IBM WebSphere Business Integration Server
Express and Express Plus

Adapter for JDBC User Guide

Version 4.3

Note!
Before using this information and the product it supports, read the information in "Notices" on page 113.

14 May 2004

This edition of this document applies to IBM WebSphere Business Integration Server Express, version 4.3, IBM Websphere Business Integration Server Express Plus, version 4.3, and to all subsequent releases and modifications until otherwise indicated in new editions.

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About this document

The products IBM® WebSphere® Business Server Express and IBM® WebSphere® Business Server Express Plus are made up of the following components: InterChange Server Express, the associated Toolset Express, CollaborationFoundation, and a set of software integration adapters. The tools in the Toolset help you to create, modify, and manage business processes. You can choose from among the prepackaged adapters for your business processes that span applications. The standard processes template - CollaborationFoundation - allows you to quickly create customized processes.

This document describes the installation, configuration, and business object development for the adapter for JDBC.

Except where noted, all the information in this guide applies to both IBM WebSphere Business Integration Server Express and IBM WebSphere Business Integration Server Express Plus. The term WebSphere Business Integration Server Express and its variants refer to both products.

Audience

This document is for consultants, developers, and system administrators who use the connector at customer sites.

Related documents

The complete set of documentation available with this product describes the features and components common to all WebSphere Business Integration Server Express installations, and includes reference material on specific components.

You can download, install, and view the documentation at the following site: http://www.ibm.com/websphere/wbiserverexpress/infocenter

Note: Important information about this product may be available in Technical Support Technotes and Flashes issued after this document was published. These can be found on the WebSphere Business Integration Support Web site, http://www.ibm.com/software/integration/websphere/support/. Select the component area of interest and browse the Technotes and Flashes sections.

Typographic conventions

This document uses the following conventions:

`courier font`	Indicates a literal value, such as a command name, file name, information that you type, or information that the system prints on the screen.
bold	Indicates a new term the first time that it appears.
`italic`	Indicates a variable name or a cross-reference.
blue outline	Blue outline, which is visible only when you view the manual online, indicates a cross-reference hyperlink. Click inside the outline to jump to the object of the reference.

ProductDir	Represents the directory where the IBM WebSphere Business Integration Server Express product is installed. The default product directory is WebSphereAdapters.
{ }	In a syntax line, curly braces surround a set of options from which you must choose one and only one.
|	In a syntax line, a pipe separates a set of options from which you must choose one and only one.
[ ]	In a syntax line, square brackets surround an optional parameter.
...	In a syntax line, ellipses indicate a repetition of the previous parameter. For example, `option[,...]` means that you can enter multiple, comma-separated options.
< >	Angle brackets surround individual elements of a name to distinguish them from each other, as in `<server_name><`*`connector_name`*`>tmp.log`.
/, \	In this document, backslashes (\) are used as the convention for directory paths. All product pathnames are relative to the directory where the connector for JDBC is installed on your system.
%text% and *$text*	Text within percent (%) signs indicates the value of the Windows `text` system variable or user variable.

New in this release

Release 4.3

This is the first release of this guide.

Chapter 1. Overview of the adapter

This chapter describes the Adapter for JDBC component of the IBM WebSphere Business Integration Server Express and Express Plus.

This chapter contains the following sections:

Connector components

Connectors consist of two parts: the **connector framework** and the **application-specific component**.

The connector framework, whose code is common to all connectors, acts as an intermediary between the integration broker and the application-specific component.

The application-specific component contains code tailored to a particular application or technology (in this case, JDBC). The connector framework provides the following services between the integration broker and the application-specific component:

- Receives and sends business objects
- Manages the exchange of startup and administrative messages

The connector for JDBC enables the integration broker to exchange business objects with an application built on any database supported by a driver that follows the JDBC 2.0 or above specification. This section presents a high-level description of the connector's architecture and use of different JDBC drivers.

For specifying the driver to be used by the connector to connect to the database, see "Enabling multi-driver support" on page 11.

The connector connects to the application database by using the JDBC Connect mechanism. One connector-specific configuration parameter (`DatabaseURL`) allows you to specify the name of the database server to which the connector should connect. For information on the configuration parameters, see "Configuring the connector" on page 12.

When the connector is started, it establishes a connection pool with the database. It uses connections from this pool for all transaction processing with the database. On termination of the connector, all connections in the pool are closed.

Connector architecture

Figure 1 shows the connector components and their relationships within the business integration system.

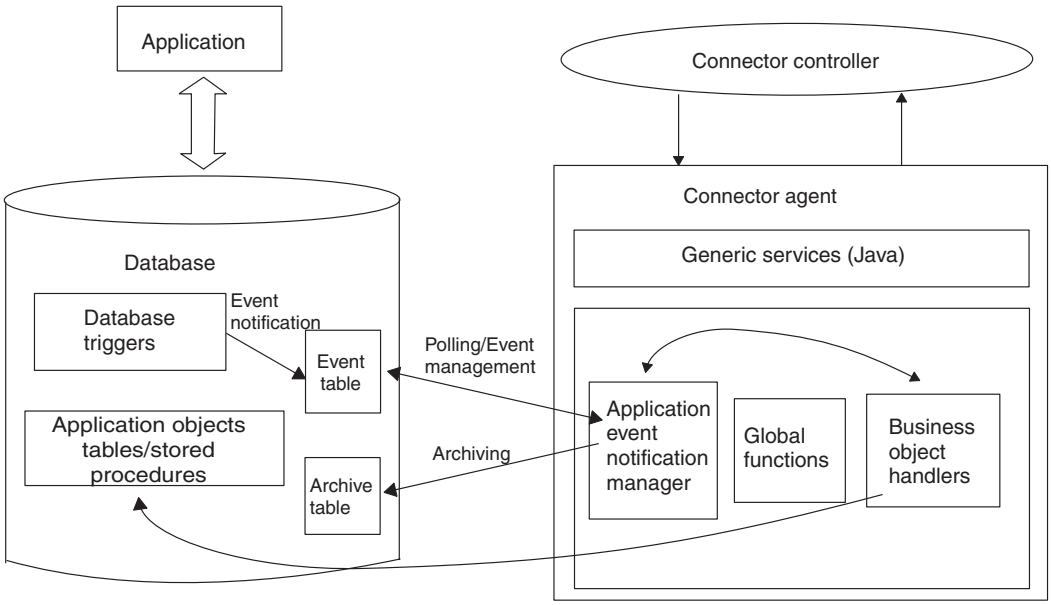


Figure 1. Business object request architecture

How the connector works

This section describes how meta-data enhances the connector's flexibility, and presents a high-level description of business object processing and event notification.

The connector and meta-data

The connector is meta-data-driven. **Meta-data**, in the IBM WebSphere Business Integration Server Express and Express Plus environment, is application-specific data that is stored in business objects and that assists the connector in its interaction with the application. A meta-data-driven connector handles each business object that it supports based on meta-data encoded in the business object definition rather than on instructions hard coded in the connector.

Business object meta-data includes the structure of a business object, the settings of its attribute properties, and the content of its application-specific information. Because the connector is meta-data driven, it can handle new or modified business objects without requiring modifications to the connector code.

The connector executes SQL statements or stored procedures to retrieve or change data in the database/application. To build dynamic SQL statements or stored procedures, the connector uses application-specific meta-data. These SQL statements and stored procedures perform the required retrieval from or changes to the database/application for the business object and for the verb that the connector is processing. For information using application-specific information, see Chapter 3, "Understanding business objects for the connector," on page 27.

Business object processing

This section provides an overview of how the connector processes business object requests and application events. For more detailed information, see "Business object verb processing" on page 31.

Processing business object requests

When the connector receives a request to perform an application operation, the connector processes hierarchical business objects recursively; that is, it performs the same steps for each child business object until it has processed all individual business objects. The order in which the connector processes child business objects and the top-level business object depends on whether the child business objects are contained with or without ownership and whether they are contained with single cardinality or multiple cardinality.

Note: The term **hierarchical** business object refers to a complete business object, including all the child business objects that it contains at any level. The term **individual** business object refers to a single business object, independent of any child business objects it might contain or that contain it. The term **top-level** business object refers to the individual business object at the top of the hierarchy that does not itself have a parent business object.

Business object retrieval: When an integration broker asks the connector to retrieve a hierarchical business object from the database, the connector attempts to return a business object that exactly matches the current database representation of that business object. In other words, all simple attributes of each individual business object returned to the integration broker match the value of the corresponding field in the database. Also, the number of individual business objects in each array contained by the returned business object match the number of children in the database for that array.

To perform such a retrieval, the connector uses the primary key values in the top-level business object to recursively descend through the corresponding data in the database.

Business object RetrievalByContent: When an integration broker asks the connector to retrieve a hierarchical business object based on values in non-key attributes in the top-level business object, the connector uses the value of all non-null attributes as the criteria for retrieving the data.

Business object creation: When an integration broker asks the connector to create a hierarchical business object in the database, the connector performs the following steps:

1. Recursively creates each single-cardinality child business object contained with ownership into the database.
2. Processes each single-cardinality child business object contained without ownership.
3. Creates the top-level business object in the database.
4. Creates each single-cardinality child business object that stores the parent/child relationship in the child.
5. Creates each multiple-cardinality child business object.

Business object modification: When an integration broker asks the connector to update a hierarchical business object in the database, the connector performs the following steps:

1. Uses the primary key values of the source business object to retrieve the corresponding entity from the database.
2. Recursively updates all single-cardinality children of the top-level business object.

3. For single-cardinality child business objects that store the relationship in the parent, sets each foreign key value in the parent to the value of the primary key in the corresponding single-cardinality child business object.
4. Updates all simple attributes of the retrieved business object except those whose corresponding attribute in the source business object contain the value CxIgnore.
5. Sets all foreign key values in each child that stores the parent/child relationship in the child (both multiple-cardinality and single-cardinality) to the primary key value of its corresponding parent business object.
6. Processes all arrays of the retrieved business object.

Business object deletion: When an integration broker asks the connector to delete a hierarchical business object from the database, the connector performs the following steps:

1. Deletes the single-cardinality children.
2. Deletes the multiple-cardinality children.
3. Deletes the top-level business object.

Processing application events

The connector handles the Create, Update, and Delete events generated by the application in the manner described below.

Create notification: When the connector encounters a Create event in the event table, it creates a business object of the type specified by the event, sets the key values for the business object (using the keys specified in the event table), and retrieves the business object from the database. After it retrieves the business object, the connector sends it with the Create verb to the integration broker.

Update notification: When the connector encounters an Update event in the event table, it creates a business object of the type specified by the event, sets the key values for the business object (using the keys specified in the event table), and retrieves the business object from the database. After it retrieves the business object, the connector sends it with the Update verb to the integration broker.

Delete notification: When the connector encounters a Delete event in the event table, it creates a business object of the type specified by the event, sets the key values for the business object (using the keys specified in the event table), and sends it with the Delete verb to the integration broker. All values other than the key values are set to CxIgnore. If any of the non-key fields are significant at your site, modify the value of the fields as needed.

The connector handles logical and physical Delete operations that are triggered by its application. In the case of physical deletes, the SmartFiltering mechanism removes all of the business object's unprocessed events (such as Create or Update) before inserting the Delete event into the event table. In the case of logical deletes, the connector inserts a Delete event in the event table without removing other events for the business object.

Retrieving business objects for event processing: A Retrieve can be done in two ways on a business object for event processing. The first is a Retrieve based on key attributes in a business object. The second is a Retrieve based on both key and non-key attributes. In this case, the business object needs to support the `RetrieveByContent` verb and must use `name_value` pair for the object keys.

Note: If the object key does not use `name_value` pair, the keys in the object key field should follow the same order as the keys in the business object.

Event notification

The connector's event detection mechanism uses an event table, an archive table, stored procedures, and database triggers. Because there are potential failure points associated with the processing of events, the event management process does not delete an event from the event table until it has been inserted it into the archive table.

The database triggers populate an event table whenever an event of interest occurs in the database. The connector polls this table at a regular, configurable interval, retrieves the events, and processes the events first by priority and then sequentially. When the connector has processed an event, the event's status is updated.

Note: You must add the triggers to the database as part of the installation procedure.

The setting of its ArchiveProcessed property determines whether the connector archives an event into the archive table after updating its status. For more information on the ArchiveProcessed property, see "Configuring the connector" on page 12.

Table 1 illustrates the archiving behavior depending on the setting of the ArchiveProcessed property.

Table 1. Archiving behavior

Archive processed setting	Reason deleted from event table	Connector behavior
`true` or no value	Successfully processed	Archived with status of `Sent to InterChange`
	Unsuccessfully processed	Archived with status of `Error`
	No subscription for business object	Archived with status of `Unsubscribed`
`false`	Successfully processed	Not archived and deleted from event table
	Unsuccessfully processed	Remains in event table with status of `Error`
	No subscription for business object	Remains in event table with status of `Unsubscribed`

SmartFiltering is a mechanism within the database triggers that minimizes the amount of processing the integration broker and connector must perform. For example, if an application has updated the Contract business object 15 times since the connector last polled for events, the SmartFiltering stores those changes as a single Update event.

Handling lost database connections

There are numerous reasons for losing a database connection. If this occurs, the connector terminates. The JDBC specification does not provide a mechanism for detecting lost connections. As this connector supports different databases, there is no single error code definition for a lost connection to a database.

The PingQuery property is provided to handle this detection. If a failure occurs during a service call request, the connector executes this PingQuery to confirm that the failure was not due to a lost connection to a database. If the PingQuery fails and the AutoCommit property is set to false, the connector will attempt to create a new connection to the database. If it succeeds in creating a new connection to the database, it will continue processing, otherwise, the connector returns an APPRESPONSETIMEOUT, which results in the termination of the connector.

The PingQuery is executed if a failure occurs when accessing a database for any type of transaction. For example:

- While accessing the event and archive tables
- While retrieving the business object that is related to the event
- While creating or updating a record pertaining to a business object

Processing locale-dependent data

The connector has been internationalized so that it can support double-byte character sets, and deliver message text in the specified language. When the connector transfers data from a location that uses one character code set to a location that uses a different code set, it performs character conversion to preserve the meaning of the data.

The Java runtime environment within the Java Virtual Machine (JVM) represents data in the Unicode character code set. Unicode contains encodings for characters in most known character code sets (both single-byte and multibyte). Most components in the WebSphere business integration system are written in Java. Therefore, when data is transferred between most WebSphere business integration system components, there is no need for character conversion.

To log error and informational messages in the appropriate language and for the appropriate country or territory, configure the Locale standard configuration property for your environment. For more information on these properties, see Appendix A, “Standard configuration properties for connectors,” on page 81.

Chapter 2. Installing and configuring the connector

This chapter describes how to install and configure the IBM WebSphere Business Integration Server Express for JDBC and how to configure applications to work with the connector. It contains the following sections:

Adapter environment

Before installing, configuring, and using the adapter, you must understand its environment requirements. They are listed in the following section.

Adapter platforms

The adapter is supported on the following software.

Operating systems:

- Windows 2000

Databases:

Any database for which JDBC drivers are available.

Third-party software:

- JDBC drivers

Adapter dependencies

The adapter for JDBC requires the following software.

- JDBC driver files

Globalization

This adapter is DBCS (double-byte character set)-enabled and is translated.

Prerequisites

Before you use the connector, you must do the following:

- Install the JDBC driver that will be used.

- Verify that all required vendor-specific software, including JDBC driver requirements, has been installed.
- Verify the existence of a user account in the application.

  The connector processes data in any application built on any database supported by a driver that follows the JDBC specification. For the connector to process data in the database, with which it talks directly, it must have access to a user account and password that is valid for the application. The user account must have the privileges to retrieve, insert, update, and delete data from the application's database. If you do not already have such an account, you must create one.
- Verify the character code set of the connected database.

  The Java runtime environment within the Java Virtual Machine (JVM) represents data in the Unicode character code set. Unicode contains encodings for characters in most known character sets (both single-byte and multibyte). Because the connector is written in Java, it understands Unicode.

Installing the adapter and related files

For information on installing the adapter, refer to the *Installation Guide for WebSphere Business Integration Server Express*, located in the WebSphere Business Integration Server Express Infocenter at the following site:

http://www.ibm.com/websphere/wbiserverexpress/infocenter

Installed file structure

The following subsections describe the installed file structure of the adapter.

Installed file structure on a Windows system

For instructions on installing the JDBC adapter on a Windows system, see the *Installation Guide for WebSphere Business Integration Server Express.* Table 2 describes the Windows file structure used by the connector.

Table 2. Installed Windows file structure for the connector

Subdirectory of %*ProductDir*%	**Description**
`connectors\JDBC`	Contains the connector CWJDBC.jar and the start_JDBC.bat files.
`connectors\JDBC\dependencies`	Contains the SQL scripts that create the event, archive, and unique identifier tables.
`connectors\messages`	Contains the JDBCConnector.txt file as well as the JDBCConnector_*ll_TT*.txt files (message files specific to a language (*ll*) and a country or territory (*TT*)).
`repository\JDBC`	Contains the `CN_JDBC.txt` file.
`connectors\JDBC\Samples`	Contains README_Samples.txt and sample files for creating different stored procedures and business objects.
`\lib`	Contains the WBIA. jar file.
`\bin`	Contains the CWConnEnv.bat file.

Installer adds an icon for the connector file to the IBM WebSphere Business Integration Server Express menu. For a fast way to start the connector, create a shortcut to this file on the desktop.

For more information on installing the connector component, refer to

Enabling the application for the connector

You must set up the event notification mechanism in the database before the connector can process event delivery. To do this, you must complete the following tasks:

- Create the event and archive tables in the database.
- Install database triggers on the application's tables to support the required business objects. It is assumed that you develop your own database triggers.
- Optionally, install a counter table. Perform this step only if you require the connector to generate a unique ID when creating a business object. For more information on generating unique IDs, see the `UID=CW.uidcolumnname[=UseIfMissing]` parameter.

The sections that follow provide information on creating and configuring the event and archive tables.

Event and archive tables

The connector uses the event table to queue events for pickup. If you have set the ArchiveProcessed property to true or to no value, the connector uses the archive table to store events after updating their status in the event table.

For each event, the connector gets the business object's name, verb, and key from the event table. The connector uses this information to retrieve the entire entity from the application. If the entity was changed after the event was first logged, the connector gets the initial event and all subsequent changes. In other words, if an entity is created and updated before the connector gets it from the event table, the connector gets both data changes in the single retrieval.

The following three outcomes are possible for each event processed by a connector:

- Event was processed successfully
- Event was not processed successfully
- Event was not subscribed to (for subscription information specific to your integration broker, refer to the broker's implementation guide)

If events are not deleted from the event table after the connector picks them up, they occupy unnecessary space there. However, if they are deleted, all events that are not processed are lost and you cannot audit the event processing. Therefore, it is recommended that you also create an archive table and keep the `ArchiveProcessed` property set to true. Whenever an event is deleted from the event table, the connector inserts it into the archive table.

Note: If problems accessing the application database cause the connector to fail while deleting an event from the event table or inserting an event into the archive table, the connector returns APPRESPONSETIMEOUT.

Configuring event and archive processing

To configure event and archive processing, you must use configuration properties to specify the following information:

- The name of the event table (`EventTableName`). You need not specify a value for this property if you use the connector only to process business object requests.
- The interval frequency (`"PollFrequency" on page 91`).

- The number of events for each polling interval (PollQuantity).
- The name of the archive table (ArchiveTableName).
- Whether the connector archives unsubscribed and unprocessed events (ArchiveProcessed). For subscription information specific to your integration broker, refer to the broker's implementation guide.
- The unique ID of the connector, which is important when multiple connectors poll the same table (ConnectorID).

You can also specify a value for the EventOrderBy property to specify the order of events to be processed. For information on these and other configuration properties, see Appendix A, "Standard configuration properties for connectors," on page 81and Table 5 on page 13.

Note: Creation of the event and archive tables is optional. However, if you specify a value for EventTableName but do not use the connector to poll for events and do not create an event table, the connector times out. To prevent such time-out, leave the value of EventTableName as null (as a string).

By default, the name of the event queue table is xworlds_events, and the name of the archive queue table is xworlds_archive_events.

To use the connector only for request processing, use the -fno option when starting it and set the value of EventTableName to null (as a string).

If the driver being used does not support Java class DatabaseMetaData, and you want the connector to avoid the checking for the existence of event and archive tables, disable the CheckForEventTableInInit by setting its value to false. By default, it is true. It is recommended that the value not be set to false.

Note: If your site will not archive events into the archive table, set the value of ArchiveProcessed to false.

SQL scripts for installing the event and archive tables

The scripts to install the event, archive, and unique identifier tables for a DB2 database are:

- event_table_db2.sql
- event_package_db2.sql
- archive_table_db2.sql
- uid_table_db2.sql

The scripts to install the event, archive, and unique identifier tables for a Microsoft SQL Server database are:

- event_table_mssqlserver.sql
- event_package_mssqlserver.sql
- archive_table_mssqlserver.sql
- uid_table_mssqlserver.sql

These files are located in the following directories:

connectors\JDBC\dependencies\

Note: These scripts are provided only as a template to assist you in creating the required tables for the connector. For other databases, please create your scripts using these as guidelines. The order and data type in the table

columns is very important. Please refer to the "Event and archive table schema" to view the correct order and type.

It is recommended that the DBA or person implementing the connector modify these scripts to meet specific installation and query optimization requirements. For example, these scripts do not create indexes on the tables. It is the responsibility of the person implementing the connector to create indexes to enhance performance with the query optimizer.

Event and archive table schema

Table 3 describes the columns in the event and archive tables.

Table 3. Event and archive table schema

Name	Description	Type	Constraint
event_id	Internal identifier of the event	NUMBER	Primary key
connector_id	Unique ID of the connector for which the event is destined. This value is important when multiple connectors poll the same table.	VARCHAR	
object_key	Primary key of the business object. The key can be represented as a name_value pair, or as a set of keys delimited by a colon or other configurable delimiter (for example, 1000065:10056:2333). See the "EventKeyDel" on page 18 property for more information.	VARCHAR	Not `null`
object_name	Name of the business object	VARCHAR	Not `null`
object_verb	Verb associated with the event	VARCHAR	Not `null`
event_priority	Event priority (0 is highest, *n* is lowest), which the connector uses to get events on a priority basis. The connector does not use this value to lower or raise priorities.	NUMBER	Not `null`
event_time	Date and time the event occurred	DATETIME	Default current date/time (for archive table, actual event time)
archive_time	Date and time the event was archived (applies only to the archive table)	DATETIME	Archive date/time
event_status	`-2` (Error sending event to the integration broker) `-1` (Error processing event) `0` (Ready for poll) `1` (Sent to the integration broker) `2` (No Subscriptions for the business object) `3` (In Progress). This status is used only in the event table and not in the archive table.	NUMBER	Not `null`
event_comment	Description of the event or error string	VARCHAR	

Enabling multi-driver support

You can specify the driver by doing the following:

1. Install the driver on your machine.
2. Put all dynamic libraries that the connector requires at runtime in the `connectors/JDBC` directory under the product directory.
3. Edit the connector's start file to include all relevant class pathnames (including license information if required) in the `JDBCDRIVERPATH` variable.

   The start file is:

%ProductDir%\connectors\JDBC\start_JDBC.bat

4. Specify a value for the JDBCDriverClass configuration property.

   Note: For all features that it supports, the connector can operate with any driver that follows the JDBC 2.0 or above specification. If the driver does not support a particular feature, the connector does not function properly. For example, if the driver does not support all method calls used by JDBCODA, the JDBCODA log indicates the process that the driver does not support. In such a case, you must use a different driver.

Enabling the custom business object handler class

The connector supports the custom business object handler class, CustomBOH. It implements the JDBCBOhandlerInterface interface. The syntax of this interface is:

```
public interface JDBCBOhandlerInterface{
   public int doVerbForCustom(CWConnectorBusObj busObj) throws
     VerbProcessingFailedException, ConnectionFailureException;
}
```

When you implement the doVerbForCustom method, ensure that it throws but does not catch the two exceptions. Also set the status and message of each exception before throwing them.

- VerbProcessingFailedException—Thrown when the operation specified by the verb fails.
- ConnectionFailureException—Thrown when the connector can not establish a connection with the application.

To enable the connector to support this business object handler:

- Specify the CustomBOH class name in the verb application-specific information.

  The connector obtains the name of the custom business object handler class from the verb application-specific information. Use the following syntax:

  CustomBOH=*customBOhandlerClassName*

  For example, assume the verb application-specific information is specified as follows:

  CustomBOH=JDBCBOhandlerForOverrideSQL

  In this case, JDBCBOhandlerForOverrideSQL is the name of the custom business object handler class.
- Ensure that CustomBOH belongs to com.crossworlds.connectors.JDBC

  If the connector finds "CustomBOH=" in the verb application-specific information and finds the class in the com.crossworlds.connectors.JDBC package, it executes the custom business object handler. If it does not find CustomBOH, it throws an error saying that it could not find the class.

Configuring the connector

You must set the connector's standard and connector-specific configuration properties before you can run it. Use one of the following tools to set a connector's configuration properties:

- Connector Configurator Express - Access this tool from the System Manager.
- For more information about Connector Configurator Express see Appendix B, "Connector Configurator Express," on page 95.

Standard connector properties

Standard configuration properties provide information that all connectors use. See Appendix A, "Standard configuration properties for connectors," on page 81 for detailed information about these properties.

Important: Because the connector for JDBC supports the InterChange Server Express broker, configuration properties are relevant to the connector.

In addition, refer to Table 4 for configuration information specific to the Adapter for JDBC. The information in this table supplements the information in the appendix.

Table 4. Property information specific to this connector

Property	Notes
CharacterEncoding	This connector does not use the CharacterEncoding property
Locale	Because this connector has been internationalized, you can change the value of the Locale property.

Note that you must provide a value for the `ApplicationName` configuration property before running the connector.

Connector-specific properties

Connector-specific configuration properties provide information needed by the connector at runtime. Connector-specific properties also provide a way of changing static information or logic within the connector without having to recode and rebuild it.

Table 5 lists the connector-specific configuration properties for the connector. See the sections that follow for explanations of the properties.

Table 5. Connector-specific configuration properties

Name	Possible values	Default value	Required
ApplicationPassword	*Password for connector user account*		`Yes*`
ApplicationUserName	*Name of connector user account*		`Yes*`
ArchiveProcessed	`true` or `false`	`true`	`No`
ArchiveTableName	*Name of archive queue table*	`xworlds_archive_events`	`Yes` if Archive Processed is `true`
AutoCommit	`true` or `false`	`false`	`No`
CheckforEventTableInInit	`true` or `false`	`true`	`No`
ChildUpdatePhyDelete	`true` or `false`	`false`	`No`
CloseDBConnection	`true` or `false`	`false`	`No`
ConnectorID	*Unique ID for the connector*	`null`	`No`
DatabaseURL	*Name of the database server*		`Yes`
DateFormat	*A time pattern String*	`MM/dd/yyyy HH:mm:ss`	`No`
DriverConnectionProperties	*Additional JDBC driver connection properties*		`No`
EventKeyDel	*Delimiter character or characters for object key column of event table*	`semicolon (;)`	`No`

Table 5. Connector-specific configuration properties (continued)

Name	Possible values	Default value	Required
EventOrderBy	none, *ColumnName*, *ColumnName*, ...]		No
EventQueryType	Fixed or Dynamic	Fixed	No
EventTableName	*Name of event queue table*	xworlds_events	Yes, if polling is required; null (as a string) if polling is not required
JDBCDriverClass	driver classname		Yes
MaximumDatabaseConnections	*Number of simultaneous database connections*	5	Yes
PingQuery	SELECT 1 FROM <*tablename*>		No
PollQuantity	Values are 1 to 500	1	No
PreserveUIDSeq	true or false	true	No
RDBMS.initsession	*SQL statement that initializes every database session*		No
RDBMSVendor	DB2, *Others*		Yes
ReplaceAllStr	true or false	false	No
ReplaceStrList	A set composed of a single character, a character delimiter, and the character's substitution string. Also, multiple such sets with a termination delimiter between them.	Q,DSQNote: In the connector configuration tool, these characters represent a single quotation mark, followed by a comma, followed by two single quotation marks.	No
RetryCountAndInterval	*Count, interval in seconds*	3,20	No
SchemaName	Schema on which the events reside		No
SPBeforePollCall	Name of the stored procedure to be executed for each poll call		No
StrDelimiter	The character and termination delimiters used in the ReplaceStrList property	,:	No
TimingStats	0, 1, 2	0	No
UniqueIDTableName	*Name of table used for generation of IDs*	xworlds_uid	No
UseDefaults	true or false	false	Yes
UseDefaultsForCreatingChildBOs	true or false	false	No
UseDefaultsForRetrieve	true or false	false	No

*ApplicationPassword and ApplicationUserName are not required if you are using trusted authentication.

ApplicationPassword

Password for the connector's user account.

There is no default value.

ApplicationUserName

Name of the connector's user account.

There is no default value.

ArchiveProcessed
Specifies whether the connector archives events for which there are no current subscriptions.

Set this property to `true` to cause events to be inserted into the archive table after they are deleted from the event table.

Set this property to `false` to cause the connector not to perform archive processing. In this case, it does not check the value of the `ArchiveTableName` property. If ArchiveProcessed is set to `false`, the connector performs the following behavior:

- If the event is successfully processed, the connector deletes it from the event table and does not archive it.
- If the connector does not subscribe to the event's business object, the connector leaves the event in the event table and changes its event status to `Unsubscribed`. For subscription information specific to your integration broker, refer to the broker's implementation guide.
- If the business object encounters a problem while being processed, the connector leaves the event in the event table with event status of `Error`.

If this property is set to `false` and the poll quantity is low, the connector appears to be polling the event table, but it is simply picking up the same events repeatedly.

If this property has no value, the connector assumes the value to be `true`. If the ArchiveTableName property also has no value, the connector assumes the archive table's name is `xworlds_archive_events`.

The default value is `true`.

ArchiveTableName
Name of archive queue table.

If the `ArchiveProcessed` property is set to `false`, it is unnecessary to set a value for this property.

The default name is `xworlds_archive_events`.

AutoCommit
This property makes the AutoCommit setting configurable. When set to `true`, all transactions are automatically committed. Some databases require `AutoCommit` to be set to `true`. If set to `false`, stored procedures on Sybase to fail.

If the database connection is lost, the connector will attempt to create a new connection to restart the complete processing as long as `AutoCommit` is set to `false`. If the new connection is invalid, or if `AutoCommit` is set to `true`, the connector returns `APPRESPONSETIMEOUT`, which results in the termination of the connector.

The default value is `false`.

CheckforEventTableInInit
Setting this connector property to `false` prevents the connector from checking for the existence of the event and archive tables during connector initialization. It is recommended that you always set it to `true` unless the JDBC driver you are using does not support the JDBC class `DatabaseMetaData`.

When the property is set to false, although the connector does not check for the existence of EventTable and ArchiveTable, the event and archive tables should always exist because the connector uses them during the initialization process. To prevent the connector from using the event and archive tables during initialization, set the property EventTableName to null.

The default value is true.

ChildUpdatePhyDelete

During an update operation, specifies how the connector handles data represented by a child business object that is missing from the incoming business object but exists in the database.

Set this property to true to cause the connector to physically delete the data record from the database.

Set this property to false to cause the connector to logically delete the data record from the database by setting the status column to the appropriate value. The application-specific information obtains the name of the status column and its value from the StatusColumnValue (SCN) parameter specified in its business-object level application-specific information. For more information, see "Application-specific information at the business-object level" on page 49.

Default value is false.

CloseDBConnection

This property makes the closing of the database connection configurable. When set to true, for every service call request and poll call, the database connection is closed. Setting this property to true impairs performance and is not advisable.

The default value is false.

ConnectorID

A unique ID for the connector. This ID is useful to retrieve events for a particular instance of the connector.

Default value is null.

DatabaseURL

Name of the database server to which the connector should connect.

If you use the WebSphere business integration system branded SQLServer driver, the recommended URL is:

```
jdbc:ibm-crossworlds:sqlserver://MachineName:PortNumber;DatabaseName=DBname
```

Important

If AutoCommit is set to false, you must set an additional parameter, SelectMethod: jdbc:ibm-crossworlds:sqlserver://*MachineName*:*PortNumber*;DatabaseName=*DBname*; SelectMethod=cursorBy default, SelectMethod is set to direct. For more information, see "AutoCommit" on page 15.

You must provide a value for this property in order for the connector to process successfully.

DateFormat

Specifies the date format that the connector expects to receive and return. This property supports any format that is based on the syntax as contained in Table 6.

Table 6 Defines the time format syntax using a time pattern string. In this pattern, all ASCII letters are reserved as pattern letters.

Table 6. Time format syntax

Symbol	Meaning	Presentation	Example
G	era designator	(Text)	AD
y	year	(Number)	1996
M	month in year	(Text & Number)	July & 07
d	day in month	(Number)	10
h	hour in am/pm(1-12)	(Number)	12
H	hour in day(0-23)	(Number)	0
m	minute in hour	(Number)	30
s	second in minute	(Number)	55
S	millisecond	(Number)	978
E	day in week	(Text)	Tuesday
D	day in year	(Number)	189
F	day of week in month	(Number)	2 (2nd Wed in July)
w	week in year	(Number)	27
W	week in month	(Number)	2
a	am/pm marker	(Text)	PM
k	hour in day(1-24)	(Number)	24
K	hour in am/pm(0-11)	(Number)	0
z	time zone	(Text)	Pacific Standard Time
'	escape for text	(Delimiter)	
''	single quote	(Literal)	'

Table 7. Examples using the US locale

Format pattern	Result
"yyyy.MM.dd G 'at' hh:mm:ss z"	1996.07.10 AD at 15:08:56 PDT
"EEE, MMM d, ''yy"	Wed, July 10, '96
"h:mm a"	12:08 PM
"hh 'o''clock' a, zzzz"	12 o'clock PM, Pacific Daylight Time
"K:mm a, z"	0:00 PM, PST
"yyyy.MMMMM.dd GGG hh:mm aaa"	1996.July.10 AD 12:08 PM

DriverConnectionProperties

Besides the user name and password, a JDBC driver might need additional properties or information. The `DriverConnectionProperties` connector property will take additional properties that a JDBC driver needs, as name-value pairs. The properties should be specified as follows:

```
property1=value1[;property2=value2...]
```

The properties must be given as name value pairs, separated by semi-colons. The property is separated from its value by an equals sign (with no extra spaces).

For example, assume the JDBC driver needs license information and port number. The property name it expects for license information is `MyLicense` and the value is `ab23jk5`. The property name it expects for port number is `PortNumber` and value is `1200`. The `DriverConnectionProperties` should be set to the value `MyLicense=ab23jk5;PortNumber=1200`.

EventKeyDel

Specifies the delimiter when the `object_key` column of the event table contains multiple attribute values.

There are two ways to retrieve the business object that has been created, updated, or deleted in the triggering application.

- The first is to populate the `object_key` column with values for attributes that are keys in a business object. Set the `EventKeyDel` configuration property to a single character that is not part of the key field. For **example**, if the delimiter is specified as "**;**", then the `object_key` will be as follows: *xxx;123*
- The second is to populate the `object_key` column with values for any attribute in a business object. These values should be represented as `name_value` pair. The first delimiter will be for the `name_value` and the second is for the keys. For example, if the delimiter is specified as "**=;**", then the `object_key` will be as follows: *CustomerName=xxx;CustomerId=123;*

  If the delimiter is specified as "**=:**", then the `object_key` will be as follows: *CustomerName=xxx:CustomerId=123*:

Note: The order that the key values are defined should follow the same order as the key attributes in a business object.

Important: If you use Date attribute data, avoid using a colon (:) delimiter, because it may be included in the attribute's data.

The default value is a semicolon (;), which is based on keys, not `name_value` pairs.

EventOrderBy

Specifies whether to turn off the ordering of events, or specifies an order of event processing that is different from the default order.

By default, at each poll the connector pulls only the number of events specified in its `PollQuantity` property, and orders event processing by the values in the event_time and event_priority columns of the Event table.

To cause the connector not to order events, set the value of this property to `none`.

To cause the connector to order by different columns in the Event table, specify the names of those columns. Separate column names with a comma (**,**). Specifying a value for this property overwrites the default value.

There is no default value for this property.

EventQueryType

The `EventQueryType` property is used to indicate whether the connector should dynamically generate a query to retrieve events from the event table or use its built in query. For the dynamically generated query, the connector maps its event structure to the columns in the event table. The order of the data in the table columns is very important. Please refer to the "Event and archive table schema" on page 11 to view the correct order.

If the value in the EventQueryType is Fixed (as a string), the default query is executed. If set to Dynamic (as a string), a new query is built by getting the column names from the table that is specified in the "EventTableName" property.

The event table column names can change but the order and data type of the columns must remain the same as specified in the event table creation section. "EventOrderBy" on page 18 will be appended to either the default or the dynamically generated query.

If the EventQueryType property is not added or it contains no value, it is defaulted to Fixed.

Default value is Fixed (as a string).

EventTableName

Name of event queue table, which is used by the connector's polling mechanism.

The default name is xworlds_events.

Set this to null (as a string) when polling is turned off for the connector. This prevents validation of the existence of the event and archive tables.

For a user defined event table, ensure that the event_id maps to one of the following JDBC types: INTEGER, BIGINT, NUMERIC, VARCHAR.

JDBCDriverClass

Specifies the class name of a driver. To use a particular JDBC driver, specify the driver's class name in this configuration property. For example, to specify the Oracle thin driver, set the value of this property to:
oracle.jdbc.driver.OracleDriver.

For more information, see "Enabling multi-driver support" on page 11 and "UseDefaultsForCreatingChildBOs" on page 23.

No default value is provided.

MaximumDatabaseConnections

Specifies the maximum number of simultaneous database connections allowed. At runtime, the number of open database connections is the sum of this value plus 1.

If the "PreserveUIDSeq" on page 20 property is set to false, at runtime, the number of open database connections is the sum of this value plus 2.

The default value is 5.

PingQuery

Specifies the SQL statement or stored procedure that the connector executes to check database connectivity.

The following is an example of an SQL statement used as a ping query:

```
SELECT 1 FROM <tablename>
```

The following is an example of a stored procedure call (sampleSP) used as a ping query with a DB2 database:

```
call sampleSP( )
```

Note that stored procedure calls cannot have output parameters. If an input parameter is required by the database, the input value must be specified as part of the ping query. For example:

```
Call checkproc(2)
```

There is no default value. For more information, see "Handling lost database connections" on page 5 and "Loss of connection to the application" on page 78.

PollQuantity

Number of rows in the database table that the connector retrieves per polling interval. Allowable values are 1 to 500.

The default value is 1.

PreserveUIDSeq

Specifies whether or not the incoming unique ID sequence will be preserved in the unique identifier table.

If set to `true`, the unique ID is not committed until the business object is successfully processed in the destination application. All other processes attempting to access the unique identifier table must wait until the transaction is committed.

If set to `false`, the unique ID is committed when the business object requests it. The business object processing and the unique ID processing each have their own transaction block (internal to the connector). This is only possible if the transaction relating to the unique identifier table has its own connection.

Note: If this property is not added to the connector configuration, the default behavior is the same as if this property were added and set to `true`. Also, if "AutoCommit" on page 15 is set to `true`, the connector executes the same behavior as if `PreserveUIDSeq` is set to `false`.

If the "PreserveUIDSeq" property is set to false, at runtime, the number of open database connections is the sum of this value plus 2.

The default value is `true`.

RDBMS.initsession

SQL statement that initializes every session with the database. The connector takes a query and executes it at startup. There should not be a return value for this query. The property name is required, but a value is not.

There is no default value.

RDBMSVendor

Specifies which RDBMS the connector uses for special processing. Set the value of this property to `DB2`. If you are using a different database, set the value to the name of that database, or leave the value blank.

If using a non-default database, ensure that the proper driver is loaded. If this property is set to `Others`, the connector determines which database to use by locating the driver.

A value is required for the connector to process successfully.

No default value is provided.

ReplaceAllStr

Specifies whether the connector replaces all instances of each character identified in the `ReplaceStrList` property with the substitution string specified in that property. The connector evaluates ReplaceAllStr only if the `ESC=[true|false]` parameter of each attribute's AppSpecificInfo property does not contain a value. In other words, if the `ESC` parameter has been specified, its value takes precedence over the value set for the `ReplaceAllStr` property. To cause the connector to use the value of `ReplaceAllStr`, verify that the `ESC` parameter has not been specified.

The default value of `ReplaceAllStr` is `false`.

Note: The ESC parameter and the ReplaceAllStr and ReplaceStrList properties provide support for database escape character functionality (for example, escaping single quotes). Because the same functionality is also available from the Prepared Statements provided by the JDBC driver, these properties will be deprecated in future releases of the connector. The connector currently supports the use of the JDBC Prepared Statements.

ReplaceStrList

Specifies one or more substitution sets, each composed of an individual character to be replaced, a character delimiter, and a substitution string. The connector performs this substitution on an attribute's value only if a value has been specified for the `ESC=[true|false]` parameter of the attribute's AppSpecificInfo property or for the connector's `ReplaceAllStr` property.

Note: The ESC parameter and the ReplaceAllStr and ReplaceStrList properties provide support for database escape character functionality (for example, escaping single quotes). Because the same functionality is also available from the Prepared Statements provided by the JDBC driver, these properties will be deprecated in future releases of the connector. The connector currently supports the use of the JDBC Prepared Statements.

The syntax for this attribute is:

single_char1,*substitution_str1*[:*single_char2*,*substitution_str2*[:...]]

where:

single_char	A character to be replaced.
single_char	The substitution string that the connector uses to replace the character.
single_char	The character delimiter, which separates the character to be replaced from the string that replaces it. By default, the character delimiter is a comma (,). You can configure this delimiter by setting the first delimiter in the `StrDelimiter` property.
single_char	The termination delimiter, which separates substitution sets (each of which is composed of the character to be replaced, a character delimiter, and the substitution string). By default, the termination delimiter is a colon (:). You can configure this delimiter by setting the second delimiter in the `StrDelimiter` property.

For example, assume you want to replace a single percent sign (%) with two percent signs (%%), and a caret (^) with a backslash and a caret (\^). By default, StrDelimiter specifies a comma (,) as the character delimiter, and a colon (:) as the termination delimiter. If you keep the default delimiters, use the following string as the value of `ReplaceStrList`:

```
%,%%:^,\^
```

Note: A restriction of the connector configuration tool prevents entering single quotation marks. Therefore, you must represent a single quotation with the character `Q`, and two single quotations with the characters `DSQ`. In the above example, if you also want to substitute a single quotation mark (') with two single quotation marks (''), use the following notation: `Q,DSQ:%,%%:^,\^`

RetryCountAndInterval

Specifies the number of attempts and the interval in seconds that the connector should use when it is unable to lock data while performing an update operation.

Before it performs an update, the connector locks rows related to the update and attempts to retrieve current data. If the connector cannot lock the rows, it tries again to get the lock for the count and interval specified in this configuration property. The connector eventually times out if the lock is not obtainable within the values specified here.

Specify the value in the format: count, interval in seconds. For example, a value of `3,20` specifies three retries with an interval of 20 seconds in between.

The default is `3,20`.

SchemaName

This property limits the search for the event and archive tables within that particular schema. If this property is not added or if it is left empty, the connector will search all of the schemas that the user has access to. This SchemaName is also used when building the queries to access the event and archive tables.

Note: DB2 schema names are case sensitive. You must specify the schema name in uppercase letters.

No default value is provided.

SPBeforePollCall

This property names the stored procedure that is executed for every poll call. If the property `SPBeforePollCall` has a value (the name of a stored procedure), then at the start of each poll call, the connector calls the stored procedure, passing it the values of the connector properties `ConnectorID` and `PollQuantity`. The procedure will update `PollQuantity` number of rows, setting the connector-id column to `ConnectorID` where status=0 and connector-id is `null`. This enables load balancing in the connector.

Note: In the case where a poll call fails prematurely (the database is down, or the connection is lost), the connector-id remains set. This may result in records being skipped during polling. It is therefore recommended that periodically, the connector-id is reset back to `null` for all records in the event table with a status of 0.

StrDelimiter

Specifies the character and termination delimiters for use in the `ReplaceStrList` property.

- The character delimiter separates the character to be replaced from the string that replaces it. The character delimiter occupies the first (left-hand) position of this property's values and defaults to a comma (`,`).
- The termination delimiter separates substitution sets (each of which is composed of the character to be replaced, a character delimiter, and the substitution string). The termination delimiter occupies the second (right-hand) position of this property's values and defaults to a colon (`:`).

You can specify your own value for either or both of these delimiters. If you do so, do not specify a space or other character between them.

Default value is a comma followed immediately by a colon (`,:`)

TimingStats

Allows you to time each verb operation of the connector to look for problems. Available settings are:

`0` (No timing statistics)

`1` (Timing displayed at entry and exit of the verb operation for an entire hierarchical business object).

`2` (Timing displayed at entry and exit of each verb operation for each individual business object in a hierarchical business object).

Timing messages are log messages rather than trace messages. They can be turned on and off, independent of trace levels.

The default value is `0`.

UniqueIDTableName

Specifies the table that contains the latest value used for generation of a unique ID. By default, the table has one column (`id`). You can customize the table to add a column for each attribute that requires generation of a UID.

The default value is `xworlds_uid`.

UseDefaults

If UseDefaults is set to `true` or is not set, the connector checks whether a valid value or a default value is provided for each required business object attribute. If a value is provided, the Create succeeds; otherwise, it fails.

If UseDefaults is set to `false`, the connector checks only whether a valid value is provided for each required business object attribute; the Create operation fails if a valid value is not provided.

The default value is `false`.

UseDefaultsForCreatingChildBOs

If UseDefaultsForCreatingChildBOs is set to `true` or is not set, the connector checks whether a valid value or a default value is provided for each required business object attribute. If a value is provided, the Create succeeds; otherwise, it fails.

If UseDefaultsForCreatingChildBOs is set to `false`, the connector checks only whether a valid value is provided for each required business object attribute; the Create operation fails if a valid value is not provided.

UseDefaultsForRetrieve

For polling: If UseDefaultsForRetrieve is not defined and set to `true`, the default values will be set in the BO before it is retrieved from the database and dispatched to the server.

If UseDefaultsForRetrieve is defined and set to `false`, the default values will not be set in the BO before it is retrieved from the database and dispatched to the server.

For request processing: If UseDefaultsForRetrieve is not defined and set to `false`, the default values will not be set in the BO before it is retrieved from the database and dispatched to the server.

If UseDefaultsForRetrieve is defined and set to `true`, the default values will be set in the BO before it is retrieved from the database and dispatched to the server.

Creating multiple instances of the connector

Creating multiple instances of a connector is in many ways the same as creating a custom connector.

Note: Each additional instance of any adapter supplied with WebSphere Business Integration Server Express will be treated as a separate adapter by the function that limits the total number of adapters that can be deployed.

You can set your system up to create and run multiple instances of a connector by following the steps below. You must:

- Create a new directory for the connector instance
- Make sure you have the requisite business object definitions
- Create a new connector definition file
- Create a new start-up script

Create a new directory

You must create a connector directory for each connector instance. This connector directory should be named:

```
ProductDir\connectors\connectorInstance
```

where `connectorInstance` uniquely identifies the connector instance.

If the connector has any connector-specific meta-objects, you must create a meta-object for the connector instance. If you save the meta-object as a file, create this directory and store the file here:

```
ProductDir\repository\connectorInstance
```

Create business object definitions

If the business object definitions for each connector instance do not already exist within the project, you must create them.

1. If you need to modify business object definitions that are associated with the initial connector, copy the appropriate files and use Business Object Designer

Express to import them. You can copy any of the files for the initial connector. Just rename them if you make changes to them.

2. Files for the initial connector should reside in the following directory:

   `ProductDir\repository\initialConnectorInstance`

   Any additional files you create should be in the appropriate `connectorInstance` subdirectory of `ProductDir\repository`.

Create a connector definition

You create a configuration file (connector definition) for the connector instance in Connector Configurator Express. To do so:

1. Copy the initial connector's configuration file (connector definition) and rename it.
2. Make sure each connector instance correctly lists its supported business objects (and any associated meta-objects).
3. Customize any connector properties as appropriate.

Create a start-up script

To create a startup script:

1. Copy the initial connector's startup script and name it to include the name of the connector directory:

   dirname

2. Put this startup script in the connector directory you created in "Create a new directory" on page 24.
3. Create a startup script shortcut.
4. Copy the initial connector's shortcut text and change the name of the initial connector (in the command line) to match the name of the new connector instance.

You can now run both instances of the connector on your integration server at the same time.

Starting the connector

A connector must be explicitly started using its **connector start-up script**. The startup script should reside in the connector's runtime directory:

ProductDir`\connectors\`*connName*

where *connName* identifies the connector. The name of the startup script depends on the operating-system platform, as Table 8 shows.

Table 8. Startup scripts for a connector

Operating system	Startup script
Windows	`start_`*connName*`.bat`

You can invoke the connector startup script in any of the following ways:

- On Windows systems, from the **Start** menu

  Select **Programs>IBM WebSphere Business Integration Express>Adapters>Connectors>***your_connector_name*.

  By default, the program name is "IBM WebSphere Business Integration Express". However, it can be customized. Alternatively, you can create a desktop shortcut to your connector.

- From the command line
  - On Windows systems:

    `start_connName connName ICS [-cconfigFile ]`

  where *connName* is the name of the connector.
- From System Monitor

  You can load, activate, deactivate, pause, shutdown or delete a connector using this tool.
- On Windows systems, you can configure the connector to start as a Windows service. In this case, the connector starts when the Windows system boots (for an Auto service) or when you start the service through the Windows Services window (for a Manual service).

For more information on how to start a connector, including the command-line startup options, refer to the *System Administration Guide*.

Stopping the connector

The way to stop a connector depends on the way that the connector was started, as follows:

- If you started the connector from the command line, with its connector startup script:
  - On Windows systems, invoking the startup script creates a separate "console" window for the connector. In this window, type "Q" and press Enter to stop the connector.
- From System Monitor

  You can load, activate, deactivate, pause, shutdown or delete a connector using this tool.
- On Windows systems, you can configure the connector to start as a Windows service. In this case, the connector stops when the Windows system shuts down.

Chapter 3. Understanding business objects for the connector

This chapter describes how the connector for JDBC processes business objects and describes the assumptions the connector makes when retrieving and modifying data. It contains the following sections:

- "Business object and attribute naming conventions"
- "Business object structure"
- "Business object verb processing" on page 31
- "Business object attribute properties" on page 46
- "Business object application-specific information" on page 48

You can use this information as a guide to modifying existing business objects or as suggestions for implementing new ones. For information on the utility that automates the creation of business object definition files from database tables, see Chapter 4, "Generating business object definitions using JDBCODA," on page 61.

The connector makes assumptions about the structure of its supported business objects, the relationships between parent and child business objects, the format of the application-specific information, and the database representation of the business object. Therefore, when you create or modify a business object that will be processed by the connector, your modifications must conform to the rules the connector is designed to follow. If they do not, the connector cannot process new or modified business objects correctly.

Business object and attribute naming conventions

The name of a business object used by the connector can consist only of alphanumeric characters or the underscore character. Business object attribute names also can consist only of alphanumeric characters or the underscore character.

Business object structure

In most cases, the connector assumes that every individual business object is represented by one database table or view, and that each **simple attribute** (that is, an attribute that represents a single value, such as a `String` or `Integer` or `Date`) within the object is represented by a column in that table or view. Thus, attributes within the same individual business object cannot be stored in different database tables. However, the following situations are possible:

- The database table might have more columns than the corresponding individual business object has simple attributes (that is, some columns in the database are not represented in the business object). Include in your design only those columns needed for the business object processing.
- The individual business object might have more simple attributes than the corresponding database table has columns (that is, some attributes in the business object are not represented in the database). The attributes that do not have a representation in the database either have no application-specific information or are set with a default value or specify stored procedures.
- The individual business object can represent a view that spans multiple database tables. The connector can use such a business object when processing Create,

Retrieve, Update, and Delete events triggered in the application. However, when processing business object requests, the connector can use such a business object only for Retrieve requests.

- The individual business object can represent a wrapper object that is used as a container for unrelated business objects. The wrapper object is not represented by a database table or view. Wrapper objects may not be used as children of other objects.

Note: If a business object is based on a stored procedure, each simple attribute (other than the special SP attributes) may or may not have application-specific information. For more information, see "Stored procedures" on page 40.

Business objects can be flat or hierarchical. All the attributes of a **flat** business object are simple and represent a single value.

A hierarchical business object has attributes that represent a child business object, an array of child business objects, or a combination of both. In turn, each child business object can contain a child business object or an array of business objects, and so on. A **single-cardinality relationship** occurs when an attribute in a parent business object represents a single child business object. In this case, the attribute is of the same type as the child business object.

A **multiple-cardinality relationship** occurs when an attribute in the parent business object represents an array of child business objects. In this case, the attribute is an array of the same type as the child business objects.

Note: The term **hierarchical** business object refers to a complete business object, including all the child business objects that it contains at any level. The term **individual** business object refers to a single business object, independent of any child business objects it might contain or that contain it. The term **top-level** business object refers to the individual business object at the top of the hierarchy that does not itself have a parent business object.

The connector supports the following relationships among business objects:

- "Single-cardinality relationships"
- "Single-cardinality relationships and data without ownership" on page 29
- "Multiple-cardinality relationships" on page 30
- "Single-cardinality relationships that store the relationship in the child" on page 31
- "Wrapper objects" on page 31

In each type of cardinality, the relationship between the parent and child business objects is described by the application-specific information of the key attribute of the business object storing the relationship. For more information on this application-specific information, see `"FK=[fk_object_name.]fk_attribute_name" on page 51` in Table 10 on page 51.

Single-cardinality relationships

Typically, a business object that contains a single-cardinality child business object has at least two attributes that represent the relationship. The type of one attribute is the same as the child's type. The other attribute is a simple attribute that contains the child's primary key as a foreign key in the parent. The parent has as many foreign-key attributes as the child has primary-key attributes.

Because the foreign keys that establish the relationship are stored in the parent, each parent can contain only one single-cardinality child of a given type.

Figure 2 illustrates a typical single-cardinality relationship. In the example, `fk1` is the simple attribute that contains the child's primary key, and `child[1]` is the attribute that represents the child business object.

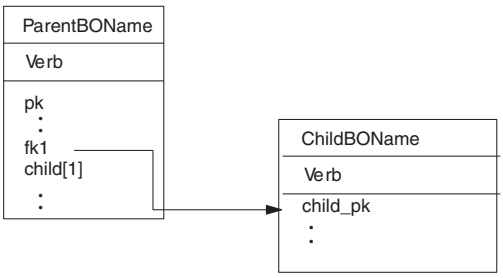


Figure 2. Typical single-cardinality relationship

Single-cardinality relationships and data without ownership

Typically, each parent business object **owns** the data within the child business object that it contains. For example, if each Customer business object contains a single Address business object, when a new customer is created, a new row is inserted into both the customer and the address tables. The new address is unique to the new customer. Likewise, when deleting a customer from the customer table, the customer's address is also deleted from the address table.

However, there are situations where multiple hierarchical business objects contain the same data, which none of them owns. For example, assume that an Address business object has a `StateProvince[1]` attribute that represents the `StateProvince lookup table with single cardinality`. Because the `lookup` table is rarely updated and is maintained independently of the address data, creation or modification of address data does not affect the data in the lookup table. The connector either finds an existing state or province name or fails. It does not add or change values in the lookup table.

When multiple business objects contain the same single-cardinality child business object, the foreign-key attribute in each parent business object must specify the relationship as `NO_OWNERSHIP`. When an integration broker sends the connector a hierarchical business object with a Create, Delete, or Update request, the connector ignores single-cardinality children contained without ownership. The connector performs only retrieves on these business objects. If the connector fails to retrieve such a single-cardinality business object, it returns an error and stops processing.

For information on how to specify the relationship without ownership, see "Attributes that represent a single-cardinality child business object" on page 56. For more information on specifying foreign key relationships, see "Specifying an attribute's foreign key" on page 53.

Denormalized data and data without ownership

In addition to facilitating use of static lookup tables, containment without ownership provides another capability: synchronizing normalized and denormalized data.

Synchronizing from normalized to denormalized data: Specifying a relationship as `NO_OWNERSHIP` allows you to create or change data when you synchronize from a

normalized application to a denormalized one. For example, assume that your normalized source application stores data in two tables, A and B. Assume further that your denormalized destination application stores all the data in a single table such that each entity A redundantly stores B data.

In this example, to synchronize a change in table B data from your source application to your destination application, you must trigger a table A event whenever table B data changes. Moreover, because table B data is stored redundantly in table A, you must send a business object for each row in table A that contains the changed data from table B.

Synchronizing from denormalized to normalized data: When synchronizing data from a denormalized source application to a normalized destination application, the connector does not create, delete, or update data contained without ownership in the normalized application.

When synchronizing data to a normalized application, the connector ignores all single-cardinality children contained without ownership. In order to create, remove, or modify such child data, you must process the data manually.

Multiple-cardinality relationships

Typically, a business object that contains an array of child business objects has only one attribute that represents the relationship. The type of the attribute is an array of the same type as the child business objects. In order for a parent to contain more than one child, the foreign keys that establish the relationship are stored in each child.

Therefore, each child has at least one simple attribute that contains the parent's primary key as a foreign key. The child has as many foreign-key attributes as the parent has primary key attributes.

Because the foreign keys that establish the relationship are stored in the child, each parent can have zero or more children.

Figure 3 illustrates a multiple-cardinality relationship. In the example, `parentId` is the simple attribute that contains the parent's primary key, and `child[n]` is the attribute that represents the array of child business objects.

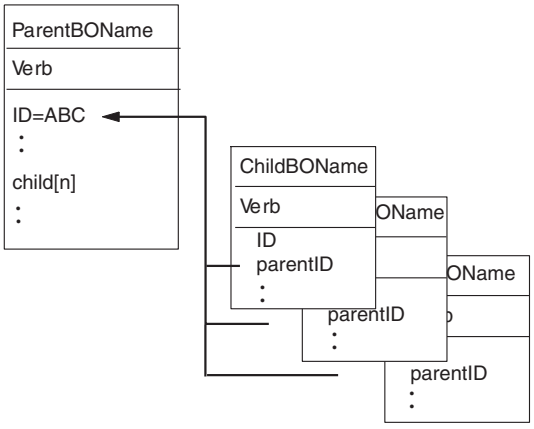


Figure 3. Multiple-cardinality business object relationship

Single-cardinality relationships that store the relationship in the child

Some applications store a single child entity so that the relationship is stored in the child rather than in the parent. In other words, the child contains a foreign key whose value is identical to the value stored in the parent's primary key.

Figure 4 illustrates this special type of single-cardinality relationship.

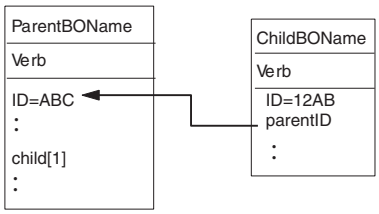


Figure 4. Single-cardinality business object with relationship stored in the child

Applications use this type of single-cardinality relationship when child data does not exist independently of its parent and can be accessed only through its parent. Such child data is never owned by more than one parent, and requires that the parent and its primary-key value exist before the child and its foreign-key value can be created.

To accommodate such applications, the connector also supports hierarchical business objects that contain a child with single cardinality but store the relationship in the child rather than in the parent.

To specify that a parent business object contains a single-cardinality child in this special way, when you specify the application-specific information of the attribute that contains the child, do not include the `CONTAINMENT` parameter. For more information, see "Attributes that represent a single-cardinality child business object" on page 56.

Wrapper objects

The wrapper object is a top-level business object that does not correspond to any database table or view. The wrapper object is denoted by the top-level business object property of `WRAPPER` with a value of `true`. The wrapper object is a dummy parent that is used as a container for unrelated children. In processing the wrapper object, the connector ignores the top-level business object and processes only the children. The wrapper object may contain N cardinality or N-1 cardinality entities or both.

A N cardinality entity should have at least one unique attribute marked as a primary key and at least one attribute marked as a foreign key. This foreign key will then be added as a primary key in the wrapper object. The entity's foreign key will reference the wrapper object's primary key that was just added.

In the case of a N-1 cardinality entity, the primary key should be marked as both a primary key and a foreign key, referencing the primary key in the wrapper, which is the same as the primary key in the N-1 entity.

Business object verb processing

This section describes the following aspects of processing a business object's verbs:

- "Verb determination," which explains how the connector determines the verb to use for each individual, source business object
- "Afterimages and deltas," which defines the terms and explains how the connector works with afterimages
- "Verb processing" on page 33, which explains the steps the connector takes when creating, retrieving, updating, or deleting a business object
- "SQL statements" on page 39, which explains how the connector uses simple SQL statements for selecting, updating, retrieving or deleting operations
- "Stored procedures" on page 40, which explains how the connector uses stored procedures
- "Transaction commit and rollback" on page 46, which briefly explains how the connector uses transaction blocks

Verb determination

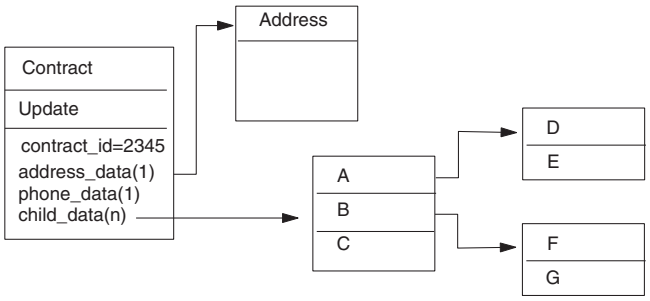
A top-level business object and each of its individual child business objects can contain their own verbs. Therefore, an integration broker can pass a business object that has different verbs for parent and child business objects to the connector. When this occurs, the connector uses the verb of the top-level parent business object to determine how to process the entire business object. For more information, see "Verb processing" on page 33.

Afterimages and deltas

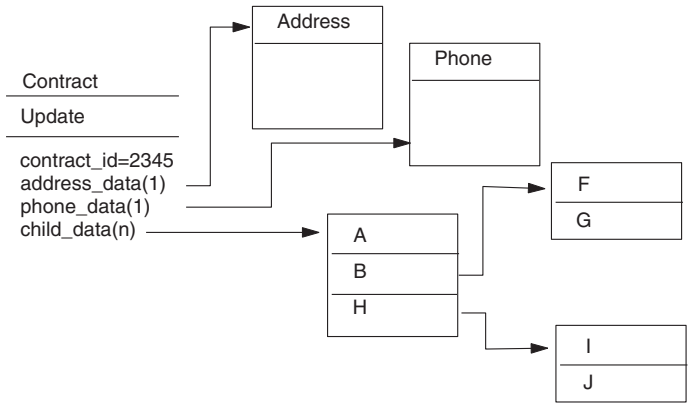
An afterimage is the state of a business object after all changes have been made to it. A delta is a business object used in an update operation that contains only key values and the data to be changed. Because the connector supports only afterimages, when it receives a business object for update, the connector assumes that the business object represents the desired state of the data after update.

Therefore, when an integration broker sends a business object with the Update verb to the connector, the connector changes the current representation of the business object in the database so that it exactly matches the source business object. To do this, the connector changes simple attribute values and adds or removes child business objects.

For example, assume the current state of Contract 2345 in the database is as follows:



Assume further that the integration broker passes the following business object to the connector:



To process the update, the connector applies the following changes to the database:

- Update the simple attributes in the top-level Contract and Address business objects
- Create the Phone business object
- Update the simple attributes in the child business objects A, B, F and G
- Delete the child business objects C, D and E
- Create the child business objects H, I and J

Because the connector assumes that each business object it receives from the integration broker represents an afterimage, it is important to ensure that each business object sent to such a connector for updating contains valid existing child business objects. Even if none of a child business object's simple attributes have changed, the child business object must be included in the source business object.

There is a way, however, that you can prevent some connectors from deleting missing child business objects during an update operation. You can use the application-specific information for the attribute that represents the child or array of children to instruct the connector to keep child business objects that are not included in the source business object. To do so, set `KEEP_RELATIONSHIP` to `true`. For more information, see "Specifying an attribute's foreign key" on page 53.

Verb processing

This section outlines the steps the connector takes when creating, retrieving, updating, or deleting a business object that it receives from an integration broker. The connector processes hierarchical business objects recursively; that is, it performs the same steps for each child business object until it has processed all individual business objects.

Note: A top-level business object that is a wrapper supports the create, retrieve, update and delete verbs. The only difference in processing a wrapper object is that the wrapper object is not processed, only the objects that it contains are processed.

Business object comparison

At various points in the processing outlined below, the connector compares two business objects to see if they are the same. For example, during an update operation, the connector determines whether a particular business object exists in an array of business objects. To perform the check, the connector compares the

business object to each business object within the array. For two business objects to be identical, the following two conditions must be satisfied:

- The type of the business objects being compared must be the same. For example, a Customer business object is never considered identical to a Contact business object even if all of their attributes are exactly the same.
- All corresponding key attributes in the two business objects must contain identical values. If a key attribute is set to `CxIgnore` in both business objects, the connector considers them identical. However, if a key attribute is set to `CxIgnore` in one business object but not in the other, the business objects are not identical.

Create operations

When creating a business object, the connector returns a status either of `VALCHANGE` if the operation was successful (regardless of whether the operation caused changes to the business object), or `FAIL` if the operation failed.

The connector performs the following steps when creating a hierarchical business object:

1. Recursively inserts each single-cardinality child business object contained with ownership into the database. In other words, the connector creates the child and all child business objects that the child and its children contain.

   If the business object definition specifies that an attribute represents a child business object with single cardinality and that attribute is empty, the connector ignores the attribute. However, if the business object definition requires that attribute to represent a child and it does not, the connector returns an error and stops processing.
2. Processes each single-cardinality child business object contained without ownership as follows:
   a. Recursively attempts to retrieve the child from the database using the key values passed in by the integration broker.
   b. If the retrieve is unsuccessful, indicating that the child does not currently exist in the database, the connector returns an error and stops processing. If the retrieve is successful, the connector recursively updates the child business object.

   Note: For this approach to work correctly when the child business object already exists in the application database, ensure that primary key attributes in child business objects are cross-referenced correctly on create operations. If the child business object does not already exist in the application database, set the primary key attributes to `CxBlank`.
3. Inserts the top-level business object in the database as follows:
   a. Sets each of its foreign-key values to the primary-key values of the corresponding child business object represented with single cardinality. Because values in child business objects can be set by database sequences or counters or by the database itself during the creation of the child, this step ensures that the foreign-key values in the parent are correct before the connector inserts the parent in the database.
   b. Generates a new unique ID value for each attribute that is set automatically by the database. The name of the database sequence or counter is stored in the attribute's application-specific information. If an attribute has an associated database sequence or counter, the value generated by the connector overwrites any value passed in by the integration broker. For more information on specifying a database sequence or counter, see `UID=AUTO` in "Application-specific information for simple attributes" on page 50.

c. Copies the value of an attribute to the value of another attribute as specified by the CA (CopyAttribute) parameter of the attribute's application-specific information. For more information on using the CA parameter, see CA=set_attr_name in "Application-specific information for simple attributes" on page 50.

d. Inserts the top-level business object into the database.

Note: A top-level business object that is a wrapper will not be inserted into the database.

4. Processes each of its single-cardinality child business objects that stores the parent/child relationship in the child, as follows:
   a. Sets the foreign-key values in the child to reference the value in the corresponding primary-key attributes in the parent. Because the parent's primary-key values may have been generated during the creation of the parent, this ensures that the foreign-key values in each child are correct before the connector inserts the child into the database.
   b. Inserts the child into the database.
5. Processes each of its multiple-cardinality child business objects, as follows:
   a. Sets the foreign-key values in each child to reference the value in the corresponding primary-key attributes in the parent. Because the parent's primary-key values may have been generated during the creation of the parent, this ensures that the foreign-key values in each child are correct before the connector inserts the child into the database.
   b. Inserts each of its multiple-cardinality child business objects into the database.

Retrieve operations

The connector performs the following steps when retrieving a hierarchical business object:

1. Removes all child business objects from the top-level business object that it received from the integration broker.
2. Retrieves the top-level business object from the database.
   - If the retrieval returns 1 row, the connector continues processing.
   - If the retrieval returns no rows, indicating that the top-level business object does not exist in the database, the connector returns BO_DOES_NOT_EXIST.
   - If the retrieval returns more than one row, the connector returns FAIL.

   Note: A business object can have attributes that do not correspond to any database column, such as placeholder attributes. During retrieval, the connector does not change such attributes in the top-level business object; they remain set to the values received from the integration broker. In child business objects, the connector sets such attributes to their default values during retrieval.

   Note: A top-level business object that is a wrapper must contain any attribute values from the objects at the level immediately below the wrapper object, which would be necessary to retrieve the objects, including keys and placeholder attributes. The wrapper object must have all keys and placeholder attributes populated. Simple attributes in the wrapper object that will be used as foreign keys in the objects one level below the wrapper should be marked as keys in the wrapper object.
3. Recursively retrieves all multiple-cardinality child business objects.

Note: The connector does not enforce uniqueness when populating an array of business objects. It is the database's responsibility to ensure uniqueness. If the database returns duplicate child business objects, the connector returns duplicate children.

4. Recursively retrieves each of the single-cardinality children regardless of whether the child business object is contained with or without ownership.

   Note: All single cardinality child business objects are processed based on occurrence in the business object and before the parent business object is processed. Child object ownership and non-ownership do not determine the processing sequence, but do determine the type of processing.

RetrieveByContent operations

A RetrieveByContent verb is applicable only for the top-level business object, because the connector performs a retrieval based on attributes only in the top-level business object.

If a top-level business object uses the RetrieveByContent verb, all of the attributes (including non-key attributes) that are not null are used as retrieval criteria.

If more than one row is returned, the connector uses the first row as the result row and returns `MULTIPLE_HITS`.

Note: A RetrieveByContent verb is not applicable for a top-level business object that is a wrapper.

Update operations

When updating a business object, the connector returns a status either of `VALCHANGE` if the operation was successful (regardless of whether the operation caused changes to the business object), or `FAIL` if the operation failed. When working with an Oracle database, the connector locks data while retrieving it to ensure data integrity.

The connector performs the following steps when updating a hierarchical business object:

1. Uses the primary-key values of the source business object to retrieve the corresponding entity from the database. The retrieved business object is an accurate representation of the current state of the data in the database.
   - If the retrieval fails, indicating that the top-level business object does not exist in the database, the connector returns `BO_DOES_NOT_EXIST` and the update fails.

     Note: A top-level business object that is a wrapper does not have to exist in the database. However, it must contain any attribute values from the objects at the level immediately below the wrapper object, which would be necessary to retrieve the objects including keys and placeholder attributes. The wrapper object must have all keys and placeholder attributes populated. Simple attributes in the wrapper object that will be used as foreign keys in the objects one level below the wrapper should be marked as keys in the wrapper object.
   - If the retrieval succeeds, the connector compares the retrieved business object to the source business object to determine which child business objects require changes in the database. The connector does not, however, compare

values in the source business object's simple attributes to those in the retrieved business object. The connector updates the value of all non-key simple attributes.

If all the simple attributes in the top-level business object represent keys, the connector cannot generate an update query for the top-level business object. In this case, the connector logs a warning and continues to step 2.

2. Recursively updates all single-cardinality children of the top-level business object.

   If the business object definition requires that an attribute represent a child business object, the child must exist in both the source business object and the retrieved business object. If it does not, the update fails, and the connector returns an error.

   The connector handles single-cardinality children contained with ownership in one of the following ways:

   - If the child is present in both the source and the retrieved business objects, instead of updating the already existing child in the database, the connector deletes the existing child and creates the new child.
   - If the child is present in the source business object but not in the retrieved business object, the connector recursively creates it in the database.
   - If the child is present in the retrieved business object but not in the source business object, the connector recursively deletes it from the database. The type of delete, physical or logical, depends on the value of its `ChildUpdatePhyDelete` property.

   For single-cardinality children contained without ownership, the connector attempts to retrieve every child from the database that is present in the source business object. If it successfully retrieves the child, the connector populates the child business object but does not update it, as single cardinality children contained without ownership are never modified by the connector.

3. For single-cardinality child business objects that store the relationship in the parent, sets each foreign-key value in the parent to the value of the primary key in the corresponding single-cardinality child business object. This step is necessary because single-cardinality children may have been added to the database during previous steps, resulting in the generation of new unique IDs.
4. Updates all simple attributes of the retrieved business object except those whose corresponding attribute in the source business object contain the value `CxIgnore`.

   Because the business object being updated must be unique, the connector verifies that only one row is processed as a result. It returns an error if more than one row is returned.

5. Sets all foreign-key values in each child that stores the parent/child relationship in the child (both multiple-cardinality and single-cardinality) to the primary-key value of its corresponding parent business object. (When InterChange Server Express is used as the integration broker, these values have typically been cross-referenced during data mapping.) However, this step is important to ensure that the foreign-key values of new children that store the relationship in the child are correct before the connector updates those children.
6. Processes each multiple-cardinality child of the retrieved business object in one of the following ways:

   - If the child exists in both the source and the retrieved business objects' arrays, the connector recursively updates it in the database.
   - If the child exists in the source array but not in the retrieved business object's array, the connector recursively creates it in the database.

- If the child exists in the retrieved business object's array but not in the source array, the connector recursively deletes it from the database unless the application-specific information for the attribute that represents the child in the parent has KEEP_RELATIONSHIP set to true. In this case, the connector does not delete the child from the database. For more information, see "Specifying an attribute's foreign key" on page 53. The type of delete, physical or logical, depends on the value of its ChildUpdatePhyDelete property.

Note: The integration broker must ensure that business objects contained with multiple cardinality in the source business object are unique (that is, that an array does not contain two or more copies of the same business object). If the connector receives duplicates of a business object in a source array, it processes the business object twice, with possibly unpredictable results.

DeltaUpdate operations

DeltaUpdate verb processing is different from update verb processing as follows:

1. On a DeltaUpdate no retrieve is done before updating, as is done in update verb processing.
2. No comparisons are made between the incoming business object and the business object in the database.
3. All children will be processed based on the verb set in each child object. If a child doesn't have a verb set in it, the connector will return an error.

When delta updating a business object, the connector returns a status of either VALCHANGE if the operation was successful (regardless of whether the operation caused changes to the business object) or FAIL if the operation failed.

The connector performs the following steps when delta updating a hierarchical business object:

1. Recursively processes all single-cardinality children of the parent object. If a child is marked as IsRequired in the business object specification, it must be present in the inbound object. If not, the delta update will fail and the connector will return an error.
2. Sets all foreign key values in the parent that reference attributes in single-cardinality children to their corresponding child values. This is necessary because single-cardinality children may have been added to the database during the previous steps, resulting in the generation of new sequence values.
3. Updates the current object being processed via an SQL UPDATE statement or a stored procedure. All simple attributes of the individual business object are updated, except those attributes set to IsIgnore in the inbound business object. The connector does not compare the inbound object to the current object on an attribute level to determine which attributes need to be added to the update statement; they are all updated. Since the object being updated should be unique, the connector checks to make sure that only one row is processed as a result. An error is returned if more than one row is processed.
4. Sets all foreign key values in all cardinality N children of the current object that reference parent attributes to the corresponding parent values. Usually these values will already be cross-referenced during data mapping; however, this may not be the case for new children in cardinality N containers. This ensures that the foreign key values in all cardinality N children are correct before those children are updated.
5. Updates all cardinality N containers of the current object.

When the child objects are processed, each child's verb is taken and the appropriate operation is done. The allowed verbs on a child in DeltaUpdate are Create, Delete and DeltaUpdate.

- If a Create verb is found in the child, the child gets created in the database if it is an ownership child. Non-ownership children are retrieved to validate their existence in the database.
- If a Delete verb is found in the child, that child gets deleted.
- If a DeltaUpdate verb is found in the child, the child gets updated in the database.

Delete operations

When deleting a business object, the connector returns a status of `SUCCESS` if the operation was successful or `FAIL` if the operation failed. The parent business object is first retrieved and then the adapter recursively deletes all single-cardinality children that have an ownership relationship to the parent, then the parent business object itself, and finally all cardinality N children. Single-cardinality no-ownership children are never deleted.If the business object does not exist, the connector returns a `FAIL.`

The connector supports logical and physical deletes, depending on the Status Column Name (SCN) value in the object's application-specific information. If the SCN value is defined, the connector performs a logical delete. If the SCN value is not defined, the connector performs a physical delete.

Physical deletes: The connector performs the following steps when physically deleting a hierarchical business object:

1. Recursively deletes all single-cardinality child business objects contained with ownership.
2. Deletes the top-level business object.
3. Recursively deletes all multiple-cardinality child business objects.

Note: A top-level business object that is a wrapper does not have a corresponding database table, hence it will not be deleted from the database. Any simple attribute values for a wrapper will be ignored.

Logical deletes: When logically deleting a business object, the connector performs the following steps:

1. Issues an `UPDATE` that sets the business object's status attribute to the value specified by the business object's application-specific information. The connector ensures that only one database row is updated as a result, and it returns an error if this is not the case.
2. Recursively logically deletes all single-cardinality children contained with ownership and all multiple-cardinality children. The connector does not delete single-cardinality children contained without ownership.

SQL statements

The connector can use simple SQL statements for select, update, retrieve or delete operations. The column names for SQL statements are derived from an attribute's `AppSpecificInfo` property. Each query spans one table only, unless posted to a view.

Stored procedures

A stored procedure is a group of SQL statements that form a logical unit and perform a particular task. A stored procedure encapsulates a set of operations or queries for the connector to execute on an object in a database server.

The connector calls stored procedures in the following circumstances:

- Before processing a business object, to perform preparatory operational processes
- After processing a business object, to perform post-operational processes
- To perform a set of operations on a business object, instead of using a simple `INSERT`, `RETRIEVE`, `UPDATE`, or `DELETE` statement

When it processes a hierarchical business object, the connector can use a stored procedure to process the top-level business object or any of its child business objects. However, each business object or array of business objects must have its own stored procedure.

Specifying a stored procedure

This section describes the steps you must perform to cause the connector to use a stored procedure for a business object. It contains the following sections:

- "Adding attributes to the business object"
- "Syntax of a stored procedure" on page 41
- "Examples of stored procedures" on page 42
- "Specifying the stored procedure" on page 42

Adding attributes to the business object: You must add a special kind of attribute to the business object for each type of stored procedure that the connector processes. These attributes represent only the stored procedure's type and the application-specific information that defines it. These attributes do not use the application-specific information parameters available for a standard simple attribute.

Name the attribute according to the type of stored procedure to be used. For example, to cause the connector to use AfterUpdate and BeforeRetrieve stored procedures, add the `AfterUpdateSP` and `BeforeRetrieveSP` attributes.

The connector recognizes the following business object attribute names:

```
BeforeCreateSP
AfterCreateSP
CreateSP
BeforeUpdateSP
AfterUpdateSP
UpdateSP
BeforeDeleteSP
AfterDeleteSP
DeleteSP
BeforeRetrieveSP
AfterRetrieveSP
RetrieveSP
BeforeRetrieveByContentSP
AfterRetrieveByContentSP
RetrieveByContentSP
BeforeRetrieveUpdateSP
AfterRetrieveUpdateSP
RetrieveUpdateSP
```

Note: Create an attribute only for those stored procedures that you want the connector to execute. Use the application-specific information or mapping

(only if InterChange Server Express is used as the integration broker) to specify values for these attributes before the business object is sent to the connector. The connector must be restarted to recognize changes to these values for subsequent calls on a business object.

Syntax of a stored procedure: The syntax for specifying a stored procedure is:

```
SPN=StoredProcedureName;RS=true|false[;IP=Attribute_Name1[:Attribute_Name2[:...]]]
[;OP=Attribute_Name1| RS[:Attribute_Name2| RS[:...]]]
[;IO=Attribute_Name1[:Attribute_Name2[:...]]]
```

where:

StoredProcedureName	The name of the stored procedure.
RS	Is true if the stored procedure returns a result set or false if it does not. By default, false. If the value is true, the ColumnName property in an attribute's application-specific information points to the appropriate column in the result set. If RS is part of the output parameter list, then that particular parameter returns a result set. Only one result set OUT parameter is supported. If more than one result set is returned as an OUT parameter, only the first result set is returned and all others are ignored. Currently, this feature is supported for Oracle 8i and above, stored procedures that use the Oracle JDBC Driver. For the stored procedure in the database, the corresponding parameter should return a REFCURSORtype.
IP	Input Parameters: The list of business object attributes whose values the connector should use as input values when executing the stored procedure.
OP	Output Parameters: The list of business object attributes to which the connector should return values after executing the stored procedure. See RS for a description of the result set.
IO	InputOutput Parameters: The list of business object attributes whose values the connector should use as input values and to which the connector should return values after executing the stored procedure.

Note: The order of StoredProcedureName, RS, and parameters is important; the order of parameters among themselves is not important. In other words, it makes no difference to the connector if the stored procedure groups all parameters of each type or intersperses the types of parameters.

When multiple parameters of the same type are grouped together, separate the values with a colon delimiter; you need not repeat the parameter's name for each value. Separate parameters of different types with a semicolon delimiter. When specifying parameter values, do not put a blank space on either side of the equal sign (=).

Examples of stored procedures: The following examples use stored procedures named `CustomerInsert` and `VendorInsert` that get values from two input attributes, and return values to four output attributes. The examples illustrate different structures for stored procedures.

- Parameters of the same type are grouped together (IP, IP, OP, OP, OP, IO):

```
SPN=CustomerInsert;RS=false;IP=LastName:FirstName;OP=CustomerName:
CustomerID:ErrorStatus:ErrorMessage;IO=VendorID
```

- Parameters of the same type are interspersed (IP, OP, OP, OP, IP, IO, OP):

```
SPN=VendorInsert;RS=false;IP=LastName;OP=CustomerName:
CustomerID:ErrorStatus;IP=FirstName;IO=VendorID;OP=ErrorMessage
```

The connector supports only the simple data types supported by the JDBC driver.

Specifying the stored procedure: There are two ways to specify the stored procedure name and its parameter values:

- Attribute's `AppSpecificInfo` property

  If the length of the text that specifies the stored procedure is less than or equal to 4000 bytes, you can specify the value in the attribute's `AppSpecificInfo` property. You can use this property to specify the stored procedure regardless of whether the connector has polled for the business object (that is, the business object represents an application event) or has received the business object as an integration broker request.

  The following example illustrates specification of the stored procedure in application-specific information. In this case, the value specified for the `MaxLength` property is not important to the stored procedure.

```
   [Attribute]
   Name = BeforeCreateSP
   Type = String
   MaxLength = 15
   IsKey = false
   IsRequired = false
   AppSpecificInfo =SPN=ContactInsert;IP=LastName:FirstName;OP=CustomerName:
CustomerID:ErrorStatus:ErrorMessage

[End]
```

- Attribute's value (relevant only if InterChange Server Express is used as the integration broker)

  If the length of the text that specifies the stored procedure is more than 4000 bytes, you must use mapping to specify the stored procedure. You can use mapping to specify the stored procedure only if the business object represents an integration broker request. In other words, you cannot use an attribute's value to specify a stored procedure when the connector is polling for events.

  If the text of the stored procedure is longer than 4000 bytes and you use mapping to specify it, remember to expand the value of the `MaxLength` property to accommodate the full text.

Note: If a stored procedure that handles a create, update, or delete operation is executed on a hierarchical business object containing an array of child business objects, the connector processes each child business object individually. For example, if the connector executes a `BeforeCreate` stored procedure, it does not process the array as a unit but processes each member in the array. When it processes a `BeforeRetrieve` stored procedure, the connector operates on a single business object. When it processes an `AfterRetrieve` stored procedure, the connector operates on all business objects returned by the retrieval.

Processing business objects using stored procedures or simple SQL statements

The following sections explain how the connector processes the stored procedures:

- "Business object create operations"
- "Business object update operations"
- "Business object delete operations" on page 44
- "Business object retrieve operations" on page 44
- "Business object RetrieveByContent operations" on page 45
- "Business object Retrieve-for-Update operations" on page 45

Business object create operations: A Create stored procedure usually returns values that the connector uses to populate the simple attributes in the top-level business object. The connector performs the following steps when processing the Create stored procedures (`BeforeCreate`, `Create`, `AfterCreate`):

1. Checks whether the business object contains a `BeforeCreateSP` attribute. If it does, calls the `BeforeCreate` stored procedure.
2. If the stored procedure returns values through output parameters, uses the values to set the value of simple attributes in the business object.
3. Creates the single-cardinality child business objects.
4. Sets each of the top-level business object's foreign key values to the primary-key value of each single-cardinality child business object.
5. Checks whether the business object contains a `CreateSP` attribute. If it does, calls the `Create` stored procedure to create the top-level business object. If it does not, builds and executes an `INSERT` statement to create the top-level business object.
6. If the `Create` stored procedure returns values through output parameters, uses the values to set the value of simple attributes in the business object.
7. Sets the foreign-key value in each multiple-cardinality child to the value of its parent's primary-key attribute.
8. Creates the multiple-cardinality child business objects.
9. Checks whether the business object contains an `AfterCreateSP` attribute. If it does, calls the `AfterCreate` stored procedure.
10. If the stored procedure returns values through output parameters, uses the values to set the values of simple attributes in the business object.

The connector can use values returned in step 10 to change the values of a business object that it created in steps 3 or 5.

Business object update operations: An Update stored procedure usually returns values that the connector uses to populate the simple attributes in the top-level business object. The connector performs the following steps when processing the Update stored procedures (`BeforeUpdate`, `Update`, `AfterUpdate`):

1. Checks whether the business object contains a `BeforeUpdateSP` attribute. If it does, calls the `BeforeUpdate` stored procedure.
2. If the `BeforeUpdate` stored procedure returns values through output parameters, uses the values to set the value of simple attributes in the business object.
3. Updates the single-cardinality child business objects.
4. Sets each of the top-level business object's foreign-key values to the primary-key value of each child business object contained with single cardinality.

5. Checks whether the business object contains an UpdateSP attribute. If it does, calls the Update stored procedure to update the top-level business object. If it does not, builds and executes an UPDATE statement to update the top-level business object.
6. If the Update stored procedure returns values through output parameters, uses the values to set the value of simple attributes in the business object.
7. Sets foreign-key values in the multiple-cardinality children to reference the value in the corresponding primary-key attributes in the parent.
8. Updates the multiple-cardinality child business objects.
9. Checks whether the business object contains an AfterUpdateSP attribute. If it does, calls the AfterUpdate stored procedure.
10. If the stored procedure returns values through output parameters, uses the values to set the value of simple attributes in the business object.

Business object delete operations: A Delete stored procedure does not return values to the connector. The connector performs the following steps when processing the Delete stored procedures (BeforeDelete, Delete, AfterDelete):

1. Checks whether the business object contains a BeforeDeleteSP attribute. If it does, calls the BeforeDelete stored procedure.
2. Deletes the single-cardinality child business objects.
3. Deletes the multiple-cardinality child business objects.
4. Checks whether the business object contains a DeleteSP attribute. If it does, calls the Delete stored procedure to delete the top-level business object. If it does not, builds and executes a DELETE statement.
5. Checks whether the business object contains an AfterDeleteSP attribute. If it does, calls the AfterDelete stored procedure.

Business object retrieve operations: For simple RETRIEVE operations, stored procedures can be used for top-level business object, single cardinality children, as well as multiple cardinality children. The order of the procedures is as follows:

- BeforeRetrieve
- Retrieve
- AfterRetrieve

The connector creates a temporary object to retrieve a single cardinality child business object or a multiple cardinality child business object. The connector applies the BeforeRetrieve stored procedure to the temporary business object. The AfterRetrieve stored procedure is applied to each of the child objects retrieved for the container.

The connector executes the AfterRetrieve stored procedure after it executes a Retrieve query generated dynamically from the business object meta-data or stored procedure on the business object.

According to the JDBC specification there are three types of StoredProcedure calls as follows:

- {call <spName>(?,?,?)}
- {call <spName>}
- {?= call <spName>(?,?,?)}

The connector supports the first two types. It will process the ResultSet that is returned from StoredProcedure.

In the stored procedure syntax, if RS=true, the result set from the stored procedure is processed. If RS=false, the result set is not processed. By default the value of RS is false. After the result set values are processed, the stored procedure output variables are processed. If RS=true, multiple cardinality children cannot specify the output variables in the related stored procedure.

Note: Result set processing is supported only for Retrieve verb operations and for RetrieveSP only.

Processing result set returned from retrieve stored procedure (RetrieveSP):: ResultSetMetaData is obtained for the result set returned from the stored procedure. Values of all the columns in the result set are obtained and set on the corresponding attribute of the business object. The ColumnName property of an attribute's application-specific information should contain the ResultSet column name to match the attribute to the column.

For single cardinality objects, the corresponding result set should consist of only one row. If multiple rows are returned in the result set, an error is reported.

For multiple cardinality children, multiple rows can be returned through the result set. For each row returned, a new object is created and added to the container. The container is then added to the parent object at the required attribute index.

Business object RetrieveByContent operations: For simple RetrieveByContent operations, stored procedures can be used only for the top-level business object and its single-cardinality children; that is, they cannot be used to return a result set or multiple rows. The order of the procedures is as follows:

- BeforeRetrieveByContent
- RetrieveByContent
- AfterRetrieveByContent

The connector creates a temporary object to retrieve a single cardinality child business object or a multiple cardinality child business object. For multiple cardinality business objects, the connector applies the BeforeRetrieveByContent stored procedure to the temporary business object. The AfterRetrieveByContent stored procedure is applied to each of the child objects retrieved for the container.

The connector executes the AfterRetrieveByContent stored procedure after it executes a RetrieveByContent query generated dynamically from the business object meta-data or stored procedure on the business object. In this case, even though the retrieval of a hierarchical business object also retrieves its child business objects, the connector executes the AfterRetrieveByContent stored procedure on every business object present in the array.

Business object Retrieve-for-Update operations: The following stored procedures are called on the top-level business object and retrieve all child business objects in the same way as the simple Retrieve.

The order of the procedures is as follows:

- BeforeRetrieveUpdate
- RetrieveUpdate
- AfterRetrieveUpdate

These stored procedures perform the same operations as BeforeRetrieve and AfterRetrieve. They have distinguishing names so that you can create separate

attributes to cause the connector to perform both BeforeRetrieve and BeforeRetrieveUpdate operations, as well as AfterRetrieve and AfterRetrieveUpdate operations.

The connector creates a temporary object to retrieve a single cardinality child business object or a multiple cardinality child business object. For multiple cardinality business objects, the connector applies the BeforeRetrieveUpdate stored procedure to the temporary business object. The AfterRetrieveUpdate stored procedure is applied to each of the child objects retrieved for the container.

The connector executes the AfterRetrieveUpdate stored procedure after it executes a RETRIEVE query generated dynamically from the business object meta-data or stored procedure on the business object. In this case, even though the retrieval of a hierarchical business object also retrieves its child business objects, the connector executes the AfterRetrieveUpdate stored procedure on every business object present in the array.

Transaction commit and rollback

Whenever the connector receives a business object for processing, it begins a transaction block. All SQL statements that the connector executes while processing that business object are encapsulated within the transaction block. When the connector finishes processing the business object, it commits the transaction block if the processing was successful, or rolls back the transaction if it encountered an error.

Business object attribute properties

Business object architecture defines various properties that apply to attributes. This section describes how the connector interprets several of these properties and describes how to set them when modifying a business object.

Name property

Each business object attribute must have a unique name.

Type property

Each business object attribute must have a type, such as Integer, String, or the type of a child business object. When the connector encounters an attribute of type Date, Long Text, or String, the connector wraps the value in quotation marks and handles the value as character data.

Cardinality property

Each business object attribute that represents a child or array of child business objects has the value of 1 or n, respectively, in this attribute. All attributes that represent child business objects also have a ContainedObjectVersion property (which specifies the child's version number) and a Relationship property (which specifies the value Containment).

Max length property

If the attribute is of type String, this property specifies the maximum length allowed for the attribute's value.

Key property

At least one simple attribute in each business object must be specified as the key. To define an attribute as a key, set this property to `Yes`. If the business object attribute is of type `String`, it is recommended that the data type in the database is of type `Varchar` instead of `char`.

Note: The connector does not support specifying an attribute that represents a child business object or an array of child business objects as a key attribute.

If the key property is set to `true` for a simple attribute, the connector adds that attribute to the `WHERE` clause of `SELECT`, `UPDATE`, `RETRIEVE`, and `DELETE` SQL statements that it generates while processing the business object.

If the key property is set to `true` for an attribute in a child that stores the parent/child relationship in the child (both multiple-cardinality and single-cardinality), the connector uses the parent's primary keys in the `WHERE` clause of the `SELECT` statement, and it does not use the `Key` property. For information on specifying the name of business object attributes whose values are used to set the child's foreign-key attributes, see "Application-specific information at the attribute level" on page 50.

Foreign key property

The connector uses this property to determine whether an attribute is a foreign key.

Required property

The `Required` property specifies whether an attribute must contain a value.

If this property is specified for an attribute that represents a single-cardinality child business object, the connector requires the parent business object to contain a child business object for this attribute.

When the connector receives a business object with a Create request, the connector causes the Create operation to fail if both of the following conditions are true:

- The business object does not have a valid value or a default value for a required attribute.
- Application-specific information does not specify that the connector generate the unique ID.

When the connector receives a business object with a Retrieve request and the business object does not have a valid value or a default value for a required attribute, the connector causes the retrieval operation to fail.

The connector does not use this property for attributes that contain an array of child business objects.

Note: If the key attribute uses a sequence or counter or is populated by the database (`UID=AUTO`), it should not be marked as Required.

AppSpecificInfo

For information on this property, see "Application-specific information at the attribute level" on page 50.

Default value property

This property specifies a default value that the connector uses to populate a simple attribute if it is not populated with a value from the database table. The connector does not evaluate this property for attributes that represent a child business object or an array of child business objects.

The connector evaluates this property only if the `UseDefaults` configuration property is set to `true`. For more information, see Table 5 on page 13.

Special attribute value

Simple attributes in business objects can have the special value, `CxIgnore`. When it receives a business object from the integration broker, the connector ignores all attributes with a value of `CxIgnore`. It is as if those attributes were invisible to the connector.

When the connector retrieves data from the database and the `SELECT` statement returns a `null` value for an attribute, the connector sets the value of that attribute to `CxIgnore` by default. If a value has been specified for the `UNVL` parameter of the attribute's application-specific information, the connector uses that value to represent the `null`.

Because the connector requires every business object to have at least one primary-key attribute, developers should ensure that WebSphere Business Integration Adapter business objects passed to the connector have at least one primary key that is not set to `CxIgnore`. The only exception to this requirement is a business object whose primary key is to be generated by the connector using a counter or sequence, or is generated by the database.

When the connector inserts data into the database and a business object attribute has no value specified, it uses the value specified by the attribute's `UseNullValue` property. For more information about `UseNullValue`, see `UNVL=value` in Table 10 on page 51.

Business object application-specific information

Application-specific information in business object definitions provides the connector with application-dependent instructions on how to process business objects. The connector parses the application-specific information from the attributes or verb of a business object or from the business object itself to generate queries for create, update, retrieve, and delete operations.

The connector stores some of the business object's application-specific information in cache and uses this information to build queries for all the verbs.

If you extend or modify an application-specific business object, you must make sure that the application-specific information in the business object definition matches the syntax that the connector expects.

This section provides information on the object-level, attribute, and verb application-specific information format for business objects supported by the connector.

Table 9 on page 49 provides an overview of the functionality available in business object application-specific information.

Table 9. Overview of application-specific information in supported business objects

Scope of application-specific information	Functionality
Entire business object	Specifies: • The name of the corresponding database table. • Defines the column whose value the connector uses in the `WHERE` clause to perform a logical (or soft) delete. • That the top-level business object is a wrapper.
Simple attributes	Specifies: • The database column name for an attribute. • The foreign key relationship between an attribute in the current business object and a parent or child business object. • Automatic generation of unique identifier values. • The name of another attribute within the same business object whose value the connector must use to set the value of the current attribute. • Whether to use the current attribute when sorting a retrieval. • The value to use when the value of the current attribute is `null`. • String substitution behavior. • Whether to use the `LIKE operator` or `= operator` when comparing strings. • The value to use as the wildcard position when the `LIKE operator` is used.
Attributes that contain a child or an array of child business objects	Specifies whether a single-cardinality child is owned by the parent. Specifies whether the connector deletes child data during an update operation if the data is not represented in the source business object.
Business object verb	Used only for the Retrieve verb, this text specifies the attributes to be included in the `WHERE` clause for a retrieval. You can also specify operators and attribute values.

The following sections discuss this functionality in more detail.

Application-specific information at the business-object level

Application-specific information at the business-object level allows you to:

- Specify the name of the corresponding database table.
- Provide the information necessary to perform a physical or logical delete.
- Specify that the top-level business object is a wrapper object.

At the business-object level, application-specific information format consists of parameters separated by colon (:) or semicolon (;) delimiters:

`TN=`*`TableName`*`; SCN=`*`StatusColumnName`*`:`*`StatusValue`*

where `TableName` identifies the database table, *`StatusColumnName`* is the name of the database column used to perform logical deletes, and *`StatusValue`* is the value that signifies that a business object is inactive or deleted.

For example, assume that a Customer business object has the following value specified for its business object application-specific information:

```
TN=CUSTOMER; SCN=CUSTSTATUS:DELETED
```

Assume also that the connector receives a request to delete the customer. Such a value causes the connector to issue the following SQL statement:

```
UPDATE CUSTOMER SET CUSTSTATUS = 'DELETED' WHERE CUSTOMER_ID = 2345
```

If the SCN parameter is not included or no value is specified for it, the connector physically deletes the business object from the database. In other words, if the business object with the Delete verb includes the SCN parameter in its application-specific information, the connector performs a logical delete. If the business object with the Delete verb does not include the SCN parameter in its application-specific information, the connector performs a physical delete.

Both update and delete operations may use the value of the SCN property:

- When performing an update, the connector uses the value of its `ChildUpdatePhyDelete` property to determine whether to physically or logically delete missing child data. If logically deleting the child data, it uses the value of its SCN parameter to obtain the name of the status column and the text of the status value. For more information, see "Update operations" on page 36.
- When performing a delete, the connector uses the value of its SCN parameter to determine whether to physically or logically delete the entire business object. If the SCN parameter contains a value, the connector performs a logical delete. If the SCN parameter does not contain a value, the connector performs a physical delete. For more information, see "Delete operations" on page 39.

At the business-object level, application-specific information may be used to specify a wrapper:

```
WRAPPER=true|false
```

If the wrapper parameter is set to true, the top-level business object is a wrapper object. The wrapper object is not represented by a database table or view. A wrapper is used as a container for unrelated business objects. The connector ignores the top-level object and processes only the children. The wrapper object may contain N cardinality or N-1 cardinality entities or both.

Application-specific information at the attribute level

The application-specific information for attributes differs depending on whether the attribute is a simple attribute or an attribute that represents a child or an array of child business objects. The application-specific information for an attribute that represents a child also differs depending on whether the parent/child relationship is stored in the child or in the parent. For information on application-specific information for attributes that represent a child or array of child business objects, see "Specifying an attribute's foreign key" on page 53.

Application-specific information for simple attributes

For simple attributes, application-specific information format consists of eleven name-value parameters, each of which includes the parameter name and its value. Each parameter set is separated from the next by a colon (:) delimiter.

The format of attribute application-specific information is shown below. Square brackets ([ ]) surround an optional parameter. A vertical bar (|) separates the members of a set of options. Reserve the colon as a delimiter.

```
CN=col_name:[FK=[fk_object_name.]fk_attribute_name]:
[UID=[AUTO|uid_name| schema_name.uid_name[=UseIfMissing]|CW.uidcolumnname
[=UseIfMissing]]]:
```

```
[PH=true|false]:[CA=set_attr_name| ..set_attr_name]:[OB=[ASC|DESC]]:[UNVL=value]:
[ESC=true|false]:[FIXEDCHAR=true|false]:
[BYTEARRAY=true|false]:[USE_LIKE=true|false:
[WILDCARD_POSITION=non-negative number|NONE|BEGIN|END|BOTH]]:
[CLOB=true]
```

The only required parameter for a simple attribute that you want the connector to process is the column name. For example, to specify only the column name, use the following format:

```
CN=customer_id
```

Table 10 describes each name-value parameter.

Table 10. Name-value parameters in attribute application-specific information

Parameter	Description
CN=*col_name*	The name of the database column for this attribute.
FK=[*fk_object_name*.]*fk_attribute_name*	The value of this property depends on whether the parent/child relationship is stored in the parent business object or the child If an attribute is not a foreign key, do not include this parameter in the application-specific information. For more information, see "Specifying an attribute's foreign key" on page 53.
UID=AUTO UID=*uid_name*| schema_name.uid_name [=UseIfMissing] UID=CW.*uidcolumnname*[=UseIfMissing]	The connector uses this parameter to generate the unique ID for the business object. If an attribute does not require generation of a unique ID, do not include this parameter in the application-specific information. See the PreserveUIDSeq property description for details on preserving the unique ID during business object processing. For more information, see "Generating a business object's unique identifier" on page 55. **Note:** CW is a keyword used to represent the type of UID and does not represent the tablename.
PH=true|false	If PH=true, then the corresponding simple attribute is a placeholder attribute. A simple attribute is also a placeholder if its ASI is blank or null.
CA=*set_attr_name*| ..set_attr_name	If set_attr_name is set to the name of another attribute within the current individual business object, the connector uses the value of the specified attribute to set the value of this attribute before it adds the business object to the database during a Create operation. The value of set_attr_name cannot reference an attribute in a child business object, but it can reference an attribute in the parent business object if there if set_attr_nameis preceded by the two periods. If you do not include this parameter in the application-specific information, the connector uses the value of the current attribute without copying the attribute's value (CA) from another attribute.
OB=[ASC|DESC]	If a value is specified for this parameter and the attribute is in a child business object, the connector uses the value of the attribute in the ORDER BY clause of retrieval queries. The connector can retrieve child business objects in ascending order or descending order. Use ASC to specify retrieval in ascending order. Use DESC to specify retrieval in descending order. If you do not include this parameter in the application-specific information, the connector does not use this attribute when specifying retrieval order.
UNVL=*value*	Specifies the value the connector uses to represent a null when it retrieves a business object with null-valued attributes. If you do not include this parameter in the application-specific information, the connector inserts a CxIgnore for the attribute's value.

Table 10. Name-value parameters in attribute application-specific information (continued)

Parameter	Description
ESC=[true|false]	Determines whether the connector replaces all instances of each character identified in the ReplaceAllStr property with the substitution strings also specified in the ReplaceStrList property. If this parameter does not contain a value, the connector uses the value of the ReplaceStrList property to make this determination. **Note:** The ESC parameter and the ReplaceAllStr and ReplaceStrList properties provide support for database escape character functionality (for example, escaping single quotes). Because the same functionality is also available from the Prepared Statements provided by the JDBC driver, these properties will be deprecated in future releases of the connector. The connector currently supports the use of the JDBC Prepared Statements.
FIXEDCHAR=true|false	Specifies whether the attribute is of fixed length when the columns in the table are of type CHAR, not VARCHAR. For example, if a particular attribute is linked to a column that is of type CHAR, the connector expects FIXEDCHAR in length; for the application specific information of that attribute specify FIXEDCHAR=true. Ensure that the MaxLength property of the attribute is of the CHAR length, which is specified in the database. By default, FIXEDCHAR=false.
BYTEARRAY=true|false	If BYTEARRAY=true, the connector will read and write binary data to the database and will send that data as a string to InterChange Server Express Broker. BYTEARRAY=false is the default. For more information, see "Working with binary data" on page 57.
USE_LIKE=true|false	Specifies whether the connector compares strings using the = operator or the LIKE operator. If USE_LIKE is set to true, wildcard queries can be performed by setting WILDCARD_POSITION. If USE_LIKE is set to false, the =operator will be used.
WILDCARD_POSITION=non-negative number|NONE|BEGIN|END|BOTH	If USE_LIKE is true, the WILDCARD_POSITION is used to specify the position that is the wildcard. This value can be any non-negative number, NONE, BEGIN, END, or BOTH. For example, using BEGIN will place the wildcard character in the first position of the string (%string). Using END will place the wildcard character in the last position of the string (string%). Using BOTH will place wildcard characters in both the first and last position in the string (%string%).
CLOB=true	Only applicable for String Attribute Type. Specifies that the database column that corresponds to this attribute is a CLOB datatype. **Note:** A CLOB datatype is defined as follows:. • The CLOB attribute has a String Type whose length is used to define the length of the CLOB • The CLOB attribute has ASI=CN=xyz; CLOB=true • Any other attribute type with reference to CLOB in the ASI would result in an error • CLOB=false would result in an error A regular String Type would be the same and with no reference to CLOB in the ASI. CLOB datatypes of 4k and larger can be inserted or updated. But they can be used only with Oracle and require the latest thin driver withCLOB support. Using any other driver may cause errors.

Note: If none of the application-specific information in any of a business object's attributes cause the connector to build or execute a query, the connector logs a warning and continues operating. It does not throw an exception or return a failure.

Specifying an attribute's foreign key: The value of this property depends on whether the parent/child relationship is stored in the parent business object or the child:

- Stored in the parent—set the value to include both the type of the child business object and the name of the attribute in the child to be used as the foreign key.
- In the child—set the value to include only the name of the attribute in the parent to be used as the foreign key.

If the value of `fk_object_name` does not match the type of the child business object, and the value of *`fk_attribute_name`* does not match the name of the attribute in the parent or child (as applicable), the connector cannot process this attribute as a foreign key. The case of the business object's name and the attribute's name is significant.

For example, assume that the Customer business object contains the `Addr[1]` attribute, which represents the Address child business object, and the `AID` attribute, which stores the primary key of the child business object as a foreign key. In this case, the application-specific information of the parent's foreign key attribute must contain the type of the child business object (Address) as well as the name of its primary key attribute (ID). In this example, the application-specific information of the `AID` attribute would include `FK=Address.ID`.

Naming a foreign key attribute: Multiple parent business objects can contain the same child business object, regardless of whether the child is stored with single cardinality or multiple cardinality, and regardless of whether the parent/child relationship is stored on the parent or on the child. However, all parent business objects that store the parent/child relationship must use identically named attributes to contain the child's primary key. Moreover, all child business objects that store the parent/child relationship must use identically named attributes to contain the parent's primary key. Figure 5 illustrates these relationships.

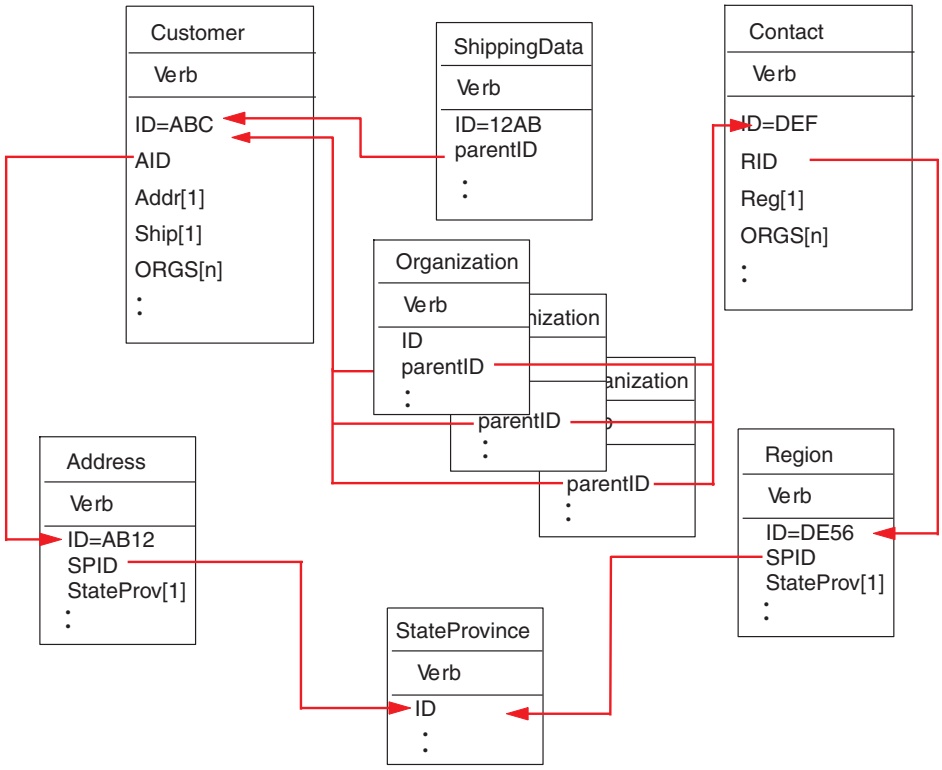


Figure 5. Example of relationships among business objects

Figure 5 illustrates the following relationships:

- The `ORGS[n]` attribute of Customer ABC and Contact DEF represents an array of Organization business objects. The foreign key value for each business object in the array of Organizations corresponds to the primary key value in the `ID` attribute in the Customer and Contact business objects. In this case, each business object in the array is contained by multiple parents.

  The application-specific information for the `ORGS` attribute might be:

  ```
  KEEP_RELATIONSHIP=true
  ```

  For more information on the KEEP_RELATIONSHIP parameter, see "Application-specific information for attributes that represent children" on page 56.

  The application-specific information for the `parentID` attribute of each child in the array of Organizations contains the name of the column in the database that corresponds to the current attribute, and specifies the current attribute's foreign key by containing the name of the parent's primary key attribute; for example:

  ```
  CN=ORG_ID:FK=ID
  ```

  Note: For multiple business objects to contain the same child (where the parent/child relationship is stored in the child), all parent business objects must use an identically named attribute to contain the foreign key for the child. The foreign key parameter of that child's application-specific information identifies only the attribute's name and not the type of the parent business object. The connector assumes that the direct parent is the owner of each child.

- The `Addr[1]` attribute of Customer represents the Address business object with ownership. The `AID` attribute of Customer identifies the primary key of the Address business object as a foreign key in the parent. In this case, the parent's

foreign key attribute must contain the type of the child business object as well as the name of its primary key attribute. The single-cardinality child, Address, is contained by only one parent.

The application-specific information for the Addr attribute is:

```
CONTAINMENT=OWNERSHIP
```

The application-specific information for the AID attribute contains the name of the column in the database that corresponds to the current attribute, and specifies the current attribute's foreign key by containing the type of the child business object and the name of its primary key attribute; for example:

```
CN=FK_AD:FK=Address.ID
```

The application-specific information for the child's primary-key attribute is

```
CN=pk
```

- The StateProv[1] attributes of the Address and Region business objects represent the StateProvince business object without ownership. The SPID attributes of the Address and Region business objects contain the type of the child business object (StateProvince) and the name of its primary key attribute, which serve as the parent's foreign key. The same single-cardinality child, StateProvince, is contained by multiple parents.

  The application-specific information for the SPID attribute is:

  ```
  CONTAINMENT=NO_OWNERSHIP
  ```

  For more information on the CONTAINMENT parameter, see "Application-specific information for attributes that represent children" on page 56.

  The application-specific information for the Address SPID attribute contains the name of the column in the database that corresponds to the current attribute, and specifies the current attribute's foreign key by containing the type of the child business object and the name of its primary key attribute; for example:

  ```
  CN=FK_SP:FK=StateProvince.ID
  ```

  The application-specific information for the child's primary key attribute is:

  ```
  CN=SP_ID
  ```

  Note: For multiple business objects (that store the parent/child relationship in the parent) to contain the same child, all child business objects must use an identically named attribute to contain the foreign key for the parent.

- The Ship[1] attribute of Customer represents a ShippingData business object that contains the customer's shipping information. The ID attribute of Customer functions as the foreign key for the shipping data. In this case, because ShippingData cannot exist independently of its parent and is created only after its parent is created, the parent/child relationship is stored in the child.

  The application-specific information for the child's parentID attribute contains the name of the column in the database that corresponds to the current attribute, and specifies the current attribute's foreign key by containing the name of its parent's primary key attribute; for example:

  ```
  CN=SD_ID:FK=ID
  ```

Generating a business object's unique identifier: The connector uses the UID parameter to generate the unique ID for the business object. The connector generates unique IDs by using sequences (as Oracle does), or counters (which are structured as tables), and then issues the INSERT statement.

IBM DB2 and Microsoft SQL Server do not require that the ID be passed in an INSERT statement. Instead, they generate the ID at the time of creation. After successful creation of the business object, the connector can retrieve and use this value.

The connector uses a sequence or counter to generate the ID value and then issues the INSERT statement:

- If UID = AUTO, the database generates the ID and the connector must retrieve it. This setting is only available for IBM DB2 and Microsoft SQL Server databases.
- If UID = *uid_name*, the value of *uid_name* provides the name of the Oracle sequence that the connector uses to generate a unique ID for the attribute. After the connector fetches the sequence value, it populates the key attribute and issues the INSERT statement. This syntax is currently used only for Oracle databases.
- If UID = *uid_name*=UseIfMissing and if the value of the attribute is not CxIgnore, the connector uses the attribute's value rather than generating a unique ID. The =UseIfMissing parameter cannot contain blanks and is case-insensitive. This option is available only for Oracle databases.
- If UID=CW.*uidcolumnname*, the connector uses a counter table to generate a unique ID for the attribute. The table, whose name is configurable, is created with a single column named id. You can customize the table to add a column for each attribute that requires generation of a UID. Use the *uidcolumnname* parameter to specify the name of the column for the connector to use when generating the unique ID. Note that the connector supports only the numeric data type for columns that require generation of a UID.

  For information on configuring the table's name, see UniqueIDTableName. The scripts for installing this table are:

  ```
  \connectors\JDBC\dependencies\uid_table_oracle.sql

  \connectors\JDBC\dependencies\uid_table_mssqlserver.sql

  \connectors\JDBC\dependencies\uid_table_db2.sql
  ```
- If UID=CW.*uidcolumnname*=UseIfMissing and if the value of the attribute is not CxIgnore, the connector uses the attribute's value rather than generating a unique ID. The =UseIfMissing parameter cannot contain blanks and is case-insensitive.

See the "PreserveUIDSeq" on page 20 property for information on preserving the unique ID sequence during processing.

Application-specific information for attributes that represent children

Attributes that represent a single-cardinality child business object can specify whether the child is owned by the parent or shared among multiple parents.

Attributes that represent a single-cardinality child or an array of child business objects can specify the connector's behavior when updating the parent and a subset of the children.

Attributes that represent a single-cardinality child business object: The format of the application-specific information for attributes that represent a single-cardinality child business object is:

```
CONTAINMENT= [OWNERSHIP|NO_OWNERSHIP]
```

Set CONTAINMENT to OWNERSHIP to represent a single-cardinality relationship where the parent owns the child business object. Set CONTAINMENT to NO_OWNERSHIP to represent a single-cardinality relationship where the parent shares the child business object. Do not include the CONTAINMENT parameter when you represent a single-cardinality relationship that stores the relationship in the child rather than in the parent.

For more information, see "Single-cardinality relationships and data without ownership" on page 29 and "Single-cardinality relationships that store the relationship in the child" on page 31.

Attributes that represent a child that stores the parent's key: For Update operations on an array of business objects that store the parent/child relationship in the child, there is a special value for the attribute that represents the child: you can set KEEP_RELATIONSHIP to true to prevent the connector from deleting existing child data that is not represented in the source business object.

For example, assume an existing contract is associated with an existing site, such as New York. Assume further that the connector receives a request to update a Contract business object that contains a single child business object that associates San Francisco as the site. If KEEP_RELATIONSHIP evaluates to true for the attribute that represents the site data, the connector updates the contract to add its association with San Francisco and does not delete its association with New York.

However, if KEEP_RELATIONSHIP evaluates to false, the connector deletes all existing child data that is not contained in the source business object. In such a case, the contract is associated only with San Francisco.

The format for this application-specific information is:

```
KEEP_RELATIONSHIP=[true|false]
```

Case is ignored in checking for this application-specific information.

Working with binary data: If BYTEARRAY=true, the connector will read and write binary data to the database. Since there is no support for binary data in the current version of the WebSphere business integration system, the binary data is converted to a String and then sent to the integration broker. The format of this string is a hexadecimal number with 2 characters per byte. For example, if the binary data in the database is 3 bytes with the (decimal) values (1, 65, 255), the string will be "0141ff".

Application-specific information format for verbs

The connector uses verb application-specific information for the Retrieve and RetrieveByContent verbs. This text allows you to specify the attributes to be included in the WHERE clause for a retrieval. You can also specify operators and attribute values.

The syntax for application-specific information for the Retrieve and RetrieveByContent verbs is shown below:

```
[condition_variable conditional_operator @ [...]:[..]attribute_name [, ...]]
```

where:

condition_variable	The name of the database column.

conditonal_operator	The operator supported by the database, for example =, >, OR, AND, and IN (*value1*, *value2*).
@	A variable that is substituted with the value retrieved by getAttrValue(*attribute_name*). The substitution is positional; that is, the connector substitutes the first @ with the value of the first *attribute_name* variable specified after the : delimiter.
..	The attribute specified in the attribute_name variable belongs to the immediate parent business object; if this value is missing, the attribute belongs in the current business object.
attribute_name	The name of the attribute whose value the connector substitutes for @.

To understand the syntax of this property, assume that an Item business object has an item_id attribute whose value is XY45 and a Color attribute whose value is RED. Assume further that you specify the Retrieve verb's AppSpecificInfo property as:

```
Color='RED'
```

The above application-specific information value causes the connector to build the following WHERE clause for a retrieval:

```
where item_id=XY45 and Color = 'RED'
```

For a more complicated example, assume that the Customer business object has a customer_id attribute whose value is 1234 and a creation_date attribute whose value is 01/01/90. Assume also that this business object's parent has a quantity attribute whose value is 20.

Assume further that you specify the Retrieve verb's AppSpecificInfo property as:

```
creation_date > @ OR quantity = @ AND customer_status IN
('GOLD', 'PLATINUM') : creation_date, ..quantity
```

The above application-specific information value causes the connector to build the following WHERE clause for a retrieval:

```
where customer_id=1234 and creation_date > '01/01/90'
OR quantity = 20 AND customer_status IN ('GOLD', 'PLATINUM')
```

The connector gets the date value ('01/01/90') from the creation_date attribute in the current business object. It gets the quantity value (20) from the quantity attribute in the parent business object (as indicated by ..quantity in the application-specific information.

After the connector parses the application-specific information for the Retrieve verb, it adds the text to the WHERE clause of the RETRIEVE statement that it constructs from the business object's primary or foreign keys. The connector adds the leading AND to the WHERE clause. The value of the application-specific information must be valid SQL syntax. In the case of RetrieveByContent, the application-specific information is added to the WHERE clause of the RETRIEVE statement that it constructs from the business object's attributes that have their values populated.

The WHERE clause can also refer to placeholder attributes instead of the actual attributes in the parent business object. These placeholders do not have any application-specific information. An attribute can be a placeholder if it satisfies one of the following conditions for its ASI:

1. Simple attribute with ASI=null or ''
2. Simple attribute with ASI=PH=TRUE

For example: An Order business object contains a multiple cardinality line item business object, and retrieval of only specific line items is needed. This retrieval can be handled through a placeholder attribute in the Order business object. This placeholder is required in the parent object because the child objects are all pruned. The placeholder attribute can be populated at runtime by the integration broker with a list of the specific line items, separated by a comma (,).

For this example, you would add the following information to the WHERE clause for the retrieve verb on the child line item business object:

```
line_item_id in(@,@,@):..placeholder1,..placeholder2,..placeholder3
```

Where line_item_id in is the ID in the child business object, placeholder is the attribute in the parent. If placeholder contains the values 12,13,14 the query would select the following from the WHERE clause:

```
line_item_id in(12,13,14)
```

Where SELECT:..FROM:..WHERE *x* in (1,2,3) is a standard database SQL syntax.

In the RetrieveByContent verb, if the length of the WHERE clause is 0, the connector will use the application-specific information in the WHERE clause of the RETRIEVE statement. With this feature, the user can send a business object with no attribute values populated and specify verb application-specific information for RetrieveByContent, and the connector will build the WHERE clause based on what was specified in the verb application-specific information alone.

Chapter 4. Generating business object definitions using JDBCODA

This chapter describes JDBCODA, an object discovery agent (ODA), which generates business object definitions for the connector for JDBC. Because the connector works with objects that are table-based or view-based, JDBCODA uses database tables and views to discover business object requirements specific to its JDBC data source.

Note: Familiarity with database concepts and JDBC drivers (for configuration purposes) can aid in understanding how JDBCODA operates.

This chapter contains the following sections:

Installation and usage

This section discusses the following:

Before using JDBCODA

Before you can run JDBCODA, you must:

- Ensure that the appropriate JDBC driver is installed for the database product that you will be using.

  Important: JDBCODA can connect to any database using a JDBC driver that supports JDBC 2.0 or above.
- Because JDBCODA generates business object names and attribute names from the names of corresponding database tables and columns, and because business object names and attribute names must be in ISO Latin-1, verify that the appropriate database components have Latin-1 names. If they do not, you have the following choices:
  - Create the business object definition manually in Business Object Designer Express.
  - Edit the definition generated by JDBCODA so that all business object names and attribute names are in Latin-1.
- Open for editing the shell or batch file and configure the values described in Table 11 on page 62.

Table 11. Shell and batch file configuration variables

Variable	Explanation	Example
AGENTNAME	Name of the ODA	set AGENTNAME=JDBCODA
AGENT	Name of the ODA's jar file	set AGENT= %CROSSWORLDS%\ODA\JDBC\JDBCODA.jar
DRIVERPATH	Path of JDBC driver library; JDBCODA uses the driver classes to establish a connection to a specified database	set DRIVERPATH=%CROSSWORLDS%\ / lib\xwutil.jar;%CROSSWORLDS%\lib\ / xwbase.jar;%CROSSWORLDS%\lib\ / xwsqlserver.jar;%CROSSWORLDS%\lib\ / spy\lib\spy.jar
DRIVERLIB	Path of the native libraries used by the JDBC driver	DRIVERLIB=%CROSSWORLDS%\bin\db2jdbc.dll

After installing the JDBC driver and setting configuration values in the shell or batch file, you must do the following to generate business objects:

1. Launch the ODA.
2. Launch Business Object Designer Express.
3. Follow a six-step process in Business Object Designer Express to configure and run the ODA.

The following sections describe these steps in detail.

Launching JDBCODA

You can launch the JDBCODA with the startup script appropriate for your operating system.

start_JDBCODA.bat

You configure and run JDBCODA using Business Object Designer Express. Business Object Designer Express locates each ODA by the name specified in the AGENTNAME variable of each script or batch file. The default ODA name for this connector is JDBCODA.

Running multiple instances of JDBCODA

It is recommended that you change the name of the ODA when you run multiple instances of it. To create additional uniquely named instances of JDBCODA:

- Create a separate script or batch file for each instance.
- Specify a unique name in the AGENTNAME variable of each script or batch file.

It is recommended that you prefix each name with the name of the host machine when you run ODA instances on different machines.

"Select the ODA" on page 64 tells you how to select the ODA to run.

Working with error and trace message files

Error and trace message files (the default is JDBCODAAgent.txt) are located in \ODA\messages\, which is under the product directory. These files use the following naming convention:

*AgentName*Agent.txt

If you create multiple instances of the ODA script or batch file and provide a unique name for each represented ODA, you can have a message file for each ODA instance. Alternatively, you can have differently named ODAs use the same message file. There are two ways to specify a valid message file:

- If you change the name of an ODA and do not create a message file for it, you must change the name of the message file in Business Object Designer Express as part of ODA configuration. Business Object Designer Express provides a name for the message file but does not actually create the file. If the file displayed as part of ODA configuration does not exist, change the value to point to an existing file.
- You can copy the existing message file for a specific ODA, and modify it as required. Business Object Designer Express assumes you name each file according to the naming convention. For example, if the AGENTNAME variable specifies `JDBCODA1`, the tool assumes that the name of the associated message file is `JDBCODA1Agent.txt`. Therefore, when Business Object Designer Express provides the filename for verification as part of ODA configuration, the filename is based on the ODA name. Verify that the default message file is named correctly, and correct it as necessary.

Important: Failing to correctly specify the message file's name when you configure the ODA causes it to run without messages. For more information on specifying the message file name, see "Configure initialization properties" on page 65.

During the configuration process, you specify:

- The name of the file into which JDBCODA writes error and trace information
- The level of tracing, which ranges from `0` to `5`.

Table 12 describes these values.

Table 12. Tracing levels

Trace level	Description
0	Logs all errors
1	Traces all entering and exiting messages for method
2	Traces the ODA's properties and their values
3	Traces the names of all business objects
4	Traces details of all spawned threads
5	• Indicates the ODA initialization values for all of its properties • Traces a detailed status of each thread that JDBCODA spawned • Traces the business object definition dump

For information on where you configure these values, see "Configure initialization properties" on page 65.

Using JDBCODA in business object designer

This section describes how to use JDBCODA in Business Object Designer Express to generate business object definitions. For information on launching Business Object Designer Express, see the *Business Object Development Guide*.

After you launch an ODA, you must launch Business Object Designer Express to configure and run it. There are six steps in Business Object Designer Express to

generate a business object definition using an ODA. Business Object Designer Express provides a wizard that guides you through each of these steps.

After starting the ODA, do the following to start the wizard:

1. Open Business Object Designer Express.
2. From the File menu, select the New Using ODA... submenu.

   Business Object Designer Express displays the first window in the wizard, named Select Agent. Figure 6 on page 64 illustrates this window.

To select, configure, and run the ODA, follow these steps:

1. "Select the ODA"
2. "Configure initialization properties" on page 65
3. "Expanding nodes and selecting tables, views and stored procedures" on page 66
4. "Confirming database object selections" on page 67
5. "Generating definitions" on page 68 and, optionally, "Providing additional information" on page 68
6. "Saving definitions" on page 70

Select the ODA

Figure 6 illustrates the first dialog box in Business Object Designer Express's six-step wizard. From this window, select the ODA to run.

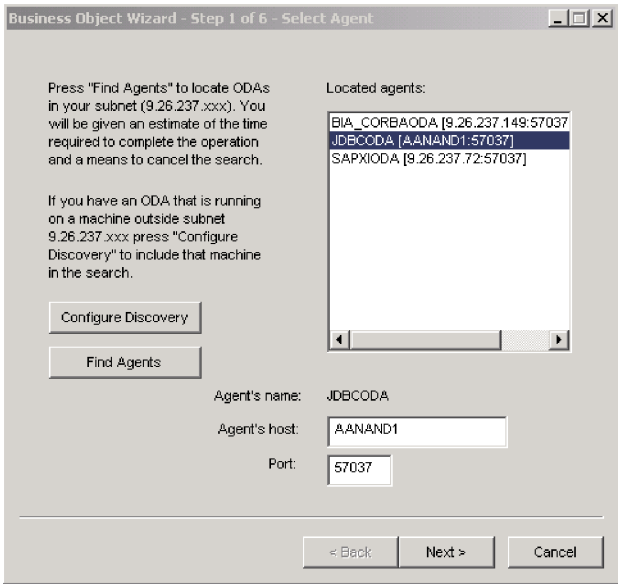


Figure 6. Selecting the ODA

To select the ODA:

1. Click the Find Agents button to display all registered or currently running ODAs in the Located agents field.

   Note: If Business Object Designer Express does not locate your desired ODA, check the setup of the ODA.
2. Select the desired ODA from the displayed list.

Business Object Designer Express displays your selection in the Agent's name field.

Configure initialization properties

The first time Business Object Designer Express communicates with JDBCODA, it prompts you to enter a set of initialization properties as shown in Figure 7. You can save these properties in a named profile so that you do not need to re-enter them each time you use JDBCODA. For information on specifying an ODA profile, see the *Business Object Development Guide*.

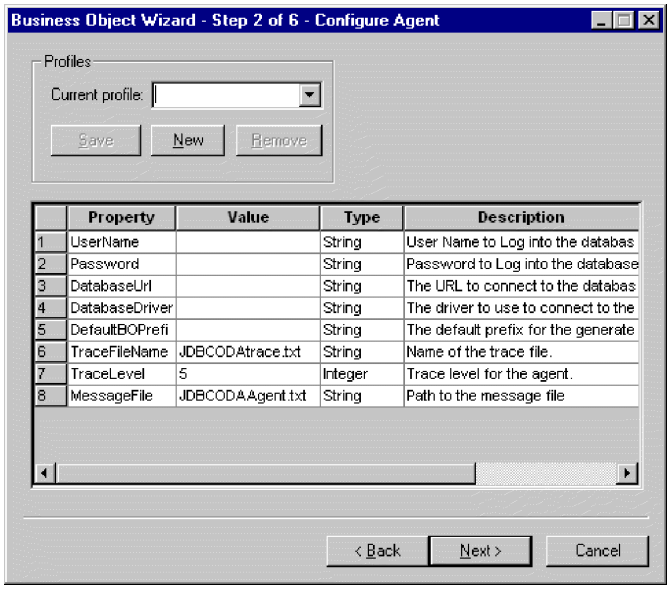


Figure 7. Configuring agent initialization properties

Configure the JDBCODA properties described in Table 13.

Table 13. JDBCODA properties

Row number	Property name	Property type	Description
1	`UserName`	String	Name of the user with authorization to connect to the database
2	`Password`	String	Password of the user with authorization to connect to the database
3	`DatabaseUrl`	String	URL that enables a connection to the database. For example: `jdbc:oracle:thin:@MACHINENAME:1521:SIDNAME`
4	`DatabaseDriver`	String	Name of the driver used to establish the connection. For example: `oracle.jdbc.driver.OracleDriver`
5	`DefaultBOPrefix`	String	Text that is prepended to the name of the business object to make it unique. You can change this later, if required, when Business Object Designer Express prompts you for business object properties. For more information, see "Providing additional information" on page 68.
6	`TraceFileName`	String	File into which JDBCODA writes trace information. If the file does not exist, JDBCODA creates it in the `\ODA\JDBC` directory. If the file already exists, JDBCODA appends to it. JDBCODA names the file according to the naming convention. For example, if the agent is named `JDBCODA`, it generates a trace file named `JDBCODAtrace.txt`. Use this property to specify a different name for this file.

Table 13. JDBCODA properties (continued)

Row number	Property name	Property type	Description
7	`TraceLevel`	Integer	Level of tracing enabled for JDBCODA
8	`MessageFile`	String	Name of the error and message file. JDBCODA displays the filename according to the naming convention. For example, if the agent is named `JDBCODA`, the value of the message file property displays as `JDBCODAAgent.txt`.**Important**: The error and message file must be located in the `\ODA\messages` directory. Use this property to verify or specify an existing file.

Important

Correct the name of the message file if the default value displayed in Business Object Designer Express represents a non-existent file. If the name is not correct when you move forward from this dialog box, Business Object Designer Express displays an error message in the window from which the ODA was launched. This message does not popup in Business Object Designer Express. Failing to specify a valid message file causes the ODA to run without messages.

Expanding nodes and selecting tables, views and stored procedures

After you configure all initialization properties for JDBCODA, Business Object Designer Express connects to the specified database and displays a tree with all the schema names in the database. These names, which are presented as nodes in the tree, are expandable. Click on them to display all the tables, views and stored procedures in each schema. Figure 8 illustrates this dialog box with some schema expanded.

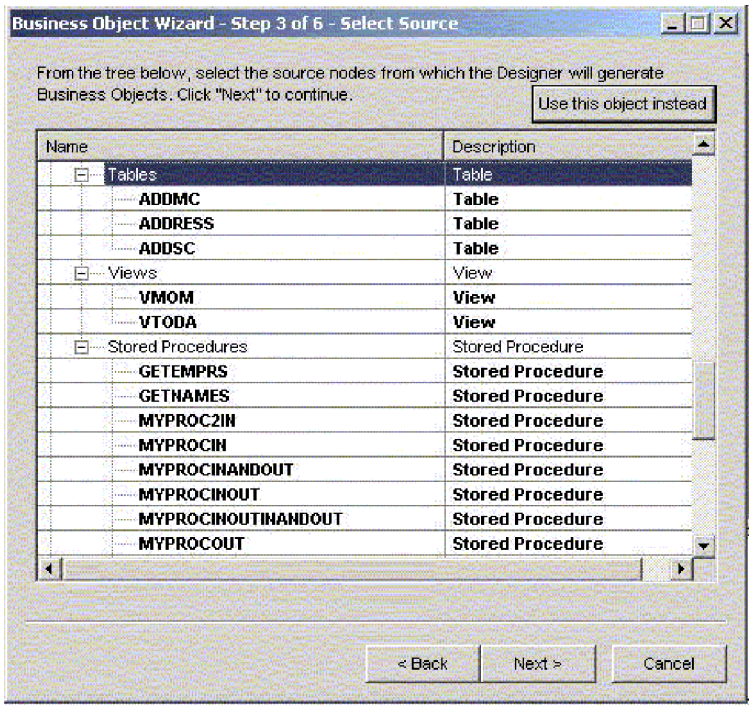


Figure 8. Tree of Schema with Expanded Nodes

To identify all the database objects that store data for the generated business object definition, select all the required tables, views and stored procedures, and click Next. For information on how to filter the objects returned, see the *Business Object Development Guide.*

Confirming database object selections

After you identify all the database objects to be associated with the generated business object definition, Business Object Designer Express displays the dialog box with only the selected tables and views. Figure 9 illustrates this dialog box.

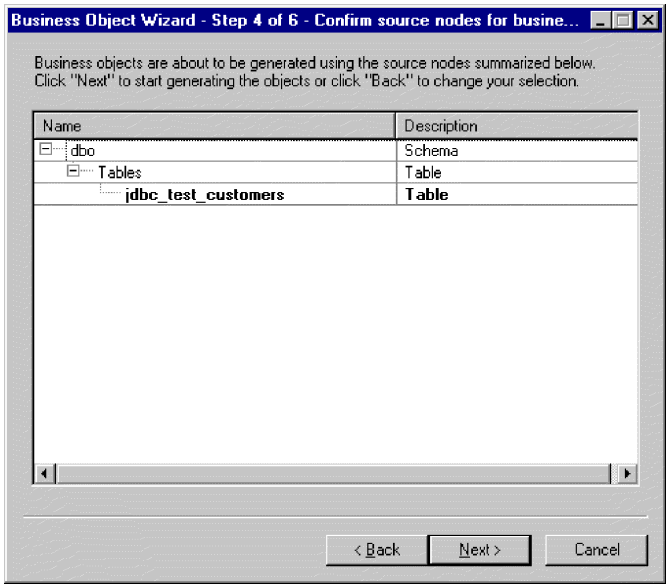


Figure 9. Confirming Selection of Database Objects

This window provides the following options:

- To confirm the selection, click Next.
- If the selection is not correct, click Back to return to the previous window and make the necessary changes. When the selection is correct, click Next.

Generating definitions

After you confirm the database objects, the next dialog box informs you that Business Object Designer Express is generating the definitions.

Providing additional information

If the JDBCODA needs additional information, Business Object Designer Express displays the BO Properties window, which prompts you for the information.

In the BO Properties window, enter or change the following information:

- *Prefix*—The text that is prepended to the name of the business object to make it unique. If you are satisfied with the value you entered for the *DefaultBOPrefix* property in the Configure Agent window (Figure 7), you do not need to change the value here.
- *Verbs*— Click in the *Value* field and select one or more verbs from the pop-up menu. These are the verbs supported by the business object.
- *Add Stored Procedure*—Click `Yes` or `No` in the Value field:
  - If you select `Yes` and click OK, JDBCODA displays a window that provides a list of all stored procedure attributes. Select the stored procedure attributes that you want added to the business object.
  - Select `No` to ensure that no stored procedure attributes are added to the generated business object definition.

  The default is `Yes`.

Note: If a field in the BO Properties dialog box has multiple values, the field appears to be empty when the dialog box first displays. Click in the field to display a drop-down list of its values.

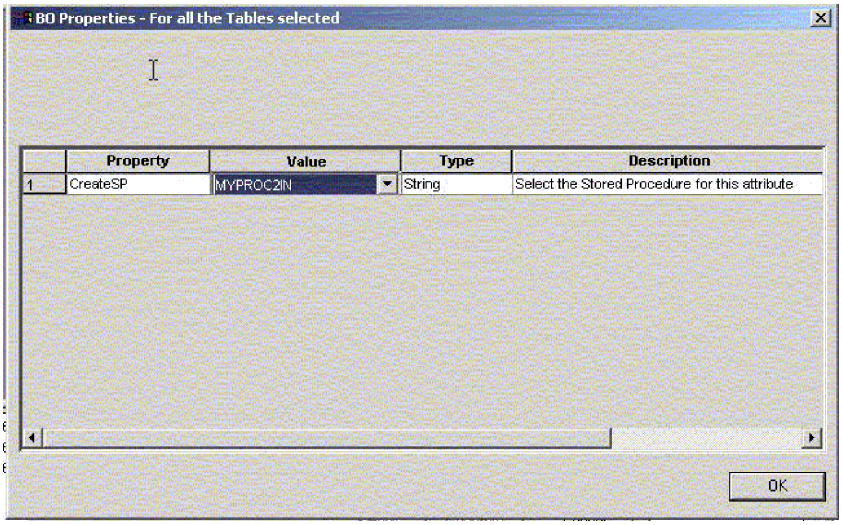


Figure 10. Associating Stored Procedures with Stored Procedure Attributes

The stored procedure attributes to be added to the business object can be associated with one of the stored procedures in the database in that schema. You can choose a stored procedure from a drop down list of all stored procedures in the database in that schema, against each stored procedure attribute. This information will generate the necessary ASI information for that attribute.

The ASI (application-specific information) for the object level will look like `TN=tableName`

And for the attribute level, the ASI will look like `CN=ColumnName`

If a business object is being generated from a stored procedure, and if JDBC Adapter stored procedure attributes, such as SPForCreate, are associated with it, then the ODA provides a list of all stored procedure names in that schema against the stored procedure attributes and enables you to associate the required stored procedure with the business object. This will generate the ASI for the JDBC Adapter stored procedure attribute as follows:

```
SPN=stored procedure Name; IN=a1:a2; OUT=b1:b2; IO=c1:c2
```

Where IN means the parameter of the stored procedure is INPUT type, OUT means the parameter is OUTPUT type, and IO means it is INPUT/OUTPUT type. The ODA will not set RS to true or false on the ASI, so you need to set it manually.

The verbs added to the business object are the standard verbs, essentially Retrieve, RetrieveByContent, Create, Update and Delete.

If the return parameter of the stored procedure is of ResultSet Type, the ODA will analyst the result set and create a business object, making the columns of the result set attributes of the business object. The ASI for the stored procedure columns will be set as `CN=StoredProcedureColumnName`. The ODA sets the key attributes based on the JDBC metadata information returned by the driver. If none is returned, the ODA does not mark any attributes by default as keys. All other attributes, such as length and type, are set as for the attributes generated from tables.

Saving definitions

After you provide all required information in the BO Properties dialog box and click OK, Business Object Designer Express displays the final dialog box in the wizard. Here, you can save the definition to the server or to a file, or you can open the definition for editing in Business Object Designer Express. For more information, and to make further modifications, see the *Business Object Development Guide*.

Contents of the generated definition

The business object definition that JDBCODA generates contains:

- An attribute for each column in the specified database tables and views
- The verbs specified in the BO Properties window
- Application-specific information:
  - At the business-object level
  - For each attribute
  - For each verb

This section describes:

- "Business-object-level properties"
- "Attribute properties" on page 70
- "Verbs" on page 72

Business-object-level properties

JDBCODA generates the following information at the business-object level:

- Name of the business object
- Version—defaults to `1.0.0`
- Application-specific information

Application-specific information at the business-object level allows you to:

- Specify the name of the corresponding database table
- Provide the information necessary to perform a physical or logical delete

At the business-object level, application-specific information format consists of parameters separated by semicolon (;) delimiters. The name of the parameter and its value are separated by a colon (:) delimiter. The syntax is:

`TN=`*`TableName`*`; SCN=`*`StatusColumnName`*`:`*`StatusValue`*

where `TableName` identifies the database table, *`StatusColumnName`* is the name of the database column used to perform logical deletes, and *`StatusValue`* is the value that signifies that a business object is inactive or deleted.

The `AppSpecificInfo` that JDBCODA generates at this level contains a value only for the name of the database table or view. For information on specifying a value for the status column, see "Application-specific information at the business-object level" on page 49.

Attribute properties

This section describes the properties that JDBCODA generates for each attribute. For more information about the attributes, see "Business object attribute properties" on page 46.

Name property

JDBCODA obtains the value of the attribute's name from the column name in the database table or view.

Data type property

When setting the type of an attribute, JDBCODA converts the data type of a column in the table or view to a corresponding IBM WebSphere Business Integration Adapter Business Object type. This conversion is done in two steps. First, the data type in the database is converted to a JDBC type. Then, the JDBC type is converted to a Business Object type. The first conversion is done by the JDBC driver that you are using. Please refer to the JDBC specification (2.0 and above) for details on individual database type mapping to a JDBC type. Table 14 shows the conversion from the JDBC Type to the corresponding Business Object type.

Table 14. Correspondence of data types

JDBC type	WebSphere Business Integration Adapter business object type
BIT	BOOLEAN
CHAR	STRING
VARCHAR	STRING
LONGVARCHAR	STRING
INTEGER	INTEGER
NUMERIC	INTEGER
SMALLINT	INTEGER
TINYINT	INTEGER
BIGINT	INTEGER
DATE	DATE
TIME	DATE
TIMESTAMP	DATE
DECIMAL	STRING
DOUBLE	DOUBLE
FLOAT	DOUBLE
REAL	FLOAT
BINARY	STRING, add BYTEARRAY=TRUE to AppSpecificInfo
VARBINARY	STRING, add BYTEARRAY=TRUE to AppSpecificInfo

Note: If a column's data type is not one of those shown in Table 14 on page 71, JDBCODA skips the column and displays a message stating that the column cannot be processed.

Cardinality property

JDBCODA sets the cardinality of all simple attributes to 1.

MaxLength property

JDBCODA obtains the length of a string from the length specified for the `varchar`, `char`, or `text` data type.

IsKey property

If the column is a primary key in the table, JDBCODA marks it as a key attribute. However, if a view, instead of a table, is selected as the source node to generate Business Objects, JDBCODA does not mark the column as a key attribute. In this case, the key attribute needs to be set manually.

IsForeignKey property

JDBCODA does not set the `IsForeignKey` property. You can set it in Business Object Designer Express.

IsRequired property

If a field is designated `not null` in the table or view, JDBCODA marks it as a required attribute. However, JDBCODA does not mark the key field as required because there may be a sequence associated with it, or it may be an identity column.

AppSpecificInfo property

JDBCODA includes two parameters for the `AppSpecificInfo` property at the attribute level. The syntax of the specified parameters are:

`CN=`*`ColumnName`*

where `ColumnName` is the name of the column in the database table or view associated with the specific attribute.

`BYTEARRAY=`*`true`*`|`*`false`*

JDBCODA recognizes columns with binary data and creates an attribute of type String with an `AppSpecificInfo` property of `BYTEARRAY=true`.

Note: You can set additional `AppSpecificInfo` parameters in Business Object Designer Express. For information about these parameters, see "Application-specific information at the attribute level" on page 50.

Verbs

JDBCODA generates the verbs specified in the BO Properties window. It creates an `AppSpecificInfo` property for each verb but does not populate it. For more information, see "Application-specific information format for verbs" on page 57.

Sample business object definition file

A sample business object definition follows:

```
[BusinessObjectDefinition]
Name = CUSTOMER
Version = 1.0.0
AppSpecificInfo = TN=ra_customers;SCN=
```

```
                [Attribute]
                   Name = customer_id
                   Type = Integer
                   Cardinality = 1
                   MaxLength = 0
                   IsKey = true
                   IsForeignKey = false
                   IsRequired = false
                   AppSpecificInfo = CN=customer_id
                   DefaultValue =
                   [End]

                   *******Other attributes *********

[Attribute]
                   Name = ObjectEventId
                   Type = String
                   Cardinality = 1
                   MaxLength = 0
                   IsKey = false
                   IsForeignKey = false
                   IsRequired = false
                   AppSpecificInfo =
                   DefaultValue =
                   [End]

                   [Verb]
                   Name = Delete
                   AppSpecificInfo =
                   [End]

                   [Verb]
                   Name = Update
                   AppSpecificInfo =
                   [End]

                   [Verb]
                   Name = Create
                   AppSpecificInfo =
                   [End]

                   [Verb]
                   Name = Retrieve
                   AppSpecificInfo =
                   [End]
[End]
```

Inserting attributes that contain child business objects

Use Business Object Designer Express to insert attributes that represent single-cardinality or multiple-cardinality child business objects. For more information, see the *Business Object Development Guide*.

Adding information to the business object definition

Because the database tables and views may not have all the information that a business object definition requires, it may be necessary to add information to the business object definition that JDBCODA creates. For more information, see Chapter 3, “Understanding business objects for the connector,” on page 27.

To examine the business object definition or add information, you can use Business Object Designer Express or a text editor. To reload a revised definition into the IBM

WebSphere Business Integration Adapter repository, you can use Business Object Designer Express or, if InterChange Server Express is the integration broker, the `repos_copy` command.

Chapter 5. Troubleshooting and error handling

The chapter describes problems that you may encounter when starting up or running the connector for JDBC. It contains the following sections:

Startup problems

If you encounter difficulties when trying to start the connector, check to make sure that integration broker is up and running.

Event processing

If there are events in the event table, and they are not being processed while the connector is running, ensure that:

- The relevant business process is running.
- The name of the business object in the event table matches the name of the business object specified for the business process port.

Mapping (InterChange Server Express Integration Broker only)

This section discusses the following:

- "Mapping problems"
- "Date conversion"

Mapping problems

If the business objects are not being mapped or mapping is not being invoked, check to make sure the maps have been installed in the correct directory.

Date conversion

Note: This date conversion procedure applies only to versions of the connector prior to version 1.5.0.

Use maps to convert data stored in `Date` format in the database to the `String` format used by a WebSphere Business Integration Adapter business object.

For example, assume that you want to convert the following date, which is stored in an Oracle database:

```
Sun Jan 01 00:00:00 CEST 1999
```

to the following string, which is processed in a WebSphere Business Integration Adapter for JDBC business object:

```
Jan 01 1999 00:00:00
```

To perform this conversion, use the `DtpDate()` and `DtpSplitString()` constructors defined for data transformation in mapping. For the syntax and a description of these constructors and the classes whose objects they construct, see the *Map Development Guide*.

To use a map to convert the `Date` value to a `String`, follow these steps:

1. Use `DtpSplitString()` with a space delimiter to split the string into its six pieces and rearrange it into an order that `DtpDate` can use. To convert the example date, use:

   ```
   DtpSplitString OurSplitString = new DtpSplitString
      ("Sun Jan 01 00:00:00 CEST 1999"," ");
   ```

   In the above statement, `OurSplitString` is a user-defined variable of type `DtpSplitString`, and a space is specified as the delimiter.
2. Use the `nextElement()` method of the `DtpSplitString` class to loop through the newly created `OurSplitString` variable, putting each of the variable's six elements into an array whose elements are of type `String`. The following example specifies `OurStringPieces` as the output array:

   ```
   String[] OurStringPieces = new String[6];
   for (i=0;i<=5;i=i+1){
      OurStringPieces[i]=OurSplitString.nextElement();
   }
   ```

   This looping produces the following array elements:

   ```
   OurStringPieces[0] = Sun
   OurStringPieces[1] = Jan
   OurStringPieces[2] = 01
   OurStringPieces[3] = 00:00:00
   OurStringPieces[4] = CEST
   OurStringPieces[5] = 1999
   ```
3. Concatenate the pieces of the string needed for `DtpDate` input. The example conversion uses `"M D Y h:m:s"` as the input format for `DtpDate`, which requires the converted string to look like `"Jan 01 1999 00:00:00"`. This example `String` uses elements 1, 2, 5, and 3 of the `OurStringPieces` array:

   ```
   OurConcatenatedString =
   OurStringPieces[1]+OurStringPieces[2]+OurStringPieces[5]+OurStringPieces[3];
   ```
4. Use your new concatenated string as input into `DtpDate`:

   ```
   DtpDate OurDtpDate = new DtpDate(OurConcatenatedString,"M D Y h:m:s");
   ```

After you have put the `Date` value into `DtpDate` format, you are ready to work with the date in your map.

Error handling and logging

The connector logs an error message whenever it encounters a condition that causes its current processing of a business object and verb to fail. When such an error occurs, the connector also prints a textual representation of the failed business object as it was received. It writes the text to the connector log file or the standard output stream, depending on its configuration. You can use the text as an aid in determining the source of the error.

Error types

Table 15 describes the types of tracing messages that the connector outputs at each trace level. These messages are in addition to any tracing messages output by the IBM WebSphere Business Integration Server Express adapter architecture, such as the Java connector execution wrapper.

Table 15. Connector tracing messages

Tracing level	Tracing messages
Level 0	Message that identifies the connector version. No other tracing is done at this level. This is the default value.
Level 1	• Status messages • Messages that provide identifying (key) information for each business object processed • Messages delivered each time the pollForEvents method is executed
Level 2	• Business object handler messages that contain information such as the arrays and child business objects that the connector encounters or retrieves during the processing of a business object • Messages logged each time a business object is posted to the integration broker, either from `gotApplEvent()` or `executeCollaboration()` • Messages that indicate that a business object has been received as an integration broker request
Level 3	• Foreign key processing messages that contain such information as when the connector has found or has set a foreign key in a business object • Messages that provide information about business object processing. For example, these messages are delivered when the connector finds a match between business objects, or finds a business object in an array of child business objects
Level 4	• Application-specific information messages, for example, messages showing the values returned by the functions that parse the business object's application-specific information fields • Messages that identify when the connector enters or exits a function, which helps trace the process flow of the connector • All thread-specific messages. If the connector spawns multiple threads, a message appears for the creation of each new thread
Level 5	• Messages that indicate connector initialization, for example, messages showing the value of each configuration property retrieved from the integration broker • Messages that include statements executed in the application. At this trace level, the connector log file contains all statements executed in the destination application and the value of any variables that are substituted. • Messages that comprise a representation of a business object before the connector begins processing it (displaying its state as the connector receives it) and after the connector has completed its processing (displaying its state as the connector returns it) • Messages that comprise a business object dump • Messages that indicate the status of each thread the connector spawns while it is running

Error messages

Connector message file

All the error messages that the connector generates are stored in a message file named JDBCConnector.txt or JDBCConnector_*II_TT*.txt (where *ll* specifies a language, and *TT* specifies a country or territory). Each error has an error number followed by the error message. For example:

```
20017
Connector Infrastructure version does not match.
20018
Connection from {1} to the Application is lost! Please enter 'q'
to stop the connector, then restart it after the problem is fixed.
20019
Error: ev_id is NULL in pollForEvent().
```

Loss of connection to the application

If the connector fails to establish connection, it sends `FAIL` to the integration broker and terminates.

When `AutoCommit` is set to `false` and the `PingQuery` fails, the connector will attempt to create a new connection to the database. If it succeeds in creating a new connection to the database it will continue processing, otherwise the connector returns an `APPRESPONSETIMEOUT`, which results in the termination of the connector.

Fetch out-of-sequence error

The `AutoCommit` property must be set to false when using Oracle 8.1 with Windows 2000. Otherwise, you will experience ORA-01002 (fetch out of sequence) error messages. In prior versions of Oracle databases this error will not occur. Setting `AutoCommit` to false will improve performance.

Inability to locate event or archive tables when DB2 is used

During startup, the connector attempts to locate the event and archive tables within the database specified by the SchemaName configuration property. If you are using DB2 as the database, the connector sometimes fails to locate the event and archive tables and returns the following error:

```
Event/Archive table table_name does not exist in the database.
```

To avoid this problem, always specify DB2 schema names in upper case (for example, SUSER) in the connector's SchemaName configuration property.

Enabling the connector to work with a DB2 database

Before you can use the connector with a DB2 database, you must perform the following steps:

1. Copy the file named db2java.zip from the DB2 host to the $*ProductDir*\lib directory on the machine on which the connector is going to run.
2. Copy the file named db2jdbc.dll from the DB2 host to the $*ProductDir*\bin directory on the machine on which the connector is going to run.
3. Change the following in the connector's startup file (start_JDBC.bat):

   ```
   set JDBCDRIVERPATH=%ProductDir%\lib\db2java.zip
   ```

4. On the DB2 host machine, start the DB2/bin/db2jstrt process. Be sure to specify the number of the port you are using (for example, DB2/bin/db2jstrt 50000).
5. Set the value of the connector's JDBCDriverClass property to `COM.ibm.db2.jdbc.net.DB2Driver` (or `COM.ibm.db2.jdbc.app.DB2Driver` if the DB2 database is on the same machine on which the connector is going to run).
6. Set the value of the connector's `DatabaseURL` property to `jdbc:db2://`*`MachineName`*`:`*`PortNumber`*`/`*`DBname`* (or *`jdbc:db2:DBname`* if the DB2 database is on the same machine on which the connector is going to run).

Resource-busy error

Note: This connector only encounters this error when it is running on an Oracle database.

The connector sometimes encounters an error like the following when retrieving or changing data in an application.

```
[Time: 2001/05/29 16:30:07.356] [System: ConnectorAgent] [SS: SOVTConnector]
[Type: Trace] [Mesg: Select CLIENT,COUNTRY,STRT_CODE,CITY_CODE,CITYP_CODE,
STRTYPEAB,COMMU_CODE,REGIOGROUP,TAXJURCODE from ADRSTREET where CLIENT='100'
and COUNTRY='DE' and STRT_CODE='000001114136' FOR UPDATE NOWAIT]
[Time: 2001/05/29 16:30:07.526] [System: ConnectorAgent] [SS: SOVTConnector]
[Type: Trace ] [Mesg: :logMsg]
[Time: 2001/05/29 16:30:07.536] [System: ConnectorAgent] [SS: SOVTConnector]
 [Type: Error ] [MsgID: 37002]
[Mesg: Execution of Retrieve statement failed : java.
sql.SQLException: ORA-00054: Versuch, mit NOWAIT eine bereits
belegte Ressourceanzufordern.]
```

This error occurs when the connector tries to update a record that is currently locked. The record may be locked by another process, or because the connector is multi-threaded, it may be locked by the connector itself.

Note that records must be locked during the update process. The connector attempts to retrieve an afterimage of the object received by the integration broker and, in the process, locks the entire object in the database to preserve data integrity.

To resolve this problem, you can stop the process that is preventing the connector from obtaining a lock on the record, or you can adjust the RetryCountInterval configuration property for the connector.

JDBCODA behaves improperly because of unsupported JDBC driver

If the JDBC driver does not support a feature of JDBCODA, the object discovery agent does not function properly. For example, if the driver does not support all method calls that JDBCODA uses, the JDBCODA log indicates the failed process. The following is an example from the log:

```
[Time: 2002/05/15 17:00:55.147] [System: Object Discovery Agent] [SS: null]
[Type: 6] [Mesg: A SQL Error occurred in getting Schema Names from Database.
Reason [ProductName][ODBC ProductName Driver]Optional feature not
implemented]
```

In such a case, you must use a different JDBC driver.

Appendix A. Standard configuration properties for connectors

This appendix describes the standard configuration properties for the connector component of the adapters in WebSphere Business Integration Server Express, running on WebSphere InterChange Server Express.

Not every connector makes use of all these standard properties. When you select an integration broker from Connector Configurator Express, you will see a list of the standard properties that you need to configure for your adapter.

For information about properties specific to the connector, see the relevant adapter user guide.

Configuring standard connector properties

Adapter connectors have two types of configuration properties:

- Standard configuration properties
- Connector-specific configuration properties

This section describes the standard configuration properties. For information on configuration properties specific to a connector, see its adapter user guide.

Using Connector Configurator Express

You configure connector properties from Connector Configurator Express, which you access from System Manager. For more information on using Connector Configurator Express, refer to the Connector Configurator Express appendix.

Setting and updating property values

The default length of a property field is 255 characters.

The connector uses the following order to determine a property's value (where the highest number overrides other values):

1. Default
2. Repository
3. Local configuration file
4. Command line

A connector obtains its configuration values at startup. If you change the value of one or more connector properties during a run-time session, the property's **Update Method** determines how the change takes effect. There are four different update methods for standard connector properties:

- **Dynamic**
  The change takes effect immediately after it is saved in System Manager.
- **Component restart**
  The change takes effect only after the connector is stopped and then restarted in System Manager. You do not need to stop and restart the application-specific component or the integration broker.

- **Server restart**
  The change takes effect only after you stop and restart the application-specific component and the integration broker.
- **Agent restart**
  The change takes effect only after you stop and restart the application-specific component.

To determine how a specific property is updated, refer to the **Update Method** column in the Connector Configurator Express window, or see the Update Method column in the Property Summary table below.

Summary of standard properties

Table 16 provides a quick reference to the standard connector configuration properties. Not all the connectors make use of all these properties, and property settings may differ from integration broker to integration broker, as standard property dependencies are based on `RepositoryDirectory`.

You must set the values of some of these properties before running the connector. See the following section for an explanation of each property.

Table 16. Summary of standard configuration properties

Property name	Possible values	Default value	Update method	Notes
AdminInQueue	Valid JMS queue name	*CONNECTORNAME* /ADMININQUEUE	Component restart	Delivery Transport is JMS
AdminOutQueue	Valid JMS queue name	*CONNECTORNAME*/ADMINOUTQUEUE	Component restart	Delivery Transport is JMS
AgentConnections	1-4	1	Component restart	Delivery Transport is IDL
AgentTraceLevel	0-5	0	Dynamic	
ApplicationName	Application name	Value specified for the connector application name	Component restart	
BrokerType	ICS	ICS		
CharacterEncoding	ascii7, ascii8, SJIS, Cp949, GBK, Big5, Cp297, Cp273, Cp280, Cp284, Cp037, Cp437 **Note:** This is a subset of supported values.	ascii7	Component restart	
ConcurrentEventTriggeredFlows	1 to 32,767	1	Component restart	Repository directory is <REMOTE>
ContainerManagedEvents	No value or JMS	No value	Component restart	Delivery Transport is JMS
ControllerStoreAndForwardMode	true or false	truetrue	Dynamic	Repository directory is <REMOTE>

Table 16. Summary of standard configuration properties (continued)

Property name	Possible values	Default value	Update method	Notes
ControllerTraceLevel	0-5	0	Dynamic	Repository directory is <REMOTE>
DeliveryQueue		*CONNECTORNAME*/DELIVERYQUEUE	Component restart	JMS transport only
DeliveryTransport	IDL or JMS	IDL	Component restart	
DuplicateEventElimination	true or false	false	Component restart	JMS transport only: Container Managed Events must be <NONE>
EnableOidForFlowMonitoring	true or false	false	Component restart	
FaultQueue		*CONNECTORNAME*/FAULTQUEUE	Component restart	JMS transport only
jms.FactoryClassName	CxCommon.Messaging.jms .IBMMQSeriesFactory or any Java class name	CxCommon.Messaging. jms.IBMMQSeriesFactory	Component restart	JMS transport only
jms.MessageBrokerName	crossworlds.queue. manager	crossworlds.queue.manager	Component restart	JMS transport only
jms.NumConcurrentRequests	Positive integer	10	Component restart	JMS transport only
jms.Password	Any valid password		Component restart	JMS transport only
jms.UserName	Any valid name		Component restart	JMS transport only
JvmMaxHeapSize	Heap size in megabytes	128m	Component restart	Repository directory is <REMOTE>
JvmMaxNativeStackSize	Size of stack in kilobytes	128k	Component restart	Repository directory is <REMOTE>
JvmMinHeapSize	Heap size in megabytes	1m	Component restart	Repository directory is <REMOTE>
Locale	en_US, ja_JP, ko_KR, zh_CN, zh_TW, fr_FR, de_DE, it_IT, es_ES, pt_BR **Note:** This is a subset of the supported locales.	en_US	Component restart	
LogAtInterchangeEnd	true or false	false	Component restart	
MaxEventCapacity	1-2147483647	2147483647	Dynamic	Repository Directory is <REMOTE>
MessageFileName	Path or filename	InterchangeSystem.txt	Component restart	

Table 16. Summary of standard configuration properties (continued)

Property name	Possible values	Default value	Update method	Notes
MonitorQueue	Any valid queue name	*CONNECTORNAME*/MONITORQUEUE	Component restart	JMS transport only: DuplicateEvent Elimination must be true
OADAutoRestartAgent	`true` or `false`	`false`	Dynamic	Repository Directory is <REMOTE>
OADMaxNumRetry	A positive number	`1000`	Dynamic	Repository Directory is <REMOTE>
OADRetryTimeInterval	A positive number in minutes	`10`	Dynamic	Repository Directory is <REMOTE>
PollEndTime	`HH:MM` (HH is 0-23, MM is 0-59)	`HH:MM`	Component restart	
PollFrequency	A positive integer in milliseconds `no` (to disable polling) `key` (to poll only when the letter `p` is entered in the connector's Command Prompt window)	`10000`	Dynamic	
PollQuantity	`1-500`	`1`	Agent restart	JMS transport only: Container Managed Events is specified
PollStartTime	`HH:MM`(HH is 0-23, MM is 0-59)	`HH:MM`	Component restart	
RepositoryDirectory	Location of metadata repository		Agent restart	Set to <REMOTE>
RequestQueue	Valid JMS queue name	*CONNECTORNAME*/REQUESTQUEUE	Component restart	Delivery Transport is JMS
ResponseQueue	Valid JMS queue name	*CONNECTORNAME*/RESPONSEQUEUE	Component restart	Delivery Transport is JMS:
RestartRetryCount	`0-99`	`3`	Dynamic	
RestartRetryInterval	A sensible positive value in minutes: 1 - 2147483547	`1`	Dynamic	
SourceQueue	Valid JMS queue name	*CONNECTORNAME*/SOURCEQUEUE	Agent restart	Only if Delivery Transport is JMS and Container Managed Events is specified
SynchronousRequestQueue	Valid JMS queue name	*CONNECTORNAME*/ SYNCHRONOUSREQUESTQUEUE	Component restart	Delivery Transport is JMS

Table 16. Summary of standard configuration properties (continued)

Property name	Possible values	Default value	Update method	Notes
SynchronousRequestTimeout	0 - any number (millisecs)	0	Component restart	Delivery Transport is JMS
SynchronousResponseQueue	Valid JMS queue name	*CONNECTORNAME*/SYNCHRONOUSRESPONSEQUEUE	Component restart	Delivery Transport is JMS
WireFormat	CwBO	CwBO	Agent restart	

Standard configuration properties

This section lists and defines each of the standard connector configuration properties.

AdminInQueue

The queue that is used by the integration broker to send administrative messages to the connector.

The default value is CONNECTORNAME/ADMININQUEUE.

AdminOutQueue

The queue that is used by the connector to send administrative messages to the integration broker.

The default value is CONNECTORNAME/ADMINOUTQUEUE.

AgentConnections

The AgentConnections property controls the number of ORB connections opened by orb.init[].

By default, the value of this property is set to 1. There is no need to change this default.

AgentTraceLevel

Level of trace messages for the application-specific component. The default is 0. The connector delivers all trace messages applicable at the tracing level set or lower.

ApplicationName

Name that uniquely identifies the connector's application. This name is used by the system administrator to monitor the WebSphere business integration system environment. This property must have a value before you can run the connector.

BrokerType

Identifies the integration broker that you are using, which is ICS.

CharacterEncoding

Specifies the character code set used to map from a character (such as a letter of the alphabet, a numeric representation, or a punctuation mark) to a numeric value.

Note: Java-based connectors do not use this property. A C++ connector currently uses the value ascii7 for this property.

By default, a subset of supported character encodings only is displayed in the drop list. To add other supported values to the drop list, you must manually modify the \Data\Std\stdConnProps.xml file in the product directory. For more information, see the appendix on using Connector Configurator Express in this guide.

ConcurrentEventTriggeredFlows

Determines how many business objects can be concurrently processed by the connector for event delivery. Set the value of this attribute to the number of business objects you want concurrently mapped and delivered. For example, set the value of this property to 5 to cause five business objects to be concurrently processed. The default value is 1.

Setting this property to a value greater than 1 allows a connector for a source application to map multiple event business objects at the same time and deliver them to multiple collaboration instances simultaneously. This speeds delivery of business objects to the integration broker, particularly if the business objects use complex maps. Increasing the arrival rate of business objects to collaborations can improve overall performance in the system.

To implement concurrent processing for an entire flow (from a source application to a destination application), you must:

- Configure the collaboration to use multiple threads by setting its Maximum number of concurrent events property high enough to use multiple threads.
- Ensure that the destination application's application-specific component can process requests concurrently. That is, it must be multi-threaded, or be able to use connector agent parallelism and be configured for multiple processes. Set the Parallel Process Degree configuration property to a value greater than 1.

The ConcurrentEventTriggeredFlows property has no effect on connector polling, which is single-threaded and performed serially.

ContainerManagedEvents

This property allows a JMS-enabled connector with a JMS event store to provide guaranteed event delivery, in which an event is removed from the source queue and placed on the destination queue as a single JMS transaction.

This property only appears if the DeliveryTransport property is set to the value JMS.

The default value is No value.

When ContainerManagedEvents is set to JMS, you must configure the following properties to enable guaranteed event delivery:

- PollQuantity = 1 to 500
- SourceQueue = CONNECTORNAME/SOURCEQUEUE

You must also configure a data handler with the MimeType, DHClass, and DataHandlerConfigMOName (optional) properties. To set those values, use the **Data Handler** tab in Connector Configurator Express. The fields for the values under the Data Handler tab will be displayed only if you have set ContainerManagedEvents to JMS.

Note: When ContainerManagedEvents is set to JMS, the connector does *not* call its pollForEvents() method, thereby disabling that method's functionality.

ControllerStoreAndForwardMode

Sets the behavior of the connector controller after it detects that the destination application-specific component is unavailable.

If this property is set to true and the destination application-specific component is unavailable when an event reaches ICS, the connector controller blocks the request to the application-specific component. When the application-specific component becomes operational, the controller forwards the request to it.

However, if the destination application's application-specific component becomes unavailable **after** the connector controller forwards a service call request to it, the connector controller fails the request.

If this property is set to false, the connector controller begins failing all service call requests as soon as it detects that the destination application-specific component is unavailable.

The default is true.

ControllerTraceLevel

Level of trace messages for the connector controller. The default is 0.

DeliveryQueue

Applicable only if DeliveryTransport is JMS.

The queue that is used by the connector to send business objects to the WebSphere InterChange Server Express.

The default value is CONNECTORNAME/DELIVERYQUEUE.

DeliveryTransport

Specifies the transport mechanism for the delivery of events. Possible values are IDL for CORBA IIOP or JMS for Java Messaging Service. The default is IDL.

The connector sends service call requests and administrative messages over CORBA IIOP if the value configured for the DeliveryTransport property is IDL.

JMS

Enables communication between the connector and client connector framework using Java Messaging Service (JMS).

If you select JMS as the delivery transport, additional JMS properties such as jms.MessageBrokerName, jms.FactoryClassName, jms.Password, and jms.UserName, appear in Connector Configurator Express. The first two of these properties are required for this transport.

Important: There may be a memory limitation if you use the JMS transport mechanism for a connector running on WebSphere InterChange Server Express.

In this environment, you may experience difficulty starting both the connector controller (on the server side) and the connector (on the client side) due to memory use within the WebSphere MQ client.

DuplicateEventElimination

When you set this property to `true`, a JMS-enabled connector can ensure that duplicate events are not delivered to the delivery queue. To use this feature, the connector must have a unique event identifier set as the business object's **ObjectEventId** attribute in the application-specific code. This is done during connector development.

This property can also be set to `false`.

Note: When `DuplicateEventElimination` is set to `true`, you must also configure the `MonitorQueue` property to enable guaranteed event delivery.

EnableOidForFlowMonitoring

When you set this property to `true`, the adapter framework will mark the incoming **ObjectEventId** as a foreign key for the purpose of flow monitoring.

The default is `false`.

FaultQueue

If the connector experiences an error while processing a message then the connector moves the message to the queue specified in this property, along with a status indicator and a description of the problem.

The default value is `CONNECTORNAME/FAULTQUEUE`.

JvmMaxHeapSize

The maximum heap size for the agent (in megabytes).

The default value is 128m.

JvmMaxNativeStackSize

The maximum native stack size for the agent (in kilobytes).

The default value is 128k.

JvmMinHeapSize

The minimum heap size for the agent (in megabytes).

The default value is 1m.

jms.FactoryClassName

Specifies the class name to instantiate for a JMS provider. You *must* set this connector property when you choose `JMS` as your delivery transport mechanism (DeliveryTransport).

The default is `CxCommon.Messaging.jms.IBMMQSeriesFactory`.

jms.MessageBrokerName

Specifies the broker name to use for the JMS provider. You *must* set this connector property when you choose JMS as your delivery transport mechanism (see DeliveryTransport).

The default is crossworlds.queue.manager.

jms.NumConcurrentRequests

Specifies the maximum number of concurrent service call requests that can be sent to a connector at the same time. Once that maximum is reached, new service calls block and wait for another request to complete before proceeding.

The default value is 10.

jms.Password

Specifies the password for the JMS provider. A value for this property is optional.

There is no default.

jms.UserName

Specifies the user name for the JMS provider. A value for this property is optional.

There is no default.

Locale

Specifies the language code, country or territory, and, optionally, the associated character code set. The value of this property determines such cultural conventions as collation and sort order of data, date and time formats, and the symbols used in monetary specifications.

A locale name has the following format:

ll_TT.codeset

where:

ll	a two-character language code (usually in lower case)
TT	a two-letter country or territory code (usually in upper case)
codeset	the name of the associated character code set; this portion of the name is often optional.

By default, only a subset of supported locales appears in the drop list. To add other supported values to the drop list, you must manually modify the \Data\Std\stdConnProps.xml file in the product directory. For more information, see the appendix on using Connector Configurator Express in this guide.

The default value is en_US. If the connector has not been globalized, the only valid value for this property is en_US. To determine whether a specific connector has been globalized, see the connector version list on these websites:

http://www.ibm.com/software/websphere/wbiadapters/infocenter, or
http://www.ibm.com/websphere/integration/wicserver/infocenter

LogAtInterchangeEnd

Specifies whether to log errors to the integration broker's log destination. Logging to the broker's log destination also turns on e-mail notification, which generates e-mail messages for the MESSAGE_RECIPIENT specified in the InterchangeSystem.cfg file when errors or fatal errors occur.

For example, when a connector loses its connection to its application, if LogAtInterChangeEnd is set to true, an e-mail message is sent to the specified message recipient. The default is false.

MaxEventCapacity

The maximum number of events in the controller buffer. This property is used by flow control.

The value can be a positive integer between 1 and 2147483647. The default value is 2147483647.

MessageFileName

The name of the connector message file. The standard location for the message file is \connectors\messages. Specify the message filename in an absolute path if the message file is not located in the standard location.

If a connector message file does not exist, the connector uses InterchangeSystem.txt as the message file. This file is located in the product directory.

Note: To determine whether a specific connector has its own message file, see the individual adapter user guide.

MonitorQueue

The logical queue that the connector uses to monitor duplicate events. It is used only if the DeliveryTransport property value is JMS and DuplicateEventElimination is set to TRUE.

The default value is CONNECTORNAME/MONITORQUEUE

OADAutoRestartAgent

Specifies whether the connector uses the automatic and remote restart feature. This feature uses the MQ-triggered Object Activation Daemon (OAD) to restart the connector after an abnormal shutdown, or to start a remote connector from System Monitor.

This property must be set to true to enable the automatic and remote restart feature. For information on how to configure the MQ-triggered OAD feature, see the *Installation Guide for Windows*.

The default value is false.

OADMaxNumRetry

Specifies the maximum number of times that the MQ-triggered OAD automatically attempts to restart the connector after an abnormal shutdown. The OADAutoRestartAgent property must be set to true for this property to take effect.

The default value is 1000.

OADRetryTimeInterval

Specifies the number of minutes in the retry-time interval for the MQ-triggered OAD. If the connector agent does not restart within this retry-time interval, the connector controller asks the OAD to restart the connector agent again. The OAD repeats this retry process as many times as specified by the OADMaxNumRetry property. The OADAutoRestartAgent property must be set to true for this property to take effect.

The default is 10.

PollEndTime

Time to stop polling the event queue. The format is HH:MM, where *HH* represents 0-23 hours, and *MM* represents 0-59 seconds.

You must provide a valid value for this property. The default value is HH:MM, but must be changed.

PollFrequency

The amount of time between polling actions. Set PollFrequency to one of the following values:

- The number of milliseconds between polling actions.
- The word key, which causes the connector to poll only when you type the letter p in the connector's Command Prompt window. Enter the word in lowercase.
- The word no, which causes the connector not to poll. Enter the word in lowercase.

The default is 10000.

Important: Some connectors have restrictions on the use of this property. To determine whether a specific connector does, see the installing and configuring chapter of its adapter guide.

PollQuantity

Designates the number of items from the application that the connector should poll for. If the adapter has a connector-specific property for setting the poll quantity, the value set in the connector-specific property will override the standard property value.

PollStartTime

The time to start polling the event queue. The format is *HH:MM*, where *HH* represents 0-23 hours, and *MM* represents 0-59 seconds.

You must provide a valid value for this property. The default value is HH:MM, but must be changed.

RequestQueue

The queue that is used by WebSphere InterChange Server Express to send business objects to the connector.

The default value is CONNECTOR/REQUESTQUEUE.

RepositoryDirectory

The location of the repository from which the connector reads the XML schema documents that store the meta-data for business object definitions.

This value must be set to <REMOTE> because the connector obtains this information from the InterChange Server Express repository.

ResponseQueue

Applicable only if `DeliveryTransport` is JMS.

Designates the JMS response queue, which delivers a response message from the connector framework to the integration broker. WebSphere InterChange Server Express sends the request and waits for a response message in the JMS response queue.

RestartRetryCount

Specifies the number of times the connector attempts to restart itself. When used for a parallel connector, specifies the number of times the master connector application-specific component attempts to restart the slave connector application-specific component.

The default is 3.

RestartRetryInterval

Specifies the interval in minutes at which the connector attempts to restart itself. When used for a parallel connector, specifies the interval at which the master connector application-specific component attempts to restart the slave connector application-specific component. Possible values ranges from 1 to 2147483647.

The default is 1.

SourceQueue

Applicable only if `DeliveryTransport` is JMS and ContainerManagedEvents is specified.

Designates the JMS source queue for the connector framework in support of guaranteed event delivery for JMS-enabled connectors that use a JMS event store. For further information, see “ContainerManagedEvents” on page 86.

The default value is `CONNECTOR/SOURCEQUEUE`.

SynchronousRequestQueue

Applicable only if `DeliveryTransport` is JMS.

Delivers request messages that require a synchronous response from the connector framework to the broker. This queue is necessary only if the connector uses synchronous execution. With synchronous execution, the connector framework sends a message to the `SynchronousRequestQueue` and waits for a response back from the broker on the `SynchronousResponseQueue`. The response message sent to the connector bears a correlation ID that matches the ID of the original message.

The default is `CONNECTORNAME/SYNCHRONOUSREQUESTQUEUE`

SynchronousResponseQueue

Applicable only if `DeliveryTransport` is JMS.

Delivers response messages sent in reply to a synchronous request from the broker to the connector framework. This queue is necessary only if the connector uses synchronous execution.

The default is `CONNECTORNAME/SYNCHRONOUSRESPONSEQUEUE`

SynchronousRequestTimeout

Applicable only if `DeliveryTransport` is JMS.

Specifies the time in minutes that the connector waits for a response to a synchronous request. If the response is not received within the specified time, then the connector moves the original synchronous request message into the fault queue along with an error message.

The default value is 0.

WireFormat

This is the message format on the transport. The setting is`CwBO`.

Appendix B. Connector Configurator Express

This appendix describes how to use Connector Configurator Express to set configuration property values for your adapter.

The topics covered in this appendix are:

Overview of Connector Configurator Express

Connector Configurator Express allows you to configure the connector component of your adapter for use with WebSphere InterChange Server Express.

You use Connector Configurator Express to:

- Create a **connector-specific property template** for configuring your connector.
- Create a **connector configuration file**; you must create one configuration file for each connector you install.
- Set properties in a configuration file.
  You may need to modify the default values that are set for properties in the connector templates. You must also designate supported business object definitions and maps for use with collaborations as well as specify messaging, logging and tracing, and data handler parameters, as required.

Connector configuration properties include both standard configuration properties (the properties that all connectors have) and connector-specific properties (properties that are needed by the connector for a specific application or technology).

Because **standard properties** are used by all connectors, you do not need to define those properties from scratch; Connector Configurator Express incorporates them into your configuration file as soon as you create the file. However, you do need to set the value of each standard property in Connector Configurator Express.

The range of standard properties may not be the same for all brokers and all configurations. Some properties are available only if other properties are given a specific value. The Standard Properties window in Connector Configurator Express will show the properties available for your particular configuration.

For **connector-specific properties**, however, you need first to define the properties and then set their values. You do this by creating a connector-specific property template for your particular adapter. There may already be a template set up in your system, in which case, you simply use that. If not, follow the steps in "Creating a new template" on page 97 to set up a new one.

Note: Connector Configurator Express runs only in a Windows environment. If you are running the connector in a UNIX environment, use Connector Configurator Express in Windows to modify the configuration file and then copy the file to your UNIX environment.

Starting Connector Configurator Express

You can start and run Connector Configurator Express in either of two modes:

- Independently, in stand-alone mode
- From System Manager

Running Configurator Express in stand-alone mode

You can run Connector Configurator Express independently and work with connector configuration files, irrespective of your broker.

To do so:

- From **Start>Programs**, click **IBM WebSphere Business Integration Server Express> Toolset Express>Development>Connector Configurator Express**.
- Select **File>New>Configuration File**.

You may choose to run Connector Configurator Express independently to generate the file, and then connect to System Manager to save it in a System Manager project (see "Completing a configuration file" on page 101.)

Running Configurator Express from System Manager

You can run Connector Configurator Express from System Manager.

To run Connector Configurator Express:

1. Open the System Manager.
2. In the System Manager window, expand the **Integration Component Libraries** icon and highlight **Connectors**.
3. From the System Manager menu bar, click **Tools>Connector Configurator Express**. The Connector Configurator Express window opens and displays a **New Connector** dialog box.

To edit an existing configuration file:

1. In the System Manager window, select any of the configuration files listed in the Connector folder and right-click on it.
2. Click the Standard Properties tab to see which properties are included in this configuration file.

Creating a connector-specific property template

To create a configuration file for your connector, you need a connector-specific property template as well as the system-supplied standard properties.

You can create a brand-new template for the connector-specific properties of your connector, or you can use an existing file as the template.

- To create a new template, see "Creating a new template" on page 97.
- To use an existing file, simply modify an existing template and save it under the new name.

Creating a new template

This section describes how you create properties in the template, define general characteristics and values for those properties, and specify any dependencies between the properties. Then you save the template and use it as the base for creating a new connector configuration file.

To create a template:

1. Click **File>New>Connector-Specific Property Template**.
2. The **Connector-Specific Property Template** dialog box appears, with the following fields:
   - **Template**, and **Name**

     Enter a unique name that identifies the connector, or type of connector, for which this template will be used. You will see this name again when you open the dialog box for creating a new configuration file from a template.
   - **Old Template**, and **Select the Existing Template to Modify**

     The names of all currently available templates are displayed in the Template Name display.
   - To see the connector-specific property definitions in any template, select that template's name in the **Template Name** display. A list of the property definitions contained in that template will appear in the **Template Preview** display. You can use an existing template whose property definitions are similar to those required by your connector as a starting point for your template.
3. Select a template from the **Template Name** display, enter that template name in the **Find Name** field (or highlight your selection in **Template Name**), and click **Next**.

If you do not see any template that displays the connector-specific properties used by your connector, you will need to create one.

Specifying general characteristics

When you click **Next** to select a template, the **Properties - Connector-Specific Property Template** dialog box appears. The dialog box has tabs for General characteristics of the defined properties and for Value restrictions. The General display has the following fields:

- **General:**
  Property Type
  Updated Method
  Description
- **Flags**
  Standard flags
- **Custom Flag**
  Flag

After you have made selections for the general characteristics of the property, click the **Value** tab.

Specifying values

The **Value** tab enables you to set the maximum length, the maximum multiple values, a default value, or a value range for the property. It also allows editable values. To do so:

1. Click the **Value** tab. The display panel for Value replaces the display panel for General.

2. Select the name of the property in the **Edit properties** display.
3. In the fields for **Max Length** and **Max Multiple Values**, make any changes. The changes will not be accepted unless you also open the **Property Value** dialog box for the property, described in the next step.
4. Right-click the box in the top left-hand corner of the value table and click **Add**. A **Property Value** dialog box appears. Depending on the property type, the dialog box allows you to enter either a value, or both a value and range. Enter the appropriate value or range, and click **OK**.
5. The **Value** panel refreshes to display any changes you made in **Max Length** and **Max Multiple Values**. It displays a table with three columns:

   The **Value** column shows the value that you entered in the **Property Value** dialog box, and any previous values that you created.

   The **Default Value** column allows you to designate any of the values as the default.

   The **Value Range** shows the range that you entered in the **Property Value** dialog box.

   After a value has been created and appears in the grid, it can be edited from within the table display. To make a change in an existing value in the table, select an entire row by clicking on the row number. Then right-click in the **Value** field and click **Edit Value**.

Setting dependencies

When you have made your changes to the **General** and **Value** tabs, click **Next**. The **Dependencies - Connector-Specific Property Template** dialog box appears.

A dependent property is a property that is included in the template and used in the configuration file *only if* the value of another property meets a specific condition. For example, `PollQuantity` appears in the template only if JMS is the transport mechanism and `DuplicateEventElimination` is set to `True`.
To designate a property as dependent and to set the condition upon which it depends, do this:

1. In the **Available Properties** display, select the property that will be made dependent.
2. In the **Select Property** field, use the drop-down menu to select the property that will hold the conditional value.
3. In the **Condition Operator** field, select one of the following:

   == (equal to)

   != (not equal to)

   > (greater than)

   < (less than)

   >= (greater than or equal to)

   <=(less than or equal to)
4. In the **Conditional Value** field, enter the value that is required in order for the dependent property to be included in the template.
5. With the dependent property highlighted in the **Available Properties** display, click an arrow to move it to the **Dependent Property** display.
6. Click **Finish**. Connector Configurator Express stores the information you have entered as an XML document, under `\data\app` in the`\bin` directory where you have installed Connector Configurator Express.

Creating a new configuration file

You create a connector configuration file from a connector-specific template or by modifying an existing configuration file.

Creating a configuration file from a connector-specific template

Once a connector-specific template has been created, you can use it to create a configuration file:

1. Click **File>New>Connector Configuration**.
2. The **New Connector** dialog box appears, with the following fields:
   - **Name**

     Enter the name of the connector. Names are case-sensitive. The name you enter must be unique, and must be consistent with the file name for a connector that is installed on the system.

     Important: Connector Configurator Express does not check the spelling of the name that you enter. You must ensure that the name is correct.
   - **System Connectivity**

     The default broker is ICS. You cannot change this value.
   - **Select Connector-Specific Property Template**

     Type the name of the template that has been designed for your connector. The available templates are shown in the **Template Name** display. When you select a name in the Template Name display, the **Property Template Preview** display shows the connector-specific properties that have been defined in that template.

     Select the template you want to use and click **OK**.
3. A configuration screen appears for the connector that you are configuring. The title bar shows the integration broker and connector names. You can fill in all the field values to complete the definition now, or you can save the file and complete the fields later.
4. To save the file, click **File>Save>To File** or **File>Save>To Project**. To save to a project, System Manager must be running.
   If you save as a file, the **Save File Connector** dialog box appears. Choose `*.cfg` as the file type, verify in the File Name field that the name is spelled correctly and has the correct case, navigate to the directory where you want to locate the file, and click **Save**. The status display in the message panel of Connector Configurator Express indicates that the configuration file was successfully created.

   Important: The directory path and name that you establish here must match the connector configuration file path and name that you supply in the startup file for the connector.
5. To complete the connector definition, enter values in the fields for each of the tabs of the Connector Configurator Express window, as described later in this chapter.

Using an existing file

To use an existing file to configure a connector, you must open the file in Connector Configurator Express, revise the configuration, and then save the file as a configuration file (`*.cfg`).

You may have an existing file available in one or more of the following formats:

- A connector definition file.
  This is a text file that lists properties and applicable default values for a specific connector. Some connectors include such a file in a `\repository` directory in their delivery package (the file typically has the extension `.txt`; for example, CN_XML.txt for the XML connector).
- An InterChange Server Express repository file.
  Definitions used in a previous InterChange Server Express implementation of the connector may be available to you in a repository file that was used in the configuration of that connector. Such a file typically has the extension `.in` or `.out`.
- A previous configuration file for the connector.
  Such a file typically has the extension `*.cfg.`

Although any of these file sources may contain most or all of the connector-specific properties for your connector, the connector configuration file will not be complete until you have opened the file and set properties, as described later in this chapter.

To use an existing file to configure a connector, you must open the file in Connector Configurator Express, revise the configuration, and then resave the file.

Follow these steps to open a `*.txt`, `*.cfg` or `*.in` file from a directory:

1. In Connector Configurator Express, click **File>Open>From File**.
2. In the **Open File Connector** dialog box, select one of the following file types to see the available files:
   - Configuration (`*.cfg`)
   - InterChange Server Express Repository (`*.in`, `*.out`)

     Choose this option if a repository file was used to configure the connector. A repository file may include multiple connector definitions, all of which will appear when you open the file.
   - All files (*.*)

     Choose this option if a `*.txt` file was delivered in the adapter package for the connector, or if a definition file is available under another extension.
3. In the directory display, navigate to the appropriate connector definition file, select it, and click **Open**.

Follow these steps to open a connector configuration from a System Manager project:

1. Start System Manager. A configuration can be opened from or saved to System Manager only if System Manager has been started.
2. Start Connector Configurator Express.
3. Click **File>Open>From Project**.

Completing a configuration file

When you open a configuration file or a connector from a project, the Connector Configurator Express window displays the configuration screen, with the current attributes and values.

Connector Configurator Express requires values for properties described in the following sections:

- "Setting standard connector properties"
- "Setting application-specific configuration properties" on page 102
- "Specifying supported business object definitions" on page 103
- "Associated maps" on page 104
- "Setting trace/log file values" on page 105

Note: For connectors that use JMS messaging, an additional category may display, for special configuration of data handlers that convert the data to business objects. For further information, see "Data handlers" on page 106.

Setting the configuration file properties

When you create and name a new connector configuration file, or when you open an existing connector configuration file, Connector Configurator Express displays a configuration screen with tabs for the categories of required configuration values.

Standard properties differ from connector-specific properties as follows:

- Standard properties of a connector are shared by both the application-specific component of a connector and its broker component. All connectors have the same set of standard properties. These properties are described in Appendix A of each adapter guide. You can change some but not all of these values.
- Application-specific properties apply only to the application-specific component of a connector, that is, the component that interacts directly with the application. Each connector has application-specific properties that are unique to its application. Some of these properties provide default values and some do not; you can modify some of the default values. The installation and configuration chapters of each adapter guide describe the application-specific properties and the recommended values.

The fields for **Standard Properties** and **Connector-Specific Properties** are color-coded to show which are configurable:

- A field with a grey background indicates a standard property. You can change the value but cannot change the name or remove the property.
- A field with a white background indicates an application-specific property. These properties vary according to the specific needs of the application or connector. You can change the value and delete these properties.
- You can configure Value fields.
- The **Update Method** displayed for each property indicates whether a component or agent restart is necessary to activate changed values.

Setting standard connector properties

To change the value of a standard property:

1. Click in the field whose value you want to set.
2. Either enter a value, or select one from the drop-down menu if it appears.

3. After entering all the values for the standard properties, you can do one of the following:
   - To discard the changes, preserve the original values, and exit Connector Configurator Express, click **File>Exit** (or close the window), and click **No** when prompted to save changes.
   - To enter values for other categories in Connector Configurator Express, select the tab for the category. The values you enter for **Standard Properties** (or any other category) are retained when you move to the next category. When you close the window, you are prompted to either save or discard the values that you entered in all the categories as a whole.
   - To save the revised values, click **File>Exit** (or close the window) and click **Yes** when prompted to save changes. Alternatively, click **Save>To File** from either the File menu or the toolbar.

Setting application-specific configuration properties

For application-specific configuration properties, you can add or change property names, configure values, delete a property, and encrypt a property. The default property length is 255 characters.

1. Right-click in the top left portion of the grid. A pop-up menu bar will appear. Click **Add** to add a property. To add a child property, right-click on the parent row number and click **Add child**.
2. Enter a value for the property or child property.
3. To encrypt a property, select the **Encrypt** box.
4. Choose to save or discard changes, as described for "Setting standard connector properties" on page 101.

The Update Method displayed for each property indicates whether a component or agent restart is necessary to activate changed values.

Important: Changing a preset application-specific connector property name may cause a connector to fail. Certain property names may be needed by the connector to connect to an application or to run properly.

Encryption for connector properties

Application-specific properties can be encrypted by selecting the **Encrypt** check box in the **Edit Property** window. To decrypt a value, click to clear the **Encrypt** check box, enter the correct value in the **Verification** dialog box, and click **OK**. If the entered value is correct, the value is decrypted and displays.

The adapter user guide for each connector contains a list and description of each property and its default value.

If a property has multiple values, the **Encrypt** check box will appear for the first value of the property. When you select **Encrypt**, all values of the property will be encrypted. To decrypt multiple values of a property, click to clear the **Encrypt** check box for the first value of the property, and then enter the new value in the **Verification** dialog box. If the input value is a match, all multiple values will decrypt.

Update method

Refer to the descriptions of update methods found in the *Standard configuration properties for connectors* appendix, under "Setting and updating property values" on page 81.

Connector properties are almost all static and the **Update Method** is `Component restart`. For changes to take effect, you must restart the connector after saving the revised connector configuration file.

Specifying supported business object definitions

Use the **Supported Business Objects** tab in Connector Configurator Express to specify the business objects that the connector will use. You must specify both generic business objects and application-specific business objects, and you must specify associations for the maps between the business objects.

For you to specify a supported business object, the business objects and their maps must exist in the system. Business object definitions, including those for data handler meta-objects, and map definitions should be saved into Integration Component Library (ICL) projects. For more information on ICL projects, see the *User Guide for WebSphere Business Integration Server Express*.

Note: Some connectors require that certain business objects be specified as supported in order to perform event notification or additional configuration (using meta-objects) with their applications. For more information, see the chapter on business objects in this guide as well as the *Business Object Development Guide*.

To specify that a business object definition is supported by the connector, or to change the support settings for an existing business object definition, click the **Supported Business Objects** tab and use the following fields.

Business object name

To designate that a business object definition is supported by the connector, with System Manager running:

1. Click an empty field in the **Business Object Name** list. A drop-down list displays, showing all the business object definitions that exist in the System Manager project.
2. Click on a business object to add it.
3. Set the **Agent Support** (described below) for the business object.
4. In the File menu of the Connector Configurator Express window, click **Save to Project**. The revised connector definition, including designated support for the added business object definition, is saved to the project in System Manager.

To delete a business object from the supported list:

1. To select a business object field, click the number to the left of the business object.
2. From the **Edit** menu of the Connector Configurator Express window, click **Delete Row**. The business object is removed from the list display.
3. From the **File** menu, click **Save to Project**.

Deleting a business object from the supported list changes the connector definition and makes the deleted business object unavailable for use in this implementation of this connector. It does not affect the connector code, nor does it remove the business object definition itself from System Manager.

Agent support

If a business object has Agent Support, the system will attempt to use that business object for delivering data to an application via the connector agent.

Typically, application-specific business objects for a connector are supported by that connector's agent, but generic business objects are not.

To indicate that the business object is supported by the connector agent, check the **Agent Support** box. The Connector Configurator Express window does not validate your Agent Support selections.

Maximum transaction level

The maximum transaction level for a connector is the highest transaction level that the connector supports.

For most connectors, `Best Effort` is the only possible choice.

You must restart the server for changes in transaction level to take effect.

Associated maps

Each connector supports a list of business object definitions and their associated maps that are currently active in InterChange Server Express. This list appears when you select the **Associated Maps** tab.

The list of business objects contains the application-specific business object which the agent supports and the corresponding generic object that the controller sends to the subscribing collaboration. The association of a map determines which map will be used to transform the application-specific business object to the generic business object or the generic business object to the application-specific business object.

If you are using maps that are uniquely defined for specific source and destination business objects, the maps will already be associated with their appropriate business objects when you open the display, and you will not need (or be able) to change them.

If more than one map is available for use by a supported business object, you will need to explicitly bind the business object with the map that it should use.

The **Associated Maps** tab displays the following fields:

- **Business Object Name**

  These are the business objects supported by this connector, as designated in the **Supported Business Objects** tab. If you designate additional business objects under the Supported Business Objects tab, they will be reflected in this list after you save the changes by choosing **Save to Project** from the **File** menu of the Connector Configurator Express window.
- **Associated Maps**

  The display shows all the maps that have been installed to the system for use with the supported business objects of the connector. The source business object for each map is shown to the left of the map name, in the **Business Object Name** display.
- **Explicit**

  In some cases, you may need to explicitly bind an associated map.

  Explicit binding is required only when more than one map exists for a particular supported business object. When InterChange Server Express boots, it tries to automatically bind a map to each supported business object for each connector.

If more than one map takes as its input the same business object, the server attempts to locate and bind one map that is the superset of the others.

If there is no map that is the superset of the others, the server will not be able to bind the business object to a single map, and you will need to set the binding explicitly.

To explicitly bind a map:

1. In the **Explicit** column, place a check in the check box for the map you want to bind.
2. Select the map that you intend to associate with the business object.
3. In the **File** menu of the Connector Configurator Express window, click **Save to Project**.
4. Deploy the project to InterChange Server Express.
5. Reboot the server for the changes to take effect.

Resources

The **Resource** tab allows you to set a value that determines whether and to what extent the connector agent will handle multiple processes concurrently, using connector agent parallelism.

Not all connectors support this feature. If you are running a connector agent that was designed in Java to be multi-threaded, you are advised not to use this feature, since it is usually more efficient to use multiple threads than multiple processes.

Setting trace/log file values

When you open a connector configuration file or a connector definition file, Connector Configurator Express uses the logging and tracing values of that file as default values. You can change those values in Connector Configurator Express.

To change the logging and tracing values:

1. Click the **Trace/Log Files** tab.
2. For either logging or tracing, you can choose to write messages to one or both of the following:
   - To console (STDOUT):
     Writes logging or tracing messages to the STDOUT display.

     Note: You can only use the STDOUT option from the **Trace/Log Files** tab for connectors running on the Windows platform.
   - To File:
     Writes logging or tracing messages to a file that you specify. To specify the file, click the directory button (ellipsis), navigate to the preferred location, provide a file name, and click **Save**. Logging or tracing message are written to the file and location that you specify.

     Note: Both logging and tracing files are simple text files. You can use the file extension that you prefer when you set their file names. For tracing files, however, it is advisable to use the extension `.trace` rather than `.trc`, to avoid confusion with other files that might reside on the system. For logging files, `.log` and `.txt` are typical file extensions.

Data handlers

The data handlers section is available for configuration only if you have designated a value of JMS for DeliveryTransport and a value of JMS for ContainerManagedEvents. Adapters that make use of the guaranteed event delivery enable this tab.

See the descriptions under `ContainerManagedEvents` in the Standard Properties appendix for values to use for these properties.

Saving your configuration file

After you have created the configuration file and set its properties, you need to deploy it to the correct location for your connector. Save the configuration in an ICL project, and use System Manager to load the file into InterChange Server Express.

The file is saved as an XML document. You can save the XML document in three ways:

- From System Manager, as a file with a `*.con` extension in an Integration Component Library, or
- In a directory that you specify.
- In stand-alone mode, as a file with a `*.cfg` extension in a directory folder.

For details about using projects in System Manager, and for further information about deployment, see the *User Guide for IBM WebSphere Business Integration Server Express.*

Completing the configuration

After you have created a configuration file for a connector and modified it, make sure that the connector can locate the configuration file when the connector starts up.

To do so, open the startup file used for the connector, and verify that the location and file name used for the connector configuration file match exactly the name you have given the file and the directory or path where you have placed it.

Using Connector Configurator Express in a globalized environment

Connector Configurator Express is globalized and can handle character conversion between the configuration file and the integration broker. Connector Configurator Express uses native encoding. When it writes to the configuration file, it uses UTF-8 encoding.

Connector Configurator Express supports non-English characters in:

- All value fields
- Log file and trace file path (specified in the **Trace/Log files** tab)

The drop list for the `CharacterEncoding` and `Locale` standard configuration properties displays only a subset of supported values. To add other values to the drop list, you must manually modify the `\Data\Std\stdConnProps.xml` file in the product directory.

For example, to add the locale en_GB to the list of values for the Locale property, open the stdConnProps.xml file and add the line in boldface type below:

```
<Property name="Locale"
isRequired="true"
updateMethod="component restart">
                <ValidType>String</ValidType>
            <ValidValues>
                                <Value>ja_JP</Value>
                                <Value>ko_KR</Value>
                                <Value>zh_CN</Value>
                                <Value>zh_TW</Value>
                                <Value>fr_FR</Value>
                                <Value>de_DE</Value>
                                <Value>it_IT</Value>
                                <Value>es_ES</Value>
                                <Value>pt_BR</Value>
                                <Value>en_US</Value>
                                <Value>en_GB</Value>
                    <DefaultValue>en_US</DefaultValue>
            </ValidValues>
    </Property>
```

Appendix C. Business object samples

This appendix details the sample business objects that are included with the connector for JDBC. The JDBC connector includes the following business object samples:

- AfterUpdateSPSampleBO.txt
- BeforeCreateSPSampleBO.txt
- BOwithDifferentParameterOrder.txt
- BOwithIOandOPParams.txt
- BOwithFewerSPParamsthanBOAttribs.txt
- CreateSPUpdateSPSampleBO.txt

AfterUpdateSPSampleBO.txt

Attribute name: AfterUpdateSP

Contains the `Jdbctest_Customer` business object. Application-specific information of this attribute contains the following information: `SPN=UpdateAllColumns;IP=fid:CustomerName:CustomerNumber:CustomerDesc`. `UpdateAllColumns` is the name of the stored procedure that uses all four business object attributes (`fid,CustomerName,CustomerNumberandCustomerDesc`) as input parameters. This stored procedure is executed after the `Update` operation is completed.

BeforeCreateSPSampleBO.txt

Attribute name: BeforeCreateSP

Contains the `Jdbctest_Customer` business object. Application- specific information of this attribute contains the following information: `SPN=GetCustomerID;OP=fid` `GetCustomerID` is the name of the stored procedure that uses the `fid` business object attribute as an output parameter (preferably to get an ID value from a MasterID table). The stored procedure is executed before the `Create` operation is completed.

BOwithDifferentParameterOrder.txt

Attribute name: AfterRetrieveSP

Contains the `Jdbctest_Address` business object. Application- specific information of this attribute contains the following information: `SPN=UpdateAddress;IP=addressid;IP=zipcode:city:street`. `UpdateAddress` is the name of the stored procedure that uses all the business object attributes as input parameters (preferably to update the address in a table other than `Jdbctest_Address`). Note that the parameter order differs from that of the business object attribute order and that it contains more than one name:value pair for the input parameters. The stored procedure is executed after the `Retrieve` operation is completed.

BOwithIOandOPParams.txt

Attribute name: RetireveSP

Contains the `Jdbctest_Address` business object. Application- specific information of this attribute contains the following information: `SPN=RetrieveAddress;IO=addressid;OP=street:city:zipcode`. `RetrieveAddress` is the name of the stored procedure that uses the business object attribute `addressid` as an input/output parameter. It also uses the remaining business object attributes as output parameters: `zipcode, city, street` . The stored procedure is executed instead of the `Retrieve` operation.

BOwithFewerSPParamsthanBOAttribs.txt

Attribute name: AfterUpdateSP

Contains the `Jdbctest_Address` business object. Application- specific information of this attribute contains the following information: `SPN=UpdateZipOnly;IP=addressid:zipcode`. `UpdateZipOnly` is the name of the stored procedure that uses the `addressid` and `zipcode` business object attributes as input parameters. Note that the total number of stored procedure parameters is less than the total number of business object attributes.

CreateSPUpdateSPSampleBO.txt

Attribute name: CreateSP

Contains the `Jdbctest_Address` business object. Application- specific information of this attribute contains the following information: `SPN=CreateAddress;IP=addressid;IP=street:city:zipcode`. `CreateAddress` is the name of the stored procedure that uses all four business object attributes as input parameters. Note that it contains more than one name:value pair for the input parameters. The stored procedure is executed instead of the `Create` operation. This business object also contains the `UpdateSP` attribute. It contains the following text: `SPN=UpdateCity;IP=addressid:city`. `UpdateCity` is the name of the stored procedure that uses `addressid` and `city` as input parameters. Note that the total number of stored procedure parameters is less than the total number of business attributes. The stored procedure is executed instead of the `Update` operation.

Appendix D. Support for null and blank values

This appendix details different pass and fail scenarios where the key value in a business object is blank or null. This appendix also contains the functional changes required for blank or null business object values.

Pass and Fail Scenarios

If a key value in a business object is blank or has a null value in the database, then build the where clause with the ″is null″ type instead of the ″=″ operator type.

IBM recommends that business objects have at least one key attribute that does not have a blank value.

The following scenario is a parent object with one key that has a null value. This scenario fails under these conditions.

Table 17. Customer

Attribute	**Type**
cid	Integer (Key)
name	String
comments	String

The following scenario is a parent object with two keys and one key has a null value. This scenario passes under these conditions.

Table 18. Customer

Attribute	**Type**
cid	Integer (Key)
name	String
comments	String

In scenario two, build the retrieve query by selecting cid, name, and comments from customer, where cid=1000 and name is set to null.

The following scenario is a parent object with one child object in a container object with a foreign key reference. This scenario fails under these conditions.

Table 19. Customer

Attribute	**Type**
cid	Integer (Key)
name	String (Key)
comments	String
Address	Address
Aid	Integer (Key) ASI:FK=cid
Acity	String

Table 19. Customer (continued)

Attribute	Type
Azip	String

If cid contains a null value, then build the retrieve query by selecting Aid, Acity, and Azip from address. Set the value of Aid to null.

The following scenario is a parent object with one child object in a container object with two key references. This scenario passes under these conditions.

Table 20. Customer

Attribute	Type
cid	Integer (Key)
name	String
comments	String
Address	Address
Aid	Integer (Key) ASI:FK=cid
Acity	String (Key) ASI:FK=name
Azip	String

If name has a null value, then build the Retrieve query by selecting Aid, Acity, and Azip from address, where Aid=Cid and Acity has a null value.

Functionality

If the connector encounters a blank value on a key, it then compares that value with the UseNull value in the attribute. If the value is true, then the connector adds null value to the query. This affects the following verb operations:

- Retrieve
- RetrieveBy Content
- Update
- Delete

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