HCL Informix 14.10 - ODBC Driver Programmer's Manual

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Chapter 1. Informix® ODBC Driver Guide

These topics serve as a user guide and reference for HCL Informix® ODBC Driver, which is the Informix® implementation of the Microsoft™ Open Database Connectivity (ODBC) interface, Version 3.0.

These topics explain how to use the HCL Informix® ODBC Driver application programming interface (API) to access the Informix® database and interact with the Informix® database server.

These topics are written for C programmers who use HCL Informix® ODBC Driver to access Informix® databases.

These topics assume that you have the following background:

- A working knowledge of your computer, your operating system, and the utilities that your operating system provides
- Some experience working with relational or object-relational databases, or exposure to relational database concepts
- C programming language

For information about software compatibility, see the Informix® Client SDK release notes.

These topics are taken from *IBM® Informix® ODBC Driver Programmer's Manual*.

What's new in ODBC driver for Client SDK, Version 3.70

This publication includes information about new features and changes in existing functionality.

For a complete list of what's new in this release, go to .

Table 1. What's new in *IBM® Informix® ODBC Driver Programmer's Manual* for Version 3.70.xC3

Overview	Reference
Getting complete Informix® and ISAM error messages You can set the SQL_INFX_ATTR_IDSISAMERRMSG attribute through the SQLSetConnectAttr API to obtain the HCL Informix® and ISAM error descriptions together from the SQLGetDiagRec API.	Informix and ISAM error descriptions in SQLGetDiagRec on page 26

Table 2. What's new in *IBM® Informix® ODBC Driver Programmer's Manual* for Version 3.70.xC1

Overview	Reference
Trusted connections improve security for multiple-tier application environments You can define trusted contexts, which can then be used to establish trusted connections between an application server and the Informix® database server on a network. Trusted connections let you set the identity of each specific user accessing a database through the middle-tier server, which facilitates discretionary access control and auditing based on user identity. Without a trusted connection in such an environment, each action on a	Trusted-context objects and trusted connect

Table 2. What's new in *IBM® Informix® ODBC Driver Programmer's Manual* for Version 3.70.xC1 (continued)

Overview	Reference
database is performed with the single user ID of the middle-tier server, potentially lessening granular control and oversight of database security. This feature is documented in the *HCL® Informix® Security Guide*. New editions and product names HCL Informix® Dynamic Server editions were withdrawn and new Informix® editions are available. Some products were also renamed. The publications in the Informix® library pertain to the following products: • HCL Informix® database server, formerly known as HCL Informix® Dynamic Server (IDS) • IBM® OpenAdmin Tool (OAT) for Informix®, formerly known as OpenAdmin Tool for Informix® Dynamic Server (IDS) • HCL Informix® SQL Warehousing Tool, formerly known as Informix® Warehouse Feature	ions on page

Overview of HCL Informix® ODBC Driver

These topics introduce the HCL Informix® ODBC Driver and describe its advantages and architecture. The topics also describe conformance, isolation and lock levels, libraries, and environment variables.

What is HCL Informix® ODBC Driver?

Open Database Connectivity (ODBC) is a specification for a database application programming interface (API).

Microsoft™ ODBC, Version 3.0, is based on the Call Level Interface specifications from X/Open and the International Standards Organization/International Electromechanical Commission (ISO/IEC). ODBC supports SQL statements with a library of C functions. An application calls these functions to implement ODBC functionality.

ODBC applications enable you to perform the following operations:

- Connect to and disconnect from data sources
- Retrieve information about data sources
- Retrieve information about HCL Informix® ODBC Driver
- Set and retrieve HCL Informix® ODBC Driver options
- Prepare and send SQL statements
- Retrieve SQL results and process the results dynamically
- Retrieve information about SQL results and process the information dynamically

ODBC lets you allocate storage for results before or after the results are available. This feature lets you determine the results and the action to take without the limitations that predefined data structures impose.

ODBC does not require a preprocessor to compile an application program.

ODBC supports Secure Sockets Layer (SSL) connections. For information about using the SSL protocol, see Secure sockets layer protocol on page .

HCL Informix® ODBC Driver features

HCL Informix® ODBC Driver implements the Microsoft™ Open Database Connectivity (ODBC), Version 3.0 standard.

The HCL Informix® ODBC Driver product also provides the following features and functionality:

- Data Source Name (DSN) migration
- Driver Manager Replacement Module, which supports compatibility between ODBC 2.x applications and the ODBC driver, version 3.0.
- Microsoft™ Transaction Server (MTS), which is an environment that lets you develop, run, and manage scalable, component-based Internet and intranet server applications. MTS performs the following tasks:
    - Manages system resources, including processes, threads, and database connections, so that your application can scale to many simultaneous users
    - Manages server component creation, execution, and deletion
    - Automatically initiates and controls transactions to make your application reliable
    - Implements security so that unauthorized users cannot access your application
    - Provides tools for configuration, management, and deployment

  Important: If you want to use distributed transactions managed by MTS with the HCL Informix® ODBC Driver, you must have connection pooling enabled.

- Extended data types, including rows and collections
- Long identifiers
- Limited support of bookmarks
- GLS data types
- Extensive error detection
- Unicode support
- XA support
- Internet Protocol Version 6 support for internet protocols of 128 bits. (For more information, see *HCL® Informix® Administrator's Guide*.)

Support for extended data types

HCL Informix® ODBC Driver supports the extended data types.

HCL Informix® ODBC Driver supports the following extended data types:

- Collection (LIST, MULTISET, SET)
- DISTINCT
- OPAQUE (fixed, unnamed)
- Row (named, unnamed)

- Smart large object (BLOB, CLOB)
- Client functions to support some of the extended data types

Support for GLS data types

HCL Informix® ODBC Driver supports the GLS data types.

HCL Informix® ODBC Driver supports the following GLS data types:

- NCHAR
- NVARCHAR

Related reference

SQL data types on page 55

Extended error detection

HCL Informix® ODBC Driver detects the ISM and XA types of errors.

Additional values for some ODBC function arguments

HCL Informix® ODBC Driver supports additional values for some ODBC function arguments.

These additional values for some ODBC function arguments include:

- *fDescType* values for SQLColAttributes
    - SQL_INFX_ATTR_FLAGS
    - SQL_INFX_ATTR_EXTENDED_TYPE_ALIGNMENT
    - SQL_INFX_ATTR_EXTENDED_TYPE_CODE
    - SQL_INFX_ATTR_EXTENDED_TYPE_NAME
    - SQL_INFX_ATTR_EXTENDED_TYPE_OWNER
    - SQL_INFX_ATTR_SOURCE_TYPE_CODE
- *fInfoType* return value for SQLGetInfo
    - SQL_INFX_LO_PTR_LENGTH
    - SQL_INFX_LO_SPEC_LENGTH
- SQL_INFX_LO_STAT_LENGTH
- *fOption* value for SQLGetConnectOption and SQLSetConnectOption: SQL_INFX_OPT_LONGID
- *fOption* value for SQLGetConnectOption and SQLSetConnectOption: SQL_ATTR_ENLIST_IN_DTC

ODBC component overview

ODBC with the HCL Informix® ODBC Driver includes several components.

ODBC with the HCL Informix® ODBC Driver can include the following components:

- Driver manager

  An application can link to a driver manager, which links to the driver specified by the data source. The driver manager also checks parameters and transitions. On most UNIX™ platforms, the ODBC Driver Manager can be purchased from a third-party vendor.

  On Microsoft™ Windows™ platforms, the ODBC Driver Manager is a part of the OS.
- HCL Informix® ODBC Driver

  The driver provides an interface to Informix® database server. Applications can use the driver in the following configurations:
  - to link to the ODBC driver manager
  - to link to the Driver Manager Replacement & the driver
  - to link to the driver directly
- Data sources

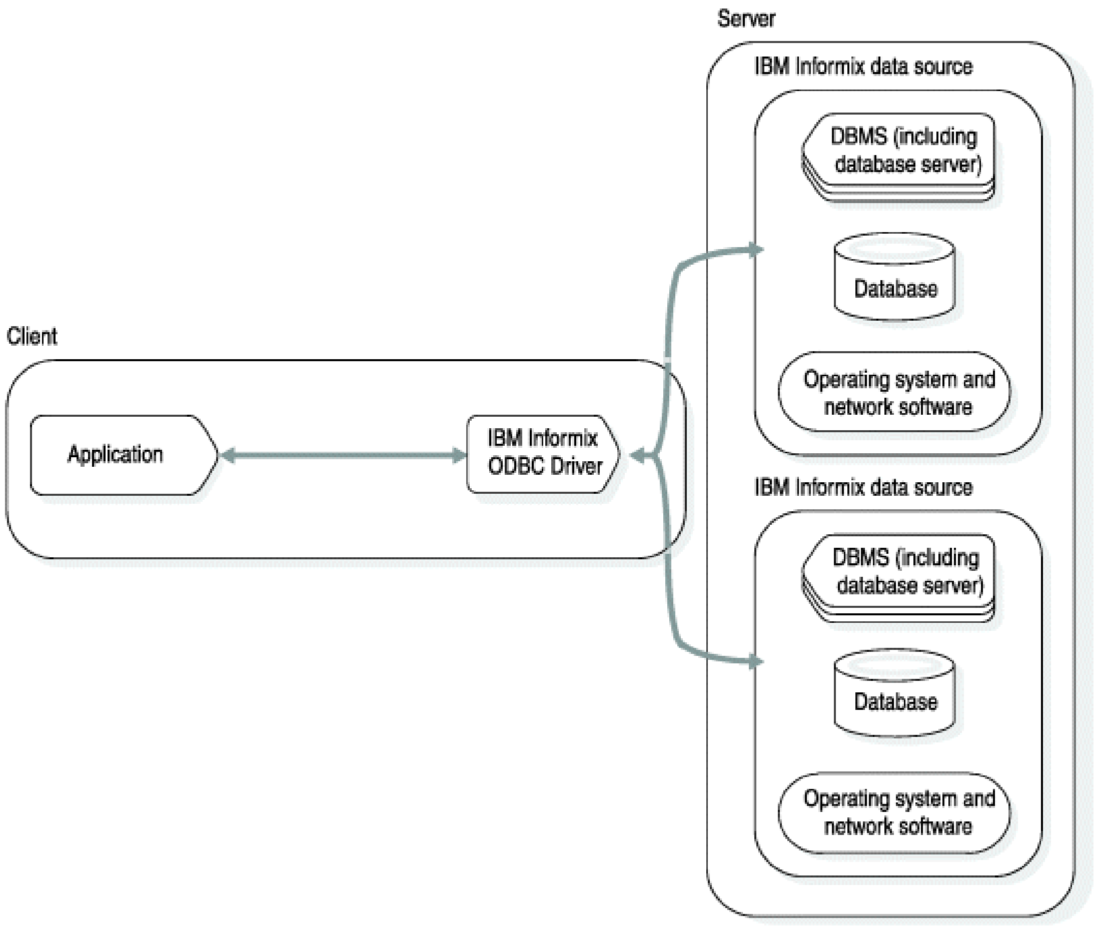
  The driver provides access to the following data sources:
  - database management systems (DBMS), including a database server
  - databases
  - operating systems and network software required for accessing the database

HCL Informix® ODBC Driver without a driver manager (UNIX™)

There is software architecture when a driver manager is not included in the system.

The following figure shows an application that uses HCL Informix® ODBC Driver without a driver manager. In this case, the application must link to the HCL Informix® ODBC Driver library.

Figure 1. HCL Informix® ODBC Driver without a driver manager


Server
IBM Informix data source
DBMS (including database server)
Database
Operating system and network software
IBM Informix data source
DBMS (including database server)
Database
Operating system and network software
Client
Application
IBM Informix ODBC Driver

Related information

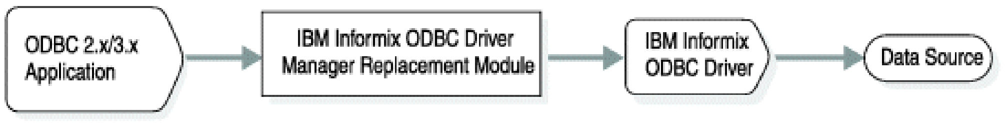
Libraries on page 11

HCL Informix® ODBC Driver with the DMR

HCL Informix® ODBC Driver includes a Driver Manager Replacement (DMR) library. The DMR replaces the driver manager on platforms where no driver manager is available.

The following figure shows an ODBC configuration with the DMR.

Figure 2. Architecture of the driver manager replacement module



You cannot use the HCL® Informix® DMR to connect to non-Informix® data sources. The DMR does not support connection pooling. The DMR does not map between Unicode and ANSI APIs.

HCL Informix® ODBC Driver components

HCL Informix® ODBC Driver includes the four components.

HCL Informix® ODBC Driver includes the following components:

- Environment variables
- Header files
- Data types
- Libraries

Environment variables

There are four environment variables that you must set for the driver.

The following list describes environment variables that you must set for the driver. For more information about environment variables, see the *HCL® Informix® Guide to SQL: Reference*.

INFORMIXDIR

Full path of the directory where the HCL Informix® Client Software Development Kit is installed.

On Windows™ platforms, **INFORMIXDIR** is a registry setting rather than an environment variable. It is set during installation.

PATH

Directories that are searched for executable programs. Your **PATH** setting must include the path to your `$INFORMIXDIR/bin` directory.

DBCENTURY (optional)

Controls the setting of year values. **DBCENTURY** affects a client program when a user issues a statement that contains a date or datetime string that specifies only the last two digits of the year. For example:

```
insert into datetable (datecol) values ("01/01/01");
```

The database server stores the date specified in this statement as either 01-01-1901 or 01-01-2001, depending on the **DBCENTURY** value on the client.

GL_DATE (optional)

GL_DATE controls the interpretation of dates. For example, you can specify whether the date format is `mm-dd-yyyy` or `yyyy-mm-dd`.

Set environment variables on UNIX™

If you set the environment variables at the command line, you must reset them whenever you log on to your system. If you set the environment variables in a file, they are set automatically when you log on to your system.

HCL Informix® ODBC Driver provides a sample setup file called `setup.odbc` in `$INFORMIXDIR/etc`. You can use this file to set environment variables for the driver. The following list describes the environment variables that are in `setup.odbc`.

INFORMIXDIR

Full path of the directory where HCL Informix® Client Software Development Kit is installed.

INFORMIXSQLHOSTS

This value is optional. It specifies the directory that contains `sqlhosts`. By default, `sqlhosts` is in `$INFORMIXDIR/etc`. Set **INFORMIXSQLHOSTS** if you want `sqlhosts` to be in a different directory.

ODBCINI

This value is optional. You can use it to specify an alternative location for the `odbc.ini` file. The default location is your home directory.

Set environment variables in Windows™

If you set the environment variables at the command line, you must reset them whenever you log in to your Windows™ environment. If you set them in the Windows™ registry, however, they are set automatically when you log in.

HCL Informix® ODBC Driver stores environment variables in the following location in the Windows™ registry:

```
\HKEY_CURRENT_USERS\Software\Informix\Environment
```

In a Windows™ environment you must use `setnet32.exe`, or a tool that updates the registry correctly, to set environment variables that HCL Informix® dynamic link libraries (DLLs), such as `iclit09b.dll`, use. The Setnet utility can only be used to set Informix® environment variables.

You can use environment variables as required by your development environment. For example, the compiler needs to know where to find the include files. To specify the location of the include files, set the environment variable **INFORMIXDIR** (or some other environment variable) and then set the include path to `INFORMIXDIR\incl\cli`.

The options for setting environment variables have the following precedence:

1. Setnet utility
2. Command line
3. Windows™ registry

Header files

You can use the `sql.h` and `sqlext.h` header files, which are part of the Microsoft™ compiler, to run HCL Informix® ODBC Driver.

To run Informix® extensions, include the `infxcli.h` file, which is installed in `INFORMIXDIR/incl/cli`. This file defines HCL Informix® ODBC Driver constants and types, and provides function prototypes for the HCL Informix® ODBC Driver functions. If you include the `infxcli.h` file, it automatically includes the `sql.h` and `sqlext.h` files.

The `sql.h` and `sqlext.h` header files contain definitions of the C data types.

Include the `xa.h` header file in XA ODBC applications. ODBC applications on Windows™ require the HCL Informix® Client Software Development Kit to compile. Existing applications that use the ODBC driver might need to include the location of the Client SDK in the **PATH** environment variable before they are recompiled.

Related reference

Data types on page 54

Data types

A column of data stored on a data source has an SQL data type.

HCL Informix® ODBC Driver maps Informix®-specific SQL data types to ODBC SQL data types, which are defined in the ODBC SQL grammar. (The driver returns these mappings through SQLGetTypeInfo. It also uses the ODBC SQL data types to describe the data types of columns and parameters in SQLColAttributes and SQLDescribeCol).

Each SQL data type corresponds to an ODBC C data type. By default, the driver assumes that the C data type of a storage location corresponds to the SQL data type of the column or parameter to which the location is bound. If the C data type of a storage location is not the *default* C data type, the application can specify the correct C data type with the *TargetType* argument for SQLBindCol, the *fCType* argument for SQLGetData, and the *ValueType* argument in SQLBindParameter. Before the driver returns data from the data source, it converts the data to the specified C data type. Before the driver sends data to the data source, it converts the data from the specified C data type to the SQL data type.

The Informix® data type names differ from the Microsoft™ ODBC data type names. For information about these differences, see the appendix about data types in the *IBM® Informix® ODBC Driver Programmer's Manual*.

Related reference

Data types on page 54

Libraries

There is an installation procedure that installs libraries for UNIX™ and Windows™.

UNIX™

The installation procedure installs the following libraries into `INFORMIXDIR/lib/cli`. In each data source specification section in the `odbc.ini` file, set the driver value indicating the full path to one of the following library file names.

`libifcli.a` or `libcli.a`

Static version for single (nonthreaded) library

`libifcli.so` or `iclis09b.so`

Shared version for single (nonthreaded) library

`libthcli.a`

Static version for multithreaded library

`libthcli.so` or `iclit09b.so`

Shared version for multithreaded library

`libifdrm.so` or `idmrs09a.so`

Shared library for DMR (thread safe)

If you do not use a driver manager, your application needs to link to either the static or the shared version of the HCL Informix® ODBC Driver libraries.

The following compile command links an application to the thread-safe version of the HCL Informix® ODBC Driver libraries:

```
cc ... -L$INFORMIXDIR/lib/cli -lifdmr - lthcli
```

Windows™

The installation procedure installs the following libraries into `INFORMIXDIR\lib`.

`iclit09b.lib`

Enables linking directly to the driver without the use of a driver manager

`iregt07b.lib`

Allows linking directly to `iregt07b.dll`

The following compile command links an application to the thread-safe version of the HCL Informix® ODBC Driver libraries:

```
cl ... -L$INFORMIXDIR/lib/cli iclit09b.lib
```

If you use a driver manager, you must link your application to the driver manager library only, as the following example shows:

```
cl odbc32.lib
```

Related reference

HCL Informix ODBC Driver without a driver manager (UNIX) on page 7

The odbc.ini file on page 32

The HCL Informix® ODBC Driver API

An application uses the HCL Informix® ODBC Driver API to make a connection to a data source, send SQL statements to a data source, process result data dynamically, and terminate a connection.

The driver enables your application to perform the following steps:

1. Connect to the data source.

   You can connect to the data source through a DSN connection, or you can use DSN-less connection strings. Specify the data-source name and any additional information needed to complete the connection.
2. Process one or more SQL statements:
   a. Place the SQL text string in a buffer. If the statement includes parameter markers, set the parameter values.
   b. If the statement returns a result set, either assign a cursor name for the statement or let the driver assign one.

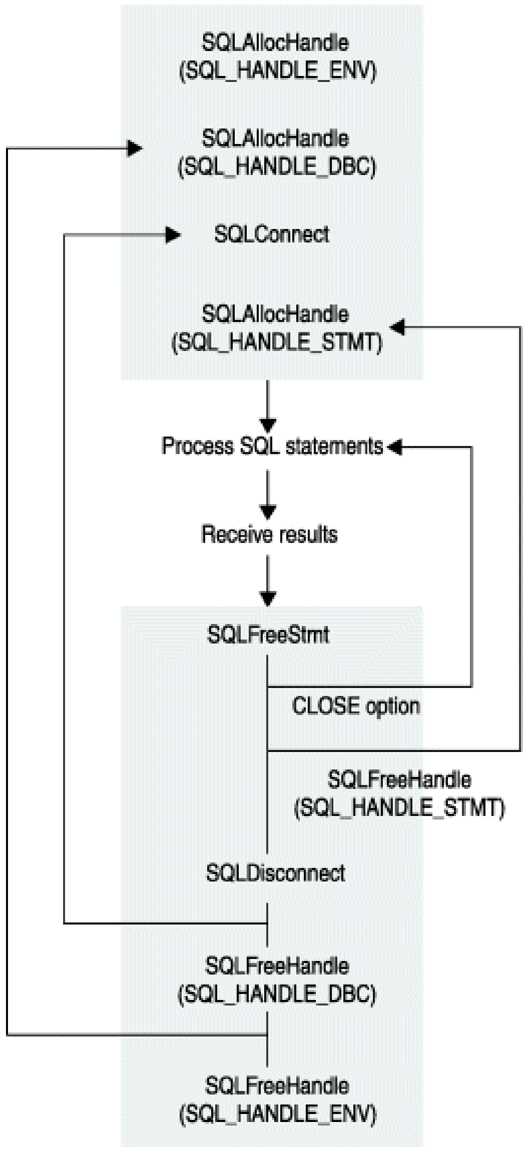
c. Either prepare the statement or submit it for immediate execution.
d. If the statement creates a result set, you can inquire about the attributes of the result set, such as the number of columns and the name and type of a specific column. For each column in the result set, assign storage and fetch the results.
e. If the statement causes an error, retrieve error information from the driver and take the appropriate action.

3. End any transaction by committing it or rolling it back.
4. Terminate the connection when the application finishes interacting with the data source.

Every HCL Informix® ODBC Driver function name starts with the prefix SQL. Each function accepts one or more arguments. Arguments are defined as input (to the driver) or output (from the driver).

The following figure shows the basic function calls that an application makes even though an application generally calls other functions also.

Figure 3. Sample listing of function calls that the HCL Informix® ODBC Driver application makes


SQLAllocHandle (SQL_HANDLE_ENV)
SQLAllocHandle (SQL_HANDLE_DBC)
SQLConnect
SQLAllocHandle (SQL_HANDLE_STMT)
Process SQL statements
Receive results
SQLFreeStmt
CLOSE option
SQLFreeHandle (SQL_HANDLE_STMT)
SQLDisconnect
SQLFreeHandle (SQL_HANDLE_DBC)
SQLFreeHandle (SQL_HANDLE_ENV)

Environment, connection, and statement handles

When an application requests it, the driver and the driver manager allocate storage for information about the environment, each connection, and each SQL statement.

The driver returns a handle for each of these allocations to the application, which uses one or more handles in each call to a function.

The HCL Informix® ODBC Driver API uses the following types of handles:

Environment handles

Environment handles identify memory storage for global information, including the valid connection handles and the current active connection handle. The environment handle is an *henv* variable type. An application uses one environment handle. It must request this handle before it connects to a data source.

Connection handles

Connection handles identify memory storage for information about particular connections. A connection handle is an *hdbc* variable type. An application must request a connection handle before it connects to a data source. Each connection handle is associated with the environment handle. However, the environment handle can be associated with multiple connection handles.

Statement handles

Statement handles identify memory storage for information about SQL statements. A statement handle is an *hstmt* variable type. An application must request a statement handle before it submits SQL requests. Each statement handle is associated with exactly one connection handle. However, each connection handle can be associated with multiple statement handles.

Buffers

An application passes data to the driver in an input buffer. The driver returns data to the application in an output buffer.

The application must allocate memory for both input and output buffers. If the application uses the buffer to retrieve string data, the buffer must contain space for the null termination byte.

Some functions accept pointers to buffers that are used later by other functions. The application must ensure that these pointers remain valid until all applicable functions have used them. For example, the argument *rgbValue* in SQLBindCol points to an output buffer where SQLFetch returns the data for a column.

Input buffers

An application passes the address and length of an input buffer to the driver.

The length of the buffer must be one of the following values:

- A length greater than or equal to zero

  This value is the actual length of the data in the input buffer. For character data, a length of zero indicates that the data is an empty (zero length) string. A length of zero is different from a null pointer. If the application specifies the length of character data, the character data does not need to be null-terminated.

- SQL_NTS

  This value specifies that a character data value is null-terminated.

- SQL_NULL_DATA

  This value tells the driver to ignore the value in the input buffer and use a NULL data value instead. It is valid only when the input buffer provides the value of a parameter in an SQL statement.

For character data that contains embedded null characters, the operation of HCL Informix® ODBC Driver functions is undefined; for maximum interoperability, it is better not to use them. Informix® database servers treat null characters as end-of-string markers or as indicators that no more data exists.

Unless it is prohibited in a function description, the address of an input buffer can be a null pointer. In such cases, the value of the corresponding buffer-length argument is ignored.

Related information

Convert data from SQL to C on page 80

Output buffers

An application passes arguments to the driver so that the driver can return data in an output buffer.

These arguments are:

- The address of the output buffer, to which the driver returns the data

  Unless it is prohibited in a function description, the address of an output buffer can be a null pointer. In such cases, the driver does not return anything in the buffer and, in the absence of other errors, returns SQL_SUCCESS.

  If necessary, the driver converts data before returning it. The driver always null-terminates character data before returning it.

- The length of the buffer

  The driver ignores this value if the returned data has a fixed length in C, as with an integer, real number, or date structure.

- The address of a variable in which the driver returns the length of the data (the length buffer)

The returned length of the data is SQL_NULL_DATA if the data is a null value in a result set. Otherwise, the returned length of the data is the number of bytes of data that are available to return. If the driver converts the data, the returned length of the data is the number of bytes that remain after the conversion; for character data, it does not include the null-termination byte that the driver adds.

If the output buffer is too small, the driver attempts to truncate the data. If the truncation does not cause a loss of significant data, the driver returns the truncated data in the output buffer, returns the length of the available data (as opposed to the length of the truncated data) in the length buffer, and returns SQL_SUCCESS_WITH_INFO. If the truncation causes a loss of significant data, the driver leaves the output and length buffers untouched and returns SQL_ERROR. The application calls SQLGetDiagRec to retrieve information about the truncation or the error.

Related information

Convert data from SQL to C on page 80

SQLGetInfo argument implementation

HCL Informix® implements the SQLGetInfo arguments for HCL Informix® ODBC Driver.

The following table describes the HCL Informix® implementation of SQLGetInfo arguments for HCL Informix® ODBC Driver.

Argument name	Informix® implementation
SQL_ACTIVE_ENVIRONMENTS	HCL® Informix® driver does not have a limit on number of active environments. Zero is always returned.
SQL_AGGREGATE_FUNCTIONS	HCL® Informix® driver returns all aggregate functions that the database server supports.
SQL_ASYNC_MODE	HCL® Informix® driver returns SQL_AM_NONE.
SQL_ATTR_METADATA_ID	Supported for GetInfo and PutInfo
SQL_BATCH_ROW_COUNT	HCL® Informix® driver returns bitmask zero.
SQL_BATCH_SUPPORT	HCL® Informix® driver returns bitmask zero.
SQL_CA1_POS_DELETE	Operation arguments supported in a call to SQLSetPos
SQL_CA1_POS_POSITION	Operation arguments supported in a call to SQLSetPos
SQL_CA1_POS_REFRESH	Operation arguments supported in a call to SQLSetPos
SQL_CA1_POS_UPDATE	Operation arguments supported in a call to SQLSetPos
SQL_CA1_POSITIONED_DELETE	A DELETE WHERE CURRENT OF SQL statement is supported when the cursor is a forward-only cursor. (An SQL-92 entry-level-conforming driver always return this option as supported.)

Argument name	Informix® implementation
SQL_CA1_POSITIONED_UPDATE	An UPDATE WHERE CURRENT OF SQL statement is supported when the cursor is a static-only cursor. (An SQL-92 entry-level-conforming driver always return this option as supported.)
SQL_CA1_LOCK_NO_CHANGE	A LockType argument of SQL_LOCK_NO_CHANGE is supported in a call to SQLSetPos when the cursor is a static-only cursor.
SQL_CA1_SELECT_FOR_UPDATE	A SELECT FOR UPDATE SQL statement is supported when the cursor is a forward-only cursor. (An SQL-92 entry-level-conforming driver always return this option as supported.)
SQL_CATALOG_NAME	HCL® Informix® driver returns 'Y'
SQL_COLLATION_SEQ	INTERSOLV DataDirect ODBC Driver returns InfoValuePtr (unmodified)
SQL_DDL_INDEX	Returns bitmask SQL_DL_CREATE_INDEX | SQL_DL_DROP_INDEX
SQL_DESCRIBE_PARAMETER	Returns 'N'; parameters cannot be described. (This is because the latest Informix® database servers support function overloading such that multiple functions with the same name can accept different parameter types.)
SQL_DIAG_DYNAMIC_FUNCTION	Returns empty string
SQL_DROP_TABLE	Returns bitmask SQL_DT_DROP_TABLE | SQL_DT_CASCADE | SQL_DT_RESTRICT
SQL_DROP_VIEW	Returns bitmask SQL_DV_DROP_TABLE | SQL_DV_CASCADE | SQL_DV_RESTRICT
SQL_INDEX_KEYWORDS_	SQL_LLK_ASC | SQL_LK_DESC
SQL_INSERT_STATEMENT	Returns bitmask SQL_IS_INSERT_LITERALS | SQL_ INSERT_SEARCHED | SQL_IS_SELECT_INTO
SQL_MAX_DRIVER_CONNECTIONS	Returns zero
SQL_MAX_IDENTIFIER_LEN	Returns different values, depending on database server capability
SQL_ODBC_INTERFACE_CONFORMANCE	Returns SQL_OIC_CORE
SQL_PARAM_ARRAY_ROW_COUNTS	Returns SQL_PARC_NO_BATCH
SQL_PARAM_ARRAY_SELECTS	Returns SQL_PAS_NO_SELECT

Argument name	Informix® implementation
SQL_SQL_CONFORMANCE	Returns SQL_OSC_CORE
SQL_SQL92_FOREIGN_KEY_DELETE_RULE	Returns bitmask zero
SQL_SQL92_FOREIGN_KEY_UPDATE_RULE	Returns bitmask zero
SQL_SQL92_GRANT	Returns bitmask zero
SQL_SQL92_NUMERIC_VALUE_FUNCTIONS	Returns bitmask zero
SQL_SQL92_PREDICATES	Returns bitmask zero
SQL_SQL92_RELATIONAL_JOIN_OPERATORS	Returns bitmask zero
SQL_SQL92_REVOKE	SQL_SR_CASCADE | SQL_SR_RESTRICT
SQL_SQL92_ROW_VALUE_CONSTRUCTOR	Returns bitmask zero
SQL_SQL92_STRING_FUNCTIONS	Returns bitmask zero
SQL_SQL92_VALUE_EXPRESSIONS	Returns bitmask zero
SQL_STANDARD_CLI_CONFORMANCE	Returns bitmask SQL_SCC_XOPEN_CLI_VERSION1 | SQL_SCC_ISO92_CLI
SQL_STATIC_CURSOR_ATTRIBUTES1	Scrollable only
SQL_STATIC_CURSOR_ATTRIBUTES2	Scrollable only
SQL_XOPEN_CLI_YEAR	Returns string "1995"

Related reference

SQLGetInfo (level one only) on page 233

Global Language Support

HCL Informix® products can support many languages, cultures, and code sets. Global Language Support (GLS) provides support for all language- and culture-specific information.

The following table describes how to set the GLS options depending on your platform.

Platform	How to set GLS options
UNIX™	Specify the GLS options in the `odbc.ini` file.
Windows™	Specify the GLS options in the HCL Informix® ODBC Driver DSN Setup dialog box.

The following table describes the GLS options for HCL Informix® ODBC Driver.

GLS option	Description
Client locale	**Description:** Locale and code set that the application runs in **Format:** locale.codeset@modifier **`odbc.ini` field for UNIX™:** **CLIENT_LOCALE** **Default value for UNIX™:** **en_us.8859-1** **Default value for Windows™:** **en_us.1252** **Important:** The setting of the **CLIENT_LOCALE** environment variable in the operating system environment and in Setnet32 are ignored by HCL Informix® ODBC Driver. To change the client locale, you must use this GLS option.
Database locale	**Description:** Locale and code set that the database was created in **Format:** locale.codeset@modifier **`odbc.ini` field for UNIX™:** **DB_LOCALE** **Default value for UNIX™:** **en_us.8859-1** **Default value for Windows™:** **en_us.1252** **Important:** The setting of the **DB_LOCALE** environment variable in the operating system environment and in Setnet32 are ignored by HCL Informix® ODBC Driver. To change the database locale, you must use this GLS option.
Translation	**Description:** Performs the code set conversion

GLS option	Description
library	**Format:** Path to the file for the library. The translation DLL must follow the ODBC standard for translation libraries. For more information, see the *IBM® Informix® ODBC Driver Programmer's Manual*. **`odbc.ini` field for UNIX™:** TRANSLATIONDLL **Default value for UNIX™:** `$INFORMIXDIR/lib/esql/igo4a304.`*xx* where *xx* is platform-specific extension for shared library **Default value for Windows™:** `igo4n304.dll`
Translation option	**Description:** Option for a non-HCL® Informix® translation library **Format:** Determined by the vendor **`odbc.ini` field for UNIX™:** TRANSLATION_OPTION **Default value for Windows™:** Determined by the vendor **Restriction:** Do not set this option for the HCL Informix® translation library. The HCL Informix® translation library determines the translation option based on the client locale and database locale values.
VMB character	**Description:** Varying multibyte character length reporting option that specifies how to set *pcbValue* when *rgbValue* (the output area) is not large enough for the code-set-converted data. The possible values are: **Estimate** HCL Informix® ODBC Driver makes a worst-case estimate of the storage space needed to return the data. **Exact** HCL Informix® ODBC Driver writes the code-set-converted data to disk until all the data is converted. Because this option can degrade performance, it is recommended that you do not use this option unless your application does not work with **Estimate**.

GLS option	Description
	When you use a multibyte code set (in which characters vary in length from 1 to 4 bytes) for either the database or client locale, the length of a character string or simple large object (TEXT) in the database locale does not indicate the length of the string after it is converted to the client locale. **Possible values for UNIX™:** `0` = **Estimate** `1` = **Exact** **Possible values for Windows™:** **Estimate** **Exact** **`odbc.ini` field for UNIX™:** VMBCHARLENEXACT **Default value for UNIX™:** **Estimate** **Default value for Windows™:** **Estimate**

For more information about GLS and locales, see the *HCL® Informix® GLS User's Guide*.

Related reference

Configure a DSN on UNIX on page 30

Unicode on page 248

Related information

Configuring a DSN in Windows on page 42

X/Open standard interface

In addition to the standard ODBC functions, the HCL Informix® ODBC Driver also supports the additional functions.

The following functions are supported by HCL Informix® ODBC Driver

_fninfx_xa_switch

Function for acquiring the xa_switch structure defined by IBM® Enterprise Records Manager

IFMX_SQLGetXaHenv

Function for obtaining the environment handle associated with an XA Connection

IFMX_SQLGetXaHdbc

Function for obtaining the database handle associated with an XA Connection

xa_open

Function takes an xa_info parameter. The HCL Informix® ODBC Driver uses this xa_info to establish a XA connection

The format of xa_info is as follows:

```
<appilcationtoken>|<DSN name>
```

The application token is a unique number the application generates for each xa_open request. It must use the same application token as parameter to IFMX_SQLGetXaHenv and IFMX_SQLGetXaHdbc to get the associated environment and database handles.

External authentication

For HCL Informix® Version 10.0 and later, you can implement external authentication through the HCL Informix® ODBC Driver.

There are two external authentication modules available to use with the HCL Informix® ODBC Driver. The Pluggable Authentication Module (PAM), works on UNIX™ and Linux™ servers and the LDAP Authentication is supported on Microsoft™ Windows™ operating systems.

Pluggable Authentication Module (PAM) on UNIX™ and Linux™

You can use Pluggable Authentication Module (PAM) with the HCL Informix® ODBC Driver on the UNIX™ and Linux™ operating systems that support PAM.

PAM enables system administrators to implement different authentication mechanisms for different applications. For example, the needs of a system like the UNIX™ login program might be different from an application that accesses sensitive information from a database. PAM allows for many such scenarios in a single machine, because the authentication services are attached at the application level.

LDAP Authentication on Windows™

You can use LDAP Authentication with the HCL Informix® ODBC Driver on Windows™ operating systems. LDAP Authentication is similar to the Pluggable Authentication Module.

Use the LDAP Authentication Support module when you want to use an LDAP server to authenticate your system users. The module contains source code that you can modify for your specific LDAP Authentication Support module. For information about installing and customizing the LDAP Authentication Support module, see the *HCL® Informix® Security Guide*.

The SQLSetConnectAttr() function with authentication

Use the SQLSetConnectAttr() function to specify the callback function used by the server.

SQLSetConnectAttr() is also used to specify what parameters are used by the callback function. Parameter attributes are passed back to the callback function exactly as they are specified to the driver.

The following attributes are Informix®-specific extensions to the ODBC standard:

Parameter	Type	Description
SQL_INFX_ATTR_PAM_FUNCTION	void *	A pointer to the callback function.
SQL_INFX_ATTR_PAM_RESPONSE_BUF	void *	A generic pointer to a buffer containing the response to an authentication challenge.
SQL_INFX_ATTR_PAM_RESPONSE_LEN	int	The length of the response buffer in bytes.
SQL_INFX_ATTR_PAM_RESPONSE_LEN_PTR	int *	The address which stores the number of bytes in the response.
SQL_INFX_ATTR_PAM_CHALLENGE_BUF	void *	A generic pointer to a buffer containing the authentication challenge. The driver stores any challenge received from the server into this buffer. If the buffer is not large enough to contain the challenge, the challenge is truncated. The callback function can detect this challenge by comparing the buffer length with the number of bytes in the challenge. It is up to the application developer to detect this situation and handle it correctly.
SQL_INFX_ATTR_PAM_CHALLENGE_BUF_LEN	int	The length of the challenge buffer in bytes.
SQL_INFX_ATTR_PAM_CHALLENGE_LEN_PTR	int *	The address that stores the number of bytes in the challenge.

The challenge and response buffer pointers can be null. If the authentication server requires the information that would be stored in these buffers, a connection failure results due to an authentication failure. The challenge length information is returned whether the connection is successful or not. If the message type does not require a response, the response buffer might be null (default) or it might contain an empty string.

The attributes in the previous table can be set at any time and in any order. However, they are only valid for connections established with subsequent calls to one of the driver's connect functions.

You can set the isolation level with the SQLSetConnectAttr() API by using one of the following connection attributes:

- SQL_TXN_READ_UNCOMMITTED = Read Uncommitted
- SQL_TXN_READ_COMMITTED = Read Committed
- SQL_TXN_SERIALIZABLE = Serializable
- SQL_TXN_REPEATABLE_READ = Repeatable Read
- SQL_TXN_LAST_COMMITTED = Last Committed
- SQL_TXN_TRANSACTION = Transaction

If you use the SQL_TXN_LAST_COMMITTED or SQL_TXN_TRANSACTION attributes with the SQLSetConnectAttr() API, then your applications must link directly to the HCL Informix® ODBC Driver instead of to the ODBC Driver Manager. However, if the attribute is specified in the `odbc.ini` file or the Data Source Administrator, the application can be linked with ODBC Driver Manager.

If you use the SQL_TXN_TRANSACTION attribute, then the isolation level set in the DTC application is propagated to the server. This option should be used only in Windows™ DTC applications.

The default behavior of the ODBC driver is to trim blank characters from the end of VARCHAR column results. To preserve trailing spaces, set the **SQL_INFX_ATTR_LEAVE_TRAILING_SPACES** attribute:

```
SQLSetConnectAttr( hdbc, SQL_INFX_ATTR_LEAVE_TRAILING_SPACES,
(SQLPOINTER)SQL_TRUE, SQL_IS_INTEGER );
```

To trim trailing spaces, change SQL_TRUE to SQL_FALSE.

The behavior is limited to the connection.

Connect functions

Any ODBC function which establishes a connection, SQLConnect(), SQLDriverConnect(), or SQLBrowseConnect(), can be used with authentication modules.

Consider the following when using these functions.

The SQLConnect() function

The DriverCompletion parameter to the SQLConnect() function can take the following values

- SQL_DRIVER_PROMPT
- SQL_DRIVER_COMPLETE
- SQL_DRIVER_COMPLETE_REQUIRED
- SQL_DRIVER_NOPROMPT

If an authentication challenge is expected, it is recommended that you use **SQL_DRIVER_NOPROMPT**. Using other values might result in the user being presented with multiple requests for authentication information.

The SQLBrowseConnect() function

The SQLBrowseConnect() function is designed to be used iteratively where the driver provides guidance to the application on how to complete the connection string and the application prompts the user for the required values. This can create situations where the user is presented with multiple prompts between connection string completion and authentication.

Additionally, it is typical for the driver to present a choice of databases to the application as part of the connection string completion process. However, the driver is not able to query the server for a list of databases until after the user is authenticated. Depending on application logic, whether it provides a database name in the original connection string, and whether a challenge is going to be received from the authentication server, it might not be possible to use SQLBrowseConnect() when the server uses authentication.

Third-party applications or intermediate code

When using authentication, it is the responsibility of the application to handle any challenges that originate from the authentication server.

To handle the challenges, the application programmer must be able to register a callback function with the driver. Because there are no attributes defined in the ODBC standard that are used to accomplish this, the attributes used are HCL Informix® extensions.

Many applications are written with ADO layer of Microsoft™ to abstract the ODBC calls from the developer. Most Visual Basic applications are written with ADO objects. These applications and third-party applications in general are not aware of the HCL Informix® extensions and are not able to handle an authentication challenge.

The ODBC Data Source Administrator on Windows™ also falls under the class of third-party applications. Not all features are available when configuring a UNIX™ data source. For example, the **Apply and Test Connection** button and the **User Server Database Locale** toggle does not work if a challenge is received because those features require the ability to connect to the server.

Bypass ODBC parsing

You can bypass ODBC parsing by using several options.

Sometimes you might want to improve performance by bypassing ODBC parsing. Do not bypass ODBC parsing if these conditions exist:

- You intend to use ODBC escape sequences in your query.
- You intend to call any catalog functions (for example, SQLColumns, SQLProcedureColumns, or SQLTables) after running your SQL query.

You can bypass ODBC parsing in the following ways:

- Set SKIPPARSING to 1 in the connection string. The connection string is used in a SQLDriverConnect call. For example:

  ```
  connString="DB=xxx;UID=xxx;....;SKIPPARSING=1;"
  ```

- Include SQL_INFX_ATTR_SKIP_PARSING in a SQLSetConnectAttr call, for example:

  ```
  SQLSetConnectAttr (hdbc, SQL_INFX_ATTR_SKIP_PARSING,
                     (SQLPOINTER)SQL_TRUE, SQL_IS_USMALLINT);
  ```

  Use this call after the connection is completed. To restore ODBC parsing, change SQL_TRUE to SQL_FALSE. After this value is enabled at the connection level, all statement handles that are allocated with the connection inherit this property.

- In a SQLSetStmtAttr call, include SQL_TRUE. To restore ODBC parsing, change SQL_TRUE to SQL_FALSE.

  ```
  SQLSetStmtAttr (hstmt, SQL_INFX_ATTR_SKIP_PARSING,
                  (SQLPOINTER)SQL_TRUE, SQL_IS_USMALLINT);
  ```

- On UNIX™ systems, in `.odbc.ini` set `SKIPPARSING=1`. To restore ODBC parsing, reset the value to `SKIPPARSING=0`.

The precedence of bypassing ODBC parsing is as follows:

- If ODBC parsing is bypassed or reset in the `odbc.ini` file (on UNIX™ systems) and also in the application with the SQLDriverConnect, SQLSetConnectAttr, or the SQLSetStmtAttr APIs, the API setting takes precedence.
- If ODBC parsing is bypassed or reset in the application with the SQLDriverConnect API and also in the SQLSetConnectAttr or SQLSetStmtAttr APIs, the latter takes precedence.

BufferLength in character for SQLGetDiagRecW

The SQLGetDiagRecW API returns diagnostic information in the output buffer, where the BufferLength parameter is the length of buffer allocated.

The default for BufferLength is the number of bytes allocated. After setting the SQL_INFX_ATTR_LENGTHINCHARFORDIAGRECW attribute to TRUE, the BufferLength is treated as a specific number of characters. As a Widechar API, one character=sizeof(SQLWCHAR) bytes.

Set the attribute in the following ways:

-
  ```
  SQLSetEnvAttr (henv, SQL_INFX_ATTR_LENGTHINCHARFORDIAGRECW,
                 (SQLPOINTER)SQL_TRUE, SQL_IS_UINTEGER);
  ```

-
  ```
  SQLSetConnectAttr (hdbc, SQL_INFX_ATTR_LENGTHINCHARFORDIAGRECW,
                     (SQLPOINTER)SQL_TRUE, SQL_IS_UINTEGER);
  ```

-
  ```
  SQLSetStmtAttr (hstmt, SQL_INFX_ATTR_LENGTHINCHARFORDIAGRECW,
                  (SQLPOINTER)SQL_TRUE, SQL_IS_UINTEGER);
  ```
- Set the `LENGTHINCHARFORDIAGRECW=1` in the connection string.
- On UNIX™ systems, in `odbc.ini` set `LENGTHINCHARFORDIAGRECW=1`

The precedence of setting SQL_INFX_ATTR_LENGTHINCHARFORDIAGRECW is:

- Setting the SQLSetEnvAttr attribute reflects to the henv, hdbc, and hstmt handles.
- Resetting the hdbc and hstmt handles through
  - Setting SQLSetConnectAttr
  - Passing the attribute in connection string
  - Enabling the **Length in Chars for SQLGetDiagRecW** option in the DSN
- If the hstmt handle is set or not set by the previously mentioned methods, setting SQLSetStmtAttr resets it.

Informix® and ISAM error descriptions in SQLGetDiagRec

The SQLGetDiagRec API returns diagnostic information in the output buffer, where the error description is for the HCL Informix® error message.

When the HCL Informix® server encounters an error, it returns the Informix® error code and the associated error description. There is an additional error code, the ISAM error code, which provides information that is necessary to understand the circumstances that caused the Informix® error code.

If you do not set an attribute for the SQLSetConnectAttr API, the SQLGetDiagRec API returns the Informix® error message.

If you set the SQL_DIAG_ISAM_ERROR attribute for the SQLGetDiagField API, the SQLGetDiagField API returns the ISAM error message.

If you set the SQL_INFX_ATTR_IDSISAMERRMSG attribute for the SQLSetConnectAttr API, the SQLGetDiagRec API returns both the Informix® error message and the ISAM error message.

Set the SQL_INFX_ATTR_IDSISAMERRMSG attribute in the following way:

```
SQLSetConnectAttr (hdbc, SQL_INFX_ATTR_IDSISAMERRMSG,
                   (SQLPOINTER)SQL_TRUE, SQL_IS_UINTEGER);
```

Improved performance for single-threaded applications

You are likely to improve the performance of single-threaded applications by using the SINGLETHREADED connection parameter. The value is off by default.

Do not use this parameter in an XA/MSDTC environment. You can set the SINGLETHREADED connection parameter in a connection string as the following example shows:

```
DSN=xxx;Uid=xxx;Pwd=xxx;SINGLETHREADED=1;"
```

Partially supported and unsupported ODBC features

HCL Informix® ODBC Driver supports partial implementation of several ODBC features.

These ODBC features are

- Transaction processing
- ODBC cursors
- ODBC bookmarks
- **SQLBulkOperations**

Transaction processing

HCL Informix® ODBC Driver implementation of transaction isolation levels and transaction modes is slightly different from the Microsoft™ ODBC implementation of these features.

The following topics describe the implementation of transaction isolation levels and transaction modes in HCL Informix® ODBC Driver.

Transaction isolation levels

HCL Informix® ODBC Driver supports three transaction isolation levels for the Informix® database server.

The following table lists the transaction isolation levels that HCL Informix® ODBC Driver supports for the Informix® database server.

Database servers	Transaction isolation levels
HCL Informix®	• SQL_TXN_READ_COMMITTED • SQL_TXN_READ_UNCOMMITTED • SQL_TXN_SERIALIZABLE

The default transaction isolation level is SQL_TXN_READ_COMMITTED. To change the transaction isolation level, call SQLSetConnectOption() with an *fOption* value of SQL_TXN_ISOLATION.

For more information about transaction isolation levels, see the SQL_DEFAULT_TXN_ISOLATION and SQL_TXN_ISOLATION_OPTION descriptions in the *IBM® Informix® ODBC Driver Programmer's Manual*.

Changing the transaction mode

You can change the transaction mode from its default of auto-commit to manual commit.

About this task

To change the transaction mode to manual commit:

1. Enable transaction logging for your database server.

   For information about transaction logging, see your *HCL® Informix® Administrator's Guide*.
2. Call SQLSetConnectOption() with SQL_AUTOCOMMIT set to SQL_AUTOCOMMIT_OFF.

ODBC cursors

HCL Informix® ODBC Driver supports static and forward cursors but not dynamic and keyset-driven cursors.

For more information about cursors, see the *IBM® Informix® ODBC Driver Programmer's Manual*.

ODBC bookmarks

A *bookmark* is a value that identifies a row of data.

HCL Informix® ODBC Driver supports bookmarks with **SQLFetchScroll** and SQLExtendedFetch and does not support them with **SQLBulkOperations**.HCL Informix® ODBC Driver supports bookmarks to the following extent:

- Uses only variable length bookmarks.
- SQL_DESC_OCTET_LENGTH is set to 4 for bookmark columns.
- A bookmark is an integer that contains the row number within the row set, starting with 1.
- Bookmarks persist only if the cursor remains open.
- **SQLFetchScroll**, using SQL_FETCH_BOOKMARK for the fetch orientation argument, is fully supported.
- **SQLBulkOperations** does not update the bookmark column for SQL_ADD.

For more information about ODBC bookmarks, see the *IBM® Informix® ODBC Driver Programmer's Manual*.

SQLBulkOperations

HCL Informix® ODBC Driver supports only the SQL_ADD argument of **SQLBulkOperations**.

SQLDescribeParam

SQLDescribeParam is an ODBC API which returns metadata for the parameters of a query.

In earlier releases of the HCL Informix® ODBC Driver, the SQLDescribeParam API returned SQL_UNKNOWN if the API was called to get information about an expression value or a parameter that was embedded inside another routine. This restriction no longer applies to values of BOOLEAN, LVARCHAR, or of built-in non-opaque Informix® data types that are returned by the following expressions in other UDRs:

- Binary arithmetic expressions
  - Addition (+)
  - Subtraction (-)
  - Multiplication (*)
  - Division (/)
- Relational operator expressions
  - Less than (<)
  - Less than or equal to (<=)
  - Equal to (=, ==)
  - Greater than or equal to (>=)
  - Greater than (>)
  - Not equal to (<>, !=)
- The following string operations
  - Concatenation (||)
  - MATCHES
  - LIKE
- BETWEEN ... AND conditional expressions

For example, if the column **tab1.c1** is an INT data type, SQLDescribeParam() returns type int for the input host variable of the following query:

```
select c1, c2 from tab1 where  ABS(c1) > ?;
```

The UDR from the other side of the expression can be a column expression or a built-in routine, but it cannot be a user-defined routine. In earlier releases, the SQLDescribeParam API returns SQL_UNKNOWN for expression values and parameters that are embedded in another procedure in the following cases:

- The value on the other side of the expression is a user-defined routine.
- Another operand of the same expression is a user-defined routine.
- The data type of any operand of the expression is not a BOOLEAN, LVARCHAR, or a built-in non-opaque data type.

Unsupported Microsoft™ ODBC driver features

HCL Informix® ODBC Driver does not support implementation of the certain Microsoft™ ODBC driver features.

The unsupported Microsoft™ ODBC driver features are:

- Asynchronous communication mode
- Concurrency checking
    - SQL_CA2_OPT_ROWVER_CONCURRENCY
    - SQL_CA2_OPT_VALUES_CONCURRENCY
- CONVERT scalar functions
- Cursor simulation features:
    - SQL_CA2_CRC_APPROXIMATE
    - SQL_CA2_CRC_EXACT
    - SQL_CA2_SIMULATE_NON_UNIQUE
    - SQL_CA2_SIMULATE_TRY_UNIQUE
    - SQL_CA2_SIMULATES_UNIQUE
- Dynamic cursor attributes
- Installer DLL

Configure data sources

These topics explain how to configure a data source (DSN) on UNIX™ and Windows™ for HCL Informix® ODBC Driver.

After you install the driver, you must configure your DSN before you can connect to it.

Related reference

Connection level optimizations on page 186

Configure a DSN on UNIX™

The configuration files provide information, such as driver attributes, that the driver uses to connect to DSNs.

This section provides information about driver specifications and DSN specifications on UNIX™, and describes the following DSN configuration files:

- `sqlhosts`
- `odbcinst.ini`
- `odbc.ini`

To modify these files, use a text editor. The section also provides examples of driver and DSN specifications.

If you are enabling single-sign on (SSO), additional steps are in "Configuring ESQL/C and ODBC Drivers for SSO" in *HCL® Informix® Security Guide*.

Related reference

Global Language Support on page 18

The odbcinst.ini file

The `odbcinst.ini` file has entries for all the installed drivers on your computer.

Installed ODBC drivers use the `odbcinst.ini` sample file, which is located in `$INFORMIXDIR/etc/odbcinst.ini`. To create your `odbcinst.ini` file, copy the `odbcinst.ini` sample file to your home directory as `$HOME/.odbcinst.ini` (note the added dot at the beginning of the file name). Update this file when you install a new driver or a new version of a driver. The following table describes section items in the `$HOME/.odbcinst.ini` file.

Section	Description	Status
ODBC drivers	List of names of all the installed ODBC drivers	Optional
ODBC driver specifications	List of driver attributes and values	Optional

ODBC drivers

Use examples to obtain information about ODBC drivers.

The following example illustrates information about drivers:

```
[ODBC Drivers]
driver_name1=Installed
driver_name2=Installed
:;
```

The following example illustrates information about installed drivers:

```
[ODBC Drivers]
IBM INFORMIX ODBC DRIVER=Installed
```

Driver specifications

Each installed driver has a properties section under the name of the driver.

The following example illustrates a driver-specification format:

```
[driver name1]
Driver=driver_library_path
Setup=setup/driver_library_path
APILevel=api_level_supported
ConnectFunctions=connectfunctions
DriverODBCVer=odbc_version
FileUsage=file_usage
SQLLevel=sql_level
:;
```

The following example illustrates information about driver specifications:

```
[IBM INFORMIX ODBC DRIVER]
Driver=/vobs/tristarm/odbc/iclis09b.so
Setup=/vobs/tristarm/odbc/iclis09b.so
APILevel=1
ConnectFunctions=YYY
DriverODBCVer=03.50
FileUsage=0
SQLLevel=1
```

The following table describes the keywords that are in the driver-specification section.

Keywords	Description	Status
API Level	ODBC interface conformance level that the driver supports 0=None 1=Level 1 supported 2=Level 2 supported	Required
ConnectFunctions	Three-character string that indicates whether the driver supports SQLConnect, SQLDriverConnect, and SQLBrowseConnect	Required
DriverODBCVer	Character string with the version of ODBC that the driver supports	Required
Driver	Driver library path	Required
FileUsage	Number that indicates how a file-based driver directly treats files in a DSN	Required
Setup	Setup library	Required
SQLLevel	Number that indicates the SQL-92 grammar that the driver supports	Required

For a detailed description of the Driver Specification section, see the *IBM® Informix® ODBC Driver Programmer's Manual*.

The odbc.ini file

The `odbc.ini` file is a sample data-source configuration information file.

For the location of the `odbc.ini` file, see the release notes. To create this file, copy `odbc.ini` to your home directory as `$HOME/.odbc.ini` (note the added dot at the beginning of the file name). Every DSN to which your application connects must have an entry in this file. The following table describes the sections in `$HOME/.odbc.ini`.

Section	Description	Status
ODBC Data Sources	This section lists the DSNs and associates them with the name of the driver. You need to provide this section only if you use an ODBC driver manager from a third-party vendor.	Required

Section	Description	Status
Data Source Specification	Each DSN listed in the ODBC Data Sources section has a Data-Source Specification section that describes the DSN.	Required
ODBC	This section lists ODBC tracing options.	Optional

Follow these rules to include comments in the `odbc.ini` file on UNIX™ systems:

- Begin a comment with a semicolon (;) or number sign (#) in the first position of the first line.
- If a comment includes multiple lines, you can begin following comment lines with a space or tab character (\t).
- You can include blank lines in comments.

Related information

Libraries on page 11

ODBC Data Sources

Each entry in the ODBC Data Sources section lists a DSN and the driver name.

The *data_source_name* value is any name that you choose. It is like an envelope that contains all relevant connection information about the DSN.

The following example illustrates an ODBC data-source format:

```
[ODBC Data Sources]
data_source_name=IBM INFORMIX ODBC DRIVER
:;
```

The following example defines two DSNs called EmpInfo and CustInfo:

```
[ODBC Data Sources]
EmpInfo=IBM INFORMIX ODBC DRIVER
CustInfo=IBM INFORMIX ODBC DRIVER
```

Data-source specification

Each DSN in the data sources section has a data-source specification section.

The following example illustrates a data-source specification format:

```
[data_source_name]
Driver=driver_path
Description=data_source_description
Database=database_name
LogonID=user_id
pwd=user_password
Server=database_server
CLIENT_LOCALE=application_locale
DB_LOCALE=database_locale
TRANSLATIONDLL=translation_path
```

```
CURSORBEHAVIOR=cursor_behavior
DefaultUDTFetchType=default_UDT_Fetch_type
ENABLESCROLLABLECURSORS=enable_scroll_cursors
ENABLEINSERTCURSORS=enable_insert_cursors
OPTIMIZEAUTOCOMMIT=optimize_auto_commit
NEEDODBCTYPESONLY=need_odbc_types_only
OPTOFC=open_fetch_close_optimization
REPORTKEYSETCURSORS=report_keyset_cursors
FETCHBUFFERSIZE=fetchbuffer_size
DESCRIBEDECIMALFLOATPOINT=describe_decimal_as_float
USESERVERDBLOCALE=use_server_dblocale
DONOTUSELVARCHAR=do_not_use_lvarchar
REPORTCHARCOLASWIDECHARCOL=char_col_as_widechar_col
UPDATE_DESCRIBE=update_describe
[ODBC]
   UNICODE=unicode_type
LENGTHINCHARFORDIAGRECW=bufferlength_as_number_of_characters
LEAVE_TRAILING_SPACES=leave_trailing_spaces
```

The following table describes the keywords that are in the data-source specification section and the order that they appear in each section.

Keywords	Description	Status
data_source_name	Data source specified in the Data Sources section	Required
Driver	Path for the driver Set this value to the complete path name for the driver library. For more information about the library directory and file names, see the release notes.	Required
Description	Description of the DSN Configured for a single user or for system users.	Optional
Database	Database to which the DSN connects by default	Required
LogonID	User identification or account name for access to the DSN	Optional
pwd	Password for access to the DSN	Optional
Server	HCL Informix® database server on which *database_name* is in	Required
CLIENT_LOCALE (GLS only)	Client locale. Default value: **en_us.8859-1**	Optional
DB_LOCALE (GLS only)	Database locale. Default value: **en_us.8859-1**	Optional
TRANSLATIONDLL (GLS only)	DLL that performs code-set conversion; default value: `$INFORMIXDIR/lib/esql/ig04a304.`*`xx`* where *xx* represents a platform-specific file extension	Optional
CURSORBEHAVIOR	Flag for cursor behavior when a commit or rollback transaction is called.	Optional

Keywords	Description	Status
	Possible values are: • 0=close cursor • 1=preserve cursor Default value: 0	
DefaultUDTFetchType	Default UDT fetch type. Default value: SQL_C_BINARY Possible values are: • SQL_C_BINARY • SQL_C_CHAR	Optional

ENABLESCROLLABLECURSORS	If this option is activated, the HCL Informix® ODBC Driver supports only scrollable, static cursors.
	Available only as a connection option:
	`SQL_INFX_ATTR_ENABLE_SCROLL_CRUSORS`
	or as a connection attribute string:
	`EnableScrollableCursors`
	Default value is: 0 (disabled)
		Optional

ENABLEINSERTCURSORS	Reduces the number of network messages sent to and from the server by buffering the inserted rows used with arrays of parameters and insert statements. This option improves the performance of bulk insert operations.
	Available as both a connection and statement option:
	`SQL_INFX_ATTR_ENABLE_INSERT_CURSORS`
	or as a connection attribute string:
	`EnableInsertCursors`
	Default value is: 0
		Optional

OPTIMIZEAUTOCOMMIT	Defers automatic commit operations while cursors remain open. This option can reduce database communication when the application is using non-ANSI logging databases. Available as a connection option:	Optional

Keywords	Description	Status

	`SQL_INFX_ATTR_OPTIMIZE_AUTOCOMMIT`
	
	or as a connection attribute string:
	
	`OptimizeAutoCommit`
	
	Default value is: 1 (enabled)	

OPTOFC	Causes the driver to buffer the open, fetch, and close cursor messages to the server. This option eliminates one or more message cycles when you use SQLPrepare, SQLExecute, and SQLFetch statements to fetch data with a cursor.
	
	Only available as a connection option:
	
	`SQL_INFX_ATTR_OPTOFC`
	
	or as a connection attribute string:
	
	`OPTOFC`
	
	Default is: 0 (disabled)
		Optional

REPORTKEYSETCURSORS	Causes the driver to report (through SQLGetInfo) that is supports forward-only, static, and keyset-driver cursors even though the driver only supports forward-only and static cursors. This option is used to enable dynaset-type functions, such as Microsoft™ Visual Basic, which require drivers that support keyset-driven cursors.
	
	Also available as connection option:
	
	`SQL_INFX_ATTR_REPORT_KEYSET_CURSORS`
	
	or as a connection attribute string:
	
	`ReportKeysetCursors`
	
	Default is: 0 (disabled)
		Optional

FETCHBUFFERSIZE	Size of a fetch buffer in bytes. Available as connection attribute string: `FETCHBUFFERSIZE` The maximum size of the fetch buffer is 2 GB. Default is: 32767	Optional
DESCRIBEDECIMALFLOATPOINT	Describes all floating-point decimal columns as:	Optional

Keywords	Description	Status
	• Float(SQL_REAL) or • Float(SQL_DOUBLE) A floating-point decimal column is a column that was created without a scale, for example DECIMAL(12). Some prepackaged applications such as Visual Basic cannot properly format Decimal columns that do not have a fixed scale. To use these applications, you must enable this option or redefine the column with a fixed scale. Enabling this option has the disadvantage that SQL_DECIMAL is an exact numeric data type while SQL_REAL and SQL_DOUBLE are approximate numeric data types. SQL_DECIMAL with a precision of 8 or less are described as SQL_REAL. With a precision greater than 8, it is described as SQL_DOUBLE. Available as connection attribute string: `DESCRIBEDECIMALFLOATPOINT` Default is: 0 (disabled)	
USESERVERDBLOCALE	Users server database locale. Available as a connection attribute string: `USERSERVERDBLOCALE` Default is: 0 (disabled)	Optional
DONOTUSELVARCHAR	If enabled, the SQLGetTypeInfo does not report LVARCHAR as a supported type (DATA_TYPE) of SQL_VARCHAR. Some applications use LVARCHAR instead of VARCHAR, even in columns that are less than 256 bytes. The minimum number of bytes transmitted for LVARCHAR is higher than VARCHAR. Many LVARCHAR columns can result in the rowset size exceeding the maximum. **Important:** Enable this option only if your SQL_VARCHAR columns are less than 256 bytes. Available as a connection attribute string: `DONOTUSELVARCHAR`	Optional

Keywords	Description	Status
	Default is: 0 (disabled)	
REPORTCHARCOLASWIDECHARCOL	Causes SQLDescribeCol to report character columns as wide character columns as follows: • SQL_CHAR is reported as SQL_WCHAR • SQL_VARCHAR is reported as SQL_WVARCHAR • SQL_LONGVARCHAR is reported as SQL_WLONGVARCHAR Available as a connection attribute string: `REPORTCHARCOLASWIDECHARCOL` Default is: 0 (disabled)	Optional
UPDATE_DESCRIBE OR UPD_DESC	This is required particularly for BLOB/CLOB data types. If enabled, server will send the description of these data types which will be used by ODBC Driver. This option should only be enabled when needed. It should not be turned on all the time as that would cause more round trips between client and server. Possible values are: • 0 • 1 Default value is: 0	Optional
UNICODE	Indicates the type of Unicode used by an application. This attribute applies to UNIX™ applications only and is set in the ODBC section of the `odbc.ini` file. The following considerations apply: • Applications on UNIX™ not linking to Data Direct ODBC driver manager should set this to UCS-4 • Applications on IBM® AIX® with version lower than 5L should set this attribute to UCS-2. • Applications using Data Direct driver manager do not need to set this attribute. Default is: UTF-8	Required

Keywords	Description	Status
	For more information about using Unicode in an ODBC application, see Unicode on page 248.	
LENGTHINCHARFORDIAGRECW	If enabled, the SQLGetDiagRecW API treats the BufferLength parameter as the number of characters. Default is: FALSE (disabled) For more information about using the BufferLength parameter seeBufferLength in character for SQLGetDiagRecW on page 26.	
LEAVE_TRAILING_SPACES	If enabled, the driver preserves blank characters at the end of VARCHAR column results. Possible values are: • 0 (trim trailing spaces) • 1 (preserve trailing spaces) Default value is: 0	

The following example shows the configuration for a DSN called EmpInfo:

```
[EmpInfo]
Driver=/informix/lib/cli/iclis09b.so
Description=Demo data source
Database=odbc_demo
LogonID=admin
pwd=tiger
Server=ifmx_91
CLIENT_LOCALE=en_us.8859-1
DB_LOCALE=en_us.8859-1
TRANSLATIONDLL=/opt/informix/lib/esql/igo4a304.so
```

The following example shows the configuration for a DSN called Informix® 9:

```
[Informix9]
Driver=/work/informix/lib/cli/iclis09b.so
Description=Informix 9.x ODBC Driver
LogonID=user1
pwd=tigress4
Database=odbc_demo
ServerName=my_server
```

If you specify a null `LogonID` or `pwd`, the following error occurs:

```
Insufficient connect information supplied
```

Tip: You can establish a connection to a DSN with null values for `LogonID` and `pwd` if the local Informix® database server is on the same computer where the client is located. In this case, the current user is considered a trusted user.

A sample data source, with no `LogonID` and `pwd`, where the server and client are on the same computer, might look like the following example:

```
Driver=/work/informix/lib/cli/iclis09b.so
Description=Informix 9.x ODBC Driver
LogonID=
pwd=tiger
Database=odbc_demo
ServerName=ifmx_server
```

Set the isolation level (UNIX™ only)

Set the isolation level in the `odbc.ini` file by using the ISOLATIONLEVEL and SQL_TXN_LAST_COMMITTED keywords.

To specify the isolation level in the `odbc.ini` file, use the following keyword and values:

- ISOLATIONLEVEL = level
- SQL_TXN_LAST_COMMITTED = last committed

where level is a number from 0 to 5:

- 0 = Automatically considers the default based on database type
- 1 = Read Uncommitted
- 2 = Read Committed (default for non-ANSI databases)
- 3 = Repeatable Read (default for ANSI databases)
- 4 = Serializable
- 5 = Last Committed

If an application calls SQLSetConnectAttr with the SQL_ATTR_TXN_ISOLATION attribute and sets the value before connecting, and later sets ISOLATIONLEVEL or ISOLVL in the connection string, the connection string is the final value to be used.

The SQL_TXN_TRANSACTION isolation level is not supported on UNIX™ platforms.

ODBC section

The values in the ODBC section of `odbc.ini` specify ODBC tracing options.

With tracing, you can find the log of calls made and also the return codes for each call. These options are set through the Tracing tab of the ODBC Data Source Administrator dialog box on Windows™.

The following table describes the tracing options in the ODBC section:

Table 3. Tracing options for ODBC section of odbc.ini

Option	Details
TRACE=1	Tracing enabled
TRACE=0	Tracing disabled
TRACEFILE	Set to where you want to driver to write the call logs.
TRACEDLL	Always idmrs09a.so

The following example illustrates an ODBC section specification format:

```
[ODBC]
TRACE=1
TRACEFILE=/WORK/ODBC/ODBC.LOG
TRACEDLL=idmrs09a.so
UNICODE=UCS-4
```

You must set the TRACEFILE to where you want the driver to write all of the call logs. Keep in mind that TRACE=1 means that tracing is enabled. TRACE=0 disables tracing options.

Set the $ODBCINI environment variable

Set the **$ODBCINI** environment variable to provide access to your DSN by system users

By default, HCL Informix® ODBC Driver uses configuration information found in the `$HOME/.odbc.ini` file. If you want to provide access to your DSN by system users, modify the path in the **$ODBCINI** environment variable to point to another configuration file that also contains the configuration information found in the `$HOME/.odbc.ini` file. Then change the configuration file permissions to allow read access for system users. Do not change the permissions to the `$HOME/.odbc.ini` file.

In the following example, the configuration file name is `myodbc.ini`:

```
setenv ODBCINI /work/myodbc.ini
```

The .netrc file

The `.netrc` file contains data for logging in to a remote database server over the network.

Create the `.netrc` file in the home directory where the client computer initiates the connection. Set the `.netrc` file permissions for the user to deny read access by the group and others.

To connect to a remote database server, create entries in the `.netrc` file for the `LogonID` and `pwd` required to autoconnect to the data source. To establish a connection to a remote data source, the ODBC driver first reads the `LogonID` and `pwd` from the data source entry in the `$HOME/.odbc.ini` file. If the `$HOME/.odbc.ini` file does not specify a `LogonID` and `pwd`, the ODBC driver searches the `$HOME/.netrc` file.

For example, to allow an autologin to the computer called **ray** by using the login name `log8in` with password `mypassword`, your `.netrc` file contains the following line:

```
machine ray login log8in password mypassword
```

For information about the `.netrc` file, see the UNIX™ man pages.

Configuring a DSN in Windows™

In Windows™ environments, HCL Informix® ODBC Driver provides a GUI to configure DSNs.

About this task

To configure a DSN:

- Choose a procedure to modify your DSN:

  Choose from:

  - Choose the User DSN option to restrict access to one user.
  - Choose the System DSN option to restrict access to system users.
  - Choose the File DSN option to allow access to all users on a network.
- Enter DSN-configuration values to create a DSN, such as the data-source name, the database server name, and the database locale.

What to do next

For a description of values, see the following two tables. Values are shown in the order that they appear in each section. You can also use Microsoft™ ODBC, Version 2.5 or later, to configure a DSN.

Tip: To find out what DSN you have, click the **About** tab and read the contents of the **Description** text box.

Important: To configure a DSN on the Windows™ 64-bit platform, you must use the 32-bit ODBC Data Source Administrator:

```
C:\WINDOWS\SysWOW64\odbcad32.exe
```

You must specify the user and password or the CSM setting for SSO.If you are enabling single-sign on (SSO), additional steps are in "Configuring ESQL/C and ODBC Drivers for SSO" in *HCL® Informix® Security Guide*.

Note: Support for Communication Support Module (CSM) is removed starting Informix Server 14.10.xC9 . You should use Transport Layer Security (TLS)/Secure Sockets Layer (SSL) instead.

Table 4. Required DSN values

Required values	Description
Data Source Name	DSN to access

Table 4. Required DSN values (continued)

Required values	Description
	This value is any name that you choose. **Data Source Name** is like an envelope that contains all relevant connection information about the DSN.
Database Name	Name of the database to which the DSN connects by default
Host Name	Computer on which **Server** is in
Protocol	Protocol used to communicate with **Server** After you have added a DSN, the menu will display the available choices.
Server Name	HCL® Informix® database server on which **Database** is in
Service	HCL® Informix® database server process that runs on your **Host** computer Confirm the service name with your system administrator or database administrator.

Table 5. Optional DSN values

Optional values	Description
Client Locale	Default value: **en_us.1252**
Database Locale	Default value: **en_us.1252**
Description	Any information, such as version number and service
Options	General information, such as password settings For more information about this value, see the `sqlhosts` information in your *HCL® Informix® Administrator's Guide*.
Password	Password for access to the DSN
Translation Library	Dynamic linked library (DLL) that performs code-set conversion; default value: `$INFORMIXDIR\bin\ig04n304.dll`
User ID	User identification or account name for access to the DSN
Translation Option	Option for a non-HCL® Informix® translation library Varying multibyte character length reporting option that specifies how to set *pcbValue* when *rgbValue* (the output area) is not large enough for the code-set-converted data Possible values: • 0=Estimate • 1=Exact

Table 5. Optional DSN values (continued)

Optional values	Description
	Default value: 0
Cursor Behavior	Flag for cursor behavior when a commit or rollback transaction is called Possible values are: • 0=close cursor • 1=preserve cursor Default value: 0

After you complete these steps, you will connect to the DSN.

Related reference

Global Language Support on page 18

Related information

Reconfiguring an existing DSN on page 49

Configuring a new user DSN or system DSN

Access the ODBC Data Source Administrator dialog box to configure a new user DSN or system DSN.

About this task

To configure a new user DSN or system DSN:

1. Choose **Start > Settings > Control Panel**.
2. Double-click ODBC to open the ODBC Data Source Administrator dialog box.

   Choose from:

   - To configure a user DSN, go to step 3 on page 44.
   - To configure a system DSN, click the **System DSN** tab and go to step 3 on page 44.

   All subsequent steps are the same to configure either a user DSN or a system DSN.
3. Click **Add**.

   The Create New Data Source dialog box opens.
4. Double-click **IBM INFORMIX ODBC driver** on the Create New Data Source wizard.

   The **General** page for the HCL Informix® ODBC Driver Setup dialog box opens.
5. Enter the values in the **General** page, as the following example shows:

   Example

- Data Source Name: `odbc33int`
- Description: `file DSN 3.81 on turbo`

For a description of the values, see Table 4: Required DSN values on page 42 and Table 5: Optional DSN values on page 43.

Restriction: Do not click **OK** after you enter the values on this page. If you click **OK** before you enter all the values, you get an error message.

6. Click the **Connection** tab to display the **Connection** page and enter the values, as the following example shows:

   Example

   - Server Name: `ol_clipper` (or use the menu to choose a server that is on the sqlhosts registry. If you use the menu, the ODBC application sets the Host Name, Service, Protocol, and Options values.)
   - Host Name: `clipper`
   - Service: `turbo`
   - Protocol: `onsoctcp` (or use the menu to choose a protocol)
   - Options: `csm=(SPWDCSM)`

     Note: Support for Communication Support Module (CSM) is removed starting Informix Server 14.10.xC9 . You should use Transport Layer Security (TLS)/Secure Sockets Layer (SSL) instead.

   - Database Name: `odbc_demo` (or use the menu to find a database name)
   - User ID: *`myname`*
   - Password: `*******`

     To save the values you chose and verify that your DSN connects successfully, click Apply & Test Connection. An ODBC Message dialog box opens. The box tells you if your connection was successful or, if it was not, tells you which Connection-tab value is incorrect.

7. Click the **Environment** tab to display the **Environment** page and enter the values, as the following example shows:

   Example

   - Client Locale: `en_US.CP1252`
   - Database Locale: `en_US.CP1252`
   - Use Server Database Locale: if check box is checked, database locale value is set to the server locale. If the check box is cleared, the database locale is set to the default locale, `en_US.CP1252.`
   - Translation Library: `INFORMIXDIR\lib\esql\ig04n304.dll`
   - Translation Option: `0`
   - Cursor Behavior: `0 - Close`
   - VMB Character: `0 - Estimate`
   - Fetch Buffer Size: `4096`
   - Isolation Level: `0 - Default will be considered, Read Committed (non-ANSI databases) or Repeatable Read (ANSI databases)`

8. Click the **Advanced** tab to display the **Advanced** page and click all applicable boxes.

Option	Description
Auto commit optimization	This option defers automatic commit operations while cursors remain open and can reduce database communication when the application is using non-ANSI logging databases. This option is available only as a connection option: `SQL_INFX_ATTR_OPTIMIZE_AUTOCOMMIT` or as a connection attribute string: "OptimizeAutoCommit" The default is: `1` (enabled).
Open-Fetch-Close optimization	This option causes the driver to buffer the open, fetch, and close cursor messages to the server. In addition, this option eliminates one or more message round trips when you use SQLPrepare, SQLExecute, and SQLFetch statements to fetch data with a cursor. This option is available only as a connection option: `SQL_INFX_ATTR_OPTOFC` or as a connection attribute string: "OPTOFC" The default is: `0` (disabled).
Insert cursors	This option reduces the number of network messages sent to and from the server by buffering the inserted rows that are used with arrays of parameters and insert statements. This option can greatly improve the performance of bulk insert operations, and is available as both connection and statement options: `SQL_INFX_ATTR_ENABLE_INSERT_CURSORS.` or as a connection attribute string: "EnableInsertCursors" The default is: `0` (disabled).
Scrollable cursor	If this option is activated, HCL Informix® ODBC Driver, Version 2.90 and later, supports only scrollable, static cursors. This option is available only as a connection option: `SQL_INFX_ATTR_ENABLE_SCROLL_CURSORS` or as a connection attribute string: "EnableScrollableCursors" The default is: `0` (disabled).
Report KeySet cursors	This option causes the driver to report (through SQLGetInfo) that it supports forward-only, static, and keyset-driven cursor types, although the driver only supports forward-only and static cursors. When you set this option, the driver enables dynaset-type functions, such as functions for Microsoft™ Visual Basic. These functions require drivers that support keyset-driven cursor types. This option is also available as a connection attribute: `SQL_INFX_ATTR_REPORT_KEYSET_CURSORS` or as a connection attribute string: "ReportKeysetCursors"

Option	Description
	The default is: `0` (disabled).
Report standard ODBC types only	If you activate this feature, the driver causes SQLGetTypeInfo to map all occurrences of user-defined types (UDTs) as follows: **Blob** **SQL_LONGVARBINARY** **Clob** **SQL_LONGVARBINARY** **Multiset** **SQL_C_CHAR/SQL_C_BINARY** **Set** **SQL_C_CHAR/SQL_C_BINARY** **List** **SQL_C_CHAR/SQL_C_BINARY** **Row** **SQL_C_CHAR/SQL_C_BINARY** The driver maps multiset, set, row, and list data types to **SQL_C_CHAR** or **SQL_C_BINARY**, which is the default UDT FetchType to **SQL_C_CHAR** features. The default is: `0` (disabled).
Describe decimal floating point as SQL_REAL / SQL_DOUBLE	This option describes all floating-point decimal columns as Float (SQL_REAL or SQL_DOUBLE). A floating-point decimal column is a column that was created without a scale, ex: DECIMAL(12). Some prepackaged applications such as Visual Basic cannot properly format Decimal columns that do not have a fixed scale. To use these applications you must enable this option or redefine the column with a fixed scale. There is a disadvantage to enabling this option however, SQL_DECIMAL is an exact numeric data type while SQL_REAL and SQL_DOUBLE are approximate numeric data types. A SQL_DECIMAL with a precision of 8 or less aree described as SQL_REAL, with a precision greater than 8 it is SQL_DOUBLE. The default is: 0 (disabled).
Do not use LVARCHAR	Causes SQLGetTypeInfo to not report LVARCHAR as a supported type of DATA_TYPE of SQL_VARCHAR.

Option	Description
	Some applications such as MS Access97 use LVARCHAR instead of VARCHAR even for columns that are less than 256 bytes long. The minimum number of bytes transmitted for LVARCHAR is higher than for VARCHAR and many LVARCHAR columns can result in the rowset size exceeding the maximum. Enable this option only if your SQL_VARCHAR columns are less than 256 bytes in length. The default is: 0 (disabled).
Report CHAR columns as wide CHAR columns	Causes SQLDescribeCol to report char columns as wide char columns. SQL_CHAR column is reported as SQL_WCHAR, SQL_VARCHAR as SQL_WVARCHAR and SQL_LONGVARCHAR column as SQL_WLONGVARCHAR The default is: 0 (disabled).
Length in Chars for SQLGetDiag RecW	If enabled, the SQLGetDiagRecW API treats the BufferLength Parameter as the number of characters. The default is: FALSE (disabled).
Leave Trailing Spaces	If enabled, the driver preserves blank characters at the end of VARCHAR column results. The default is: 0 (disabled).
Describe input parameters for SQL statements	This is required particularly for BLOB/CLOB data types. If enabled, server will send the description of these data types which will be used by ODBC Driver. This option should only be enabled when needed. It should not be turned on all the time as that would cause more round trips between client and server. The default is: 0 (disabled).

9. To check your connection to the database server, click **Test Connection**.
10. Click **OK** to return to the ODBC Data Source Administrator dialog box and to update the DSN information in the appropriate files.

Results

When your application connects to this DSN, the values that you entered are the default entries for the DSN connection.

Removing a DSN

Access the ODBC Data Source Administrator dialog box to remove a DSN.

About this task

To remove a DSN:

1. Follow steps 1 on page 44 and 2 on page 44 from Configuring a new user DSN or system DSN on page 44.
2. Click **Remove** in the ODBC Data Source Administrator dialog box.

   The 32-bit ODBC Administrator dialog box opens.
3. Click **Yes** to remove the DSN and return to the ODBC Data Source Administrator dialog box.

Reconfiguring an existing DSN

Access the ODBC Data Source Administrator dialog box to reconfigure an exiting user DSN.

About this task

To reconfigure an existing DSN:

1. Follow steps 1 on page 44 and 2 on page 44 from Configuring a new user DSN or system DSN on page 44
2. Click **Configure** to display the HCL Informix® ODBC Driver Setup dialog box.

   Enter the new configuration values in the corresponding text boxes and click **OK** to return to the ODBC Data Source Administrator dialog box.

Results

After you complete these steps, you will connect to the DSN.

Related information

Configuring a DSN in Windows on page 42

Configuring a file DSN

Access the ODBC Data Source Administrator dialog box to configure a file DSN.

About this task

To configure a file DSN:

1. Choose **Start > Settings > Control Panel**.
2. Double-click the ODBC icon to open the ODBC Data Source Administrator dialog box.
3. Click the **File DSN** tab to display the **File DSN** page.

   Choose the File DSN option to allow access to the DSN to all users on a network. For a description of values, see Table 4: Required DSN values on page 42 and Table 5: Optional DSN values on page 43.
4. Click **Add**.

   The Create New Data Source wizard opens.

5. Select **IBM INFORMIX ODBC Driver** from the driver list and click **Next** to display the Create New Data Source Setup wizard, which contains a file data source text box.
6. If you know the name of the date source file, type the name into the text box, click **Next** to display the completed Create New Data Source wizard, and go to step 9 on page 50

   If you do not know the name of the file, click **Browse** to display the Save As dialog box and enter the values, as the following example shows:
    - File Name: `File_DSN`
    - Save as type: `ODBC File Data Sources`

   Select a file name or type a file name in the **File_name** text box.
7. Click **Save** to display the Create New Data Source wizard, which displays information about the data source name.
8. Click **Next** to display the completed Create New Data Source wizard.
9. Click **Finish** to display the HCL Informix® Connect dialog box.
   For a description of the values, see Table 4: Required DSN values on page 42 and Table 5: Optional DSN values on page 43. For **Advanced** tab values, see Configuring a new user DSN or system DSN on page 44.
10. Click **OK** to save the values and display the ODBC Data Source Administrator dialog box.

    The name of the data file that you chose or typed in step 6 on page 50 is displayed in the text box.

Results

After you add or change DSN-configuration information, the driver updates the appropriate Windows™ registry to reflect the specified values. To be compatible with other HCL® Informix® connectivity products, the driver stores the DSN-configuration information in the Windows™ registry.

Creating logs of calls to the drivers

Access the **Tracing** page to create logs of calls to the drivers.

About this task

To create logs of calls to the drivers:

1. Click the **Tracing** tab to display the **Tracing** page.
2. Select **Start Tracing Now** to turn on tracing.
3. To enter an existing log file, click **Browse** to display the Select ODBC Log File dialog box.
4. Enter the file name in the **File_name** text box and click **Save** to return to the **Tracing** page.
5. To select a custom trace dynamic link library (DLL), click **Select DLL** to display the Select a custom trace dll dialog box, and enter the values, as the following example shows:
   Example
    - File name: `test2_dsn`
    - Files of type: `Dynamic link libraries(*.dll)`

   Choose a file or type a file name in the **File_name** text box.

6. Click **Open** to display the Tracing page.
7. Click **OK** to save the changes.

Creating and configuring a DSN on Mac OS X

The Mac OS X environment has a GUI interface for creating and configuring an HCL® Informix® ODBC data source name (DSN). This utility is the ODBC Administrator.

To create and configure an Informix® DSN on Mac OS X:

1. Open the ODBC Administrator by choosing **Applications > Utilities > ODBC Administrator**.
2. Click the **System DSN** tab.
3. Click **Add**.
4. Select **HCL Informix® ODBC Driver**, and click **OK**.
5. Enter a name in the **Data Source Name** field.
6. **Optional:** Enter information in the **Description** field if you want to include it.
7. Click **Add**.
8. Click **Key**, which appears directly under the Keyword column heading.
   A single click here enables you to edit the field in this row.
9. Type `UID` in the field so that it overwrites **Key**.
10. Click **Value** on the right side of the row, which appears directly under the Value column heading so that you can edit the field.
11. Type in the name of the login user that is used to connect to the database.
12. Repeat steps 7 on page 51 and 9 on page 51 to create three more row entries so that all the Keyword-Value pairs correspond with the entries in the following table. Enter the real information of your system in place of the variables in the Value column of the following table.

Keyword	Value
UID	*your_login_user*
PWD	*password_of_login_user*
Database	*your_database*
ServerName	*your_server_name*

13. Click **OK**.
14. Edit the global `sqlhosts` file to specify server connectivity information for Informix® ODBC data sources.
    This file is at `/etc/InformixODBC/sqlhosts`. The following is an example of a line entry in the `sqlhosts` file:

```
odbc_demo   onsoctcp   clipper   turbo   csm=(SPWDCSM)
```

    The fields in this line define the following connectivity parameters:
    - Column 1 (`odbc_demo` in the example): server name (this should be identical to ServerName defined in the DSN)
    - Column 2 (`onsoctcp` as example): connection protocol

- Column 3 (`clipper` as example): host name (a local computer must end in `.local`)
- Column 4 (`turbo` as example): service name (as defined in `etc/services`) or port number
- Column 5 (`csm=SPWDCSM` as example): optional connection setting, such as an Informix® communications support module

Note: Support for Communication Support Module (CSM) is removed starting Informix Server 14.10.xC9 . You should use Transport Layer Security (TLS)/Secure Sockets Layer (SSL) instead.

See the *HCL® Informix® Administrator's Guide* for details on how to set up the `sqlhosts` file.

Connection string keywords that make a connection

Use connection string keywords to make a connection with or without DSN and with the DRIVER keywords.

The following table lists the connection string keywords that can be used in making a connection:

Keyword	Short version
CLIENT_LOCALE	CLOC
CONNECTDATABASE	CONDB
CURSORBEHAVIOR	CURB
DATABASE	DB
DB_LOCALE	DLOC
DESCRIBEDECIMALFLOATPOINT	DDFP
DESCRIPTION	DESC
DONOTUSELVARCHAR	DNL
DRIVER	DRIVER
DSN	DSN
ENABLEINSERTCURSORS	ICUR
ENABLESCROLLABLECURSORS	SCUR
EXCLUSIVE	XCL
FETCHBUFFERSIZE	FBC
FILEDSN	FILEDSN
HOST	HOST
NEEDODBCTYPESONLY	ODTYP
OPTIMIZEAUTOCOMMIT	OAC
OPTIONS	OPT

Keyword	Short version
OPTOFC	OPTOFC
PWD	PWD
REPORTCHARCOLASWIDECHARCOL	RCWC
REPORTKEYSETCURSORS	RKC
SAVEFILE	SAVEFILE
SERVER	SRVR
SERVICE	SERV
SINGLETHREADED	SINGLETH
SKIPPARSING	SKIPP
TRANSLATIONDLL	TDLL
TRANSLATIONOPTION	TOPT
UID	UID
UPDATE_DESCRIBE	UPDDESC

DSN migration tool

You can use the DSN migration tool by creating a text file with an `.ini` extension.

To use the DSN migration tool, `dsnmigrate.exe`, that accompanies HCL Informix® ODBC Driver, create a text file with the extension `.ini`; and then type the names and values of the DSNs that you want to migrate or restore. The migration log file is located in `%INFORMIXDIR%\release\dsnMigr.log`. The restore information is located in `%INFORMIXDIR%\release\dsnMigr.sav`.

The following restrictions apply:

- A user DSN can be used or migrated only by the user who created that DSN.
- A system DSN can be used by all users of the system.
- A file DSN requires write privileges to the file.

Setting up and using the DSN migration tool

Set up and use the DSN migration tool with a text editor to create a text file.

About this task

To set up and use the DSN migration tool:

1. Open a text editor and create a text file with an `.ini` extension.
2. Create a section in the file for each type of DSN (user, system, and file) to be modified.

3. On a separate line in each section, specify your DSNs by using the following format:

   ```
   DSNname=drivername
   ```

   drivername must be `IBM INFORMIX ODBC DRIVER`
4. To run `dsnmigrate.exe`, use the following command:

   ```
   dsnMigrate -f filename
   ```

   where *filename* is the name of the text file created in step 1 on page 53

DSN migration tool examples

The DSN migration tool examples illustrate various DSNs migrated to the HCL Informix® ODBC Driver.

In the following example a DSN named **Test1** migrates to `IBM INFORMIX ODBC DRIVER`, and a DSN named **Test2** migrates to `IBM INFORMIX ODBC DRIVER`. Both DSNs are restricted to the user who created them.

```
[User DSN]
Test1=IBM INFORMIX ODBC DRIVER
Test2=IBM INFORMIX ODBC DRIVER
```

In the second example a DSN named **Test3** migrates to `IBM INFORMIX ODBC DRIVER`, and a DSN named **Test4** migrates to its original DSN. Both DSNs can be used by all users of the system. The user who migrates these system DSNs must have permission to modify ODBC system DSN registry entries.

```
[System DSN]
Test3=IBM INFORMIX ODBC DRIVER
Test4=restore
```

In the third example, two file DSNs named **test5.dsn** and **test6.dsn** migrate to `IBM INFORMIX ODBC DRIVER`.

```
[File DSN]
C:\Program Files\ODBC\Data Sources\test5.dsn=IBM INFORMIX ODBC DRIVER
C:\Program Files\ODBC\Data Sources\test6.dsn=IIBM INFORMIX ODBC DRIVER
```

Data types

These topics contain information about the data types that are supported by HCL Informix® ODBC Driver.

Related information

Header files on page 10

Data types on page 11

Smart large objects on page 92

Rows and collections on page 132

Data types

HCL Informix® ODBC Driver supports five different data types.

The following table describes the data types that HCL Informix® ODBC Driver supports.

Data type	Description	Example
Informix® SQL data type	Data types that your Informix® database server uses	CHAR(*n*)
Informix® ODBC Driver SQL data type	Data types that correspond to the Informix® SQL data types	SQL_CHAR
Standard C data type	Data types that your C compiler defines	unsigned char
Informix® ODBC Driver typedef	Typedefs that correspond to the standard C data types	UCHAR
Informix® ODBC Driver C data type	Data types that correspond to the standard C data types	SQL_C_CHAR

SQL data types

HCL Informix® database server uses SQL data types.

For detailed information about the HCL Informix® SQL data types, see *HCL® Informix® Guide to SQL: Reference*, *HCL® Informix® Guide to SQL: Tutorial*, and *HCL® Informix® User-Defined Routines and Data Types Developer's Guide*.

Related reference

Support for GLS data types on page 6

Standard SQL data types

Standard HCL Informix® SQL data types have corresponding HCL Informix® ODBC Driver data types.

The following table lists the standard HCL Informix® SQL data types and their corresponding HCL Informix® ODBC Driver data types.

Informix® SQL data type	Informix® ODBC driver SQL data type (fSqlType)	Description
BIGINT	SQL_INFX_BIGINT	Signed numeric value with precision 10, scale 0, and range *n* $(-(2^{63} - 1) \le n \le 2^{63} - 1)$
BIGSERIAL	SQL_INFX_BIGINT	Sequential positive integers to $2^{63} - 1)$
BOOLEAN	SQL_BIT	't' or 'f'
BYTE	SQL_LONGVARBINARY	Binary data of variable length
CHAR(*n*), CHARACTER(*n*)	SQL_CHAR	Character string of fixed length *n* $(1 \le n \le 32,767)$

Informix® SQL data type	**Informix® ODBC driver SQL data type (fSqlType)**	**Description**
CHARACTER VARYING(*m*, *r*)	SQL_VARCHAR	Character string of variable length with maximum length *m* (1 ≤ *m* ≤ 255) and minimum amount of reserved space *r* (0 ≤ *r* < *m*)
DATE	SQL_DATE	Calendar date
DATETIME	SQL_TIMESTAMP	Calendar date and time of day
DEC(*p*,*s*), DECIMAL(*p*, *s*)	SQL_DECIMAL	Signed numeric value with precision *p* and scale *s*: (1 ≤ *p* ≤ 32; 0 ≤ *s* ≤ *p*) **Important:** • If you use a value for scale > 14, inconsistencies in rounding are possible. • When a DECIMAL column contains floating-point data, Informix® ODBC reports the column's scale as 255. This is to differentiate from fixed-point data, which has a maximum scale of 32. The DataDirect ODBC Driver always returns a scale of zero.
DOUBLE PRECISION	SQL_DOUBLE	Signed numeric value with the same characteristics as the standard C **double** data type
FLOAT	SQL_DOUBLE	Signed numeric value with the same characteristics as the standard C **double** data type

Informix® SQL data type	Informix® ODBC driver SQL data type (fSqlType)	Description
IDSSECURITYLABEL		Built-in DISTINCT OF VARCHAR(128) data type; use is restricted to label-based access control
INT, INTEGER	SQL_INTEGER	Signed numeric value with precision 10, scale 0, and range *n* (-2,147,483,647 ≤ *n* ≤ 2,147,483,647)
INT8	SQL_BIGINT	Signed numeric value with precision 10, scale 0, and range *n* $(-(2^{63} - 1) \leq n \leq 2^{63} - 1)$
INTERVAL MONTH(*p*)	SQL_INTERVAL_MONTH	Number of months between two dates; *p* is the interval leading precision.
INTERVAL YEAR(*p*)	SQL_INTERVAL_YEAR	Number of years and months between two dates; *p* is the interval leading precision.
INTERVAL YEAR(*p*) TO MONTH	SQL_INTERVAL_YEAR_TO_MONTH	Number of years and months between two dates; *p* is the interval leading precision.
INTERVAL DAY(*p*)	SQL_INTERVAL_DAY	Number of days between two dates; *p* is the interval leading precision.
INTERVAL HOUR(*p*)	SQL_INTERVAL_HOUR	Number of hours between two date times; *p* is the interval leading precision.
INTERVAL MINUTE(*p*)	SQL_INTERVAL_MINUTE	Number of minutes between two date/times; *p* is the interval leading precision.
INTERVAL SECOND(*p*,*q*)	SQL_INTERVAL_SECOND	Number of seconds between two date/times; *p* is the interval leading precision and *q* is the interval seconds precision.
INTERVAL DAY(*p*) TO HOUR	SQL_INTERVAL_DAY_TO_HOUR	Number of days/hours between two date/times; *p* is the interval leading precision.

Informix® SQL data type	**Informix® ODBC driver SQL data type (fSqlType)**	**Description**
INTERVAL DAY(*p*) TO MINUTE	SQL_INTERVAL_DAY_TO_MINUTE	Number of days/hours/minutes between two date/times; *p* is the interval leading precision.
INTERVAL DAY(*p*) TO SECOND(*q*)	SQL_INTERVAL_DAY_TO_SECOND	Number of days/hours/minutes/seconds between two date/times; *p* is the interval leading precision and *q* is the interval seconds precision.
INTERVAL HOUR (*p*) TO MINUTE	SQL_INTERVAL_HOUR_TO_MINUTE	Number of hours/minutes between two date/times; *p* is the interval leading precision.
INTERVAL HOUR(*p*) TO SECOND(*q*)	SQL_INTERVAL_HOUR_TO_SECOND	Number of hours/minutes/seconds between two date/times; *p* is the interval leading precision and *q* is the interval seconds precision.
INTERVAL MINUTE(*p*) TO SECOND(*q*)	SQL_INTERVAL_MINUTE_TO_SECOND	Number of minutes/seconds between two date/times; *p* is the interval leading precision and *q* is the interval seconds precision.
LVARCHAR	SQL_VARCHAR	Character string of variable length with length *l* (255 ≤ *l* ≤ 32,000) When connecting to HCL Informix® 10.0 servers with the ODBC driver, the SQLDescribeCol, SQLColAttributes & SQLDescribeParam APIs report the length mentioned during creation of the LVARCHAR column. If no length was mentioned during creation, length defaults to 2048 bytes.
MONEY(*p*, *s*)	SQL_DECIMAL	Signed numeric value with precision *p* and scale *s* (1 ≤ *p* ≤ 32; 0 ≤ *s* ≤ *p*)

Informix® SQL data type	**Informix® ODBC driver SQL data type (fSqlType)**	**Description**
NUMERIC	SQL_NUMERIC	Signed, exact, numeric value with precision *p* and scale *s* (1 ≤ *p* ≤ 15; 0 ≤ *s* ≤ *p*)
REAL	SQL_REAL	Signed numeric value with the same characteristics as the standard C **float** data type
SERIAL	SQL_INTEGER	Sequential INTEGER
SERIAL8	SQL_BIGINT	Sequential INT8
SMALLFLOAT	SQL_REAL	Signed numeric value with the same characteristics as the standard C **float** data type
SMALLINT	SQL_SMALLINT	Signed numeric value with precision 5, scale 0, and range *n* (-32,767 ≤ *n* ≤ 32,767)
TEXT	SQL_LONGVARCHAR	Character string of variable length
VARCHAR(*m*, *r*)	SQL_VARCHAR	Character string of variable length with maximum length *m* (1 ≤ *m* ≤ 255) and minimum amount of reserved space *r* (0 ≤ *r* < *m*)

Visual Basic client-side cursors

When you use Visual Basic client-side cursors to perform rowset update related operations with using CHAR or LVARCHAR columns that have lengths greater than or equal to 16,385, the HCL Informix® ODBC Driver might return an error.

Visual Basic sends the SQL data type to SQLBindParameter as SQL_LONGVARCHAR instead of SQL_VARCHAR when the length is greater than or equal to 16,385. HCL Informix® ODBC Driver maps SQL_LONGVARCHAR to TEXT data type. Therefore, applications might see the error:

```
[Informix][Informix ODBC Driver]No cast from text to lvarchar
```

or

```
[Informix][Informix ODBC Driver]Illegal attempt to use Text/Byte host variable.
```

Additional SQL data types for GLS

Additional SQL data types for GLS have corresponding HCL Informix® ODBC Driver data types.

The following table lists the additional HCL Informix® SQL data types for GLS and their corresponding HCL Informix® ODBC Driver data types. Informix® ODBC driver does not provide full GLS support. For more information about GLS, see the *HCL® Informix® GLS User's Guide*.

Informix® SQL data type	**Informix® ODBC driver SQL data type (fSqlType)**	**Description**
NCHAR(*n*)	SQL_CHAR	Character string of fixed length *n* (1 ≤ *n* ≤ 32,767). Collation depends on locale.
NVARCHAR(*m*, *r*)	SQL_VARCHAR	Character string of variable length with maximum length *m* (1 ≤ *m* ≤ 255) and minimum amount of reserved space *r* (0 ≤ *r* < *m*). Collation depends on locale.

Additional SQL data types for Informix®

Additional HCL Informix® SQL data types for Informix® have corresponding HCL Informix® ODBC Driver data types.

The following table lists the additional HCL Informix® SQL data types for Informix® and their corresponding HCL Informix® ODBC Driver data types. To use the Informix® ODBC driver SQL data types for Informix®, include `infxcli.h`.

Informix® SQL data type	**Informix® ODBC driver SQL data type (fSqlType)**	**Description**
Collection (LIST, MULTISET, SET)	Any Informix® ODBC driver SQL data type	Composite value that consists of one or more elements, where each element has the same data type.
DISTINCT	Any Informix® ODBC driver SQL data type	UDT that is stored the same way as its source data type but has different casts and functions
OPAQUE (fixed)	SQL_INFX_UDT_FIXED	Fixed-length UDT with an internal structure that has the same size for all possible values
OPAQUE (varying)	SQL_INFX_UDT_VARYING	Variable-length UDT with an internal structure that can have a different size for each different value
Row (Named row, unnamed row)	Any Informix® ODBC Driver SQL data type	Composite value that consists of one or more elements, where each element can have a different data type.
Smart large object (BLOB or CLOB)	SQL_IFMX_UDT_BLOB SQL_IFMX_UDT_CLOB	Large object that is stored in an sbspace on disk and is recoverable.

Related information

Smart large objects on page 92

Rows and collections on page 132

Precision, scale, length, and display size

The functions that get and set precision, scale, length, and display size for SQL values have size limitations for their input arguments.

Therefore, these values are limited to the size of an SDWORD that has a maximum value of 2,147,483,647. The following table describes these values.

Value	Description for a numeric data type	Description for a non-numeric data type
Precision	Maximum number of digits.	Either the maximum length or the specified length.
Scale	Maximum number of digits after the decimal point. For floating point values, the scale is undefined because the number of digits to the right of the decimal point is not fixed.	Not applicable.
Length	Maximum number of bytes that a function returns when a value is transferred to its default C data type.	Maximum number of bytes that a function returns when a value is transferred to its default C data type. The length does not include the NULL termination byte.
Display size	Maximum number of bytes needed to display data in character form.	Maximum number of bytes needed to display data in character form.

Standard SQL data types

View the values for the precision, scale, length, and display size for standard HCL Informix® ODBC Driver SQL data types.

The following table describes the precision, scale, length, and display size for the standard HCL Informix® ODBC Driver SQL data types.

Informix® ODBC driver sql data type (fSqlType)	Description
SQL_BIGINT	**Precision** 19. SQLBindParameter ignores the value of *cbColDef* for this data type. **Scale** 0. SQLBindParameter ignores the value of *ibScale* for this data type.

Informix® ODBC driver sql data type (fSqlType)	Description
	Length 8 bytes **Display size** 20 digits. One digit is for the sign.
SQL_BIT	**Precision** 1. SQLBindParameter ignores the value of *cbColDef* for this data type. **Scale** 0. SQLBindParameter ignores the value of *ibScale* for this data type. **Length** 1 byte **Display size** 1 digit
SQL_CHAR	**Precision** Same as the length **Scale** Not applicable. SQLBindParameter ignores the value of *ibScale* for this data type. **Length** The specified length. For example, the length of CHAR(10) is 10 bytes. **Display size** Same as the length.
SQL_DATE	**Precision** 10. SQLBindParameter ignores the value of *cbColDef* for this data type. **Scale** Not applicable. SQLBindParameter ignores the value of *ibScale* for this data type. **Length** 6 bytes **Display size** 10 digits in the format `yyyy-mm-dd`.

Informix® ODBC driver sql data type (fSqlType)	Description
SQL_DECIMAL	**Precision** The specified precision. For example, the precision of DECIMAL (12, 3) is 12. **Scale** The specified scale. For example, the scale of DECIMAL(12, 3) is 3. **Length** The specified precision plus 2. For example, the length of DECIMAL(12, 3) is 14 bytes. The two additional bytes are used for the sign and the decimal points because functions return this data type as a character string. **Display size** Same as the length.
SQL_DOUBLE	**Precision** 15. SQLBindParameter ignores the value of *cbColDef* for this data type. **Scale** Not applicable. SQLBindParameter ignores the value of *ibScale* for this data type. **Length** 8 bytes **Display size** 22 digits. The digits are for a sign, 15 numeric characters, a decimal point, the letter E, another sign, and 2 more numeric characters.
SQL_INTEGER	**Precision** 10. SQLBindParameter ignores the value of *cbColDef* for this data type. **Scale** 0. SQLBindParameter ignores the value of *ibScale* for this data type. **Length** 4 bytes **Display size** 11 digits. One digit is for the sign.
SQL_LONGVARBINARY	**Precision** Same as the length.

Informix® ODBC driver sql data type (fSqlType)	Description
	Scale Not applicable. SQLBindParameter ignores the value of *ibScale* for this data type. **Length** The maximum length. If a function cannot determine the maximum length, it returns SQL_NO_TOTAL. **Display size** The maximum length times 2. If a function cannot determine the maximum length, it returns SQL_NO_TOTAL.
SQL_LONGVARCHAR	**Precision** Same as the length. **Scale** Not applicable. SQLBindParameter ignores the value of *ibScale* for this data type. **Length** The maximum length. If a function cannot determine the maximum length, it returns SQL_NO_TOTAL. **Display size** Same as the length.
SQL_REAL	**Precision** 7. SQLBindParameter ignores the value of *cbColDef* for this data type. **Scale** Not applicable. SQLBindParameter ignores the value of *ibScale* for this data type. **Length** 4 bytes **Display size** 13 digits. The digits are for a sign, 7 numeric characters, a decimal point, the letter E, another sign, and 2 more numeric characters.
SQL_SMALLINT	**Precision** 5. SQLBindParameter ignores the value of *cbColDef* for this data type.

Informix® ODBC driver sql data type (fSqlType)	**Description**
	Scale 0. SQLBindParameter ignores the value of *ibScale* for this data type. **Length** 2 bytes **Display size** 6 digits. One digit is for the sign.
SQL_TIMESTAMP	**Precision** 8. SQLBindParameter ignores the value of *cbColDef* for this data type. **Scale** The number of digits in the FRACTION field. **Length** 16 bytes **Display size** 19 or more digits: • If the scale of the time stamp is 0: 19 digits in the format `yyyy-mm-dd hh:mm:ss`. • If the scale of the time stamp exceeds 0: 20 digits plus digits for the FRACTION field in the format `yyyy-mm-dd hh:mm:ss.f...`
SQL_VARCHAR	**Precision** Same as the length. **Scale** Not applicable. SQLBindParameter ignores the value of *ibScale* for this data type. **Length** The specified length. For example, the length of VARCHAR(10) is 10 bytes. **Display size** Same as the length.

Additional SQL data types for Informix®

View the values for the precision, scale, length, and display size for additional HCL Informix® ODBC Driver SQL data types.

The following table describes the precision, scale, length, and display size for the HCL Informix® ODBC Driver SQL data types for Informix®.

Informix® ODBC driver sql data type (fSqlType)	Description
SQL_IFMX_UDT_BLOB	**Precision** Variable value. To determine this value, call a function that returns the precision for a column. **Scale** Not applicable. A function that returns the scale for a column returns -1 for this data type. **Length** Variable value. To determine this value, call a function that returns the length for a column. **Display size** Variable value. To determine this value, call a function that returns the display size for a column.
SQL_IFMX_UDT_CLOB	**Precision** Variable value. To determine this value, call a function that returns the precision for a column. **Scale** Not applicable. A function that returns the scale for a column returns -1 for this data type. **Length** Variable value. To determine this value, call a function that returns the length for a column. **Display size** Variable value. To determine this value, call a function that returns the display size for a column.
SQL_INFX_UDT_FIXED	**Precision** Variable value. To determine this value, call a function that returns the precision for a column. **Scale** Not applicable. A function that returns the scale for a column returns -1 for this data type.

Informix® ODBC driver sql data type (fSqlType)	Description
	Length Variable value. To determine this value, call a function that returns the length for a column. **Display size** Variable value. To determine this value, call a function that returns the display size for a column.
SQL_INFX_UDT_VARYING	**Precision** Variable value. To determine this value, call a function that returns the precision for a column. **Scale** Not applicable. A function that returns the scale for a column returns -1 for this data type. **Length** Variable value. To determine this value, call a function that returns the length for a column. **Display size** Variable value. To determine this value, call a function that returns the display size for a column.

C data types

HCL Informix® ODBC Driver applications use C data types to store values that the application processes.

The following table describes the C data types that HCL Informix® ODBC Driver provides.

Important: String arguments in Informix® ODBC driver functions are unsigned. Therefore, you need to cast a CString object as an unsigned string before you use it as an argument in the Informix® ODBC driver function.

Value	Informix® ODBC driver C data type (fCType)	Informix® ODBC driver typedef	Standard C data type
Binary	**SQL_C_BINARY**	UCHAR FAR *	**unsigned char FAR ***
Boolean	**SQL_C_BIT**	UCHAR	**unsigned char**
Character	**SQL_C_CHAR**	UCHAR FAR *	**unsigned char FAR ***
Wide Character	**SQL_C_WCHAR**	WCHAR FAR *	**wchar_t FAR ***

Value	Informix® ODBC driver C data type (fCType)	Informix® ODBC driver typedef	Standard C data type
Date	**SQL_C_DATE**	DATE_STRUCT	`struct tagDATE_STRUCT{ SWORD year; UWORD month; UWORD day; }`
Interval	**SQL_C_INTERVAL_YEAR**	SQL_INTERVAL_STRUCT	**C Interval Structure**
	SQL_C_INTERVAL_MONTH	SQL_INTERVAL_STRUCT	**C Interval Structure**
	SQL_C_INTERVAL_DAY	SQL_INTERVAL_STRUCT	**C Interval Structure**
	SQL_C_INTERVAL_HOUR	SQL_INTERVAL_STRUCT	**C Interval Structure**
	SQL_C_INTERVAL_MINUTE	SQL_INTERVAL_STRUCT	**C Interval Structure**
	SQL_C_INTERVAL_SECOND	SQL_INTERVAL_STRUCT	**C Interval Structure**
	SQL_C_INTERVAL_YEAR _TO_MONTH	SQL_INTERVAL_STRUCT	**C Interval Structure**
	SQL_C_INTERVAL_DAY _TO_HOUR	SQL_INTERVAL_STRUCT	**C Interval Structure**
	SQL_C_INTERVAL_DAY_ TO_MINUTE	SQL_INTERVAL_STRUCT	**C Interval Structure**
	SQL_C_INTERVAL_DAY_ TO_SECOND	SQL_INTERVAL_STRUCT	**C Interval Structure**
	SQL_C_INTERVAL_HOUR _TO_MINUTE	SQL_INTERVAL_STRUCT	**C Interval Structure**
	SQL_C_INTERVAL_HOUR _TO_SECOND	SQL_INTERVAL_STRUCT	**C Interval Structure**
	SQL_C_INTERVAL_MINUTE _TO_SECOND	SQL_INTERVAL_STRUCT	**C Interval Structure**
Numeric	**SQL_C_DOUBLE**	SDOUBLE	**signed double**
	SQL_C_FLOAT	SFLOAT	**signed float**
	SQL_C_LONG	SDWORD	**signed long int**
	SQL_C_NUMERIC	SQL_NUMERIC_STRUCT	`struct tag SQL_NUMERIC_STRUCT { SQLCHAR precision; SQLSCHAR scale; SQLCHAR sign; SQLCHAR val [SQL_MAX_ NUMERIC_LEN]; }SQL_NUMERIC_ STRUCT;`

Value	Informix® ODBC driver C data type (fCType)	Informix® ODBC driver typedef	Standard C data type
	SQL_C_SHORT	SWORD	**signed short int**
	SQL_C_SLONG	SDWORD	**signed long int**
	SQL_C_SSHORT	SWORD	**signed short int**
	SQL_C_STINYINT	SCHAR	**signed char**
	SQL_C_TINYINT	SCHAR	**signed char**
	SQL_C_ULONG	UDWORD	**unsigned long int**
	SQL_C_USHORT	UWORD	**unsigned short int**
	SQL_C_UTINYINT	UCHAR	**unsigned char**
Time stamp	**SQL_C_TIMESTAMP**	TIMESTAMP_STRUCT	`struct tagTIMESTAMP_STRUCT { SWORD year; UWORD month; UWORD day; UWORD hour; UWORD minute; UWORD second; UDWORD fraction; }`

C interval structure

Specify the C data type for the SQL interval data type by using a C interval structure.

The following structures specify the C data type for the SQL interval data type:

```
typedef struct tagSQL_INTERVAL_STRUCT
   {
   SQLINTERVAL interval_type;
   SQLSMALLINT   interval_sign;
   union
      {
      SQL_YEAR_MONTH_STRUCT year_month;
      SQL_DAY_SECOND_STRUCT day_second;
      } intval;
   }SQLINTERVAL_STRUCT;

typedef enum
   {
   SQL_IS_YEAR=1,
   SQL_IS_MONTH=2,
   SQL_IS_DAY=3,
   SQL_IS_HOUR=4,
   SQL_IS_MINUTE=5,
   SQL_IS_SECOND=6,
   SQL_IS_YEAR_TO_MONTH=7,
   SQL_IS_DAY_TO_HOUR=8,
   SQL_IS_DAY_TO_MINUTE=9,
   SQL_IS_DAY_TO_SECOND=10,
   SQL_IS_HOUR_TO_MINUTE=11,
   SQL_IS_HOUR_TO_SECOND=12,
   SQL_IS_MINUTE_TO_SECOND=13,
   }SQLINTERVAL;

typedef struct tagSQL_YEAR_MONTH
   {
   SQLUINTEGER year;
   SQLUINTEGER month;
   }SQL_YEAR_MOHTH_STRUCT;

typedef struct tagSQL_DAY_SECOND
   {
   SQLUINTEGER day;
   SQLUNINTEGER hour;
   SQLUINTEGER minute;
   SQLUINTEGER second;
   SQLUINTEGER fraction;
   }SQL_DAY_SECOND_STRUCT;
```

Transfer data

Among data sources that use the same DBMS, you can safely transfer data in the internal form that a DBMS uses.

For a particular piece of data, the SQL data types must be the same in the source and target data sources. The C data type is **SQL_C_BINARY**.

When you call SQLFetch, SQLExtendedFetch, or SQLGetData to retrieve this data from a data source, HCL Informix® ODBC Driver retrieves the data and transfers it, without conversion, to a storage location of type **SQL_C_BINARY**. When you call SQLExecute, SQLExecDirect, or SQLPutData to send this data to a target data source, HCL Informix® ODBC Driver retrieves the data from the storage location and transfers it, without conversion, to the target data source.

The binary representation of INT8, SERIAL8, and BIGSERIAL data types is an array of two unsigned long integers followed by a short integer that indicates the sign field. The sign field is `1` for a positive value, `-1` for a negative value, or `0` for a null value.

Important: Applications that transfer any data (except binary data) in this manner are not interoperable among DBMSs.

Report standard ODBC types

HCL Informix® ODBC Driver supports existing applications that support standard ODBC data types only. Check the DSN option **Report Standard ODBC Types** to turn on this behavior.

When an application sets this option, the driver sets the following behavior:

- Only Standard ODBC data types are reported for all the driver defined new data types.
- The data type access method for smart-large-object (LO) data can be accessed as SQL_LONGVARCHAR and SQL_LONGVARBINARY. In other words, SQL_LONGVARCHAR and SQL_LONGVARBINARY act like the simple large objects, byte, and text.
- The defaultUDTfetchtype is set to **SQL_C_CHAR**.

However, you can control each of the preceding behaviors individually as a connection or a statement level option. Use the following connection and statement level attributes:

- SQL_INFX_ATTR_ODBC_TYPES_ONLY
- SQL_INFX_ATTR_LO_AUTOMATIC
- SQL_INFX_ATTR_DEFAULT_UDT_FETCH_TYPE

Applications can use SQLSetConnectAttr and SQLSetStmtAttr to set and unset these values. (ODBC 2.x applications can use SQLSetConnectOption and SQLSetStmtOption equivalently.)

SQL_INFX_ATTR_ODBC_TYPES_ONLY

Applications can set the SQL_INFX_ATTR_ODBC_TYPES_ONLY attribute to value SQL_TRUE or SQL_FALSE.

This attribute can be set and unset at connection and statement level. All the statements allocated under the same connection inherit this value. Alternatively each statement can change this attribute. By default this attribute is set to SQL_FALSE.

An application can change the value of this attribute by using SQLSetConnectAttr and SQLSetStmtAttr (SQLSetConnectOption and SQLSetStmtOption in ODBC 2.x). Applications can retrieve the values set by using SQLGetConnectAttr and SQLGetStmtAttr (SQLGetConnectOption and SQLGetStmtOption in ODBC 2.x).

This attribute cannot be set to SQL_TRUE when SQL_INFX_ATTR_LO_AUTOMATIC is set SQL_FALSE. An error message is returned that reports the following message:

```
Attribute cannot be set. LoAutomatic should be ON to set this value
```

.

The application should first set the SQL_INFX_ATTR_LO_AUTOMATIC attribute to SQL_TRUE and then set the attribute SQL_INFX_ATTR_ODBC_TYPES_ONLY to SQL_TRUE.

SQL_INFX_ATTR_LO_AUTOMATIC

Applications can set the SQL_INFX_ATTR_LO_AUTOMATIC attribute to value SQL_TRUE or SQL_FALSE.

This attribute can be set and unset at connection and statement level. All the statements allocated under the same connection inherit this value. Alternatively each statement can change this attribute. By default this attribute is set to SQL_FALSE.

An application can change the value of this attribute by using SQLSetConnectAttr and SQLSetStmtAttr (SQLSetConnectOption and SQLSetStmtOption in ODBC 2.x). Applications can retrieve the values set by using SQLGetConnectAttr and SQLGetStmtAttr (SQLGetConnectOption and SQLGetStmtOption in ODBC 2.x).

The attribute SQL_INFX_ATTR_LO_AUTOMATIC cannot be set to SQL_FALSE when SQL_INFX_ATTR_ODBC_TYPES_ONLY is set to SQL_TRUE. An error message is returned that reports the following message:

```
Attribute cannot be set. ODBC types only should be OFF to set this value
```

.

Applications should first set the attribute SQL_INFX_ODBC_TYPES_ONLY to SQL_FALSE and then set the attribute SQL_INFX_ATTR_LO_AUTOMATIC to SQL_FALSE.

Applications would like to set attribute SQL_INFX_ATTR_UPDATE_DESCRIBE (this option could also be enabled using DSN and/or connection string. For more information, see Connection string keywords that make a connection on page 52) using SQLSetConnectAttr() API. By enabling this option server will send the description of BLOB/CLOB data types which will be used by ODBC Driver. This option should only be enabled when needed. It should not be enabled all the time, otherwise it would cause more round trips between client and server.

SQL_INFX_ATTR_DEFAULT_UDT_FETCH_TYPE

Applications can set the SQL_INFX_ATTR_DEFAULT_UDT_FETCH_TYPE attribute to **SQL_C_CHAR** or **SQL_C_BINARY** to set the default fetch type for UDTs.

The default value of this attribute is set depending on the following conditions:

- If the DSN setting for **Report Standard ODBC Types** is ON, the value of DefaultUDTFetchType is set to **SQL_C_CHAR**.
- If the DSN setting for **Report Standard ODBC Types** is OFF, the value of DefaultUDTFetchType is set to **SQL_C_BINARY**.
- If a user has set a registry key, the value of DefaultUDTFetchType is set to the value in the registry provided **Report Standard ODBC Types** is not set.

An application can change the value of this attribute by using SQLSetConnectAttr and SQLSetStmtAttr (SQLSetConnectOption and SQLSetStmtOption in ODBC 2.x). Applications can retrieve the values set by using SQLGetConnectAttr and SQLGetStmtAttr (SQLGetConnectOption and SQLGetStmtOption in ODBC 2.x).

Setting the **Report Standard ODBC Types** to ON always overrides DefaultUDTFetchType to **SQL_C_CHAR**.

Report wide character columns

HCL Informix® servers do not support wide character data types.

When an application sets the **Report Char Columns as Wide Char Columns** option, the driver sets the following behavior:

- SQLDescribeCol reports char columns as wide char columns
- SQL_CHAR column is reported as SQL_WCHAR
- SQL_VARCHAR column is reported as SQL_WVARCHAR
- SQL_LONGVARCHAR column is reported as SQL_WLONGVARCHAR
- The default is 0: (disabled)

After setting the **Report Char Columns as Wide Char Columns** option, calls to SQLBindParameter with SQL data types have the following behavior:

- SQL_WCHAR is mapped to SQL_CHAR
- SQL_WVARCHAR is mapped to SQL_VARCHAR
- SQL_WLONGVARCHAR is mapped to SQL_LONGVARCHAR

DSN settings for report standard ODBC data types

For UNIX™ and Windows™, you can add the new DSN option **NeedODBCTypesOnly**.

For UNIX™, add a new DSN option **NeedODBCTypesOnly** under your DSN setting in your `odbc.ini` file [default is 0]. For example:

```
[Informix9]
Driver=/informix/lib/cli/libthcli.so
Description=IBM Informix ODBC Driver
.
NeedODBCTypesOnly=1
```

For Windows™, check this option under the **Advanced** tab of the ODBC Administration for HCL Informix® Driver DSN [default is 0].

The following table shows how the Informix® data types map to the standard ODBC data types.

Table 6. Informix® and ODBC data type mapping

Informix®	ODBC
Bigint	SQL_BIGINT
Bigserial	SQL_BIGINT
Blob	SQL_LONGVARBINARY
Boolean	SQL_BIT
Clob	SQL_LONGVARCHAR
Int8	SQL_BIGINT
Lvarchar	SQL_VARCHAR
Serial8	SQL_BIGINT
Multiset	SQL_C_CHAR or SQL_C_BINARY
Set	SQL_C_CHAR or SQL_C_BINARY
List	SQL_C_CHAR or SQL_C_BINARY

Table 6. Informix® and ODBC data type mapping (continued)

Informix®	ODBC
Row	SQL_C_CHAR or SQL_C_BINARY

Important:

- For multiset, set, row, and list data types, the data type is mapped to the defaultUDTFetchType attribute set (**SQL_C_CHAR** or **SQL_C_BINARY**).
- To enable SQL_BIGINT to work correctly with SQLBindCol and SQLBindParameter, you must use SQL_C_UBIGINT (which has a supported data range of 8 byte unsigned integer) and not SQL_C_LONG (which has a supported data range of 4 byte integer).

Convert data

The word *convert* is used in this section in a broad sense; it includes the transfer of data from one storage location to another without a conversion in data type.

Standard conversions

Standard conversions exist between the HCL Informix® SQL data types and the HCL Informix® ODBC Driver C data types.

Only Informix® can convert data to **SQL_C_BIT**.

The Informix® ODBC driver C data types, **SQL_C_BINARY**, **SQL_C_CHAR**, and **SQL_C_WCHAR**, support conversion between all Informix® SQL data types listed in the following tables.

The following tables show the supported conversions between the Informix® SQL data types and the Informix® ODBC Driver C data types.

Table 7. Supported conversions between Informix® SQL data types and ODBC Driver C data types

SQL data type	ODBC driver C data types (target type)			
	SQL_C_BIT	**SQL_C_DATE**	**SQL_C_DOUBLE**	**SQL_C_FLOAT**
BOOLEAN	yes	no	no	no
CHAR, CHARACTER	yes	no	yes	yes

Table 7. Supported conversions between Informix® SQL data types and ODBC Driver C data types

(continued)

SQL data type	ODBC driver C data types (target type)			
	SQL_C_BIT	SQL_C_DATE	SQL_C_DOUBLE	SQL_C_FLOAT
CHARACTER VARYING	yes	no	yes	yes
DATE	no	yes	no	no
DATETIME	no	yes	no	no
DEC, DECIMAL	yes	no	yes	yes
DOUBLE PRECISION	no	no	yes	yes
FLOAT	no	no	yes	yes
INT, INTEGER	yes	no	yes	yes
INT8	no	no	no	no
LVARCHAR	yes	yes	no	yes
MONEY	no	yes	yes	yes
NUMERIC	no	yes	yes	yes
REAL	no	yes	yes	yes
SERIAL	no	yes	yes	yes
SMALLFLOAT	yes	no	yes	yes
SMALLINT	yes	no	yes	yes
TEXT	yes	yes	yes	yes
VARCHAR	yes	yes	yes	yes

Table 8. Supported conversions between Informix® SQL data types and ODBC Driver C data types

SQL data type	ODBC driver C data types (target type)			
	SQL_C_LONG	SQL_C_NUMERIC	SQL_C_SHORT	SQL_C_SLONG
BIGINT	yes	yes	no	yes
BIGSERIAL	yes	yes	yes	yes

Table 8. Supported conversions between Informix® SQL data types and ODBC Driver C data types

(continued)

SQL data type	**ODBC driver C data types (target type)**			
	SQL_C_LONG	**SQL_C_NUMERIC**	**SQL_C_SHORT**	**SQL_C_SLONG**
BYTE	no	no	no	no
CHAR, CHARACTER	yes	yes	yes	yes
CHARACTER VARYING	yes	yes	yes	yes
DEC, DECIMAL	yes	yes	yes	yes
DOUBLE PRECISION	yes	yes	yes	yes
FLOAT	yes	yes	yes	yes
INT, INTEGER	yes	yes	yes	yes
INT8	yes	yes	no	yes
LVARCHAR	yes	no	yes	yes
MONEY	yes	yes	yes	yes
NUMERIC	yes	yes	yes	yes
REAL	yes	yes	yes	yes
SERIAL	yes	no	yes	yes
SERIAL8	yes	yes	yes	yes
SMALLFLOAT	yes	yes	yes	yes
SMALLINT	yes	yes	yes	yes
TEXT	yes	yes	yes	yes
VARCHAR	yes	yes	yes	yes

Table 9. Supported conversions between Informix® SQL data types and ODBC Driver C data types

SQL data type	ODBC driver C data types (target type)		
	SQL_C_SSHORT	**SQL_C_STINYINT**	**SQL_C_TIMESTAMP**
BIGINT	yes	no	no
BIGSERIAL	yes	no	no
CHAR, CHARACTER	yes	yes	no
CHARACTER VARYING	yes	yes	no
DATE	no	no	yes
DATETIME	no	no	yes
DEC, DECIMAL	yes	yes	no
DOUBLE PRECISION	yes	yes	no
FLOAT	yes	yes	no
INT, INTEGER	yes	yes	no
INT8	yes	no	no
LVARCHAR	yes	yes	yes
MONEY	yes	yes	yes
NUMERIC	yes	yes	yes
REAL	yes	yes	yes
SERIAL	yes	yes	yes
SERIAL8	yes	no	no
SMALLFLOAT	yes	yes	no
SMALLINT	yes	yes	no
TEXT	yes	yes	yes
VARCHAR	yes	yes	yes

The ODBC driver C data type **SQL_C_ULONG** supports conversion between all the SQL data types listed in the following table.

Table 10. Supported conversions between Informix® SQL data types and ODBC Driver C data types

SQL data type	**ODBC driver C data types (target type)**		
	SQL_C_TINYINT	**SQL_C_USHORT**	**SQL_C_UTINYINT**
BIGINT	no	no	no
BIGSERIAL	no	yes	no
CHAR, CHARACTER	yes	yes	yes
CHARACTER VARYING	yes	yes	yes
DEC, DECIMAL	yes	yes	yes
DOUBLE PRECISION	yes	yes	yes
FLOAT	yes	yes	yes
INT, INTEGER	yes	yes	yes
INT8	no	no	no
LVARCHAR	yes	yes	yes
MONEY	yes	yes	yes
NUMERIC	yes	yes	yes
REAL	yes	yes	yes
SERIAL	yes	yes	yes
SERIAL8	no	yes	no
SMALLFLOAT	yes	yes	yes
SMALLINT	yes	yes	yes
TEXT	yes	yes	yes
VARCHAR	yes	yes	yes

Additional conversions for GLS

There are supported conversions between the additional HCL Informix® SQL data types for GLS and the HCL Informix® ODBC Driver C data types.

Only Informix® can convert data to **SQL_C_BIT**.

The Informix® NCHAR and NVARCHAR SQL data types support conversion between the following ODBC driver C data types (fCType):

- **SQL_C_BINARY**
- **SQL_C_BIT**
- **SQL_C_CHAR**
- **SQL_C_DATE**
- **SQL_C_DOUBLE**
- **SQL_C_FLOAT**
- **SQL_C_LONG**
- **SQL_C_SHORT**
- **SQL_C_SLONG**
- **SQL_C_SSHORT**
- **SQL_C_STINYINT**
- **SQL_C_TIME STAMP**
- **SQL_C_TINYINT**
- **SQL_C_ULONG**
- **SQL_C_USHORT**
- **SQL_C_UTINYINT**

Additional conversions for Informix®

There are supported conversions between the additional HCL Informix® SQL data types for Informix® and the HCL Informix® ODBC Driver C data types.

The Informix® SQL data types, Collection, DISTINCT, Row, and Smart large object, support conversions between the following Informix® ODBC driver C data types (fCType):

- **SQL_C_BINARY**
- **SQL_C_BIT**
- **SQL_C_CHAR**
- **SQL_C_DATE**
- **SQL_C_DOUBLE**
- **SQL_C_FLOAT**
- **SQL_C_LONG**
- **SQL_C_SHORT**
- **SQL_C_SLONG**
- **SQL_C_SSHORT**
- **SQL_C_STINYINT**
- **SQL_C_TIMESTAMP**
- **SQL_C_TINYINT**
- **SQL_C_ULONG**

- **SQL_C_USHORT**
- **SQL_C_UTINYINT**

The Informix® SQL data type OPAQUE supports conversion between the **SQL_C_BINARY** and **SQL_C_CHAR** ODBC driver C data types (fCType). Use **SQL_C_CHAR** to access an OPAQUE value in the external format as a string. Use **SQL_C_BINARY** to access an OPAQUE value in the internal binary format.

Convert data from SQL to C

When you call SQLExtendedFetch, SQLFetch, or SQLGetData, HCL Informix® ODBC Driver retrieves data from a data source.

If necessary, HCL Informix® ODBC Driver converts the data from the source data type to the data type that the *TargetType* argument in SQLBindCol or the *fCType* argument in SQLGetData specifies. Finally, HCL Informix® ODBC Driver stores the data in the location pointed to by the *rgbValue* argument in SQLBindCol or SQLGetData.

The tables in the following sections describe how HCL Informix® ODBC Driver converts data that it retrieves from a data source. For a given HCL Informix® ODBC Driver SQL data type, the first column of the table lists the legal input values of the *TargetType* argument in SQLBindCol and the *fCType* argument in SQLGetData. The second column lists the outcomes of a test, often by using the *cbValueMax* argument specified in SQLBindCol or SQLGetData, which HCL Informix® ODBC Driver performs to determine whether it can convert the data. For each outcome, the third and fourth columns list the values of the *rgbValue* and *pcbValue* arguments specified in SQLBindCol or SQLGetData after HCL Informix® ODBC Driver tries to convert the data.

The last column lists the SQLSTATE returned for each outcome by SQLExtendedFetch, SQLFetch, or SQLGetData.

If the *TargetType* argument in SQLBindCol or the *fCType* argument in SQLGetData contains a value for the HCL Informix® ODBC Driver C data type that is not shown in the table for a given HCL Informix® ODBC Driver SQL data type, SQLExtendedFetch, SQLFetch, or SQLGetData returns SQLSTATE 07006 (Restricted data type attribute violation). If the *fCType* argument or the *TargetType* argument contains a value that specifies a conversion from a driver-specific SQL data type to the HCL Informix® ODBC Driver C data type and HCL Informix® ODBC Driver does not support this conversion, then SQLExtendedFetch, SQLFetch, or SQLGetData returns SQLSTATE S1C00 (Driver not capable).

Although the tables in this chapter do not show it, the *pcbValue* argument contains SQL_NULL_DATA when the SQL data value is null. When HCL Informix® ODBC Driver converts SQL data to character C data, the character count returned in *pcbValue* does not include the null-termination byte. If *rgbValue* is a null pointer, SQLBindCol or SQLGetData returns SQLSTATE S1009 (Invalid argument value).

The following terms and conventions are used in the tables:

Length of data

The number of bytes of C data that are available to return in *rgbValue*, regardless of whether the data is truncated before it returns to the application. For string data, this does not include the null-termination byte.

Display size

Total number of bytes that are needed to display the data in character format.

Words in *italics*

Represent function arguments or elements of the HCL Informix® ODBC Driver SQL grammar.

Related information

Input buffers on page 14

Output buffers on page 15

Default C data types

You can specify the **SQL_C_DEFAULT** for different functions so that HCL Informix® ODBC Driver uses the C data type.

If you specify **SQL_C_DEFAULT** for the *TargetType* argument in SQLBindCol, the *fCType* argument in SQLGetData, or the *ValueType* argument in SQLBindParameter, HCL Informix® ODBC Driver uses the C data type of the output or input buffer for the SQL data type of the column or parameter to which the buffer is bound.

Standard default C data types

There is default C data type for each HCL Informix® ODBC Driver SQL data type.

For each HCL Informix® ODBC Driver SQL data type, the following table shows the default C data type.

Informix® ODBC driver SQL data type (fSqlType)	Default Informix® ODBC driver C data type (fCType)
SQL_BIGINT	**SQL_C_CHAR**
SQL_BIT	**SQL_C_BITS**
SQL_CHAR	**SQL_C_CHAR**
SQL_DATE	**SQL_C_DATE**
SQL_DECIMAL	**SQL_C_CHAR**
SQL_DOUBLE	**SQL_C_DOUBLE**
SQL_INTEGER	**SQL_C_SLONG**
SQL_LONGVARBINARY	**SQL_C_BINARY**
SQL_LONGVARCHAR	**SQL_C_CHAR**
SQL_NUMERIC	**SQL_C_NUMERIC**
SQL_REAL	**SQL_C_FLOAT**
SQL_SMALLINT	**SQL_C_SSHORT**
SQL_TIMESTAMP	**SQL_C_TIMESTAMP**
SQL_VARCHAR	**SQL_C_CHARS**

Additional default C data types for Informix®

There is default C data type for each additional HCL Informix® ODBC Driver SQL data type.

For each additional HCL Informix® ODBC Driver SQL data type for Informix®, the following table shows the default C data type.

Informix® ODBC driver SQL data type (fSqlType)	**Default Informix® ODBC driver C data type (fCType)**
SQL_IFMX_UDT_BLOB	**SQL_C_BINARY**
SQL_IFMX_UDT_CLOB	**SQL_C_BINARY**
SQL_INFX_UDT_FIXED	This HCL Informix® ODBC Driver SQL data type does not have a default HCL Informix® ODBC Driver C data type. Because this Informix® ODBC driver SQL data type can contain binary data or character data, you must bind a variable for this Informix® ODBC driver SQL data type before you fetch a corresponding value. The data type of the bound variable specifies the C data type for the value.
SQL_INFX_UDT_VARYING	This HCL Informix® ODBC Driver SQL data type does not have a default HCL Informix® ODBC Driver C data type. Because this Informix® ODBC Driver SQL data type can contain binary data or character data, you must bind a variable for this Informix® ODBC Driver SQL data type before you fetch a corresponding value. The data type of the bound variable specifies the C data type for the value.

SQL to C: Boolean

The Boolean HCL Informix® ODBC Driver SQL data type is SQL_BIT.

The following table shows the HCL Informix® ODBC Driver C data types to which Boolean SQL data can be converted. When HCL Informix® ODBC Driver converts Boolean SQL data to character C data, the possible values are `0` and `1`.

fCType	**Test**	**rgbValue**	**pcbValue**	**SQLSTATE**
SQL_C_BINARY	*cbValueMax* ≤ 1	Data	1	N/A
	cbValueMax < 1	Untouched	Untouched	22003
SQL_C_BIT	HCL Informix® ODBC Driver ignores the value of *cbValueMax* for this conversion. HCL Informix® ODBC Driver uses the size of *rgbValue* for the size of the C data type.	Data	1 (This is the size of the corresponding C data type.)	N/A

fCType	Test	rgbValue	pcbValue	SQLSTATE
SQL_C_CHAR	*cbValueMax* > 1	Data	1	N/A
	cbValueMax ≤ 1	Untouched	Untouched	22003

SQL to C: Time stamp

The time stamp HCL Informix® ODBC Driver SQL data type is SQL_TIMESTAMP.

The following table shows the Informix® ODBC Driver C data types to which time stamp SQL data can be converted.

fCType	Test	rgbValue	pcbValue	SQLSTATE
SQL_C_BINARY	Length of data ≤ *cbValueMax*.	Data	Length of data	N/A
	Length of data > *cbValueMax*.	Untouched	Untouched	22003
SQL_C_CHAR	cbValueMax > Display size.	Data	Length of data	N/A
	20 ≤ *cbValueMax* ≤ Display size.	Truncated data (HCL Informix® ODBC Driver truncates the fractional seconds portion of the time stamp.)	Length of data	01004
	cbValueMax < 20.	Untouched	Untouched	22003
SQL_C_DATE	Time portion of time stamp is zero.	Data	6	N/A
	Time portion of time stamp is nonzero. (HCL Informix® ODBC Driver ignores the value of *cbValueMax* for this conversion. HCL Informix® ODBC Driver uses the size of *rgbValue* for the size of the C data type.)	Truncated data (HCL Informix® ODBC Driver truncates the time portion of the time stamp.)	6 (The size of the corresponding C data type is 6.)	01004
SQL_C_TIMESTAMP	Fractional seconds portion of time stamp is not truncated.	Data	16	N/A

fCType	Test	rgbValue	pcbValue	SQLSTATE
	Fractional seconds portion of time stamp is truncated. (HCL Informix® ODBC Driver ignores the value of *cbValueMax* for this conversion. HCL Informix® ODBC Driver uses the size of *rgbValue* for the size of the C data type.)	Truncated data (HCL Informix® ODBC Driver truncates the fractional seconds portion of the time stamp.)	16 (The size of the corresponding C data type is 16.)	01004

When HCL Informix® ODBC Driver converts time stamp SQL data to character C data, the resulting string is in the `yyyy-mm-dd hh:mm:ss[.f...]` format, where up to nine digits can be used for fractional seconds. Except for the decimal point and fractional seconds, the entire format must be used, regardless of the precision of the time stamp SQL data type.

SQL-to-C data conversion examples

The examples show how HCL Informix® ODBC Driver converts SQL data to C data.

The following table illustrates how HCL Informix® ODBC Driver converts SQL data to C data. "\0" represents a null-termination byte ("\0" represents a wide null termination character when the C data type is SQL_C_WCHAR). HCL Informix® ODBC Driver always null-terminates **SQL_C_CHAR** and **SQL_C_WCHAR** data. For the combination of SQL_DATE and **SQL_C_TIMESTAMP**, HCL Informix® ODBC Driver stores the numbers that are in the *rgbValue* column in the fields of the TIMESTAMP_STRUCT structure.

SQL data type	SQL data value	C data type	cbValueMax	rgbValue	SQLSTATE
SQL_CHAR	tigers	**SQL_C_CHAR**	7	tigers\0	N/A
SQL_CHAR	tigers	**SQL_C_CHAR**	6	tiger\0	01004
SQL_CHAR	tigers	**SQL_C_WCHAR**	14	tigers\0	N/A
SQL_CHAR	tigers	**SQL_C_WCHAR**	12	tiger\0	01004
SQL_DECIMAL	1234.56	**SQL_C_CHAR**	8	1234.56\0	N/A
SQL_DECIMAL	1234.56	**SQL_C_CHAR**	5	1234\0	01004
SQL_DECIMAL	1234.56	**SQL_C_CHAR**	4	—	22003
SQL_DECIMAL	1234.56	**SQL_C_WCHAR**	16	1234.56\0	N/A
SQL_DECIMAL	1234.56	**SQL_C_WCHAR**	10	1234\0	01004
SQL_DECIMAL	1234.56	**SQL_C_WCHAR**	8	—	220023

SQL data type	SQL data value	C data type	cbValueMax	rgbValue	SQLSTATE
SQL_DECIMAL	1234.56	**SQL_C_FLOAT**	Ignored	1234.56	N/A
SQL_DECIMAL	1234.56	**SQL_C_SSHORT**	Ignored	1234	01004
SQL_DECIMAL	1234.56	**SQL_C_STINYINT**	Ignored	—	22003
SQL_DOUBLE	1.2345678	**SQL_C_DOUBLE**	Ignored	1.234567	N/A
SQL_DOUBLE	1.2345678	**SQL_C_FLOAT**	Ignored	1.234567	N/A
SQL_DOUBLE	1.2345678	**SQL_C_STINYINT**	Ignored	1	N/A
SQL_DATE	1992-12-31	**SQL_C_CHAR**	11	1992-12-31\0	N/A
SQL_DATE	1992-12-31	**SQL_C_CHAR**	10	—	22003
SQL_DATE	1992-12-31	**SQL_C_WCHAR**	22	1992-12-31\0	N/A
SQL_DATE	1992-12-31	**SQL_C_WCHAR**	20	—	22003
SQL_DATE	1992-12-31	**SQL_C_TIMESTAMP**	Ignored	1992,12,31, 0,0,0,0	N/A
SQL_TIMESTAMP	1992-12-31 23:45:55.12	**SQL_C_CHAR**	23	1992-12-31 23:45:55.12\0	N/A
SQL_TIMESTAMP	1992-12-31 23:45:55.12	**SQL_C_CHAR**	22	1992-12-31 23:45:55.1\0	01004
SQL_TIMESTAMP	1992-12-31 23:45:55.12	**SQL_C_CHAR**	18	—	22003
SQL_TIMESTAMP	1992-12-31 23:45:55.12	**SQL_C_WCHAR**	46	1992-12-31 23:45:55.12\0	N/A
SQL_TIMESTAMP	1992-12-31 23:45:55.12	**SQL_C_WCHAR**	44	1992-12-31 23:45:55.1\0	01004
SQL_TIMESTAMP	1992-12-31 23:45:55.12	**SQL_C_WCHAR**	36	—	22003

Important: The size of a wide character (wchar_t) is platform dependent. The previous examples are applicable to Windows™ where the size of wide characters is 2 bytes. On most UNIX™ platforms, wide characters are 4 bytes. On IBM® AIX® versions lower than AIX5L, it is 2 bytes.

Convert data from C to SQL

When you call SQLExecute or SQLExecDirect, HCL Informix® ODBC Driver retrieves the data for parameters that are bound with SQLBindParameter from storage locations in the application.

For data-at-execution parameters, call SQLPutData to send the parameter data. If necessary, HCL Informix® ODBC Driver converts the data from the data type that the *ValueType* argument specifies in SQLBindParameter to the data type that the *fSqlType* argument specifies in the SQLBindParameter. Finally, HCL Informix® ODBC Driver sends the data to the data source.

If the *rgbValue* and *pcbValue* arguments specified in SQLBindParameter are both null pointers, then that function returns SQLSTATE S1009 (Invalid argument value). To specify a null SQL data value, set the value that the *pcbValue* argument of SQLBindParameter points to or the value of the *cbValue* argument to SQL_NULL_DATA. To specify that the value in *rgbValue* is a null-terminated string, set these values to SQL_NTS.

The following terms are used in the tables:

Length of data

The number of bytes of SQL data that are available to send to the data source, regardless of whether the data is truncated before it goes to the data source. For string data, this does not include the null-termination byte.

Column length and display size

Defined for each SQL data type in Precision, scale, length, and display size on page 61.

Number of digits

The number of characters that represent a number, including the minus sign, decimal point, and exponent (if needed).

Words in *italics*

Represent elements of the HCL Informix® ODBC Driver SQL syntax.

C to SQL: Binary

The binary HCL Informix® ODBC Driver C data type is **SQL_C_BINARY**.

The following table shows the HCL Informix® ODBC Driver SQL data types to which binary C data can be converted. In the Test column, the SQL data length is the number of bytes needed to store the data on the data source. This length might be different from the column length, as defined in Precision, scale, length, and display size on page 61.

fSqlType	Test	SQLSTATE
SQL_BIGINT	Length of data = SQL data length.	N/A
	Length of data SQL data length.	22003
SQL_BIT	Length of data = SQL data length.	N/A
	Length of data SQL data length.	22003
SQL_CHAR SQL_LONGVARCHAR SQL_VARCHAR	Length of data ≤ Column length.	N/A
	Length of data > Column length.	01004
SQL_DATE SQL_TIMESTAMP	Length of data = SQL data length.	N/A
	Length of data SQL data length.	22003
SQL_DECIMAL SQL_DOUBLE SQL_INTEGER SQL_REAL SQL_SMALLINT	Length of data = SQL data length.	N/A
	Length of data SQL data length.	22003
SQL_LONGVARBINARY	Length of data ≤ Column length.	N/A
	Length of data > Column length.	01004

C to SQL: Bit

The bit HCL Informix® ODBC Driver C data type is **SQL_C_BIT**.

The following table shows the HCL Informix® ODBC Driver SQL data types to which bit C data can be converted.

fSqlType	Test	SQLSTATE
SQL_BIGINT SQL_DECIMAL SQL_DOUBLE SQL_INTEGER SQL_REAL	None	N/A

fSqlType	Test	SQLSTATE
SQL_SMALLINT		
SQL_BIT	None	N/A
SQL_CHAR SQL_LONGVARCHAR SQL_VARCHAR	None	N/A

HCL Informix® ODBC Driver ignores the value that the *pcbValue* argument of SQLBindParameter points to and the value of the *cbValue* argument of SQLPutData when it converts data from the Boolean C data type. HCL Informix® ODBC Driver uses the size of *rgbValue* for the size of the Boolean C data type.

C to SQL: Character

The character HCL Informix® ODBC Driver C data type is **SQL_C_CHAR**.

The following table shows the HCL Informix® ODBC Driver SQL data types to which C character data can be converted.

fSqlType	Test	SQLSTATE
SQL_BIGINT	Data converted without truncation.	N/A
	Data converted with truncation of fractional digits.	01004
	Conversion of data would result in loss of whole (as opposed to fractional) digits.	22003
	Data value is not a *numeric-literal*.	22005
SQL_BIT	Data is 0 or 1.	N/A
	Data is greater than 0, less than 2, and not equal to 1.	01004
	Data is less than 0 or greater than or equal to 2.	22003
	Data is not a *numeric-literal*.	22005
SQL_CHAR SQL_LONGVARCHAR SQL_VARCHAR	Length of data ≤ Column length.	N/A
	Length of data > Column length.	01004
SQL_DATE	Data value is a valid Informix® ODBC driver date-literal.	N/A
	Data value is a valid Informix® ODBC driver *timestamp-literal*; time portion is zero.	N/A

fSqlType	Test	SQLSTATE
	Data value is a valid Informix® ODBC driver *timestamp-literal*; time portion is non-zero. Informix® ODBC driver truncates the time portion of the time stamp.	01004
	Data value is not a valid Informix® ODBC driver *date-literal* or Informix® ODBC driver *timestamp-literal*.	22008
SQL_DECIMAL SQL_INTEGER SQL_SMALLINT	Data converted without truncation.	N/A
	Data converted with truncation of fractional digits.	01004
	Conversion of data would result in loss of whole (as opposed to fractional) digits.	22003
	Data value is not a *numeric-literal*.	22005
SQL_DOUBLE SQL_REAL	Data is within the range of the data type to which the number is being converted.	N/A
	Data is outside the range of the data type to which the number is being converted.	22003
	Data value is not a *numeric-literal*.	22005
SQL_LONGVARBINARY	(Length of data) / 2 ≤ Column length.	N/A
	(Length of data) / 2 > Column length.	01004
	Data value is not a hexadecimal value.	22005
SQL_TIMESTAMP	Data value is a valid Informix® ODBC driver *timestamp-literal*; fractional seconds portion not truncated.	N/A
	Data value is a valid Informix® ODBC driver *timestamp-literal*; fractional seconds portion truncated.	01004
	Data value is a valid Informix® ODBC driver *date-literal*. Informix® ODBC driver sets the time portion of the time stamp to zero.	N/A
	Data value is a valid Informix® ODBC driver *time-literal*. Informix® ODBC driver sets the date portion of the time stamp to the current date.	N/A
	Data value is not a valid Informix® ODBC driver *date-literal*, Informix® ODBC driver *time-literal*, or Informix® ODBC driver *timestamp-literal*.	22008

When HCL Informix® ODBC Driver converts character C data to numeric, date, or time stamp SQL data, it ignores leading and trailing blanks. When HCL Informix® ODBC Driver converts character C data to binary SQL data, it converts each two bytes of character data to one byte of binary data. Each two bytes of character data represent a number in hexadecimal form. For example, HCL Informix® ODBC Driver converts "01" to binary 00000001 and "FF" to binary 11111111.

HCL Informix® ODBC Driver always converts pairs of hexadecimal digits to individual bytes and ignores the null-termination byte. Because of this conversion, if the length of the character string is odd, the last byte of the string (excluding the null termination byte, if any) is not converted.

C to SQL: Numeric

There are a total of ten HCL Informix® ODBC Driver C data types.

The numeric HCL Informix® ODBC Driver C data types are:

- **SQL_C_DOUBLE**
- **SQL_C_FLOAT**
- **SQL_C_LONG**
- **SQL_C_SHORT**
- **SQL_C_SLONG**
- **SQL_C_STINYINT**
- **SQL_C_TINYINT**
- **SQL_C_ULONG**
- **SQL_C_USHORT**
- **SQL_C_UTINYINT**

The following table shows the HCL Informix® ODBC Driver SQL data types to which numeric C data can be converted.

fSqlType	Test	SQLSTATE
SQL_BIGINT	Data converted without truncation.	N/A
	Data converted with truncation of fractional digits.	01004
	Conversion of data would result in loss of whole (as opposed to fractional) digits.	22003
SQL_BIT	Data is 0 or 1.	N/A
	Data is greater than 0, less than 2, and|not equal to 1.	01004
	Data is less than 0 or greater than or equal to 2.	22003
SQL_CHAR SQL_LONGVARCHAR	Number of digits ≤ Column length.	N/A
	Number of whole (as opposed to fractional) digits ≤ Column length.	01004

fSqlType	Test	SQLSTATE
SQL_VARCHAR	Number of whole (as opposed to fractional) digits > Column length.	22003
SQL_DECIMAL SQL_INTEGER SQL_SMALLINT	Data converted without truncation	N/A
	Data converted with truncation of fractional digits.	01004
	Conversion of data would result in loss of whole (as opposed to fractional) digits.	22003
SQL_DOUBLE SQL_REAL	Data is within the range of the data type to which the number is being converted.	N/A
	Data is outside the range of the data type to which the number is being converted.	22003

HCL Informix® ODBC Driver ignores the value that the *pcbValue* argument of SQLBindParameter points to and the value of the *cbValue* argument of SQLPutData when it converts data from the numeric C data types. HCL Informix® ODBC Driver uses the size of *rgbValue* for the size of the numeric C data type.

C-to-SQL data conversion examples

The examples show how HCL Informix® ODBC Driver converts C data to SQL data.

The following table illustrates how HCL Informix® ODBC Driver converts C data to SQL data. "\0" represents a null-termination byte. The null-termination byte is required only if the length of the data is SQL_NTS. For **SQL_C_DATE**, the numbers that are in the C Data Value column are the numbers that are stored in the fields of the DATE_STRUCT structure. For **SQL_C_TIMESTAMP**, the numbers that are in the C Data Value column are the numbers that are stored in the fields of the TIMESTAMP_STRUCT structure.

C data type	C data value	SQL data type	Column length	SQL data value	SQLSTATE
SQL_C_CHAR	tigers\0	SQL_CHAR	6	tigers	N/A
SQL_C_CHAR	tigers\0	SQL_CHAR	5	tiger	01004
SQL_C_CHAR	1234.56\0	SQL_DECIMAL	8 (In addition to bytes for numbers, one byte is required for a sign and another for the decimal point.)	1234.56	N/A
SQL_C_CHAR	1234.56\0	SQL_DECIMAL	7	1234.5	01004

C data type	C data value	SQL data type	Column length	SQL data value	SQLSTATE
			(In addition to bytes for numbers, one byte is required for a sign and another for the decimal point.)		
SQL_C_CHAR	1234.56\0	SQL_DECIMAL	4	—	22003
SQL_C_FLOAT	1234.56	SQL_FLOAT	not applicable	1234.56	N/A
SQL_C_FLOAT	1234.56	SQL_INTEGER	not applicable	1234	01004
SQL_C_FLOAT	1234.56	SQL_TINYINT	not applicable	—	22003
SQL_C_DATE	1992,12,31	SQL_CHAR	10	1992-12-31	N/A
SQL_C_DATE	1992,12,31	SQL_CHAR	9	—	22003
SQL_C_DATE	1992,12,31	SQL_TIMESTAMP	not applicable	1992-12-31 00:00:00.0	N/A
SQL_C_TIMESTAMP	1992,12,31, 23,45,55, 120000000	SQL_CHAR	22	1992-12-31 23:45:55.12	N/A
SQL_C_TIMESTAMP	1992,12,31, 23,45,55, 120000000	SQL_CHAR	21	1992-12-31 23:45:55.1	01004
SQL_C_TIMESTAMP	1992,12,31, 23,45,55, 120000000	SQL_CHAR	18	—	22003

Smart large objects

These topics describe how to store, create, and access a smart large object; how to transfer smart-large-object data; how to retrieve the status of a smart large object; and how to read or write a smart large object to or from a file.

The information in these topics apply only if your database server is HCL Informix®.

A smart large object is a recoverable large object that is stored in an sbspace on disk. You can access a smart large object with read, write, and seek operations similar to an operating-system file. The two data types for smart large objects are *character large object* (CLOB) and *binary large object* (BLOB). A CLOB consists of text data and a BLOB consists of binary data in an undifferentiated byte stream.

For more information about smart-large-object data types, see the *HCL® Informix® Guide to SQL: Reference*.

Related reference

Additional SQL data types for Informix on page 60

Data types on page 54

Related information

Client functions on page 151

Data structures for smart large objects

Because a smart large object can be huge, HCL Informix® has two alternatives to store the content of a smart large object.

Therefore, instead of storing the content of a smart large object in a database table, HCL Informix® does the following:

- Stores the content of the smart large object in an sbspace
- Stores a pointer to the smart large object in the database table

Because a smart large object can be huge, the HCL Informix® ODBC Driver application cannot receive a smart large object in a variable. Instead, the application sends or receives information about the smart large object in a data structure. The following table describes the data structures that HCL Informix® ODBC Driver uses for smart large objects.

Data structure	Name	Description
lofd	Smart-large-object file descriptor	Provides access to a smart large object. Uses a file descriptor to access smart-large-object data as if it were in an operating-system file.
loptr	Smart-large-object pointer structure	Provides security information and a pointer to a smart large object. This structure is the data that the database server stores in a database table for a smart large object. Therefore, SQL statements such as INSERT and SELECT accept a smart-large-object pointer structure as a value for a column or a parameter that has a data type of smart large object.
lospec	Smart-large-object specification structure	Specifies the storage characteristics for a smart large object.
lostat	Smart-large-object status structure	Stores status information for a smart large object. Normally you can fetch a user-defined data type (UDT) in either binary or character representation. However, it is not possible to convert a smart-large-object status structure to character representation.

Data structure	Name	Description
		Therefore, you need to use **SQL_C_BINARY** as the HCL Informix® ODBC Driver C data type for **lostat**.

Restriction: These data structures are opaque to HCL Informix® ODBC Driver applications and their internal structures might change. Therefore, do not access the internal structures directly. Use the smart-large-object client functions to manipulate the data structures.

The application is responsible for allocating space for these smart-large-object data structures.

Working with a smart-large-object data structure

You can use this procedure to work with a smart-large-object data structure. An example is included.

About this task

To work with a smart-large-object data structure:

1. Determine the size of the smart-large-object structure.
2. Use either a fixed size array or a dynamically allocated buffer that is at least the size of the data structure.
3. Free the array or buffer space when you are done with it.

Results

The following code example illustrates these steps:

```
rc = SQLGetInfo(hdbc, SQL_INFX_LO_SPEC_LENGTH, &lospec_size,
   sizeof(lospec_size), NULL);
lospec_buffer = malloc(lospec_size);
⁝;
free(lospec_buffer);
```

Storage of smart large objects

The smart-large-object specification structure stores the disk-storage information and create-time flags for a smart large object.

Disk-storage information

Disk-storage information helps HCL Informix® determine how to store the smart large object most efficiently on disk.

The following table describes the types of disk-storage information and the corresponding client functions. For most applications, it is recommended that you use the values for the disk-storage information that the database server determines.

Disk-storage information	Description	Client functions

Estimated size	An estimate of the final size, in bytes, of the smart large object. The database server uses this value to determine the extents in which to store the smart large object. This value provides optimization information. If the value is grossly incorrect, it does not cause incorrect behavior. However, it does mean that the database server might not necessarily choose optimal extent sizes for the smart large object.	ifx_lo_specget_estbytes()
		
		ifx_lo_specset_estbytes()

Maximum size	The maximum size, in bytes, for the smart large object. The database server does not allow the smart large object to grow beyond this size.	ifx_lo_specget_maxbytes()
		
		ifx_lo_specset_maxbytes()

Allocation extent size	The allocation extent size is specified in kilobytes. Optimally, the allocation extent is the single extent in a chunk that holds all the data for the smart large object.
	
	The database server performs storage allocations for smart large objects in increments of the allocation extent size. It tries to allocate an allocation extent as a single extent in a chunk. However, if no single extent is large enough, the database server must use multiple extents as necessary to satisfy the request.
		ifx_lo_specget_extsz()
		
		ifx_lo_specset_extsz()

Name of the sbspace	The name of the sbspace that contains the smart large object. On this database server, an sbspace name can be up to 128 characters long and must be null terminated.	ifx_lo_specget_sbspace()
		
		ifx_lo_specset_sbspace()

Create-time flags

Create-time flags tell HCL Informix® what options to assign to the smart large object.

The following table describes the create-time flags.

Type of indicator	Create-time flag	Description
Logging	LO_LOG	Tells the database server to log changes to the smart large object in the system log file.

Type of indicator	Create-time flag	Description
		Consider carefully whether to use the LO_LOG flag value. The database server incurs considerable overhead to log smart large objects. You must also make sure that the system log file is large enough to hold the value of the smart large object. For more information, see your *HCL® Informix® Administrator's Guide*.
	LO_NOLOG	Tells the database server to turn off logging for all operations that involve the associated smart large object.
Last access-time	LO_KEEP_LASTACCESS_TIME	Tells the database server to save the last access time for the smart large object. This access time is the time of the last read or write operation. Consider carefully whether to use the LO_KEEP_LASTACCESS_TIME flag value. The database server incurs considerable overhead to maintain last access times for smart large objects.
	LO_NOKEEP_LASTACCESS_TIME	Tells the database server not to maintain the last access time for the smart large object.

The ifx_lo_specset_flags() function sets the create-time flags to a new value. The ifx_lo_specget_flags() function retrieves the current value of the create-time flag.

Logging indicators and the last access-time indicators are stored in the smart-large-object specification structure as a single flag value. To set a flag from each group, use the C-language OR operator to mask the two flag values together. However, masking mutually exclusive flags causes an error. If you do not specify a value for one of the flag groups, the database server uses the inheritance hierarchy to determine this information.

Related reference

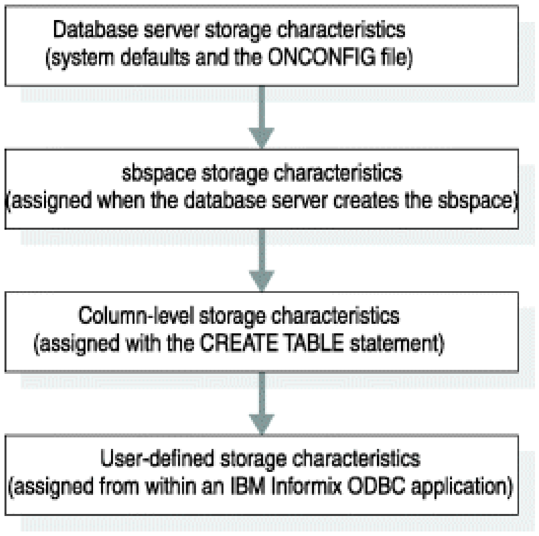
The ifx_lo_specset_flags() function on page 166

Inheritance hierarchy

HCL Informix® uses an inheritance hierarchy to obtain storage characteristics.

The following figure shows the inheritance hierarchy for smart-large-object storage characteristics.

Figure 4. Inheritance hierarchy for storage characteristics


Database server storage characteristics
(system defaults and the ONCONFIG file)
sbspace storage characteristics
(assigned when the database server creates the sbspace)
Column-level storage characteristics
(assigned with the CREATE TABLE statement)
User-defined storage characteristics
(assigned from within an IBM Informix ODBC application)

Using system-specified storage characteristics

HCL Informix® uses one set of storage characteristics as the system-specified storage characteristics.

About this task

HCL Informix® uses one of the following sets of storage characteristics:

- If the sbspace in which the smart large object is stored specifies a value for a particular storage characteristic, the database server uses the sbspace value as the system-specified storage characteristic.

  The database administrator can use the onspaces utility to define storage characteristics for an sbspace.
- If the sbspace in which the smart large object is stored does not specify a value for a particular storage characteristic, the database server uses the system default as the system-specified storage characteristic.

  The database server defines the system defaults for storage characteristics internally. However, you can specify a default sbspace name with the SBSPACENAME configuration parameter in the `onconfig` file. Also, an application call to ifx_lo_col_info() or ifx_lo_specset_sbspace() can supply the target sbspace in the smart-large-object specification structure.

Important: An error occurs if the SBSPACENAME configuration parameter is not specified and the smart-large-object specification structure does not contain the name of the target sbspace.

It is recommended that you use the system-specified storage characteristics for the disk-storage information. For more information about sbspaces and the description of the onspaces utility, see your *HCL® Informix® Administrator's Guide*.

To use system-specified storage characteristics for a new smart large object:

1. Call ifx_lo_def_create_spec() to allocate a smart-large-object specification structure and to initialize the structure to null values.
2. Call ifx_lo_create() to create an instance of the smart large object.

Using column-level storage characteristics

The CREATE TABLE statement assigns storage characteristics to a database column.

About this task

The PUT clause of the CREATE TABLE statement specifies storage characteristics for a smart-large-object column. The **syscolattribs** system catalog table stores the column-level storage characteristics.

To use column-level storage characteristics for a new smart-large-object instance:

1. Call ifx_lo_def_create_spec() to allocate a smart-large-object specification structure and initialize this structure to null values.
2. Call ifx_lo_col_info() to retrieve the column-level storage characteristics and store them in the specified smart-large-object specification structure.
3. Call ifx_lo_create() to create an instance of the smart large object.

User-defined storage characteristics

To specify user-defined storage characteristics, call an ifx_lo_specset_* function.

You can define a unique set of storage characteristics for a new smart large object, as follows:

- For a smart large object that will be stored in a column, you can override some storage characteristics for the column when you create an instance of a smart large object.

  If you do not override some or all of these characteristics, the smart large object uses the column-level storage characteristics.
- You can specify a wider set of characteristics for a smart large object because a smart large object is not constrained by table column properties.

  If you do not override some or all of these characteristics, the smart large object inherits the system-specified storage characteristics.

Example of creating a smart large object

The code example, `locreate.c`, shows how to create a smart large object.

You can find the `locreate.c` file in the `%INFORMIXDIR%/demo/clidemo` directory on UNIX™ platforms and in the `%INFORMIXDIR%\demo\odbcdemo` directory in Windows™ environments. You can also find instructions on how to build the **odbc_demo** database in the same location.

```
/*
**      locreate.c
```

```
**
**  To create a smart large object
**
**    OBDC Functions:
**      SQLAllocHandle
**      SQLBindParameter
**      SQLConnect
**      SQLFreeStmt
**      SQLGetInfo
**      SQLDisconnect
**      SQLExecDirect
*/

#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#ifndef NO_WIN32
#include <io.h>
#include <windows.h>
#include <conio.h>
#endif /*NO_WIN32*/

#include "infxcli.h"

#define BUFFER_LEN      12
#define ERRMSG_LEN      200

UCHAR   defDsn[] = "odbc_demo";


int checkError (SQLRETURN         rc,
                SQLSMALLINT     handleType,
                SQLHANDLE       handle,
                char            *errmsg)
{
   SQLRETURN         retcode = SQL_SUCCESS;

   SQLSMALLINT     errNum = 1;
   SQLCHAR         sqlState[6];
   SQLINTEGER      nativeError;
   SQLCHAR         errMsg[ERRMSG_LEN];
   SQLSMALLINT     textLengthPtr;

   if ((rc != SQL_SUCCESS) && (rc != SQL_SUCCESS_WITH_INFO))
   {
      while (retcode != SQL_NO_DATA)
      {
         retcode = SQLGetDiagRec (handleType, handle, errNum, sqlState,
            &nativeError, errMsg, ERRMSG_LEN, &textLengthPtr);

         if (retcode == SQL_INVALID_HANDLE)
         {
            fprintf (stderr, "checkError function was called with an
               invalid handle!!\n");
            return 1;
         }
         if ((retcode == SQL_SUCCESS)     || (retcode == SQL_SUCCESS_WITH_INFO))
            fprintf (stderr, "ERROR: %d:  %s : %s \n", nativeError,
               sqlState, errMsg);

         errNum++;
      }

      fprintf (stderr, "%s\n", errmsg);
      return 1;   /* all errors on this handle have been reported */
   }
   else
      return 0;   /* no errors to report */
}

int main (long         argc,
          char        *argv[])
{
   /* Declare variables
   */

   /* Handles */
   SQLHDBC     hdbc;
   SQLHENV     henv;
   SQLHSTMT    hstmt;

   /* Smart large object file descriptor */
   long        lofd;
   long        lofd_valsize = 0;

   /* Smart large object pointer structure */
   char*       loptr_buffer;
   short       loptr_size;
   long        loptr_valsize = 0;

   /* Smart large object specification structure */
   char*       lospec_buffer;
   short       lospec_size;
   long        lospec_valsize = 0;

   /* Write buffer */
   char*             write_buffer;
   short            write_size;
   long            write_valsize = 0;

   /* Miscellaneous variables */
   UCHAR    dsn[20];/*name of the DSN used for connecting to the
                        database*/
   SQLRETURN   rc = 0;
   int         in;

   FILE*       hfile;
   char*       lo_file_name = "advert.txt";

   char        colname[BUFFER_LEN] = "item.advert";
   long        colname_size = SQL_NTS;
   long        mode = LO_RDWR;
   long        cbMode = 0;

   char*       insertStmt = "INSERT INTO item VALUES (1005, 'Helmet', 235,
                  'Each', ?, '39.95')";


/*   STEP 1.  Get data source name from command line (or use default).
   **       Allocate environment handle and set ODBC version.
   **       Allocate connection handle.
   **       Establish the database connection.
   **       Allocate the statement handle.
   */

   /* If (dsn is not explicitly passed in as arg) */
   if (argc != 2)
   {
      /* Use default dsn - odbc_demo */
      fprintf (stdout, "\nUsing default DSN : %s\n", defDsn);
      strcpy ((char *)dsn, (char *)defDsn);
   }
   else
   {
      /* Use specified dsn */
      strcpy ((char *)dsn, (char *)argv[1]);
      fprintf (stdout, "\nUsing specified DSN : %s\n", dsn);
   }

   /* Allocate the Environment handle */
   rc = SQLAllocHandle (SQL_HANDLE_ENV, SQL_NULL_HANDLE, &henv);
   if (rc != SQL_SUCCESS)
   {
      fprintf (stdout, "Environment Handle Allocation failed\nExiting!!");
      return (1);
   }

   /* Set the ODBC version to 3.5 */
   rc = SQLSetEnvAttr (henv, SQL_ATTR_ODBC_VERSION,
         (SQLPOINTER)SQL_OV_ODBC3, 0);
   if (checkError (rc, SQL_HANDLE_ENV, henv, "Error in Step 1 --
         SQLSetEnvAttr failed\nExiting!!"))
      return (1);

   /* Allocate the connection handle */
   rc = SQLAllocHandle (SQL_HANDLE_DBC, henv, &hdbc);
   if (checkError (rc, SQL_HANDLE_ENV, henv, "Error in Step 1 -- Connection
         Handle Allocation failed\nExiting!!"))
      return (1);

   /* Establish the database connection */
   rc = SQLConnect (hdbc, dsn, SQL_NTS, "", SQL_NTS, "", SQL_NTS);
   if (checkError (rc, SQL_HANDLE_DBC, hdbc, "Error in Step 1 -- SQLConnect
         failed\n"))
      return (1);

   /* Allocate the statement handle */
   rc = SQLAllocHandle (SQL_HANDLE_STMT, hdbc, &hstmt);
   if (checkError (rc, SQL_HANDLE_DBC, hdbc, "Error in Step 1 -- Statement
         Handle Allocation failed\nExiting!!"))
      return (1);

   fprintf (stdout, "STEP 1 done...connected to database\n");


/* STEP 2.  Get the size of the smart large object specification
   **       structure.
   **       Allocate a buffer to hold the structure.
   **       Create a default smart large object specification structure.
   **       Reset the statement parameters.
   */

   /* Get the size of a smart large object specification structure */
   rc = SQLGetInfo (hdbc, SQL_INFX_LO_SPEC_LENGTH, &lospec_size,
         sizeof(lospec_size), NULL);
   if (checkError (rc, SQL_HANDLE_DBC, hdbc, "Error in Step 2 -- SQLGetInfo
         failed\n"))
      goto Exit;

   /* Allocate a buffer to hold the smart large object specification
         structure*/
   lospec_buffer = malloc (lospec_size);

   /* Create a default smart large object specification structure */
   rc = SQLBindParameter (hstmt, 1, SQL_PARAM_INPUT_OUTPUT, SQL_C_BINARY,
         SQL_INFX_UDT_FIXED, (UDWORD)lospec_size, 0, lospec_buffer,
         lospec_size, &lospec_valsize);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 2 --
         SQLBindParameter failed\n"))
      goto Exit;
   rc = SQLExecDirect (hstmt, "{call ifx_lo_def_create_spec(?)}", SQL_NTS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 2 --
         SQLExecDirect failed\n"))
      goto Exit;

   /* Reset the statement parameters */
   rc = SQLFreeStmt (hstmt, SQL_RESET_PARAMS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 2 --
         SQLFreeStmt failed\n"))
      goto Exit;

   fprintf (stdout, "STEP 2 done...default smart large object specification
         structure created\n");


/* STEP 3.  Initialise the smart large object specification structure
   **       with values for the database column where the smart large
   **       object is being inserted.
   **       Reset the statement parameters.
   */

   /* Initialise the smart large object specification structure */
   rc = SQLBindParameter (hstmt, 1, SQL_PARAM_INPUT, SQL_C_CHAR, SQL_CHAR,
         BUFFER_LEN, 0, colname, BUFFER_LEN, &colname_size);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 3 --
         SQLBindParameter failed (param 1)\n"))
      goto Exit;

   lospec_valsize = lospec_size;

   rc = SQLBindParameter (hstmt, 2, SQL_PARAM_INPUT_OUTPUT, SQL_C_BINARY,
         SQL_INFX_UDT_FIXED, (UDWORD)lospec_size, 0, lospec_buffer,
         lospec_size, &lospec_valsize);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 3 --
         SQLBindParameter failed (param 2)\n"))
      goto Exit;

   rc = SQLExecDirect (hstmt, "{call ifx_lo_col_info(?, ?)}", SQL_NTS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 3 --
         SQLExecDirect failed\n"))
      goto Exit;

   /* Reset the statement parameters */
   rc = SQLFreeStmt (hstmt, SQL_RESET_PARAMS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 3 --
         SQLFreeStm failed\n"))
      goto Exit;

   fprintf(stdout, "STEP 3 done...smart large object specification
         structure initialised\n");


/* STEP 4.  Get the size of the smart large object pointer structure.
   **       Allocate a buffer to hold the structure.
   */

   /* Get the size of the smart large object pointer structure */
   rc = SQLGetInfo (hdbc, SQL_INFX_LO_PTR_LENGTH, &loptr_size,
         sizeof(loptr_size), NULL);
   if (checkError (rc, SQL_HANDLE_DBC, hdbc, "Error in Step 4 --
         SQLGetInfo failed\n"))
      goto Exit;

   /* Allocate a buffer to hold the smart large object pointer structure */
   loptr_buffer = malloc (loptr_size);

   fprintf (stdout, "STEP 4 done...smart large object pointer structure
         allocated\n");


/* STEP 5.  Create a new smart large object.
   **       Reset the statement parameters.
   */

   /* Create a new smart large object */
   rc = SQLBindParameter (hstmt, 1, SQL_PARAM_INPUT, SQL_C_BINARY,
         SQL_INFX_UDT_FIXED, (UDWORD)lospec_size, 0, lospec_buffer,
         lospec_size, &lospec_valsize);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 5 --
         SQLBindParameter failed (param 1)\n"))
      goto Exit;
   rc = SQLBindParameter (hstmt, 2, SQL_PARAM_INPUT, SQL_C_SLONG,
         SQL_INTEGER, (UDWORD)0, 0, &mode, sizeof(mode), &cbMode);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 5 --
         SQLBindParameter failed (param 2)\n"))
      goto Exit;

   loptr_valsize = loptr_size;

   rc = SQLBindParameter (hstmt, 3, SQL_PARAM_INPUT_OUTPUT, SQL_C_BINARY,
         SQL_INFX_UDT_FIXED, (UDWORD)loptr_size, 0, loptr_buffer,
         loptr_size, &loptr_valsize);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 5 --
         SQLBindParameter failed (param 3)\n"))
      goto Exit;

   rc = SQLBindParameter (hstmt, 4, SQL_PARAM_OUTPUT, SQL_C_SLONG,
         SQL_INTEGER, (UDWORD)0, 0, &lofd, sizeof(lofd), &lofd_valsize);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 5 --
         SQLBindParameter failed (param 4)\n"))
      goto Exit;

   rc = SQLExecDirect (hstmt, "{call ifx_lo_create(?, ?, ?, ?)}", SQL_NTS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 5 --
         SQLExecDirect failed\n"))
      goto Exit;

   /* Reset the statement parameters */
   rc = SQLFreeStmt (hstmt, SQL_RESET_PARAMS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 5 --
         SQLFreeStmt failed\n"))
      goto Exit;

   fprintf (stdout, "STEP 5 done...smart large object created\n");


/* STEP 6.  Open the file containing data for the new smart large object.
   **       Allocate a buffer to hold the smart large object data.
   **       Read data from the input file into the smart large object.
   **       data buffer
   **       Write data from the data buffer into the new smart large.
   **       object.
   **       Reset the statement parameters.
   */

   /* Open the file containing data for the new smart large object */
   hfile = open (lo_file_name, "rt");
   /* sneaky way to get the size of the file */
   write_size = lseek (open (lo_file_name, "rt"), 0L, SEEK_END);

   /* Allocate a buffer to hold the smart large object data */
   write_buffer = malloc (write_size + 1);

   /* Read smart large object data from file */
   read (hfile, write_buffer, write_size);

   write_buffer[write_size] = '\0';
   write_valsize = write_size;
   /* Write data from the data buffer into the new smart large object */
   rc = SQLBindParameter (hstmt, 1, SQL_PARAM_INPUT, SQL_C_SLONG,
         SQL_INTEGER, (UDWORD)0, 0, &lofd, sizeof(lofd), &lofd_valsize);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 6 --
         SQLBindParameter failed (param 1)\n"))
      goto Exit;

   rc = SQLBindParameter (hstmt, 2, SQL_PARAM_INPUT, SQL_C_CHAR, SQL_CHAR,
         (UDWORD)write_size, 0, write_buffer, write_size, &write_valsize);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 6 --
         SQLBindParameter failed (param 2)\n"))
      goto Exit;

   rc = SQLExecDirect (hstmt, "{call ifx_lo_write(?, ?)}", SQL_NTS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 6 --
         SQLExecDirect failed\n"))
      goto Exit;

   /* Reset the statement parameters */
   rc = SQLFreeStmt (hstmt, SQL_RESET_PARAMS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 6 --
         SQLFreeStmt failed\n"))
      goto Exit;

   fprintf (stdout, "STEP 6 done...data written to new smart large
         object\n");


/* STEP 7.  Insert the new smart large object into the database.
   **       Reset the statement parameters.
   */

   /* Insert the new smart large object into the database */
   loptr_valsize = loptr_size;

   rc = SQLBindParameter (hstmt, 1, SQL_PARAM_INPUT, SQL_C_BINARY,
         SQL_INFX_UDT_FIXED, (UDWORD)loptr_size, 0, loptr_buffer,
         loptr_size, &loptr_valsize);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 7 --
         SQLBindParameter failed\n"))
      goto Exit;

   rc = SQLExecDirect (hstmt, insertStmt, SQL_NTS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 7 --
         SQLExecDirect failed\n"))
      goto Exit;

   /* Reset the statement parameters */
   rc = SQLFreeStmt (hstmt, SQL_RESET_PARAMS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 7 --
         SQLFreeStmt failed\n"))
      goto Exit;

   fprintf (stdout, "STEP 7 done...smart large object inserted into the
         database\n");
```

```
/* STEP 8.  Close the smart large object.
   */

   rc = SQLBindParameter (hstmt, 1, SQL_PARAM_INPUT, SQL_C_LONG,
         SQL_INTEGER, (UDWORD)0, 0, &lofd, sizeof(lofd), &lofd_valsize);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 8 --
         SQLBindParameter failed\n"))
      goto Exit;

   rc = SQLExecDirect (hstmt, "{call ifx_lo_close(?)}", SQL_NTS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 8 --
         SQLExecDirect failed\n"))
      goto Exit;

   fprintf (stdout, "STEP 8 done...smart large object closed\n");


/* STEP 9.  Free the allocated buffers.
   */

   free (lospec_buffer);
   free (loptr_buffer);
   free (write_buffer);

   fprintf (stdout, "STEP 9 done...smart large object buffers freed\n");

   Exit:

   /* CLEANUP: Close the statement handle
   **          Free the statement handle
   **          Disconnect from the datasource
   **          Free the connection and environment handles
   **          Exit
   */

   /* Close the statement handle */
   SQLFreeStmt (hstmt, SQL_CLOSE);

   /* Free the statement handle */
   SQLFreeHandle (SQL_HANDLE_STMT, hstmt);

   /* Disconnect from the data source */
   SQLDisconnect (hdbc);

   /* Free the environment handle and the database connection handle */
   SQLFreeHandle (SQL_HANDLE_DBC, hdbc);
   SQLFreeHandle (SQL_HANDLE_ENV, henv);

   fprintf (stdout,"\n\nHit <Enter> to terminate the program...\n\n");
   in = getchar ();
   return (rc);
}
```

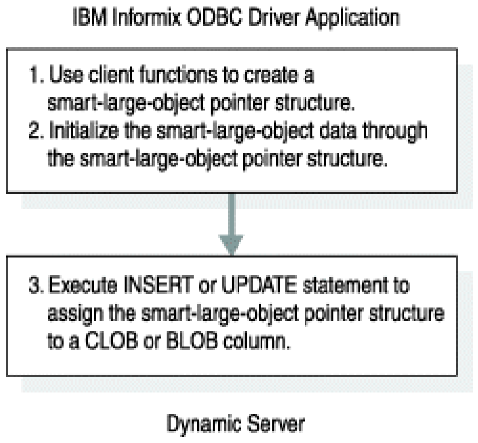
Transfer smart-large-object data

An INSERT or UPDATE statement does not perform the actual input of the smart-large-object data. It does, however, provide a means for the application to identify which smart-large-object data to associate with the column.

A BLOB or CLOB column in a database table stores the smart-large-object pointer structure for a smart large object. Therefore, when you store a BLOB or CLOB column, you provide a smart-large-object pointer structure for the column in a **loptr** variable to the INSERT or UPDATE statement.

The following figure shows how an application transfers the data of a smart large object to the database server.

Figure 5. Transfer smart-large-object data from client application to database server


IBM Informix ODBC Driver Application
1. Use client functions to create a smart-large-object pointer structure.
2. Initialize the smart-large-object data through the smart-large-object pointer structure.
3. Execute INSERT or UPDATE statement to assign the smart-large-object pointer structure to a CLOB or BLOB column.
Dynamic Server

The smart large object that a smart-large-object pointer structure identifies exists if the smart-large-object pointer structure exists. When you store a smart-large-object pointer structure in a database, the database server deallocates the smart large object when appropriate.

If your application does not store the smart-large-object pointer structure for a new smart large object in the database, the smart-large-object pointer structure is only valid to access the version of the smart large object that was current when the pointer was passed to the application. If the smart large object is updated later, the pointer is invalid. The smart-large-object pointer structures that you store in a row do not expire when the object version changes.

When you retrieve a row and then update a smart large object that is contained in that row, the database server exclusively locks the row for the time that it updates the smart large object. Moreover, long updates for smart large objects (whether logging is enabled and whether they are associated with a table row) create the potential for a long transaction condition if the smart large object takes a long time to update or create.

The smart-large-object pointer structure, not the CLOB or BLOB data itself, is stored in a CLOB or BLOB column in the database. Therefore, SQL statements such as INSERT and SELECT accept and return a smart-large-object pointer structure as the column value for a smart-large-object column.

Access a smart large object

This section describes how to select, open, delete, modify, and close a smart large object by using either the standard ODBC API or by using ifx_lo functions.

Smart-large-object automation

Instead of accessing smart large objects with the ifx_lo functions, you can access smart large objects by using the standard ODBC API.

Operations supported when accessing smart large objects with the standard ODBC API include select, insert, update, and delete for CLOB and BLOB data types. You cannot access BYTE and TEXT simple large objects in this way.

Set the access method using SQL_INFX_ATTR_LO_AUTOMATIC

You can use the SQL_INFX_ATTR_LO_AUTOMATIC attribute to tell the database server whether you will access smart large objects by using the ODBC API or the ifx_lo functions.

If the application enables the SQL_INFX_ATTR_LO_AUTOMATIC attribute as a connection attribute, all statements for that connection inherit the attribute value. To change this attribute value per statement, you have to set and reset it as a statement attribute. If you enable this attribute for the statement, the application can access the smart large object by using the standard ODBC way, as previously described. If you do not enable this attribute for the statement, the application accesses smart large objects by using ifx_lo functions. The application cannot use the ifx_lo functions if this attribute is enabled for the statement.

You can also enable the SQL_INFX_ATTR_LO_AUTOMATIC attribute by turning on the **Report Standard ODBC Types** option under the **Advanced** tab of the ODBC Administration for HCL Informix® Driver DSN.

SQLDescribeCol for a CLOB data type column returns SQL_LONGVARCHAR for the DataPtrType. SQLDescribeCol for a BLOB data type column returns SQL_LONGVARBINARY, if the SQL_INFX_ATTR_LO_AUTOMATIC attribute is enabled for that statement.

SQLColAttributes for a CLOB data type column returns SQL_LONGVARCHAR for the Field Identifier of SQL_DESC_TYPE, whereas for the BLOB data type column it returns SQL_LONGVARBINARY only if the SQL_INFX_ATTR_LO_AUTOMATIC attribute is enabled for that statement.

Insert, update, and delete smart large objects using the ODBC API

When you insert, update, and delete either a CLOB or BLOB data type, the application binds the data type by using SQLBindParameter with a C type.

When you insert, update, or delete a CLOB data type, the application binds the CLOB data type by using SQLBindParameter with C type as **SQL_C_CHAR** and SQL type as SQL_LONGVARCHAR.

When you insert, update, or delete a BLOB data type, the application binds BLOB data type by using SQLBindParameter with C type as **SQL_C_BINARY** and SQL type as SQL_LONGVARBINARY.

HCL Informix® ODBC Driver performs insertion of smart large objects in the following way:

- The driver sends a request to the database server to create a smart large object on the server side in the form of a new file.
- The driver gets back the file descriptor (for example, lofd) of this file from the database server.

- The driver sends the preceding lofd file and the smart-large-object data that was bound by the application with SQLBindParameter to the database server.
- The database server writes the data onto the file.

Select smart large objects using the ODBC API

When you select a CLOB data type, the application binds the C type of the column as **SQL_C_CHAR**. When you select a BLOB data type, the C type is bound as **SQL_C_BINARY**.

HCL Informix® ODBC Driver selects smart large objects in the following way:

- The driver sends a request to the database server to open the smart large object as a file on the server side.
- The driver gets back the file descriptor (for example, lofd) of this file from the database server.
- The driver sends the preceding lofd and a read request to the database server to read the smart-large-object data from the file.
- The database server reads the data from the corresponding file by using the preceding lofd and sends it to the driver.
- The driver writes the data to the buffer that was bound by the application with SQLBindParameter.

The ifx_lo functions

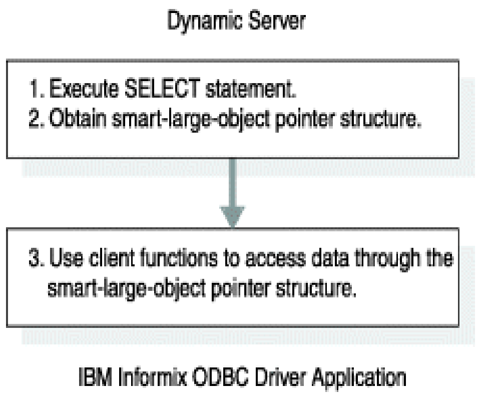
This section describes how to select, open, delete, modify, and close a smart large object by using ifx_lo functions.

Select a smart large object using ifx_lo functions

A SELECT statement does not perform the actual output for the smart-large-object data. It does, however, establish a means for the application to identify a smart large object so that the application can then perform operations on the smart large object.

The following figure shows how the database server transfers the data of a smart large object to the application.

Figure 6. Transferring smart-large-object data from database server to client application


Dynamic Server
1. Execute SELECT statement.
2. Obtain smart-large-object pointer structure.
3. Use client functions to access data through the smart-large-object pointer structure.
IBM Informix ODBC Driver Application

Open a smart large object using ifx_lo functions

When you open a smart large object, you obtain a smart-large-object file descriptor for the smart large object.

Through the smart-large-object file descriptor, you can access the data of a smart large object as if it were in an operating-system file.

Access modes

When you open a smart large object, you specify the access mode for the data. The access mode determines which read and write operations are valid on the open smart large object.

The following table describes the access modes that ifx_lo_open() and ifx_lo_create() support.

Access mode	**Purpose**	**Constant**
Read only	Only read operations are valid on the data.	LO_RDONLY
Dirty read	Lets you 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 this smart large object. Do not base updates on data that you obtain from a smart large object in dirty-read mode.	LO_DIRTY_READ
Write only	Only write operations are valid on the data.	LO_WRONLY
Append	Intended for use with LO_WRONLY or LO_RDWR. Sets the location pointer to the end of the object immediately before each write. Appends any data you write to the end of the smart large object. If LO_APPEND is used alone, the object is opened for reading only.	LO_APPEND
Read/write	Both read and write operations are valid on the data.	LO_RDWR
Buffered access	Uses standard database server buffer pool.	LO_BUFFER
Lightweight I/O	Uses private buffers from the session pool of the database server.	LO_NOBUFFER

When you open a smart large object with LO_APPEND only, the database server opens the smart large object as read-only. Seek operations and read operations move the file pointer. Write operations fail and do not move the file pointer.

You can mask the LO_APPEND flag with another access mode. In any of these OR combinations, the seek operation remains unaffected. The following table shows the effect on the read and write operations that each of the OR combinations has.

OR operation	Read operations	Write operations
LO_RDONLY | LO_APPEND	Occur at the file position and then move the file position to the end of the data that has been read.	Fail and do not move the file position.
LO_WRONLY | LO_APPEND	Fail and do not move the file position.	Move the file position to the end of the smart large object and then write the data; file position is at the end of the data after the write.
LO_RDWR | LO_APPEND	Occur at the file position and then move the file position to the end of the data that has been read.	Move the file position to the end of the smart large object and then write the data; file position is at the end of the data after the write.

Related reference

The ifx_lo_create() function on page 155

The ifx_lo_open() function on page 157

Lightweight I/O

When the database server accesses smart large objects, it uses buffers from the buffer pool for buffered access. Unbuffered access is called *lightweight I/O*.

Lightweight I/O uses private buffers instead of the buffer pool to hold smart large objects. These private buffers are allocated out of the database server session pool.

Lightweight I/O allows you to bypass the overhead of the least recently used (LRU) queues that the database server uses to manage the buffer pool. For more information about LRU queues, see your .

You can specify lightweight I/O by setting the flags parameter to LO_NOBUFFER when you create or open a smart large object. To specify buffered access, which is the default, use the LO_BUFFER flag.

Important: Keep in mind the following issues when you use lightweight I/O:

- Close smart large objects with ifx_lo_close() when you finish with them to free memory allocated to the private buffers.
- All open operations that use lightweight I/O for a particular smart large object share the same private buffers. Consequently, one operation can cause the pages in the buffer to be flushed while other operations expect the object to be present in the buffer.

The database server imposes the following restrictions on switching from lightweight I/O to buffered I/O:

- You can use the ifx_lo_alter() function to switch a smart large object from lightweight I/O (LO_NOBUFFER) to buffered I/O (LO_BUFFER) if the smart large object is not open. However, ifx_lo_alter() generates an error if you try to change a smart large object that uses buffered I/O to one that uses lightweight I/O.
- Unless you first use ifx_lo_alter() to change the access mode to buffered access (LO_BUFFER), you can only open a smart large object that was created with lightweight I/O with the LO_NOBUFFER access-mode flag. If an open operation specifies LO_BUFFER, the database server ignores the flag.
- You can open a smart large object that has been created with buffered access (LO_BUFFER) with the LO_NOBUFFER flag only if you open the object in read-only mode. If you attempt to write to the object, the database server returns an error. To write to the smart large object, you must close it and then reopen it with the LO_BUFFER flag and an access flag that allows write operations.

You can use the database server utility onspaces to specify lightweight I/O for all smart large objects in an sbspace. For more information about the onspaces utility, see your *HCL® Informix® Administrator's Guide*.

Smart-large-object locks

To prevent simultaneous access to smart-large-object data, the database server locks a smart large object when you open it.

Locks on smart large objects are different from row locks. If you retrieve a smart large object from a row, the database server might hold a row lock as well as a smart-large-object lock. The database server locks smart large objects because many columns can contain the same smart-large-object data.

To specify the lock mode of a smart large object, pass the access-mode flags, LO_RDONLY, LO_DIRTY_READ, LO_APPEND, LO_WRONLY, LO_RDWR, and LO_TRUNC, to the ifx_lo_open() and ifx_lo_create() functions. When you specify LO_RDONLY, the database server places a lock on the smart-large-object data. When you specify LO_DIRTY_READ, the database server does not place a lock on the smart-large-object data. If you specify any other access-mode flag, the database server obtains an update lock, which it promotes to an exclusive lock on first write or other update operation.

Share and update locks (read-only mode or write mode before an update operation occurs) are held until your application takes one of the following actions:

- Closes the smart large object
- Commits the transaction or rolls it back

Exclusive locks are held until the end of a transaction even if you close 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 database server detects that a smart large object does not have an active lock, it places a new lock the next time that you access the smart large object. The lock that it places is based on the original open mode of the smart large object.

Duration of an open operation on a smart large object

After you open a smart large object with the ifx_lo_create() function or the ifx_lo_open() function, it remains open until certain events occurs.

A smart large object remains open until one of these events occur:

- The ifx_lo_close() function closes the smart large object.
- The session ends.

Important: The end of the current transaction does not close a smart large object. It does, however, release any lock on a smart large object.

Close smart large objects as soon as you finish with them. Leaving smart large objects open unnecessarily uses system memory. Leaving many smart large objects open can eventually produce an out-of-memory condition.

Delete a smart large object

A smart large object cannot be deleted until certain conditions are met.

A smart large object is not deleted until both of the following conditions are met:

- The current transaction commits.
- The smart large object is closed, if the application opened the smart large object.

Modifying a smart large object

You can modify a smart large object by using either an UPDATE or INSERT statement.

About this task

To modify the data of a smart large object:

1. Read and write the data in the open smart large object.
2. Use an UPDATE or INSERT statement to store the smart-large-object pointer in the database.

Close a smart large object

After you finish modifying a smart large object, call ifx_lo_close() to deallocate the resources that are assigned to it.

When the resources are freed, you can reallocate them to other structures that your application needs. You can also reallocate the smart-large-object file descriptor to other smart large objects.

Example of retrieving a smart large object from the database using ifx_lo functions

The code example, `loselect.c`, shows how to retrieve a smart large object from the database.

You can find the `loselect.c` file in the `%INFORMIXDIR%/demo/clidemo` directory on UNIX™ platforms and in the `%INFORMIXDIR%\demo\odbcdemo` directory on Windows™ platforms. You can also find instructions on how to build the **odbc_demo** database in the same location.

```
/*
**    loselect.c
**
** To access a smart large object
**    SQLBindCol
**    SQLBindParameter
**    SQLConnect
**    SQLFetch
**    SQLFreeStmt
**    SQLGetInfo
**    SQLDisconnect
**    SQLExecDirect
*/

#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#ifndef NO_WIN32
#include <io.h>
#include <windows.h>
#include <conio.h>
#endif /*NO_WIN32*/

#include "infxcli.h"

#define ERRMSG_LEN  200

UCHAR   defDsn[] = "odbc_demo";

int checkError (SQLRETURN     rc,
               SQLSMALLINT    handleType,
               SQLHANDLE      handle,
               char           *errmsg)
{
   SQLRETURN   retcode = SQL_SUCCESS;

   SQLSMALLINT errNum = 1;
   SQLCHAR     sqlState[6];
   SQLINTEGER  nativeError;
   SQLCHAR     errMsg[ERRMSG_LEN];
   SQLSMALLINT textLengthPtr;


   if ((rc != SQL_SUCCESS) && (rc != SQL_SUCCESS_WITH_INFO))
   {
      while (retcode != SQL_NO_DATA)
      {
         retcode = SQLGetDiagRec (handleType, handle, errNum, sqlState,
               &nativeError, errMsg, ERRMSG_LEN, &textLengthPtr);

         if (retcode == SQL_INVALID_HANDLE)
         {
            fprintf (stderr, "checkError function was called with an
               invalid handle!!\n");
            return 1;
         }

         if ((retcode == SQL_SUCCESS) || (retcode ==
               SQL_SUCCESS_WITH_INFO))
            fprintf (stderr, "ERROR: %d:  %s : %s \n", nativeError,
                  sqlState, errMsg);

         errNum++;
      }

      fprintf (stderr, "%s\n", errmsg);
      return 1;   /* all errors on this handle have been reported */
   }
   else
      return 0;   /* no errors to report */
}

int main (long    argc,
         char     *argv[])
{
   /* Declare variables
   */

   /* Handles */
   SQLHDBC     hdbc;
   SQLHENV     henv;
   SQLHSTMT    hstmt;

   /* Smart large object file descriptor */
   long        lofd;
   long           lofd_valsize = 0;

   /* Smart large object pointer structure */
   char*       loptr_buffer;
   short       loptr_size;
   long        loptr_valsize = 0;

   /* Smart large object status structure */
   char*       lostat_buffer;
   short       lostat_size;
   long        lostat_valsize = 0;

   /* Smart large object data */
   char*       lo_data;
   long        lo_data_valsize = 0;

   /* Miscellaneous variables */
   UCHAR       dsn[20]; /*name of the DSN used for connecting to the
                  database*/
   SQLRETURN   rc = 0;
   int         in;

   char*       selectStmt = "SELECT advert FROM item WHERE item_num =
                  1004";
   long        mode = LO_RDONLY;
   long        lo_size;
   long        cbMode = 0, cbLoSize = 0;


/* STEP 1.  Get data source name from command line (or use default)
   **       Allocate the environment handle and set ODBC version
   **       Allocate the connection handle
   **       Establish the database connection
   **       Allocate the statement handle
   */

   /* If(dsn is not explicitly passed in as arg) */
   if (argc != 2)
   {
      /* Use default dsn - odbc_demo */
      fprintf (stdout, "\nUsing default DSN : %s\n", defDsn);
      strcpy ((char *)dsn, (char *)defDsn);
   }
   else
   {
      /* Use specified dsn */
      strcpy ((char *)dsn, (char *)argv[1]);
      fprintf (stdout, "\nUsing specified DSN : %s\n", dsn);
   }

   /* Allocate the Environment handle */
   rc = SQLAllocHandle (SQL_HANDLE_ENV, SQL_NULL_HANDLE, &henv);
   if (rc != SQL_SUCCESS)
   {
      fprintf (stdout, "Environment Handle Allocation
            failed\nExiting!!\n");
      return (1);
   }

   /* Set the ODBC version to 3.5 */
   rc = SQLSetEnvAttr (henv, SQL_ATTR_ODBC_VERSION,
         (SQLPOINTER)SQL_OV_ODBC3, 0);
   if (checkError (rc, SQL_HANDLE_ENV, henv, "Error in Step 1 --
         SQLSetEnvAttr failed\nExiting!!\n"))
      return (1);

   /* Allocate the connection handle */
   rc = SQLAllocHandle (SQL_HANDLE_DBC, henv, &hdbc);
   if (checkError (rc, SQL_HANDLE_ENV, henv, "Error in Step 1 -- Connection
         Handle Allocation failed\nExiting!!\n"))
      return (1);

   /* Establish the database connection */
   rc = SQLConnect (hdbc, dsn, SQL_NTS, "", SQL_NTS, "", SQL_NTS);
   if (checkError (rc, SQL_HANDLE_DBC, hdbc, "Error in Step 1 -- SQLConnect
         failed\nExiting!!"))
      return (1);
   /* Allocate the statement handle */
   rc = SQLAllocHandle (SQL_HANDLE_STMT, hdbc, &hstmt);
   if (checkError (rc, SQL_HANDLE_DBC, hdbc, "Error in Step 1 -- Statement
         Handle Allocation failed\nExiting!!"))
      return (1);

   fprintf (stdout, "STEP 1 done...connected to database\n");


/* STEP 2.  Select a smart-large object from the database
   **       -- the select statement executed is -
   **       "SELECT advert FROM item WHERE item_num = 1004"
   */

   /* Execute the select statement */
   rc = SQLExecDirect (hstmt, selectStmt, SQL_NTS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 2 --
         SQLExecDirect failed\n"))
      goto Exit;

   fprintf (stdout, "STEP 2 done...select statement executed...smart large
         object retrieved from the databse\n");


/* STEP 3.  Get the size of the smart large object pointer structure.
   **       Allocate a buffer to hold the structure.
   **       Get the smart large object pointer structure from the
   **       database.
   **       Close the result set cursor.
   */

   /* Get the size of the smart large object pointer structure */
   rc = SQLGetInfo (hdbc, SQL_INFX_LO_PTR_LENGTH, &loptr_size,
         sizeof(loptr_size),
         NULL);
   if (checkError (rc, SQL_HANDLE_DBC, hdbc, "Error in Step 3 -- SQLGetInfo
         failed\n"))
      goto Exit;

   /* Allocate a buffer to hold the smart large object pointer structure */
   loptr_buffer = malloc (loptr_size);

   /* Bind the smart large object pointer structure buffer allocated to the
         column in the result set & fetch it from the database */
   rc = SQLBindCol (hstmt, 1, SQL_C_BINARY, loptr_buffer, loptr_size,
         &loptr_valsize);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 3 --
         SQLBindCol failed\n"))
      goto Exit;

   rc = SQLFetch (hstmt);
   if (rc == SQL_NO_DATA_FOUND)
   {
      fprintf (stdout, "No Data Found\nExiting!!\n");
      goto Exit;
   }
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 3 -- SQLFetch
         failed\n"))
      goto Exit;

   /* Close the result set cursor */
   rc = SQLCloseCursor (hstmt);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 3 --
         SQLCloseCursor failed\n"))
      goto Exit;

   fprintf (stdout, "STEP 3 done...smart large object pointer structure
      fetched from the database\n");


/* STEP 4.  Use the smart large object's pointer structure to open it
   **       and obtain the smart large object file descriptor.
   **       Reset the statement parameters.
   */

   rc = SQLBindParameter (hstmt, 1, SQL_PARAM_OUTPUT, SQL_C_LONG,
         SQL_INTEGER, (UDWORD)0, 0, &lofd, sizeof(lofd), &lofd_valsize);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 4 --
         SQLBindParameter failed (param 1)\n"))
      goto Exit;

   rc = SQLBindParameter (hstmt, 2, SQL_PARAM_INPUT, SQL_C_BINARY,
         SQL_INFX_UDT_FIXED, (UDWORD)loptr_size, 0, loptr_buffer,
         loptr_size, &loptr_valsize);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 4 --
         SQLBindParameter failed (param 2)\n"))
      goto Exit;

   rc = SQLBindParameter (hstmt, 3, SQL_PARAM_INPUT, SQL_C_LONG,
         SQL_INTEGER, (UDWORD)0, 0, &mode, sizeof(mode), &cbMode);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 4 --
         SQLBindParameter failed (param 3)\n"))
      goto Exit;

   rc = SQLExecDirect (hstmt, "{? = call ifx_lo_open(?, ?)}", SQL_NTS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 4 --
         SQLExecDirect failed\n"))
      goto Exit;

   /* Reset the statement parameters */
   rc = SQLFreeStmt (hstmt, SQL_RESET_PARAMS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 4 --
         SQLFreeStmt failed\n"))
      goto Exit;

   fprintf (stdout, "STEP 4 done...smart large object opened... file
         descriptor obtained\n");


/* STEP 5.  Get the size of the smart large object status structure.
   **       Allocate a buffer to hold the structure.
   **       Get the smart large object status structure from the
   **       database.
   **       Reset the statement parameters.
   */

   /* Get the size of the smart large object status structure */
   rc = SQLGetInfo (hdbc, SQL_INFX_LO_STAT_LENGTH, &lostat_size,
         sizeof(lostat_size), NULL);
   if (checkError (rc, SQL_HANDLE_DBC, hdbc, "Error in Step 5 -- SQLGetInfo
         failed\n"))
      goto Exit;

   /* Allocate a buffer to hold the smart large object status structure. */
   lostat_buffer = malloc(lostat_size);

   /* Get the smart large object status structure from the database. */
   rc = SQLBindParameter (hstmt, 1, SQL_PARAM_INPUT, SQL_C_LONG,
         SQL_INTEGER, (UDWORD)0, 0, &lofd, sizeof(lofd), &lofd_valsize);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 5 --
         SQLBindParameter failed (param 1)\n"))
      goto Exit;

   rc = SQLBindParameter (hstmt, 2, SQL_PARAM_INPUT_OUTPUT, SQL_C_BINARY,
         SQL_INFX_UDT_FIXED, (UDWORD)lostat_size, 0, lostat_buffer,
         lostat_size, &lostat_valsize);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 5 --
         SQLBindParameter failed (param 2)\n"))
      goto Exit;

   rc = SQLExecDirect (hstmt, "{call ifx_lo_stat(?, ?)}", SQL_NTS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 5 --
         SQLExecDiret failed\n"))
      goto Exit;

   /* Reset the statement parameters */
   rc = SQLFreeStmt (hstmt, SQL_RESET_PARAMS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 5 --
         SQLFreeStmt failed\n"))
      goto Exit;

   fprintf (stdout, "STEP 5 done...smart large object status structure
         fetched from the database\n");


/* STEP 6.  Use the smart large object's status structure to get the
   **       size of the smart large object.
   **       Reset the statement parameters.
   */

   /* Use the smart large object status structure to get the size of the
         smart large object */
   rc = SQLBindParameter (hstmt, 1, SQL_PARAM_INPUT, SQL_C_BINARY,
         SQL_INFX_UDT_FIXED, (UDWORD)lostat_size, 0, lostat_buffer,
         lostat_size, &lostat_valsize);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 6 --
         SQLBindParameter failed (param 1)\n"))
      goto Exit;

   rc = SQLBindParameter (hstmt, 2, SQL_PARAM_OUTPUT, SQL_C_LONG,
         SQL_BIGINT, (UDWORD)0, 0, &lo_size, sizeof(lo_size), &cbLoSize);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 6 --
         SQLBindParameter failed (param 1)\n"))
      goto Exit;

   rc = SQLExecDirect (hstmt, "{call ifx_lo_stat_size(?, ?)}", SQL_NTS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 6 --
         SQLExecDirect failed\n"))
      goto Exit;

   /* Reset the statement parameters */
   rc = SQLFreeStmt (hstmt, SQL_RESET_PARAMS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 6 --
         SQLFreeStmt failed\n"))
      goto Exit;

   fprintf (stdout, "STEP 6 done...smart large object size = %ld bytes\n",
         lo_size);


/* STEP 7.  Allocate a buffer to hold the smart large object's data.
   **       Read the smart large object's data using its file descriptor.
   **       Null-terminate the last byte of the smart large-object's data.
   **       Print out the contents of the smart large object.
   **       Reset the statement parameters.
   */

   /* Allocate a buffer to hold the smart large object's data chunks */
   lo_data = malloc (lo_size + 1);

   /* Read the smart large object's data */
   rc = SQLBindParameter (hstmt, 1, SQL_PARAM_INPUT, SQL_C_LONG,
         SQL_INTEGER, (UDWORD)0, 0, &lofd, sizeof(lofd), &lofd_valsize);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 7 --
         SQLBindParameter failed (param 1)\n"))
      goto Exit;

   rc = SQLBindParameter (hstmt, 2, SQL_PARAM_OUTPUT, SQL_C_CHAR, SQL_CHAR,
         lo_size, 0, lo_data, lo_size, &lo_data_valsize);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 7 --
         SQLBindParameter failed (param 2)\n"))
      goto Exit;

   rc = SQLExecDirect (hstmt, "{call ifx_lo_read(?, ?)}", SQL_NTS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 7 --
         SQLExecDirect failed\n"))
      goto Exit;

   /* Null-terminate the last byte of the smart large objects data */
   lo_data[lo_size] = '\0';

   /* Print the contents of the smart large object */
   fprintf (stdout, "Smart large object contents are.....\n\n\n%s\n\n\n",
         lo_data);

   /* Reset the statement parameters */
   rc = SQLFreeStmt (hstmt, SQL_RESET_PARAMS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 7 --
         SQLFreeStmt failed\n"))
      goto Exit;

   fprintf (stdout, "STEP 7 done...smart large object read completely\n");



/* STEP 8.  Close the smart large object.
   */

   rc = SQLBindParameter (hstmt, 1, SQL_PARAM_INPUT, SQL_C_LONG,
         SQL_INTEGER, (UDWORD)0, 0, &lofd, sizeof(lofd), &lofd_valsize);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 8 --
         SQLBindParameter failed\n"))
      goto Exit;

   rc = SQLExecDirect (hstmt, "{call ifx_lo_close(?)}", SQL_NTS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 8 --
         SQLExecDirect failed\n"))
      goto Exit;

   fprintf (stdout, "STEP 8 done...smart large object closed\n");


/* STEP 9.  Free the allocated buffers.
   */

   free (loptr_buffer);
   free (lostat_buffer);
   free (lo_data);

   fprintf (stdout, "STEP 9 done...smart large object buffers freed\n");

   Exit:

   /* CLEANUP: Close the statement handle
   **          Free the statement handle
   **          Disconnect from the datasource
   **          Free the connection and environment handles
   **          Exit
   */

   /* Close the statement handle */
   SQLFreeStmt (hstmt, SQL_CLOSE);

   /* Free the statement handle */
   SQLFreeHandle (SQL_HANDLE_STMT, hstmt);

   /* Disconnect from the data source */
   SQLDisconnect (hdbc);

   /* Free the environment handle and the database connection handle */
   SQLFreeHandle (SQL_HANDLE_DBC, hdbc);
   SQLFreeHandle (SQL_HANDLE_ENV, henv);
   fprintf (stdout,"\n\nHit <Enter> to terminate the program...\n\n");
   in = getchar ();
   return (rc);
}
```

Retrieve the status of a smart large object

The status information of a smart large object has corresponding client functions.

The following table describes the status information and the corresponding client functions.

Disk-storage information	Description	Client functions
Last access time	The time, in seconds, that a smart large object was last accessed. This value is available only if the LO_KEEP_LASTACCESS_TIME flag is set for the smart large object.	ifx_lo_stat_atime()
Last time of status change	The time, in seconds, of the last status change for a smart large object. A change in status includes updates, changes in ownership, and changes to the number of references.	ifx_lo_stat_ctime()
Last modification time (seconds)	The time, in seconds, that a smart large object was last modified.	ifx_lo_stat_mtime_sec()
Last modification time (microseconds)	The microsecond component of the time of last modification. This value is only supported on platforms that provide system time to microsecond granularity.	ifx_lo_stat_mtime_usec()
Reference count	A count of the number of references to a smart large object.	ifx_lo_stat_refcnt()
Size	The size, in bytes, of a smart large object.	ifx_lo_stat_size()

The time values (such as last access time and last change time) might differ slightly from the system time. This difference is due to the algorithm that the database server uses to obtain the time from the operating system.

Example of retrieving information about a smart large object

The code example, `loinfo.c`, shows how to retrieve information about a smart large object.

You can find the `loinfo.c` file in the `%INFORMIXDIR%/demo/clidemo` directory on UNIX™ platforms and in the `%INFORMIXDIR%\demo\odbcdemo` directory in Windows™ environments. You can also find instructions on how to build the **odbc_demo** database in the same location.

```
/*
**    loinfo.c
**
** To check the status of a smart large object
**
**    OBDC Functions:
**       SQLBindCol
**       SQLBindParameter
**       SQLConnect
**       SQLFetch
**       SQLFreeStmt
**       SQLDisconnect
**       SQLExecDirect
*/


#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#ifndef NO_WIN32
#include <io.h>
#include <windows.h>
#include <conio.h>
#endif /*NO_WIN32*/

#include "infxcli.h"

#define BUFFER_LEN  20
#define ERRMSG_LEN  200

UCHAR   defDsn[] = "odbc_demo";

int checkError (SQLRETURN     rc,
               SQLSMALLINT    handleType,
               SQLHANDLE      handle,
               char           *errmsg)
{
   SQLRETURN      retcode = SQL_SUCCESS;

   SQLSMALLINT    errNum = 1;
   SQLCHAR        sqlState[6];
   SQLINTEGER     nativeError;
   SQLCHAR        errMsg[ERRMSG_LEN];
   SQLSMALLINT    textLengthPtr;

   if ((rc != SQL_SUCCESS) && (rc != SQL_SUCCESS_WITH_INFO))
   {
      while (retcode != SQL_NO_DATA)
      {
         retcode = SQLGetDiagRec (handleType, handle, errNum, sqlState,
               &nativeError, errMsg, ERRMSG_LEN, &textLengthPtr);
         if (retcode == SQL_INVALID_HANDLE)
         {
            fprintf (stderr, "checkError function was called with an
                  invalid handle!!\n");
            return 1;
         }

         if ((retcode == SQL_SUCCESS) || (retcode ==
               SQL_SUCCESS_WITH_INFO))
            fprintf (stderr, "ERROR: %d:  %s : %s \n", nativeError,
                  sqlState, errMsg);

         errNum++;
      }

      fprintf (stderr, "%s\n", errmsg);
      return 1;   /* all errors on this handle have been reported */
   }
   else
      return 0;   /* no errors to report */
}

int main (long    argc,
         char     *argv[])
{
   /* Declare variables
   */

   /* Handles */
   SQLHDBC     hdbc;
   SQLHENV     henv;
   SQLHSTMT    hstmt;

   /* Smart large object file descriptor */
   long        lofd;
   long        lofd_valsize = 0;

   /* Smart large object specification structure */
   char*        lospec_buffer;
   short        lospec_size;
   long         lospec_valsize = 0;

   /* Smart large object status structure */
   char*       lostat_buffer;
   short       lostat_size;
   long        lostat_valsize = 0;

   /* Smart large object pointer structure */
   char*       loptr_buffer;
   short       loptr_size;
   long        loptr_valsize = 0;

   /* Miscellaneous variables */
   UCHAR       dsn[20]; /*name of the DSN used for connecting to the
                  database*/
   SQLRETURN   rc = 0;
   int         in;
   char*       selectStmt = "SELECT advert FROM item WHERE item_num =
                  1004";
   long        lo_size;
   long        mode = LO_RDONLY;

   char        sbspace_name[BUFFER_LEN];
   long        sbspace_name_size = SQL_NTS;

   long        cbMode = 0, cbLoSize = 0;


/* STEP 1.  Get data source name from command line (or use default).
   **       Allocate the environment handle and set ODBC version.
   **       Allocate the connection handle.
   **       Establish the database connection.
   **       Allocate the statement handle.
   */

   /* If (dsn is not explicitly passed in as arg) */
   if (argc != 2)
   {
      /* Use default dsn - odbc_demo */
      fprintf (stdout, "\nUsing default DSN : %s\n", defDsn);
      strcpy ((char *)dsn, (char *)defDsn);
   }
   else
   {
      /* Use specified dsn */
      strcpy ((char *)dsn, (char *)argv[1]);
      fprintf (stdout, "\nUsing specified DSN : %s\n", dsn);
   }

   /* Allocate the Environment handle */
   rc = SQLAllocHandle (SQL_HANDLE_ENV, SQL_NULL_HANDLE, &henv);
   if (rc != SQL_SUCCESS)
   {
      fprintf (stdout, "Environment Handle Allocation
         failed\nExiting!!\n");
      return (1);
   }

   /* Set the ODBC version to 3.5 */
   rc = SQLSetEnvAttr (henv, SQL_ATTR_ODBC_VERSION,
         (SQLPOINTER)SQL_OV_ODBC3, 0);
   if (checkError (rc, SQL_HANDLE_ENV, henv, "Error in Step 1 --
         SQLSetEnvAttr failed\nExiting!!\n"))
      return (1);

   /* Allocate the connection handle */
   rc = SQLAllocHandle (SQL_HANDLE_DBC, henv, &hdbc);
   if (checkError (rc, SQL_HANDLE_ENV, henv, "Error in Step 1 -- Connection
         Handle Allocation failed\nExiting!!\n"))
      return (1);


   /* Establish the database connection */
   rc = SQLConnect (hdbc, dsn, SQL_NTS, "", SQL_NTS, "", SQL_NTS);
   if (checkError (rc, SQL_HANDLE_DBC, hdbc, "Error in Step 1 -- SQLConnect
         failed\nExiting!!"))
      return (1);

   /* Allocate the statement handle */
   rc = SQLAllocHandle (SQL_HANDLE_STMT, hdbc, &hstmt );
   if (checkError (rc, SQL_HANDLE_DBC, hdbc, "Error in Step 1 -- Statement
         Handle Allocation failed\nExiting!!"))
      return (1);

   fprintf (stdout, "STEP 1 done...connected to database\n");


/* STEP 2.  Select a smart-large object from the database.
   **       -- the select  statement executed is -
   **       "SELECT advert FROM item WHERE item_num = 1004"
   */

   /* Execute the select statement */
   rc = SQLExecDirect (hstmt, selectStmt, SQL_NTS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 2 --
         SQLExecDirect failed\n"))
      goto Exit;

   fprintf (stdout, "STEP 2 done...select statement executed...smart large
      object retrieved from the databse\n");


/* STEP 3.  Get the size of the smart large object pointer structure.
   **       Allocate a buffer to hold the structure.
   **       Get the smart large object pointer structure from the database.
   **       Close the result set cursor.
   */

   /* Get the size of the smart large object pointer structure */
   rc = SQLGetInfo (hdbc, SQL_INFX_LO_PTR_LENGTH, &loptr_size,
         sizeof(loptr_size), NULL);
   if (checkError (rc, SQL_HANDLE_DBC, hdbc, "Error in Step 3 -- SQLGetInfo
         failed\n"))
      goto Exit;

   /* Allocate a buffer to hold the smart large object pointer structure */
   loptr_buffer = malloc (loptr_size);

   /* Bind the smart large object pointer structure buffer allocated to the
         column in the result set & fetch it from the database */
   rc = SQLBindCol (hstmt, 1, SQL_C_BINARY, loptr_buffer, loptr_size,
         &loptr_valsize);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 3 --
         SQLBindCol failed\n"))
      goto Exit;

   rc = SQLFetch (hstmt);
   if (rc == SQL_NO_DATA_FOUND)
   {
      fprintf (stdout, "No Data Found\nExiting!!\n");
      goto Exit;
   }
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 3 -- SQLFetch
         failed\n"))
      goto Exit;

   /* Close the result set cursor */
   rc = SQLCloseCursor (hstmt);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 3 --
         SQLCloseCursor failed\n"))
      goto Exit;

   fprintf (stdout, "STEP 3 done...smart large object pointer structure
      fetched from the database\n");


/* STEP 4.  Use the smart large object's pointer structure to open it
   **       and obtain the smart large object file descriptor.
   **       Reset the statement parameters.
   */

   rc = SQLBindParameter (hstmt, 1, SQL_PARAM_OUTPUT, SQL_C_LONG,
         SQL_INTEGER, (UDWORD)0, 0, &lofd, sizeof(lofd), &lofd_valsize);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 4 --
         SQLBindParameter failed (param 1)\n"))
      goto Exit;

   rc = SQLBindParameter (hstmt, 2, SQL_PARAM_INPUT, SQL_C_BINARY,
         SQL_INFX_UDT_FIXED, (UDWORD)loptr_size, 0, loptr_buffer,
         loptr_size, &loptr_valsize);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 4 --
         SQLBindParameter failed (param 2)\n"))
      goto Exit;

   rc = SQLBindParameter (hstmt, 3, SQL_PARAM_INPUT, SQL_C_LONG,
         SQL_INTEGER, (UDWORD)0, 0, &mode, sizeof(mode), &cbMode);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 4 --
         SQLBindParameter failed (param 3)\n"))
      goto Exit;

   rc = SQLExecDirect (hstmt, "{? = call  ifx_lo_open(?, ?)}", SQL_NTS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 4 --
         SQLExecDirect failed\n"))
      goto Exit;

   /* Reset the statement parameters */
   rc = SQLFreeStmt (hstmt, SQL_RESET_PARAMS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 4 --
         SQLFreeStmt failed\n"))
      goto Exit;

   fprintf (stdout, "STEP 4 done...smart large object opened... file
      descriptor obtained\n");


/* STEP 5.  Get the size of the smart large object status structure.
   **       Allocate a buffer to hold the structure.
   **       Get the smart large object status structure from the database.
   **       Reset the statement parameters.
   */

   /* Get the size of the smart large object status structure */
   rc = SQLGetInfo (hdbc, SQL_INFX_LO_STAT_LENGTH, &lostat_size,
         sizeof(lostat_size), NULL);
   if (checkError (rc, SQL_HANDLE_DBC, hdbc, "Error in Step 5 -- SQLGetInfo
         failed\n"))
      goto Exit;

   /* Allocate a buffer to hold the smart large object status structure. */
   lostat_buffer = malloc(lostat_size);

   /* Get the smart large object status structure from the database. */
   rc = SQLBindParameter (hstmt, 1, SQL_PARAM_INPUT, SQL_C_LONG,
         SQL_INTEGER, (UDWORD)0, 0, &lofd, sizeof(lofd), &lofd_valsize);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 5 --
         SQLBindParameter failed (param 1)\n"))
      goto Exit;

   rc = SQLBindParameter (hstmt, 2, SQL_PARAM_INPUT_OUTPUT, SQL_C_BINARY,
         SQL_INFX_UDT_FIXED, (UDWORD)lostat_size, 0, lostat_buffer,
         lostat_size, &lostat_valsize);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 5 --
         SQLBindParameter failed (param 2)\n"))
      goto Exit;

   rc = SQLExecDirect (hstmt, "{call ifx_lo_stat(?, ?)}", SQL_NTS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 5 --
         SQLExecDirect failed\n"))
      goto Exit;

   /* Reset the statement parameters */
   rc = SQLFreeStmt (hstmt, SQL_RESET_PARAMS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 5 --
         SQLFreeStmt failed\n"))
      goto Exit;

   fprintf (stdout, "STEP 5 done...smart large object status structure
      fetched from the database\n");


/* STEP 6.  Use the smart large object's status structure to get the size
   **       of the smart large object.
   **       Reset the statement parameters.
   **       You can use additional ifx_lo_stat_*() functions to get more
   **       status information about the samrt large object.
   **       You can also use it to retrieve the smart large object
   **       specification structure and get further information about the
   **       smart large objectusing it's specification structure.
   */

   /* Use the smart large object status structure to get the size of the
         smart large object. */
   rc = SQLBindParameter (hstmt, 1, SQL_PARAM_INPUT, SQL_C_BINARY,
         SQL_INFX_UDT_FIXED, (UDWORD)lostat_size, 0, lostat_buffer,
         lostat_size, &lostat_valsize);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 6 --
         SQLBindParameter failed (param 1)\n"))
      goto Exit;

   rc = SQLBindParameter (hstmt, 2, SQL_PARAM_OUTPUT, SQL_C_LONG,
         SQL_BIGINT, (UDWORD)0, 0, &lo_size, sizeof(lo_size), &cbLoSize);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 6 --
         SQLBindParameter failed (param 1)\n"))
      goto Exit;

   rc = SQLExecDirect (hstmt, "{call ifx_lo_stat_size(?, ?)}", SQL_NTS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 6 --
         SQLExecDirect failed\n"))
      goto Exit;

   /* Reset the statement parameters */
   rc = SQLFreeStmt (hstmt, SQL_RESET_PARAMS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 6 --
         SQLFreeStmt failed\n"))
      goto Exit;

   fprintf (stdout, "LARGE OBJECT SIZE = %ld\n", lo_size);
   fprintf (stdout, "STEP 6 done...smart large object size retrieved\n");


/* STEP 7.  Get the size of the smart large object specification structure.
   **       Allocate a buffer to hold the structure.
   **       Get the smart large object specification structure from the
   **       database.
   **       Reset the statement parameters.
   */

   /* Get the size of the smart large object specification structure */
   rc = SQLGetInfo (hdbc, SQL_INFX_LO_SPEC_LENGTH, &lospec_size,
         sizeof(lospec_size), NULL);
   if (checkError (rc, SQL_HANDLE_DBC, hdbc, "Error in Step 7 -- SQLGetInfo
         failed\n"))
      goto Exit;

   /* Allocate a buffer to hold the smart large object specification
         structure */
   lospec_buffer = malloc (lospec_size);

   /* Get the smart large object specification structure from the
         database */
   rc = SQLBindParameter (hstmt, 1, SQL_PARAM_INPUT, SQL_C_BINARY,
         SQL_INFX_UDT_FIXED, (UDWORD)lostat_size, 0, lostat_buffer,
         lostat_size, &lostat_valsize);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 7 --
         SQLBindParameter failed (param 1)\n"))
      goto Exit;

   rc = SQLBindParameter (hstmt, 2, SQL_PARAM_OUTPUT, SQL_C_BINARY,
         SQL_INFX_UDT_FIXED, (UDWORD)lospec_size, 0, lospec_buffer,
         lospec_size, &lospec_valsize);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 7 --
         SQLBindParameter failed (param 2)\n"))
      goto Exit;

   rc = SQLExecDirect (hstmt, "{call ifx_lo_stat_cspec(?, ?)}", SQL_NTS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 7 --
         SQLExecDirect failed\n"))
      goto Exit;

   fprintf (stdout, "STEP 7 done...smart large object status structure
      fetched from the database\n");


/* STEP 8.  Use the smart large object's specification structure to get
   **       the sbspace name where the smart large object is stored.
   **       Reset the statement parameters.
   */

   /*  Use the smart large object's specification structure to get the
         sbspace name of the smart large object. */
   rc = SQLBindParameter (hstmt, 1, SQL_PARAM_INPUT, SQL_C_BINARY,
         SQL_INFX_UDT_FIXED, (UDWORD)lospec_size, 0, lospec_buffer,
         lospec_size, &lospec_valsize);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 8 --
         SQLBindParameter failed (param 1)\n"))
      goto Exit;

   rc = SQLBindParameter (hstmt, 2, SQL_PARAM_OUTPUT, SQL_C_CHAR, SQL_CHAR,
         BUFFER_LEN, 0, sbspace_name, BUFFER_LEN, &sbspace_name_size);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 8 --
         SQLBindParameter failed (param 2)\n"))
      goto Exit;

   rc = SQLExecDirect (hstmt, "{call ifx_lo_specget_sbspace(?, ?)}",
         SQL_NTS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 8 --
         SQLExecDirect failed\n"))
      goto Exit;

   fprintf (stdout, "LARGE OBJECT SBSPACE NAME = %s\n", sbspace_name);
   fprintf (stdout, "STEP 8 done...large object sbspace name retrieved\n");


/* STEP 9.  Close the smart large object.
   */

   rc = SQLBindParameter (hstmt, 1, SQL_PARAM_INPUT, SQL_C_LONG,
         SQL_INTEGER, (UDWORD)0, 0, &lofd, sizeof(lofd), &lofd_valsize);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 9 --
         SQLBindParameter failed\n"))
      goto Exit;

   rc = SQLExecDirect (hstmt, "{call ifx_lo_close(?)}", SQL_NTS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 9 --
         SQLExecDirect failed\n"))
      goto Exit;

   fprintf (stdout, "STEP 9 done...smart large object closed\n");
```

```
/* STEP 10.Free the allocated buffers.
   */

   free (loptr_buffer);
   free (lostat_buffer);
   free (lospec_buffer);

   fprintf (stdout, "STEP 10 done...smart large object buffers freed\n");


   Exit:

   /* CLEANUP: Close the statement handle.
   **          Free the statement handle.
   **          Disconnect from the datasource.
   **          Free the connection and environment handles.
   **          Exit.
   */

   /* Close the statement handle */
   SQLFreeStmt (hstmt, SQL_CLOSE);

   /* Free the statement handle */
   SQLFreeHandle (SQL_HANDLE_STMT, hstmt);

   /* Disconnect from the data source */
   SQLDisconnect (hdbc);

   /* Free the environment handle and the database connection handle */
   SQLFreeHandle (SQL_HANDLE_DBC, hdbc);
   SQLFreeHandle (SQL_HANDLE_ENV, henv);

   fprintf (stdout,"\n\nHit <Enter> to terminate the program...\n\n");
   in = getchar ();
   return (rc);
}
```

Read or write a smart large object to or from a file

You can use the SQL functions to read or write a smart large object to or from a file.

You can use the SQL functions FILETOBLOB() and FILETOCLOB() to transfer data from a file to a smart large object. The file can be on a client computer or on a server computer.

You can use the SQL function LOTOFILE() to transfer data from a smart large object to a file. The file might be on a client computer or on a server computer. LOTOFILE() accepts a smart-large-object pointer as a parameter. You can use the smart-large-object pointer structure for this parameter.

For more information about these SQL functions, see the *HCL® Informix® Guide to SQL: Syntax*.

Rows and collections

Rows and collections are composite values that consist of one or more elements.

The information in these topics apply only if your database server is HCL Informix®.

You can use the SELECT, UPDATE, INSERT, and DELETE statements to access an entire row or collection. However, these SQL statements do not let you access an element that is in a row or collection. To access an element, you need to retrieve the row or collection and then access the element from the local copy of the row or collection.

For more information about rows and collections, see the *HCL® Informix® Guide to SQL: Reference*, and *HCL® Informix® User-Defined Routines and Data Types Developer's Guide*.

Related reference

Additional SQL data types for Informix on page 60

Data types on page 54

Related information

Client functions on page 151

Allocating and binding a row or collection buffer

When you retrieve a row or collection, the database server puts the row or collection into a buffer that is local to your HCL Informix® ODBC Driver application.

About this task

To allocate and bind a row or collection buffer:

1. Call ifx_rc_create() to allocate the buffer.
2. Call SQLBindCol() to bind the buffer handle to the database column.
3. Execute a SELECT statement to transfer the row or collection data to the local buffer.
4. Use the row or collection buffer.
5. Call ifx_rc_free() to deallocate the buffer.

Fixed-type buffers and unfixed-type buffers

There are several differences between fixed-type buffers and unfixed-type buffers.

The following table describes the differences between fixed-type buffers and unfixed-type buffers.

Buffer	Description
Fixed type	When you call ifx_rc_create() to create a row or collection buffer, you specify the following data types for the buffer: • The buffer data type (a row or one of the collection types) • The data types of the elements that are in the row or collection

Buffer	Description
	When you retrieve the row or collection, the database server compares the source and target data types and converts data from one Informix® SQL data type to another as necessary. You can modify the row or collection buffer before you retrieve data into the buffer.
Unfixed type	When you call ifx_rc_create() to create a row or collection buffer, you specify only the buffer data type (a row or a collection) and not the element types. When you retrieve the row or collection, the database server does not compare data types because you did not specify the target data types. Instead, the row or collection buffer adopts the data types of the source data. You must initialize the row or collection buffer before you modify it. To initialize the buffer, retrieve a row or collection into it. The buffer type remains unfixed even when it contains data.

Buffers and memory allocation

When you retrieve data into a buffer that already contains a row or collection, HCL Informix® ODBC Driver does not reuse the same buffer.

Instead, HCL Informix® ODBC Driver performs the following steps:

1. Creates a row or collection buffer.
2. Associates the new buffer with the given buffer handle.
3. Deallocates the original buffer.

SQL data

The database server calls cast functions to convert the data from the source HCL Informix® SQL data types to the target Informix® SQL data types.

If the data types for a row or collection that are on a database server differ from the data types for a row or collection buffer into which the data is retrieved, the database server calls cast functions to convert the data from the source HCL Informix® SQL data types to the target Informix® SQL data types. The following table lists the provider of the cast functions for each combination of source data type and target data type. Cast functions that a data type provides are located on the database server.

Source data type	Target data type	Provider of cast functions
Built-in	Built-in	Database server
Built-in	Extended	Data type
Extended	Built-in	Data type

Source data type	Target data type	Provider of cast functions
Extended	Extended	Data type

Performing a local fetch

HCL Informix® ODBC Driver performs a local fetch when you retrieve a row or collection from one location on the client computer to another location on the client computer.

About this task

A local fetch has the following limits on SQL data conversion:

- HCL Informix® ODBC Driver cannot convert extended data types for which the cast functions are on a database server.
- HCL Informix® ODBC Driver cannot convert data from one named row type to another. Only the database server can perform this type of conversion.
- HCL Informix® ODBC Driver cannot convert SQL data types when retrieving an entire row or collection. Thus, HCL Informix® ODBC Driver can perform a local fetch of an entire row or collection only if the internal structures for the source and destination are the same or if the destination is an unfixed-type buffer.

  For example, if you define a local collection as **list (char(1) not null)**, the database server can put a **list (int not null)** value from the database server into the local collection. During this operation, the database server converts each integer into a string and constructs a new list to return to the client computer. You cannot perform this operation on the client computer where you retrieve a local list of integers into a list of characters.

To perform a local fetch:

1. Call ifx_rc_create() to allocate a row or collection buffer.
2. Call SQLBindCol() to bind the buffer handle to the local row or collection.
3. Execute a SELECT statement to transfer the row or collection data to the local buffer.
4. For each element in the row or collection, call ifx_rc_fetch() to copy the value to the buffer.
5. Use the row or collection buffer.
6. Call ifx_rc_free() to deallocate the buffer.

Example of retrieving row and collection data from the database

The sample program, `rcselect.c`, retrieves row and collection data from the database and displays it.

This example also illustrates the fact that the same client functions can use row and collection handles interchangeably.

You can find the `rcselect.c` file in the `%INFORMIXDIR%/demo/clidemo` directory on UNIX™ and in the `%INFORMIXDIR%\demo\odbcdemo` directory in Windows™. You can also find instructions on how to build the **odbc_demo** database in the same location.

```
/*
**      rcselect.c
```

```
**
** To access rows and collections
**    OBDC Functions:
**       SQLBindParameter
**       SQLConnect
**       SQLDisconnect
**       SQLExecDirect
**       SQLFetch
**       SQLFreeStmt
*/

#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#ifndef NO_WIN32
#include <io.h>
#include <windows.h>
#include <conio.h>
#endif /*NO_WIN32*/

#include "infxcli.h"

#define BUFFER_LEN     25
#define ERRMSG_LEN     200

UCHAR   defDsn[] = "odbc_demo";

int checkError (SQLRETURN     rc,
               SQLSMALLINT    handleType,
               SQLHANDLE      handle,
               char           *errmsg)
{
   SQLRETURN      retcode = SQL_SUCCESS;

   SQLSMALLINT    errNum = 1;
   SQLCHAR        sqlState[6];
   SQLINTEGER     nativeError;
   SQLCHAR        errMsg[ERRMSG_LEN];
   SQLSMALLINT    textLengthPtr;

   if ((rc != SQL_SUCCESS) && (rc != SQL_SUCCESS_WITH_INFO))
   {
      while (retcode != SQL_NO_DATA)
      {
         retcode = SQLGetDiagRec (handleType, handle, errNum, sqlState,
               &nativeError, errMsg, ERRMSG_LEN, &textLengthPtr);

         if (retcode == SQL_INVALID_HANDLE)
         {
            fprintf (stderr, "checkError function was called with an
                  invalid handle!!\n");
            return 1;
         }

         if ((retcode == SQL_SUCCESS)   ||   (retcode == SQL_SUCCESS_WITH_INFO))
            fprintf (stderr, "ERROR: %d:  %s : %s \n", nativeError,
                  sqlState, errMsg);

         errNum++;
      }

      fprintf (stderr, "%s\n", errmsg);
      return 1;   /* all errors on this handle have been reported */
   }
   else
      return 0;   /* no errors to report */
}

/*
**  Executes the given select statement and assumes the results will be
**  either rows or collections. The 'hrc' parameter may reference either
**  a row or a collection. Rows and collection handles may often be used
**  interchangeably.
**
**  Each row of the select statement will be fetched into the given row or
**  collection handle.  Then each field of the row or collection will be
**  individually converted into a character buffer and displayed.
**
**  This function returns 0 if an error occurs, else returns 1
**
*/

int do_select  (SQLHDBChdbc,
               char*    select_str,
               HINFX_RChrc)
{
   SQLHSTMT    hRCStmt;
   SQLHSTMT    hSelectStmt;
   SQLRETURN   rc = 0;

   short       index, rownum;
   short       position = SQL_INFX_RC_ABSOLUTE;
   short       jump;

   char        fname[BUFFER_LEN];
   char        lname[BUFFER_LEN];
   char        rc_data[BUFFER_LEN];

   SQLINTEGER            cbFname = 0, cbLname = 0, cbHrc = 0;
   SQLINTEGERcbPosition = 0, cbJump = 0, cbRCData = 0;

/* STEP A.  Allocate the statement handles for the select statement and
   **       the statement used to retrieve the row/collection data.
   */

   /* Allocate the statement handle */
   rc = SQLAllocHandle (SQL_HANDLE_STMT, hdbc, &hRCStmt);
   if (checkError (rc, SQL_HANDLE_DBC, hdbc, "Error in Step A -- Statement
         Handle Allocation failed for row/collection
         statement\nExiting!!"))
      return 0;

   /* Allocate the statement handle */
   rc = SQLAllocHandle (SQL_HANDLE_STMT, hdbc, &hSelectStmt);
   if (checkError (rc, SQL_HANDLE_DBC, hdbc, "Error in Step A -- Statement
         Handle Allocation failed for select statement\nExiting!!"))
      return 0;

   fprintf (stdout, "STEP A done...statement handles allocated\n");


/* STEP B.  Execute the select statement.
   **       Bind the result set columns -
   **       --  col1 = fname
   **       col2 = lname
   **       col3 = row/collection data
   */

   /* Execute the select statement */
   rc = SQLExecDirect (hSelectStmt, select_str, SQL_NTS);
   if (checkError (rc, SQL_HANDLE_STMT, hSelectStmt, "Error in Step B --
         SQLExecDirect failed\n"))
      return 0;

   /* Bind the result set columns */
   rc = SQLBindCol (hSelectStmt, 1, SQL_C_CHAR, (SQLPOINTER)fname,
         BUFFER_LEN, &cbFname);
   if (checkError (rc, SQL_HANDLE_STMT, hSelectStmt, "Error in Step B --
         SQLBindCol failed for column 'fname'\n"))
      return 0;

   rc = SQLBindCol (hSelectStmt, 2, SQL_C_CHAR, (SQLPOINTER)lname,
         BUFFER_LEN, &cbLname);
   if (checkError (rc, SQL_HANDLE_STMT, hSelectStmt, "Error in Step B --
         SQLBindCol failed for column 'lname'\n"))
      return 0;

   rc = SQLBindCol (hSelectStmt, 3, SQL_C_BINARY, (SQLPOINTER)hrc,
         sizeof(HINFX_RC), &cbHrc);
   if (checkError (rc, SQL_HANDLE_STMT, hSelectStmt, "Error in Step B --
         SQLBindCol failed for row/collection column\n"))
      return 0;

   fprintf (stdout, "STEP B done...select statement executed and result set
      columns bound\n");


/* STEP C. Retrieve the results.
   */

   for (rownum = 1;; rownum++)
   {
      rc = SQLFetch (hSelectStmt);
      if (rc == SQL_NO_DATA_FOUND)
      {
         fprintf (stdout, "No data found...\n");
         break;
      }
      else if (checkError (rc, SQL_HANDLE_STMT, hSelectStmt, "Error in
            Step C -- SQLFetch failed\n"))
         return 0;


      fprintf(stdout, "Retrieving row number %d:\n\tfname -- %s\n\tlname --
         %s\n\tRow/Collection Data --\n", rownum, fname, lname);

      /*  For each row in the result set, display each field of the
            retrieved row/collection */
      for (index = 1;; index++)
      {
         strcpy(rc_data, "<null>");

         /* Each value in the local row/collection will be fetched into a
          * character buffer and displayed using fprintf().
          */

         rc = SQLBindParameter (hRCStmt, 1, SQL_PARAM_OUTPUT, SQL_C_CHAR,
               SQL_CHAR, 0, 0, rc_data, BUFFER_LEN, &cbRCData);
         if (checkError (rc, SQL_HANDLE_STMT, hRCStmt, "Error in Step C --
               SQLBindParameter failed (param 1)\n"))
            return 0;

         rc = SQLBindParameter (hRCStmt, 2, SQL_PARAM_INPUT, SQL_C_BINARY,
               SQL_INFX_RC_COLLECTION, sizeof(HINFX_RC), 0, hrc,
               sizeof(HINFX_RC), &cbHrc);
         if (checkError (rc, SQL_HANDLE_STMT, hRCStmt, "Error in Step C --
               SQLBindParameter failed (param 2)\n"))
            return 0;

         rc = SQLBindParameter (hRCStmt, 3, SQL_PARAM_INPUT, SQL_C_SHORT,
               SQL_SMALLINT, 0, 0, &position, 0, &cbPosition);
         if (checkError (rc, SQL_HANDLE_STMT, hRCStmt, "Error in Step C --
               SQLBindParameter failed (param 3)\n"))
            return 0;

         jump = index;
         rc = SQLBindParameter (hRCStmt, 4, SQL_PARAM_INPUT, SQL_C_SHORT,
               SQL_SMALLINT, 0, 0, &jump, 0, &cbJump);
         if (checkError (rc, SQL_HANDLE_STMT, hRCStmt, "Error in Step C --
               SQLBindParameter failed (param 4)\n"))
            return 0;

         rc = SQLExecDirect(hRCStmt, "{ ? = call ifx_rc_fetch( ?, ?, ? )     }",
               SQL_NTS);
         if (rc == SQL_NO_DATA_FOUND)
         {
            break;
         }
         else if (checkError (rc, SQL_HANDLE_STMT, hRCStmt, "Error in
               Step C -- SQLExecDirect failed\n"))
            return 0;

         /* Display retrieved row */
         fprintf(stdout, "\t\t%d: %s\n", index, rc_data);
      }
   }
   fprintf (stdout, "STEP C done...results retrieved\n");

   /* Free the statement handles */
   SQLFreeHandle (SQL_HANDLE_STMT, hSelectStmt);
   SQLFreeHandle (SQL_HANDLE_STMT, hRCStmt);

   return 1; /* no error */
}

/*
 * This function allocates the row and collection buffers, passes
 * them to the do_select() function, along with an appropriate select
 * statement and then frees all allocated handles.
 */
int main (long argc,
         char *argv[])
{
   /* Declare variables
   */

   /* Handles */
   SQLHDBC     hdbc;
   SQLHENV     henv;
   SQLHSTMT    hstmt;
   HINFX_RC    hrow, hlist;

   /* Miscellaneous variables */

   UCHAR       dsn[20];/*name of the DSN used for connecting to the
                        database*/
   SQLRETURN   rc = 0;
   int         in;

   int         data_size = SQL_NTS;
   char*       listSelectStmt = "SELECT fname, lname, contact_dates FROM
               customer";
   char*       rowSelectStmt = "SELECT fname, lname, address FROM
               customer";

   SQLINTEGER  cbHlist = 0, cbHrow = 0;


/* STEP 1.  Get data source name from command line (or use default).
   **       Allocate environment handle and set ODBC version.
   **       Allocate connection handle.
   **       Establish the database connection.
   **       Allocate the statement handle.
   */

   /* If(dsn is not explicitly passed in as arg) */
   if (argc != 2)
   {
      /* Use default dsn - odbc_demo */
      fprintf (stdout, "\nUsing default DSN : %s\n", defDsn);
      strcpy ((char *)dsn, (char *)defDsn);
   }
   else
   {
      /* Use specified dsn */
      strcpy ((char *)dsn, (char *)argv[1]);
      fprintf (stdout, "\nUsing specified DSN : %s\n", dsn);
   }

   /* Allocate the Environment handle */
   rc = SQLAllocHandle (SQL_HANDLE_ENV, SQL_NULL_HANDLE, &henv);
   if (rc != SQL_SUCCESS)
   {
      fprintf (stdout, "Environment Handle Allocation failed\nExiting!!");
      return (1);
   }

   /* Set the ODBC version to 3.5 */
   rc = SQLSetEnvAttr (henv, SQL_ATTR_ODBC_VERSION,
         (SQLPOINTER)SQL_OV_ODBC3, 0);
   if (checkError (rc, SQL_HANDLE_ENV, henv, "Error in Step 1 --
         SQLSetEnvAttr failed\nExiting!!"))
      return (1);

   /* Allocate the connection handle */
   rc = SQLAllocHandle (SQL_HANDLE_DBC, henv, &hdbc);
   if (checkError (rc, SQL_HANDLE_ENV, henv, "Error in Step 1 -- Connection
         Handle Allocation failed\nExiting!!"))
      return (1);

   /* Establish the database connection */
   rc = SQLConnect (hdbc, dsn, SQL_NTS, "", SQL_NTS, "", SQL_NTS);
   if (checkError (rc, SQL_HANDLE_DBC, hdbc, "Error in Step 1 -- SQLConnect
         failed\n"))
      return (1);

   /* Allocate the statement handle */
   rc = SQLAllocHandle (SQL_HANDLE_STMT, hdbc, &hstmt);
   if (checkError (rc, SQL_HANDLE_DBC, hdbc, "Error in Step 1 -- Statement
         Handle Allocation failed\nExiting!!"))
      return (1);

   fprintf (stdout, "STEP 1 done...connected to database\n");


/* STEP 2.  Allocate an unfixed collection handle.
   **       Retrieve database rows containing a list.
   **       Reset the statement parameters.
   */

   /* Allocate an unfixed list handle */
   rc = SQLBindParameter (hstmt, 1, SQL_PARAM_OUTPUT, SQL_C_BINARY,
         SQL_INFX_RC_LIST, sizeof(HINFX_RC), 0, &hlist, sizeof(HINFX_RC),
         &cbHlist);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 2 --
         SQLBindParameter (param 1) failed\n"))
      goto Exit;

   rc = SQLBindParameter (hstmt, 2, SQL_PARAM_INPUT, SQL_C_CHAR, SQL_CHAR,
         0, 0, (UCHAR *) "list", 0, &data_size);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 2 --
         SQLBindParameter (param 2) failed\n"))
      goto Exit;

   rc = SQLExecDirect (hstmt, "{? = call ifx_rc_create(?)}", SQL_NTS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 2 --
         SQLExecDirect failed\n"))
      goto Exit;

   /* Retrieve databse rows containing a list */
    if (!do_select (hdbc, listSelectStmt, hlist))
      goto Exit;

   /* Reset the statement parameters */
   rc = SQLFreeStmt (hstmt, SQL_RESET_PARAMS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 2 --
         SQLFreeStmt failed\n"))
      goto Exit;

   fprintf (stdout, "STEP 2 done...list data retrieved\n");
   fprintf (stdout,"\nHit <Enter> to continue...");
   in = getchar ();

/* STEP 3.  Allocate an unfixed row handle.
   **       Retrieve database rows containing a row.
   **       Reset the statement parameters.
   */

   /* Allocate an unfixed row handle */
   rc = SQLBindParameter (hstmt, 1, SQL_PARAM_OUTPUT, SQL_C_BINARY,
         SQL_INFX_RC_ROW, sizeof(HINFX_RC), 0, &hrow, sizeof(HINFX_RC),
         &cbHrow);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 3 --
         SQLBindParameter (param 1) failed\n"))
      goto Exit;

   rc = SQLBindParameter (hstmt, 2, SQL_PARAM_INPUT, SQL_C_CHAR, SQL_CHAR,
         0, 0, (UCHAR *) "row", 0, &data_size);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 3 --
         SQLBindParameter (param 2) failed\n"))
      goto Exit;

   rc = SQLExecDirect (hstmt, "{? = call ifx_rc_create(?)}", SQL_NTS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 3 --
         SQLExecDirect failed\n"))
      goto Exit;

   /* Retrieve databse rows containing a row */
   if (!do_select (hdbc, rowSelectStmt, hrow))
      goto Exit;

   /* Reset the statement parameters */
   rc = SQLFreeStmt (hstmt, SQL_RESET_PARAMS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 3 --
         SQLFreeStmt failed\n"))
      goto Exit;
   fprintf (stdout, "STEP 3 done...row data retrieved\n");


/* STEP 4.  Free the row and list handles.
   */

   /* Free the row handle */
   rc = SQLBindParameter(hstmt, 1, SQL_PARAM_INPUT, SQL_C_BINARY,
         SQL_INFX_RC_ROW, sizeof(HINFX_RC), 0, hrow, sizeof(HINFX_RC),
         &cbHrow);

   rc = SQLExecDirect(hstmt, (UCHAR *)"{call ifx_rc_free(?)}", SQL_NTS);

   /* Free the list handle */
   rc = SQLBindParameter(hstmt, 2, SQL_PARAM_INPUT, SQL_C_BINARY,
         SQL_INFX_RC_LIST, sizeof(HINFX_RC), 0, hlist, sizeof(HINFX_RC),
         &cbHlist);

   rc = SQLExecDirect(hstmt, (UCHAR *)"{call ifx_rc_free(?)}", SQL_NTS);

   fprintf (stdout, "STEP 4 done...row and list handles freed\n");

   Exit:

/* CLEANUP: Close the statement handle.
   **       Free the statement handle.
   **       Disconnect from the datasource.
   **       Free the connection and environment handles.
   **       Exit.
   */

   /* Close the statement handle */
   SQLFreeStmt (hstmt, SQL_CLOSE);

   /* Free the statement handle */
   SQLFreeHandle (SQL_HANDLE_STMT, hstmt);

   /* Disconnect from the data source */
   SQLDisconnect (hdbc);

   /* Free the environment handle and the database connection handle */
   SQLFreeHandle (SQL_HANDLE_DBC, hdbc);
   SQLFreeHandle (SQL_HANDLE_ENV, henv);
   fprintf (stdout,"\n\nHit <Enter> to terminate the program...\n\n");
   in = getchar ();
   return (rc);
```

Example of creating a row and a list on the client

The code example, `rccreate.c`, creates a row and a list on the client, adds items to them, and inserts them into the database.

You can find the `rccreate.c` file in the `%INFORMIXDIR%/demo/clidemo` directory on UNIX™ and in the `%INFORMIXDIR%\demo\odbcdemo` directory in Windows™. You can also find instructions on how to build the **odbc_demo** database in the same location.

```
/*
**    rccreate.c
**
** To create a collection & insert it into the database table
**
**
**    OBDC Functions:
**       SQLBindParameter
**       SQLConnect
**       SQLDisconnect
**       SQLExecDirect
*/

#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#ifndef NO_WIN32
#include <io.h>
#include <windows.h>
#include <conio.h>
#endif /*NO_WIN32*/

#include "infxcli.h"

#define BUFFER_LEN   25
#define ERRMSG_LEN   200

UCHAR    defDsn[] = "odbc_demo";

int checkError (SQLRETURNrc,
               SQLSMALLINT    handleType,
               SQLHANDLE      handle,
               char           *errmsg)
{
   SQLRETURN      retcode = SQL_SUCCESS;

   SQLSMALLINT    errNum = 1;
   SQLCHAR        sqlState[6];
   SQLINTEGER     nativeError;
   SQLCHAR        errMsg[ERRMSG_LEN];
   SQLSMALLINT    textLengthPtr;
   if ((rc != SQL_SUCCESS) && (rc != SQL_SUCCESS_WITH_INFO))
   {
      while (retcode != SQL_NO_DATA)
      {
         retcode = SQLGetDiagRec (handleType, handle, errNum, sqlState,
               &nativeError, errMsg, ERRMSG_LEN, &textLengthPtr);

         if (retcode == SQL_INVALID_HANDLE)
         {
            fprintf (stderr, "checkError function was called with an
                  invalid handle!!\n");
            return 1;
         }

         if ((retcode == SQL_SUCCESS) || (retcode ==
                  SQL_SUCCESS_WITH_INFO)) fprintf (stderr, "ERROR: %d:  %s
                  : %s \n", nativeError, sqlState, errMsg);

         errNum++;
      }

      fprintf (stderr, "%s\n", errmsg);
      return 1;   /* all errors on this handle have been reported */
   }
   else
      return 0;   /* no errors to report */
}

int main (long    argc,
         char     *argv[])
{
   /* Declare variables
   */

   /* Handles */
   SQLHDB      hdbc;
   SQLHENV     henv;
   SQLHSTMT    hstmt;

   HINFX_RC    hrow;
   HINFX_RC    hlist;

   /* Miscellaneous variables */
   UCHAR       dsn[20];/*name of the DSN used for connecting to the
                        database*/
   SQLRETURN   rc = 0;
   int         i, in;
   int         data_size = SQL_NTS;
   short       position = SQL_INFX_RC_ABSOLUTE;
   short       jump;

   UCHAR       row_data[4][BUFFER_LEN] = {"520 Topaz Way", "Redwood City",
                     "CA", "94062"};
   int         row_data_size = SQL_NTS;

   UCHAR        list_data[2][BUFFER_LEN] = {"1991-06-20", "1993-07-17"};
   int         list_data_size = SQL_NTS;

   char*       insertStmt = "INSERT INTO customer VALUES (110, 'Roy',
               'Jaeger', ?, ?)";
   SQLINTEGER  cbHrow = 0, cbHlist = 0, cbPosition = 0, cbJump = 0;
/* STEP 1.  Get data source name from command line (or use default).
   **       Allocate environment handle and set ODBC version.
   **       Allocate connection handle.
   **       Establish the database connection.
   **       Allocate the statement handle.
   */

   /* If(dsn is not explicitly passed in as arg) */
   if (argc != 2)
   {
      /* Use default dsn - odbc_demo */
      fprintf (stdout, "\nUsing default DSN : %s\n", defDsn);
      strcpy ((char *)dsn, (char *)defDsn);
   }
   else
   {
      /* Use specified dsn */
      strcpy ((char *)dsn, (char *)argv[1]);
      fprintf (stdout, "\nUsing specified DSN : %s\n", dsn);
   }
   /* Allocate the Environment handle */
    rc = SQLAllocHandle (SQL_HANDLE_ENV, SQL_NULL_HANDLE, &henv);
    if (rc != SQL_SUCCESS)
   {
      fprintf (stdout, "Environment Handle Allocation failed\nExiting!!");
      return (1);
   }

   /* Set the ODBC version to 3.5 */
   rc = SQLSetEnvAttr (henv, SQL_ATTR_ODBC_VERSION,
         (SQLPOINTER)SQL_OV_ODBC3, 0);
   if (checkError (rc, SQL_HANDLE_ENV, henv, "Error in Step 1 --
         SQLSetEnvAttr failed\nExiting!!"))
      return (1);

   /* Allocate the connection handle */
   rc = SQLAllocHandle (SQL_HANDLE_DBC, henv, &hdbc);
   if (checkError (rc, SQL_HANDLE_ENV, henv, "Error in Step 1 -- Connection
         Handle Allocation failed\nExiting!!"))
      return (1);

   /* Establish the database connection */
   rc = SQLConnect (hdbc, dsn, SQL_NTS, "", SQL_NTS, "", SQL_NTS);
   if (checkError (rc, SQL_HANDLE_DBC, hdbc, "Error in Step 1 -- SQLConnect
         failed\n"))
      return (1);

   /* Allocate the statement handle */
   rc = SQLAllocHandle (SQL_HANDLE_STMT, hdbc, &hstmt );
   if (checkError (rc, SQL_HANDLE_DBC, hdbc, "Error in Step 1 -- Statement
         Handle Allocation failed\nExiting!!"))
      return (1);

   fprintf (stdout, "STEP 1 done...connected to database\n");


/* STEP 2.  Allocate fixed-type row handle -- this creates a non-null row
   **       buffer, each of whose values is null, and can be updated.
   **       Allocate a fixed-type list handle -- this creates a non-null
   **       but empty list buffer into which values can be inserted.
   **       Reset the statement parameters.
   */

   /* Allocate a fixed-type row handle -- this creates a row with each
      value empty */

   rc = SQLBindParameter (hstmt, 1, SQL_PARAM_OUTPUT, SQL_C_BINARY,
         SQL_INFX_RC_ROW, sizeof(HINFX_RC), 0, &hrow, sizeof(HINFX_RC),
         &cbHrow);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 2 --
         SQLBindParameter (param 1) failed for row handle\n"))       goto Exit;

   rc = SQLBindParameter (hstmt, 2, SQL_PARAM_INPUT, SQL_C_CHAR, SQL_CHAR,
         0, 0, (UCHAR *) "ROW(address1 VARCHAR(25), city VARCHAR(15), state
         VARCHAR(15), zip  VARCHAR(5))", 0, &data_size);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 2 --
         SQLBindParameter (param 2) failed for row handle\n"))
      goto Exit;

   rc = SQLExecDirect (hstmt, (UCHAR *) "{? = call ifx_rc_create(?)}",
         SQL_NTS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 2 --
         SQLExecDirect failed for row handle\n"))
      goto Exit;

   /* Allocate a fixed-type list handle */
   rc = SQLBindParameter (hstmt, 1, SQL_PARAM_OUTPUT, SQL_C_BINARY,
         SQL_INFX_RC_LIST, sizeof(HINFX_RC), 0, &hlist, sizeof(HINFX_RC),
         &cbHlist);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 2 --
         SQLBindParameter (param 1) failed for list handle\n"))
      goto Exit;

   data_size = SQL_NTS;
   rc = SQLBindParameter (hstmt, 2, SQL_PARAM_INPUT, SQL_C_CHAR, SQL_CHAR,
         0, 0, (UCHAR *) "LIST (DATETIME YEAR TO DAY NOT NULL)",0,
         &data_size);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 2 --
         SQLBindParameter (param 2) failed for list handle\n"))
      goto Exit;

   rc = SQLExecDirect (hstmt, (UCHAR *) "{? = call ifx_rc_create(?)}",
      SQL_NTS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 2 --
         SQLExecDirect failed for list handle\n"))
      goto Exit;

   /* Reset the statement parameters */
   rc = SQLFreeStmt (hstmt, SQL_RESET_PARAMS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 2 --
         SQLFreeStmt failed\n"))
      goto Exit;

   fprintf (stdout, "STEP 2 done...fixed-type row and collection handles
      allocated\n");

/* STEP 3.  Update the elements of the fixed-type row buffer allocated.
   **       Insert elements into the fixed-type list buffer allocated.
   **       Reset the statement parameters.
   */

   /* Update elements of the row buffer */
   for (i=0; i<4; i++)
   {
      rc = SQLBindParameter (hstmt, 1, SQL_PARAM_INPUT, SQL_C_BINARY,
            SQL_INFX_RC_ROW, sizeof(HINFX_RC), 0, hrow, sizeof(HINFX_RC),
            &cbHrow);
      if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 3 --
            SQLBindParameter (param 1) failed for row handle\n"))
         goto Exit;

      rc = SQLBindParameter (hstmt, 2, SQL_PARAM_INPUT, SQL_C_CHAR,
            SQL_CHAR, BUFFER_LEN, 0, row_data[i], 0, &row_data_size);
      if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 3 --
            SQLBindParameter (param 2) failed for row handle\n"))
         goto Exit;

      rc = SQLBindParameter (hstmt, 3, SQL_PARAM_INPUT, SQL_C_SHORT,
            SQL_SMALLINT, 0, 0, &position, 0, &cbPosition);
      if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 3 --
            SQLBindParameter (param 3) failed for row handle\n"))
         goto Exit;      jump = i + 1;
      rc = SQLBindParameter (hstmt, 4, SQL_PARAM_INPUT, SQL_C_SHORT,
            SQL_SMALLINT, 0, 0, &jump, 0, &cbJump);
      if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 3 --
            SQLBindParameter (param 4) failed for row handle\n"))
         goto Exit;

      rc = SQLExecDirect (hstmt,
            (UCHAR *)"{call ifx_rc_update(?, ?, ?, ?)}", SQL_NTS);
      if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 3 --
            SQLExecDirect failed for row handle\n"))
         goto Exit;
   }

   /* Insert elements into the list buffer */
   for (i=0; i<2; i++)
   {
      rc = SQLBindParameter (hstmt, 1, SQL_PARAM_INPUT, SQL_C_BINARY,
            SQL_INFX_RC_LIST, sizeof(HINFX_RC), 0, hlist, sizeof(HINFX_RC),
            &cbHlist);
      if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 3 --
            SQLBindParameter (param 1) failed for list handle\n"))
         goto Exit;

      rc = SQLBindParameter (hstmt, 2, SQL_PARAM_INPUT, SQL_C_CHAR,
            SQL_DATE, 25, 0, list_data[i], 0, &list_data_size);
      if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 3 --
            SQLBindParameter (param 2) failed for list handle\n"))
         goto Exit;

      rc = SQLBindParameter (hstmt, 3, SQL_PARAM_INPUT, SQL_C_SHORT,
            SQL_SMALLINT, 0, 0, &position, 0, &cbPosition);
      if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 3 --
            SQLBindParameter (param 3) failed for list handle\n"))
         goto Exit;

      jump = i + 1;
      rc = SQLBindParameter (hstmt, 4, SQL_PARAM_INPUT, SQL_C_SHORT,
            SQL_SMALLINT, 0, 0, &jump, 0, &cbJump);
      if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 3 --
            SQLBindParameter (param 4) failed for list handle\n"))
         goto Exit;
      rc = SQLExecDirect (hstmt,
            (UCHAR *)"{call ifx_rc_insert( ?, ?, ?, ? )}", SQL_NTS);
      if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 3 --
            SQLExecDirect failed for list handle\n"))
         goto Exit;
   }

   /* Reset the statement parameters */
   rc = SQLFreeStmt (hstmt, SQL_RESET_PARAMS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 3 --
         SQLFreeStmt failed\n"))
      goto Exit;

   fprintf (stdout, "STEP 3 done...row and list buffers populated\n");


/* STEP 4.  Bind parameters for the row and list handles.
   **       Execute the insert statement to insert the new row into table
   **       'customer'.
   */

   rc = SQLBindParameter (hstmt, 1, SQL_PARAM_INPUT, SQL_C_BINARY,
         SQL_INFX_RC_COLLECTION, sizeof(HINFX_RC), 0, hrow,
         sizeof(HINFX_RC), &cbHrow);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 4 --
         SQLBindParameter failed (param 1)\n"))
      goto Exit;

   rc = SQLBindParameter (hstmt, 2, SQL_PARAM_INPUT, SQL_C_BINARY,
         SQL_INFX_RC_COLLECTION, sizeof(HINFX_RC), 0, hlist,
         sizeof(HINFX_RC), &cbHlist);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 4 --
         SQLBindParameter failed (param 2)\n"))
      goto Exit;

   rc = SQLExecDirect (hstmt, (UCHAR *)insertStmt, SQL_NTS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, "Error in Step 4 --
         SQLExecDirect failed\n"))
      goto Exit;

   fprintf (stdout, "STEP 4 done...new row inserted into table
      'customer'\n");


/* STEP 5.  Free the row and list handles.
   */

   /* Free the row handle */
   rc = SQLBindParameter (hstmt, 1, SQL_PARAM_INPUT, SQL_C_BINARY,
         SQL_INFX_RC_ROW, sizeof(HINFX_RC), 0, hrow, sizeof(HINFX_RC),
         &cbHrow);

   rc = SQLExecDirect(hstmt, (UCHAR *)"{call ifx_rc_free(?)}", SQL_NTS);

   /* Free the list handle */
   rc = SQLBindParameter (hstmt, 2, SQL_PARAM_INPUT, SQL_C_BINARY,
         SQL_INFX_RC_LIST, sizeof(HINFX_RC), 0, hlist, sizeof(HINFX_RC),
         &cbHlist);

   rc = SQLExecDirect(hstmt, (UCHAR *)"{call ifx_rc_free(?)}", SQL_NTS);

   fprintf (stdout, "STEP 5 done...row and list handles freed\n");

   Exit:

/* CLEANUP: Close the statement handle.
   **       Free the statement handle.
   **       Disconnect from the datasource.
   **       Free the connection and environment handles.
   **       Exit.
   */

   /* Close the statement handle */
   SQLFreeStmt (hstmt, SQL_CLOSE);

   /* Free the statement handle */
   SQLFreeHandle (SQL_HANDLE_STMT, hstmt);

   /* Disconnect from the data source */
   SQLDisconnect (hdbc);

   /* Free the environment handle and the database connection handle */
   SQLFreeHandle (SQL_HANDLE_DBC, hdbc);
   SQLFreeHandle (SQL_HANDLE_ENV, henv);

   fprintf (stdout,"\n\nHit <Enter> to terminate the program...\n\n");
   in = getchar ();
   return (rc);
```

Modify a row or collection

HCL Informix® ODBC Driver provides functions that can be used to modify rows and collections.

The following table provides an overview of the functions that HCL Informix® ODBC Driver provides for modifying rows and collections.

Function	Modification	Row	Collection
ifx_rc_delete()	Delete an element	No	Yes
ifx_rc_insert()	Insert an element	No	Yes (See the following table.)
ifx_rc_setnull()	Set the row or collection to null	Yes	Yes
ifx_rc_update()	Update the value of an element	Yes	Yes

The following table describes the collection locations into which you can insert an element. You can insert an element only at the end of a SET or MULTISET collection because elements in these types of collections do not have ordered positions.

	Beginning	Middle	End
List	Yes	Yes	Yes
Multiset	No	No	Yes
Set	No	No	Yes

Tip: If you only need to insert or update a row or collection column with literal values, you do not need to use a row or collection buffer. Instead, you can explicitly list the literal value in either the INTO clause of the INSERT statement or the SET clause of the UPDATE statement.

Each row and collection maintains a seek position that points to the current element in the row or collection. When the row or collection is created, the seek position points to the first element that is in the row or collection. All calls to client functions share the same seek position for a row or collection buffer. Therefore, one client function can affect the seek position for another client function that uses the same buffer handle. The following table describes how client functions use and modify the seek position.

Client function	Acts on	Changes
ifx_rc_delete()	At the specified position	Sets the seek position to the position after the one that was deleted
ifx_rc_fetch()	At the specified position	Sets the seek position to the specified position
ifx_rc_insert()	Before the specified position	Sets the seek position to the specified position
ifx_rc_update()	At the specified position	Sets the seek position to the specified position

Retrieve information about a row or collection

HCL Informix® ODBC Driver provides functions that can be used to retrieve information about rows and collections.

The following table provides an overview of the functions that HCL Informix® ODBC Driver provides for retrieving information about rows and collections. The ifx_rc_describe() function returns the data types of elements in a row or collection.

Function	Information	Reference
ifx_rc_count()	Number of columns	The ifx_rc_count() function on page 174
ifx_rc_describe()	Data type information	The ifx_rc_describe() function on page 175
ifx_rc_isnull()	Value that indicates whether it is null	The ifx_rc_isnull() function on page 179
ifx_rc_typespec()	Type specification	The ifx_rc_typespec() function on page 180

Related information

Client functions on page 151

Client functions

These topics describe the HCL Informix® ODBC Driver client functions. Use these functions to access and manipulate smart large objects and rows and collections.

The information in these topics apply only if your database server is HCL Informix®.

Related reference

Retrieve information about a row or collection on page 150

Related information

Smart large objects on page 92

Rows and collections on page 132

Call a client function

This section describes the syntax of client functions, their input/output arguments, return values, and SQL_BIGINT.

Function syntax

The database server and the application both partially implement each client function.

You can execute a client function with either SQLPrepare() and SQLExecute() or with SQLExecDirect(). You need to call SQLBindParameter() or SQLBindCol() to bind each parameter before you call SQLExecute() or SQLExecDirect().

Executing a client function with SQLPrepare() and SQLExecute()

You can execute a client function with the SQLPrepare() and SQLExecute() functions.

About this task

To execute a client function with SQLPrepare() and SQLExecute():

1. Prepare the SQL statement for the client function.
2. Bind the parameters.
3. Execute the SQL statement.

Results

The following code example illustrates these steps for ifx_lo_open():

```
rc = SQLPrepare(hstmt, "{? = call ifx_lo_open(?, ?, ?)}", SQL_NTS);
rc = SQLBindParameter(...);
rc = SQLExecute(hstmt);
```

Executing a client function with SQLExecDirect()

You can execute a client function with the SQLExecDirect() function.

About this task

To execute a client function with SQLExecDirect():

1. Bind the parameters.
2. Execute the SQL statement.

Results

The following code example illustrates these steps for ifx_lo_open():

```
rc = SQLBindParameter(...);
rc = SQLExecDirect(hstmt, "{? = call ifx_lo_open(?, ?, ?)}", SQL_NTS);
```

Input and output parameters

Most of the input and output parameters for client functions are output parameters from the perspective of the client application.

However, a client function that accepts an input/output parameter initializes the parameter internally and sends it to the database server with the request to execute the client function. Therefore, you need to pass these parameters as input/output parameters to the driver.

The SQL_BIGINT data type

HCL Informix® supports the INT8 Informix® SQL data type.

By default, the driver maps INT8 to the SQL_BIGINT HCL Informix® ODBC Driver SQL data type and to the **SQL_C_CHAR** default HCL Informix® ODBC Driver C data type. However, client functions cannot access all the data type conversion functions. Therefore, you must use a data type other than **SQL_C_CHAR** when you use a value of type SQL_BIGINT.

For example, before you call ifx_lo_specset_estbytes(), you need to bind a variable for the *estbytes* input argument. Because *estbytes* is an SQL_BIGINT, you would normally bind *estbytes* to an **SQL_C_CHAR**. However, **SQL_C_CHAR** does not work for SQL_BIGINT for a client function. The following code example illustrates how to bind *estbytes* to an **SQL_C_LONG** instead of an **SQL_C_CHAR** for ifx_lo_specset_estbytes():

```
rc = SQLBindParameter(hstmt, 2, SQL_PARAM_INPUT, SQL_C_LONG,
   SQL_BIGINT, (UDWORD)0, 0, &estbytes, sizeof(estbytes), NULL);
rc = SQLExecDirect(hstmt, "{call ifx_lo_specset_estbytes(?, ?)}", SQL_NTS);
```

Related reference

The ifx_lo_readwithseek() function on page 159

The ifx_lo_seek() function on page 160

The ifx_lo_specget_estbytes() function on page 161

The ifx_lo_specget_maxbytes() function on page 163

The ifx_lo_specset_estbytes() function on page 164

The ifx_lo_specset_maxbytes() function on page 166

The ifx_lo_stat_size() function on page 170

The ifx_lo_tell() function on page 171

The ifx_lo_truncate() function on page 171

The ifx_lo_writewithseek() function on page 173

Return codes

The client functions do not provide return codes.

For success or failure information, see the return codes for the HCL Informix® ODBC Driver function with which you call the client function (SQLExecDirect() or SQLExecute()).

Functions for smart large objects

This section describes each client function that the driver provides for smart large objects.

The functions are listed alphabetically. For more information, see Smart large objects on page 92.

The ifx_lo_alter() function

The ifx_lo_alter() function alters the storage characteristics of a smart large object.

Syntax

```
ifx_lo_alter(loptr, lospec)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
loptr	SQL_INFX_UDT_FIXED	Input	Smart-large-object pointer structure
lospec	SQL_INFX_UDT_FIXED	Input	Smart-large-object specification structure

Usage

The ifx_lo_alter() function performs the following steps to update the storage characteristics of a smart large object:

1. Gets an exclusive lock for the smart large object.
2. Uses the characteristics that are in the *lospec* smart-large-object specification structure to update the storage characteristics of the smart large object. The ifx_lo_alter() function lets you change the following storage characteristics:
    - Logging characteristics
    - Last-access time characteristics
    - Extent size
3. Unlocks the smart large object.

As an alternative to calling this function, you can call one of the following functions if you want to change only one of these characteristics:

- ifx_lo_specset_flags()
- ifx_lo_specset_extsz()

The ifx_lo_close() function

The ifx_lo_close() function closes a smart large object.

Syntax

```
ifx_lo_close(lofd)
```

Arguments

The function accepts the following argument.

Argument	Type	Use	Description
lofd	SQL_INTEGER	Input	Smart-large-object file descriptor

Usage

The ifx_lo_close() function closes a smart large object. During this function, the database server tries to unlock the smart large object. If the isolation mode is repeatable read or if the lock is an exclusive lock, the database server does not release the lock until the end of the transaction.

Tip: If you do not update a smart large object inside a BEGIN WORK transaction block, each update is a separate transaction.

The ifx_lo_col_info() function

The ifx_lo_col_info() function updates a smart-large-object specification structure with column-level storage characteristics.

Syntax

```
ifx_lo_col_info(colname, lospec)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description

colname	SQL_CHAR	Input	Pointer to a buffer that contains the name of a database column
			
			This value must be in the following format:
			`database@server_name:table.column`
			
			If the column is in a database that is ANSI-compliant, you can include the owner name. In this case, use the following format:
			`database@server_name:owner.table.column`

lospec	SQL_INFX_UDT_FIXED	I/O	Smart-large-object specification structure

Usage

The ifx_lo_col_info() function sets the fields for a smart-large-object specification structure to the storage characteristics for the *colname* database column. If the specified column does not have column-level storage characteristics defined, the database server uses the storage characteristics that are inherited.

Important: You must call ifx_lo_def_create_spec() before you call this function.

The ifx_lo_create() function

The ifx_lo_create() function creates and opens a new smart large object.

Syntax

```
ifx_lo_create(lospec, flags, loptr, lofd)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
lospec	SQL_INFX_UDT_FIXED	Input	Smart-large-object specification structure that contains storage characteristics for the new smart large object
flags	SQL_INTEGER	Input	Mode in which to open the new smart large object.

Argument	Type	Use	Description
loptr	SQL_INFX_UDT_FIXED	I/O	Smart-large-object pointer structure
lofd	SQL_INTEGER	Output	Smart-large-object file descriptor. This file descriptor is only valid within the current database connection.

Usage

The ifx_lo_create() function performs the following steps to create and open a new smart large object:

1. Creates a smart-large-object pointer structure.
2. Assigns a pointer to this structure and returns this pointer in *loptr*.
3. Assigns storage characteristics for the smart large object from the smart-large-object specification structure that lospec indicates.

   If *lospec* is null, ifx_lo_create() uses the system-specified storage characteristics. If the smart-large-object specification structure exists but does not contain storage characteristics, ifx_lo_create() uses the storage characteristics from the inheritance hierarchy.
4. Opens the smart large object in the access mode that *flags* specifies.
5. Associates the smart large object with the current connection.

   When you close this connection, the database server deallocates any associated smart large objects that have a reference count of zero. The reference count indicates the number of database columns that refer to the smart large object.
6. Returns a file descriptor that identifies the smart large object.

The database server uses the default parameters that the call to ifx_lo_create() establishes to determine whether to lock or log subsequent operations on the smart large object.

Related information

Access modes on page 110

The ifx_lo_def_create_spec() function

The ifx_lo_def_create_spec() function creates a smart-large-object specification structure.

Syntax

```
ifx_lo_def_create_spec(lospec)
```

Arguments

The function accepts the following argument.

Argument	Type	Use	Description
lospec	SQL_INFX_UDT_FIXED	I/O	Smart-large-object specification structure

Usage

The ifx_lo_def_create_spec() function creates a smart-large-object specification structure and initializes the fields to null values. If you do not change these values, the null values tell the database server to use the system-specified defaults for the storage characteristics of the smart large object.

The ifx_lo_open() function

The ifx_lo_open() function opens a smart large object.

Syntax

```
ifx_lo_open(lofd, loptr, flags)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
lofd	SQL_INTEGER	Output	Smart-large-object file descriptor. This file descriptor is only valid within the current database connection.
loptr	SQL_INFX_UDT_FIXED	Input	Smart-large-object pointer structure
flags	SQL_INTEGER	Input	Mode in which to open the smart large object.

Usage

The ifx_lo_open() function performs the following steps to open a smart large object:

1. Opens the *loptr* smart large object in the access mode that *flags* specifies.
2. Sets the seek position to byte zero.
3. Locks the smart large object.

Important: The database server does not check access permissions on the smart large object. Your application must make sure that the user or application is trusted.

As the following table describes, the access mode determines the type of lock.

Access mode	Type of lock
Dirty read	No lock
Read only	Shared lock

Access mode	Type of lock
Write only, write/append, or read/write	Update lock. When you call ifx_lo_write() or ifx_lo_writewithseek() for the smart large object, the database server promotes the lock to an exclusive lock.

The database server loses this lock when the current transaction terminates. The database server obtains the lock again the next time you call a function that needs a lock.

As an alternative, you can use a BEGIN WORK transaction block and place a COMMIT WORK or ROLLBACK WORK statement after the last statement that needs to use the lock.

1. Associates the smart large object with the current connection.

   When you close this connection, the database server deallocates any associated smart large objects that have a reference count of zero. The reference count indicates the number of database columns that refer to the smart large object.
2. Returns a file descriptor that identifies the smart large object.

The database server uses the default parameters that the call to ifx_lo_open() establishes to determine whether to lock or log subsequent operations on the smart large object.

Related information

Access modes on page 110

The ifx_lo_read() function

The ifx_lo_read() function reads data from an open smart large object.

Syntax

```
ifx_lo_read(lofd, buf)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
lofd	SQL_INTEGER	Input	Smart-large-object file descriptor
buf	SQL_CHAR	Output	Pointer to a character buffer into which the function will read the data

Usage

The ifx_lo_read() function reads data from an open smart large object. The read begins at the current seek position for *lofd*. You can call ifx_lo_tell() to obtain the current seek position.

The ifx_lo_read() function reads *cbValueMax* bytes of data. *cbValueMax* is an input argument for SQLBindParameter() and SQLBindCol(). The size of *buf* or *cbValueMax* cannot exceed 2 gigabytes. To read a smart large object that is larger than 2 gigabytes, read it in 2-gigabyte chunks. The ifx_lo_read() function reads this data into the user-defined buffer to which *buf* points.

If SQLBindParameter() or SQLBindCol() returns SQL_SUCCESS, then *pcbValue*, which is an argument for each of these functions, contains the number of bytes that the function read from the smart large object. If SQLBindParameter() or SQLBindCol() returns SQL_SUCCESS_WITH_INFO, then *pcbValue* contains the number of bytes that are available to read from the smart large object.

The ifx_lo_readwithseek() function

The ifx_lo_readwithseek() function performs a seek operation and then reads data from an open smart large object.

Syntax

```
ifx_lo_readwithseek(lofd, buf, offset, whence)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
lofd	SQL_INTEGER	Input	Smart-large-object file descriptor
buf	SQL_CHAR	Output	Pointer to a character buffer into which the function will read the data
offset	SQL_BIGINT	Input	Offset from the starting seek position, in bytes. Instead of using the default HCL Informix® ODBC Driver C data type of **SQL_C_CHAR** for *offset*, use **SQL_C_LONG** or **SQL_C_SHORT**.
whence	SQL_INTEGER	Input	Starting seek position. The possible values are: **LO_SEEK_CUR** The current seek position in the smart large object **LO_SEEK_END** The end of the smart large object **LO_SEEK_SET** The start of the smart large object

Usage

The ifx_lo_readwithseek() function performs a seek operation and then reads data from an open smart large object. The read begins at the seek position of *lofd* that the *offset* and *whence* arguments indicate.

The ifx_lo_readwithseek() function reads *cbValueMax* bytes of data. *cbValueMax* is an input argument for SQLBindParameter() and SQLBindCol(). The size of *buf* or *cbValueMax* cannot exceed 2 GB. To read a smart large object that is larger than 2 gigabytes, read it in 2-GB chunks. The ifx_lo_readwithseek() function reads this data into the user-defined buffer to which *buf* points.

If SQLBindParameter() or SQLBindCol() returns SQL_SUCCESS, then *pcbValue*, which is an argument for each of these functions, contains the number of bytes that the function read from the smart large object. If SQLBindParameter() or SQLBindCol() returns SQL_SUCCESS_WITH_INFO, then *pcbValue* contains the number of bytes that are available to read from the smart large object.

Related information

The SQL_BIGINT data type on page 152

The ifx_lo_seek() function

The ifx_lo_seek() function sets the file position for the next read or write operation on an open smart large object.

Syntax

```
ifx_lo_seek(lofd, offset, whence, seek_pos)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
lofd	SQL_INTEGER	Input	Smart-large-object file descriptor
offset	SQL_BIGINT	Input	Offset from the starting seek position, in bytes. Instead of using the default HCL Informix® ODBC Driver C data type of **SQL_C_CHAR** for *offset*, use **SQL_C_LONG** or **SQL_C_SHORT**.
whence	SQL_INTEGER	Input	Starting seek position. The possible values are: **LO_SEEK_CUR** The current seek position in the smart large object **LO_SEEK_END** The end of the smart large object **LO_SEEK_SET** The start of the smart large object
seek_pos	SQL_BIGINT	I/O	New seek position. Instead of using the default HCL Informix® ODBC Driver C data type of **SQL_C_CHAR** for *seek_pos*, use

Argument	Type	Use	Description
			SQL_C_LONG. For more information, see The SQL_BIGINT data type on page 152.

Usage

The ifx_lo_seek() function sets the seek position of *lofd* to the position that the *offset* and *whence* arguments indicate.

Related information

The SQL_BIGINT data type on page 152

The ifx_lo_specget_estbytes() function

The ifx_lo_specget_estbytes() function gets the estimated number of bytes from a smart-large-object specification structure.

Syntax

```
ifx_lo_specget_estbytes(lospec, estbytes)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
lospec	SQL_INFX_UDT_FIXED	Input	Smart-large-object specification structure
estbytes	SQL_BIGINT	Output	Estimated final size of the smart large object, in bytes. This estimate is an optimization hint for the smart-large-object optimizer. Instead of using the default HCL Informix® ODBC Driver C data type of **SQL_C_CHAR** for *estbytes*, use **SQL_C_LONG**.

Usage

The ifx_lo_specget_estbytes() function gets the estimated number of bytes from a smart-large-object specification structure.

Related information

The SQL_BIGINT data type on page 152

The ifx_lo_specget_extsz() function

The ifx_lo_specget_extsz() function gets the allocation extent from a smart-large-object specification structure.

Syntax

```
ifx_lo_specget_extsz(lospec, extsz)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
lospec	SQL_INFX_UDT_FIXED	Input	Smart-large-object specification structure
extsz	SQL_INTEGER	Output	Extent size of the smart large object, in bytes. This value is the size of the allocation extents to be allocated for the smart large object when the database server writes beyond the end of the current extent. This value overrides the estimate that the database server generates for how large an extent should be.

Usage

The ifx_lo_specget_extsz() function gets the allocation extent from a smart-large-object specification structure.

The ifx_lo_specget_flags() function

The ifx_lo_specget_flags() function gets the create-time flags from a smart-large-object specification structure.

Syntax

```
ifx_lo_specget_flags(lospec, flags)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
lospec	SQL_INFX_UDT_FIXED	Input	Smart-large-object specification structure
flags	SQL_INTEGER	Output	Create-time flags. For more information, see Access modes on page 110.

Usage

The ifx_lo_specget_flags() function gets the create-time flags from a smart-large-object specification structure.

The ifx_lo_specget_maxbytes() function

The ifx_lo_specget_maxbytes() function gets the maximum number of bytes from a smart-large-object specification structure.

Syntax

```
ifx_lo_specget_maxbytes(lospec, maxbytes)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
lospec	SQL_INFX_UDT_FIXED	Input	Smart-large-object specification structure
maxbytes	SQL_BIGINT	Input	Maximum size, in bytes, of the smart large object. Instead of using the default HCL Informix® ODBC Driver C data type of **SQL_C_CHAR** for *maxbytes*, use **SQL_C_LONG**.

Usage

The ifx_lo_specget_maxbytes() function gets the maximum number of bytes from a smart-large-object specification structure.

Related information

The SQL_BIGINT data type on page 152

The ifx_lo_specget_sbspace() function

The ifx_lo_specget_sbspace() function gets the sbspace name from a smart-large-object specification structure.

Syntax

```
ifx_lo_specget_sbspace(lospec, sbspace)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
lospec	SQL_INFX_UDT_FIXED	Input	Smart-large-object specification structure
sbspace	SQL_CHAR	Output	Name of the sbspace for the smart large object. An sbspace name can be up to 18 characters long and must be null terminated.

Usage

The ifx_lo_specget_sbspace() function returns the name of the sbspace in which to store the smart large object. The function copies up to (*pcbValue*-1) bytes into the *sbspace* buffer and makes sure that it is null terminated. *pcbValue* is an argument for SQLBindParameter() and SQLBindCol().

The ifx_lo_specset_estbytes() function

The ifx_lo_specset_estbytes() function sets the estimated number of bytes in a smart-large-object specification structure.

Syntax

```
ifx_lo_specset_estbytes(lospec, estbytes)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
lospec	SQL_INFX_UDT_FIXED	Input	Smart-large-object specification structure
estbytes	SQL_BIGINT	Input	Estimated final size of the smart large object, in bytes. This estimate is an optimization hint for the smart large object optimizer. This value cannot exceed 2 gigabytes. If you do not specify an *estbytes* value when you create a new smart large object, the database server gets the value from the inheritance hierarchy of storage characteristics. Do not change this system value unless you know the estimated size for the smart large object. If you do set the estimated size for a smart large object, do not specify a value much higher than the final size of the smart large object. Otherwise, the database server might allocate unused storage. Instead of using the default HCL Informix® ODBC Driver C data type of **SQL_C_CHAR** for *estbytes*, use **SQL_C_LONG** or **SQL_C_SHORT**.

Usage

The ifx_lo_specset_estbytes() function sets the estimated number of bytes in a smart-large-object specification structure.

Related information

The SQL_BIGINT data type on page 152

The ifx_lo_specset_extsz() function

The ifx_lo_specset_extsz() function sets the allocation extent size in a smart-large-object specification structure.

Syntax

```
ifx_lo_specset_extsz(lospec, extsz)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
lospec	SQL_INFX_UDT_FIXED	Input	Smart-large-object specification structure
extsz	SQL_INTEGER	Input	Extent size of the smart large object, in bytes. This value specifies the size of the allocation extents to be allocated for the smart large object when the database server writes beyond the end of the current extent. This value overrides the estimate that the database server generates for how large an extent should be. If you do not specify an *extsz* value when you create a new smart large object, the database server attempts to optimize the extent size based on past operations on the smart large object and other storage characteristics (such as maximum bytes) that it obtains from the inheritance hierarchy of storage characteristics. Do not change this system value unless you know the allocation extent size for the smart large object. Only applications that encounter severe storage fragmentation should ever set the allocation extent size. For such applications, make sure that you know exactly the number of bytes by which to extend the smart large object.

Usage

The ifx_lo_specset_extsz() function sets the allocation extent size in a smart-large-object specification structure.

The ifx_lo_specset_flags() function

The ifx_lo_specset_flags() function sets the create-time flags in a smart-large-object specification structure.

Syntax

```
ifx_lo_specset_flags(lospec, flags)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
lospec	SQL_INFX_UDT_FIXED	Input	Smart-large-object specification structure
flags	SQL_INTEGER	Input	Create-time flags.

Usage

The ifx_lo_specset_flags() function sets the create-time flags in a smart-large-object specification structure.

Related information

Create-time flags on page 95

The ifx_lo_specset_maxbytes() function

The ifx_lo_specset_maxbytes() function sets the maximum number of bytes in a smart-large-object specification structure.

Syntax

```
ifx_lo_specset_maxbytes(lospec, maxbytes)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
lospec	SQL_INFX_UDT_FIXED	Input	Smart-large-object specification structure
maxbytes	SQL_BIGINT	Input	Maximum size of the smart large object, in bytes. This value cannot exceed 2 gigabytes. Instead of using the default HCL Informix® ODBC Driver C data type of **SQL_C_CHAR** for *maxbytes*, use **SQL_C_LONG** or **SQL_C_SHORT**.

Usage

The ifx_lo_specset_maxbytes() function sets the maximum number of bytes in a smart-large-object specification structure.

Related information

The SQL_BIGINT data type on page 152

The ifx_lo_specset_sbspace() function

The ifx_lo_specset_sbspace() function sets the sbspace name in a smart-large-object specification structure.

Syntax

```
ifx_lo_specset_sbspace(lospec, sbspace)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
lospec	SQL_INFX_UDT_FIXED	Input	Smart-large-object specification structure
sbspace	SQL_CHAR	Input	Name of the sbspace for the smart large object. An sbspace name can be up to 18 characters long and must be null terminated. If you do not specify an *sbspace* when you create a new smart large object, the database server obtains the sbspace name from either the column information or from the SBSPACENAME parameter of the `onconfig` file.

Usage

The ifx_lo_specset_sbspace() function uses *pcbValue* to determine the length of the sbspace name. *pcbValue* is an argument for SQLBindParameter() and SQLBindCol().

The ifx_lo_stat() function

The ifx_lo_stat() function initializes a smart-large-object status structure.

Syntax

```
ifx_lo_stat(lofd, lostat)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
lofd	SQL_INTEGER	Input	Smart-large-object file descriptor
lostat	SQL_INFX_UDT_FIXED	I/O	Smart-large-object status structure

Usage

Before you call ifx_lo_stat(), call SQLGetInfo() to get the size of the smart-large-object status structure. Use this size to allocate memory for the structure.

The ifx_lo_stat() function allocates a smart-large-object status structure and initializes it with the status information for the smart large object.

The ifx_lo_stat_atime() function

The ifx_lo_stat_atime() function retrieves the last access time for a smart large object.

Syntax

```
ifx_lo_stat_atime(lostat, atime)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
lostat	SQL_INFX_UDT_FIXED	Input	Smart-large-object status structure
atime	SQL_INTEGER	Output	Time of the last access for a smart large object, in seconds. The database server maintains the time of last access only if the LO_KEEP_LASTACCESS _TIME flag is set for the smart large object.

Usage

The ifx_lo_stat_atime() function retrieves the last access time for a smart large object.

The ifx_lo_stat_cspec() function

The ifx_lo_stat_cspec() function retrieves a smart-large-object specification structure.

Syntax

```
ifx_lo_stat_cspec(lostat, lospec)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
lostat	SQL_INFX_UDT_FIXED	Input	Smart-large-object status structure
lospec	SQL_INFX_UDT_FIXED	Output	Smart-large-object specification structure

Usage

The ifx_lo_stat_cspec() function retrieves a smart-large-object specification structure and returns a pointer to the structure.

The ifx_lo_stat_ctime() function

The ifx_lo_stat_ctime() function retrieves the time of the last change of a smart large object.

Syntax

```
ifx_lo_stat_ctime(lostat, ctime)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
lostat	SQL_INFX_UDT_FIXED	Input	Smart-large-object status structure
ctime	SQL_INTEGER	Out	Time of the last change of the smart large object, in seconds. The time of the last status change includes modification of storage characteristics, including a change in the number of references and writes to the smart large object.

Usage

The ifx_lo_stat_ctime() function retrieves the time of the last change of a smart large object.

The ifx_lo_stat_refcnt() function

The ifx_lo_stat_refcnt() function retrieves the number of references to a smart large object.

Syntax

```
ifx_lo_stat_refcnt(lostat, refcount)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
lostat	SQL_INFX_UDT_FIXED	Input	Smart-large-object status structure

Argument	Type	Use	Description
refcount	SQL_INTEGER	Output	Number of references to a smart large object. This value is the number of database columns that refer to the smart large object.

Usage

The ifx_lo_stat_refcnt() function retrieves the number of references to a smart large object.

A database server can remove a smart large object and reuse any resources that are allocated to it when the reference count for the smart large object is zero and one of the following events occurs:

- The transaction in which the reference count is decremented to zero commits.
- The connection during which the smart large object was created terminates, but the reference count is not incremented.

  The database server increments a reference counter when it stores the smart-large-object pointer structure for a smart large object in a row.

The ifx_lo_stat_size() function

The ifx_lo_stat_size() function retrieves the size of a smart large object.

Syntax

```
ifx_lo_stat_size(lostat, size)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
lostat	SQL_INFX_UDT_FIXED	Input	Smart-large-object status structure
size	SQL_BIGINT	Output	Size of a smart large object, in bytes. This value cannot exceed 2 gigabytes. Instead of using the default HCL Informix® ODBC Driver C data type of **SQL_C_CHAR** for *size*, use **SQL_C_LONG**.

Usage

The ifx_lo_stat_size() function retrieves the size of a smart large object.

Related information

The SQL_BIGINT data type on page 152

The ifx_lo_tell() function

The ifx_lo_tell() function retrieves the current file or seek position for an open smart large object.

Syntax

```
ifx_lo_tell(lofd, seek_pos)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
lofd	SQL_INTEGER	Input	Smart-large-object file descriptor
seek_pos	SQL_BIGINT	I/O	New seek position, which is the offset for the next read or write operation on the smart large object. Instead of using the default HCL Informix® ODBC Driver C data type of **SQL_C_CHAR** for *seek_pos*, use **SQL_C_LONG**.

Usage

The ifx_lo_tell() function retrieves the current file or seek position for an open smart large object.

This function works correctly for smart large objects up to 2 gigabytes in size.

Related information

The SQL_BIGINT data type on page 152

The ifx_lo_truncate() function

The ifx_lo_truncate() function truncates a smart large object at the specified position.

Syntax

```
ifx_lo_truncate(lofd, offset)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
lofd	SQL_INTEGER	Input	Smart-large-object file descriptor
offset	SQL_BIGINT	Input	End of the smart large object. If this value exceeds the end of the smart large object, the function extends the smart large object. If this value is less than the end of the smart large object, the

Argument	Type	Use	Description
			database server reclaims all storage from the offset position to the end of the smart large object. Instead of using the default HCL Informix® ODBC Driver C data type of **SQL_C_CHAR** for *offset*, use **SQL_C_LONG** or **SQL_C_SHORT**.

Usage

The ifx_lo_truncate() function sets the end of a smart large object to the location that the *offset* argument specifies.

Related information

The SQL_BIGINT data type on page 152

The ifx_lo_write() function

The ifx_lo_write() function writes data to an open smart large object.

Syntax

```
ifx_lo_write(lofd, buf)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
lofd	SQL_INTEGER	Input	Smart-large-object file descriptor
buf	SQL_CHAR	Input	Buffer that contains the data that the function writes to the smart large object. The size of the buffer cannot exceed 2 gigabytes.

Usage

The ifx_lo_write() function writes data to an open smart large object. The write begins at the current seek position for *lofd*. You can call ifx_lo_tell() to obtain the current seek position.

The ifx_lo_write() function writes *cbValueMax* bytes of data. *cbValueMax* is an input argument for SQLBindParameter() and SQLBindCol(). The size of *buf* or *cbValueMax* cannot exceed 2 GB. To write to a smart large object that is larger than 2 gigabytes, write to it in 2-GB chunks. The ifx_lo_write() function gets the data from the user-defined buffer to which *buf* points.

If SQLExecDirect() or SQLExecute() returns SQL_SUCCESS_WITH_INFO, then the database server wrote less than *cbValueMax* bytes of data to the smart large object and *pcbValue*, which is an argument for each of these functions, contains the number of bytes that the function wrote. This condition can occur when the sbspace runs out of space.

The ifx_lo_writewithseek() function

The ifx_lo_writewithseek() function performs a seek operation and then writes data to an open smart large object.

Syntax

```
ifx_lo_writewithseek(lofd, buf, offset, whence)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
lofd	SQL_INTEGER	Input	Smart-large-object file descriptor.
buf	SQL_CHAR	Input	Buffer that contains the data that the function writes to the smart large object. The size of the buffer must not exceed 2 gigabytes.
offset	SQL_BIGINT	Input	Offset from the starting seek position, in bytes. Instead of using the default HCL Informix® ODBC Driver C data type of **SQL_C_CHAR** for *offset*, use **SQL_C_LONG** or **SQL_C_SHORT**.
whence	SQL_INTEGER	Input	Starting seek position. The possible values are: **LO_SEEK_CUR** The current seek position in the smart large object **LO_SEEK_END** The end of the smart large object **LO_SEEK_SET** The start of the smart large object

Usage

The ifx_lo_writewithseek() function performs a seek operation and then writes data to an open smart large object. The write begins at the seek position of *lofd* that the *offset* and *whence* arguments indicate.

The ifx_lo_writewithseek() function writes *cbValueMax* bytes of data. *cbValueMax* is an input argument for SQLBindParameter() and SQLBindCol(). The size of *buf* or *cbValueMax* cannot exceed 2 GB. To write to a smart large object that is larger than 2 gigabytes, write to it in 2-GB chunks. The ifx_lo_writewithseek() function gets the data from the user-defined buffer to which *buf* points.

If SQLExecDirect() or SQLExecute() returns SQL_SUCCESS_WITH_INFO, then the database server wrote less than *cbValueMax* bytes of data to the smart large object and *pcbValue*, which is an argument for each of these functions, contains the number of bytes that the function wrote. This condition can occur when the sbspace runs out of space.

Related information

The SQL_BIGINT data type on page 152

Functions for rows and collections

This section describes each client function that HCL Informix® ODBC Driver provides for rows and collections.

The functions are listed alphabetically. For more information about rows and collections, see Rows and collections on page 132.

The ifx_rc_count() function

The ifx_rc_count() function returns the number of elements or fields that are in a row or collection.

Syntax

```
ifx_rc_count(rowcount, rchandle)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
rowcount	SQL_SMALLINT	Output	Number of elements or fields that are in the row or collection
rchandle	HINFX_RC	Input	Handle for a row or collection buffer

Usage

The ifx_rc_count() function returns the number of elements or fields that are in the row or collection.

The ifx_rc_delete() function

The ifx_rc_delete() function deletes an element from a collection.

Syntax

```
ifx_rc_delete(rchandle, action, jump)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
rchandle	HINFX_RC	Input	Handle for a collection buffer
action	SQL_SMALLINT	Input	Location of the element relative to the seek position. The possible values are

Argument	Type	Use	Description
			• SQL_INFX_RC_ABSOLUTE: Element number *jump* where the first element in the buffer is element number one • SQL_INFX_RC_CURRENT: Current® element • SQL_INFX_RC_FIRST: First element • SQL_INFX_RC_LAST: Last element • SQL_INFX_RC_NEXT: Next element • SQL_INFX_RC_PRIOR: Previous element • SQL_INFX_RC_RELATIVE: Element that is *jump* elements past the current element
jump	SQL_SMALLINT	Input	Offset when *action* is SQL_INFX_RC_ABSOLUTE or SQL_INFX_RC_RELATIVE

Usage

The ifx_rc_delete() function deletes an element from a collection from the location that is specified by *action* and *jump*. The function sets the seek position to the position of the value that was deleted. It is not possible to delete an element from a row.

The ifx_rc_describe() function

The ifx_rc_describe() function returns descriptive information about the data type for a row or collection or for an element that is in a row or collection.

Syntax

```
ifx_rc_describe(rchandle, fieldnum, fieldname, typecode,
 columnsize, decdigits, nullable, typename, typeowner)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
rchandle	HINFX_RC	Input	Handle for a row or collection buffer
fieldnum	SQL_SMALLINT	Input	Field number. If this value is 0, the function returns information for the entire row or collection. For a collection, any value other than 0 causes the function to return information for the elements that are in the collection. For a row, this value specifies the element for which the function returns information.

Argument	Type	Use	Description
fieldname	SQL_CHAR	Output	Field name. The function returns this value only for an element that is in a row.
typecode	SQL_SMALLINT	Output	HCL Informix® ODBC Driver SQL data type of the element
columnsize	SQL_INTEGER	Output	Column size. For a character element, this value is the size of the column, in bytes. For a numeric element, this value is the precision. For other data types, the function does not return this value.
decdigits	SQL_SMALLINT	Output	Decimal digits. For a numeric element, this value is the number of digits after the decimal point. For other data types, the function does not return this value.
nullable	SQL_SMALLINT	Output	Null indicator. The possible values are: • SQL_NO_NULLS • SQL_NULLABLE
typename	SQL_CHAR	Output	Type name. For a named row, this value is the name of the row. For collections and unnamed rows, the function does not return this value.
typeowner	SQL_CHAR	Output	Type owner. This value is the name of the owner of the data type. This name can be up to 18 characters long.

Usage

The ifx_rc_describe() function returns information about the data type for a row or collection or for an element that is in a row or collection. For elements that are in a collection, this information is the same for all elements that are in the collection. This function does not change the seek position.

The ifx_rc_fetch() function

The ifx_rc_fetch() function retrieves the value of an element that is in a row or collection.

Syntax

```
ifx_rc_fetch(result, rchandle, action, jump)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
result	Data type of the element	Output	Retrieved value

Argument	Type	Use	Description
rchandle	HINFX_RC	Input	Handle for a row or collection buffer
action	SQL_SMALLINT	Input	Location of the element relative to the seek position. The possible values are: • SQL_INFX_RC_ABSOLUTE: Element number *jump* where the first element in the buffer is element number one • SQL_INFX_RC_CURRENT: Current® element • SQL_INFX_RC_FIRST: First element • SQL_INFX_RC_LAST: Last element • SQL_INFX_RC_NEXT: Next element • SQL_INFX_RC_PRIOR: Previous element • SQL_INFX_RC_RELATIVE: Element that is *jump* elements past the current element
jump	SQL_SMALLINT	Input	Offset when *action* is SQL_INFX_RC_ABSOLUTE or SQL_INFX_RC_RELATIVE

Usage

The ifx_rc_fetch() function retrieves the value of the element that is specified by *action* and *jump* and returns the value in *result*. The function sets the seek position to the position of the value that was just fetched.

The ifx_rc_free() function

The ifx_rc_free() function frees a row or collection handle.

Syntax

```
ifx_rc_free(rchandle)
```

Arguments

The function accepts the following argument.

Argument	Type	Use	Description
rchandle	HINFX_RC	Input	Handle for a row or collection buffer

Usage

The ifx_rc_free() function frees all the resources that are associated with a row or collection handle and frees the handle.

The ifx_rc_insert() function

The ifx_rc_insert() function inserts a new element into a collection.

Syntax

```
ifx_rc_insert(rchandle, value, action, jump)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
rchandle	HINFX_RC	Input	Handle for a collection buffer
value	Data type of the element	Input	Value to insert
action	SQL_SMALLINT	Input	Location of the element relative to the seek position. The possible values are: • SQL_INFX_RC_ABSOLUTE: Element number *jump* where the first element in the buffer is element number one • SQL_INFX_RC_CURRENT: Current® element • SQL_INFX_RC_FIRST: First element • SQL_INFX_RC_LAST: Last element • SQL_INFX_RC_NEXT: Next element • SQL_INFX_RC_PRIOR: Previous element • SQL_INFX_RC_RELATIVE: Element that is *jump* elements past the current element
jump	SQL_SMALLINT	Input	Offset when *action* is SQL_INFX_RC_ABSOLUTE or SQL_INFX_RC_RELATIVE

Usage

The ifx_rc_insert() function inserts a new element into a collection before the location that is specified by *action* and *jump*. The function sets the seek position to the position of the value that was inserted. It is not possible to insert a new element into a row.

The following table describes the allowable insertion locations for each type of collection.

Type of collection	Allowable insertion locations
List	Anywhere in the buffer

Type of collection	Allowable insertion locations
Set or multiset	At the end of the buffer

If the seek position specified by *action* and *jump* exceeds the end of the buffer, ifx_rc_insert() appends the new element at the end of the buffer. Likewise, if the seek position specified by *action* and *jump* precedes the beginning of the buffer, ifx_rc_insert() inserts the new element at the beginning of the buffer. If *action* specifies an insertion point other than the end for a set or multiset, ifx_rc_insert() fails.

For example, if *action* is SQL_INFX_RC_LAST, the function inserts the new element before the last element. To append a new element, take one of the following actions:

- Set the seek position to the end of the buffer and set *action* to SQL_INFX_RC_NEXT.
- Set *action* to SQL_INFX_RC_ABSOLUTE or SQL_INFX_RC_RELATIVE and set *jump* to a value that exceeds the end of the buffer.

To insert a new element at the beginning of a buffer, set *action* to SQL_INFX_RC_FIRST.

The ifx_rc_isnull() function

The ifx_rc_isnull() function returns a value that indicates whether a row or collection is null.

Syntax

```
ifx_rc_isnull(nullflag, rchandle)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
nullflag	SQL_SMALLINT	Output	Flag that indicates whether a row or collection is null. The possible values are: • TRUE • FALSE
rchandle	HINFX_RC	Input	Handle for a row or collection buffer

Usage

The ifx_rc_isnull() function returns a value that indicates whether a row or collection is null.

The ifx_rc_setnull() function

The ifx_rc_setnull() function sets a row or collection to null.

Syntax

```
ifx_rc_setnull(rchandle)
```

Arguments

The function accepts the following argument.

Argument	Type	Use	Description
rchandle	HINFX_RC	Input	Handle for a row or collection buffer

Usage

The ifx_rc_setnull() function sets a row or collection to null. The ifx_rc_setnull() function does not set each element within the row or collection to null.

The ifx_rc_typespec() function

The ifx_rc_typespec() function returns the type specification for a row or collection.

Syntax

```
ifx_rc_typespec(typespec, rchandle, flag)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
typespec	SQL_CHAR	Output	Type specification. The format for this value is the same as the type specification syntax for ifx_rc_create().
rchandle	HINFX_RC	Input	Handle for a row or collection buffer
flag	SQL_SMALLINT	Input	Flag that specifies whether to return the current or original type specification. If this value is TRUE, the function returns the original type specification. Otherwise, the function returns the current type specification.

Usage

The ifx_rc_typespec() function returns the type specification for a row or collection.

Related information

The ifx_rc_create() function

The ifx_rc_update() function

The ifx_rc_update() function updates the value for an element that is in a row or collection.

Syntax

```
ifx_rc_update(rchandle, value, action, jump)
```

Arguments

The function accepts the following arguments.

Argument	Type	Use	Description
rchandle	HINFX_RC	Input	Handle for a row or collection buffer
value	Data type of the element	Input	Value with which to update the element
action	SQL_SMALLINT	Input	Location of the element relative to the seek position. The possible values are: • SQL_INFX_RC_ABSOLUTE: Element number *jump* where the first element in the buffer is element number one • SQL_INFX_RC_CURRENT: Current® element • SQL_INFX_RC_FIRST: First element • SQL_INFX_RC_LAST: Last element • SQL_INFX_RC_NEXT: Next element • SQL_INFX_RC_PRIOR: Previous element • SQL_INFX_RC_RELATIVE: Element that is *jump* elements past the current element
jump	SQL_SMALLINT	Input	Offset when *action* is SQL_INFX_RC_ABSOLUTE or SQL_INFX_RC_RELATIVE

Usage

The ifx_rc_update() function updates the value for an element that immediately precedes the location that is specified by *action* and *jump*. The function sets the seek position to the position of the value that was updated.

Application tracking in ODBC

Set the **CLIENT_LABEL** environment variable in CSDK 4.50.xC4 onwards to assign a character string to ODBC client session and identify that character string on the database server. You can use this variable to distinguish one database session from the other.

CLIENT_LABEL variable support

You can set the CLIENT_LABEL variable in ODBC using the following methods:

The methods listed is in the decreasing order of priority, for example, setting CLIENT_LABEL in the “connection string will have the highest priority even if it is set using other methods.

- Set as part of connection string: "DSN=MyDsn;CLIENT_LABEL=MyLabel"
- Use SQLSetConnectAttr(SQL_INFX_ATTR_CLIENT_LABEL)
- Specify in the .odbc.ini file (only on Linux/Unix): CLIENT_LABEL=MyLabel
- Use environment variable : "export CLIENT_LABEL=MyLabel"
- Use setnet32 CLIENT_LABEL variable

Example

ODBC Sample Program

Following ODBC sample program shows the usage of the above mentioned methods. While running the sample program, you can run onstat -g env all | egrep "session|CLIENT_LABEL" on the Informix server command prompt.

```
/****************************************************************************

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*
HCL Informix ODBC Application
*
Copyright HCL 2020 All rights reserved.
*
Title: ClientLabel.c
*
Description: Support CLIENT_LABEL variable as part of connection string.
*
Author : Sheshnarayan Agrawal
*
***************************************************************************
*/
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#ifndef NO_WIN32
#include <io.h>
#include <windows.h>
#include <conio.h>
#endif /NO_WIN32/

#define __REENTRANT
#include <signal.h>
#ifdef NO_WIN32
#include <sys/wait.h>
#include <pthread.h>
#endif
```

```
#include <time.h>
#include <infxcli.h>

#define ERRMSG_LEN 200
#define NAMELEN 300
#define NUM_OF_INSTANCE 2

SQLHDBC hdbc;
SQLHENV henv;
SQLHSTMT hstmt;
SQLCHAR connStrIn[NAMELEN];

SQLINTEGER checkError (SQLRETURN rc,
SQLSMALLINT handleType,
SQLHANDLE handle,
SQLCHAR* errmsg)
{
SQLRETURN retcode = SQL_SUCCESS;

SQLSMALLINT errNum = 1;
SQLCHAR sqlState[6];
SQLINTEGER nativeError;
SQLCHAR errMsg[ERRMSG_LEN];
SQLSMALLINT textLengthPtr;

if ((rc != SQL_SUCCESS) && (rc != SQL_SUCCESS_WITH_INFO))
{
while (retcode != SQL_NO_DATA)
{
retcode = SQLGetDiagRec (handleType, handle, errNum, sqlState, &nativeError, errMsg, ERRMSG_LEN,
 &textLengthPtr);

if (retcode == SQL_INVALID_HANDLE)

{ fprintf (stderr, "CheckError function was called with an invalid handle!!\n"); return 1; }
if ((retcode == SQL_SUCCESS) || (retcode == SQL_SUCCESS_WITH_INFO))
fprintf (stderr, "ERROR: %d: %s : %s \n", nativeError, sqlState, errMsg);

errNum++;
}

fprintf (stderr, "%s\n", errmsg);
return 1; /* all errors on this handle have been reported */
}
else
return 0; /* no errors to report */
}

void SetConnectionString()

{ //sprintf((char *) connStrIn, "DSN=sheshdsn"); sprintf((char *)connStrIn,
 "DSN=sheshdsn;CLIENT_LABEL=FromOdbcApp"); return; }
int main (long argc,
char* argv[])
{
/* Miscellaneous variables */
SQLRETURN rc = 0;
```

```
SQLINTEGER i = 0;
SQLINTEGER getSesID = 0;
SQLCHAR connStrOut[NAMELEN];
SQLSMALLINT connStrOutLen;

/* Allocate the Environment handle */
rc = SQLAllocHandle (SQL_HANDLE_ENV, SQL_NULL_HANDLE, &henv);
if (rc != SQL_SUCCESS)

{ fprintf (stdout, "Environment Handle Allocation failed\nExiting!!"); exit (-1); }
/* Set the ODBC version to 3.0 */
rc = SQLSetEnvAttr (henv, SQL_ATTR_ODBC_VERSION, (SQLPOINTER) SQL_OV_ODBC3, 0);
if (checkError (rc, SQL_HANDLE_ENV, henv, (SQLCHAR *) "Error(main) in Step 1 – SQLSetEnvAttr
 failed\nExiting!!"))
exit (-1);

/* Allocate the connection handle */
rc = SQLAllocHandle (SQL_HANDLE_DBC, henv, &hdbc);
if (checkError (rc, SQL_HANDLE_ENV, henv, (SQLCHAR *) "Error(main) in Step 2 – Connection Handle Allocation
 failed\nExiting!!"))
exit (-1);
/*
rc = SQLSetConnectAttr(hdbc, SQL_INFX_ATTR_CLIENT_LABEL, (SQLPOINTER)"FromSetConnect", SQL_NTS);
if (checkError (rc, SQL_HANDLE_ENV, henv, (SQLCHAR *) "Error(main) in Step 2 – Connection Handle Allocation
 failed\nExiting!!"))
exit (-1);
*/
/* Establish the database connection */
SetConnectionString();
rc = SQLDriverConnect (hdbc, NULL, connStrIn, SQL_NTS, connStrOut, NAMELEN, &connStrOutLen,
 SQL_DRIVER_NOPROMPT);
if (checkError (rc, SQL_HANDLE_DBC, hdbc, (SQLCHAR *) "Error(main) in Step 3 – SQLDriverConnect
 failed\nExiting!!"))
exit (-1);

char clientLabel[129];
/*
rc = SQLGetConnectAttr(hdbc, SQL_INFX_ATTR_CLIENT_LABEL, (char *)clientLabel, 128, NULL);
if( rc != SQL_NO_DATA)

{ if (checkError (rc, SQL_HANDLE_ENV, henv, (SQLCHAR *) "Error(main) in Step 2 -- Connection Handle Allocation
 failed\nExiting!!"))
 exit (-1); printf("\nSQLGetConnectAttr(SQL_INFX_ATTR_CLIENT_LABEL) = %s \n", clientLabel); }
*/
printf("\nDatabase connection successful\n");
printf("\nHit <Enter> to exit the program \n");
SQLINTEGER in = getchar();

Exit:

/* CLEANUP: Close the statement handle

Free the statement handle
Disconnect from the datasource
Free the connection and environment handles
Exit
*/
```

```
/* Disconnect from the data source */
SQLDisconnect (hdbc);

/* Free the environment handle and the database connection handle */
SQLFreeHandle (SQL_HANDLE_DBC, hdbc);
SQLFreeHandle (SQL_HANDLE_ENV, henv);

return (rc);
}
```

Improve application performance

These topics suggest ways to improve performance of HCL Informix® ODBC Driver applications.

Error checking during data transfer

The **IFX_LOB_XFERSIZE** environment variable is used to specify the number of kilobytes 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 kilobytes is transferred. If an error occurs, the remaining data is not sent and an error is reported. If no error occurs, the file transfer continues until it finishes.

The valid range for **IFX_LOB_XFERSIZE** is from 1 to 9223372036854775808 kilobytes. The **IFX_LOB_XFERSIZE** environment variable is set on the client.

For more information about **IFX_LOB_XFERSIZE**, see the *HCL® Informix® Guide to SQL: Reference*.

Enable delimited identifiers in ODBC

By default delimited identifiers are disabled when connecting through ODBC.

There are three ways to enable them, listed here in order of decreasing precedence:

The DELIMIDENT connection string keyword

If you are using a connection string to connect you can set the DELIMIDENT keyword to enable or disable delimited identifiers. If the keyword is set to `y` then delimited identifiers are enabled for the connection. If the keywords are set to `n` delimited identifiers are disabled for the connection. If the keyword is present but is set to no value it has no effect on whether delimited identifiers are enabled.

For example, this connection string connects by using a data source name (DSN) of `mydsn` and enables delimited identifiers for the connection.

```
"DSN=mydsn;DELIMIDENT=y;"
```

This connection string also connects by using the DSN `mydsn` but has no effect on whether delimited identifiers are used.

```
"DSN=mydsn;DELIMIDENT=;"
```

Setting the DELIMIDENT keyword in the connection string overrides any connection attributes or environment variables that enable or disable delimited identifiers.

The SQL_INFX_ATTR_DELIMIDENT connection attribute

You can enable or disable delimited identifiers for a given connection by setting the SQL_INFX_ATTR_DELIMIDENT connection attribute before connecting. The SQL_INFX_ATTR_DELIMIDENT connection attribute accepts the values listed in the following table.

Table 11. Allowed values for the SQL_INFX_ATTR_DELIMIDENT connection attribute

Value	Effect
SQL_TRUE	Delimited identifiers are enabled for the connection.
SQL_FALSE	Delimited identifiers are disabled for the connection.
SQL_IFX_CLEAR	Clears any previous settings so that this connection attribute has no effect on whether delimited identifiers are used.

For example, this call causes delimited identifiers to be enabled when the connection is made:

```
SQLSetConnectAttr(hdbc, SQL_INFX_ATTR_DELIMIDENT, SQL_TRUE, SQL_IS_INTEGER);
```

If this connection attribute is set to SQL_TRUE or SQL_FALSE the setting overrides the **DELIMIDENT** environment variable but not the DELIMIDENT connection string keyword.

The DELIMIDENT environment variable

In some HCL Informix® APIs, such as ESQL/C, delimited identifiers are enabled by setting the **DELIMIDENT** environment variable to any value. In ODBC, however, delimited identifiers are enabled by setting the **DELIMIDENT** environment variable to `y` and are disabled by setting it to `n`.

Connection level optimizations

Establishing a connection to a database is an expensive process. Optimally, an application performs as many tasks as possible while a connection is open.

This process can by achieved by:

- Pooling connections when using Windows™ Driver Manager
- Using multiple statement handles on the same connection handle

Also, you can fine tune application performance by setting the following connection level attributes:

- AutoCommit optimization
- Message transfer optimization (OPTMSG)
- Open-Fetch-Close optimization (OPTOFC)

Related reference

Configure data sources on page 30

Optimizing query execution

There are several items you must consider when using prepared SQL queries.

Consider the following when using prepared SQL queries:

- SQLExecDirect is optimized for a single execution of an SQL statement. Thus, it is used for SQL queries that are not executed repeatedly.
- In cases where SQL queries are executed multiple times, using SQLPrepare and SQLExecute improves performance. Typically, you can do this with input and output parameters.
- SPL routines can be called from an ODBC application to perform certain SQL tasks and to expand what you can accomplish with SQL alone. Because SPL is native to the database and SPL routines are parsed and optimized at creation, rather than at runtime, SPL routines can improve performance for some tasks. SPL routines can also reduce traffic between a client application and the database server and reduce program complexity.
- When a stored procedure with a return value is executed using the HCL Informix® ODBC Driver, errors returned by the procedure are not returned to the application until a fetch is called on the result set. Error information from stored procedures with no returned values is available immediately following the execution of the procedure.

Insert multiple rows

Use an insert cursor to efficiently insert rows into a table in bulk.

To create an insert cursor, set the SQL_ENABLE_INSERT_CURSOR attribute by using SQLSetStmtOption, then call SQLParamOptions with the number of rows as a parameter. You can create an insert cursor for data types VARCHAR, LVARCHAR, and opaque.

When you open an insert cursor, a buffer is created in memory to hold a block of rows. The buffer receives rows of data as the program produces them; then they are passed to the database server in a block when the buffer is full. The buffer reduces the amount of communication between the program and the database server. As a result, the insertions go faster.

Automatically freeing a cursor

When an application uses a cursor, it usually sends a FREE statement to the database server to deallocate memory assigned to a cursor after it no longer needs that cursor.

Execution of this statement involves of message requests between the application and the database server. When the AUTOFREE is enabled, HCL Informix® ODBC Driver saves message requests because it does not need to execute the FREE statement. When the database server closes an insert cursor, it automatically frees the memory that it has allocated for it.

Enabling the AUTOFREE feature

You can enable the AUTOFREE feature for an ODBC application in two ways.

About this task

The SQL_INFX_ATTR_AUTO_FREE attribute can be set in any connection state between C2 and C5 (both included) when setting it using SQLSetConnectAttr, whereas it can be set by using SQLSetStmtAttr only when the statement is in S1 (allocated) state. The value of the SQL_INFX_ATTR_AUTO_FREE attribute can be retrieved by using SQLGetConnectAttr or SQLSetStmtAttr.

You can enable the AUTOFREE feature for an ODBC application in either of the following ways:

- Set the SQL_INFX_ATTR_AUTO_FREE attribute with SQLSetConnectAttr.

  When you use SQLSetConnectAttr to enable this attribute, all new allocated statements for that connection inherit the attribute value. The only way to change this attribute value per statement is to set and reset it again as a statement attribute. The default is DISABLED for the connection attribute.
- Set the SQL_INFX_ATTR_AUTO_FREE attribute with SQLSetStmtAttr.

The AUTOFREE feature

The AUTOFREE feature only works withresult generating statements executed by using SQLExecDirect, as it opens the cursor which is then closed and released by the corresponding SQLCloseCursor or SQLFreeStmt.

The AUTOFREE feature does not work when the application has to prepare a statement once and then execute it several times (for example, using SQLPrepare to prepare and then executing it by calling SQLExecute several times). When you close the cursor with SQLCloseCursor after SQLExecute, it only closes the cursor but does not release the cursor memory on the database server side. But if you close the cursor by using SQLFreeStmt with SQL_CLOSE or SQL_DROP, it not only closes and releases the cursor, but it also unprepares the statement. In the latter case there is savings of a network roundtrip, but the application is unable to execute the statement again until it reprepares it.

When AUTOFREE is enabled, the application sees an improvement in the network performance when the application closes the cursor with SQLCloseCursor or SQLFreeStmt with SQL_DROP.

Delay execution of the SQL PREPARE statement

You can defer execution of the SQLPrepare statement by enabling the deferred-PREPARE feature.

This feature works primarily with dynamic SQL statements where the application does a series of SQLPrepare and SQLExecute statements. It optimizes the number of round-trip messages to the database server by not sending SQLPrepare statements to the database server until the application calls SQLExecute on that statement.

When deferred-PREPARE is enabled, the following behavior is expected of the application:

- Execution of SQLPrepare does not put the statement in a prepared state.
- Syntax errors in an SQLPrepare statement are not known until the statement is executed because the SQL statement is never sent to the database server until it is executed. If open-fetch-close optimization is turned on, errors are not returned to the client until the first fetch, because open-fetch-close optimizes the OPEN/FETCH so that OPEN is sent on the first fetch.
- SQLColAttributes, SQLDescribeCol, SQLNumResultCols, and SQLNumParams always return HY010 (function sequence error) if called after SQLPrepare but before SQLExecute by the application.

- SQLCopyDesc returns HY010 if the source descriptor handle is an IRD if called after SQLPrepare but before SQLExecute by the application.
- SQLGetDescField and SQLGetDescRec return HY010 if the descriptor handle is an IRD if called after SQLPrepare but before SQLExecute by the application.

You can enable the deferred-PREPARE feature for an ODBC application in either of the following ways:

- Set the SQL_INFX_ATTR_DEFERRED_PREPARE attribute with SQLSetConnectAttr.

  When you use SQLSetConnectAttr to enable this attribute, all new allocated statements for that connection inherit the attribute value. The only way to change this attribute value per statement, is to set/reset it again as a statement attribute. The default is DISABLED for the connection attribute.
- Set the SQL_INFX_ATTR_DEFERRED_PREPARE attribute with SQLSetStmtAttr.

The SQL_INFX_ATTR_DEFERRED_PREPARE attribute can be set in any connection state between C2 and C5 (both included) when setting it using SQLSetConnectAttr, whereas it can be set by with SQLSetStmtAttr only when the statement is in S1 (allocated) state. The value of the SQL_INFX_ATTR_DEFERRED_PREPARE attribute can be retrieved with SQLGetConnectAttr or SQLSetStmtAttr.

Set the fetch array size for simple-large-object data

To reduce the network overhead for fetches involving multiple rows of simple-large-object data, you can set the array size.

Set the array size so when the driver receives a multiple-row fetch request, it optimizes the fetch buffer size and the internal fetch array size, and eliminates a round trip to the database server for every simple large object.

Setting the array size greater than 1 can result in a performance improvement even for other types of data because it has the side effect of automatically increasing the fetch buffer size if necessary. (If the number of rows specified can fit in the current fetch buffer, setting it has little effect.)

An application can request that multiple rows be returned to it by setting the statement attribute SQL_ATTR_ROW_ARRAY_SIZE or setting the ARD header field SQL_DESC_ARRAY_SIZE to a value greater than one, and then calling either SQLFetch or SQLFetchScroll. (The default value of SQL_ATTR_ROW_ARRAY_SIZE is one.) The driver then recognizes when it receives a multiple-row fetch request and optimizes the settings for the fetch buffer size and the internal fetch array size. Settings for these are based on the internal tuple size, the user setting of row array size, and the current setting of fetch array size.

You cannot use the internal fetch array feature under the following conditions:

- When OPTOFC and deferred-PREPARE are both enabled

  To use the fetch array feature, the driver is dependent upon knowing how large a row is going to be, as received from the database server, before sending the fetch request to the database server. When both of these are enabled, this information is unavailable until after a fetch is performed.
- When using scroll cursors

There are separate internal client-to-server protocols used for scroll cursors that are distinct from those protocols used for fetching arrays. The database server does not support simple large object columns in a scroll cursor. An error is returned.

- When using SQLGetData

  In order for the driver to use the fetch array feature, it has to be able to tell the database server how much data it is prepared to receive at the time of the fetch request. Calls to SQLGetData take place after SQLFetch.

  According to the ODBC standard, when using block cursors, the application must call SQLSetPos to position the cursor on a particular row before calling SQLGetData. SQLSetPos is only usable with scroll cursors and simple-large-object columns are not allowed in scroll cursors. Also according to the standard, SQLGetData must not be used with a forward-only cursor with a rowset size greater than 1.

  The alternative to using SQLGetData is to use SQLBindCol, which would come before the call to SQLFetch.

You might want to optimize use of SQL_ATTR_ROW_ARRAY_SIZE so the application sets the value of it according to the maximum number of rows that can be transported in a single buffer. After a statement is prepared, the application might call SQLGetStmtAttr to get the value of SQL_INFX_ATTR_FET_ARR_SIZE. If the data fits in one fetch buffer, the internal setting of SQL_INFX_ATTR_FET_ARR_SIZE equals the application setting of SQL_ATTR_ROW_ARRAY_SIZE. In practice, this is only useful on large result sets.

The SPL output parameter feature

HCL Informix® ODBC Driver supports the ODBC defined method of getting the return value from a database procedure.

Specifically, ODBC supports the parameter to that precedes the equals sign in a procedure-call escape sequence. The host variable associated with that parameter is updated upon statement execution either with SQLExecute or SQLExecDirect.

In the HCL Informix® ODBC Driver definition of a procedure-call escape sequence, there is only one return value; therefore, the following restrictions are placed on this feature:

- Procedures used with this feature must return only one value, although they might return multiple rows.

  If this condition is not met, the parameter and its binding are ignored.
- Data from the first row only be placed in the host variable associated with the bound parameter, although procedures used with this feature can return multiple rows.

To return multiple-value, multiple-row result sets from the HCL Informix® database server, you have to fetch the data as though it were the result columns of a select statement. This output parameter feature works with existing applications that bind column or columnss and call SQLFetch or call SQLFetch and SQLGetData when accessing data through a procedure call. Therefore, no error or warning is generated when more than one row is available to be returned.

You can use either or both methods for retrieving the data from a stored procedure. A host variable can be bound as a parameter or as a column, or both. If separate buffers are used, only the host variable bound as a parameter is updated upon statement execution, and only the host variable bound as a column is updated upon a fetch. Unbound columns accessed through SQLGetData remain unaffected.

OUT and INOUT parameters

As of , HCL Informix® Client Software Development Kit supports the use of OUT and INOUT parameters during execution of SPL.

The following data types are supported:

- BIGINT
- BLOB
- BOOLEAN
- DATETIME
- CHAR
- CLOB
- DECIMAL
- FLOAT
- INT8
- INTEGER
- INTERVAL
- LVARCHAR
- MONEY
- NCHAR
- NVARCHAR
- SMALLFLOAT
- SMALLINT
- VARCHAR

These restrictions exist when using OUT or INOUT parameters in SPL execution:

- Collection data types such as LIST, MULTISET, ROW, and SET are not supported.
- Returning result sets is not supported. After executing SPL with OUT or INOUT parameters, you cannot call SQLFetch or SQLGetData.
- Only one value can be returned; that is, only one set of OUT or INOUT parameters can be returned per individual SPL execution.

  The following SPL execution example creates one OUT, one INOUT, and one IN (default) parameter and one return value.

  ```
  create procedure myproc(OUT intparam INT, INOUT charparam char(20),
    inparam int) returns int
  <body of SPL>
  end procedure;
  ```

The following code example, `outinoutparamblob.c`, shows how to use OUT and INOUT parameters with BLOB, INTEGER, and VARCHAR data types.

```
/* Drop procedure */
   SQLExecDirect(hstmt, (UCHAR *)"drop procedure spl_out_param_blob;", SQL_NTS);
SQLExecDirect(hstmt, (UCHAR *)"drop table tab_blob;", SQL_NTS);

/* Create table with BLOB column */
rc = SQLExecDirect(hstmt, (UCHAR *)"create table tab_blob(c_blob BLOB,
   c_int INTEGER, c_char varchar(20));", SQL_NTS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, (SQLCHAR *) "Error in Step 2 --
   SQLExecDirect failed\n"))
 goto Exit;

/* Insert one row into the table */
rc = SQLExecDirect(hstmt, (UCHAR *)"insert into tab_blob
 values(filetoblob('insert.data', 'c'), 10, 'blob_test');", SQL_NTS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, (SQLCHAR *) "Error in Step 2
   -- SQLExecDirect failed\n"))
 goto Exit;

/* Create procedure */
rc = SQLExecDirect(hstmt, "CREATE PROCEDURE spl_out_param_blob(inParam int,
  OUT blobparam BLOB, OUT intparam int, OUT charparam varchar(20)) \n"
                       "returning integer; \n"
                             "select c_blob, c_int, c_char into blobparam,
                             intparam, charparam from tab_blob; \n"
                             "return inParam; \n"
                             "end procedure; ",
                             SQL_NTS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, (SQLCHAR *) "Error in Step 2
   -- SQLExecDirect failed\n"))
 goto Exit;

/* Prepare stored procedure to be executed */
   rc = SQLPrepare(hstmt, (UCHAR *)"{? = call spl_out_param_blob
   (?, ?, ?, ?)}", SQL_NTS);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, (SQLCHAR *)
   "Error in Step 2 -- SQLPrepare failed\n"))
 goto Exit;

/* Bind the required parameters */
   rc = SQLBindParameter(hstmt, 1, SQL_PARAM_OUTPUT, SQL_C_LONG,
   SQL_INTEGER, 3, 0, &sParm1, 0, &cbParm1);
   if (checkError (rc, SQL_HANDLE_STMT, hstmt, (SQLCHAR *)
   "Error in Step 2 -- SQLBindParameter 1 failed\n"))
  goto Exit;

    rc = SQLBindParameter(hstmt, 2, SQL_PARAM_INPUT, SQL_C_LONG,
    SQL_INTEGER, 10, 0, &sParm2, 0, &cbParm2);
    if (checkError (rc, SQL_HANDLE_STMT, hstmt, (SQLCHAR *)
    "Error in Step 2 -- SQLBindParameter 2 failed\n"))
  goto Exit;

 rc = SQLBindParameter(hstmt, 3, SQL_PARAM_OUTPUT, SQL_C_BINARY,
    SQL_LONGVARBINARY, sizeof(blob_buffer), 0, blob_buffer,
    sizeof(blob_buffer), &cbParm3);
    if (checkError (rc, SQL_HANDLE_STMT, hstmt, (SQLCHAR *)
    "Error in Step 2 -- SQLBindParameter 3 failed\n"))
  goto Exit;

     rc = SQLBindParameter(hstmt, 4, SQL_PARAM_OUTPUT, SQL_C_LONG,
     SQL_INTEGER, 10, 0, &sParm3, 0, &cbParm4);
    if (checkError (rc, SQL_HANDLE_STMT, hstmt, (SQLCHAR *)
    "Error in Step 2 -- SQLBindParameter 4 failed\n"))
    goto Exit;

     rc = SQLBindParameter (hstmt, 5, SQL_PARAM_OUTPUT, SQL_C_CHAR,
      SQL_VARCHAR, sizeof(schar), 0, schar, sizeof(schar), &cbParm6);
     if (checkError (rc, SQL_HANDLE_STMT, hstmt, (SQLCHAR *)
     "Error in Step 2 -- SQLBindParameter 5 failed\n"))
    goto Exit;

  /* Exeute the prepared stored procedure */
  rc = SQLExecute(hstmt);
  if (checkError (rc, SQL_HANDLE_STMT, hstmt, (SQLCHAR *)
      "Error in Step 2 -- SQLExecute failed\n"))
       goto Exit;

         len =
      strlen("123456789abcdefghijklmnopqrstuvwxyz
           1234567890123456789012345678901234567890 ");

       if( (sParm2 != sParm1) || (10 != sParm3) ||
        (strcmp("blob_test", schar)) || (cbParm3 != len) )
        {
            fprintf(stdout, "\n 1st Data compare failed!");
              goto Exit;
        }
    else
    {
          fprintf(stdout, "\n 1st Data compare successful");
        }

        /* Reset the parameters */
       rc = SQLFreeStmt(hstmt, SQL_RESET_PARAMS);
       if (checkError (rc, SQL_HANDLE_STMT, hstmt, (SQLCHAR *)
       "Error in Step 3 -- SQLFreeStmt failed\n"))
      goto Exit;

      /* Reset variables */
      sParm1 = 0;
            cbParm6 = cbParm1 = SQL_NTS;
      cbParm3 = SQL_NULL_DATA;
      schar[0]=0;
           blob_buffer[0]=0;
```

Asynchronous execution

Design your application to take advantage of data sources that support asynchronous execution. Asynchronous calls do not perform faster, but well-designed applications appear to run more efficiently.

Turning on asynchronous execution does not by itself improve performance. Well-designed applications, however, can take advantage of asynchronous query execution by allowing the user to work on other things while the query is being evaluated on the database server. Perhaps users start one or more subsequent queries or choose to work in another application, all while the query is executing on the database server. Designing for asynchronous execution makes your application appear to run faster by allowing the user to work concurrently on multiple tasks.

By default, an application calls to an ODBC driver that then executes statements against the database server in a synchronous manner. In this mode of operation, the driver does not return control to the application until its own request to the database server is complete. For statements that take more than a few seconds to complete execution, this control return delay can result in the perception of poor performance.

Some data sources support asynchronous execution. When in asynchronous mode, an application calls to an ODBC driver and control is returned almost immediately. In this mode, the driver returns the status SQL_STILL_EXECUTING to the application and then sends the appropriate request to the database server for execution. The application polls the driver at various intervals at which point the driver itself polls the database server to see if the query has completed execution. If the query is still executing, then the status SQL_STILL_EXECUTING is returned to the application. If it has completed, then a status such as SQL_SUCCESS is returned, and the application can then begin to fetch records.

Update data with positioned updates and deletes

Although positioned updates do not apply to all types of applications, try to use positioned updates and deletes whenever possible.

Positioned updates (with UPDATE WHERE CURRENT OF CURSOR) allow you to update data by positioning the database cursor to the row to be changed and signaling the driver to change the data. You are not forced to build a complex SQL statement; you supply the data to be changed.

Besides making the code more maintainable, positioned updates typically result in improved performance. Because the database server is already positioned on the row (for the SELECT statement currently in process), expensive operations to locate the row to be changed are unnecessary. If the row must be located, the database server typically has an internal pointer to the row available (for example, ROWID).

To support positioned UPDATE and DELETE statements with scrollable cursors, HCL Informix® ODBC Driver constructs a new searched UPDATE or DELETE statement from the original positioned statement. However, the database server cannot update scroll cursors directly. Instead, HCL Informix® ODBC Driver constructs a WHERE clause that references each column fetched in the SELECT statement referenced in the WHERE CURRENT OF CURSOR clause. Values from the rowset data cache of the SELECT statement are bound to each value in the constructed WHERE clause.

This method of positioning is both slower and more error prone than using a WHERE CURRENT OF CURSOR clause with FORWARD ONLY cursors. If the fetched rows do not contain a unique key value, the constructed WHERE clause might identify one or many rows, causing many rows to be deleted or updated. Deletion of rows in this manner affects both positioned UPDATE and DELETE statements, and SQLSetPos statements when you use scroll cursors.

Use SQLSpecialColumns to determine the optimal set of columns to use in the WHERE clause for updating data. Many times pseudocolumns provide the fastest access to the data; you can determine these columns only by using SQLSpecialColumns.

Many applications cannot be designed to take advantage of positioned updates and deletes. These applications typically update data by forming a WHERE clause that consists of some subset of the column values that are returned in the result set. Some applications might formulate the WHERE clause by using all searchable result columns or by calling SQLStatistics to find columns that might be part of a unique index. These methods typically work but can result in fairly complex queries.

Consider the following example:

```
rc = SQLExecDirect (hstmt, "SELECT first_name, last_name, ssn,
   address, city, state, zip FROM emp", SQL_NTS);
// fetchdata
⁝;
rc = SQLExecDirect (hstmt, "UPDATE EMP SET ADDRESS = ?
   WHERE first_name = ? AND last_name = ? AND ssn = ? AND
   address = ? AND city = ? AND state = ? AND zip = ?", SQL_NTS);
// fairly complex query
```

Applications should call SQLSpecialColumns/SQL_BEST_ROWID to retrieve the optimal set of columns (possibly a pseudocolumn) that identifies any given record. Many databases support special columns that are not explicitly user-defined in the table definition but are hidden columns of every table (for example, ROWID, TID, and other columns). These pseudocolumns almost always provide the fastest access to the data because they typically are pointers to the exact location of the record. Because pseudocolumns are not part of the explicit table definition, they are not returned from SQLSpecialColumns. The only way to determine whether pseudocolumns exist is to call SQLSpecialColumns.

Consider the previous example, this time with SQLSpecialColumns:

```
⁝;
rc = SQLSpecialColumns (hstmt, ..... 'emp', ...);
⁝;
rc = SQLExecDirect (hstmt, "SELECT first_name, last_name, ssn,
   address, city, state, zip, ROWID FROM emp", SQL_NTS);
// fetch data and probably "hide" ROWID from the user
⁝;
rc = SQLExecDirect (hstmt, "UPDATE emp SET address = ? WHERE
   ROWID = ?", SQL_NTS);
// fastest access to the data!
```

If your data source does not contain special pseudocolumns, the result set of SQLSpecialColumns consists of the columns of the optimal unique index on the specified table (if a unique index exists). Therefore, your application does not additionally call SQLStatistics to find the smallest unique index.

BIGINT and BIGSERIAL data types

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.

Message transfer optimization

If you activate the message transfer optimization feature (OPTMSG), the driver minimizes message transfers with the database server for most HCL Informix® ODBC functions.

In addition, the driver chains messages from the database server together and eliminates some small message packets to accomplish optimized message transfers.

To activate message transfer optimization, set the SQL_INFX_ATTR_OPTMSG statement attribute to one (1). The optimization default is: OFF.

Message chaining restrictions

HCL Informix® ODBC does not chain SQL functions even when you enable message transfer optimization.

The SQL functions that ODBC does not chain are:

- SQLDisconnect
- SQLConnect
- SQLEndTran
- SQLExecute (if the driver returns results by using the select or call procedure and when the driver uses insert cursors to perform a bulk insert)
- SQLExtendedFetch
- SQLFetch
- SQLFetchScroll
- SQLPrepare

When the driver reaches one of the functions listed previously, it performs the following actions:

1. Flushes the message queue to the database server only when it encounters SQL statements that require a response from the database server.

   The driver does not flush the message queue when it encounters functions that do not require network traffic, such as SQLAllocStmt.
2. Continues message chaining for subsequent SQL statements.

Disable message chaining

You can choose to disable message chaining.

Before you disable message chaining, consider the following situations:

- Some SQL statements require immediate replies. If you disable message chaining, re-enable the OPTMSG feature after the restricted SQL statement is completed.
- If you perform debugging, you can disable the OPTMSG feature when you are trying to determine how each SQL statement responds.
- If you enable OPTMSG, the message is queued up for the database server but it is not sent for processing. Consider disabling message chaining before the last SQL statement in the program to ensure that the database server processes all messages before the application exits.

- If you disable message chaining, you must reset the SQL_INFX_ATTR_OPTMSG attribute immediately after the SQL statement that requires it to avoid unintended chaining.

  The following example shows how to disable message chaining by placing the SQL_INFX_ATTR_OPTMSG attribute after the DELETE statement. If you place the attribute after the delete statement, the driver can flush all the queued messages when the next SQL statement executes.

  ```
  SQLSetStmtOption(hstmt, SQL_INFX_ATTR_OPTMSG, 1);
  SQLExecDirect(hstmt, (unsigned char *)
  "delete from customer", SQL_NTS);
  SQLSetStmtOption(hstmt, SQL_INFX_ATTR_OPTMSG, 0);
  SQLExecDirect(hstmt, (unsigned char *)
  "create index ix1 on customer (zipcode)", SQL_NTS);
  ```

  Unintended message chaining can make it difficult to determine which of the chained statements failed.

  At the CREATE INDEX statement, the driver sends both the DELETE and the CREATE INDEX statements to the database server.

Errors with optimized message transfers

When you enable the OPTMSG feature, HCL Informix® ODBC does not perform error handling on any chained statement.

If you are not sure whether a particular statement might generate an error, include error-handling statements in your code and do not enable message chaining for that statement.

The database server stops execution of subsequent statements when an error occurs in a chained statement. For example, in the following code fragment, the intent is to chain five INSERT statements:

```
SQLExecDirect(hstmt, "create table tab1 (col1 INTEGER)", SQL_NTS);
/* enable message chaining */
SQLSetStmtOption(hstmt, SQL_INFX_ATTR_OPTMSG, 1);
/* these two INSERT statements execute successfully */
SQLExecDirect(hstmt, "insert into tab1 values (1)", SQL_NTS);
SQLExecDirect(hstmt, "insert into tab1 values (2)", SQL_NTS);
/* this INSERT statement generates an error because the data
* in the VALUES clause is not compatible with the column type */
SQLExecDirect(hstmt, "insert into tab1 values ('a')", SQL_NTS);
/* these two INSERT statements never execute */
SQLExecDirect(hstmt, "insert into tab1 values (3)", SQL_NTS);
SQLExecDirect(hstmt, "insert into tab1 values (4)", SQL_NTS);
/* disable message chaining */
SQLSetStmtOption(hstmt, SQL_INFX_ATTR_OPTMSG, 0);
/* commit work */
rc = SQLEndTran (SQL_HANDLE_DBC, hdbc, SQL_COMMIT);
if (rc != SQL_SUCCESS)
```

In this example, the following actions occur:

- The driver sends the five INSERT statements and the COMMIT WORK statements to the database server for execution.
- The database inserts col1 values of 1 and 2 into the tab1 table.

- The third INSERT statement generates an error, so the database server does not execute the subsequent INSERT statements or the COMMIT WORK statement.
- The driver flushes the message queue when the queue reaches the SQLEndTran function.
- The SQLEndTran function, which is the last statement in the chained statements, returns the error from the failed INSERT statement.

If you want to keep the values that the database server inserted into col1, you must commit them yourself.

Error messages

These topics describe the HCL Informix® ODBC Driver error messages.

The topics provide information about:

- Diagnostic SQLSTATE values
- SQLSTATE values mapped to Informix® error messages
- HCL Informix® ODBC Driver error messages mapped to specific SQLSTATE values

Diagnostic SQLSTATE values

Each HCL Informix® ODBC Driver function can return an SQLSTATE value that corresponds to the Informix® error code.

A function can return additional SQLSTATE values that arise from implementation-specific situations. SQLError returns SQLSTATE values as defined by the GLS and SQL Access Group SQL CAE specification (1992).

SQLSTATE values are character strings that consist of a two-character class value followed by a three-character subclass value. A class value of `01` indicates a warning and is accompanied by a return code of SQL_SUCCESS_WITH_INFO. Class values other than `01`, except for the class `IM`, indicate an error and are accompanied by a return code of SQL_ERROR. The class `IM` signifies warnings and errors that derive from the implementation of HCL Informix® ODBC Driver. The subclass value `000` in any class is for implementation-defined conditions within the given class. ANSI SQL-92 defines the assignment of class and subclass values.

Map SQLSTATE values to Informix® error messages

View the SQLSTATE values that HCL Informix® ODBC Driver can return.

The following table maps SQLSTATE values that HCL Informix® ODBC Driver can return.

A return value of SQL_SUCCESS normally indicates a function has executed successfully, although the SQLSTATE 00000 also indicates success.

SQLSTATE	**Error message**	**Can be returned from**
01000	`General warning`	All HCL Informix® ODBC Driver functions except:

SQLSTATE	Error message	Can be returned from
		SQLAllocEnv SQLError
01002	`Disconnect error`	SQLDisconnect
01004	`Data truncated`	SQLBrowseConnect SQLColAttributes SQLDataSources SQLDescribeCol SQLDriverConnect SQLDrivers SQLExecDirect SQLExecute SQLExtendedFetch SQLFetch SQLGetCursorName SQLGetData SQLGetInfo SQLNativeSql SQLPutData SQLSetPos
01006	`Privilege not revoked`	SQLExecDirect SQLExecute
01S00	`Invalid connection string attribute`	SQLBrowseConnect SQLDriverConnect
01S01	`Error in row`	SQLExtendedFetch SQLSetPos
01S02	`Option value changed`	SQLSetConnectOption SQLSetStmtOption
01S03	`No rows updated or deleted`	SQLExecDirect SQLExecute SQLSetPos

SQLSTATE	Error message	Can be returned from
01S04	`More than one row updated or deleted`	SQLExecDirect SQLExecute SQLSetPos
07001	`Wrong number of parameters`	SQLExecDirect SQLExecute
07006	`Restricted data type attribute violation`	SQLBindParameter SQLExtendedFetch SQLFetch SQLGetData
08001	`Unable to connect to data source`	SQLBrowseConnect SQLConnect SQLDriverConnect
08002	`Connection in use`	SQLBrowseConnect SQLConnect SQLDriverConnect SQLSetConnectOption
08003	`Connection not open`	SQLAllocStmt SQLDisconnect SQLGetConnectOption SQLGetInfo SQLNativeSql SQLSetConnectOption SQLTransact
08004	`Data source rejected establishment of connection`	SQLBrowseConnect SQLConnect SQLDriverConnect
08007	`Connection failure during transaction`	SQLTransact
08S01	`Communication link failure`	SQLBrowseConnect SQLColumnPrivileges SQLColumns SQLConnect SQLDriverConnect

SQLSTATE	Error message	Can be returned from
		SQLExecDirect SQLExecute SQLExtendedFetch SQLFetch SQLForeignKeys SQLFreeConnect SQLGetData SQLGetTypeInfo SQLParamData SQLPrepare SQLPrimaryKeys SQLProcedureColumns SQLProcedures SQLPutData SQLSetConnectOption SQLSetStmtOption SQLSpecialColumns SQLStatistics SQLTablePrivileges SQLTables
21S01	`Insert value list does not match column list`	SQLExecDirect SQLPrepare
21S02	`Degree of derived table does not match column list`	SQLExecDirect SQLPrepare SQLSetPos
22001	`String data right truncation`	SQLPutData
22003	`Numeric value out of range`	SQLExecDirect SQLExecute SQLExtendedFetch SQLFetch SQLGetData SQLGetInfo SQLPutData SQLSetPos
22005	`Error in assignment`	SQLExecDirect SQLExecute

SQLSTATE	Error message	Can be returned from
		SQLExtendedFetch SQLFetch SQLGetData SQLPrepare SQLPutData SQLSetPos
22008	`Datetime field overflow`	SQLExecDirect SQLExecute SQLExtendedFetch SQLFetch SQLGetData SQLPutData SQLSetPos
22012	`Division by zero`	SQLExecDirect SQLExecute SQLExtendedFetch SQLFetch SQLGetData
22026	`String data, length mismatch`	SQLParamData
23000	`Integrity constraint violation`	SQLExecDirect SQLExecute SQLSetPos
24000	`Invalid cursor state`	SQLColAttributes SQLColumnPrivileges SQLColumns SQLDescribeCol SQLExecDirect SQLExecute SQLExtendedFetch SQLFetch SQLForeignKeys SQLGetData SQLGetStmtOption SQLGetTypeInfo SQLPrepare SQLPrimaryKeys

SQLSTATE	Error message	Can be returned from
		SQLProcedureColumns SQLProcedures SQLSetCursorName SQLSetPos SQLSetStmtOption SQLSpecialColumns SQLStatistics SQLTablePrivileges SQLTables
25000	`Invalid transaction state`	SQLDisconnect
28000	`Invalid authorization specification`	SQLBrowseConnect SQLConnect SQLDriverConnect
34000	`Invalid cursor name`	SQLExecDirect SQLPrepare SQLSetCursorName
37000	`Syntax error or access violation`	SQLExecDirect SQLNativeSql SQLPrepare
3C000	`Duplicate cursor name`	SQLSetCursorName
40001	`Serialization failure`	SQLExecDirect SQLExecute SQLExtendedFetch SQLFetch
42000	`Syntax error or access violation`	SQLExecDirect SQLExecute SQLPrepare SQLSetPos
70100	`Operation aborted`	SQLCancel
IM001	`Driver does not support this function`	All ODBC functions except: SQLAllocConnect SQLAllocEnv SQLDataSources

SQLSTATE	Error message	Can be returned from
		SQLDrivers SQLError SQLFreeConnect SQLFreeEnv SQLGetFunctions
IM002	`Data source name not found and no default driver specified`	SQLBrowseConnect SQLConnect SQLDriverConnect
IM003	`Specified driver could not be loaded`	SQLBrowseConnect SQLConnect SQLDriverConnect
IM004	`Driver's SQLAllocEnv failed`	SQLBrowseConnect SQLConnect SQLDriverConnect
IM005	`Driver's SQLAllocConnect failed`	SQLBrowseConnect SQLConnect SQLDriverConnect
IM006	`Driver's SQLSetConnectOption failed`	SQLBrowseConnect SQLConnect SQLDriverConnect
IM007	`No data source or driver specified; dialog prohibited`	SQLDriverConnect
IM008	`Dialog failed`	SQLDriverConnect
IM009	`Unable to load translation shared library (DLL)`	SQLBrowseConnect SQLConnect SQLDriverConnect SQLSetConnectOption
IM010	`Data source name too long`	SQLBrowseConnect SQLDriverConnect
IM011	`Driver name too long`	SQLBrowseConnect SQLDriverConnect

SQLSTATE	Error message	Can be returned from
IM012	`DRIVER keyword syntax error`	SQLBrowseConnect SQLDriverConnect
IM013	`Trace file error`	All ODBC functions.
S0001	`Base table or view already exists`	SQLExecDirect SQLPrepare
S0002	`Base table not found`	SQLExecDirect SQLPrepare
S0011	`Index already exists`	SQLExecDirect SQLPrepare
S0012	`Index not found`	SQLExecDirect SQLPrepare
S0021	`Column already exists`	SQLExecDirect SQLPrepare
S0022	`Column not found`	SQLExecDirect SQLPrepare
S0023	`No default for column`	SQLSetPos
S1000	`General error`	All ODBC functions except:
S1001	`Memory allocation failure`	All ODBC functions except: SQLAllocEnv SQLError SQLFreeConnect SQLFreeEnv
S1002	`Invalid column number`	SQLBindCol SQLColAttributes SQLDescribeCol SQLExtendedFetch SQLFetch SQLGetData

SQLSTATE	Error message	Can be returned from
S1003	`Program type out of range`	SQLBindCol SQLBindParameter SQLGetData
S1004	`SQL data type out of range`	SQLBindParameter SQLGetTypeInfo
S1008	`Operation canceled`	All ODBC functions that can be processed asynchronously: SQLColAttributes SQLColumnPrivileges SQLColumns SQLDescribeCol SQLDescribeParam SQLExecDirect SQLExecute SQLExtendedFetch SQLFetch SQLForeignKeys SQLGetData SQLGetTypeInfo SQLMoreResults SQLNumParams SQLNumResultCols SQLParamData SQLPrepare SQLPrimaryKeys SQLProcedureColumns SQLProcedures SQLPutData SQLSetPos SQLSpecialColumns SQLStatistics SQLTablePrivileges SQLTables
S1009	`Invalid argument value`	SQLAllocConnect SQLAllocStmt SQLBindCol SQLBindParameter

SQLSTATE	Error message	Can be returned from
		SQLExecDirect SQLForeignKeys SQLGetData SQLGetInfo SQLNativeSql SQLPrepare SQLPutData SQLSetConnectOption SQLSetCursorName SQLSetPos SQLSetStmtOption
S1010	`Function sequence error`	SQLBindCol SQLBindParameter SQLColAttributes SQLColumnPrivileges SQLColumns SQLDescribeCol SQLDisconnect SQLExecDirect SQLExecute SQLExtendedFetch SQLFetch SQLForeignKeys SQLFreeConnect SQLFreeEnv SQLFreeStmt SQLGetConnectOption SQLGetCursorName SQLGetData SQLGetFunctions SQLGetStmtOption SQLGetTypeInfo SQLMoreResults SQLNumParams SQLNumResultCols SQLParamData SQLParamOptions SQLPrepare SQLPrimaryKeys

SQLSTATE	Error message	Can be returned from
		SQLProcedureColumns SQLProcedures SQLPutData SQLRowCount SQLSetConnectOption SQLSetCursorName SQLSetPos SQLSetScrollOptions SQLSetStmtOption SQLSpecialColumns SQLStatistics SQLTablePrivileges SQLTables SQLTransact
S1011	`Operation invalid at this time`	SQLGetStmtOption SQLSetConnectOption SQLSetStmtOption
S1012	`Invalid transaction operation code specified`	SQLTransact
S1015	`No cursor name available`	SQLGetCursorName
S1090	`Invalid string or buffer length`	SQLBindCol SQLBindParameter SQLBrowseConnect SQLColAttributes SQLColumnPrivileges SQLColumns SQLConnect SQLDataSources SQLDescribeCol SQLDriverConnect SQLDrivers SQLExecDirect SQLExecute SQLForeignKeys SQLGetCursorName SQLGetData SQLGetInfo SQLNativeSql

SQLSTATE	Error message	Can be returned from
		SQLPrepare SQLPrimaryKeys SQLProcedureColumns SQLProcedures SQLPutData SQLSetCursorName SQLSetPos SQLSpecialColumns SQLStatistics SQLTablePrivileges SQLTables
S1091	`Descriptor type out of range`	SQLColAttributes
S1092	`Option type out of range`	SQLFreeStmt SQLGetConnectOption SQLGetStmtOption SQLSetConnectOption SQLSetStmtOption
S1093	`Invalid parameter number`	SQLBindParameter
S1094	`Invalid scale value`	SQLBindParameter
S1095	`Function type out of range`	SQLGetFunctions
S1096	`Information type out of range`	SQLGetInfo
S1097	`Column type out of range`	SQLSpecialColumns
S1098	`Scope type out of range`	SQLSpecialColumns
S1099	`Nullable type out of range`	SQLSpecialColumns
S1100	`Uniqueness option type out of range`	SQLStatistics
S1101	`Accuracy option type out of range`	SQLStatistics
S1103	`Direction option out of range`	SQLDataSources SQLDrivers
S1104	`Invalid precision value`	SQLBindParameter
S1105	`Invalid parameter type`	SQLBindParameter
S1106	`Fetch type out of range`	SQLExtendedFetch

SQLSTATE	Error message	Can be returned from
S1107	`Row value out of range`	SQLExtendedFetch SQLParamOptions SQLSetPos SQLSetScrollOptions
S1108	`Concurrency option out of range`	SQLSetScrollOptions
S1109	`Invalid cursor position`	SQLExecute SQLExecDirect SQLGetData SQLGetStmtOption SQLSetPos
S1110	`Invalid driver completion`	SQLDriverConnect
S1111	`Invalid bookmark value`	SQLExtendedFetch
S1C00	`Driver not capable`	SQLBindCol SQLBindParameter SQLColAttributes SQLColumnPrivileges SQLColumns SQLExecDirect SQLExecute SQLExtendedFetch SQLFetch SQLForeignKeys SQLGetConnectOption SQLGetData SQLGetInfo SQLGetStmtOption SQLGetTypeInfo SQLPrepare SQLPrimaryKeys SQLProcedureColumns SQLProcedures SQLSetConnectOption SQLSetPos SQLSetScrollOptions SQLSetStmtOption SQLSpecialColumns

SQLSTATE	Error message	Can be returned from
		SQLStatistics SQLTablePrivileges SQLTables SQLTransact
S1T00	`Time-out expired`	SQLBrowseConnect SQLColAttributes SQLColumnPrivileges SQLColumns SQLConnect SQLDescribeCol SQLDriverConnect SQLExecDirect SQLExecute SQLExtendedFetch SQLFetch SQLForeignKeys SQLGetData SQLGetInfo SQLGetTypeInfo SQLMoreResults SQLNumParams SQLNumResultCols SQLParamData SQLPrepare SQLPrimaryKeys SQLProcedureColumns SQLProcedures SQLPutData SQLSetPos SQLSpecialColumns SQLStatistics SQLTablePrivileges SQLTables

Map Informix® error messages to SQLSTATE values

The rest of this section describes diagnostic SQLSTATE values for HCL Informix® ODBC Driver functions.

The return code for each SQLSTATE value is SQL_ERROR unless a description indicates otherwise. When a function returns SQL_SUCCESS_WITH_INFO or SQL_ERROR, you can call SQLError to get the SQLSTATE value.

Deprecated and new HCL Informix® ODBC Driver APIs

In , numerous ODBC APIs have been deprecated and their functionality transferred to new APIs.

Only the name has been changed; no functionality has changed. The following table lists the deprecated and new APIs.

Table 12. Deprecated and new ODBC APIs

Deprecated ODBC APIs	New ODBC APIs
SQLAllocConnect	SQLAllocHandle
SQLAllocEnv	SQLAllocHandle
SQLAllocStmt	SQLAllocHandle
SQLColAttributes	SQLColAttribute
SQLError	SQLGetDiagRec
SQLExtendedFetch	SQLFetch, SQLFetchScroll
SQLFreeConnect	SQLFreeHandle
SQLFreeEnv	SQLFreeHandle
SQLFreeStmt	SQLFreeHandle
SQLGetConnectOption	SQLGetConnectAttr
SQLGetStmtOption	SQLGetStmtAttr
SQLSetConnectOption	SQLSetConnectAttr
SQLSetPos	SQLBulkOperations
SQLSetStmtOption	SQLSetStmtAttr
SQLTransact	SQLEndTran

SQLAllocConnect (core level only)

This table describes the SQLSTATE and error values for SQLAllocConnect.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1009	-11066	`Invalid argument value`

SQLAllocEnv (core level only)

SQLAllocEnv allocates memory for an environment handle and initializes the driver call level interface for application use.

An application must call SQLAllocEnv before it calls any other driver function.

A driver cannot return SQLSTATE values directly after the call to SQLAllocEnv because no valid handle exists with which to call SQLError.

Two levels of SQLAllocEnv functions exist, one within the driver manager (if you are using one) and one within the driver. The driver manager does not call the driver-level function until the application calls SQLConnect, SQLBrowseConnect, or SQLDriverConnect. If an error occurs in the driver-level SQLAllocEnv function, the driver manager-level SQLConnect, SQLBrowseConnect, or SQLDriverConnect function returns SQL_ERROR. A subsequent call to SQLError with henv, SQL_NULL_HDBC, and SQL_NULL_HSTMT returns SQLSTATE IM004 (the driver SQLAllocEnv function failed), followed by one of the following errors from the driver:

- SQLSTATE S1000 (General error)
- The HCL Informix® ODBC Driver SQLSTATE value, which ranges from `S1000` to `S19ZZ`.

  For example, SQLSTATE S1001 (Memory-allocation failure) indicates that the call from the driver manager to the driver-level SQLAllocEnv returned SQL_ERROR, and the *henv* from the driver manager was set to SQL_NULL_HENV.

SQLAllocStmt (core level only)

SQLAllocStmt allocates memory for a statement handle and associates the statement handle with the connection that *hdbc* specifies.

An application must call SQLAllocStmt before it submits SQL statements.

The following table describes the SQLSTATE and error values for SQLAllocStmt.

SQLSTATE	**Error value**	**Error message**
01000	-11001	`General warning`
08003	-11017	`Connection not open`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1009	-11066	`Invalid argument value`
08S01	-11301	`A protocol error has been detected. Current connection is closed.`

SQLBindCol (core level only)

SQLBindCol assigns the storage and HCL Informix® ODBC Driver C data type for a column in a result set.

The SQLBindCol assigns the storage as follows:

- A storage buffer that receives the contents of a column of data
- The length of the storage buffer
- A storage location that receives the actual length of the column of data returned by the fetch operation
- Data type conversion from the Informix® SQL data type to the Informix® ODBC driver C data type

The following table describes the SQLSTATE and error values for SQLBindCol.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1002	-11062	`Invalid column number`
S1003	-11063	`Program type out of range`
S1010	-11067	`Function-sequence error`
S1090	-11071	`Invalid string or buffer length`
S1C00	-11092	`Driver not capable`

Important: An application can call SQLBindCol to bind a column to a new storage location, regardless of whether data has already been fetched. The new binding replaces the old binding for bookmark columns as well as other bound columns. The new binding does not apply to data already fetched; it takes effect the next time SQLFetch, SQLExtendedFetch, or SQLSetPos is called.

SQLBindParameter (level one only)

SQLBindParameter binds a buffer to a parameter marker in an SQL statement.

The following table describes the SQLSTATE and error values for SQLBindParameter.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
07006	-11013	`Restricted data type attribute violation`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1003	-11063	`Program type out of range`
S1004	-11064	`SQL data type out of range`
S1009	-11066	`Invalid argument value`

SQLSTATE	Error value	Error message
S1010	-11067	`Function-sequence error`
S1090	-11071	`Invalid string or buffer length`
S1093	-11074	`Invalid parameter number`
S1094	-11075	`Invalid scale value`
S1104	-11084	`Invalid precision value`
S1105	-11085	`Invalid parameter type`
S1C00	-11092	`Driver not capable`

SQLBrowseConnect (level two only)

SQLBrowseConnect supports an iterative method of discovering and enumerating the attributes and attribute values required to connect to a data source.

Each call to SQLBrowseConnect returns successive levels of attributes and attribute values. When all levels are enumerated, a connection to the data source is completed, and a SQLBrowseConnect string is returned with a return code of now connected to the data source.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
01004	-11003	`Data truncated`
01S00	-11005	`Invalid connection string attribute`
08001	-11015	`Unable to connect to data source`
08002	-11016	`Connection in use`
08S01	-11020	`Communication-link failure`
28000	-11033	`Invalid authorization specification`
IM002	-11041	`Data source not found and no default driver specified`
IM003	-11042	`Specified driver could not be loaded`
IM004	-11043	`Driver's SQLAllocEnv failed`
IM005	-11044	`Driver's SQLAllocConnect failed`
IM006	-11045	`Driver's SQLSetConnectOption failed`
IM009	-11048	`Unable to load translation shared library (DLL)`
IM010	-11049	`Data-source name too long`

SQLSTATE	Error value	Error message
IM011	-11050	`Driver name too long`
IM012	-11051	`DRIVER keyword syntax error`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1090	-11071	`Invalid string or buffer length`
S1T00	-11094	`Time-out expired`
08S01	-11301	`A protocol error has been detected. Current connection is closed.`
S1000	-11303	`Input connection string too large`
S1000	-11317	`Invalid connectdatabase value specified`
S1000	-11318	`Invalid vmbcharlenexact value specified`
S1000	-11320	`Syntax error`
S1000	-11323	`The statement contained an escape clause not supported by this database driver`

SQLCancel (core level only)

SQLCancel cancels the processing on an *hstmt* or a query.

The following table describes the SQLSTATE and error values for the function.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
01S05	-11010	`Cancel treated as FreeStmt/Close.`
70100	-11039	`Operation aborted`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
08S01	-11301	`A protocol error has been detected. Current connection is closed.`

SQLColAttributes (core level only)

SQLColAttributes returns descriptor information for a column in a result set.

It cannot be used to return information about the bookmark column (column 0). Descriptor information is returned as a character string, a 32-bit descriptor-dependent value, or an integer value.

The following table describes the SQLSTATE and error values for SQLColAttributes.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
01004	-11003	`Data truncated`
24000	-11031	`Invalid cursor state`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1002	-11062	`Invalid column number`
S1008	-11065	`Operation canceled`
S1010	-11067	`Function-sequence error`
S1090	-11071	`Invalid string or buffer length`
S1091	-11072	`Descriptor type out of range`
S1C00	-11092	`Driver not capable`
S1T00	-11094	`Time-out expired`

SQLColAttributes can return any SQLSTATE that can be returned by SQLPrepare or SQLExecute when it is called after SQLPrepare and before SQLExecute, depending on when the data source evaluates the SQL statement associated with the *hstmt*.

SQLColumnPrivileges (level two only)

SQLColumnPrivileges returns a list of columns and associated privileges for the specified table. The driver returns the information as a result set on the specified *hstmt*.

The following table describes the SQLSTATE and error values for SQLColumnPrivileges.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
08S01	-11020	`Communication-link failure`
24000	-11031	`Invalid cursor state`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1008	-11065	`Operation canceled`
S1010	-11067	`Function-sequence error`
S1090	-11071	`Invalid string or buffer length`

SQLSTATE	Error value	Error message
S1C00	-11092	`Driver not capable`
S1T00	-11094	`Time-out expired`
S1C00	-11300	`SQL_DEFAULT_PARAM not supported`
08S01	-11301	`A protocol error has been detected. Current connection is closed.`
S1000	-11310	`Create and Drop must be executed within a ServerOnly Connection`
S1000	-11320	`Syntax error`
S1000	-11323	`The statement contained an escape clause not supported by this database driver`

SQLColumns (level one only)

SQLColumns returns the list of column names in specified tables. The driver returns this information as a result set on the specified *hstmt*.

The following table describes the SQLSTATE and error values for SQLColumns.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
08S01	-11020	`Communication-link failure`
24000	-11031	`Invalid cursor state`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1008	-11065	`Operation canceled`
S1010	-11067	`Function-sequence error`
S1090	-11071	`Invalid string or buffer length`
S1C00	-11092	`Driver not capable`
S1T00	-11094	`Time-out expired`
S1C00	-11300	`SQL_DEFAULT_PARAM not supported`
08S01	-11301	`A protocol error has been detected. Current connection is closed.`
S1000	-11310	`Create and Drop must be executed within a ServerOnly Connection`
S1000	-11320	`Syntax error`
S1000	-11323	`The statement contained an escape clause not supported by this database driver`

SQLConnect (core level only)

SQLConnect loads a driver and establishes a connection to a data source.

The connection handle references where all information about the connection, including status, transaction state, and error information is stored.

The following table describes the SQLSTATE and error values for SQLConnect.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
08001	-11015	`Unable to connect to data source`
08002	-11016	`Connection in use`
08S01	-11020	`Communication-link failure`
28000	-11033	`Invalid authorization specification`
IM002	-11041	`Data source not found and no default driver specified`
IM003	-11042	`Specified driver could not be loaded`
IM004	-11043	`Driver's SQLAllocEnv failed`
IM005	-11044	`Driver's SQLAllocConnect failed`
IM006	-11045	`Driver's SQLSetConnectOption failed`
IM009	-11048	`Unable to load translation shared library (DLL)`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1090	-11071	`Invalid string or buffer length`
S1T00	-11094	`Time-out expired`
S1000	-11302	`Insufficient connection information was supplied`
S1000	-11320	`Syntax error`
S1000	-11323	`The statement contained an escape clause not supported by this database driver`

SQLDataSources (level two only)

SQLDataSources lists data-source names.

The following table describes the SQLSTATE and error values for SQLDataSources.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`

SQLSTATE	Error value	Error message
01004	-11003	`Data truncated`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1090	-11071	`Invalid string or buffer length`
S1103	-11083	`Direction option out of range`

SQLDescribeCol (core level only)

SQLDescribeCol returns the result descriptor (column name, type, precision, scale, and whether it can have a NULL value) for one column in the result set.

It cannot be used to return information about the bookmark column (column 0).

The following table describes the SQLSTATE and error values for SQLDescribeCol.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
01004	-11003	`Data truncated`
24000	-11031	`Invalid cursor state`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1002	-11062	`Invalid column number`
S1008	-11065	`Operation canceled`
S1010	-11067	`Function-sequence error`
S1090	-11071	`Invalid string or buffer length`
S1T00	-11094	`Time-out expired`

SQLDescribeCol can return any SQLSTATE that SQLPrepare or SQLExecute returns when SQLDescribeCol is called after SQLPrepare and before SQLExecute, depending on when the data source evaluates the SQL statement associated with the *hstmt*.

SQLDisconnect

SQLDisconnect closes the connection associated with a specific connection handle.

The following table describes the SQLSTATE and error values for SQLDisconnect.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
01002	-11002	`Disconnect error`
08003	-11017	`Connection not open`
25000	-11032	`Invalid transaction state`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1010	-11067	`Function-sequence error`
08S01	-11301	`A protocol error has been detected. Current connection is closed.`

Usage

If an application calls SQLDisconnect after SQLBrowseConnect returns SQL_NEED_DATA and before it returns a different return code, the driver cancels the connection-browsing process and returns the *hdbc* to an unconnected state.

If an application calls SQLDisconnect while an incomplete transaction is associated with the connection handle, the driver returns SQLSTATE 25000 (Invalid transaction state), indicating that the transaction is unchanged and the connection is open. An incomplete transaction is one that was not committed or rolled back with SQLTransact.

If an application calls SQLDisconnect before it frees every *hstmt* associated with the connection, the driver frees each remaining *hstmt* after it successfully disconnects from the data source. However, if one or more of the *hstmts* associated with the connection are still executing asynchronously, SQLDisconnect returns SQL_ERROR with an SQLSTATE value of S1010 (Function sequence error).

SQLDriverConnect (level one only)

SQLDriverConnect is an alternative to SQLConnect.

It supports data sources that require more connection information than the three arguments in SQLConnect dialog boxes to prompt the user for all connection information and data sources that are not defined data source names.

SQLDriverConnect provides the following connection options:

- You can establish a connection by using a connection string that contains the data source name, one or more user IDs, one or more passwords, and other information that the data source requires.
- You can establish a connection by using a partial connection string or no additional information; in this case, HCL Informix® ODBC Driver can prompt the user for connection information.

After a connection is established, SQLDriverConnect connection string is completed. The application can use this string for subsequent connection requests.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
01004	-11003	`Data truncated`
01S00	-11005	`Invalid connection string attribute`
08001	-11015	`Unable to connect to data source`
08002	-11016	`Connection in use`
08S01	-11020	`Communication-link failure`
28000	-11033	`Invalid authorization specification`
IM002	-11041	`Data source not found and no default driver specified`
IM003	-11042	`Specified driver could not be loaded`
IM004	-11043	`Driver's SQLAllocEnv failed`
IM005	-11044	`Driver's SQLAllocConnect failed`
IM006	-11045	`Driver's SQLSetConnectOption failed`
IM007	-11046	`No data source or driver specified; dialog prohibited`
IM008	-11047	`Dialog failed`
IM009	-11048	`Unable to load translation shared library`
IM010	-11049	`Data-source name too long`
IM011	-11050	`Driver name too long`
IM012	-11051	`DRIVER keyword syntax error`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1090	-11071	`Invalid string or buffer length`
S1110	-11090	`Invalid driver completion`
S1T00	-11094	`Time-out expired`
08S01	-11301	`A protocol error has been detected. Current connection is closed.`
S1000	-11302	`Insufficient connection information was supplied`
S1000	-11303	`Input connection string too large`
S1000	-11317	`Invalid connectdatabase value specified`
S1000	-11318	`Invalid vmbcharlenexact value specified`

SQLSTATE	Error value	Error message
S1000	-11320	`Syntax error`
S1000	-11323	`The statement contained an escape clause not supported by this database driver`

SQLDrivers (level two only)

SQLDrivers lists driver descriptions and driver-attribute keywords.

The following table describes the SQLSTATE and error values for SQLDrivers.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
01004	-11003	`Data truncated`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1090	-11071	`Invalid string or buffer length`
S1103	-11083	`Direction option out of range`

SQLError (core level only)

SQLError returns error or status information.

SQLError does not post error values for itself. SQLError returns SQL_NO_DATA_FOUND when it cannot retrieve any error information (in which case *sqlstate* equals 00000). If SQLError cannot access error values for any reason that would normally return SQL_ERROR, SQLError returns SQL_ERROR but does not post any error values. If the buffer for the error message is too short, SQLError returns SQL_SUCCESS_WITH_INFO but still does not return an SQLSTATE value for SQLError.

To determine that a truncation occurred in the error message, an application can compare *cbErrorMsgMax* to the actual length of the message text written to *pcbErrorMsg*.

SQLExecDirect (core level only)

SQLExecDirect executes a preparable statement by using the current values of the parameter-marker variables if any parameters exist in the statement.

SQLExecDirect is the fastest way to submit an SQL statement for one-time execution.

The following table describes the SQLSTATE and error values for SQLExecDirect.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`

SQLSTATE	Error value	Error message
01004	-11003	`Data truncated`
01006	-11004	`Privilege not revoked`
01S03	-11008	`No rows updated or deleted`
01S04	-11009	`More than one row updated or deleted`
07001	-11012	`Wrong number of parameters`
07S01	-11014	`Invalid use of default parameter`
08S01	-11020	`Communication-link failure`
21S01	-11021	`Insert value list does not match column list`
21S02	-11022	`Degree of derived table does not match column list`
22003	-11025	`Numeric value out of range`
22005	-11026	`Error in assignment`
22008	-11027	`Datetime field overflow`
22012	-11028	`Division by zero`
23000	-11030	`Integrity-constraint violation`
24000	-11031	`Invalid cursor state`
34000	-11034	`Invalid cursor name`
37000	-11035	`Syntax error or access violation`
40001	-11037	`Serialization failure`
42000	-11038	`Syntax error or access violation`
S0001	-11053	`Base table or view already exists`
S0002	-11054	`Base table not found`
S0011	-11055	`Index already exists`
S0012	-11056	`Index not found`
S0021	-11057	`Column already exists`
S0022	-11058	`Column not found`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1008	-11065	`Operation canceled`

SQLSTATE	Error value	Error message
S1009	-11066	`Invalid argument value`
S1010	-11067	`Function-sequence error`
S1090	-11071	`Invalid string or buffer length`
S1109	-11089	`Invalid cursor position`
S1C00	-11092	`Driver not capable`
S1T00	-11094	`Time-out expired`
S1C00	-11300	`SQL_DEFAULT_PARAM not supported`
08S01	-11301	`A protocol error has been detected. Current connection is closed.`
S1000	-11310	`Create and Drop must be executed within a ServerOnly Connection`
S1000	-11320	`Syntax error`
S1000	-11323	`The statement contained an escape clause not supported by this database driver`

SQLExecute (core level only)

SQLExecute executes a prepared statement by using the current values of the parameter-marker variables if any parameter markers exist in the statement.

The following table describes the SQLSTATE and error values for SQLExecute.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
01004	-11003	`Data truncated`
01006	-11004	`Privilege not revoked`
01S03	-11008	`No rows updated or deleted`
01S04	-11009	`More than one row updated or deleted`
07001	-11012	`Wrong number of parameters`
07S01	-11014	`Invalid use of default parameter.`
08S01	-11020	`Communication-link failure`
22003	-11025	`Numeric value out of range`
22005	-11026	`Error in assignment`
22008	-11027	`Datetime field overflow`
22012	-11028	`Division by zero`

SQLSTATE	Error value	Error message
23000	-11030	`Integrity constraint violation`
24000	-11031	`Invalid cursor state`
40001	-11037	`Serialization failure`
42000	-11038	`Syntax error or access violation`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1008	-11065	`Operation canceled`
S1010	-11067	`Function-sequence error`
S1090	-11071	`Invalid string or buffer length`
S1109	-11089	`Invalid cursor position`
S1C00	-11092	`Driver not capable`
S1T00	-11094	`Time-out expired`
S1C00	-11300	`SQL_DEFAULT_PARAM not supported`
08S01	-11301	`A protocol error has been detected. Current connection is closed.`
S1000	-11320	`Syntax error`
S1000	-11323	`The statement contained an escape clause not supported by this database driver`

SQLExecute can return any SQLSTATE that SQLPrepare can return based on when the data source evaluates the SQL statement associated with the *hstmt*.

SQLExtendedFetch (level two only)

SQLExtendedFetch extends the functionality of SQLFetch.

SQLExtendedFetch extends functionality in the following ways:

- It returns row-set data (one or more rows), in the form of an array, for each bound column.
- It scrolls through the result set according to the setting of a scroll-type argument.

SQLExtendedFetch works with SQLSetStmtOption.

To fetch one row of data at a time in a forward direction, an application calls SQLFetch.

The following table describes the SQLSTATE and error values for SQLExtendedFetch.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
01004	-11003	`Data truncated`
01S01	-11006	`Error in row`
07006	-11013	`Restricted data type attribute violation`
08S01	-11020	`Communication-link failure`
22002	-11024	`Indicator value required but not supplied`
22003	-11025	`Numeric value out of range`
22005	-11026	`Error in assignment`
22008	-11027	`Datetime field overflow`
22012	-11028	`Division by zero`
24000	-11031	`Invalid cursor state`
40001	-11037	`Serialization failure`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1002	-11062	`Invalid column number`
S1008	-11065	`Operation canceled`
S1010	-11067	`Function-sequence error`
S1106	-11086	`Fetch type out of range`
S1107	-11087	`Row value out of range`
S1C00	-11092	`Driver not capable`
S1T00	-11094	`Time-out expired`
08S01	-11301	`A protocol error has been detected. Current connection is closed.`
S1000	-11307	`In SQLExtendedFetch, only SQL_FETCH_NEXT is supported for SQL_SCROLL_Forward_only cursors`

If an error occurs that pertains to the entire row set, such as SQLSTATE S1T00 (Time-out expired), the driver returns SQL_ERROR and the appropriate SQLSTATE. The contents of the row set buffers are undefined, and the cursor position is unchanged.

If an error occurs that pertains to a single row, the driver performs the following actions:

- Sets the element in the *rgfRowStatus* array for the row to SQL_ROW_ERROR
- Posts SQLSTATE 01S01 (Error in row) in the error queue
- Posts zero or more additional SQLSTATE values for the error after SQLSTATE 01S01 (Error in row) in the error queue

After the driver processes the error or warning, it continues the operation for the remaining rows in the row set and returns SQL_SUCCESS_WITH_INFO. Thus, for each error that pertains to a single row, the error queue contains SQLSTATE 01S01 (Error in row) followed by zero or more additional SQLSTATEs.

After the driver processes the error, it fetches the remaining rows in the row set and returns SQL_SUCCESS_WITH_INFO. Thus, for each row that returns an error, the error queue contains SQLSTATE 01S01 (Error in row) followed by zero or more additional SQLSTATE values.

If the row set contains rows that are already fetched, the driver is not required to return SQLSTATE values for errors that occurred when the rows were first fetched. However, it is required to return SQLSTATE 01S01 (Error in row) for each row in which an error originally occurred and to return SQL_SUCCESS_WITH_INFO. For example, a static cursor that maintains a cache might cache row-status information (so that it can determine which rows contain errors) but might not cache the SQLSTATE associated with those errors.

Error rows do not affect relative cursor movements. For example, suppose the result set size is 100, and the row-set size is 10. If the current row set is rows 11 through 20 and the element in the *rgfRowStatus* array for row 11 is SQL_ROW_ERROR, calling SQLExtendedFetch with the SQL_FETCH_NEXT fetch type still returns rows 21 through 30.

If the driver returns any warnings, such as SQLSTATE 01004 (Data truncated), it returns warnings that apply to the entire row set or to unknown rows in the row set before it returns error information that applies to specific rows. It returns warnings for specific rows with any other error information about those rows.

SQLFetch (core level only)

SQLFetch fetches a row of data from a result set.

The driver returns data for all columns that were bound to storage locations with SQLBindCol.

The following table describes the SQLSTATE and error values for SQLFetch.

SQLSTATE	**Error value**	**Error message**
01000	-11001	`General warning`
01004	-11003	`Data truncated`
07006	-11013	`Restricted data-type attribute violation`
08S01	-11020	`Communication-link failure`
22002	-11024	`Indicator value required but not supplied`
22003	-11025	`Numeric value out of range`
22005	-11026	`Error in assignment`

SQLSTATE	Error value	Error message
22008	-11027	`Datetime field overflow`
22012	-11028	`Division by zero`
24000	-11031	`Invalid cursor state`
40001	-11037	`Serialization failure`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1002	-11062	`Invalid column number`
S1008	-11065	`Operation canceled`
S1010	-11067	`Function-sequence error`
S1C00	-11092	`Driver not capable`
S1T00	-11094	`Time-out expired`

SQLForeignKeys (level two only)

SQLForeignKeys can return a list of foreign keys.

SQLForeignKeys can return either of the following items:

- A list of foreign keys in the specified table (columns in the specified table that refer to primary keys in other tables)
- A list of foreign keys in other tables that refer to the primary key in the specified table

The driver returns each list as a result set on the specified *hstmt*.

The following table describes the SQLSTATE and error values for SQLForeignKeys.

SQLSTATE	Error value	Error message
01000	-11001	General warning
08S01	-11020	Communication link failure
24000	-11031	Invalid cursor state
IM001	-11040	Driver does not support this function
S1000	-11060	General error
S1001	-11061	Memory allocation failure
S1008	-11065	Operation canceled
S1009	-11066	Invalid argument value

SQLSTATE	Error value	Error message
S1010	-11067	Function sequence error
S1090	-11071	Invalid string or buffer length
S1C00	-11092	Driver not capable
S1T00	-11094	Timeout expired
S1C00	-11300	SQL_DEFAULT_PARAM not supported
08S01	-11301	A protocol error has been detected. Current® connection is closed.
S1000	-11310	Create and Drop must be executed within a ServerOnly Connection
S1000	-11320	Syntax error
S1000	-11323	The statement contained an escape clause not supported by this database driver

SQLFreeConnect (core level only)

SQLFreeConnect releases a connection handle and frees all memory associated with the handle.

The following table describes the SQLSTATE and error values for SQLFreeConnect.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
08S01	-11020	`Communication-link failure`
S1000	-11060	`General error`
S1010	-11067	`Function-sequence error`

SQLFreeEnv (core level only)

SQLFreeEnv frees the environment handle and releases all memory associated with the environment handle.

The following table describes the SQLSTATE and error values for SQLFreeEnv.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
S1000	-11060	`General error`
S1010	-11067	`Function-sequence error`

SQLFreeStmt (core level only)

SQLFreeStmt stops the processing that is associated with a specific *hstmt*, closes any open cursors that are associated with the *hstmt*, discards pending results, and, optionally, frees all resources associated with the statement handle.

The following table describes the SQLSTATE and error values for SQLFreeStmt.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1010	-11067	`Function-sequence error`
S1092	-11073	`Option type out of range`

SQLGetConnectOption (level one only)

SQLGetConnectOption returns the current setting of a connection option.

The following table describes the SQLSTATE and error values for SQLGetConnectOption.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
08003	-11017	`Connection not open`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1010	-11067	`Function-sequence error`
S1092	-11073	`Option type out of range`
S1C00	-11092	`Driver not capable`

SQLGetCursorName (core level only)

SQLGetCursorName returns the cursor name associated with a specified *hstmt*.

The following table describes the SQLSTATE and error values for SQLGetCursorName.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
01004	-11003	`Data truncated`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1010	-11067	`Function-sequence error`
S1015	-11070	`No cursor name available`

SQLSTATE	Error value	Error message
S1090	-11071	`Invalid string or buffer length`

SQLGetData (level one only)

SQLGetData returns result data for a single unbound column in the current row.

The application must call SQLFetch or SQLExtendedFetch and (optionally) SQLSetPos to position the cursor on a row of data before it calls SQLGetData. It is possible to use SQLBindCol for some columns and use SQLGetData for others within the same row. This function can be used to retrieve character or binary data values in parts from a column with a character, binary, or data source-specific data type (for example, data from SQL_LONGVARBINARY or SQL_LONGVARCHAR columns).

The following table describes the SQLSTATE and error values for SQLGetData.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
01004	-11003	`Data truncated`
07006	-11013	`Restricted data- type attribute violation`
08S01	-11020	`Communication-link failure`
22002	-11024	`Indicator value required but not supplied`
22003	-11025	`Numeric value out of range`
22005	-11026	`Error in assignment`
22008	-11027	`Datetime-field overflow`
22012	-11028	`Division by zero`
24000	-11031	`Invalid cursor state`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1002	-11062	`Invalid column number`
S1003	-11063	`Program type out of range`
S1008	-11065	`Operation canceled`
S1009	-11066	`Invalid argument value`
S1010	-11067	`Function-sequence error`
S1090	-11071	`Invalid string or buffer length`
S1109	-11089	`Invalid cursor position`

SQLSTATE	Error value	Error message
S1C00	-11092	`Driver not capable`
S1T00	-11094	`Time-out expired`
08S01	-11301	`A protocol error has been detected. Current connection is closed.`

SQLGetFunctions (level one only)

SQLGetFunctions returns information about whether the driver supports a specific function.

The following table describes the SQLSTATE and error values for SQLGetFunctions.

SQLSTATE	Error value	Error message
01000	-1101	`General warning`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1010	-11067	`Function-sequence error`
S1095	-11076	`Function type out of range`

SQLGetInfo (level one only)

SQLGetInfo returns general information about the driver and data source associated with an *hdbc*.

The following table describes the SQLSTATE and error values for SQLGetInfo.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
01004	-11003	`Data truncated`
08003	-11017	`Connection not open`
22003	-11025	`Numeric value out of range`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1009	-11066	`Invalid argument value`
S1090	-11071	`Invalid string or buffer length`
S1096	-11077	`Information type out of range`
S1C00	-11092	`Driver not capable`
S1T00	-11094	`Time-out expired`

SQLSTATE	Error value	Error message
08S01	-11301	`A protocol error has been detected. Current connection is closed.`

Related reference

SQLGetInfo argument implementation on page 16

SQLGetStmtOption (level one only)

SQLGetStmtOption returns the current setting of a statement option.

The following table describes the SQLSTATE and error values for SQLGetStmtOption.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
24000	-11031	`Invalid cursor state`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1010	-11067	`Function-sequence error`
S1011	-11068	`Operation invalid at this time`
S1092	-11073	`Option type out of range`
S1109	-11089	`Invalid cursor position`
S1C00	-11092	`Driver not capable`

SQLGetTypeInfo (level one only)

SQLGetTypeInfo returns information about data types that the data source supports.

The driver returns the information in the form of an SQL result set.

The following table describes the SQLSTATE and error values for SQLGetTypeInfo.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
08S01	-11020	`Communication-link failure`
24000	-11031	`Invalid cursor state`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`

SQLSTATE	Error value	Error message
S1004	-11064	`SQL data type out of range`
S1008	-11065	`Operation canceled`
S1010	-11067	`Function-sequence error`
S1C00	-11092	`Driver not capable`
S1T00	-11094	`Time-out expired`
08S01	-11301	`A protocol error has been detected. Current connection is closed.`
S1000	-11305	`SQLGetTypeInfo supported for FORWARD_ONLY cursors`
S1000	-11310	`Create and Drop must be executed within a ServerOnly Connection`
S1000	-11320	`Syntax error`
S1000	-11323	`The statement contained an escape clause not supported by this database driver`

SQLMoreResults (level two only)

SQLMoreResults determines whether more results are available on an *hstmt* that contains SELECT, UPDATE, INSERT, or DELETE statements and, if so, initializes processing for those results.

The following table describes the SQLSTATE and error values for SQLMoreResults.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1008	-11065	`Operation canceled`
S1010	-11067	`Function-sequence error`
S1T00	-11094	`Time-out expired`
08S01	-11301	`A protocol error has been detected. Current connection is closed.`

SQLNativeSql (level two only)

SQLNativeSql returns the SQL string that the driver translates.

The following table describes the SQLSTATE and error values for SQLNativeSql.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`

SQLSTATE	Error value	Error message
01004	-11003	`Data truncated`
08003	-11017	`Connection not open`
37000	-11035	`Syntax error or access violation`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1009	-11066	`Invalid argument value`
S1090	-11071	`Invalid string or buffer length`
S1000	-11320	`Syntax error`
S1000	-11323	`The statement contained an escape clause not supported by this database driver`

Usage

The following example shows what SQLNativeSql might return for an input SQL string that contains the scalar function LENGTH:

```
SELECT {fn LENGTH(NAME)} FROM EMPLOYEE
```

HCL Informix® might return the following translated SQL string:

```
SELECT length(NAME) FROM EMPLOYEE
```

SQLNumParams (level two only)

SQLNumParams returns the number of parameters in an SQL statement.

The following table describes the SQLSTATE and error values for SQLNumParams.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1008	-11065	`Operation canceled`
S1010	-11067	`Function-sequence error`
S1T00	-11094	`Time-out expired`

SQLNumResultCols (core level only)

SQLNumResultCols returns the number of columns in a result set.

The following table describes the SQLSTATE and error values for SQLNumResultCols.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1008	-11065	`Operation canceled`
S1010	-11067	`Function-sequence error`
S1T00	-11094	`Time-out expired`

SQLNumResultCols can return any SQLSTATE that SQLPrepare or SQLExecute can return when SQLNumResultCols is called after SQLPrepare and before SQLExecute is called, depending on when the data source evaluates the SQL statement associated with the *hstmt*.

SQLParamData (level one only)

SQLParamData is used with SQLPutData to supply parameter data when a statement executes.

The following table describes the SQLSTATE and error values for SQLParamData.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
08S01	-11020	`Communication-link failure`
22026	-11029	`String data, length mismatch`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1008	-11065	`Operation canceled`
S1010	-11067	`Function-sequence error`
S1T00	-11094	`Time-out expired`
S1C00	-11300	`SQL_DEFAULT_PARAM not supported`
08S01	-11301	`A protocol error has been detected. Current connection is closed.`

If SQLParamData is called while sending data for a parameter in an SQL statement, it can return any SQLSTATE that can be returned by the function that was called to execute the statement (SQLExecute or SQLExecDirect). If it is called while sending data for a column being updated or added with SQLSetPos, it can return any SQLSTATE that can be returned by SQLSetPos.

SQLParamOptions (core and level two only)

SQLParamOptions allows an application to specify multiple values for the set of parameters assigned by SQLBindParameter.

The ability to specify multiple values for a set of parameters is useful for bulk inserts and other work that requires the data source to process the same SQL statement multiple times with various parameter values. For example, an application can specify three sets of values for the set of parameters associated with an INSERT statement, and then execute the INSERT statement once to perform the three insert operations.

The following table lists the SQLSTATE values commonly returned by SQLParamOptions and explains each one in the context of this function; the notation `(DM)` precedes the description of each SQLSTATE returned by the driver manager. The return code associated with each SQLSTATE value is SQL_ERROR unless noted otherwise.

SQLSTATE	Error value	Error message
01000		`General warning`
S1000		`General error`
S1001		`Memory-allocation failure`
S1010		`Function-sequence error`
S1107		`Row value out of range`

SQLPrepare

SQLPrepare prepares an SQL string for execution.

The following table describes the SQLSTATE and error values for SQLPrepare.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
08S01	-11020	`Communication-link failure`
21S01	-11021	`Insert value list does not match column list`
21S02	-11022	`Degree of derived table does not match column list`
22005	-11026	`Error in assignment`
24000	-11031	`Invalid cursor state`
34000	-11034	`Invalid cursor name`
37000	-11035	`Syntax error or access violation`
42000	-11038	`Syntax error or access violation`
S0001	-11053	`Base table or view already exists`
S0002	-11054	`Base table not found`

SQLSTATE	Error value	Error message
S0011	-11055	`Index already exists`
S0012	-11056	`Index not found`
S0021	-11057	`Column already exists`
S0022	-11058	`Column not found`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1008	-11065	`Operation canceled`
S1009	-11066	`Invalid argument value`
S1010	-11067	`Function-sequence error`
S1090	-11071	`Invalid string or buffer length`
S1C00	-11092	`Driver not capable`
S1T00	-11094	`Time-out expired`
08S01	-11301	`A protocol error has been detected. Current connection is closed.`
S1000	-11310	`Create and Drop must be executed within a ServerOnly Connection`
S1000	-11320	`Syntax error`
S1000	-11323	`The statement contained an escape clause not supported by this database driver`

SQLPrimaryKeys (level two only)

SQLPrimaryKeys returns the column names that comprise the primary key for a table.

The driver returns the information as a result set. This function does not support returning primary keys from multiple tables in a single call.

The following table describes the SQLSTATE and error values for SQLPrimaryKeys.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
08S01	-11020	`Communication-link failure`
24000	-11031	`Invalid cursor state`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1008	-11065	`Operation canceled`

SQLSTATE	Error value	Error message
S1010	-11067	`Function-sequence error`
S1090	-11071	`Invalid string or buffer length`
S1C00	-11092	`Driver not capable`
S1T00	-11094	`Time-out expired`
S1C00	-11300	`SQL_DEFAULT_PARAM not supported`
08S01	-11301	`A protocol error has been detected. Current connection is closed.`
S1000	-11310	`Create and Drop must be executed within a ServerOnly Connection`
S1000	-11320	`Syntax error`
S1000	-11323	`The statement contained an escape clause not supported by this database driver`

SQLProcedureColumns (level two only)

SQLProcedureColumns returns the list of input and output parameters, as well as the columns that make up the result set for the specified procedures.

The driver returns the information as a result set on the specified *hstmt*.

The following table describes the SQLSTATE and error values for SQLProcedureColumns.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
08S01	-11020	`Communication link failure`
24000	-11031	`Invalid cursor state`
IM001	-11040	`Driver does not support this function`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1008	-11065	`Operation canceled`
S1010	-11067	`Function sequence error`
S1090	-11071	`Invalid string or buffer length`
S1C00	-11092	`Driver not capable`
S1T00	-11094	`Time-out expired`
S1C00	-11300	`SQL_DEFAULT_PARAM not supported`
08S01	-11301	`A protocol error has been detected. Current connection is closed.`

SQLSTATE	Error value	Error message
S1000	-11310	`Create and Drop must be executed within a ServerOnly Connection`
S1000	-11320	`Syntax error`
S1000	-11323	`The statement contained an escape clause not supported by this database driver`

SQLProcedures (level two only)

SQLProcedures returns the list of procedure names stored in a specific data source.

Procedure is a generic term used to describe an *executable object*, or a named entity that can be started with input and output parameters, and which can return result sets similar to the results that SELECT statements return.

The following table describes the SQLSTATE and error values for SQLProcedures.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
08S01	-11020	`Communication-link failure`
24000	-11031	`Invalid cursor state`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1008	-11065	`Operation canceled`
S1010	-11067	`Function-sequence error`
S1090	-11071	`Invalid string or buffer length`
S1C00	-11092	`Driver not capable`
S1T00	-11094	`Time-out expired`
S1C00	-11300	`SQL_DEFAULT_PARAM not supported`
08S01	-11301	`A protocol error has been detected. Current connection is closed.`
S1000	-11310	`Create and Drop must be executed within a ServerOnly Connection`
S1000	-11320	`Syntax error`
S1000	-11323	`The statement contained an escape clause not supported by this database driver`

SQLPutData (level one only)

SQLPutData allows an application to send data for a parameter or column to the driver at statement execution time.

This function can send character or binary data values in parts to a column with a character, binary, or data-source-specific data type (for example, parameters of SQL_LONGVARBINARY or SQL_LONGVARCHAR).

The following table describes the SQLSTATE and error values for SQLPutData.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
01004	-11003	`Data truncated`
07S01	-11014	`Invalid use of default parameter`
08S01	-11020	`Communication-link failure`
22001	-11023	`String data right truncation`
22003	-11025	`Numeric value out of range`
22005	-11026	`Error in assignment`
22008	-11027	`Datetime-field overflow`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1008	-11065	`Operation canceled`
S1009	-11066	`Invalid argument value`
S1010	-11067	`Function-sequence error`
S1090	-11071	`Invalid string or buffer length`
S1T00	-11094	`Time-out expired`

Important: An application can use SQLPutData to send sections of character C data to a column with a character, binary, or data source-specific data type or to send binary C data to a column with a character, binary, or data source-specific data type. If SQLPutData is called more than once under any other conditions, it returns SQL_ERROR and SQLSTATE 22003 (Numeric value out of range).

SQLRowCount (core level only)

SQLRowCount returns the number of rows affected by an UPDATE, INSERT, or DELETE statement or by an SQL_UPDATE, SQL_ADD, or SQL_DELETE operation in SQLSetPos.

The following table describes the SQLSTATE and error values for SQLRowCount.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`

SQLSTATE	Error value	Error message
S1010	-11067	`Function-sequence error`

SQLSetConnectOption (level one only)

SQLSetConnectOption sets options that govern aspects of connections.

The following table describes the SQLSTATE and error values for SQLSetConnectOption.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
01S02	-11007	`Option value changed`
08002	-11016	`Connection in use`
08003	-11017	`Connection not open`
08S01	-11020	`Communication-link failure`
IM009	-11048	`Unable to load translation shared library (DLL)`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1009	-11066	`Invalid argument value`
S1010	-11067	`Function-sequence error`
S1011	-11068	`Operation invalid at this time`
S1092	-11073	`Option type out of range`
S1C00	-11092	`Driver not capable`
08S01	-11301	`A protocol error has been detected. Current connection is closed.`
S1000	-11320	`Syntax error`
S1000	-11323	`The statement contained an escape clause not supported by this database driver`

When *fOption* is a statement option, SQLSetConnectOption can return any SQLSTATE that SQLSetStmtOption returns.

SQLSetCursorName (core level only)

SQLSetCursorName associates a cursor name with an active *hstmt*.

If an application does not call SQLSetCursorName, the driver generates cursor names as needed for SQL statement processing.

The following table describes the SQLSTATE and error values for SQLSetCursorName.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
24000	-11031	`Invalid cursor state`
34000	-11034	`Invalid cursor name`
3C000	-11036	`Duplicate cursor name`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1009	-11066	`Invalid argument value`
S1010	-11067	`Function-sequence error`
S1090	-11071	`Invalid string or buffer length`

SQLSetStmtOption (level one only)

SQLSetStmtOption sets options that are related to an *hstmt*.

To set an option for all the statements associated with a specific *hdbc*, an application can call SQLSetConnectOption.

The following table describes the SQLSTATE and error values for SQLSetStmtOption.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
01S02	-11007	`Option value changed`
08S01	-11020	`Communication-link failure`
24000	-11031	`Invalid cursor state`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1009	-11066	`Invalid argument value`
S1010	-11067	`Function-sequence error`
S1011	-11068	`Operation invalid at this time`
S1092	-11073	`Option type out of range`
S1C00	-11092	`Driver not capable`

SQLSpecialColumns (level one only)

SQLSpecialColumns retrieves information about columns.

SQLSpecialColumns retrieves the following information about columns within a specified table:

- The optimal set of columns that uniquely identifies a row in the table
- Columns that are automatically updated when any value in the row is updated by a transaction

The following table describes the SQLSTATE and error values for SQLSpecialColumns.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
08S01	-11020	`Communication-link failure`
24000	-11031	`Invalid cursor state`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1008	-11065	`Operation canceled`
S1010	-11067	`Function-sequence error`
S1090	-11071	`Invalid string or buffer length`
S1097	-11078	`Column type out of range`
S1098	-11079	`Scope type out of range`
S1099	-11080	`Nullable type out of range`
S1C00	-11092	`Driver not capable`
S1T00	-11094	`Time-out expired`
S1C00	-11300	`SQL_DEFAULT_PARAM not supported`
08S01	-11301	`A protocol error has been detected. Current connection is closed.`
S1000	-11310	`Create and Drop must be executed within a ServerOnly Connection`
S1000	-11320	`Syntax error`
S1000	-11323	`The statement contained an escape clause not supported by this database driver`

SQLStatistics (level one only)

SQLStatistics retrieves a list of statistics about a single table and the indexes associated with the table.

The driver returns this information as a result set.

The following table describes the SQLSTATE and error values for SQLStatistics.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
08S01	-11020	`Communication-link failure`
24000	-11031	`Invalid cursor state`
S1000	-11060	`General error`
S1001	-11061	`Memory- allocation failure`
S1008	-11065	`Operation canceled`
S1010	-11067	`Function-sequence error`
S1090	-11071	`Invalid string or buffer length`
S1100	-11081	`Uniqueness option type out of range`
S1101	-11082	`Accuracy option type out of range`
S1C00	-11092	`Driver not capable`
S1T00	-11094	`Time-out expired`
S1C00	-11300	`SQL_DEFAULT_PARAM not supported`
08S01	-11301	`A protocol error has been detected. Current connection is closed.`
S1000	-11310	`Create and Drop must be executed within a ServerOnly Connection`
S1000	-11320	`Syntax error`
S1000	-11323	`The statement contained an escape clause not supported by this database driver`

SQLTablePrivileges (level two only)

SQLTablePrivileges returns a list of tables and the privileges associated with each table.

The driver returns the information as a result set on the specified *hstmt*.

The following table describes the SQLSTATE and error values for SQLTablePrivileges.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
08S01	-11020	`Communication-link failure`
24000	-11031	`Invalid cursor state`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`

SQLSTATE	Error value	Error message
S1008	-11065	`Operation canceled`
S1010	-11067	`Function-sequence error`
S1090	-11071	`Invalid string or buffer length`
S1C00	-11092	`Driver not capable`
S1T00	-11094	`Time-out expired`
S1C00	-11300	`SQL_DEFAULT_PARAM not supported`
08S01	-11301	`A protocol error has been detected. Current connection is closed.`
S1000	-11310	`Create and Drop must be executed within a ServerOnly Connection`
S1000	-11320	`Syntax error`
S1000	-11323	`The statement contained an escape clause not supported by this database driver`

SQLTables (level one only)

SQLTables returns the list of table names that are stored in a specific data source.

The driver returns this information as a result set.

The following table describes the SQLSTATE and error values for SQLTables.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
08S01	-11020	`Communication-link failure`
24000	-11031	`Invalid cursor state`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1008	-11065	`Operation canceled`
S1010	-11067	`Function-sequence error`
S1090	-11071	`Invalid string or buffer length`
S1C00	-11092	`Driver not capable`
S1T00	-11094	`Time-out expired`
S1C00	-11300	`SQL_DEFAULT_PARAM not supported`
08S01	-11301	`A protocol error has been detected. Current connection is closed.`

SQLSTATE	Error value	Error message
S1000	-11310	`Create and Drop must be executed within a ServerOnly Connection`
S1000	-11320	`Syntax error`
S1000	-11323	`The statement contained an escape clause not supported by this database driver`

SQLTransact (core level only)

SQLTransact requests a commit or rollback operation for all active operations on all *hstmts* associated with a connection.

SQLTransact can also request that a commit or rollback operation is performed for all connections associated with the *henv*.

The following table describes the SQLSTATE and error values for SQLTransact.

SQLSTATE	Error value	Error message
01000	-11001	`General warning`
08003	-11017	`Connection not open`
S1000	-11060	`General error`
S1001	-11061	`Memory-allocation failure`
S1010	-11067	`Function-sequence error`
S1012	-11069	`Invalid transaction operation code specified`
S1C00	-11092	`Driver not capable`
08S01	-11301	`A protocol error has been detected. Current connection is closed.`

Unicode

These topics provide a brief overview of the Unicode standard and shows how it is used within ODBC applications.

Related reference

Global Language Support on page 18

Overview of Unicode

Unicode is a character encoding standard that provides a means of representing each character used in every major language.

In the Unicode standard, each character is assigned a unique numeric value and name. These values can be used consistently between applications across multiple platforms.

Unicode versions

Although Unicode provides a consistent way of representing text across multiple languages, there are different versions which provide different data sizes for each character.

The following list describes the versions that are supported within HCL Informix® ODBC applications.

UCS-2

ISO encoding standard that maps Unicode characters to 2 bytes each. UCS-2 is the common encoding standard on Windows™.

HCL Informix® ODBC Driver for IBM® AIX® platforms supports UCS-2 encoding. HCL Informix® ODBC Driver for Windows™ supports only UCS-2.

UCS-4

ISO encoding standard that maps Unicode characters into 4 bytes each.

The HCL Informix® ODBC Driver supports UCS-4 on UNIX™ platforms.

UTF-8

Encoding standard that is based on a single (8 bit) byte. UTF-8 defines a mechanism to transform all Unicode characters into a variable length (1 - 4) encoding of bytes.

The HCL Informix® ODBC Driver uses UTF-8 encoding for all UNIX™ applications that connect to the Data Direct (formerly Merant) driver manager.

The 7-bit ASCII characters have the same encoding under both ASCII and UTF-8. This has the advantage that UTF-8 can be used with much existing software without extensive revision.

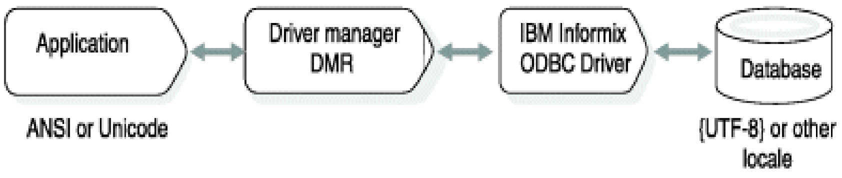
Important: In applications that use Unicode, the driver does the work of code set conversion from Unicode to the database locale and vice versa.The UTF-8 is the only type of Unicode code set that can be set as the client locale.

Unicode in an ODBC application

View the typical ODBC application architecture.

The following diagram shows the architecture of a typical ODBC application with a driver manager and the HCL Informix® ODBC Driver.

Figure 7. Typical ODBC application architecture



In this scenario, if an application calls to Unicode enabled APIs, then it must be connected to a Unicode enabled HCL Informix® ODBC Driver (Version 3.8 and later) to ensure that there is no loss of data. If the application calls to ANSI ODBC APIs, the application can be linked to either a Unicode enabled driver or an ANSI driver.

The HCL Informix® ODBC Driver continues to support HCL Informix® GLS. Hence all data fetched in character buffers are fetched in the client locale code set. Only data fetched with wide character buffers use Unicode.

On Windows™, if the ODBC driver is not Unicode enabled, the ODBC Driver Manager maps all Unicode API function calls to ANSI ODBC APIs.

If the ODBC driver is Unicode enabled, the Windows™ ODBC Driver Manager (Version 4.10 or later) maps all ANSI ODBC APIs to Unicode ODBC APIs. The Data Direct (formerly Merant) driver manager for UNIX™ also works this way.

Important: In CSDK Version 2.70 there are two ODBC drivers. One with only ANSI APIs (called ANSI ODBC Driver, Version 3.34) and another with both ANSI and UNICODE APIs (called Unicode ODBC Driver, Version 3.80). For CSDK 2.80 and later, there is only one ODBC driver that supports both ANSI and UNICODE APIs.

Important: The HCL® Informix® Driver Manager Replacement (DMR) for UNIX™ platforms does not map between Unicode and ANSI APIs.

For details about how the Windows™ ODBC driver manager handles mapping, see the section "Function Mapping in the Driver Manager" in the *ODBC Programmer's Reference* for Microsoft™.

Unicode in an ODBC application

This section provides details on compiling and configuring Unicode within HCL® Informix® ODBC applications.

Configuration

Since the HCL Informix® ODBC Driver supports different types of Unicode on UNIX™ platforms, the type of Unicode used by an application must be indicated in the ODBC section of the `odbc.ini` file.

Indicate the type of Unicode in the ODBC section as follows:

```
[ODBC]
.
.
.
UNICODE=UCS-4
```

Important: A Unicode-enabled application must indicate the type of Unicode used in the `odbc.ini` file. If the Unicode parameter is not set in `odbc.ini`, the default type is UCS-4.

It is required that all UNIX™ ODBC applications must set the Unicode type in the `odbc.ini` file as follows:

- An ANSI ODBC application on UNIX™ (including AIX® 64-bit) must set UNICODE=UCS-4
- An ANSI ODBC application on IBM® AIX® 32-bit must set UNICODE-UCS-2
- An ANSI ODBC application that uses the Data Direct (formerly Merant) ODBC driver manager never indicates a Unicode type other than UTF-8 in the `odbc.ini` file.

The following table provides an overview of the `odbc.ini` settings:

Platform	Driver manager	`odbc.ini` setting
AIX®	Data Direct	UTF-8
AIX® 32-bit	DMR or none	UCS-2
AIX® 64-bit	Data Direct	UTF-8
UNIX™	Data Direct	UTF-8
UNIX™	DMR or none	UCS-4
Windows™	Windows™ ODBC Driver Manager	N/A

Important:

If all of the following conditions exist, the settings are automatically reset without any warning or error message:

- The application is an ANSI application.
- You are linking with DMR or none.
- The Unicode setting in the odbc.ini file does not match the values shown in the table.

ODBC Smart trigger

Smart Triggers (also known as Pushdata) in ODBC 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. It is available across all CSDK/ODBC supported platforms.

It uses ODBC's standard APIs SQLSetStmtAttr()/SQLSetStmtAttrA()/SQLSetStmtAttrW() and SQLGetStmtAttr()/SQLGetStmtAttrA()/SQLGetStmtAttrW() with following Informix extensions, defined in `infxcli.h` file.

```
 SQL_INFX_ATTR_OPEN_SMART_TRIGGER
SQL_INFX_ATTR_JOIN_SMART_TRIGGER
SQL_INFX_ATTR_GET_LO_FILE_DESC_SMART_TRIGGER
SQL_INFX_ATTR_GET_SESSION_ID_SMART_TRIGGER
SQL_INFX_ATTR_REGISTER_SMART_TRIGGER
SQL_INFX_ATTR_GET_DATA_SMART_TRIGGER_LOOP
SQL_INFX_ATTR_GET_DATA_SMART_TRIGGER_NO_LOOP
SQL_INFX_ATTR_DELETE_SMART_TRIGGER
```

ODBC API

Using the following ODBC API to use Smart Trigger:

1. Allocate Environment handle
2. Allocate Connection Handle
3. Connect to “sysadmin? database
4. Allocate statement handle
5. Call SQLSetStmtAttr(SQL_INFX_ATTR_OPEN_SMART_TRIGGER) and using structure IFMX_OPEN_SMART_TRIGGER
6. Call SQLGetStmtAttr(SQL_INFX_ATTR_GET_LO_FILE_DESC_SMART_TRIGGER) and get the File Descriptor ID (to be used for registering the event/queries, the same File Descriptor to be used for multiple event/queries)
7. Following steps could be in thread loop for each event/query to be registered.
    a. SQLAllocHandle(STMT)
    b. Fill/Populate the SQL_INFX_ATTR_REGISTER_SMART_TRIGGER structure
    c. Call SQLSetStmtAttr(SQL_INFX_ATTR_REGISTER_SMART_TRIGGER)
    d. Call SQLGetStmtAttr(SQL_INFX_ATTR_GET_DATA_SMART_TRIGGER_LOOP / SQL_INFX_ATTR_GET_DATA_SMART_TRIGGER_NO_LOOP)

Once you register the event or join the already registered session, the call becomes blocking (ODBC waits for IDS server to return the message/data), once the data/response or timeout message is received from IDS server, ODBC invokes the registered callback function with output buffer.

Note: It is read only buffer and application should not tamper the buffer.

Once the control comes back to application (callback function), application may decide to come out of the loop by setting IFMX_JOIN_SMART_TRIGGER->ControlBackToApplication OR SQL_INFX_ATTR_REGISTER_SMART_TRIGGER->isDeregister to TRUE. If you decide to continue, then there is no action needed by you in the callback function (other than consuming the received output).

Register the smart trigger events

File Descriptor is required to “register the events". After successful call to SQLSetStmtAttr(SQL_INFX_ATTR_OPEN_SMART_TRIGGER), application should call following SQLGetStmtAttr() API to get the “File Descriptor?. The same “File Descriptor? should be used to “Register the smart trigger/pushdata events?.

```
SQLGetStmtAttr(hstmt, SQL_INFX_ATTR_GET_LO_FILE_DESC_SMART_TRIGGER, (int *)&FileDesc, SQL_NTS, NULL);
```

Application should use “File Descriptor? received from above SQLGetStmtAttr() call and other inputs like table, database, user, query etc to populate/fill the structure (mentioned above) IFMX_REGISTER_SMART_TRIGGER. Application should make call to SQLSetStmtAttr() as follows. Application can register as many as events/queries they want in each thread (application example below). It is advised to use separate statement handle for each registration.

```
    SQLAllocHandle (SQL_HANDLE_STMT, hdbc, &tmpHstmt );
    SQLSetStmtAttr(tmpHstmt, SQL_INFX_ATTR_REGISTER_SMART_TRIGGER, (void *)&SmartTriggerInstance, SQL_NTS);
```

If the session was opened with detachable option then session ID will be created. Application can save the same session ID and could use the same later to attach/join to the session. Below API should be used to attach/join the session using structure IFMX_JOIN_SMART_TRIGGER. All the registered events/queries with the attached/joined session will be in effect.

```
SQLSetStmtAttr(hstmt, SQL_INFX_ATTR_JOIN_SMART_TRIGGER, (void *)&gJoinSmartTrigger, SQL_NTS);
```

Delete the registered session

If the session was registered as detachable session, there should be “session ID?. The same session ID should be used to delete the session by making below call.

```
SQLSetStmtAttr(hstmt, SQL_INFX_ATTR_DELETE_SMART_TRIGGER, (int *)&sesID, SQL_NTS);
```

API Structure

- **IFMX_OPEN_SMART_TRIGGER structure**: This is input structure to be used in SQLSetStmtAttr() call while establishing the smart trigger/pushdata session. The allocation & deallocation of this structure and it’s members is application’s responsibility. Each member of the structure is explained below:

  BOOL *isDetachable -> If the session is expected to be reused at later time, even after finishing the application, one should set this flag to TRUE. Otherwise set to FALSE.

  int *timeOut-> Time in seconds, as per registered event/query, if no event happens, IDS sever will send “timeout? message to ODBC based on the value set for this member. Valid range is 0 to 12000 seconds. If it’s beyond these value, internally it will be set to 300 seconds.

  short *maxRecsPerRead->This is number of records, returned (in callback function output buffer). Default is 1. Valid allowed range is 1 to 200. The max buffer size is 8KB, if this number is set high, it will return data only max of 8KB at a time, which may not match the number of records.

  int *maxPendingOperations->Maximum pending operation. Default is 0. Allowed range is 0 to 200.

  SQLWCHAR reserved[16]->Reserved for future usage.
- **IFMX_JOIN_SMART_TRIGGER structure**: This structure is used to attach/join already opened session. Each member of the structure is explained below:

  void(*callback) (char const *jsonOutBuf)-> This is user defined callback function. This will be called when response from IDS server is received on registered event/query(events/queries) for a session to be attached/joined. The data returned is read only for the user.

  int *joinSessionID-> This is to be assigned from the value received from the SQLGetStmtAttr() call. This session ID will be used to connect to prior registered session.

  BOOL *ControlBackToApplication-> Once control comes back to application (as part of callback call), if user decides to come out of the blocking call (event registration is blocking call), user can set this flag to TRUE.

  SQLWCHAR reserved[16] -> Reserved for future usage.
- **IFMX_REGISTER_SMART_TRIGGER structure**: This structure is used to register the event/query on already opened smart trigger/pushdata session. There could be as many as trigger/event user wants to register. Each trigger/event should be invoked with separate thread. Each member of the structure is explained below.

  void(*callback) (char const *jsonOutBuf)-> This is user defined callback function. This will be called when response from IDS server is received on registered event/query. The data returned is read only for the user.

int *loFileDescriptor -> This is input, which is received from SQLGetStmtAttr(SQL_INFX_ATTR_GET_LO_FILE_DESC_SMART_TRIGGER) call. For each event/query registration for a given session, this value will remain same.

SQLWCHAR *tableName -> This is table name to be registered. The input to be provided in SQLWCHAR type. Max length as per IDS supported table length.

SQLWCHAR *ownerName -> This is user/owner of table to be registered. The input to be provided in SQLWCHAR type. Max length as per IDS supported user/owner length.

SQLWCHAR *dbName -> This is database name where the table belongs. The input to be provided in SQLWCHAR type. Max length as per IDS supported database length.

SQLWCHAR *sqlQuery -> This is the SELECT query which is on registered table. The input to be provided in SQLWCHAR type. Max length of query 4KB.

SQLWCHAR *label -> If NULL, internally, ODBC will create the label using table name, owner name database name & internal counter i.e. "%s_%s_%s_%d". The input to be provided in SQLWCHAR type.

BOOL *isDeregister -> Smart Trigger/Pushdata is blocking call, the control is back to application when ODBC calls user specified callback function. If user wants to come out of the blocking call, they can set this flag to TRUE.

BOOL *ControlBackToApplication-> Once control comes back to application (as part of callback call), if user decides to come out of the blocking call without non-registering the event (event registration is blocking call), user can set this flag to TRUE.

SQLWCHAR reserved[16] -> Reserved for future usage.

Compiling sample application on Linux

Use below compilation/linking steps, assuming C file name is SmartTrigger.c and application links directly to Informix driver (no Driver Manager).

```
gcc -g -c -fsigned-char -DNO_WIN32 -O -I$INFORMIXDIR/incl/cli -I$INFORMIXDIR/incl/esql -I$INFORMIXDIR/incl/dmi
 SmartTrigger.c
```

```
gcc -g -o SmartTrigger SmartTrigger.o -L$INFORMIXDIR/lib/cli -L$INFORMIXDIR/lib/esql -lthcli -lifdmr
 -L$INFORMIXDIR/lib/esql -lifgls -lifglx -lm -lnsl
```

Compiling sample application on Windows

Use below steps to compile the Smart Trigger application on Windows.

```
cl /Zi /DEBUG /MD /D_CRT_SECURE_NO_DEPRECATE /D_CRT_NON_CONFORMING_SWPRINTFS  /D
_CRT_NONSTDC_NO_DEPRECATE /I%INFORMIXDIR%\incl\cli %INFORMIXDIR%\lib\iclit09b.lib odbc32.lib odbccp32.lib
 SmartTrigger.c
```

The below example, supports two(2) trigger/event registration, hence two threads (NUM_OF_INSTANCE) has been used. There are following 3 functions which needs to be changed to provide appropriate input for your environment.

1. SetConnectionString() => This is for database connection, you can provide “DSN=<value>? as well, depending on your choice. In this function, you need to provide your own connection string.
2. AssignOpenParams() => In this function, you may need to change timeout, number of records(1 is recommended) etc parameters for smart trigger/pushdata session opening.
3. AssignRegisterParams() => In this function, you need to change, callback function, table, owner, database and query values which suits your environment. This function uses two such events/inputs to be registered.

ODBC sample application

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#ifndef NO_WIN32
#include <io.h>
#include <windows.h>
#include <conio.h>
#endif /*NO_WIN32*/

#define __REENTRANT
#include <signal.h>
#ifdef NO_WIN32
#include <sys/wait.h>
#include <pthread.h>
#endif
#include <time.h>
#include <infxcli.h>

#define ERRMSG_LEN         200
#define NAMELEN            300
#define NUM_OF_INSTANCE    2

SQLHDBC        hdbc;
SQLHENV        henv;
SQLHSTMT       hstmt;
SQLINTEGER     sesID = 0;
SQLWCHAR       connStrInW[NAMELEN];
SQLCHAR       connStrIn[NAMELEN];
BOOL           delete = 0;
int            gFileDesc = 0;
int            fileDesc[NUM_OF_INSTANCE];
int            timeOut;
short          maxRec;
int            maxPend;
int            detachable;
BOOL           dregister[NUM_OF_INSTANCE];
BOOL           ControlBack[NUM_OF_INSTANCE];

IFMX_REGISTER_SMART_TRIGGER  gSmartTriggerRegister[NUM_OF_INSTANCE];
IFMX_OPEN_SMART_TRIGGER      gopenSmartTrigger;
IFMX_JOIN_SMART_TRIGGER      gJoinSmartTrigger;
```

```
SQLINTEGER checkError (SQLRETURN       rc,
                       SQLSMALLINT     handleType,
                       SQLHANDLE       handle,
                       SQLCHAR*        errmsg)
{
    SQLRETURN      retcode = SQL_SUCCESS;
    SQLSMALLINT    errNum = 1;
    SQLWCHAR             sqlStateW[6];
    SQLCHAR                 *sqlState;
    SQLINTEGER     nativeError;
    SQLWCHAR             errMsgW[ERRMSG_LEN];
    SQLCHAR                 *errMsg;
    SQLSMALLINT    textLengthPtr;


    if ((rc != SQL_SUCCESS) && (rc != SQL_SUCCESS_WITH_INFO))
    {
        while (retcode != SQL_NO_DATA)
        {
            retcode = SQLGetDiagRecW (handleType, handle, errNum, sqlStateW, &nativeError, errMsgW, ERRMSG_LEN,
 &textLengthPtr);

            if (retcode == SQL_INVALID_HANDLE)
            {
                fprintf (stderr, "checkError function was called with an invalid handle!!\n");
                return 1;
            }

            if ((retcode == SQL_SUCCESS) || (retcode == SQL_SUCCESS_WITH_INFO))
            {
                sqlState = (SQLCHAR *) malloc (wcslen(sqlStateW) + sizeof(char));
                wcstombs( (char *) sqlState, sqlStateW, wcslen(sqlStateW)
                          + sizeof(char));

                errMsg = (SQLCHAR *) malloc (wcslen(errMsgW) + sizeof(char));
                wcstombs( (char *) errMsg, errMsgW, wcslen(errMsgW)
                          + sizeof(char));

                fprintf (stderr, "ERROR: %d:  %s : %s \n", nativeError, sqlState, errMsg);
            }

            errNum++;
        }

        fprintf (stderr, "%s\n", errmsg);
        return 1;   /* all errors on this handle have been reported */
    }
    else
        return 0;       /* no errors to report */
}

void TriggerCallback1(char const *outBuf)
{
  dregister[0] = FALSE; //TRUE;
  ControlBack[0] = FALSE;
  printf("\nCallback #1");
  if(outBuf != NULL)
    printf("\nData received : %s\n", outBuf);
  else
    printf("\nReturned NULL data!!");

  gSmartTriggerRegister[0].isDeregister = &dregister[0];
  gSmartTriggerRegister[0].ControlBackToApplication = &ControlBack[0];
  gJoinSmartTrigger.ControlBackToApplication = &ControlBack[0];
  return;
}

void TriggerCallback2(char const *outBuf)
{
  dregister[1] = FALSE;
  ControlBack[1] = FALSE; //TRUE;
  printf("\nCallback #2");
  if(outBuf != NULL)
    printf("\nData received : %s\n", outBuf);
  else
    printf("\nReturned NULL data!!");

  gSmartTriggerRegister[1].isDeregister = &dregister[1];
  gSmartTriggerRegister[1].ControlBackToApplication = &ControlBack[1];
  gJoinSmartTrigger.ControlBackToApplication = &ControlBack[1];
  return;
}

DWORD ThreadRegisterPushDataQuery(void *lpParam)
{
    SQLRETURN rc = 0;
    SQLHSTMT  tmpHstmt;
    SQLINTEGER      dummy = 0;

    IFMX_REGISTER_SMART_TRIGGER  temp;
    IFMX_REGISTER_SMART_TRIGGER  SmartTriggerInstance;

    SmartTriggerInstance = *((IFMX_REGISTER_SMART_TRIGGER *)lpParam);

    rc = SQLAllocHandle (SQL_HANDLE_STMT, hdbc, &tmpHstmt );
    if (checkError (rc, SQL_HANDLE_DBC, hdbc, (SQLCHAR *) "Error(Thread) in Step 1 -- Statement Handle
 Allocation failed\nExiting!!"))
        exit(-1);

    rc = SQLSetStmtAttrW(tmpHstmt, SQL_INFX_ATTR_REGISTER_SMART_TRIGGER,(IFMX_REGISTER_SMART_TRIGGER
 *)&SmartTriggerInstance, SQL_IS_POINTER);
    if (checkError(rc, SQL_HANDLE_DBC, hdbc, (SQLCHAR *) "Error(Thread) in Step 2 -- SQLSetStmtAttr
 failed\nExiting!!"))
        exit(-1);
    rc = SQLGetStmtAttrW(tmpHstmt, SQL_INFX_ATTR_GET_DATA_SMART_TRIGGER_LOOP,(void *)&dummy, SQL_NTS, NULL);
    //rc = SQLGetStmtAttrW(tmpHstmt, SQL_INFX_ATTR_GET_DATA_SMART_TRIGGER_NO_LOOP,(void *)&dummy, SQL_NTS,
 NULL);
    if (checkError(rc, SQL_HANDLE_DBC, hdbc, (SQLCHAR *) "Error(Thread) in Step 2 -- SQLGetStmtAttr
 failed\nExiting!!"))
        exit(-1);

    SQLFreeHandle(SQL_HANDLE_STMT, tmpHstmt);
    printf("\nFinished thread execution\n");
```

```
}

void SetConnectionString()
{
#ifdef NO_WIN32
   //sprintf((char *) connStrIn, "DRIVER={IBM INFORMIX ODBC
 DRIVER};HOST=x.x.x.x;SERVER=ol_informix1210_2;SERVICE=8573;PROTOCOL=onsoctcp;DATABASE=sysadmin;UID=informix;PW
D=xxx");
   wsprintf((SQLWCHAR *) connStrInW, "DSN=SmartTrigger");
#else
   //sprintf((char *) connStrIn, "DRIVER={IBM INFORMIX ODBC
 DRIVER};HOST=x.x.x.x;SERVER=ol_informix1210_1;SERVICE=20195;PROTOCOL=onsoctcp;DATABASE=sysadmin;UID=informix;P
WD=xxx");
   swprintf((SQLWCHAR *) connStrInW, L"DSN=SmartTrigger");
#endif
   return;
}

void AssignOpenParams()
{
    timeOut = 5; //In seconds
    maxRec = 1; //Maximum number of records to get, (8192 Bytes limit)
    maxPend = 0;
    detachable = FALSE; //TRUE, If want to retain session for later usage
    delete = FALSE; //TRUE, if want to delete the detachable session

    gopenSmartTrigger.timeOut = &timeOut;
    gopenSmartTrigger.isDetachable = &detachable;
    gopenSmartTrigger.maxRecsPerRead = &maxRec;
    gopenSmartTrigger.maxPendingOperations = &maxPend;

    return;
}

void AssignRegisterParams(IFMX_REGISTER_SMART_TRIGGER *SmartTriggerInstance, int FileDesc, int i)
{
    fileDesc[i] = FileDesc;
    dregister[i] = FALSE; // Just initialize, should be changed in callback
    ControlBack[i] = FALSE; // Just initialize, should be changed in callback
    SmartTriggerInstance->loFileDescriptor = &fileDesc[i];
    SmartTriggerInstance->tableName = (SQLWCHAR *)malloc(50 * sizeof(SQLWCHAR));
    SmartTriggerInstance->ownerName = (SQLWCHAR *)malloc(50 * sizeof(SQLWCHAR));
    SmartTriggerInstance->dbName = (SQLWCHAR *)malloc(50 * sizeof(SQLWCHAR));
    SmartTriggerInstance->sqlQuery = (SQLWCHAR *)malloc(500 * sizeof(SQLWCHAR));
    //SmartTriggerInstance->label = (SQLWCHAR *)malloc(50 * sizeof(SQLWCHAR));
    SmartTriggerInstance->label = NULL;
    SmartTriggerInstance->isDeregister = &dregister[i];
    SmartTriggerInstance->ControlBackToApplication = &ControlBack[i];

    //wcscpy((SQLWCHAR *)SmartTriggerInstance->ownerName, L"shesh");
    //wcscpy((SQLWCHAR *)SmartTriggerInstance->dbName, L"sheshdb");
    wsprintf((SQLWCHAR *)SmartTriggerInstance->ownerName, "shesh");
    wsprintf((SQLWCHAR *)SmartTriggerInstance->dbName, "sheshdb");

    if (i==0)
    {
       SmartTriggerInstance->callback = TriggerCallback1;
       //wcscpy((SQLWCHAR *)SmartTriggerInstance->label, L"label1");
       //wcscpy((SQLWCHAR *)SmartTriggerInstance->tableName, L"tab1");
       //wcscpy((SQLWCHAR *)SmartTriggerInstance->sqlQuery, L"select * from tab1;");
       //wsprintf((SQLWCHAR *)SmartTriggerInstance->label, "label1");
       wsprintf((SQLWCHAR *)SmartTriggerInstance->tableName, "tab1");
       wsprintf((SQLWCHAR *)SmartTriggerInstance->sqlQuery, "select * from tab1;");
    }
    else
    {
       SmartTriggerInstance->callback = TriggerCallback2;
       //wcscpy((SQLWCHAR *)SmartTriggerInstance->label, L"label2");
       //wcscpy((SQLWCHAR *)SmartTriggerInstance->tableName, L"tab2");
       //wcscpy((SQLWCHAR *)SmartTriggerInstance->sqlQuery, L"select * from tab2;");
       //wsprintf((SQLWCHAR *)SmartTriggerInstance->label, "label2");
       wsprintf((SQLWCHAR *)SmartTriggerInstance->tableName, "tab2");
       wsprintf((SQLWCHAR *)SmartTriggerInstance->sqlQuery, "select * from tab2;");
    }
    return;
}

void FreeMemory(IFMX_REGISTER_SMART_TRIGGER *SmartTriggerInstance)
{
    free(SmartTriggerInstance->tableName);
    free(SmartTriggerInstance->ownerName);
    free(SmartTriggerInstance->dbName);
    free(SmartTriggerInstance->sqlQuery);
    if(SmartTriggerInstance->label != NULL)
       free(SmartTriggerInstance->label);
    return;
}

int main (long         argc,
          char*        argv[])
{
    /* Miscellaneous variables */
    SQLRETURN       rc = 0;
    SQLINTEGER      i = 0;
    SQLINTEGER      getSesID = 0;
    SQLWCHAR         connStrOutW[NAMELEN];
    SQLSMALLINT     connStrOutLen;
    SQLINTEGER      stackSize = 40 * 1024;
    HANDLE          hThread_[NUM_OF_INSTANCE];
    DWORD           threadID_[NUM_OF_INSTANCE];
#ifdef NO_WIN32
    pthread_t       cpid[NUM_OF_INSTANCE];
#endif
    DWORD           dwThreadID=10;

    printf("\nApplication : sizeof(SQLWCHAR) = %d", sizeof(SQLWCHAR));
    /* Allocate the Environment handle */
    rc = SQLAllocHandle (SQL_HANDLE_ENV, SQL_NULL_HANDLE, &henv);
    if (rc != SQL_SUCCESS)
    {
        fprintf (stdout, "Environment Handle Allocation failed\nExiting!!");
        exit (-1);
    }

    /* Set the ODBC version to 3.0 */
    rc = SQLSetEnvAttr (henv, SQL_ATTR_ODBC_VERSION, (SQLPOINTER) SQL_OV_ODBC3, 0);
```

```
   if (checkError (rc, SQL_HANDLE_ENV, henv, (SQLCHAR *) "Error(main) in Step 1 -- SQLSetEnvAttr
failed\nExiting!!"))
       exit (-1);

   /* Allocate the connection handle */
   rc = SQLAllocHandle (SQL_HANDLE_DBC, henv, &hdbc);
   if (checkError (rc, SQL_HANDLE_ENV, henv, (SQLCHAR *) "Error(main) in Step 2 -- Connection Handle
Allocation failed\nExiting!!"))
       exit (-1);

   /* Establish the database connection */
   SetConnectionString();
   rc = SQLDriverConnectW(hdbc, NULL, connStrInW, SQL_NTS, connStrOutW, NAMELEN, &connStrOutLen,
SQL_DRIVER_NOPROMPT);
   if (checkError (rc, SQL_HANDLE_DBC, hdbc, (SQLCHAR *) "Error(main) in Step 3 -- SQLDriverConnect
failed\nExiting!!"))
       exit (-1);
   printf("\nApplication : Database connection successful");

   /* Allocate the statement handle */
   rc = SQLAllocHandle (SQL_HANDLE_STMT, hdbc, &hstmt );
   if (checkError (rc, SQL_HANDLE_DBC, hdbc, (SQLCHAR *) "Error(main) in Step 4 -- Statement Handle Allocation
failed\nExiting!!"))
       exit (-1);

  sesID = 0;
  gJoinSmartTrigger.callback = TriggerCallback1;
  gJoinSmartTrigger.joinSessionID = &sesID;

   if(sesID != 0)
   {
      rc = SQLSetStmtAttrW(hstmt, SQL_INFX_ATTR_JOIN_SMART_TRIGGER,(void *)&gJoinSmartTrigger, SQL_NTS);
      if (checkError(rc, SQL_HANDLE_STMT, hstmt, (SQLCHAR *) "Error(main) in Step 5 --
SQLSetStmtAttr(SQL_INFX_ATTR_JOIN_SMART_TRIGGER) failed\nExiting!!"))
        exit(-1);

      printf("\nJoin session was executed successfully... Exiting.\n");
      goto Exit; // Exit gracefully
   }

   AssignOpenParams();

   rc = SQLSetStmtAttrW(hstmt, SQL_INFX_ATTR_OPEN_SMART_TRIGGER,&gopenSmartTrigger, SQL_NTS);
   if (checkError(rc, SQL_HANDLE_STMT, hstmt, (SQLCHAR *) "Error(main) in Step 5 --
SQLSetStmtAttr(SQL_INFX_ATTR_OPEN_SMART_TRIGGER) failed\nExiting!!"))
      exit(-1);

   rc = SQLGetStmtAttrW(hstmt, SQL_INFX_ATTR_GET_LO_FILE_DESC_SMART_TRIGGER, (int *)&gFileDesc, SQL_NTS,
NULL);
   if (checkError(rc, SQL_HANDLE_STMT, hstmt, (SQLCHAR *) "Error(main) in Step 6 --
SQLGetStmtAttr(SQL_INFX_ATTR_GET_LO_FILE_DESC_SMART_TRIGGER) failed\nExiting!!"))
       exit(-1);

   for (i = 0; i < NUM_OF_INSTANCE; i++)
   {
          printf("\nStart Thread %d", i + 1);
          AssignRegisterParams(&gSmartTriggerRegister[i], gFileDesc, i);
#ifndef NO_WIN32
           hThread_[i] = CreateThread(
                        0, // Security Attributes (no security restrictions)
                        stackSize, // Stack Size
                        ThreadRegisterPushDataQuery, // Start address
                        (void *)&gSmartTriggerRegister[i], //&inputValues[i],
                        0, // Creation Flags (create running)
                        &(threadID_[i]) // Thread Id
               );
#else
           rc = pthread_create(&cpid[i],NULL,(void *)ThreadRegisterPushDataQuery,&gSmartTriggerRegister[i]);
#endif
        }

#ifndef NO_WIN32
        if(NUM_OF_INSTANCE > 0)
           WaitForMultipleObjects(NUM_OF_INSTANCE, hThread_, TRUE, INFINITE);
#else
        for (i = 0; i < NUM_OF_INSTANCE; ++i)
           pthread_join(cpid[i], NULL);
#endif

    rc = SQLGetStmtAttrW(hstmt, SQL_INFX_ATTR_GET_SESSION_ID_SMART_TRIGGER, (int *)&getSesID, SQL_NTS, NULL);
    if (checkError(rc, SQL_HANDLE_STMT, hstmt, (SQLCHAR *) "Error(main) in Step 7 --
 SQLGetStmtAttr(SQL_INFX_ATTR_GET_SESSION_ID_SMART_TRIGGER) failed\nExiting!!"))
        exit(-1);
    printf("\nSession ID received = %d\n", getSesID);

    if( getSesID > 0 && delete == 1 )
    {
       rc = SQLSetStmtAttrW(hstmt, SQL_INFX_ATTR_DELETE_SMART_TRIGGER, (int *)&getSesID, SQL_NTS);
       if (checkError(rc, SQL_HANDLE_STMT, hstmt, (SQLCHAR *) "Error(main) in Step 8 --
 SQLSetStmtAttr(SQL_INFX_ATTR_DELETE_SMART_TRIGGER) failed\nExiting!!"))
        exit(-1);
       printf("\nSession ID deleted = %d\n",getSesID);
    }

    for (i = 0; i < NUM_OF_INSTANCE; ++i)
    {
#ifndef NO_WIN32
       printf("Close Thread Handle : %d\n", i);
       CloseHandle(hThread_[i]);
#endif
       FreeMemory(&gSmartTriggerRegister[i]);
    }

Exit:

    /* CLEANUP: Close the statement handle
    **          Free the statement handle
    **          Disconnect from the datasource
    **          Free the connection and environment handles
    **          Exit
    */

    /* Close the statement handle */
    SQLFreeStmt (hstmt, SQL_CLOSE);
    /* Free the statement handle */
    SQLFreeHandle (SQL_HANDLE_STMT, hstmt);

    /* Disconnect from the data source */
    SQLDisconnect (hdbc);

    /* Free the environment handle and the database connection handle */
    SQLFreeHandle (SQL_HANDLE_DBC, hdbc);
    SQLFreeHandle (SQL_HANDLE_ENV, henv);

    return (rc);
}
```

Best Practices/Trouble shooting

You can link Smart Trigger ODBC application with ODBC Driver Manager(DM). Smart Trigger feature has been tested with Windows Driver Manager and unixODBC Driver Manager. Due to synchronization behaviour of certain Driver Manager, it may not allow more than one SQLSetStmtAttr(with Smart trigger) / SQLGetStmtAttr to be called until previous call is completed, Smart Trigger is blocking call (due to internal call to ifx_lo_read()). In multi-threaded Smart Trigger application, this could cause unexpected/hang behaviour, to avoid the same one of the two below available options could be used:

- For unixODBC DM configuration **in .odbcinst.ini** file, use “Threading = 0" (disables synchronization/mutex of DM)

  Note: Synchronization/mutex continues to work from Informix ODBC driver

- You can use **SQL_INFX_ATTR_GET_DATA_SMART_TRIGGER_NO_LOOP** interface in application and manage the WHILE loop in application (example given below). If you use this option, you may not need to set “Threading = 0? in DM.

SQL_INFX_ATTR_GET_DATA_SMART_TRIGGER_LOOP and SQL_INFX_ATTR_GET_DATA_SMART_TRIGGER_NO_LOOP interfaces

These two interfaces are provided to choose the appropriate one depending on the usage of DM.

In SQL_INFX_ATTR_GET_DATA_SMART_TRIGGER_LOOP interface, ODBC internally uses WHILE loop to wait for data for Smart Trigger from server until user deregister or wants control back to application (example below), this is suitable when application uses unixODBC DM and wants to register many events/queries from application by setting “Threading = 0? in DM’s .odbcinst.ini file.

In SQL_INFX_ATTR_GET_DATA_SMART_TRIGGER_NO_LOOP interface, the responsibility of looping to get next Smart Trigger from server lies with application, this way you don not really have to set “Threading = 0? in unixODBC DM.

Example

```
Thread Start
SQLSetStmtAttr(SQL_INFX_ATTR_REGISTER_SMART_TRIGGER)
SQLGetStmtAttr(SQL_INFX_ATTR_GET_DATA_SMART_TRIGGER_LOOP) \ While loop inside the ODBC code.
OR
While(TRUE)
```

```
{
    SQLGetStmtAttr(SQL_INFX_ATTR_GET_DATA_SMART_TRIGGER_NO_LOOP)
    //Break with some business condition
}
Thread End
```

Note: On Unix/Linux user libthcli.so and on Windows use iclit09b.lib, you can directly link Smart Trigger application with Informix ODBC driver

If you have multiple events/queries to be registered from single database connection, then application should be linked with multi-threaded ODBC library “libthcli.so". Multiple events/queries could be registered only with multi-threaded application, where each event/query could be registered from each thread.

In addition to above extensions, there are following structures provided in **infxcli.h** file. The allocation & deallocation of memory for these structures and its members is responsibility of application.

```
typedef struct tagIfmxJoinTrigger
{
        void(*callback)
                (char const *jsonOutBuf);
        int      *joinSessionID;
        BOOL     *ControlBackToApplication;
        SQLWCHAR     reserved[16];
} IFMX_JOIN_SMART_TRIGGER;

typedef struct tagIfmxOpenTrigger
{
        BOOL     *isDetachable;
        int      *timeOut;
        short    *maxRecsPerRead;
        int      *maxPendingOperations;
        SQLWCHAR     reserved[16];
} IFMX_OPEN_SMART_TRIGGER;

typedef struct tagIfmxRegisterTrigger
{
        void(*callback)
                (char const *jsonOutBuf);
        int      *loFileDescriptor;
        SQLWCHAR     *tableName;
        SQLWCHAR     *ownerName;
        SQLWCHAR     *dbName;
        SQLWCHAR     *sqlQuery;
        SQLWCHAR     *label;
        BOOL     *isDeregister;
        BOOL     *ControlBackToApplication;
        SQLWCHAR     reserved[16];
} IFMX_REGISTER_SMART_TRIGGER;
```

Structure IFMX_OPEN_SMART_TRIGGER should be allocated/filled with respective values and must call following SQLSetStmtAttr() API. If “isDetachable? member is TRUE, it will retain the session even after closing the connection / finishing the application execution.

```
SQLSetStmtAttr(hstmt, SQL_INFX_ATTR_OPEN_SMART_TRIGGER, &gopenSmartTrigger, SQL_NTS);
```

If session is opened with “isDetachable? member TRUE, then application can call following **SQLGetStmtAttr()** to get the session ID, which could be used later to JOIN (more info below) the session. If “isDetachable? member was FALSE while opening the session, if so calling **SQLGetStmtAttr()** may return 0 (zero) or negative number, which are invalid session ID.

```
SQLGetStmtAttr(hstmt, SQL_INFX_ATTR_GET_SESSION_ID_SMART_TRIGGER, (int *)&getSesID, SQL_NTS, NULL);
```

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