed value range, the getXXX() method raises an exception instead of converting the data type. For example, getByte(1) raises an **SQLException** if the column value is `1000`.
2. A byte array is returned.

Table 19. Character and chronological JDBC API data types from java.sql.Types (continued)

getXXX() method	VARBINARY	LONGVARBINARY	DATE	TIME	TIMESTAMP
getString()	x	x	x	x	x
getBytes()	**X**	x			
getDate()			**X**		x
getTime()				**X**	x
getTimestamp()			x		**X**
getAsciiStream()	x	x			
getCharacterStream()	x	x			
getBinaryStream()	x	**X**			
getObject()	x	x[1 on page 232]	x	x[2 on page 232]	x

Notes:

1. A byte array is returned.
2. A **Timestamp** object is returned instead of a **Time** object.

HCL OneDB™ extended data types

The following table lists the ResultSet.getXXX() methods that HCL OneDB™ JDBC Driver supports for the HCL OneDB™ extended data types, the mappings for which are shown in the table Data type mapping between extended types and Java and JDBC types on page 216. The table lists the getXXX() methods you can use to retrieve data of a particular extended data type.

An uppercase and bold **X** indicates the recommended getXXX() method to use; a lowercase x indicates other getXXX() methods supported by HCL OneDB™ JDBC Driver. The table does not include getXXX() methods that you cannot use with any of the HCL OneDB™ extended data types.

Table 20. HCL OneDB™ extended data types

getXXX() method	BOOLEAN	LVARCHAR	Opaque types	BLOB	CLOB	BYTE
getByte()	x	x				
getShort()	x					
getInt()	x					
getBoolean()	**X**					
getString()		**X**			x	
getBytes()				x		x
getAsciiStream()		x			x	
getCharacterStream()		x			x	
getBinaryStream()	x			x		**X**
getObject()	x	x	**X**	x	x	x
getBlob()				**X**		
getClob()					**X**	

Table 21. HCL OneDB™ extended data types (continued)

getXXX() method	TEXT	NAMED ROW	UNNA MED ROW	SET or MUL TISET	LIST
getString()	x				
getBytes()					

Table 21. HCL OneDB™ extended data types (continued) (continued)

getXXX() method	TEXT	NAMED ROW	UNNA MED ROW	SET or MUL TISET	LIST
getAsciiStream()	**X**				
getCharacterStream()	**X**				
getBinaryStream()					
getObject()	x	**X**	**X**	x	x
getArray()				x	x
getBlob()					
getClob()					

Data type mapping for UDT manager and UDR manager

When you use the **UDTManager** and **UDRManager** classes to create opaque types and Java™ UDRs in the database server, the driver maps Java™ method arguments and return types to SQL data types according to the tables in this section. Any data type not shown in these tables is not supported.

If the Java™ method has arguments of any of the following Java™ types, the arguments and return type are mapped to SQL types in the server as shown in the following table. The table shows the HCL OneDB™ data type to which each Java™ data type maps.

Java™ data type	SQL data type
boolean, java.lang.Boolean	BOOLEAN
char	CHAR(1)
byte	CHAR(1)
short, java.lang.Short	SMALLINT
int, java.lang.Integer	INT
long, java.lang.Long	INT8
float, java.lang.Float	SMALLFLOAT
double, java.lang.Double	FLOAT[1]
java.lang.String	LVARCHAR
java.math.BigDecimal	DECIMAL

Java™ data type	SQL data type
	Default precision is set by the server to be: DECIMAL(`16,0`) for an ANSI database decimal (`16,255`) for a non-ANSI database
java.sql.Date	DATE
java.sql.Time	DATETIME HOUR TO SECOND
java.sql.Timestamp	DATETIME YEAR TO FRACTION(5)
com.informix.lang.IntervalYM	INTERVAL YEAR TO MONTH
com.informix.lang.IntervalDF	INTERVAL DAY TO FRACTION(5)
java.sql.Blob	BLOB
java.sql.Clob	CLOB

[1] This mapping is JDBC compliant. You can map the Java™ double data type (via the JDBC FLOAT data type) to the HCL OneDB™ SMALLFLOAT data type for backward compatibility by setting the **IFX_GET_SMFLOAT_AS_FLOAT** environment variable to 1.

Mapping for casts

The following table shows the mapping supported between the type defined for the *ifxtype* parameter in the UDTMetaData.setXXXCast() methods and SQL data types in the server.

***ifxtype* parameter type from com.informix.lang.IfxTypes**	**HCL OneDB™ data type**
IFX_TYPE_CHAR	CHAR
IFX_TYPE_SMALLINT	SMALLINT
IFX_TYPE_INT	INT
IFX_TYPE_FLOAT	FLOAT
IFX_TYPE_SMFLOAT	SMALLFLOAT
IFX_TYPE_DECIMAL	DECIMAL
IFX_TYPE_SERIAL	SERIAL
IFX_TYPE_DATE	DATE
IFX_TYPE_MONEY	MONEY
IFX_TYPE_DATETIME	DATETIME
IFX_TYPE_BYTE	BYTE

***ifxtype* parameter type from com.informix.lang.IfxTypes**	**HCL OneDB™ data type**
IFX_TYPE_TEXT	TEXT
IFX_TYPE_VARCHAR	VARCHAR
IFX_TYPE_INTERVAL	INTERVAL
IFX_TYPE_NCHAR	NCHAR
IFX_TYPE_NVARCHAR	NVARCHAR
IFX_TYPE_INT8	INT8
IFX_TYPE_SERIAL8	SERIAL8
IFX_TYPE_LVARCHAR	LVARCHAR
IFX_TYPE_SENDRECV	SENDRECV
IFX_TYPE_BOOL	BOOLEAN
IFX_TYPE_IMPEXP	IMPEXP
IFX_TYPE_IMPEXPBIN	IMPEXPBIN
IFX_TYPE_CLOB	CLOB
IFX_TYPE_BLOB	BLOB

Mapping for field types

The following table shows the mapping supported between the types defined for the *ifxtype* parameter in the UDTMetaData.setFieldType() method and the Java™ data types as they appear in the Java™ class file. Data types not shown in this table are not supported within the opaque type.

***ifxtype* parameter type from com.informix.lang.IfxTypes**	**Java™ data type**
IFX_TYPE_BIGINT	long
IFX_TYPE_BIGSERIAL	long
IFX_TYPE_CHAR	java.lang.String
IFX_TYPE_SMALLINT	short
IFX_TYPE_INT	int
IFX_TYPE_FLOAT	double
IFX_TYPE_SMFLOAT	float[1]
IFX_TYPE_DECIMAL	java.lang.BigDecimal
IFX_TYPE_SERIAL	int

***ifxtype* parameter type from com.informix.lang.IfxTypes**	**Java™ data type**
IFX_TYPE_DATE	Date
IFX_TYPE_MONEY	java.lang.BigDecimal
IFX_TYPE_DATETIME	java.lang.Timestamp if starting qualifier is Year, Month, or Day; otherwise, java.lang.Time (see Field lengths and date-time data on page 236).
IFX_TYPE_INTERVAL	com.informix.lang.IfxIntervalYM if starting qualifier is Year or Month; otherwise, com.informix.lang.IfxIntervalDF (see Field lengths and date-time data on page 236).
IFX_TYPE_NCHAR	java.lang.String
IFX_TYPE_INT8	long
IFX_TYPE_SERIAL8	long
IFX_TYPE_BOOL	boolean
IFX_TYPE_CLOB	java.sql.Clob
IFX_TYPE_BLOB	java.sql.Blob

[1] This mapping is JDBC compliant. You can map IFX_TYPE_SMFLOAT data type (via the JDBC FLOAT data type) to the Java™ double data type for backward compatibility by setting the IFX_GET_SMFLOAT_AS_FLOAT environment variable to 1.

Field lengths and date-time data

When you set a field type to a date-time or interval data type by calling setFieldType(IFX_TYPE_DATETIME) or setFieldType(IFX_TYPE_INTERVAL), the driver maps the date-time field to either **java.sql.Timestamp** or **java.sql.Time**, depending on the encoded length you set by calling setFieldLength().

For example, given that the standard format for a date-time field is YYYY-MM-DD HH:MM:SS, the driver uses the following mapping algorithm:

- If the encoded length has the start code from *hour* or less, it is mapped to **java.sql.Time**.
- If the encoded length has the start code from *year* or less, it is mapped to **java.sql.TimeStamp**.

For intervals, the standards are either YYYY-MM or DD HH:MM:SS.*frac*. The mapping is as follows:

- If the encoded length has the start code from *day* or less, it is mapped to **com.informix.jdbc.IfxIntervalDF**.
- If the encoded length has the start code from *year* or less, it is mapped to **com.informix.jdbc.IfxIntervalYM**.

Convert internal HCL OneDB™ data types

For your Java™ application to work with the internal server representation of HCL OneDB™ data types, use the **IfxToJavaType** class. For example, if your application is using the HCL® OneDB® Change Data Capture API, you can use the **IfxToJavaType** class to interpret the byte stream.

The IfxToJavaType class

The **IfxToJavaType** class handles all the HCL OneDB™ to Java™ data type conversions. Separate methods are provided for converting each HCL OneDB™ data type.

The primitive data types of Java™ are boolean, char, byte, short, int, long, float, double. When ever possible, the conversion returns the primitive data type rather than the Object.

The following table shows the data types that can be converted between the HCL OneDB™ data types to Java™ data types.

Table 22. Conversion between HCL OneDB™ and Java™ data types

HCL OneDB™ data types	Java™ data types
BIGINT	long
BYTE	int (as a large object ID, without an input stream)
CHAR (n) / CHARACTER (n)	string
DATE	java.sql.Date
DATETIME	java.sql.Timestamp
DATETIME	interval
DATETIME	string
DEC/DECIMAL (p,s)	java.lang.Bignum
DOUBLE PRECISION (n)	double
FLOAT	Same as DOUBLE PRECISION
INT8	long
INT/INTEGER	int
INTERVAL	interval
MONEY (p,s)	Same as DECIMAL
NUMERIC (p,s)	Same as DECIMAL
REAL	real
SERIAL (n)	int
SMALLFLOAT	Same as REAL
SMALLINT	short
TEXT	int (as a large object ID, without an input stream)

Table 22. Conversion between HCL OneDB™ and Java™ data types (continued)

HCL OneDB™ data types	Java™ data types
VARCHAR (m,r)	string

In addition to the conversion methods, the follow methods are also provided

- convertDateToDays()
- convertDaysToDate()
- rleapyear()
- widenByte()

The convertDateToDays() method

The convertDateToDays() method converts java.sql.Date to an **int** data type that encodes the number of days since January 1, 1900 as 1. Dates earlier than January 1, 1900 are encoded as negative numbers.

Method signature

```
public static int convertDateToDays (java.sql.Date dt)
```

Input parameter

dt

The java.sql date.

The convertDaysToDate() method

The convertDaysToDate() method converts days to year, date, or month. The convertDaysToDate() method handles negative days, interpreted as backwards from December 31, 1899 as 0. The convertDaysToDate() method interprets January 1, 1900 as 1. No dates before January 1, 0000 are allowed. The method relies on HCL OneDB™ to generate valid dates.

Method signature

```
public static java.sql.Date convertDaysToDate (int dt)
```

Input parameter

dt

The number of days since January 1, 1900 (as 1).

The IfxToJavaChar() method

The IfxToJavaChar() method converts the HCL OneDB™ CHAR (n) and CHARACTER (n) data types to the Java™ **string** data type. The conversion is achieved by creating a string from given bytes.

Method signature

```
public String IfxToJavaChar (byte b [], short prec,boolean encoption)
public String IfxToJavaChar (byte b [], boolean encoption)
public String IfxToJavaChar (byte b [], int offset, int length,
       short prec, boolean encoption)
public String IfxToJavaChar (byte b [], int offset, int length,
       boolean encoption)
public String IfxToJavaChar (byte b [], short prec, String dbEnc,
       boolean encoption)
public String IfxToJavaChar (byte b [], String dbEnc, boolean encoption)
       throws IOException
public String IfxToJavaChar (byte b [], int offset, int length,
       short prec,
       String dbEnc, boolean encoption)
public String IfxToJavaChar (byte b [], int offset, int length,
       String dbEnc, boolean encoption)
```

Input parameters

b

The bytes encoding data

dbEnc

The JDK encoding.

offset

The offset into byte array.

prec

The precision as received from HCL OneDB™.

length

The data length.

The IfxToJavaDate() method

The IfxToJavaDate() method converts the HCL OneDB™ DATE data type to the Java™ **java.sql.Date** data type.

Method signature

```
public static java.sql.Date IfxToJavaDate (byte b [], short prec)
public static java.sql.Date IfxToJavaDate (byte b [])
public static java.sql.Date IfxToJavaDate (byte b [], int offset,
       int length, short prec)
public static java.sql.Date IfxToJavaDate (byte b [], int offset)
```

Input parameters

b

The bytes encoding data

offset

The offset into byte array.

prec

The precision as received from HCL OneDB™.

length

The data length.

The IfxToJavaDateTime() method

The IfxToJavaDateTime() method converts the HCL OneDB™ DATETIME data type to the Java™ **java.sql.Timestamp** data type. The conversion path is HCL OneDB™ to decimal to timestamp.

Method signature

```
public static java.sql.Timestamp IfxToJavaDateTime (byte b [], short prec)
public static java.sql.Timestamp IfxToJavaDateTime (byte b [], int offset,
    int length, short prec)
public static java.sql.Timestamp IfxToJavaDateTime (byte b [], int offset,
    int length, short prec, Calendar cal)
```

Input parameters

b

The bytes encoding data

offset

The offset into byte array.

prec

The precision as received from HCL OneDB™.

length

The data length.

The IfxToDateTimeUnloadString() method

The IfxToDateTimeUnloadString() method converts the HCL OneDB™ DATETIME data type to the Java™ **string** data type, which is in format compatible with SQL LOAD/UNLOAD format. The conversion path is HCL OneDB™ to decimal to string.

Method signature

```
public static String IfxToDateTimeUnloadString (byte b [], int offset,
    int length, short prec)
```

Input parameters

b

The bytes encoding data

offset

The offset into byte array.

prec

The precision as received from HCL OneDB™.

length

The data length.

The IfxToJavaDecimal() method

The IfxToJavaDecimal() method converts the HCL OneDB™ DECIMAL data type to the Java™ **java.lang.Bignum** data type.

Method signature

```
public static java.math.BigDecimal IfxToJavaDecimal (byte b [], short prec)
public static java.math.BigDecimal IfxToJavaDecimal (byte b [], int offset,
    int length, short prec)
```

Input parameters

b

The bytes encoding data

offset

The offset into byte array.

prec

The precision as received from HCL OneDB™.

length

The data length.

The IfxToJavaDouble() method

The IfxToJavaDouble() method converts the HCL OneDB™ DOUBLE PRECISION data type to the Java™ **double** data type.

Method signature

```
public static double IfxToJavaDouble (byte b [], short prec)
public static double IfxToJavaDouble (byte b [])
public static double IfxToJavaDouble (byte b [], int offset, int length,
       short prec)
public static double IfxToJavaDouble (byte b [], int offset)
```

Input parameters

b

The bytes encoding data

offset

The offset into byte array.

prec

The precision as received from HCL OneDB™.

length

The data length.

The IfxToJavaInt() method

The IfxToJavaInt() method converts the HCL OneDB™ INTEGER data type to the Java™ **int** data type.

Method signature

```
public static int IfxToJavaInt (byte b [], short prec)
public static int IfxToJavaInt (byte b [])
public static int IfxToJavaInt (byte b [], int offset, int length,
       short prec)
public static int IfxToJavaInt (byte b [], int offset)
```

Input parameters

b

The bytes encoding data

offset

The offset into byte array.

prec

The precision as received from HCL OneDB™.

length

The data length.

The IfxToJavaInterval() method

The IfxToJavaInterval() method converts the HCL OneDB™ DATETIME data type to the Java™ **interval** data type. The conversion path is HCL OneDB™ to decimal to interval.

Method signature

```
public static Interval IfxToJavaInterval (byte b [], short prec)
public static Interval IfxToJavaInterval (byte b [], int offset, int length,
    short prec)
```

Input parameters

b

The bytes encoding data

offset

The offset into byte array.

prec

The precision as received from HCL OneDB™.

length

The data length.

The IfxToJavaLongBigInt() method

The IfxToJavaLongBigInt() method converts the HCL OneDB™ BIGINT data type to the Java™ **long** data type.

Method signature

```
public static long IfxToJavaLongBigInt(byte b [], short prec)
public static long IfxToJavaLongBigInt(byte b [])
public static long IfxToJavaLongBigInt(byte buf [], int offset,
       int length, short prec)
public static long IfxToJavaLongBigInt(byte b[], int offset)
```

Input parameters

b* and *buff

The bytes encoding data

offset

The offset into byte array.

prec

The precision as received from HCL OneDB™.

length

The data length.

The IfxToJavaLongInt() method

The IfxToJavaLongInt() method converts the HCL OneDB™ INT8 data type to the Java™ **long** data type.

Method signature

```
public  static long IfxToJavaLongInt(byte b [], short prec)
public  static long IfxToJavaLongInt(byte b [])
public  static long IfxToJavaLongInt(byte buf [], int offset, int length,
        short prec)
public  static long IfxToJavaLongInt(byte buf [], int offset)
```

Input parameters

b* and *buf

The bytes encoding data

offset

The offset into byte array.

prec

The precision as received from HCL OneDB™.

length

The data length.

The IfxToJavaReal() method

The IfxToJavaReal() method converts the HCL OneDB™ REAL data type to the Java™ **real** data type.

Method signature

```
public static float IfxToJavaReal (byte b [], short prec)
public static float IfxToJavaReal (byte b [])
public static float IfxToJavaReal (byte b [], int offset,
       int length, short prec)
public static float IfxToJavaReal (byte b [], int offset)
```

Input parameters

b

The bytes encoding data

offset

The offset into byte array.

prec

The precision as received from HCL OneDB™.

length

The data length.

The IfxToJavaSmallInt() method

The IfxToJavaSmallInt() method converts the HCL OneDB™ SMALLINT data type to the Java™ **short** data type.

Method signature

```
public static short IfxToJavaSmallInt (byte b [], short prec)
public static short IfxToJavaSmallInt (byte b [])
public static short IfxToJavaSmallInt (byte b [], int offset,
       int length, short prec)
public static short IfxToJavaSmallInt (byte b [], int offset)
```

Input parameters

b

The bytes encoding data

offset

The offset into byte array.

prec

The precision as received from HCL OneDB™.

length

The data length.

The rleapyear() method

The rleapyear() method determines if the year is a leap year.

Method signature

```
public static final boolean rleapyear(int yr)
```

The widenByte() method

The widenByte() method moves BYTE into the **short** data type in such a way that the high bit is not propagated.

Method signature

```
protected static final short widenByte(byte b)
```

Error messages

-79700

Method not supported

Explanation: HCL OneDB™ JDBC Driver does not support this JDBC method.

-79702

Cannot create new object

Explanation: The software could not allocate memory for a new **String** object.

-79703

Row/column index out of range

Explanation: The row or column index is out of range.

User response: Compare the index to the number of rows and columns expected from the query to ensure that it is within range.

-79704

Cant load driver

Explanation: HCL OneDB™ JDBC Driver could not create an instance of itself and register it in the **DriverManager** class. The rest of the **SQLException** text describes what failed.

-79705

Incorrect URL format

Explanation: The database URL you have submitted is invalid. HCL OneDB™ JDBC Driver does not recognize the syntax.

User response: Check the syntax and try again.

-79706

Incomplete input

Explanation: An invalid character was found during conversion of a **String** value to an **IntervalDF** or **IntervalYM** object.

User response: Check INTERVAL data type on page 83 for correct values.

-79707

Invalid qualifier

Explanation: An error was found during construction of an **Interval** qualifier from atomic elements: length, start, or end values.

User response: Check the length, start, and end values to verify that they are correct. See INTERVAL data type on page 83 for correct values.

-79708

Cannot take null input

Explanation: The string you have provided is null. HCL OneDB™ JDBC Driver does not understand null input in this case.

User response: Check the input string to ensure that it has the proper value.

-79709

Error in date format

Explanation: The expected input is a valid date string in the following format: `yyyy-mm-dd`.

User response: Check the date and verify that it has a four-digit year, followed by a valid two-digit month and two-digit day. The delimiter must be a hyphen (-).

-79710

Syntax error in SQL escape clause

Explanation: Invalid syntax was passed to a jdbc escape clause. Valid JDBC escape clause syntax is demarcated by braces and a keyword: for example, {*keyword syntax*}.

User response: Check the JDBC specification for a list of valid escape clause keywords and syntax.

-79711

Error in time format

Explanation: An invalid time format was passed to a JDBC escape clause. The escape clause syntax for time literals has the following format: {t '`hh:mm:ss`'}.

-79712

Error in timestamp format

Explanation: An invalid time stamp format was passed to a JDBC escape clause. The escape clause syntax for time stamp literals has the following format: {ts '`yyyy-mm-dd hh:mm:ss.f`...'}.

-79713

Incorrect number of arguments

Explanation: An incorrect number of arguments was passed to the scalar function escape syntax. The correct syntax is {fn *function*(*arguments*)}.

User response: Verify that the correct number of arguments was passed to the function.

-79714

Type not supported

Explanation: You have specified a data type that is not supported by HCL OneDB™ JDBC Driver.

User response: Check your program to make sure the data type used is supported by the driver.

-79715

Syntax error

Explanation: Invalid syntax was passed to a jdbc escape clause. Valid JDBC escape clause syntax is demarcated by braces and a keyword: {*keyword syntax*}.

User response: Check the JDBC specification for a list of valid escape clause keywords and syntax.

-79716

System or internal error

Explanation: An operating or runtime system error or a driver internal error occurred. The accompanying message describes the problem.

-79717

Invalid qualifier length

Explanation: The length value for an **Interval** object is incorrect.

User response: See INTERVAL data type on page 83 for correct values.

-79718

Invalid qualifier start code

Explanation: The start value for an **Interval** object is incorrect.

User response: See INTERVAL data type on page 83 for correct values.

-79719

Invalid qualifier end code

Explanation: The end value for an **Interval** object is incorrect.

User response: See INTERVAL data type on page 83 for correct values.

-79720

Invalid qualifier start or end code

Explanation: The start or end value for an **Interval** object is incorrect.

User response: See INTERVAL data type on page 83 for correct values.

-79721

Invalid interval string

Explanation: An error occurred during conversion of a **String** value to an **IntervalDF** or **IntervalYM** object. Check INTERVAL data type on page 83 for the correct format.

-79722

Numeric character(s) expected

Explanation: An error occurred during conversion of a **String** value to an **IntervalDF** or **IntervalYM** object. A numeric value was expected and not found. Check INTERVAL data type on page 83 for the correct format.

-79723

Delimiter character(s) expected

Explanation: An error occurred during conversion of a **String** value to an **IntervalDF** or **IntervalYM** object. A delimiter was expected and not found. Check the INTERVAL data type on page 83 for the correct format.

-79724

Character(s) expected

Explanation: An error occurred during conversion of a **String** value to an **IntervalDF** or **IntervalYM** object. `End of string` was encountered before conversion was complete.

User response: Check INTERVAL data type on page 83 for the correct format.

-79725

Extra character(s) found

Explanation: An error occurred during conversion of a **String** value to an **IntervalDF** or **IntervalYM** object. `End of string` was expected, but there were more characters in the string.

User response: Check INTERVAL data type on page 83 for the correct format.

-79726

Null SQL statement

Explanation: The SQL statement passed in was null.

User response: Check the SQL statement string of your program to make sure that it contains a valid statement.

-79727

Statement was not prepared

Explanation: The SQL statement was not prepared properly. If you use host variables (for example, `insert into mytab values (?, ?);`) in your SQL statement, you must use connection.prepareStatement() to prepare the SQL statement before you can execute it.

-79728

Unknown object type

Explanation: If this object type is a null opaque type, the type is unknown and cannot be processed. If this object type is a complex type, the data in the collection or array is of an unknown type and cannot be mapped to any HCL OneDB™ type. If this object type is a row, one of the elements in the row cannot be mapped to any HCL OneDB™ type. Verify the customized type mapping or data type of the object.

-79729

Method cannot take argument

Explanation: The method does not take an argument. See your Java™ API specification or the appropriate section of this guide to make sure that you are using the method properly.

-79730

Connection not established

Explanation: A connection was not established.

User response: You must obtain the connection by calling the DriverManager.getConnection() or DataSource.getConnection() method first.

-79731

MaxRows out of range

Explanation: You have specified an out-of-range **maxRow** value. Make sure that you specify a value between 0 and **Integer.MAX_VALUE**.

-79732

Illegal cursor name

Explanation: The cursor name specified is not valid. Make sure the string passed in is not null or empty.

-79733

No active result

Explanation: The statement does not contain an active result. Check your program logic to make sure that you have called the executeXXX() method before you attempt to refer to the result.

-79734

ONEDB_SERVER has to be specified

Explanation: ONEDB_SERVER is a property required for connecting to the HCL OneDB™ database. You can specify it in the database URL or as part of a **Properties** object that is passed to the connect() method.

-79735

Cant instantiate protocol

Explanation: An internal error occurred during a connection attempt. Call technical support.

-79736

No connection/statement establish yet

Explanation: There is no current connection or statement.

User response: Check your program to make sure that a connection was properly established or a statement was created.

-79737

No metadata

Explanation: There is no metadata available for this SQL statement.

User response: Make sure that the statement generates a result set before you attempt to use it.

-79738

No such column name

Explanation: The column name specified does not exist. Make sure that the column name is correct.

-79739

No current row

Explanation: The cursor is not properly positioned. You must first position the cursor within the result set by using a method such as ResultSet.next(), ResultSet.beforeFirst(), ResultSet.first(), or ResultSet.absolute().

-79740

No statement created

Explanation: There is no current statement. Make sure that the statement was properly created.

-79741

Cannot convert to

Explanation: There is no data conversion possible from the column data type to the one specified. The actual data type is appended to the end of this message.

User response: Review your program logic to make sure that the conversion you have asked for is supported. See Mapping data types on page 215 for the data mapping matrix.

-79742

Cannot convert from

Explanation: No data conversion is possible from the data type you specified to the column data type. The actual data type is appended to the end of this message.

User response: Check your program logic to make sure that the conversion you have asked for is supported. See Mapping data types on page 215 for the data mapping matrix.

-79744

Transactions not supported

Explanation: The user has tried to call commit() or rollback() on a database that does not support transactions or has tried to set **autoCommit** to `False` on a nonlogging database.

User response: Verify that the current database has the correct logging mode and review the program logic.

-79745

Read only mode not supported

Explanation: HCL OneDB™ does not support read-only mode.

-79746

No Transaction Isolation on non-logging db's

Explanation: HCL OneDB™ does not support setting the transaction isolation level on nonlogging databases.

-79747

Invalid transaction isolation level

Explanation: If the database server could not complete the rollback, this error occurs. See the rest of the **SQLException** message for more details about why the rollback failed.

This error also occurs if an invalid transaction level is passed to setTransactionIsolation(). The valid values are:

- `TRANSACTION_NONE`
- `TRANSACTION_READ_UNCOMMITTED`
- `TRANSACTION_READ_COMMITTED`
- `TRANSACTION_REPEATABLE_READ`
- `TRANSACTION_SERIALIZABLE`
- `TRANSACTION_LAST_COMMITTED`

-79748

Cannot lock the connection

Explanation: HCL OneDB™ JDBC Driver normally locks the connection object just before beginning the data exchange with the database server. The driver could not obtain the lock. Only one thread at a time should use the connection object.

-79749

Number of input values does not match number of question marks

Explanation: The number of variables that you set with the PreparedStatement.setXXX() methods in this statement does not match the number of `?` placeholders that you wrote into the statement.

User response: Locate the text of the statement and verify the number of placeholders and then check the calls to PreparedStatement.setXXX().

-79750

Method only for queries

Explanation: The Statement.executeQuery(String) and PreparedStatement.executeQuery() methods should only be used if the statement is a SELECT statement. For other statements, use the Statement.execute(String), Statement.executeBatch(), Statement.executeUpdate(String), Statement.getUpdateCount(), Statement.getResultSet(), or PreparedStatement.executeUpdate() method.

-79755

Object is null

Explanation: The object passed in is null. Check your program logic to make sure that your object reference is valid.

-79756

Must start with 'jdbc'

Explanation:

The first token of the database URL must be the keyword jdbc as in the following example:

```
jdbc:onedb://mymachine:1234/
   mydatabase;user=me;password=secret
```

-79757

Invalid subprotocol

Explanation: The current valid subprotocol is **onedb**.

-79758

Invalid IP address

Explanation: When you connect to the HCL OneDB™ database server through an IP address, the IP address must be valid. A valid IP address is a set of four numbers 0 - 255, separated by dots (.): for example, 127.0.0.1.

-79759

Invalid port number

Explanation:

The port number must be a valid four-digit number, as follows:

```
jdbc:onedb://mymachine:1234/
   mydatabase;user=me;password=secret
```

In this example, `1234` is the port number.

-79760

Invalid database name

Explanation: This statement contains the name of a database in some invalid format. Both database and cursor names must begin with a letter and contain only letters, numbers, and underscore characters. Database and cursor names can begin with an underscore. In MS-DOS systems, file names can be a maximum of eight characters plus a three-character extension.

-79761

Invalid property format

Explanation: The database URL accepts property values in key=value pairs. For example, `user=informix:password=informix` adds the key=value pairs to the list of properties that are passed to the connection object.

User response: Check the syntax of the key=value pair for syntax errors. Make sure that there is only one = sign; that there are no spaces separating the key, value, or =; and that key=value pairs are separated by one colon(:), again with no spaces.

-79762

Attempt to connect to a non 5.x server

Explanation: When connecting to a Version 5.x database server, the user must set the database URL property USE5SERVER to any non-null value. If a connection is then made to a Version 6.0 or later database server, this exception is thrown.

User response: Verify that the version of the database server is correct and modify the database URL as needed.

-79764

Invalid fetch direction value

Explanation: An invalid fetch direction was passed as an argument to the Statement.setFetchDirection() or ResultSet.setFetchDirection() method. Valid values are FETCH_FORWARD, FETCH_REVERSE, and FETCH_UNKNOWN.

-79765

ResultSet type is TYPE_FETCH_FORWARD, direction can only be FETCH_FORWARD

Explanation: The result set type has been set to TYPE_FORWARD_ONLY, but the setFetchDirection() method has been called with a value other than FETCH_FORWARD. The direction specified must be consistent with the result type specified.

-79766

Incorrect fetch size value

Explanation: The Statement.setFetchSize() method has been called with an invalid value. Verify that the value passed in is greater than `0`. If the setMaxRows() method has been called, the fetch size must not exceed that value.

-79767

ResultSet type is TYPE_FORWARD_ONLY

Explanation: A method such as ResultSet.beforeFirst(), ResultSet.afterLast(), ResultSet.first(), ResultSet.last(), ResultSet.absolute(), ResultSet.relative(), ResultSet.current(), or ResultSet.previous() has been called, but the result set type is TYPE_FORWARD_ONLY. Call only the ResultSet.next() method if the result set type is TYPE_FORWARD_ONLY.

-79768

Incorrect row value

Explanation: The ResultSet.absolute(int) method has been called with a value of `0`. The parameter must be greater than `0`.

-79769

A customized type map is required for this data type

Explanation: You must register a customized type map to use any opaque types.

-79770

Cannot find the SQLTypeName specified in the SQLData or Struct

Explanation: The **SQLTypename** object you specified in the **SQLData** or **Struct** class does not exist in the database. Make sure that the type name is valid.

-79771

Input value is not valid

Explanation: The input value is not accepted for this data type. Make sure this input value is a valid input for this data type.

-79772

No more data to read or write. Verify your SQLData class or getSQLTypeName()

Explanation: This error occurs when a Java™ user-defined routine attempts to read or set a position beyond the end of the opaque type data available from a data input stream.

User response: Check the length and structure of the opaque type carefully against the data-input UDR code. The **SQLTypeName** object that was returned by the getSQLTypeName() method might also be incorrect.

-79774

Unable to create local file

Explanation: Large object data read from the database server can be stored either in memory or in a local file. If the **LOBCACHE** value is `0` or the large object size is greater than the **LOBCACHE** value, the large object data from the database server is always stored in a file. In this case, if a security exception occurs, HCL OneDB™ JDBC Driver makes no attempt to store the large object into memory and throws this exception.

-79775

Only TYPE_SCROLL_INSENSITIVE and TYPE_FORWARD_ONLY are supported

Explanation: HCL OneDB™ JDBC Driver only supports a result set type of TYPE_SCROLL_INSENSITIVE and TYPE_FORWARD_ONLY. Only these values should be used.

-79776

Type requested (%s) does not match row type information (%s) type

Explanation: Row type information was acquired either through the system catalogs or through the supplied row definition. The row data provided does not match this row element type. The type information must be modified, or the data must be provided.

-79777

readObject/writeObject() only supports UDTs, Distincts, and complex types

Explanation: The SQLData.writeObject() method was called for an object that is not a user-defined, distinct, or complex type.

User response: Verify that you have provided customized type-mapping information.

-79778

Type mapping class must be a java.util.Collection implementation

Explanation: You provided a type mapping to override the default for a set, list, or multiset data type, but the class does not implement the **java.util.Collection** interface.

-79780

Data within a collection must all be the same Java™ class and length

Explanation: Verify that all the objects in the collection are of the same class.

-79781

Index/Count out of range

Explanation: Array.getArray() or Array.getResultSet() was called with index and count values. Either the index is out of range or the count is too large.

User response: Verify that the number of elements in the array is sufficient for the index and count values.

-79782

Method can be called only once

Explanation: Make sure methods such as Statement.getUpdateCount() and Statement.getResultSet() are called only once per result.

-79783

Encoding or code set not supported

Explanation: The encoding or code set entered in the **DB_LOCALE** or **CLIENT_LOCALE** variable is not valid.

User response: Check Support for code-set conversion on page 186 for valid code sets.

-79784

Locale not supported

Explanation: The locale entered in the **DB_LOCALE** or **CLIENT_LOCALE** variable is not valid.

User response: Check Support for code-set conversion on page 186 for valid locales.

-79785

Unable to convert JDBC escape format date string to localized date string

Explanation: The JDBC escape format for date values must be specified in the format {d '`yyyy-mm-dd`'}. Verify that the JDBC escape date format specified is correct.

User response: Verify the **DBDATE** and **GL_DATE** settings for the correct date string format if either of these environment variables was set to a value in the connection database URL string or property list.

-79786

Unable to build a Date object based on localized date string representation

Explanation: The localized date string representation specified in a char, varchar, or lvarchar column is not correct, and a date object cannot be built based on the year, month, and day values.

User response: Verify that the date string representation conforms to the **DBDATE** or **GL_DATE** date formats if either one of these is specified in a connection database URL string or property list. If neither **DBDATE** or **GL_DATE** is specified but a **CLIENT_LOCALE** or **DB_LOCALE** is explicitly set in a connection database URL string or property list, verify that the date string representation conforms to the JDK short default format (**DateFormat.SHORT**).

-79788

User name must be specified

Explanation: The user name is required to establish a connection with HCL OneDB™ JDBC Driver.

User response: Make sure that you pass in `user=your_user_name` as part of the database URL or one of the properties.

-79789

Server does not support GLS variables DB_LOCALE, CLIENT_LOCALE or GL_DATE

Explanation: These variables can only be used if the database server supports GLS.

User response: Check the documentation for your database server version and omit these variables if they are not supported.

-79790

Invalid complex type definition string

Explanation: The value returned by the getSQLTypeName() method is either null or invalid.

User response: Check the string to verify that it is either a valid named-row name or a valid row type definition.

-79792

Row must contain data

Explanation: The Array.getAttributes() or Array.getAttributes(Map) method has returned `0` elements. These methods must return a nonzero number.

-79793

Data in array does not match getBaseType() value

Explanation: The Array.getArray() or Array.getArray(Map) method has returned an array where the element type does not match the JDBC base type.

-79794

Row length provided (%s) does not match row type information (%s)

Explanation: Data in the row does not match the length in the row type information. You do not have to pad string lengths to match what is in the row definition, but lengths for other data types should match.

-79795

Row extended ID provided (%s) does not match row type information (%s)

Explanation: The extended ID of the object in the row does not match the extended ID as defined in row type information.

User response: Either update the row type information (if you are providing the row definition) or check the type mapping information.

-79796

Cannot find UDT, distinct, or named row (%s) in database

Explanation: The getSQLTypeName() method has returned a name that cannot be found in the database.

User response: Verify that the **Struct** or **SQLData** object returns the correct information.

-79797

DBDATE setting must be at least four characters and no longer than six characters

Explanation: This error occurs because the **DBDATE** format string that is passed to the database server either has too few characters or too many.

User response: To fix the problem, verify the **DBDATE** format string with the user documentation and make sure that the correct year, month, day, and possibly era parts of the **DBDATE** format string are correctly identified.

-79798

A numeric year expansion is required after 'Y' character in DBDATE string

Explanation: This error occurs because the **DBDATE** format string has a year designation (specified by the character `Y`), but there is no character following the year designation to denote the numeric year expansion (`2` or `4`).

User response: To fix the problem, modify the **DBDATE** format string to include the numeric year expansion value after the `Y` character.

-79799

An invalid character is found in the DBDATE string after the 'Y' character

Explanation: This error occurs because the **DBDATE** format string has a year designation (specified by the character `Y`), but the character following the year designation is not a `2` (two-digit years) or `4` (four-digit years).

User response: To fix the problem, modify the **DBDATE** format string to include the required numeric year expansion value after the `Y` character. Only a `2` or `4` character should immediately follow the `Y` character designation.

-79800

No 'Y' character is specified before the numeric year expansion value

Explanation: This error occurs because the **DBDATE** format string has a numeric year expansion (`2` to denote two-digit years or `4` to denote four-digit years), but the year designation character (`Y`) was not found immediately before the numeric year expansion character specified.

User response: To fix the problem, modify the **DBDATE** format string to include the required `Y` character immediately before the numeric year expansion value requested.

-79801

An invalid character is found in DBDATE format string

Explanation: This error occurs because the **DBDATE** format string has a character that is not allowed.

User response: To fix the problem, modify the **DBDATE** format string to only include the correct date part designations: year (`Y`), numeric year expansion value (`2` or `4`), month (`M`), and day (`D`). Optionally, you can include an era designation (`E`) and a default separator character (hyphen, dot, or slash), which is specified at the end of the **DBDATE** format string. Refer to the user documentation for further information about correct **DBDATE** format string character designations.

-79802

Not enough tokens are specified in the string representation of a date value

Explanation: This error occurs because the date string specified does not have the minimum number of tokens or separators needed to form a valid date value (composed of year, month, and day numeric parts). For example, 12/15/98 is a valid date string representation with the slash character as the separator or token. But 12/1598 is not a valid date string representation, because there are not enough separators or tokens.

User response: To fix the problem, modify the date string representation to include a valid format for separating the day, month, and year parts of a date value.

-79803

Date string index out of bounds during date format parsing to build Date object

Explanation: This error occurs because there is not a one-to-one correspondence between the date string format required by **DBDATE** or **GL_DATE** and the actual date string representation you defined. For example, if **GL_DATE** is set to `%b %D %y` and you specify a character string of `Oct`, there is a definite mismatch between the format required by **GL_DATE** and the actual date string.

User response: To fix the problem, modify the date string representation of the **DBDATE** or **GL_DATE** setting so that the date format specified matches one-to-one with the required date string representation.

-79804

No more tokens are found in DBDATE string representation of a date value

Explanation: This error occurs because the date string specified does not have any more tokens or separators needed to form a valid date value (composed of year, month, and day numeric parts) based on the **DBDATE** format string. For example, 12/15/98 is a valid date string representation when **DBDATE** is set to `MDY2/`. But 12/1598 is not a valid date string representation, because there are not enough separators or tokens.

User response: To fix the problem, modify the date string representation to include a valid format for separating the day, month, and year parts of a date value based on the **DBDATE** format string setting.

-79805

No era designation found in DBDATE/GL_DATE string representation of date value

Explanation: This error occurs because the date string specified does not have a valid era designation, as required by the **DBDATE** or **GL_DATE** format string setting. For example, if **DBDATE** is set to `Y2MDE-`, but the date string representation specified by the user is `98-12-15`, this is an error because there is no era designation at the end of the date string value.

User response: To fix the problem, modify the date string representation to include a valid era designation based on the **DBDATE** or **GL_DATE** format string setting. In this example, a date string representation of `98-12-15 AD` would probably suffice, depending on the locale.

-79806

Numerical day value can not be determined from date string based on DBDATE

Explanation: This error occurs because the date string specified does not have a valid numeric day designation as required by the **DBDATE** format string setting. For example, if **DBDATE** is set to `Y2MD-`, but the date string representation you specify is `98-12-blah`, this is an error, because `blah` is not a valid numeric day representation.

User response: To fix the problem, modify the date string representation to include a valid numeric day designation (from `1` to `31`) based on the **DBDATE** format string setting.

-79807

Numerical month value can not be determined from date string based on DBDATE

Explanation: This error occurs because the date string specified does not have a valid numeric month designation as required by the **DBDATE** format string setting. For example, if **DBDATE** is set to `Y2MD-`, but the date string representation you specify is `98-blah-15`, this is an error, because `blah` is not a valid numeric month representation.

User response: To fix the problem, modify the date string representation to include a valid numeric month designation (from 1 to 12) based on the **DBDATE** format string setting.

-79808

Not enough tokens specified in %D directive representation of date string

Explanation: This error occurs because the date string specified does not have the correct number of tokens or separators needed to form a valid date value based on the **GL_DATE** %D directive (`mm/dd/yy` format). For example, 12/15/98 is a valid date string representation based on the **GL_DATE** %D directive, but 12/1598 is not a valid date string representation, because there are not enough separators or tokens.

User response: To fix the problem, modify the date string representation to include a valid format for the **GL_DATE** %D directive.

-79809

Not enough tokens specified in %x directive representation of date string

Explanation: This error occurs because the date string specified does not have the correct number of tokens or separators needed to form a valid date value based on the **GL_DATE** %x directive (format required is based on day, month, and year parts, and the ordering of these parts is determined by the specified locale). For example, 12/15/98 is a valid date string representation based on the **GL_DATE** %x directive for the U.S. English locale, but 12/1598 is not a valid date string representation because there are not enough separators or tokens.

User response: To fix the problem, modify the date string representation to include a valid format for the **GL_DATE** %x directive based on the locale.

-79811

Connection without user/password not supported

Explanation: You called the getConnection() method for the **DataSource** object, and the user name or the password is null.

User response: Use the user name and password arguments of the getConnection() method or set these values in the **DataSource** object.

-79812

User/Password does not match with datasource

Explanation: You called the **getConnection(user, passwd)** method for the **DataSource** object, and the values you supplied did not match the values already found in the data source.

-79814

Blob/Clob object is either closed or invalid

Explanation: If you retrieve a smart large object using the ResultSet.getBlob() or ResultSet.getClob() method or create one using the IfxBlob() or IfxCblob() constructor, a smart large object is opened. You can then read from or write to the smart large object. After you execute the IfxBlob.close() method, do not use the smart large object handle for further read/write operations, or this exception is thrown.

-79815

Not in Insert mode. Need to call moveToInsertRow() first

Explanation: You tried to use the insertRow() method, but the mode is not set to Insert.

User response: Call the moveToInsertRow() method before calling insertRow().

-79816

Cannot determine the table name

Explanation: The table name in the query is either incorrect or refers to a table that does not exist.

-79817

No serial, rowid, or primary key specified in the statement

Explanation: The updatable scrollable feature works only for tables that have a SERIAL column, a primary key, or a row ID specified in the query. If the table does not have any of these attributes, an updatable scrollable cursor cannot be created.

-79818

Statement concurrency type is not set to CONCUR_UPDATABLE

Explanation: You tried to call the insertRow(), updateRow(), or deleteRow() method for a statement that has not been created with the CONCUR_UPDATABLE concurrency type.

User response: Re-create the statement with this type set for the concurrency attribute.

-79819

Still in Insert mode. Call moveToCurrentRow() first

Explanation: You cannot call the updateRow() or deleteRow() method while still in Insert mode. Call the moveToCurrentRow() method first.

-79820

Function contains an output parameter

Explanation: You have passed in a statement that contains an OUT parameter, but you have not used the drivers CallableStatement.registerOutParameter() and getXXX() methods to process the OUT parameter.

-79821

Name unnecessary for this data type

Explanation:

If you have a data type that requires a name (an opaque type or complex type) you must call a method that has a parameter for the name, such as the following methods:

```
public void IfxSetNull(int i, int ifxType,
   String name)
public void registerOutParameter
   (int parameterIndex,
   int sqlType, java.lang.String name);
public void IfxRegisterOutParameter
   (int parameterIndex,
   int ifxType, java.lang.String name);
```

The data type you have specified does not require a name.

User response: Use another method that does not have a type parameter.

-79822

OUT parameter has not been registered

Explanation: The function specified using the **CallableStatement** interface has an OUT parameter that has not been registered.

User response: Call one of the registerOutParameter() or IfxRegisterOutParameter() methods to register the OUT parameter type before calling the executeQuery() method.

-79823

IN parameter has not been set

Explanation: The function specified using the **CallableStatement** interface has an IN parameter that has not been set.

User response: Call the setMaxRows() or IfxSetNull() method if you want to set a null IN parameter. Otherwise, call one of the set methods inherited from the **PreparedStatement** interface.

-79824

OUT parameter has not been set

Explanation: The function specified using the **CallableStatement** interface has an OUT parameter that has not been set.

User response: Call the setMaxRows() or IfxSetNull() method if you want to set a null OUT parameter. Otherwise, call one of the set methods inherited from the **PreparedStatement** interface.

-79825

Type name is required for this data type

Explanation: This data type is an opaque type, distinct type, or complex type, and it requires a name.

User response: Use set methods for IN parameters and register methods for OUT parameters that take a type name as a parameter.

-79826

Ambiguous java.sql.Type, use IfxRegisterOutParameter()

Explanation: The SQL type specified either has no mapping to the HCL OneDB™ data type or has more than one mapping.

User response: Use one of the IfxRegisterOutParameter() methods to specify the HCL OneDB™ data type.

-79827

Function doesn't have an output parameter

Explanation: This function does not have an OUT parameter, or this function has an OUT parameter whose value the server version does not return. None of the methods in the **CallableStatement** interface apply. Use the inherited methods from the **PreparedStatement** interface.

-79828

Function parameter specified isnt an OUT parameter

Explanation: HCL OneDB™ functions can have only one OUT parameter, and it is always the last parameter.

-79829

Invalid directive used for the GL_DATE environment variable

Explanation: One or more of the directives specified by the **GL_DATE** environment variable is not allowed. Refer to The GL_DATE variable on page 180 for a list of the valid directives for a **GL_DATE** format.

-79830

Insufficient information given for building a time or timestamp Java™ object.

Explanation: To perform string-to-binary conversions correctly for building a **java.sql.Timestamp** or **java.sql.Time** object, all the DATETIME fields must be specified for the chosen date string representation. For **java.sql.Timestamp** objects, the year, month, day, hour, minute, and second parts must be specified in the string representation. For **java.sql.Time** objects, the hour, minute, and second parts must be specified in the string representation.

-79831

Exceeded maximum no. of connections configured for Connection Pool Manager

Explanation: If you repeatedly connect to a database using a **DataSource** object without closing the connection, connections accumulate. When the total number of connections for the **DataSource** object exceeds the maximum limit (100), this error is thrown.

-79834

Distributed transactions (XA) are not supported by this database server.

Explanation: This error occurs when the user calls the method XAConnection.getConnection() against an unsupported server.

-79836

Proxy Error: No database connection

Explanation: This error is thrown by the HCL OneDB™ HTTP Proxy if you try to communicate with the database on an invalid or bad database connection.

User response: Make sure your application has opened a connection to the database, check your web server and database error logs.

-79837

Proxy Error: Input/output error while communicating with database

Explanation: This error is thrown by the HCL OneDB™ HTTP Proxy if an error is detected while the proxy is communicating with the database. This error can occur if your database server is not accessible.

User response: Make sure your database server is accessible, check your database and web server error logs.

-79838

Cannot execute change permission command (chmod/attrib)

Explanation: The driver is unable to change the permissions on the client JAR file. This could happen if your client platform does not support the chmod or attrib command, or if the user running the JDBC application does not have the authority to change access permissions on the client JAR file.

User response: Make sure that the chmod or attrib command is available for your platform and that the user running the application has the authority to change access permissions on the client JAR file.

-79839

Same Jar SQL name already exists in the system catalog

Explanation: The JAR file name specified when your application called UDTManager.createJar() has already been registered in the database server.

User response: Use UDTMetaData.setJarFileSQLName() to specify a different SQL name for the JAR file.

-79840

Unable to copy jar file from client to server

Explanation: This error occurs when the path name set using setJarTmpPath() is not writable by user **informix** or the user specified in the JDBC connection.

User response: Make sure the pathname is readable and writable by any user.

-79842

No UDR information was set in UDRMetaData

Explanation: Your application called the UDRManager.createUDRs() method without specifying any UDRs for the database server to register.

User response: Specify UDRs for the database server to register by calling the UDRMetaData.setUDR() method before calling the UDRManager.createUDRs() method.

-79843

SQL name of the jar file was not set in UDR/UDT MetaData

Explanation: Your application called either the UDTManager.createUDT() or the UDRManager.createUDRs() method without specifying an SQL name for the JAR file containing the opaque types or UDRs for the database server to register.

User response: Specify an SQL name for a JAR file by calling the UDTMetaData.setJarFileSQLName() or UDRMetaData.setJarFileSQLName() method before calling the UDTManager.createUDT() or UDRManager.createUDRs() method.

-79844

Cant create/remove UDT/UDR as no database is specified in the connection

Explanation:

Your application created a connection without specifying a database. The following example establishes a connection and opens a database named **test**:

```
url = "jdbc:onedb://myhost:1533/test;user=rdtest;password=test";
conn = DriverManager.getConnection(url);
```

The following example establishes a connection with no database open:

```
url = "jdbc:onedb://myhost:1533;user=rdtest;password=test";
conn = DriverManager.getConnection(url);
```

User response:

To resolve this problem, use the following SQL statements after the connection is established and before calling the createUDT() or createUDRs() methods:

```
Statement stmt = conn.createStatement();
stmt.executeUpdate("create database test
   ...");
```

Alternatively, use the following code:

```
stmt.executeUpdate("database test");
```

-79845

JAR file on the client does not exist or cant be read

Explanation:

This error occurs for one of the following reasons:

- You failed to create a client JAR file.
- You specified an incorrect pathname for the client JAR file.
- The user running the JDBC application or the user specified in the connection does not have permission to open or read the client JAR file.

-79846

Invalid JAR file name

Explanation: The client JAR file your application specified as the second parameter to UDTManager.createUDT() or UDRManager.createUDRs() must end with the `.jar` extension.

-79847

The 'javac' or 'jar' command failed

Explanation:

The driver encountered compilation errors in one of the following cases:

- Compiling `.class` files into `.jar` files, using the jar command, in response to a createJar() command from the JDBC application
- Compiling `.java` files into `.class` files and `.jar` files, using the javac and jar commands, in response to a UDTManager.createUDTClass() method call from the JDBC application.

-79848

Same UDT SQL name already exists in the system catalog

Explanation: Your application called UDTMetaData.setSQLName() and specified a name that is already in the database server.

-79849

UDT SQL name was not set in UDTMetaData

Explanation: Your application failed to call UDTMetaData.setSQLName() to specify an SQL name for the opaque type.

-79850

UDT field count was not set in UDTMetaData

Explanation: Your application called UDTManager.createUDTClass() without first specifying the number of fields in the internal data structure that defines the opaque type.

User response: Specify the number of fields by calling UDTMetaData.setFieldCount().

-79851

UDT length was not set in UDTMetaData

Explanation: Your application called UDTManager.createUDTClass() without first specifying a length for the opaque type.

User response: Specify the total length for the opaque type by calling UDTMetaData.setLength().

-79852

UDT field name or field type was not set in UDTMetaData

Explanation: Your application called UDTManager.createUDTClass() without first specifying a field name and data type for each field in the data structure that defines the opaque type.

User response: Specify the field name by calling UDTMetaData.setFieldName(); specify a data type by calling UDTMetaData.setFieldType().

-79853

No class files to be put into the jar

Explanation:

Your application called the createJar() method and passed a zero-length string for the classnames parameter. The method signature is as follows:

```
createJar(UDTMetaData mdata, String[]
   classnames)
```

-79854

UDT java class must implement java.sql.SQLData interface

Explanation: Your application called UDTManager.createUDT() to create an opaque type whose class definition does not implement the **java.sql.SQLData** interface. UDTManager cannot create an opaque type from a class that does not implement this interface.

-79855

Specified UDT java class is not found

Explanation: Your application called the UDTManager.createUDT() method but the driver could not find a class with the name you specified for the third parameter.

-79856

Specified UDT does not exists in the database.

Explanation: Your application called **UDTManager.removeUDT(String *sqlname*)** to remove an opaque type named *sqlname* from the database, but the opaque type with that name does not exist in the database.

-79857

Invalid support function type

Explanation: This error occurs only if your application called the UDTMetaData.setSupportUDR() method and passed an integer other than `0` through `7` for the *type* parameter.

User response: Use the constants defined for the support UDR types. For more information, see The setSupportUDR() and setUDR() methods on page 152.

-79858

The command to remove file on the client failed

Explanation: If UDTMetaData.keepJavaFile() is not called or is set to `FALSE`, the driver removes the generated `.java` file when the UDTManager.createUDTClass() method executes. This error results if the driver was unable to remove the `.java` file.

-79859

Invalid UDT field number

Explanation: Your application called a UDTMetaData.setXXX() or UDTMetaData.getXXX() method and specified a field number that was less than `0` or greater than the value set through the UDTMetaData.setFieldCount() method.

-79860

Ambiguous java type(s) - can't use Object/SQLData as method argument(s)

Explanation: One or more parameters of the method to be registered as a UDR is of type **java.lang.Object** or **java.sql.SQLData**. These Java™ data types can be mapped to more than one HCL OneDB™ data type, so the driver is unable to choose a type.

User response: Avoid using **java.lang.Object** or **java.sql.SQLData** as method arguments.

-79861

Specified UDT field type has no Java™ type match

Explanation:

Your application called UDTMetaData.setFieldType() and specified a data type that has no 100 percent match in Java™. The following data types are in this category:

```
IfxTypes.IFX_TYPE_BYTE
IfxTypes.IFX_TYPE_TEXT
IfxTypes.IFX_TYPE_VARCHAR
IfxTypes.IFX_TYPE_NVARCHAR
IfxTypes.IFX_TYPE_LVARCHAR
```

User response: Use IFX_TYPE_CHAR or IFX_TYPE_NCHAR instead; these data types map to **java.lang.String**.

-79862

Invalid UDT field type

Explanation: Your application called UDTMetaData.setFieldType() and specified an unsupported data type for the opaque type. For supported data types, see Mapping for field types on page 235.

-79863

UDT field length was not set in UDTMetaData

Explanation: Your application specified a field of character, date-time, or interval type by calling UDTMetaData.setFieldType(), but failed to specify a field length. Call UDTMetaData.setFieldLength() to set a field length.

-79864

Statement length exceeds the maximum

Explanation: Your application issued an SQL PREPARE, DECLARE, or EXECUTE IMMEDIATE statement that is longer than the database server can handle. The limit differs with different implementations, but in most cases is up to 32,000 characters.

User response: Review the program logic to ensure that an error has not caused your application to present a string that is longer than intended. If the text has the intended length, revise the application to present fewer statements at a time. This is the same as error -460 returned by the database server.

-79865

Statement already closed

Explanation: This error occurs when an application attempts to access a statement method after the stmt.close() method.

-79868

Result set not open, operation not permitted

Explanation: This error occurs when an application attempts to access a **ResultSet** method after the ResultSet.close() method.

-79877

Invalid parameter value for setting maximum field size to a value less than zero

Explanation: This error occurs when an application attempts to set the maximum field size to a value less than zero.

-79878

Result set not open, operation next not permitted. Verify that autocommit is OFF

Explanation: This error occurs when an application attempts to access the ResultSet.next() method without executing a result set query.

-79879

An unexpected exception was thrown. See next exception for details

Explanation: This error occurs when a non-SQL exception occurs; for example, an IO exception.

-79880

Unable to set JDK Version for the Driver

Explanation: This error occurs when the driver cannot obtain the JDK version from the Java™ virtual machine.

-79881

Already in local transaction, so cannot start XA transaction

Explanation: This error occurs when the application attempts to start an XA transaction while a local transaction is still in progress.

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