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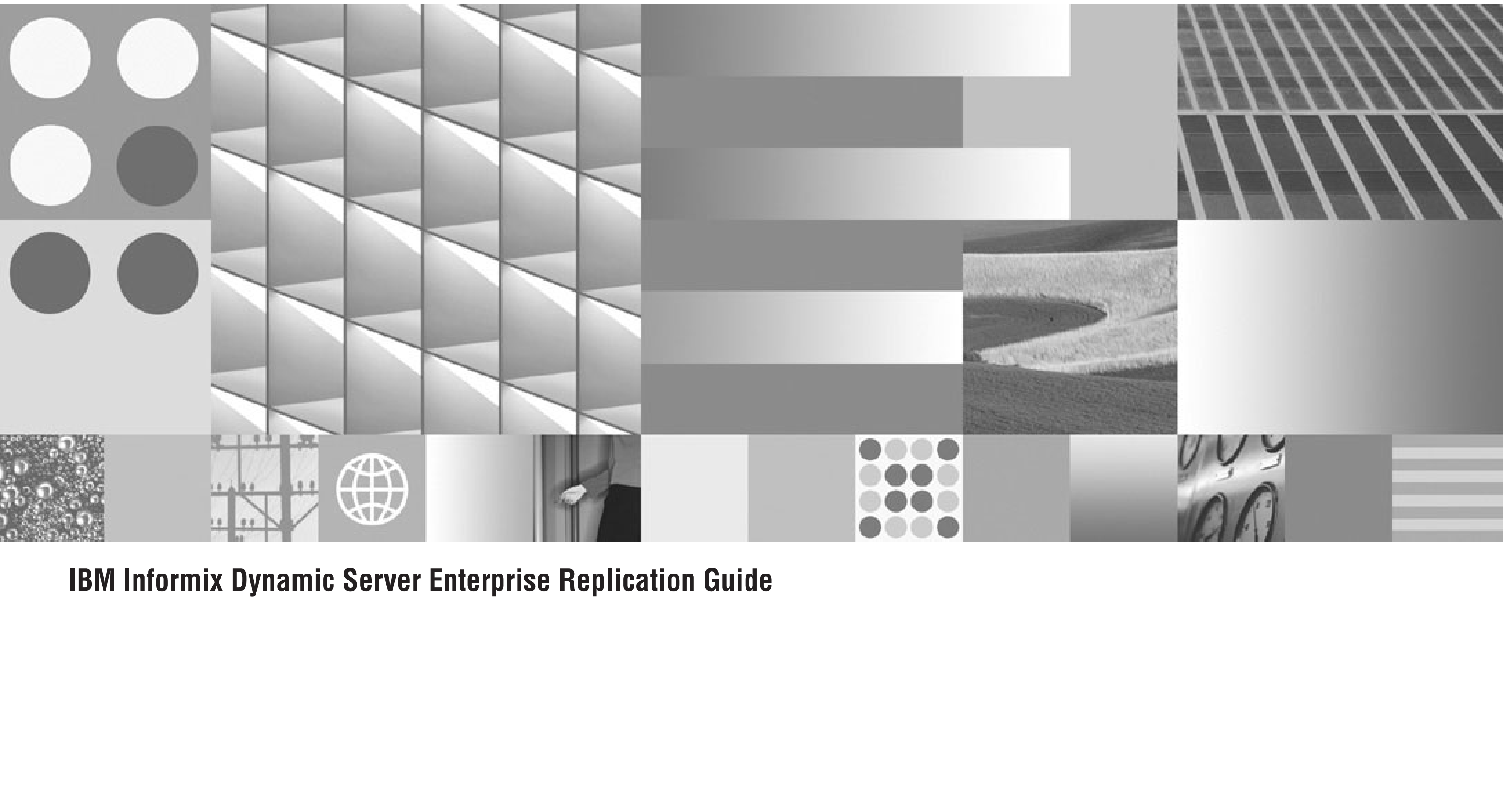

IBM Informix Dynamic Server Enterprise Replication Guide

G251-2279-02

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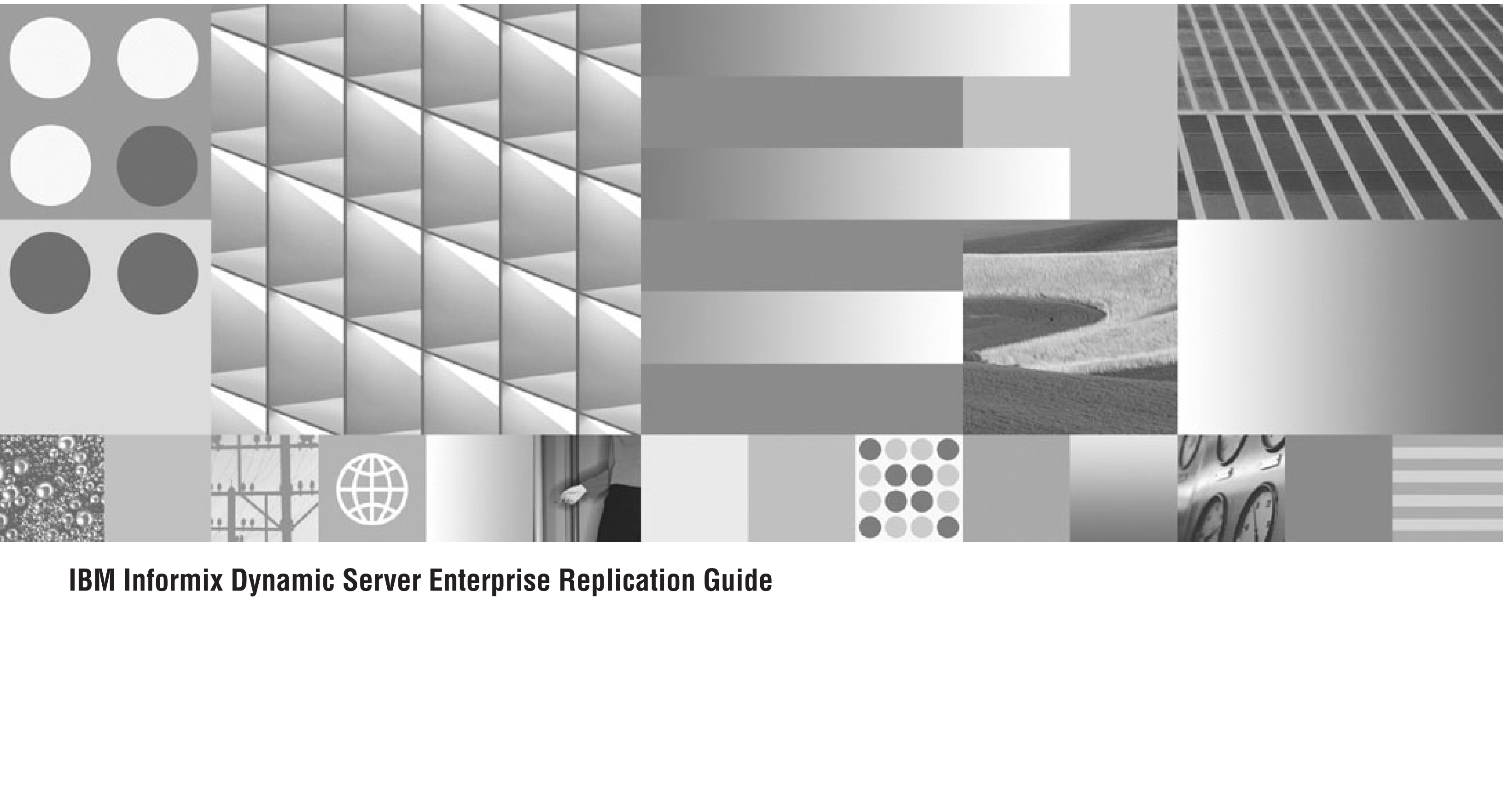

IBM Informix Dynamic Server Enterprise Replication Guide

G251-2279-02

Note:
Before using this information and the product it supports, read the information in “Notices” on page I-1.

This edition replaces G251-2279-01.

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In This Introduction

This introduction provides an overview of the information in this manual and describes the conventions it uses.

About This Manual

This manual describes IBM Informix Enterprise Replication and the concepts of data replication. This manual explains how to design your replication system, as well as administer and manage data replication throughout your enterprise.

This section discusses the intended audience and the associated software products that you must have to use Enterprise Replication.

Types of Users

This manual is for database server administrators and assumes that you have the following background:

- A working knowledge of your computer, your operating system, and the utilities that your operating system provides

- Some experience working with relational databases or exposure to database concepts
- Some experience with database server administration, operating- system administration, and network administration

If you have limited experience with relational databases, SQL, or your operating system, refer to your *IBM Informix Getting Started Guide* for a list of supplementary titles.

Software Dependencies

To use Enterprise Replication, you must use IBM Informix Dynamic Server as your database server. Check the release notes for specific version compatibility.

This manual assumes that you are using Dynamic Server, Version 10.0, as your database server.

Assumptions About Your Locale

IBM Informix products can support many languages, cultures, and code sets. All the information related to character set, collation and representation of numeric data, currency, date, and time is brought together in a single environment, called a GLS (Global Language Support) locale.

The examples in this manual are written with the assumption that you are using the default locale, **en_us.8859-1**. This locale supports U.S. English format conventions for date, time, and currency. In addition, this locale supports the ISO 8859-1 code set, which includes the ASCII code set plus many 8-bit characters such as é, è, and ñ.

If you plan to use nondefault characters in your data or your SQL identifiers, or if you want to conform to the nondefault collation rules of character data, you need to specify the appropriate nondefault locale.

For instructions on how to specify a nondefault locale, additional syntax, and other considerations related to GLS locales, see the *IBM Informix GLS User's Guide*.

Demonstration Databases

The DB–Access utility, which is provided with your IBM Informix database server products, includes one or more of the following demonstration databases:

- The **stores_demo** database illustrates a relational schema with information about a fictitious wholesale sporting-goods distributor. Many examples in IBM Informix manuals are based on the **stores_demo** database.
- The **superstores_demo** database illustrates an object-relational schema. The **superstores_demo** database contains examples of extended data types, type and table inheritance, and user-defined routines.

For information about how to create and populate the demonstration databases, see the *IBM Informix DB–Access User's Guide*. For descriptions of the databases and their contents, see the *IBM Informix Guide to SQL: Reference*.

The scripts that you use to install the demonstration databases reside in the **$INFORMIXDIR/bin** directory on UNIX® platforms and in the **%INFORMIXDIR%\bin** directory in Windows environments.

New Features in Dynamic Server, Version 10.0

This section describes new Enterprise Replication features. These features fall into the following areas:

- Functionality Enhancements
- Command-Line Changes
- Configuration Parameter and Environment Variable Changes

For a description of all new features, see the *IBM Informix Getting Started Guide*.

Functionality Enhancements

Enterprise Replication for Dynamic Server, Version 10.0, includes the following functionality enhancements:

9 • Limit Memory Use During Enterprise Replication Synchronization

9 During the synchronization operation, the size of the send queue expands
9 automatically. You can specify the increase in the amount of memory for the
9 send queue with the new **--memadjust** option for the **cdr check replicate**, **cdr**
9 **check replicateset**, **cdr sync replicate**, and **cdr sync replicateset** commands. If
9 you synchronize with the **cdr start replicate**, **cdr start replicateset**, or **cdr realize**
9 **template** commands, you can specify that the synchronization operation is
9 performed as a foreground process with the new **--foreground** option, and limit
9 the send queue growth with the **--memadjust** option.

9 • Enhanced Enterprise Replication Consistency Report

9 The Consistency Report, which is generated by the **cdr check** command with the
9 **--verbose** option, now displays the values of the mismatched rows.

9 • Obtain IDS Version Information from the cdr Utility

9 You can use the **cdr -V** command to display the version of IDS that is currently
9 running.

9 • Enhanced Installation of Enterprise Replication Checksum UDRs

9 When you install IDS, you now get the Checksum UDRs that are used by the
9 **cdr check** command to check data consistency between Enterprise Replication
9 servers. To register the UDRs, run the following command with DB-Access in
9 each replicated database: `$INFORMIXDIR/etc/idschecksum.sql`

9 • Enhanced Enterprise Replication Monitoring with New SMI Tables

9 SMI tables provide a way to obtain information by using SQL commands, either
9 locally or from remote servers. The following new SMI tables contain
9 information about Enterprise Replication that you can use to monitor status and
9 diagnose problems:

9 – syscdr_state: contains information on whether Enterprise Replication, data
9 capture, data apply, and the network between servers is active.

9 – syscdr_ddr: contains information about the status of log capture and the
9 proximity or status of transaction blocking (DDRBLOCK) or transaction
9 spooling.

9 – syscdr_nif: contains information about network connections and the flow of
9 data between Enterprise Replication servers.

9 – syscdr_rcv: contains information about transactions being applied on target
9 servers and acknowledgements being sent from target servers.

9 – syscdr_atsdir: contains information about the contents of the ATS directory.

9 – syscdr_risdir: contains information about the contents of the RIS directory.

9 – syscdr_ats: contains the first ten lines of content of each ATS file.

  - syscdr_ris: contains the first ten lines of content of each RIS file.
  - syscdr_rqmstamp: contains information about which transaction is being added into each queue.
  - syscdr_rqmhandle: contains information about which transaction is being processed in each queue.
- Monitor the Whole Enterprise Replication Domain

  You can now monitor the status of all Enterprise Replication servers from any one of those servers with the new **cdr view** command. Specify one or more subcommands, depending on what information you want to monitor. You can automatically rerun the **cdr view** command every specified interval by using the **--repeat** option.
- New Option to Preview Enterprise Replication Repair Operations

  You can now choose to preview the operations of a **cdr repair** command without making the updates. Use the new **--check** option of the **cdr repair** command to check the consistency between the database server and the ATS or RIS file and display the repair operations to stderr, but do not perform the repair operations.
- Prevent ATS and RIS File Generation

  You can prevent the generation of both ATS and RIS files by setting the CDR_DISABLE_SPOOL environment variable to 1. You can prevent the generation of either ATS or RIS files by setting the ATS or RIS directory to **/dev/null** (UNIX) or **NUL** (Windows).
- Fire Triggers During Synchronization

  If you have triggers set on replicated tables, you can configure trigger firing during a synchronization procedure by using the new **--firetrigger** option of the **cdr sync** and **cdr check** commands. You have the following options for firing triggers during synchronization:
  - Do not fire triggers
  - Always fire triggers even if the replicate does not have the **--firetrigger** option enabled Fire triggers only if the replicate has the **--firetrigger** option enabled.
- Event Alarms

  You can use event alarms that are specific to Enterprise Replication to automate many administrative tasks. See "Enterprise Replication Event Alarms" on page 8-16 for more information.
- Master Replicates

  To guarantee consistency between the nodes in your Enterprise Replication environment, you can create master replicates. See "Defining Master Replicates" on page 6-5 for more information.
- Templates

  Enterprise Replication provides templates to allow easy set up and deployment of replication for clients with large numbers of tables to replicate. See "Using Templates to Set Up Replication" on page 6-13 for more information.
- Alter Support

  You can alter a replicated table's schema or its fragmentation strategy without stopping replication. See "Performing Alter Operations on Replicated Tables" on page 7-16 for more information.
- Repair and Consistency Checking

  If replication has failed for some reason and data is inconsistent, you can synchronize your tables while replication is still active. You can also check the consistency of the replicate and optionally repair any inconsistent rows.

4 See “Resynchronizing Data Among Replication Servers” on page 7-12 for more
4 information.

- Initial Data Synchronization

  You can perform an initial synchronization when you start a replicate or replicate set to synchronize a new replicate, or add a new participant to an existing replicate.

  See “Initially Synchronizing Data Among Database Servers” on page 6-11 for more information.
- Repair using ATS and RIS files

  You can also repair data after replication has failed by using ATS and RIS files. Enterprise Replication examines the specified ATS or RIS file and attempts to reconcile the rows that failed to be applied. This method is fast, but does not allow you as much flexibility in defining how the repair should be done. See “Repairing Failed Transactions with ATS and RIS Files” on page 7-15 for more information.
- Shadow Replicates

  Enterprise Replication uses shadow replicates to manage alter and repair operations on replicated tables. If you perform manual remastering of a replicate that was defined with the **-n** option, you must create a shadow replicate. See “Defining Shadow Replicates” on page 6-6 for more information.

Command-Line Changes

This release includes the following new commands for the command-line interface:

9 • Use the new **--check** option of the **cdr repair** command to check the consistency
9 between the database server and the ATS or RIS file and display the repair
9 operations to stderr, but do not perform the repair operations.

9 • The **cdr view** command to monitor the Enterprise Replication domain.

9 • The **cdr -V** command to display the version of Dynamic Server.

- The **cdr define template** and **cdr realize template** commands to define and implement replication using a template. The **cdr list template** and **cdr delete template** commands to view and clean up templates.
- The **cdr define repair** and **cdr start repair** commands to create and run a repair job to resynchronize your replicated data. The **cdr stop repair** command to halt a running repair job. The **cdr list repair** and **cdr delete repair** commands to view and clean up repair jobs.
- The **cdr repair** command to make repairs using ATS or RIS files.
- The **cdr remaster** command to redefine a master replicate, and the **cdr swap shadow** command to switch a replicate with its shadow replicate during manual remastering.
- The **cdr alter** command to place tables in alter mode.
- The **cdr cleanstart** command to start an Enterprise Replication server with empty queues.

3 • The **cdr stats rqm** and **cdr stats recv** commands to view statistics about
3 replication.

4 • The **cdr check replicate** and **cdr check replicateset** commands to check
4 consistency within replicates and optionally repair inconsistent rows.

4 • The **cdr sync replicate** and **cdr sync replicateset** command to perform direct
4 synchronization between a reference server and one or more target servers.

This release includes the following new options for commands in the command-line interface:

9 • If you have triggers set on replicated tables, you can configure trigger firing
9 during a synchronization procedure by using the new **--firetrigger** option of the
9 **cdr sync** and **cdr check** commands.

9 • You can specify the increase in the amount of memory for the send queue with
9 the new **--memadjust** option for the **cdr check replicate**, **cdr check replicateset**,
9 **cdr sync replicate**, and **cdr sync replicateset** commands. If you synchronize with
9 the **cdr start replicate**, **cdr start replicateset**, or **cdr realize template** commands,
9 you can specify that the synchronization operation is performed as a foreground
9 process with the new **--foreground** option, and limit the send queue growth
9 with the **--memadjust** option.

- The options **--syncdatasource** and **--extratargetrows** for the **cdr start**command. These options allow you to perform an initial synchronization of data when you start a new replicate, or when you add a new participant to an existing replicate.
- The master replicate options **--master**, **--empty**, **--name**, **--verify**, and **--autocreate** for the **cdr define replicate** command.
- The shadow replicate option **--mirrors** for the **cdr define replicate** command.
- A **brief** option for the **cdr list replicate** command to display a summary of participants for all replicates.

For more information on these commands and their options, see Appendix A, "Command-Line Utility Reference," on page A-1.

Configuration Parameter and Environment Variable Changes

This release includes the following new configuration parameters:

- ENCRYPT_SWITCH to define the frequency at which ciphers and secret keys are renegotiated (The cipher is the encryption methodology. The secret key is the key used to build the encrypted data using the cipher.)
- CDR_SUPPRESS_ATSRISWARN to prevent certain Data sync errors and warnings from appearing in ATS files.

9 This release includes the following new environment variable:

9 • CDR_DISABLE_SPOOL to prevent the generation of both ATS and RIS files.

9 • CDR_ATSRISNAME_DELIM to specify the delimiter to use to separate the parts
9 of the time portion of ATS and RIS filenames.

For more information, see Appendix B, "Configuration Parameter and Environment Variable Reference," on page B-1.

Documentation Conventions

This section describes the conventions that this manual uses. These conventions make it easier to gather information from this and other volumes in the documentation set.

The following conventions are discussed:

- Typographical conventions
- Other conventions
- Syntax diagrams
- Command-line conventions
- Example code conventions

Typographical Conventions

This manual uses the following conventions to introduce new terms, illustrate screen displays, describe command syntax, and so forth.

Convention	Meaning
KEYWORD	Keywords of SQL, SPL, and some other programming languages appear in uppercase letters in a serif font.
italics	Within text, new terms and emphasized words appear in italics. Within syntax and code examples, variable values that you are to specify appear in italics.
boldface	Names of program entities (such as classes, events, and tables), environment variables, file and pathnames, and interface elements (such as icons, menu items, and buttons) appear in boldface.
`monospace`	Information that the product displays and information that you enter appear in a monospace typeface.
KEYSTROKE	Keys that you are to press appear in uppercase letters in a sans serif font.
>	This symbol indicates a menu item. For example, "Choose **Tools > Options**" means choose the **Options** item from the **Tools** menu.

Tip: When you are instructed to "enter" characters or to "execute" a command, immediately press RETURN after the entry. When you are instructed to "type" the text or to "press" other keys, no RETURN is required.

Feature, Product, and Platform Markup

Feature, product, and platform markup identifies paragraphs that contain feature-specific, product-specific, or platform-specific information. Some examples of this markup follow:

Dynamic Server

Identifies information that is specific to IBM Informix Dynamic Server

End of Dynamic Server

Windows Only

Identifies information that is specific to the Windows environment

End of Windows Only

This markup can apply to one or more paragraphs within a section. When an entire section applies to a particular product or platform, this is noted as part of the heading text, for example:

Table Sorting (Linux®)

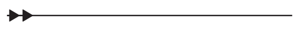
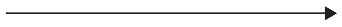
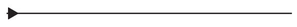
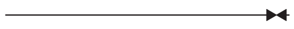
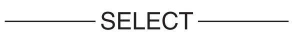
Syntax Diagrams

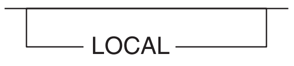
This guide uses syntax diagrams built with the following components to describe the syntax for statements and all commands other than system-level commands.

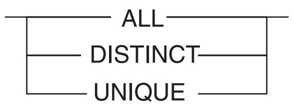
Syntax diagrams depicting SQL and command-line statements have changed in the following ways:

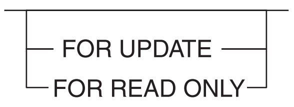
- The symbols at the beginning and end of statements are double arrows.
- The symbols at the beginning and end of syntax segment diagrams are vertical lines.
- How many times a loop can be repeated is explained in a diagram footnote, whose marker appears above the path that is describes.
- Syntax statements that are longer than one line continue on the next line.
- Product or condition-specific paths are explained in diagram footnotes, whose markers appear above the path that they describe.
- Cross-references to the descriptions of other syntax segments appear as diagram footnotes, whose markers immediately follow the name of the segment that they reference.

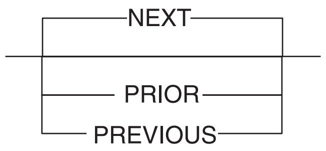
The following table describes syntax diagram components.

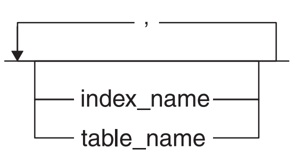
Component represented in PDF	Component represented in HTML	Meaning
	`>>----------------------`	Statement begins.
	`----------------------->`	Statement continues on next line.
	`>-----------------------`	Statement continues from previous line.
	`-----------------------><`	Statement ends.
	`--------SELECT----------`	Required item.

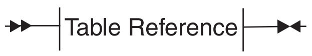
	`--+-----------------+---`
	`   '------LOCAL------'`
		Optional item.

	`---+-----ALL-------+---`
	`   +--DISTINCT-----+`
	`   '---UNIQUE------'`
		Required item with choice. One and only one item must be present.

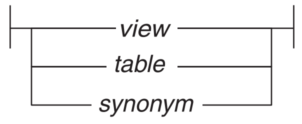
	`---+------------------+---`
	`    +--FOR UPDATE-----+`
	`    '--FOR READ ONLY--'`
		Optional items with choice are shown below the main line, one of which you might specify.

	`    .---NEXT---------.`
	`----+----------------+---`
	`    +---PRIOR--------+`
	`    '---PREVIOUS-----'`
		The values below the main line are optional, one of which you might specify. If you do not specify an item, the value above the line will be used as the default.

	` .-------,-----------.`
	` V                   |`
	`---+-----------------+---`
	`    +---index_name---+`
	`    '---table_name---'`
		Optional items. Several items are allowed; a comma must precede each repetition.

	`>>-| Table Reference |-><`	Reference to a syntax segment.

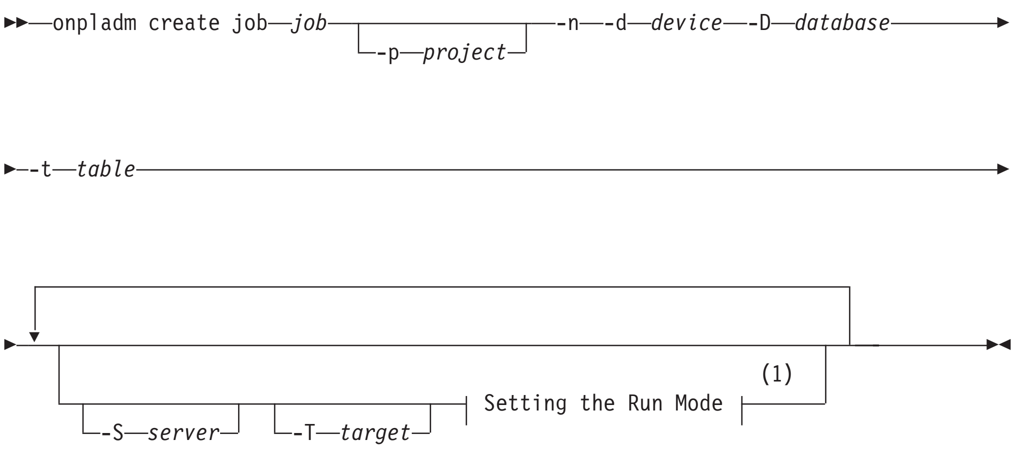
Component represented in PDF	Component represented in HTML	Meaning

Table Reference 	`Table Reference`
	`|--+-----view--------+--|`
	`   +------table------+`
	`   '----synonym------'`
		Syntax segment.

How to Read a Command-Line Syntax Diagram

The following command-line syntax diagram uses some of the elements listed in the table in the previous section.

Creating a No-Conversion Job

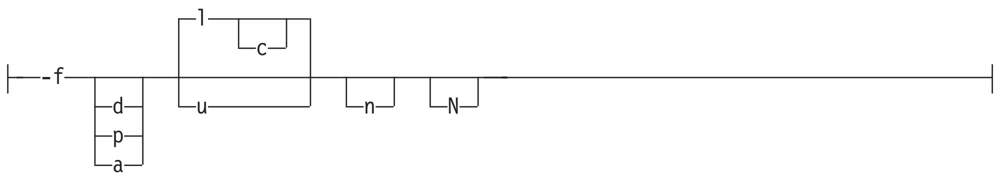


Notes:

1 See page Z-1

The second line in this diagram has a segment named "Setting the Run Mode," which according to the diagram footnote, is on page Z-1. If this was an actual cross-reference, you would find this segment in on the first page of Appendix Z. Instead, this segment is shown in the following segment diagram. Notice that the diagram uses segment start and end components.

Setting the Run Mode:



To see how to construct a command correctly, start at the top left of the main diagram. Follow the diagram to the right, including the elements that you want. The elements in this diagram are case sensitive because the illustrates utility syntax. Other types of syntax, such as SQL, are not case sensitive.

The Creating a No-Conversion Job diagram illustrates the following steps:

1. Type **onpladm create job** and then the name of the job.
2. Optionally, type **-p** and then the name of the project.
3. Type the following required elements:
   - **-n**
   - **-d** and the name of the device
   - **-D** and the name of the database
   - **-t** and the name of the table
4. Optionally, you can choose one or more of the following elements and repeat them an arbitrary number of times:
   - **-S** and the server name
   - **-T** and the target server name
   - The run mode. To set the run mode, follow the Setting the Run Mode segment diagram to type **-f**, optionally type **d**, **p**, or **a**, and then optionally type **l** or **u**.
5. Follow the diagram to the terminator.

Your diagram is complete.

Keywords and Punctuation

Keywords are words reserved for statements and all commands except system-level commands. When a keyword appears in a syntax diagram, it is shown in uppercase letters. When you use a keyword in a command, you can write it in uppercase or lowercase letters, but you must spell the keyword exactly as it appears in the syntax diagram.

You must also use any punctuation in your statements and commands exactly as shown in the syntax diagrams.

Identifiers and Names

Variables serve as placeholders for identifiers and names in the syntax diagrams and examples. You can replace a variable with an arbitrary name, identifier, or literal, depending on the context. Variables are also used to represent complex syntax elements that are expanded in additional syntax diagrams. When a variable appears in a syntax diagram, an example, or text, it is shown in *lowercase italic*.

The following syntax diagram uses variables to illustrate the general form of a simple SELECT statement.

```
►►──SELECT──column_name──FROM──table_name──────────────────────────────────►◄
```

When you write a SELECT statement of this form, you replace the variables *column_name* and *table_name* with the name of a specific column and table.

Example Code Conventions

Examples of SQL code occur throughout this manual. Except as noted, the code is not specific to any single IBM Informix application development tool.

If only SQL statements are listed in the example, they are not delimited by semicolons. For instance, you might see the code in the following example:

```
CONNECT TO stores_demo
...
```

```
DELETE FROM customer
   WHERE customer_num = 121
...

COMMIT WORK
DISCONNECT CURRENT
```

To use this SQL code for a specific product, you must apply the syntax rules for that product. For example, if you are using DB–Access, you must delimit multiple statements with semicolons. If you are using an SQL API, you must use EXEC SQL at the start of each statement and a semicolon (or other appropriate delimiter) at the end of the statement.

Tip: Ellipsis points in a code example indicate that more code would be added in a full application, but it is not necessary to show it to describe the concept being discussed.

For detailed directions on using SQL statements for a particular application development tool or SQL API, see the manual for your product.

Additional Documentation

For additional information, refer to the following types of documentation:

- Installation guides
- Online notes
- Informix® error messages
- Manuals
- Online help

IBM Informix Information Center

The Informix Dynamic Server Information Center integrates the entire IBM® Informix Dynamic Server 10.0 and IBM Informix Client SDK (CSDK) 2.90 documentation sets in both HTML and PDF formats. The Information Center provides full text search, a master index, logical categories, easy navigation, and links to troubleshooting and support files.

The IBM Informix Information Center site is located at http://publib.boulder.ibm.com/infocenter/idshelp/v10/index.jsp.

Installation Guides

Installation guides are located in the **/doc** directory of the product CD or in the **/doc** directory of the product's compressed file if you downloaded it from the IBM Web site. Alternatively, you can obtain installation guides from the IBM Informix Online Documentation site at http://www.ibm.com/software/data/informix/pubs/library/ or the IBM Informix Information Center at http://publib.boulder.ibm.com/infocenter/idshelp/v10/index.jsp.

Online Notes

The following sections describe the online files that supplement the information in this manual. Please examine these files before you begin using your IBM Informix product. They contain vital information about application and performance issues.

Online File	Description	Format
TOC Notes	The TOC (Table of Contents) notes file provides a comprehensive directory of hyperlinks to the release notes, the fixed and known defects file, and all the documentation notes files for individual manual titles.	HTML
Documentation Notes	The documentation notes file for each manual contains important information and corrections that supplement the information in the manual or information that was modified since publication.	HTML, text
Release Notes	The release notes file describes feature differences from earlier versions of IBM Informix products and how these differences might affect current products. For some products, this file also contains information about any known problems and their workarounds.	HTML, text
Machine Notes	(Non-Windows platforms only) The machine notes file describes any platform-specific actions that you must take to configure and use IBM Informix products on your computer.	text
Fixed and Known Defects File	This text file lists issues that have been identified with the current version. It also lists customer-reported defects that have been fixed in both the current version and in previous versions.	text

Locating Online Notes

Online notes are available from the IBM Informix Online Documentation site at http://www.ibm.com/software/data/informix/pubs/library/ and in the IBM Informix Information Center at http://publib.boulder.ibm.com/infocenter/idshelp/v10/index.jsp. Additionally you can locate these files before or after installation as described below.

Before Installation

All online notes are located in the **/doc** directory of the product CD. The easiest way to access the documentation notes, the release notes, and the fixed and known defects file is through the hyperlinks from the TOC notes file.

The machine notes file and the fixed and known defects file are only provided in text format.

After Installation

On UNIX platforms in the default locale, the documentation notes, release notes, and machine notes files appear under the **$INFORMIXDIR/release/en_us/0333** directory.

Dynamic Server

On Windows® the documentation and release notes files appear in the **Informix** folder. To display this folder, choose **Start > Programs > IBM** *product name version* **> Documentation Notes** or **Release Notes** from the taskbar.

Machine notes do not apply to Windows platforms.

End of Dynamic Server

Online Notes Filenames

Online notes have the following file formats:

Online File	File Format	Examples
TOC Notes	*prod_os*_toc_*version*.html	**ids_win_toc_10.0.html**
Documentation Notes	*prod_bookname*_docnotes_*version*.html/txt	**ids_hpl_docnotes_10.0.html**
Release Notes	*prod_os*_relnotes_*version*.html/txt	**ids_unix_relnotes_10.0.txt**
Machine Notes	*prod*_machine_notes_*version*.txt	**ids_machine_notes_10.0.txt**
Fixed and Known Defects File	*prod*_defects_*version*.txt ids_win_fixed_and_known _defects_*version*.txt	**ids_defects_10.0.txt** **client_defects_2.90.txt** **ids_win_fixed_and_known _defects_10.0.txt**

Informix Error Messages

This file is a comprehensive index of error messages and their corrective actions for the Informix products and version numbers.

On UNIX platforms, use the **finderr** command to read the error messages and their corrective actions.

Dynamic Server

On Windows, use the Informix Error Messages utility to read error messages and their corrective actions. To display this utility, choose **Start > Programs > IBM *product name version* > Informix Error Messages** from the taskbar.

End of Dynamic Server

You can also access these files from the IBM Informix Online Documentation site at http://www.ibm.com/software/data/informix/pubs/library/ or in the IBM Informix Information Center at http://publib.boulder.ibm.com/infocenter/idshelp/v10/index.jsp.

Manuals

Online Manuals

A CD that contains your manuals in electronic format is provided with your IBM Informix products. You can install the documentation or access it directly from the CD. For information about how to install, read, and print online manuals, see the installation insert that accompanies your CD. You can also obtain the same online manuals from the IBM Informix Online Documentation site at http://www.ibm.com/software/data/informix/pubs/library/ or in the IBM Informix Information Center at http://publib.boulder.ibm.com/infocenter/idshelp/v10/index.jsp.

Printed Manuals

To order hardcopy manuals, contact your sales representative or visit the IBM Publications Center Web site at http://www.ibm.com/software/howtobuy/data.html.

Online Help

IBM Informix online help, provided with each graphical user interface (GUI), displays information about those interfaces and the functions that they perform. Use the help facilities that each GUI provides to display the online help.

Accessibility

IBM is committed to making our documentation accessible to persons with disabilities. Our books are available in HTML format so that they can be accessed with assistive technology such as screen reader software. The syntax diagrams in our manuals are available in dotted decimal format, which is an accessible format that is available only if you are using a screen reader. For more information about the dotted decimal format, see the Accessibility appendix.

IBM Informix Dynamic Server Version 10.0 and CSDK Version 2.90 Documentation Set

The following tables list the manuals that are part of the IBM Informix Dynamic Server, Version 10.0 and the CSDK Version 2.90, documentation set. PDF and HTML versions of these manuals are available at http://www.ibm.com/software/data/informix/pubs/library/ or in the IBM Informix Information Center at http://publib.boulder.ibm.com/infocenter/idshelp/v10/index.jsp. You can order hardcopy versions of these manuals from the IBM Publications Center at http://www.ibm.com/software/howtobuy/data.html.

Table 1. Database Server Manuals

Manual	Subject
Administrator's Guide	Understanding, configuring, and administering your database server.
Administrator's Reference	Reference material for Informix Dynamic Server, such as the syntax of database server utilities **onmode** and **onstat**, and descriptions of configuration parameters, the **sysmaster** tables, and logical-log records.
Backup and Restore Guide	The concepts and methods you need to understand when you use the **ON-Bar** and **ontape** utilities to back up and restore data.
Built-In DataBlade® Modules User's Guide	Using the following DataBlade modules that are included with Dynamic Server: • MQ DataBlade module, to allow IBM Informix database applications to communicate with other MQSeries® applications. • Large Object Locator, a foundation DataBlade module that can be used by other modules that create or store large-object data.
DB-Access User's Guide	Using the **DB-Access** utility to access, modify, and retrieve data from Informix databases.
DataBlade API Function Reference	The DataBlade API functions and the subset of ESQL/C functions that the DataBlade API supports. You can use the DataBlade API to develop client LIBMI applications and C user-defined routines that access data in Informix databases.
DataBlade API Programmer's Guide	The DataBlade API, which is the C-language application-programming interface provided with Dynamic Server. You use the DataBlade API to develop client and server applications that access data stored in Informix databases.

Table 1. Database Server Manuals (continued)

Manual	**Subject**
Database Design and Implementation Guide	Designing, implementing, and managing your Informix databases.
Enterprise Replication Guide	How to design, implement, and manage an Enterprise Replication system to replicate data between multiple database servers.
Error Messages file	Causes and solutions for numbered error messages you might receive when you work with IBM Informix products.
Getting Started Guide	Describes the products bundled with IBM Informix Dynamic Server and interoperability with other IBM products. Summarizes important features of Dynamic Server and the new features for each version.
Guide to SQL: Reference	Information about Informix databases, data types, system catalog tables, environment variables, and the stores_demo demonstration database.
Guide to SQL: Syntax	Detailed descriptions of the syntax for all Informix SQL and SPL statements.
Guide to SQL: Tutorial	A tutorial on SQL, as implemented by Informix products, that describes the basic ideas and terms that are used when you work with a relational database.
High-Performance Loader User's Guide	Accessing and using the High-Performance Loader (HPL), to load and unload large quantities of data to and from Informix databases.
Installation Guide for Microsoft® Windows	Instructions for installing IBM Informix Dynamic Server on Windows.
Installation Guide for UNIX and Linux	Instructions for installing IBM Informix Dynamic Server on UNIX and Linux.
J/Foundation Developer's Guide	Writing user-defined routines (UDRs) in the Java™ programming language for Informix Dynamic Server with J/Foundation.
Migration Guide	Conversion to and reversion from the latest versions of Informix database servers. Migration between different Informix database servers.
Optical Subsystem Guide	The Optical Subsystem, a utility that supports the storage of BYTE and TEXT data on optical disk.
Performance Guide	Configuring and operating IBM Informix Dynamic Server to achieve optimum performance.
R-Tree Index User's Guide	Creating R-tree indexes on appropriate data types, creating new operator classes that use the R-tree access method, and managing databases that use the R-tree secondary access method.
SNMP Subagent Guide	The IBM Informix subagent that allows a Simple Network Management Protocol (SNMP) network manager to monitor the status of Informix servers.
Storage Manager Administrator's Guide	Informix Storage Manager (ISM), which manages storage devices and media for your Informix database server.
Trusted Facility Guide	The secure-auditing capabilities of Dynamic Server, including the creation and maintenance of audit logs.
User-Defined Routines and Data Types Developer's Guide	How to define new data types and enable user-defined routines (UDRs) to extend IBM Informix Dynamic Server.
Virtual-Index Interface Programmer's Guide	Creating a secondary access method (index) with the Virtual-Index Interface (VII) to extend the built-in indexing schemes of IBM Informix Dynamic Server. Typically used with a DataBlade module.
Virtual-Table Interface Programmer's Guide	Creating a primary access method with the Virtual-Table Interface (VTI) so that users have a single SQL interface to Informix tables and to data that does not conform to the storage scheme of Informix Dynamic Server.

Table 2. Client/Connectivity Manuals

Manual	Subject
Client Products Installation Guide	Installing IBM Informix Client Software Developer's Kit (Client SDK) and IBM Informix Connect on computers that use UNIX, Linux, and Windows.
Embedded SQLJ User's Guide	Using IBM Informix Embedded SQLJ to embed SQL statements in Java programs.
ESQL/C Programmer's Manual	The IBM Informix implementation of embedded SQL for C.
GLS User's Guide	The Global Language Support (GLS) feature, which allows IBM Informix APIs and database servers to handle different languages, cultural conventions, and code sets.
JDBC Driver Programmer's Guide	Installing and using Informix JDBC Driver to connect to an Informix database from within a Java application or applet.
.NET Provider Reference Guide	Using Informix .NET Provider to enable .NET client applications to access and manipulate data in Informix databases.
ODBC Driver Programmer's Manual	Using the Informix ODBC Driver API to access an Informix database and interact with the Informix database server.
OLE DB Provider Programmer's Guide	Installing and configuring Informix OLE DB Provider to enable client applications, such as ActiveX Data Object (ADO) applications and Web pages, to access data on an Informix server.
Object Interface for C++ Programmer's Guide	The architecture of the C++ object interface and a complete class reference.

Table 3. DataBlade Developer's Kit Manuals

Manual	Subject
DataBlade Developer's Kit User's Guide	Developing and packaging DataBlade modules using BladeSmith and BladePack.
DataBlade Module Development Overview	Basic orientation for developing DataBlade modules. Includes an example illustrating the development of a DataBlade module.
DataBlade Module Installation and Registration Guide	Installing DataBlade modules and using BladeManager to manage DataBlade modules in Informix databases.

Compliance with Industry Standards

The American National Standards Institute (ANSI) and the International Organization of Standardization (ISO) have jointly established a set of industry standards for the Structured Query Language (SQL). IBM Informix SQL-based products are fully compliant with SQL-92 Entry Level (published as ANSI X3.135-1992), which is identical to ISO 9075:1992. In addition, many features of IBM Informix database servers comply with the SQL-92 Intermediate and Full Level and X/Open SQL Common Applications Environment (CAE) standards.

IBM Welcomes Your Comments

We want to know about any corrections or clarifications that you would find useful in our manuals, which will help us improve future versions. Include the following information:

- The name and version of the manual that you are using
- Section and page number
- Your suggestions about the manual

Send your comments to us at the following email address:

docinf@us.ibm.com

This email address is reserved for reporting errors and omissions in our documentation. For immediate help with a technical problem, contact IBM Technical Support. For instructions, see the IBM Informix Technical Support website at http://www.ibm.com/planetwide.

We appreciate your suggestions.

Part 1. Introducing Enterprise Replication

Chapter 1. About IBM Informix Enterprise Replication

In This Chapter . . . 1-1
IBM Informix Enterprise Replication . . . 1-1
  Asynchronous Data Replication . . . 1-2
  Log-Based Data Capture . . . 1-2
  High Performance . . . 1-3
  High Availability . . . 1-3
  Consistent Information Delivery . . . 1-3
  Repair and Initial Data Synchronization. . . . 1-4
  Flexible Architecture . . . 1-4
  Centralized Administration . . . 1-5
  Ease of Implementation . . . 1-5
  Network Encryption . . . 1-5
How Enterprise Replication Replicates Data . . . 1-6
  Data Capture . . . 1-7
    Evaluating Data for Replication . . . 1-8
  Data Transport. . . . 1-13
  Applying Replicated Data . . . 1-13

In This Chapter

Data replication generates and manages multiple copies of data at one or more sites, which allows an enterprise to share corporate data throughout its organization.

This chapter introduces IBM Informix Enterprise Replication and explains how this product replicates data.

IBM Informix Enterprise Replication

Enterprise Replication is an asynchronous, log-based tool for replicating data between IBM Informix Dynamic Server database servers. Enterprise Replication on the source server captures transactions to be replicated by reading the logical log, storing the transactions, and reliably transmitting each transaction as replication data to the target servers.

At each target server, Enterprise Replication receives and applies each transaction contained in the replication data to the appropriate databases and tables as a normal, logged transaction.

IBM Informix Enterprise Replication provides the following features:

- Asynchronous Data Replication
- Log-Based Data Capture
- High Performance
- High Availability
- Consistent Information Delivery
- Repair and Initial Data Synchronization
- Flexible Architecture
- Centralized Administration
- Ease of Implementation
- Network Encryption

Enterprise Replication is supported by IBM Informix Dynamic Server Enterprise and Workgroup Editions only. Enterprise Replication is not supported by IBM Informix Dynamic Server Express Edition.

Asynchronous Data Replication

Enterprise Replication uses *asynchronous* data replication to update the databases that reside at a replicated site after the primary database has committed a change.

With asynchronous replication, the delay to update the replicated-site databases can vary depending on the business application and user requirements. However, the data eventually synchronizes to the same value at all sites. The major benefit of this type of data replication is that if a particular database server fails, the replication process can continue and all transactions in the replication system will be committed.

In contrast to this, *synchronous* data replication replicates data immediately when the source data is updated. Synchronous data replication uses the *two-phase commit* technology to protect data integrity. In a two-phase commit, a transaction is applied only if *all* interconnected distributed sites agree to accept the transaction. Synchronous data replication is appropriate for applications that require immediate data synchronization. However, synchronous data replication requires that all hardware components and networks in the replication system be available at all times. For more information about synchronous replication, refer to the discussion of two-phase commit in your *IBM Informix Dynamic Server Administrator's Guide*.

Asynchronous replication is often preferred because it allows for system and network failures.

Asynchronous replication allows the following replication models:

- Primary-target ("Primary-Target Replication System" on page 3-1)

  All database changes originate at the primary database and are replicated to the target databases. Changes at the target databases are not replicated to the primary.
- Update-anywhere ("Update-Anywhere Replication System" on page 3-5)

  All databases have read and write capabilities. Updates are applied at all databases.

The update-anywhere model provides the greater challenge in asynchronous replication. For example, if a replication system contains three replication sites that all have read and write capabilities, conflicts occur when the sites try to update the same data at the same time. Conflicts must be detected and resolved so that the data elements eventually have the same value at every site. For more information, see "Conflict Resolution" on page 3-6.

Log-Based Data Capture

Enterprise Replication uses *log-based data capture* to gather data for replication. Enterprise Replication reads the logical log to obtain the row images for tables that participate in replication and then evaluates the row images.

Log-based data capture takes changes from the logical log and does not compete with transactions for access to production tables. Log-based data-capture systems operate as part of the normal database-logging process and thus add minimal overhead to the system.

Two other methods of data capture, which Enterprise Replication does not support, include:

- Trigger-based data capture

  A trigger is code in the database that is associated with a piece of data. When the data changes, the trigger activates the replication process.
- Trigger-based transaction capture

  A trigger is associated with a table. Data changes are grouped into transactions and a single transaction might trigger several replications if it modifies several tables. The trigger receives the whole transaction, but the procedure that captures the data runs as a part of the original transaction, thus slowing down the original transaction.

High Performance

Enterprise Replication provides high performance by not overly burdening the data source and by using networks and all other resources efficiently.

Because Enterprise Replication captures changes from the logical log instead of competing with transactions that access production tables, Enterprise Replication minimizes the effect on transaction performance. Because the capture mechanism is internal to the database, the database server implements this capture mechanism efficiently. For more information, see "Log-Based Data Capture" on page 1-2.

All Enterprise Replication operations are performed in parallel, which further extends the performance of Enterprise Replication.

High Availability

Because Enterprise Replication implements asynchronous data replication, network and target database server outages are tolerated. In the event of a database server or network failure, the local database server continues to service local users. The local database server stores replicated transactions in persistent storage until the remote server becomes available.

If high availability is critical, you can use High-Availability Data Replication (HDR) in conjunction with Enterprise Replication. HDR supports synchronous data replication between two database servers: a primary server, which can participate in Enterprise Replication, and a secondary server, which is read-only and does not participate in Enterprise Replication. If a primary server in an HDR pair fails, you switch the secondary server to the standard server, allowing it to participate in Enterprise Replication. Client connections to the original primary server can be automatically switched to the new standard server.

For more information on using HDR with Enterprise Replication, see Chapter 5, "Using High-Availability Data Replication with Enterprise Replication."

Consistent Information Delivery

Enterprise Replication protects data integrity. All Enterprise Replication transactions are stored in a reliable queue to maintain the consistency of transactions.

Enterprise Replication uses a data-synchronization process to ensure that transactions are applied at the target database servers in any order equivalent to the order that they were committed on the source database server. If Enterprise

Replication can preserve the consistency of the database, Enterprise Replication might commit transactions in a slightly different order on the target database.

If update conflicts occur, Enterprise Replication provides built-in automatic conflict detection and resolution. You can configure the way conflict resolution behaves to meet the needs of your enterprise. For more information, see "Conflict Resolution" on page 3-6.

Repair and Initial Data Synchronization

Enterprise Replication provides an initial synchronization feature that allows you to easily bring a new table up-to-date with replication when you start a new replicate, or when you add a new participant to an existing replicate. Initial synchronization can be run online while replication is active. For more information about initial synchronization, see "Initially Synchronizing Data Among Database Servers" on page 6-11.

If replication has failed for some reason, Enterprise Replication allows you to run a repair job to resynchronize data and correct data mismatches between replicated tables. Repair jobs can be run online while replication is active. For more information, see "Resynchronizing Data Among Replication Servers" on page 7-12.

You can also repair data after replication has failed by using ATS and RIS files. Enterprise Replication examines the specified ATS or RIS file and attempts to reconcile the rows that failed to be applied. This method is fast, but does not allow as much flexibility as a repair job allows in defining how the repair should be done. See "Repairing Failed Transactions with ATS and RIS Files" on page 7-15 for more information.

Flexible Architecture

Enterprise Replication allows replications based on specific business and application requirements and does not impose model or methodology restrictions on the enterprise.

Enterprise Replication supports both primary-target and update-anywhere replication models. For more information, see "Selecting the Enterprise Replication System" on page 3-1.

Enterprise Replication supports the following network topologies:

- Fully connected

  Continuous connectivity between all participating database servers.
- Hierarchical tree

  A parent-child configuration that supports continuous and intermittent connectivity.
- Forest of trees

  Multiple hierarchical trees that connect at the root database servers.

You can add High-Availability Data Replication to any of these topologies. For more information on topologies, see "Choosing a Replication Network Topology" on page 3-11.

Enterprise Replication supports all built-in Informix data types, as well as extended and user-defined data types. For more information, see "Enterprise Replication Data Types" on page 2-12.

Enterprise Replication operates in LAN, WAN, and combined LAN/WAN configurations across a range of network transport protocols.

Enterprise Replication supports the Global Language Support (GLS) feature, which allows IBM Informix products to handle different languages, regional conventions, and code sets. For more information, see "Using GLS with Enterprise Replication" on page 2-11.

Centralized Administration

Enterprise Replication allows administrators to easily manage all the distributed components of the replication system from a single point of control.

You can use the command-line utility (CLU) to administer the replication system from your system command prompt and connect to other servers involved in replication, as necessary. For information, see Appendix A, "Command-Line Utility Reference," on page A-1.

In addition, you can use IBM Informix Server Administrator (ISA) to administer your replication system from a web browser.

Ease of Implementation

Enterprise Replication provides templates to allow easy set up and deployment of replication for clients with large numbers of tables to replicate. Administrators of Enterprise Replication can use templates to develop scripts and with only a few commands can set up replication over a large number of server nodes. Without using templates, many individual commands must be run. Using templates, you can also easily add a new server into your replication environment and optionally create and populate new database tables.

First, you create a template using the **cdr define template** command. This defines the database, tables, and columns and the characteristics of the replicates that will be created. You can view information about a template by using the **cdr list template** command from a non-leaf node.

Second, you instantiate the template on the servers where you want to replicate this data by running the **cdr realize template** command. If the table already exists on a node, Enterprise Replication verifies it matches the template definition. If the table does not exist on a node, Enterprise Replication can optionally create the table. Enterprise Replication can also optionally perform an initial data synchronization on all servers where you realize the template.

You can delete templates that you no longer need using the **cdr delete template** command.

See "Using Templates to Set Up Replication" on page 6-13 for more information. All replication commands mentioned in this section are described in detail in Appendix A, "Command-Line Utility Reference," on page A-1.

Network Encryption

Enterprise Replication supports the same network encryption that you can use with client/server communications to provide complete data encryption with the OpenSSL library. A message authentication code (MAC) is transmitted as part of the encrypted data transmission to ensure data integrity. A MAC is an encrypted message digest. The encryption algorithms use OpenSSL 0.9.6 as the code base.

However, encryption is implemented differently for Enterprise Replication than for client/server communications:

- Client/server network encryption uses the ENCCSM communications support module (CSM) that is specified in the SQLHOSTS file.
- Enterprise Replication encryption requires setting encryption configuration parameters.

Enterprise Replication cannot accept a connection that is configured with a CSM. To combine client/server network encryption with Enterprise Replication encryption, configure two network connections for each database server, one with CSM and one without. For more information, see "Network Encryption and SQLHOSTS" on page 4-5.

Important: HDR does not support encryption. If you combine Enterprise Replication with HDR, communication between Enterprise Replication servers and the HDR primary server can be encrypted, but the communication between the HDR primary server and the HDR secondary server cannot be encrypted.

Enterprise Replication encryption configuration parameters are documented in Appendix B, "Configuration Parameter and Environment Variable Reference," on page B-1.

How Enterprise Replication Replicates Data

Before you can replicate data, you must define a database server for replication and the *replicates* (the data to replicate and the database servers that participate in replication). To define a database server for replication, see "Defining Replication Servers" on page 6-2. To define replicates, see "Defining Replicates" on page 6-3. Appendix E, "Replication Examples," on page E-1, has simple examples of defining replication servers and replicates.

After you define the servers and replicates, Enterprise Replication replicates data in three phases:

1. Data Capture
2. Data Transport
3. Applying Replicated Data

9 The following diagram shows these three phases of replication and the Enterprise
9 Replication components that perform each task.

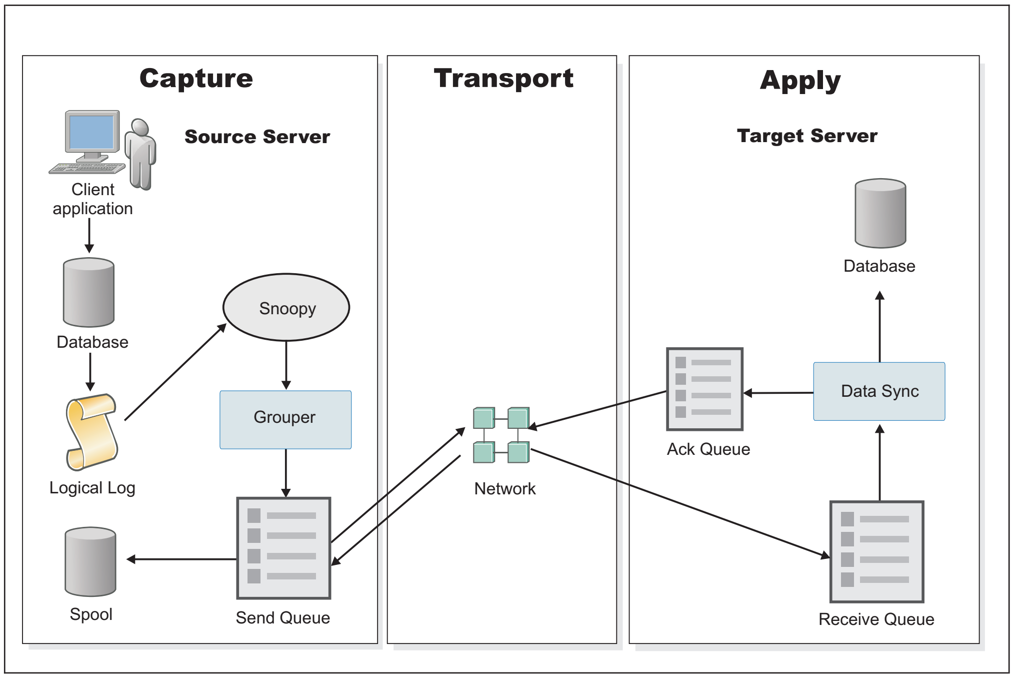


Figure 1-1. The Life Cycle of a Replicated Transaction

As shown in the diagram, the following process describes how Enterprise Replication replicates a transaction:

1. A client application performs a transaction in a database that is defined as a replicate.
2. The transaction is put into the logical log.
3. The log capture component, also known as the snoopy component, reads the logical log and passes the log records onto the grouper component.
4. The grouper component evaluates the log records for replication and groups them into a message that describe the operations that were in the original transaction.
5. The grouper component places the message in the send queue. Under certain situations, the send queue spools messages to disk for temporary storage.
6. The send queue transports the replication message across the Enterprise Replication network to the target server.
7. The replication message is placed in the receive queue at the target server.
8. The data sync component applies the transaction in the target database. If necessary, the data sync component performs conflict resolution.
9. An acknowledgement that the message was successfully applied is placed in the acknowledgement queue.
10. The acknowledgement message is sent back to the source server.

Data Capture

As the database server writes rows to the logical log, it marks rows that should be replicated. Later, Enterprise Replication reads the logical log to obtain the row images for tables that participate in replication.

Informix database servers manage the logical log in a circular fashion; the most recent logical-log entries write over the oldest entries. Enterprise Replication must read the logical log quickly enough to prevent new logical-log entries from overwriting the logs Enterprise Replication has not yet processed. If the database server comes close to overwriting a logical log that Enterprise Replication has not yet processed, user transactions are blocked until Enterprise Replication can advance. (This situation is called *DDRBLOCK mode* and occurs only if the system is severely misconfigured.)

The row images that participate in replication are passed to Enterprise Replication for further evaluation.

Evaluating Data for Replication

Enterprise Replication evaluates transactions based on a change to a final image of a row.

Row Images: Enterprise Replication evaluates the initial and final images of a row and any changes that occur between the two row images to determine which rows to replicate. Each row image contains the data in the row as well as the action performed on that row.

A row might change more than once in a particular transaction. For example, a transaction might insert and then update a row prior to committing. Enterprise Replication evaluates the net effect (final state) of a transaction based on the row buffers in the log. Enterprise Replication then determines what should replicate, based on the net effect, the initial state of the row, and whether the replicate definition (in particular, the WHERE clause) applies to the initial and final state.

Table 1-1 shows the logic that determines which rows are candidates for replication.

Table 1-1. Enterprise Replication Evaluation Logic

Initial Image	Replicate Evaluates	Final Image	Replicate Evaluates	Primary-Key Changed?	Send to Destination Database Server	Comments
INSERT	T *or* F	DELETE	T *or* F	Yes *or* no	Nothing	Net change of transaction results in no replication
INSERT	T *or* F	UPDATE	T	Yes *or* no	INSERT with final row image	Inserts final data of transaction
INSERT	T *or* F	UPDATE	F	Yes *or* no	Nothing	Final evaluation determines no replication
UPDATE	T	DELETE	T *or* F	Yes *or* no	DELETE with initial row image	Net result of transaction is delete
UPDATE	F	DELETE	T *or* F	Yes *or* no	Nothing	Net change of transaction results in no replication
UPDATE	T	UPDATE	T	Yes	DELETE with initial row image and INSERT with final row image	Ensures old primary key does not replicate
UPDATE	T	UPDATE	T	No	UPDATE with final row image	Simple update
UPDATE	T	UPDATE	F	Yes *or* no	DELETE with initial row image	Row no longer matches replicate definition
UPDATE	F	UPDATE	T	Yes *or* no	INSERT with final row image	Row now matches replicate definition

Table 1-1. Enterprise Replication Evaluation Logic (continued)

Initial Image	Replicate Evaluates	Final Image	Replicate Evaluates	Primary-Key Changed?	Send to Destination Database Server	Comments
UPDATE	F	UPDATE	F	Yes *or* no	Nothing	No match exists, and therefore, no replication

Where:
- Initial image is the before image of the transaction in the logical log.
- The replicate evaluates to T (true) or F (false).
- Final image is the image of the transaction that is replicated.

Table 1-1 on page 1-8 illustrates how Enterprise Replication evaluates the row-image type (INSERT, UPDATE, DELETE), the results of evaluating the replicate WHERE clause for both the initial and final image, and whether the primary key changes as a result of the transaction.

Tip: The evaluation logic in Table 1-1 on page 1-8 assumes that the source and the destination tables are initially synchronized (identical before replication begins). If the tables were not synchronized, anomalous behavior could result.

After Enterprise Replication identifies transactions that qualify for replication, Enterprise Replication transfers the transaction data to a queue.

Evaluating Rows for Updates: Enterprise Replication evaluates rows for primary-key updates, for WHERE-clause column updates, and for multiple updates to the same row. The following list describes an occurrence in a transaction and the Enterprise Replication action:

- Primary-key updates

  Enterprise Replication translates an update of a primary key into a delete of the original row and an insert of the row image with the new primary key. If triggers are enabled on the target system, insert triggers are executed.
- WHERE-clause column updates

  If a replicate includes a WHERE clause in its data selection, the WHERE clause imposes selection criteria for rows in the replicated table.
  - If an update changes a row so that it no longer passes the selection criteria on the source, it is deleted from the target table. Enterprise Replication translates the update into a delete and sends it to the target.
  - If an update changes a row so that it passes the selection criteria on the source, it is inserted into the target table. Enterprise Replication translates the update into an insert and sends it to the target.
- Multiple-row images in a transaction

  Enterprise Replication compresses multiple-row images and only sends the net change to the target. Because of this, triggers might not execute on the target database. For more information, see “Triggers” on page 2-8.

Enterprise Replication supports the replication of BYTE and TEXT data types (simple large objects) and BLOB and CLOB data types (smart large objects), and opaque user-defined data types, as well as all built-in Informix data types. However, Enterprise Replication implements the replication of these types of data somewhat differently from the replication of other data types. For more information, see “Replicating Simple and Smart Large Objects” on page 2-12, and “Replicating Opaque User-Defined Data Types” on page 2-15.

Send Data Queues and Receive Data Queues: Enterprise Replication uses send and receive queues to receive and deliver replication data to and from database servers that participate in a replicate:

- Send queue

  Enterprise Replication stores replication data in memory to be delivered to target database servers that participate in a replicate. If the send queue fills, Enterprise Replication spools the send-queue transaction records to a dbspace and the send-queue row data to an sbspace.
- Receive queue

  Enterprise Replication stores replication data in memory at the target database server until the target database server acknowledges receipt of the data. If the receive queue fills as a result of a large transaction, Enterprise Replication spools the receive queue transaction header and replicate records to a dbspace and the receive queue row data to an sbspace. For more information, see “Large Transactions” on page 2-9.

For more information, see “Setting Up Send and Receive Queue Spool Areas” on page 4-8 and “Preventing Memory Queues from Overflowing” on page 8-9.

The data contains the filtered log records for a single transaction. Enterprise Replication stores the replication data in a stable (recoverable) send queue on the source database server. Target sites acknowledge receipt of data when it is applied to or rejected from the target database.

If a target database server is unreachable, the replication data remains in a stable queue at the source database server. Temporary failures are common, and no immediate action is taken by the source database server; it continues to queue transactions. When the target database server becomes available again, queued transactions are transmitted and applied (see “Applying Replicated Data” on page 1-13).

If the target database server is unavailable for an extended period, the send queue on the source database server might consume excessive resources. In this situation, you might not want to save all transactions for the target database server. To prevent unlimited transaction accumulation, you can remove the unavailable target database server from the replicate (see “Managing Replication Servers” on page 7-2). Before the database server that is removed rejoins any replicate, however, you must synchronize (bring tables to consistency) with the other database servers (see “Resynchronizing Data Among Replication Servers” on page 7-12).

Data Evaluation Examples: Figure 1-2, Figure 1-3 on page 1-12, and Figure 1-4 on page 1-12 show three examples of how Enterprise Replication uses logic to evaluate transactions for potential replication.

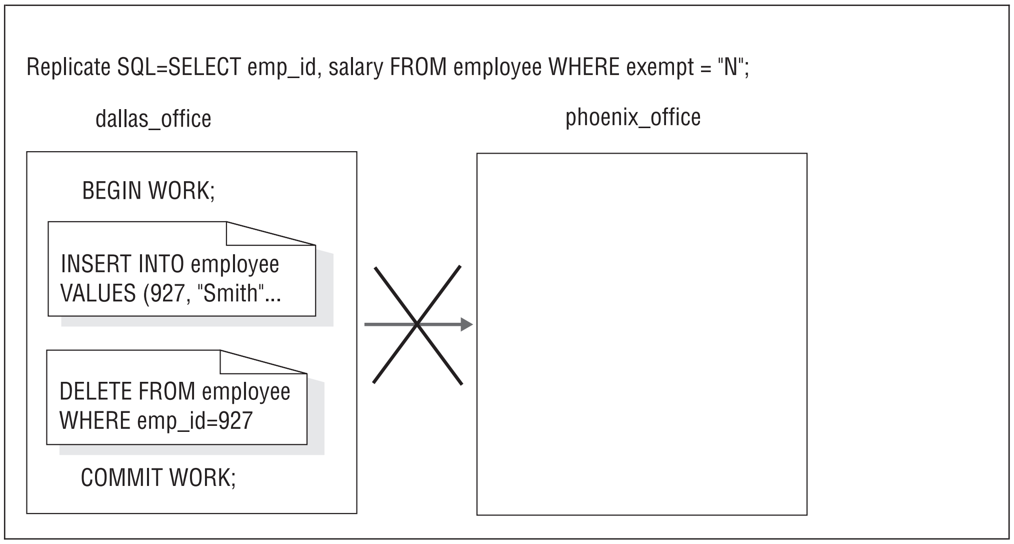

Replicate SQL=SELECT emp_id, salary FROM employee WHERE exempt = "N";
dallas_office
phoenix_office
BEGIN WORK;
INSERT INTO employee VALUES (927, "Smith"...
DELETE FROM employee WHERE emp_id=927
COMMIT WORK;

Figure 1-2. Insert Followed by a Delete

Figure 1-2 shows a transaction that takes place at the Dallas office. Enterprise Replication uses the logic in Table 1-2 to evaluate whether any information is sent to the destination database server at the Phoenix office.

Table 1-2. Insert Followed by a Delete Evaluation Logic

Initial Image	**Replicate Evaluates**	**Final Image**	**Replicate Evaluates**	**Primary-Key Changed?**	**Send to Destination Database Server**
INSERT	T *or* F	DELETE	T *or* F	Yes *or* no	Nothing

Enterprise Replication determines that the insert followed by a delete results in no replication operation; therefore, no replication data is sent.

In Figure 1-3, Enterprise Replication uses the logic in Table 1-3 to evaluate whether any information is sent to the destination database server.

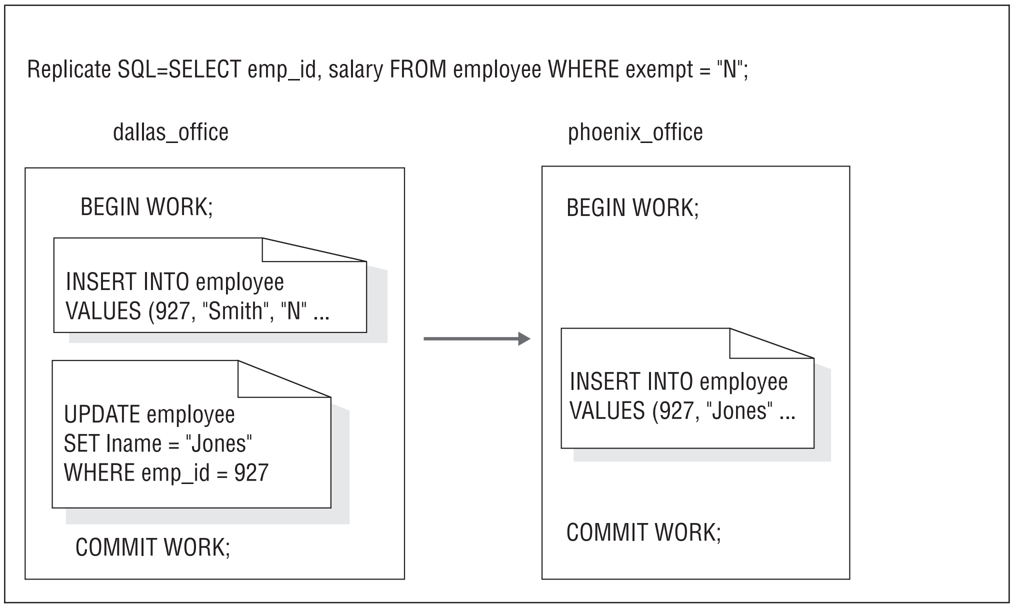


Figure 1-3. Insert Followed by an Update

Table 1-3. Insert Followed by An Update Evaluation Logic

Initial Image	Replicate Evaluates	Final Image	Replicate Evaluates	Primary-Key Changed?	Send to Destination Database Server
INSERT	T *or* F	UPDATE	T	Yes or no	INSERT with final row image

The replicate WHERE clause imposes the restriction that only rows are replicated where the exempt column contains a value of ″N.″ Enterprise Replication evaluates the transaction (an insert followed by an update) and converts it to an insert to propagate the updated (final) image.

In Figure 1-4, Enterprise Replication uses the logic in Table 1-4 to evaluate whether any information is sent to the destination database server.

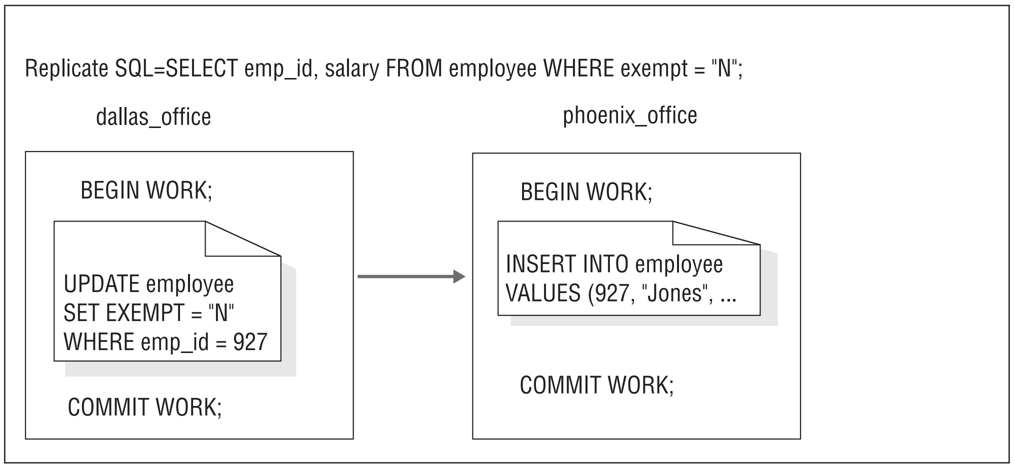


Figure 1-4. Update; Not Selected to Selected

Table 1-4. Update; Not Selected to Selected Evaluation Logic

Initial Image	Replicate Evaluates	Final Image	Replicate Evaluates	Primary-Key Changed?	Send to Destination Database Server
UPDATE	F	UPDATE	T	Yes *or* no	INSERT with final row image

The example shows a replicate WHERE clause column update. A row that does not meet the WHERE clause selection criteria is updated to meet the criteria. Enterprise Replication replicates the updated row image and converts the update to an insert.

Data Transport

Enterprise Replication ensures that all data reaches the appropriate server, regardless of a network or system failure. In the event of a failure, Enterprise Replication stores data until the network or system is operational. Enterprise Replication replicates data efficiently with a minimum of data copying and sending.

Applying Replicated Data

9 Enterprise Replication uses a data-synchronization process to apply the replicated
9 data to target database servers. The target database servers acknowledge receipt of
9 data when the data is applied to the target database. The data-synchronization
9 process ensures that transactions are applied at the target database servers in an
9 order equivalent to the order that they were committed on the source database
9 server. If consistency can be preserved, Enterprise Replication might commit
9 transactions out of order on the target database. Data modifications resulting from
9 synchronization, including modifications resulting from trigger invocation, are not
9 replicated.

When Enterprise Replication applies replication data, it checks to make sure that no *collisions* exist. A collision occurs when two database servers update the same data simultaneously. Enterprise Replication reviews the data one row at a time to detect a collision.

If Enterprise Replication finds a collision, it must resolve the conflict before applying the replication data to the target database server.

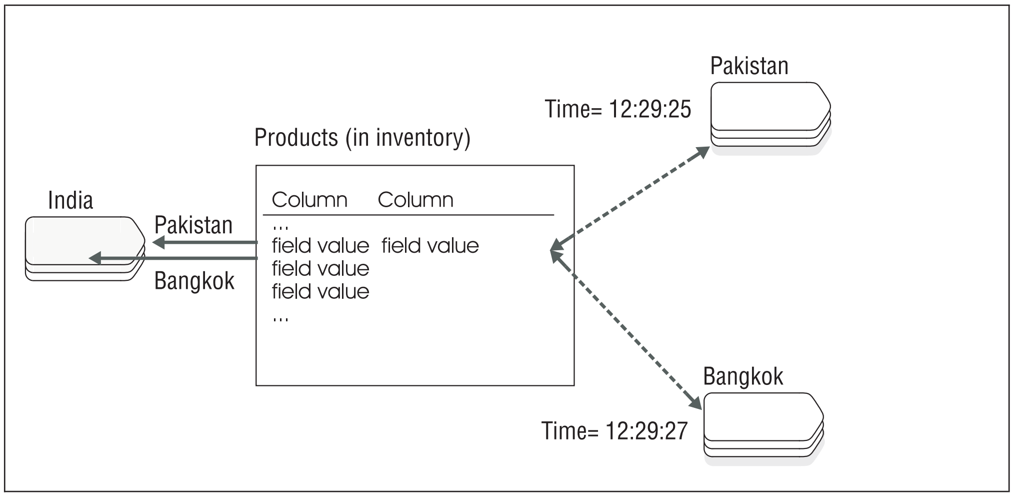


Figure 1-5. Collision Example

Figure 1-5 shows a situation that yields a conflict. Pakistan updates the row two seconds before Bangkok updates the same row. The Bangkok update arrives at the India site first, and the Pakistan update follows. The Pakistan time is earlier than the Bangkok time. Because both updates involve the same data and a time discrepancy exists, Enterprise Replication detects a collision.

For more information, see “Conflict Resolution” on page 3-6.

Enterprise Replication scans to see if the same primary key already exists in the target table or in the associated *delete table*, or if a *replication order error* is detected. A delete table stores the row images of deleted rows. A replication order error is the result of replication data that arrives from different database servers with one of the following illogical results:

- A replicated DELETE that finds no row to DELETE on the target
- An UPDATE that finds no row to UPDATE on the target
- An INSERT that finds a row that already exists on the target

Chapter 2. Overview of Enterprise Replication Administration

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In This Chapter

This chapter introduces you to Enterprise Replication administration and describes the Enterprise Replication server administrator, Enterprise Replication terminology, and considerations for using Enterprise Replication.

Overview of Enterprise Replication Administration

To set up Enterprise Replication:

1. Select the Enterprise Replication system and network topology to use for your replication environment.

   For information, see Chapter 3, “Selecting the Enterprise Replication System and Network Topology,” on page 3-1

2. Prepare the replication environment.

   For information, see Chapter 4, "Preparing the Replication Environment," on page 4-1.
3. Initialize the database server.

   For information, see Chapter 6, "Defining Replication Servers, Replicates, Participants, and Replicate Sets," on page 6-1.
4. Define database servers for replication.

   For information, see Chapter 6.
5. Define replicates and participants.

   For information, see Chapter 7, "Managing Replication Servers and Replicates," on page 7-1.
6. Create replicate sets (optional).

   For information, see "Defining Replicate Sets" on page 6-10.
7. Start the replicate.

   For information, see Chapter 7.

Once you configure Enterprise Replication, use this information to manage your replication environment:
- "Managing Replication Servers" on page 7-2
- "Managing Replicates" on page 7-4
- "Managing Replicate Sets" on page 7-8
- Chapter 8, "Monitoring and Troubleshooting Enterprise Replication," on page 8-1

Enterprise Replication Server Administrator

The Enterprise Replication server administrator must have Informix Database Server Administrator (DBSA) privileges to configure and manage Enterprise Replication.

Operating System	Privileges
UNIX	user **informix**
Windows	Member of the **Informix-Admin** group

Enterprise Replication Terminology

The following terms define the data in an Enterprise Replication system and how it is treated:
- Enterprise Replication server
- Replicate
- Master Replicate
- Shadow Replicate
- Participant
- Replicate Set
- Template
- Global Catalog

Enterprise Replication Server

An Enterprise Replication server, or *replication server*, is an Informix database server that participates in data replication. The replication server maintains information about the replication environment, which columns should be replicated, and the conditions under which the data should be replicated. This information is stored in a database, **syscdr**, that the database server creates when it is initialized. Multiple database servers can be on the same physical computer, and each database server can participate in Enterprise Replication.

Important: For each server participating in replication, you must set up a database server group in the SQLHOSTS file (UNIX) or registry (Windows). For more information, see "Setting up Database Server Groups" on page 4-3 and Appendix F, "SQLHOSTS Registry Key (Windows)," on page F-1.

Tip: This manual uses the convention that the name of a database server group is **g_** followed by the name of a database server that is in the group; for example, **g_italy**.

For more information, see "Defining Replication Servers" on page 6-2 and "cdr define server" on page A-30.

Replicate

A *replicate* defines the replication *participants* and various attributes of how to replicate the data, such as frequency and how to handle any conflicts during replication.

For more information, see "Defining Replicates" on page 6-3 and "cdr define replicate" on page A-21.

Master Replicate

A *master replicate* is a replicate that guarantees data integrity by verifying that replicated tables on different servers have consistent column attributes. Master replicates also allow you to perform alter operations on replicated tables.

For more information, "Defining Master Replicates" on page 6-5 and "cdr define replicate" on page A-21.

Shadow Replicate

A *shadow replicate* is a copy of an existing (primary) replicate. Shadow replicates allow Enterprise Replication to manage alter and repair operations on replicated tables.

For more information, see "Defining Shadow Replicates" on page 6-6 and "cdr define replicate" on page A-21.

Participant

A *participant* specifies the data (database, table, and columns) to replicate and the database servers to which the data replicates.

Important: You cannot start and stop replicates that have no participants.

For more information, see "Defining Participants" on page 6-4 and "Participant" on page A-124.

Replicate Set

A *replicate set* combines several replicates to form a set that can be administered together as a unit.

If your replication system contains many replicates that you define as part of a replicate set, you can use a single command to start, stop, suspend, or resume all the replicates in the set.

For more information, see "Managing Replicate Sets" on page 7-8 and "cdr change replicateset" on page A-6.

Template

A *template* provides a mechanism to set up and deploy replication for a group of tables on one or more servers. This is especially useful if you have a large number of tables to replicate between many servers. Internally, a template defines a group of master replicates and a replicate set for a specified group of tables using attributes such as database, tables, columns and primary keys from the master node.

You create a template using the **cdr define template** command and then instantiate, or realize, it on servers with the **cdr realize template** command. See "Using Templates to Set Up Replication" on page 6-13 for more information.

Global Catalog

Each database server that participates in Enterprise Replication maintains tables in the **syscdr** database to keep track of Enterprise Replication configuration information and state. For all *root* and *nonroot* replication servers, this catalog is a *global catalog* that maintains a global inventory of Enterprise Replication configuration information. The global catalog is created when you define the server for replication. For more information, see Table 3-5 on page 3-13.

The global catalog includes the following:

- Enterprise Replication server definitions and state
- Routing and connectivity information
- Replicate definitions and state
- Participant definitions and state
- Replicate set definitions and state
- Conflict detection and resolution rules and any associated SPL routines

The tables in one global catalog instance are automatically replicated to the global catalogs of all other replication servers (except leaf servers). Thus you can manage the entire replication environment from one non-leaf replication server. For information about managing replication servers (and their global catalogs), refer to "Managing Replication Servers" on page 7-2.

Leaf replication servers (Table 3-5 on page 3-13) have limited catalogs. Because the parent database server always manages operations that involve a leaf database server, the catalog of the leaf database server contains only enough data to allow it to interact with its parent server. Limiting the catalog of leaf database servers makes the replication system more efficient because the global catalogs do not need to be replicated to the leaf servers.

For information on defining root, nonroot, and leaf servers, see "Customizing the Replication Server Definition" on page 6-3.

Enterprise Replication Considerations

This section discusses items to consider when planning to use Enterprise Replication:

- Operational Considerations
- Backup and Restore Considerations
- Database and Table Design Considerations
- Transaction Processing Considerations
- Replication Environment Considerations
- Enterprise Replication Data Types

Operational Considerations

Enterprise Replication imposes the following operational limitations:

- Enterprise Replication supports replication on IBM Informix Dynamic Server only.
- Replication is restricted to base tables. That is, you cannot define a replicate on a view or synonym. A *view* is a synthetic table, a synthesis of data that exists in real tables and other views. A *synonym* is an alternative name for a table or a view. For more information on views and synonyms, see the *IBM Informix Database Design and Implementation Guide*.
- Replication is not inherited by any child tables in a typed hierarchy.

Enterprise Replication asynchronously propagates many control operations through the Enterprise Replication network. When you perform administrative functions using Enterprise Replication, the status that returns from those operations is indicative only of the success or failure of the operation at the database server to which you are directly connected. The operation might still be propagating through the other Enterprise Replication database servers in the network at that time.

Due to this asynchronous propagation, avoid performing control operations in quick succession that might directly conflict with one another without verifying that the first operation has successfully propagated through the entire enterprise network. Specifically, avoid deleting Enterprise Replication objects such as replicates, replicate sets, and Enterprise Replication servers, and immediately re-creating those objects with the same name. Doing so can cause failures in the Enterprise Replication system at the time of the operation or later. These failures might manifest themselves in ways that do not directly indicate the source of the problem.

If you must delete and re-create a definition, use a different name for the new object (for example, delete replicate **a.001** and recreate it as **a.002**) or wait until the delete action has successfully propagated through the entire Enterprise Replication system before you re-create the object. The former strategy is especially appropriate if you have database servers that are not connected to the Enterprise Replication network at all times. It might take a significant amount of time before the operation is propagated to those disconnected servers.

Backup and Restore Considerations

When backing up and restoring database servers that participate in replication, *do not* stop Enterprise Replication before performing a backup on an Enterprise Replication system.

Warm restores are not permitted. You must perform a cold restore for Enterprise Replication servers before resuming replication.

Database and Table Design Considerations

Consider the following when designing databases and tables for replication:
- Unbuffered Logging
- Table Types
- Shadow Columns
- Serial Data Types and Primary Keys
- Cascading Deletes
- Triggers
- Sequence Objects

Unbuffered Logging

Databases on all server instances involved in replication must be created with logging.

It is recommended that you replicate tables only from databases created with unbuffered logging. Enterprise Replication evaluates the logical log for transactions that modify tables defined for replication. If a table defined for replication resides in a database that uses buffered logging, the transactions are not immediately written to the logical log, but are instead buffered and then written to the logical log in a block of logical records. When this occurs, Enterprise Replication evaluates the buffer of logical-log records all at once, which consumes excess CPU time and memory. When you define a table for replication in a database created with unbuffered logging, Enterprise Replication can evaluate the transactions as they are produced.

To create a database with unbuffered logging, use:
```
CREATE DATABASE db_name WITH LOG
```

To minimize impact on the system, Enterprise Replication uses buffered logging whenever possible, even if the database is defined as unbuffered. For more information, see the section on CREATE DATABASE in the *IBM Informix Database Design and Implementation Guide*.

Table Types

The following table types are not supported by Enterprise Replication:
- RAW tables

  Because RAW tables are not logged, they cannot be replicated using Enterprise Replication.
- Temporary tables

Because the database server deletes temporary tables when an application terminates or closes the database, you should not include these tables in your replication environment.

For more information on table types, see *IBM Informix Database Design and Implementation Guide*.

Out-of-Row Data

Enterprise Replication collects out-of-row data for transmission after the user transaction has committed. Due to activity on the replicated row, the data might not exist at the time Enterprise Replication collects it for replication. In such cases, Enterprise Replication normally applies a NULL on the target system. Therefore, you should avoid placing a NOT NULL constraint on any replicated column that includes out-of-row data.

Shadow Columns

In an update-anywhere replication environment, you must provide for conflict resolution using a conflict-resolution rule (see “Conflict Resolution” on page 3-6). When you create a table that uses the time stamp or time stamp plus SPL conflict-resolution rule, you must define the shadow columns, **cdrserver** and **cdrtime** on both the source and target replication servers.

Tip: If you plan to use only the ignore conflict-resolution rule, you do not need to define the **cdrserver** and **cdrtime** shadow columns.

For more information, see “Preparing Tables for Conflict Resolution” on page 4-16.

Primary Key Constraint

All tables involved in replication must have a PRIMARY KEY constraint defined on at least one column, which forces the column to be unique. (For more information about primary keys, see the *IBM Informix Database Design and Implementation Guide* and the *IBM Informix Guide to SQL: Syntax*.)

Important: Because primary key updates are sent as *DELETE/INSERT* statement pairs, avoid changing the primary key and updating data in the same transaction.

Serial Data Types and Primary Keys

If you plan to use serial data types (SERIAL or SERIAL8,) as the primary key for a table, the same serial value might be generated on two servers at the same time.

To avoid this problem, use the CDR_SERIAL configuration parameter to generate non-overlapping (unique) values for serial columns across all database servers in your replication environment. Set CDR_SERIAL in the ONCONFIG file for each primary (source) database server. For more information and examples, see “CDR_SERIAL Configuration Parameter” on page B-6.

If you do not set CDR_SERIAL, you must specify that the serial column is part of a composite primary key, to avoid generating non-unique serial primary keys. The non-serial column part of the primary key identifies the server on which the row was initially created.

Cascading Deletes

If a table includes a *cascading delete*, when a parent row is deleted, the children are also deleted. If both the parent and child tables participate in replication, the deletes for both the parent and child are replicated to the target servers.

If the same table definition exists on the target database, Enterprise Replication attempts to delete the child rows twice. Enterprise Replication usually processes deletes on the parent tables first and then the children tables. When Enterprise Replication processes deletes on the children, an error might result, because the rows were already deleted when the parent was deleted. The table in Table 2-1 indicates how Enterprise Replication resolves cascading deletes with conflict-resolution scopes and rules.

For more information on cascading deletes, see the ON DELETE CASCADE section in the *IBM Informix Guide to SQL: Syntax*.

Table 2-1. Resolving Cascade Deletes

Conflict-Resolution Rule	**Conflict-Resolution Scope**	**Actions on Delete Errors**
Time stamp	Row-by-row or transaction	Continue processing rest of the transaction
Ignore	Transaction	Abort entire transaction
Ignore	Row-by-row	Continue processing rest of the transaction

Triggers

A *trigger* is a database object that automatically sets off a specified set of SQL statements when a specified event occurs.

If the **--firetrigger** option is enabled on a replicate, any triggers defined on a table that participates in replication are invoked when transactions are processed on the target server. However, because Enterprise Replication only replicates the final result of a transaction, triggers execute only once on the target regardless of how many triggers execute on the source. In cases where the final evaluation of the transaction results in no replication (for example, an INSERT where the final row image is a DELETE, as shown in Table 1-2 on page 1-11), no triggers execute on the target database.

If the same triggers are defined on both the source and target tables, any insert, update, or delete operation that the triggers generate are also sent to the target database server. For example, the target table might receive replicate data caused by a trigger that also executes locally. Depending on the conflict-resolution rule and scope, these operations can result in errors. To avoid this problem, define the replicate to not fire triggers on the target table.

For more information on triggers, see "Enabling Triggers" on page 6-10 and the CREATE TRIGGER section in *IBM Informix Guide to SQL: Syntax*.

Using Constraints

When using constraints, ensure that the constraints you add at the target server are not more restrictive than those at the source server. Discrepancies between constraints at the source and target servers can cause some rows to fail to be replicated.

4 For tables that have referential integrity constraints set up between them, if you
4 need to resynchronize the data in the tables, you can perform synchronization on
4 the replicate set. For replicate sets, Enterprise Replication synchronizes tables in an
4 order that preserves referential integrity constraints (for example, child tables are
4 synchronized after parent tables).

4 When you perform synchronization, rows that fail to be repaired due to
4 discrepancies between constraints are recorded in the ATS and RIS files. For more
4 information about ATS and RIS files, see Chapter 8, "Monitoring and
4 Troubleshooting Enterprise Replication," on page 8-1.

Sequence Objects

In bi-directional Enterprise Replication, if you replicate tables using sequence objects for update, insert, or delete operations, the same sequence values might be generated on different servers at the same time, leading to conflicts.

To avoid this problem, define sequence objects on each server so that the ranges of generated sequence values are disjunct. For more information about the CREATE SEQUENCE and ALTER SEQUENCE statements of SQL, see the *IBM Informix Guide to SQL: Syntax*.

Transaction Processing Considerations

Many variables affect what impact replicating data has on your transaction processing. This section discusses some of these variables:

- Replication Volume
- Distributed Transactions
- Large Transactions
- Supported SQL Statements

Replication Volume

To determine replication volume, you must estimate how many data rows change per day. For example, an application issues a simple INSERT statement that inserts 100 rows. If this table is replicated, Enterprise Replication must propagate and analyze these 100 rows before applying them to the targets.

Distributed Transactions

A *distributed transaction* is a transaction that commits data in a single transaction over two or more database servers.

Outside of the replication environment, Dynamic Server uses a two-phase commit protocol to ensure that the transaction is either committed completely across all servers involved or is not committed on any server. For more information about the two-phase commit protocol, see the *IBM Informix Dynamic Server Administrator's Guide*.

In a replication environment, when a distributed transaction is committed across the source servers, each part of the transaction that applies to the local server is written to the local logical logs. When Enterprise Replication retrieves the transaction from the logical logs and forms its transaction data, it is unable to identify the separate transaction data as the original single transaction.

This situation could result in Enterprise Replication applying one transaction successfully while aborting another. Another result might be a time lapse between the application of one transaction and another (depending on how much transaction data is in each server's send queue and the state of the server).

Large Transactions

While Enterprise Replication is able to handle large transactions, it is optimized for small transactions. For best performance, avoid replicating large transactions.

Large transactions are handled with a grouper paging file located in temporary smart large objects. Enterprise Replication can process transactions up to 4 TB in size. For more information, see "Setting Up the Grouper Paging File" on page 4-12. You can view Enterprise Replication grouper paging statistics with the **onstat -g grp pager** command (see "onstat -g grp" on page C-6).

Instead of using Enterprise Replication to perform a batch job, use BEGIN WORK WITHOUT REPLICATION to run the batch job locally on each database server. For more information, see "Blocking Replication" on page 4-14.

Supported SQL Statements

After you define Enterprise Replication on a table by including that table as a participant in a replicate you cannot exclusively lock a database that is involved in replication (or perform operations that require an exclusive lock). However, you can exclusively lock a table in a database.

To use the forbidden and limited SQL statements described in this section against a table defined for replication, you must first stop (not suspend) the replicate that contains the table, before running the SQL statement. After modifying the table at all required nodes, restart the replicate. For more information, see "Managing Replicates" on page 7-4.

Forbidden SQL Statements: You cannot use the following SQL statements against a table that is included in a replicate:

- DROP TABLE
- RENAME TABLE
- TRUNCATE (or TRUNCATE TABLE)

Limited SQL Statements: The following additional limitations also apply to tables defined for replication:

- Do not add or drop rowids.
- Do not add or drop CRCOLS (shadow columns):
  - ALTER TABLE ... ADD CRCOLS
  - ALTER TABLE ... DROP CRCOLS

    For more information about CRCOLS, see "Preparing Tables for Conflict Resolution" on page 4-16.
- Do not remove or disable the primary key constraint.
- Do not modify the primary key columns.

  For example, do not alter the column to add default values or other integrity constraints.
- Do not change the primary key from one column to another.

  For example, if a primary key is defined on **col1**, do not change the primary key to **col2**.

Permitted SQL Statements: Enterprise Replication permits the following SQL statements with no limitations:

- SET *object mode* (no disabling of primary key constraint)
- START VIOLATIONS TABLE
- STOP VIOLATIONS TABLE
- CREATE TRIGGER
- DROP TRIGGER
- CREATE VIEW

- DROP VIEW
- CREATE SYNONYM
- DROP SYNONYM
- ADD INDEX
- DROP INDEX
- ALTER INDEX
- ALTER TABLE (except for the primary key)
- ALTER FRAGMENT
- Creating a clustered index
- Reclustering an existing index

Tip: You can rename both dbspaces and sbspaces while Enterprise Replication is active.

Replication Environment Considerations

Each replication system that you create affects your environment. Consider the following when setting up your replication environment:

- Time Synchronization
- Using GLS with Enterprise Replication

Time Synchronization

Whenever you use replication that requires time stamp conflict resolution (see "Conflict Resolution" on page 3-6), the operating system times of the database servers that participate in the replicate must be synchronized. All time stamps and internal computations are performed in Greenwich Mean Time (GMT) and have an accuracy of plus or minus one second.

Important: Enterprise Replication does not manage clock synchronization between database servers that participate in a replicate.

To synchronize the time on one database server with the time on another database server, use one of the following commands.

Operating System	Command
UNIX	rdate hostname
Windows	`net time \\servername /set`
	`net time /domain:servername /set`

Important: These commands do not guarantee the times will remain synchronized. You should use a product that supplies a network time protocol to ensure that times remain synchronized. For information on tools for synchronizing the times, refer to your operating system documentation.

Using GLS with Enterprise Replication

An Enterprise Replication system can include databases in different locales, with the following restrictions:

- When you define a database server for Enterprise Replication, that server must be running in the U. S. English locale.

  In other words, the **syscdr** database on every Enterprise Replication server must be in the English locale.

- You can replicate only between databases that are in the same locale.
- Replicate names can be in the locale of the database.

Code-set conversion with the GLS library requires only those code-set conversion files found in the **$INFORMIXDIR/gls/cv9** directory.

- For U.S. English, locales are handled automatically by the Client SDK/Informix Connect installation and setup.
- For non-U.S. English locales, you might need to explicitly provide the locale and conversion files.

For information about how to specify a nondefault locale and other considerations related to GLS locales, see the *IBM Informix GLS User's Guide*.

Enterprise Replication Data Types

Enterprise Replication supports built-in data types and user-defined data types, including row types and collection types. This section describes how Enterprise Replication handles special data types:

- Replicating on Heterogeneous Hardware
- Replicating Simple and Smart Large Objects
- Replicating Opaque User-Defined Data Types

For general information on data types, refer to the *IBM Informix Guide to SQL: Reference*.

Important: Enterprise Replication does not support replication of simple large objects stored on optical devices.

Important: For non-master replicates, Enterprise Replication does not verify the data types of columns in tables that participate in replication. The replicated column in a table on the source database server must have the same data type as the corresponding column on the target server. The exception to this rule is cross-replication between simple large objects and smart large objects.

If you use SERIAL or SERIAL8 data types, you must be careful when defining serial columns. For more information, see "Serial Data Types and Primary Keys" on page 2-7.

Replicating on Heterogeneous Hardware

Enterprise Replication supports all primitive data types across heterogeneous hardware. If you define a replicate that includes non-primitive data types (for example, BYTE and TEXT data), the application must resolve data-representation issues that are architecture dependent.

If you use floating-point data types with heterogeneous hardware, you might need to use IEEE floating point or canonical format for the data transfers. For more information, see "Using the IEEE Floating Point or Canonical Format" on page 6-9.

Replicating Simple and Smart Large Objects

Enterprise Replication replicates:

- Simple large object data types (TEXT and BYTE)

  You can store simple large objects either in the tblspace with the rest of the table columns (in a dbspace) or in a blobspace.

- Smart large object data types (BLOB and CLOB)

  You must store smart large objects in sbspaces.

For more information about database storage, see the *IBM Informix Dynamic Server Administrator's Guide*.

Replicating Simple Large Objects from Tblspaces: Simple large object data that is stored in tblspaces (rather than in blobspaces) is placed in the logical log. Enterprise Replication reads the logical log to capture and evaluate the data for potential replication.

Replicating Large Objects from Blobspaces or Sbspaces: Enterprise Replication does not retrieve simple large object data that is stored in blobspaces and smart large object data that is stored in sbspaces from the logical log. Instead, Enterprise Replication retrieves the large object data directly from the blobspace or sbspace before sending the data to the target database server.

It is possible that a transaction subsequent to the transaction being replicated can modify or delete a simple or smart large object that Enterprise Replication is trying to retrieve. If Enterprise Replication encounters a row whose large object (simple or smart) has been modified or deleted by a subsequent transaction, Enterprise Replication does not send the data in the large object.

In most cases, the subsequent transaction that modified or deleted the large object will also be replicated, so the data again becomes consistent once that transaction is replicated. The data in the large object is inconsistent for only a short time.

Keep in mind that if you specify sending only the columns that changed, the data might not get updated during the next update of the row. For more information, see "Replicating Only Changed Columns" on page 6-8.

Tip: Enterprise Replication allows cross-replication between simple large objects and smart large objects. For example, you can replicate a simple large object on the source database server to a smart large object on the target server or vice versa.

Conflict Resolution for Simple and Smart Large Objects: By default, Enterprise Replication performs all conflict detection and resolution at the row level. However, in some cases, simple large object data that is stored in a tblspace (rather than in a blobspace) is accepted by the target server even if the row is rejected. This does not apply to simple large object data that is stored in blobspaces or smart large object data that is stored in sbspaces.

Time-Stamp Conflict Resolution for Simple Large Objects: When a replicated BYTE or TEXT column is modified on the source database server, Enterprise Replication records the value of **cdrserver** and **cdrtime** for that column. (For more information on **cdrserver** and **cdrtime**, see "Preparing Tables for Conflict Resolution" on page 4-16.) If the column on the target database server is also stored in a tablespace (rather than in a blobspace), Enterprise Replication evaluates the **cdrserver** and **cdrtime** values in the source and target columns and uses the following logic to determine if the data is to be applied:

- If the column of the replicated data has a time stamp that is greater than the time stamp of the column on the local row, the data for the column is accepted for replication.

- If the server ID and time stamp of the replicated column are equal to the server ID and time stamp on the column on the local row, the data for the column is accepted for replication.
- If there is no SPL conflict-resolution rule and the time stamps are equal, then Enterprise Replication applies the data to the row with the lowest CDR server ID.

SPL Conflict Resolution for Simple Large Objects: If the replicate is defined with an SPL conflict-resolution rule, the SPL routine must return the desired action for each BYTE or TEXT column. When the routine is invoked, information about each BYTE or TEXT column is passed to the routine as five separate fields. The following table describes the fields.

Argument	**Description**
Column size (INTEGER)	The size of the column (if data exists for this column). NULL if the column is NULL.
BLOB flag [CHAR(1)]	For the local row, the field is always NULL. For the replicated row: • `D` indicates BYTE or TEXT data is sent from the source database server. • `U` indicates BYTE or TEXT data is unchanged on the source database server.
Column type [CHAR(1)]	• `P` indicates tablespace data. • `B` indicates blobspace data.
ID of last update server [CHAR(18)]	The ID of the database server that last updated this column for tablespace data. For blobspace data: NULL
Last update time (DATETIME YEAR TO SECOND)	For tablespace data: The date and time when the data was last updated. For blobspace data: NULL

For information on creating stored procedures, see the *IBM Informix Guide to SQL: Tutorial*.

If the routine returns an action code of `A`, `D`, `I`, or `U`, the routine parses the return values of the replicated columns. Each BYTE or TEXT column can return a two-character field. For information about the action codes, refer to “SPL Conflict-Resolution Rule” on page 3-8.

The first character defines the desired option for the BYTE or TEXT column, as the following table shows.

Value	**Function**
`C`	Performs a time-stamp check for this column as used by the time-stamp rule
`N`	Sets the replicate column to NULL
`R`	Accepts the replicated data as it is received
`L`	Retains the local data

The second character defines the desired option for blobspace data if the data is found to be undeliverable, as the following table shows.

Value	Function
`N`	Sets the replicated column to NULL
`L`	Retains the local data (default)
`O`	Aborts the row
`X`	Aborts the transaction

SPL Conflict Resolution for Smart Large Objects: Enterprise Replication handles conflict resolution for smart large objects using the SPL conflict-resolution rule in the same way as for simple large objects. See "Conflict Resolution for Simple and Smart Large Objects" on page 2-13.

Distributing BYTE and TEXT Data: If Enterprise Replication processes a row and discovers undeliverable BYTE or TEXT columns, the following actions can occur:

- Any undeliverable columns are set to NULL if the replication operation is an INSERT and the row does not already exist at the target.
- The old value of the local row is retained if the replication operation is an UPDATE or if the row already exists on the target.

Considerations for Replicating Smart Large Objects: The following conditions apply to replicating smart large objects:

- Enterprise Replication does not support replication of smart large object updates performed outside of a row update.
- After you update a smart large object that is referenced explicitly in the table schema, you must update the referencing row before Enterprise Replication can replicate the updated smart large object. For example:

  ```
  UPDATE table_name SET smart_large_object_column = x
  ```

  For more information, see the *IBM Informix Guide to SQL: Syntax*.
- Enterprise Replication replicates updates to in-place smart large objects by sending a new copy of the entire smart large object. Enterprise Replication does not send only the logged changes to update smart large objects.
- Enterprise Replication does not support sharing out-of-row data (multiple references to a smart large object) during replication. If you try to replicate multiple references to the same smart large object on the source database server, Enterprise Replication does not re-create those references on the target database server. Instead, Enterprise Replication creates multiple smart large objects on the target database server.

Replicating Opaque User-Defined Data Types

Enterprise Replication supports built-in data types and extended data types, including opaque data types and user-defined types (UDTs).

Installing and Registering UDTs: You must install and register UDTs and their associated support routines on all database servers participating in Enterprise Replication prior to starting replication.

If you combine Enterprise Replication with High-Availability Data Replication (HDR), you must install UDTs on both HDR database servers, but only register them on the primary HDR database server (see *IBM Informix Dynamic Server Administrator's Guide*).

UDT Support Functions: If you plan to replicate opaque user-defined types (UDTs), the UDT designer must provide two support functions, **streamwrite()** and **streamread()**. This also applies to UDTs embedded in complex types.

The purpose of these functions is similar to the existing **send()** and **receive()** functions provided for client/server transmissions.

For information on writing these support functions, see the section on Enterprise Replication stream support functions in the *IBM Informix DataBlade API Programmer's Guide*.

When preparing a row that includes any UDT columns to queue to the target system, Enterprise Replication calls the **streamwrite()** function on each UDT column. The function converts the UDT column data from the in-server representation to a representation that can be shipped over the network. This allows Enterprise Replication to replicate the column without understanding the internal representation of the UDT.

On the target server, Enterprise Replication calls the **streamread()** function for each UDT column that it transmitted using the **streamwrite()** function.

Considerations for Replicating Opaque Data Types: The following conditions apply to replicating opaque data types:

- The WHERE clause of the SELECT statement of the participant modifier can reference an opaque UDT as long as the UDT is always stored in row.
- Any UDRs in a WHERE clause can use only parameters whose values can be extracted fully from the logged row images, plus any optional constants.
- All of the columns in the SELECT statement of each participant definition must be actual columns in that table. Enterprise Replication does not support virtual columns (results of UDRs on table columns).

  See "Participant Modifier" on page A-125 for information on the WHERE clause in participant definitions.
- You cannot use SPL routines for conflict resolution if the replicate includes any UDTs in the SELECT statement or if the replicate is defined to replicate only changed columns.

  See "Conflict Resolution" on page 3-6 and "Replicating Only Changed Columns" on page 6-8.
- Enterprise Replication allows you to define replicates on tables that contain one or more UDT columns as the primary key.

  For more information, see the section on primary key constraints in the *IBM Informix Guide to SQL: Syntax*.

Replicating Table Hierarchies: To replicate tables that form a hierarchy, you must define a separate replicate for each table. If you define a replicate on a super table, Enterprise Replication does not automatically create implicit replicate definitions on the subordinate tables.

Tip: Enterprise Replication does not require that the table hierarchies be identical on the source and target servers.

You must use conflict resolution uniformly for all tables in the hierarchy. In other words, either no conflict resolution for all tables or conflict resolution for all tables.

Verifying the Data Type of Replicated Columns

By using master replicates you can verify that all participants in a replicate have columns with matching data types. Master replicates also allow verification that each participant contains all replicated columns, and optionally that column names are the same on each participant. See “Defining Master Replicates” on page 6-5 for more information.

Part 2. Setting Up and Managing Enterprise Replication

Chapter 3. Selecting the Enterprise Replication System and Network Topology

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In This Chapter

This chapter describes types of replication systems provided by Enterprise Replication and discusses the trade-offs associated with performance and data availability.

Selecting the Enterprise Replication System

Enterprise Replication supports the following types of replication systems:
- Primary-Target Replication System
- Update-Anywhere Replication System

Primary-Target Replication System

In the primary-target replication system, the flow of information is in one direction.

In primary-target replication, all database changes originate at the primary database and are replicated to the target databases. Changes at the target databases are not replicated to the primary.

A primary-target replication system can provide one-to-many or many-to-one replication:
- One-to-many replication

  In one-to-many (*distribution*) replication, all changes to a primary database server are replicated to many target database servers. Use this replication model when information gathered at a central site must be disseminated to many scattered sites.
- Many-to-one replication

  In many-to-one (*consolidation*) replication, many primary servers send information to a single target server. Use this replication model when many sites are gathering information (for example, local field studies for an environmental study) that needs to be centralized for final processing.

Primary-Target Business Models

Primary-target Enterprise Replication systems support the following business models:

- Data Dissemination
- Data Consolidation
- Workload Partitioning
- Workflow Replication

Data Dissemination: Data dissemination supports business needs where data is updated in a central location and then replicated to read-only sites. This method of distribution can be particularly useful for online transaction processing (OLTP) systems where data is required at several sites, but because of the large amounts of data, read-write capabilities at all sites would cripple the performance of the application. Figure 3-1 on page 3-2 illustrates data dissemination.

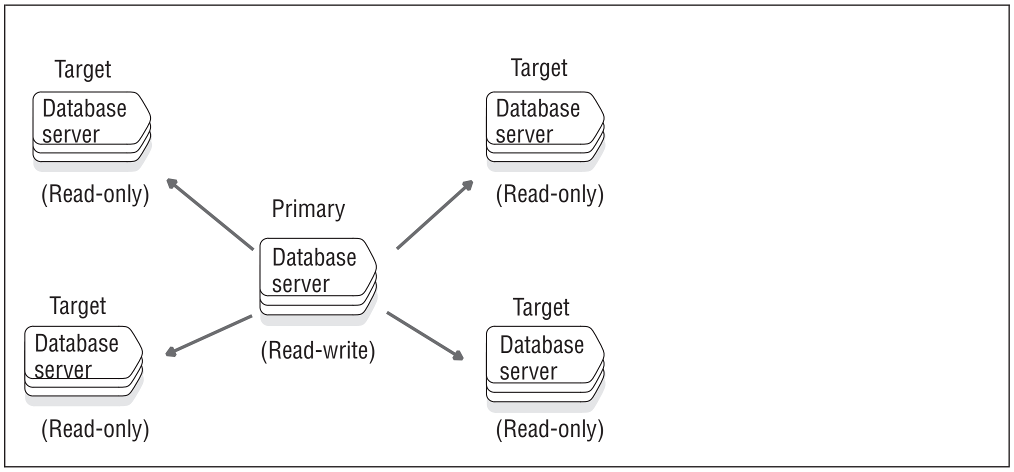

Figure 3-1. Data Dissemination in a Primary-Target Replication System

Data Consolidation: As businesses reorganize to become more competitive, many choose to consolidate data into one central database server. Data consolidation allows the migration of data from several database servers to one central database server. In Figure 3-2, the remote locations have read-write capabilities while the central database server is read-only.

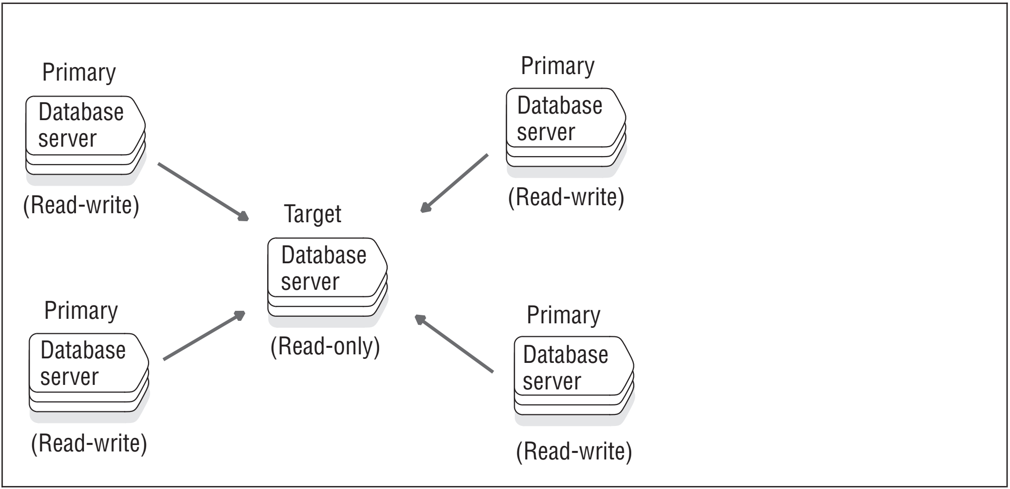

Figure 3-2. Data Consolidation in a Primary-Target Replication System

Businesses can also use data consolidation to off-load OLTP data for decision support (DSS) analysis. For example, data from several OLTP systems can be replicated to a DSS system for read-only analysis. Pay close attention to the configuration of the tables from which data is replicated to ensure that each primary key is unique among the multiple primary database servers.

Workload Partitioning: Workload partitioning gives businesses the flexibility of assigning data ownership at the table-partition level, rather than within an application. Figure 3-3 illustrates workload partitioning.

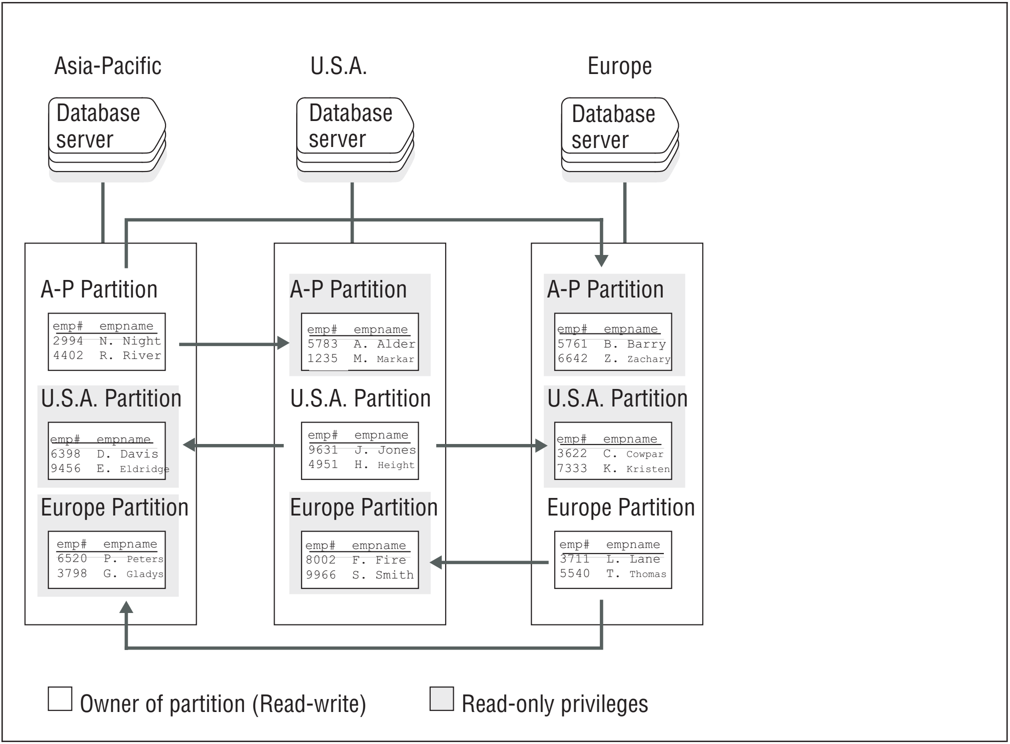

Figure 3-3. Workload Partitioning in a Primary-Target Replication System

In Figure 3-3, the replication model matches the partition model for the **employee** tables. The Asia-Pacific database server owns the partition and can therefore update, insert, and delete employee records for personnel in its region. The changes are then propagated to the U.S. and European regions. The Asia-Pacific database server can query or read the other partitions locally, but cannot update those partitions locally. This strategy applies to other regions as well.

Workflow Replication: Unlike the data dissemination model, in a workflow-replication system, the data moves from site to site. Each site processes or approves the data before sending it on to the next site.

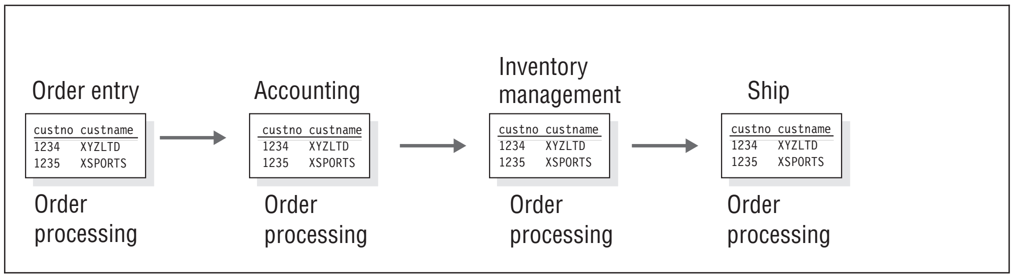

Figure 3-4. A Workflow-Replication System Where Update Authority Moves From Site to Site

Figure 3-4 illustrates an order-processing system. Order processing typically follows a well-ordered series of steps: orders are entered, approved by accounting, inventory is reconciled, and the order is finally shipped.

In a workflow-replication system, application modules can be distributed across multiple sites and databases. Data can also be replicated to sites that need read-only access to the data (for example, if order-entry sites want to monitor the progress of an order).

A workflow-replication system, like the primary-target replication system, allows only unidirectional updates. Many facts that you need to consider for a primary-target replication system should also be considered for the workflow-replication system.

However, unlike the primary-target replication system, availability can become an issue if a database server goes down. The database servers in the workflow-replication system rely on the data updated at a previous site. Consider this fact when you select a workflow-replication system.

Primary-Target Considerations

The following sections describe some of the factors to consider when you select a primary-target replication system:

- Administration

  Primary-target replication systems are the easiest to administer because all updates are unidirectional and therefore, no data update conflicts occur. Primary-target replication systems use the *ignore* conflict-resolution rule. See “Conflict-Resolution Rule” on page 3-6.
- Capacity planning

  All replication systems require you to plan for capacity changes. For more information, see “Preparing Data for Replication” on page 4-14.
- High-availability planning

  In the primary-target replication system, if a target database server or network connection goes down, Enterprise Replication continues to log information for the database server until it becomes available again. If a database server is unavailable for some time, you might want to remove the database server from the replication system. If the unavailable database server is the read-write database server, you must plan a course of action to change read-write capabilities on another database server.

If you require a fail-safe replication system, you should select a high-availability replication system. For more information, see "High-Availability Replication System" on page 5-1.

Update-Anywhere Replication System

In update-anywhere replication, changes made on any participating database server are replicated to all other participating database servers. This capability allows users to function autonomously even when other systems or networks in the replication system are not available.

Figure 3-5 illustrates an update-anywhere replication system.

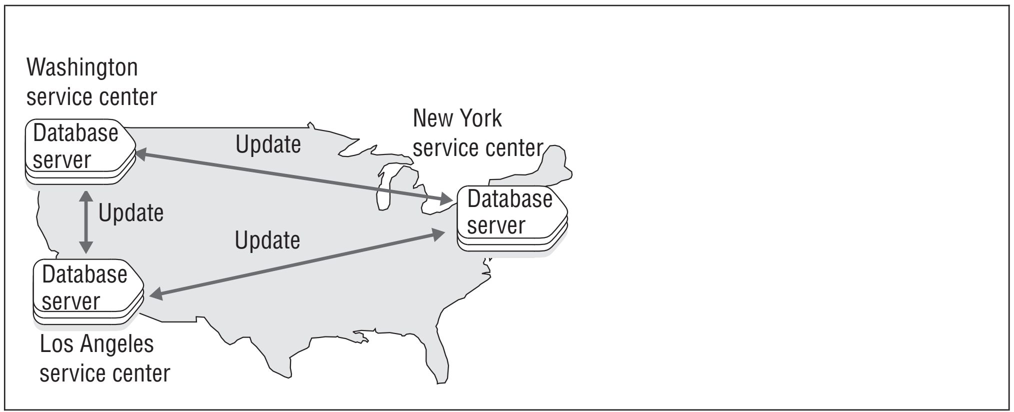

Figure 3-5. Update-Anywhere Replication System

Because each service center can update a copy of the data, conflicts can occur when the data is replicated to the other sites. To resolve update conflicts, Enterprise Replication uses *conflict resolution*. For more information, see "Conflict Resolution" on page 3-6.

Review the following information before you select your update-anywhere replication system:

- Administration

  Update-anywhere replication systems allow peer-to-peer updates, and therefore require *conflict-resolution* (see "Conflict Resolution" on page 3-6). Update-anywhere replication systems require more administration than primary-target replication systems.
- Information consistency

  Some risk is associated with delivering consistent information in an update-anywhere replication system. You determine the amount of risk based on the type of conflict-resolution rules and routines you choose for resolving conflicts. You can configure an update-anywhere replication system where no data is ever lost; however, you might find that other factors (for example, performance) outweigh your need for a fail-safe mechanism to deliver consistent information.
- Capacity Planning

  All replication systems require you to plan for capacity changes. For more information, see "Preparing Data for Replication" on page 4-14. In particular, if you choose the time stamp or time stamp plus SPL routine conflict-resolution rule, see "Delete Table Disk Space" on page 4-7 and "Shadow Column Disk Space" on page 4-8.

- High Availability

  If any of your database servers are critical, consider using HDR to provide backup servers. For more information, see "High-Availability Replication System" on page 5-1.

Conflict Resolution

When multiple database servers try to update the same row simultaneously (the time stamp for both updates is the same GMT time), a collision occurs. For more information, see "Applying Replicated Data" on page 1-13. Enterprise Replication must determine which new data to replicate. To solve conflict resolution, you must specify the following for each replicate:

- A conflict-resolution rule
- The scope of the rule

Conflict-Resolution Rule

Enterprise Replication supports the following conflict-resolution rules.

Conflict Resolution Rule	Effect	Reference
Ignore	Enterprise Replication does not attempt to resolve conflicts.	page 3-7
Time stamp	The row or transaction with the most recent time stamp is applied.	page 3-7
SPL routine	Enterprise Replication uses a routine written in SPL (Stored Procedure Language) that you provide to determine which data should be applied.	page 3-8
Time stamp with SPL routine	If the time stamps are identical, Enterprise Replication invokes an SPL routine that you provide to resolve the conflict.	page 3-7, page 3-8
Always-apply	Enterprise Replication does not attempt to resolve conflicts.	page 3-10

For all conflict-resolution rules except *ignore* and *always-apply*, you must create shadow columns in the tables on both the source and target servers involved in replication. For more information, see "Shadow Columns" on page 2-7.

Enterprise Replication supports up to two conflict-resolution rules for each replicate: a primary rule and a secondary rule (if desired). Table 3-1 shows the valid combinations of Enterprise Replication conflict-resolution rules.

Table 3-1. Valid Conflict-Resolution Rule Combinations

Primary Rule	Secondary Rule
Ignore	None
Time stamp	None
Time stamp	SPL routine
SPL routine	None
Always-apply	None

Ignore Conflict-Resolution Rule: The *ignore* conflict-resolution rule does not attempt to detect or resolve conflicts. A row or transaction either applies successfully or it fails. A row might fail to replicate because of standard database reasons, such as a *deadlock* situation, when an application locks rows.

The *ignore* conflict-resolution rule can only be used as a primary conflict- resolution rule and can have either a transaction or a row scope (as described in "Scope" on page 3-11). Table 3-2 describes the *ignore* conflict-resolution rule.

Table 3-2. Ignore Conflict-Resolution Rule

	Database Operation		
Row Exists in Target?	**Insert**	**Update**	**Delete**
No	Apply row	Discard row	Discard row
Yes	Discard row	Apply row	Apply row

When a replication message fails to apply to a target, you can spool the information to one or both of the following directories:

- Aborted-transaction spooling (ATS)

  If selected, all buffers in a failed replication message that compose a transaction are written to this directory.
- Row-information spooling (RIS)

  If selected, the replication message for a row that could not be applied to a target is written to this directory.

For more information, see Chapter 8, "Monitoring and Troubleshooting Enterprise Replication," on page 8-1.

Time-Stamp Conflict-Resolution Rule: The time-stamp rule evaluates the latest time stamp of the replication against the target and determines how to resolve any conflict.

Tip: All time stamps and internal computations are performed in Greenwich Mean Time (GMT).

The time-stamp resolution rule behaves differently depending on which scope is in effect:

- Row scope

  Enterprise Replication evaluates one row at a time. The row with the most recent time stamp wins the conflict and is applied to the target database servers. If an SPL routine is defined as a secondary conflict-resolution rule, the routine resolves the conflict when the row times are equal.
- Transaction scope

  Enterprise Replication evaluates the most recent row-update time among all the rows in the replicated transaction. This time is compared to the time stamp of the appropriate target row. If the time stamp of the replicated row is more recent than the target, the entire replicated transaction is applied. If a routine is defined as a secondary conflict-resolution rule, it is used to resolve the conflict when the time stamps are equal.

For more information, see "Scope" on page 3-11.

A secondary routine is invoked only if Enterprise Replication evaluates rows and discovers equal time stamps.

If no secondary conflict-resolution rule is defined and the time stamps are equal, the transaction from the database server with the lower value in the **cdrserver** shadow column wins the conflict.

Table 3-3 on page 3-8 shows how a conflict is resolved based on the latest time stamp with row scope. The time stamp T_{last_update} (the time of the last update) represents the row on the target database server with the last (most recent) update. The time stamp T_{repl} (the time when replication occurs) represents the time stamp on the incoming row.

Enterprise Replication first checks to see if a row with the same primary key exists in either the target table or its corresponding delete table.

Important: Do not remove the delete tables created by Enterprise Replication. The delete table is automatically removed when the last replicate defined with conflict resolution is deleted.

If the row exists, Enterprise Replication uses the latest time stamp to resolve the conflict.

Table 3-3. Conflict Resolution Based on the Time Stamp

Row Exists on Target?	**Time Stamp**	**Database Operation**		
		Insert	**Update**	**Delete**
No	n/a	Apply row	Apply row (Convert UPDATE to INSERT)	Apply row (INSERT into Enterprise Replication delete table)
Yes	$T_{last\_update} < T_{repl}$	Apply row (Convert INSERT to UPDATE)	Apply row	Apply row
	$T_{last\_update} > T_{repl}$	Discard row		
	$T_{last\_update} = T_{repl}$	Apply row if no routine is defined as a secondary conflict-resolution rule. Otherwise, invoke the routine.		

The time-stamp conflict-resolution rule assumes time synchronization between cooperating Enterprise Replication servers. For more information, see "Time Synchronization" on page 2-11.

SPL Conflict-Resolution Rule:

Tip: The SPL rule allows you complete flexibility to determine which row prevails in the database. However, for most users, the time-stamp conflict-resolution rule provides sufficient conflict resolution.

You can assign an SPL routine as the primary conflict-resolution rule. If you use an SPL routine as a secondary conflict-resolution rule, the time-stamp conflict-resolution rule must be the primary rule.

Important: The owner of an SPL routine used for conflict resolution must be the same as the owner of the table.

Routines for conflict-resolution must be in SPL. Enterprise Replication does not allow user-defined routines in C or in Java.

Important: You cannot use an SPL routine or a time stamp with an SPL routine if the replicate is defined to replicate only changed columns or the replicated table contains any extensible data types. See "Replicating Only Changed Columns" on page 6-8.

Enterprise Replication passes the following information to an SPL routine as arguments.

Argument	**Description**
Server name [CHAR(18)]	From the local target row NULL if local target row does not exist
Time stamp (DATETIME YEAR TO SECOND)	From the local target row NULL if local target row does not exist
Local delete-table indicator [CHAR(1)] or Local key delete-row indicator [CHAR(1)]	Y indicates the origin of the row is the delete table. K indicates the origin of the row is the replicate-key delete row. If a conflict occurs while deleting a primary key row, because the local row with the old key no longer exists, the received key delete row is passed as the local row (using the seventh argument, local row data, described below). The received key insert row is passed to the stored procedure as the replicated row using the eighth argument, described below.
Server name [CHAR(18)]	Of the replicate source
Time stamp (DATETIME YEAR TO SECOND)	From the replicated row
Replicate action type [CHAR(1)]	`I` - insert `D` - delete `U` - update
Local row data returned in regular SQL format	Where the regular SQL format is taken from the SELECT clause of the participant list
Replicate row data after-image returned in regular SQL format	Where the regular SQL format is taken from the SELECT clause of the participant list

The routine must set the following arguments before the routine can be applied to the replication message.

Argument	Description
An indicator of the desired database operation to be performed [CHAR(1)]	Same as the replicate action codes with the following additional codes • `A` - Accept the replicated row and apply the column values returned by the SPL routine. For example, if Enterprise Replication receives an insert and the row already exists locally, the insert is converted to an update • `S` - Accept the replicated row and apply the column values as received from the other site. For example, if Enterprise Replication receives an insert and the row already exists locally, the insert fails at the time Enterprise Replication tries to apply the transaction to the database, and the transaction aborts with an SQL error. • `O` - Discard the replicated row. • `X` - Abort the transaction.
A non-zero integer value to request logging of the conflict resolution and the integer value in the spooling files (INTEGER)	Logging value takes effect only if logging is configured for this replicate.
The columns of the row to be applied to the target table replicate action type in regular SQL format	This list of column values is not parsed if the replicate action type that the routine returns is `S`, `O`, or `X`.

You can use the arguments to develop application-specific routines. For example, you can create a routine in which a database server always wins a conflict regardless of the time stamp.

The following list includes some items to consider when you use an SPL routine for conflict resolution:

- Any action that a routine takes as a *result* of replication does not replicate.
- You cannot use an SPL routine to start another transaction.
- Frequent use of routines might affect performance.

In addition, you must determine when the SPL routine executes:

- An *optimized* SPL routine is called only when a collision is detected and the row to be replicated fails to meet one of the following two conditions:
  – It is from the same database server that last updated the local row on the target table.
  – It has a time stamp greater than or equal to that of the local row.
- A *nonoptimized* SPL routine executes every time Enterprise Replication detects a collision. By default, SPL routines are nonoptimized.

For information on specifying that the SPL routine is optimized, see "Conflict Options" on page A-23.

Tip: Do not assign a routine that is not optimized as a primary conflict-resolution rule for applications that usually insert rows successfully.

Always-Apply Conflict-Resolution Rule: The *always-apply* conflict-resolution rule does not attempt to detect or resolve conflicts. Unlike with the ignore conflict-resolution rule, replicated changes are applied even if the operations are not the same on the source and target servers. In the case of a conflict, the current row on the target is deleted and replaced with the replicated row from the source.

Table 3-4 describes the *always-apply* conflict-resolution rule.

Table 3-4. Always-Apply Conflict-Resolution Rule

	Database Operation		
Row Exists in Target?	**Insert**	**Update**	**Delete**
No	Apply row	Apply row (convert UPDATE to INSERT)	Apply row (INSERT into Enterprise Replication delete table, no error returned)
Yes	Apply as an UPDATE (overwrite the existing row)	Apply row	Deletes the row

Scope

Each conflict-resolution rule behaves differently depending on the *scope*. Enterprise Replication uses the following scopes:

- Row scope

  When you choose a row scope, Enterprise Replication evaluates one row at a time. It only applies replicated rows that win the conflict resolution with the target row. If an entire replicated transaction receives row-by-row evaluation, some replicated rows are applied while other replicated rows might not be applied.
- Transaction scope

  When you choose a transaction scope, Enterprise Replication applies the entire transaction if the replicated transaction wins the conflict resolution. If the target wins the conflict (or other database errors are present), the entire replicated transaction is not applied.

  A transaction scope for conflict resolution guarantees transactional integrity.

Important: Enterprise Replication defers some constraint checking on the target tables until the transaction commits. If a unique constraint or foreign-key constraint violation is found on any row of the transaction at commit time, the entire transaction is rejected (regardless of the scope) and, if you have ATS set up, written to the ATS directory. For more information, see "Aborted Transaction Spooling Files" on page 8-3.

Choosing a Replication Network Topology

Enterprise replication *topology* describes connections that replication servers make to interact with each other. This topology is the route of replication data (message) transfer from server to server over the network. The replication topology is not synonymous with the physical network topology. Replication server definitions create the replication topology, whereas replicate definitions determine data to be replicated and the sources and destinations within the topology

Enterprise Replication supports two types of network topology:

- Fully Connected Topology
- Hierarchical Replication Topologies

The topology that you choose influences the types of replication that you can use. The next sections describe the topologies that Enterprise Replication supports.

Fully Connected Topology

Fully connected replication topology indicates that all database servers connect to each other and that Enterprise Replication establishes and manages the connections. Replication messages are sent directly from one database server to another. No additional routing is necessary to deliver replication messages. Figure 3-6 shows a fully connected replication topology. Each database server connects directly to every other database server in the replication environment.

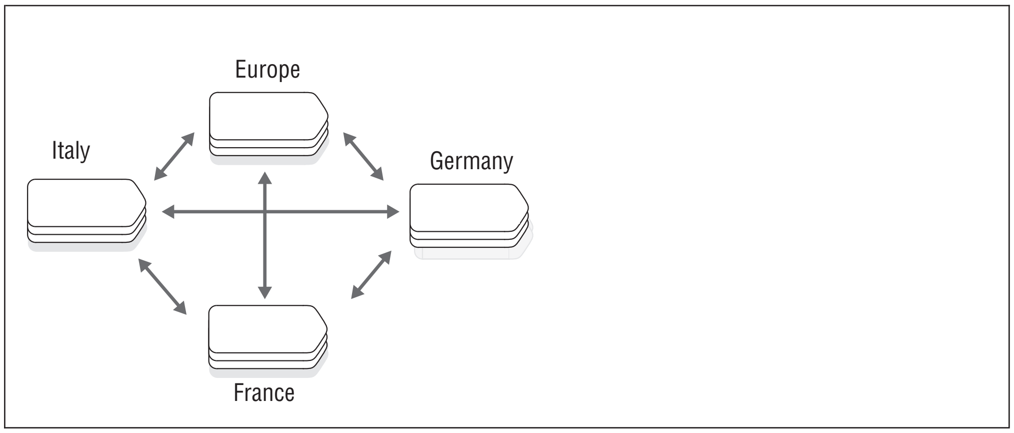

Figure 3-6. Fully Connected Topology

If necessary, you can also add HDR and a backup server to any server to provide high availability. For more information, see "High-Availability Replication System" on page 5-1.

Hierarchical Replication Topologies

Enterprise Replication provides two types of Hierarchical Routing topology:

- Hierarchical Tree
- Forest of Trees

HR Topology Terminology

Enterprise Replication uses the terms in the Table 3-5 to describe Hierarchical Routing topology.

Table 3-5. Replication Topology Terms

Term	Definition
Root server	An Enterprise Replication server that is the uppermost level in a hierarchically organized set of information The root is the point from which database servers branch into a logical sequence. All root database servers within Enterprise Replication must be fully interconnected.
Nonroot server	An Enterprise Replication server that is not a root database server but has a complete global catalog and is connected to its parent and to its children
Tree	A data structure that contains database servers that are linked in a hierarchical manner The topmost node is called the root. The root can have zero or more *child* database servers; the root is the *parent* database server to its children.
Parent-child	A relationship between database servers in a tree data structure in which the parent is one step closer to the root than the child.
Leaf server	A database server that has a limited catalog and no children.

A *root* server is fully connected to all other root servers. It has information about all other replication servers in its replication environment. Figure 3-6 on page 3-12 shows an environment with four root servers.

A *nonroot server* is similar to a root server except that it forwards all replicated messages for other root servers (and their children) through its parent. All nonroot servers are known to all root and other nonroot servers. A nonroot server might or might not have children. All root and nonroot servers are aware of all other servers in the replication environment.

Important: In *Hierarchical Routing* topologies, Enterprise Replication specifies the synchronization server as the new server's parent in the current topology. For more information, see "Customizing the Replication Server Definition" on page 6-3 and "cdr define server" on page A-30.

Hierarchical Tree

A *hierarchical tree* consists of a root database server and one or more database servers organized into a tree topology. The tree contains only one root, which has no parent. Each database server within the tree references its parent. A database server that is not a parent is a leaf. Figure 3-7 illustrates a replication tree.

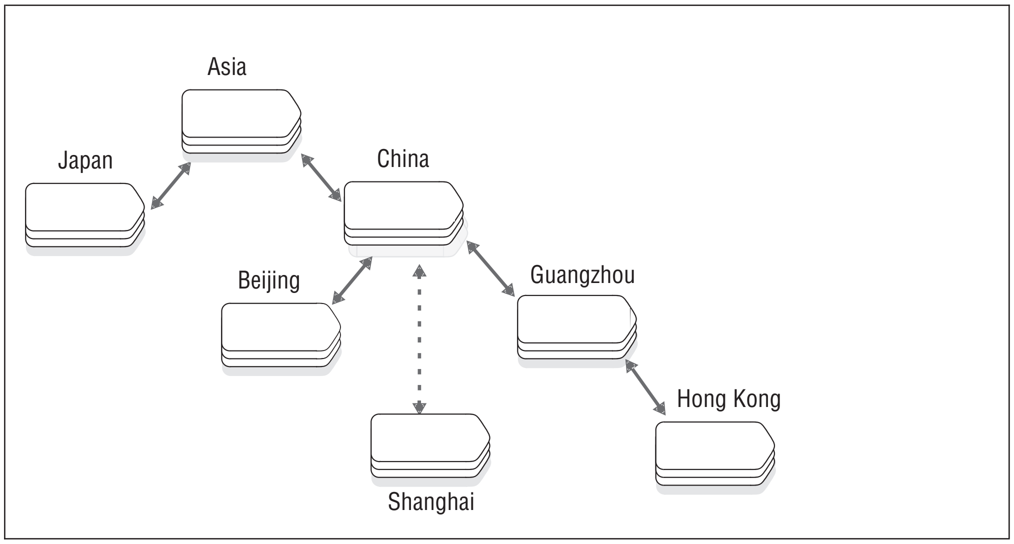

Figure 3-7. Hierarchical Tree Topology

In Figure 3-7, the parent-child relationship within the tree is as follows:

- **Asia** is the parent of **China** and **Japan**.
- **China** is the child of **Asia** *and* the parent of **Beijing**, **Shanghai**, and **Guangzhou**.
- **Guangzhou** is the child of **China** *and* the parent of **Hong Kong**.

Asia is the root database server. **Japan**, **China**, and **Guangzhou** are nonroot database servers. You can define **Beijing**, **Shanghai**, and **Hong Kong** as either nonroot database servers or leaf database servers, depending on how you plan to use them. The dashed connection from **China** to **Shanghai** indicates that Shanghai is a leaf server.

You could define a replicate that replicates data exclusively between **Shanghai** and **Japan**. However, the transaction data would have to go through **China** and **Asia**. If either **China** or **Asia** is offline replication is suspended. Similarly, a replicate defined between **Japan** and **China** would require **Asia** to be functioning, even though both **Japan** and **China**, as nonroot servers, have entries in their **sqlhosts** files for each other.

Parent servers are good candidates for using HDR to provide backup servers. For more information, see "Hierarchical Replication Topologies" on page 3-12.

Forest of Trees

A *forest of trees* consists of several hierarchical trees whose root database servers are fully connected. Each hierarchical tree starts with a root database server. The root database servers transfer replication messages to the other root servers for delivery to its child database servers. Figure 3-8 shows a forest of trees.

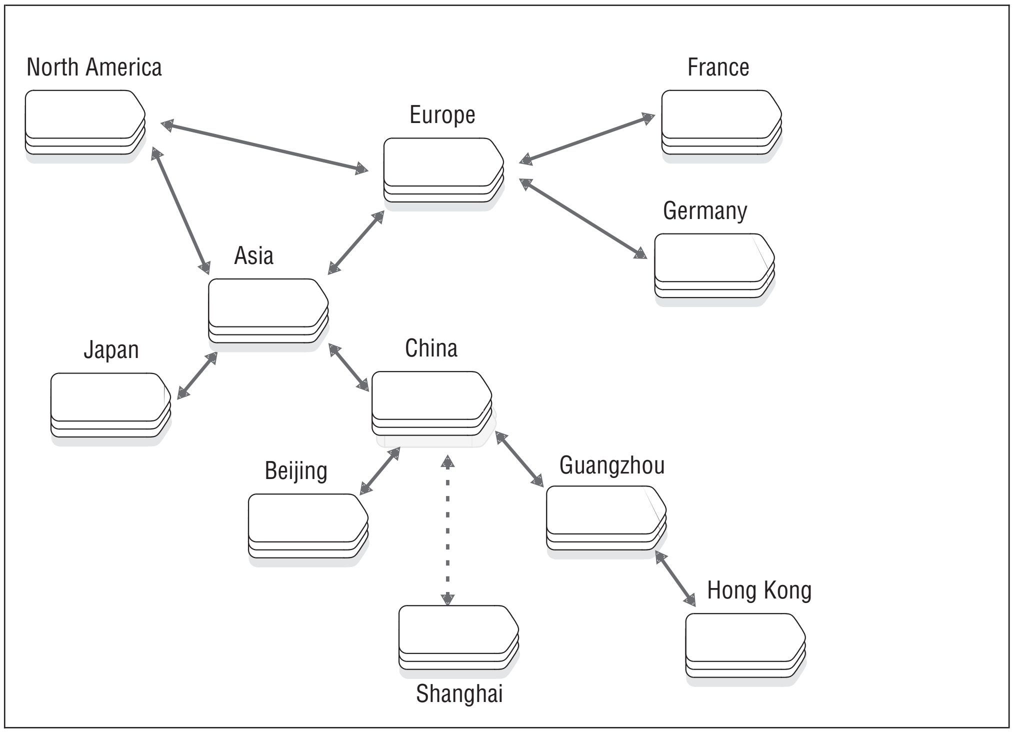

Figure 3-8. Forest-of-Trees Topology

In Figure 3-8, **North America**, **Asia**, and **Europe** are root database servers. That is, they are fully connected with each other. **France** and **Germany** are in a tree whose root is **Europe**. **Asia** is the root for the six database servers in its tree.

In a forest of trees, all replication messages from one tree to another must pass through their roots. For example, a replication message from **Beijing** to **France** must pass through **China**, **Asia**, and **Europe**.

Organizing the database servers in a hierarchical tree or a forest of trees greatly reduces the number of physical connections that are required to make a replication system. If all the database servers in Figure 3-8 were fully connected, instead of being organized in trees, 55 connections would be required.

To ensure that all servers retain access to the replication system, use HDR on parent servers. For more information, see “Using HDR in a Forest of Trees Topology” on page 5-3.

Chapter 4. Preparing the Replication Environment

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In This Chapter

This chapter covers the steps to take to prepare your environment for replicating data with Enterprise Replication: preparing the network environment, the disk, the server environment, and the data.

Preparing the Network Environment

For more information on preparing the network environment, see the chapter on client/server connectivity in the *IBM Informix Dynamic Server Administrator's Guide*. See Appendix E, "Replication Examples," on page E-1, for a sample setup.

To prepare your network environment:

1. Set up the hosts file.

   For information, see "Setting Up the Hosts File" on page 4-2.
2. Set up the services file.

   For information, see "Setting Up the Services File" on page 4-2.
3. Set up the trusted environment.

   For information, see "Setting Up the Trusted Environment" on page 4-3.
4. Verify the SQLHOSTS information.

   For information, see "Verifying SQLHOSTS" on page 4-3.
5. Test the network environment.

   For information, see "Testing the Network Environment" on page 4-6.

Setting Up the Hosts File

First, make sure the **hosts** file includes the IP addresses and system names for all database servers involved in Enterprise Replication.

Important: If you are using Domain Name Service (DNS) to identify IP addresses and system names, you do not need to configure the **hosts** file.

The **hosts** file is in the following location.

Operating System	File
UNIX	**/etc/hosts**
Windows	**%WINDIR%\system32\drivers\etc\hosts**

Important: Leave a blank line at the end of the **hosts** file on Windows.

For example, your **hosts** file might look like the following:

```
123.456.789.1 sydney
123.456.789.2 melbourne
```

Setting Up the Services File

Next, make sure that the **services** file includes the port numbers and service names for all the database servers involved in Enterprise Replication. The **services** file is in the following location.

Operating System	File
UNIX	**/etc/services**
Windows	**%WINDIR%\system32\drivers\etc\services**

Important: Leave a blank line at the end of the **services** file on Windows.

For example, your **services** file might look like the following:

```
sydney 5327/tcp
melbourne 5327/tcp
```

If the database servers reside on the same system, you must provide unique port numbers for each.

Setting Up the Trusted Environment

To establish the trust relationship for all users, set up the **hosts.equiv** file. The **hosts.equiv** file is in the following location.

Operating System	File
UNIX	**/etc/hosts.equiv**
Windows	**%WINDIR%\system32\drivers\etc\hosts.equiv**

For example, your **hosts.equiv** file might look like the following:

```
sydney
melbourne
```

Tip: Instead of allowing access to all users, you can set up **.rhosts** files in the home directory of specific users. See your operating system documentation for more information.

Verifying SQLHOSTS

Make sure that the SQLHOSTS file is set up properly on each server participating in replication.

Setting up Database Server Groups

Enterprise Replication requires that all database servers participating in replication be members of database server groups. Each server in the enterprise must have a unique identifier; the database server group uniquely identifies a server.

If you are combining Enterprise Replication with HDR, both the primary and secondary HDR servers must be members of the same database server group. For more information, see "Managing Enterprise Replication with High-Availability Data Replication" on page 5-7.

Typically, a server group includes only one database server. However, if the computer has multiple network protocols or network interface cards, the server group includes all aliases for the database server. Enterprise Replication treats the server group as one object, whether it includes one or several database server names.

All Enterprise Replication commands and options use the name of the *database server group* of the more familiar *database server* name (that is, the name specified by the **INFORMIXSERVER** environment variable) for all references to database servers. The exception is the **--connect** option, which can use both server name or group name. This manual also refers to a database server group as a *server group*.

This manual uses the convention that the name of a database server group is **g_** followed by the name of a database server that is in the group. This use of **g_** is only a convention; **g_** is not required syntax.

Database Server Groups on UNIX: On UNIX, a database server group is defined in the **sqlhosts** file. The following example shows a very simple **sqlhosts** file for four Enterprise Replication servers, **john**, **paul**, **george**, and **ringo** and their database server groups. The first line describes the database server group **g_john**, which includes the database server **john**, and so on.

dbservername	nettype	hostname	servicename	options
g_john	group	-	-	i=143
john	ontlitcp	sydney.australia.com	10110	g=g_john
g_paul	group	-	-	i=144
paul	ontlitcp	melbourne.australia.com	2939	g=g_paul
g_george	group	-	-	i=145
george	ontlitcp	perth.australia.com	5329	g=g_george
g_ringo	group	-	-	i=146
ringo	ontlitcp	brisbane.australia.com	10101	g=g_ringo

The following table describes the fields in the **sqlhosts** example above.

dbservername	Database server group name or database server name
nettype	Type of connection (composed of the database server product, interface type, and network protocol)
hostname	The name of the computer where the database server resides
servicename	The service name or port number entry in the **services** file
options	• The **g** option specifies the name of the group to which the database server belongs. • The **i** option specifies a unique identifier for the database server. Make sure that this identifier is consistent for the database server across all nodes in the enterprise.

Important: The network connection entry should appear immediately after the database server group definition.

Important: It is not necessary for the DBSERVERNAME to be set to a network connection; however, at least one of server names listed by the DBSERVERNAME or the DBSERVERALIASES configuration parameters should be set to a network protocol. For information about database server aliases, refer to the *IBM Informix Dynamic Server Administrator's Guide*.

Important: Enterprise Replication cannot use shared memory connections even if the replicating servers are on same machine.

For an example of an SQLHOSTS file when combining Enterprise Replication and High-Availability Data Replication, see "Managing Enterprise Replication with High-Availability Data Replication" on page 5-7.

For more information about database server groups and setting up SQLHOSTS, see the chapter on client/server communications in the *IBM Informix Dynamic Server Administrator's Guide*.

Database Server Groups on Windows: For information about preparing the SQLHOSTS connectivity information on Windows, see Appendix F, "SQLHOSTS Registry Key (Windows)," on page F-1.

Important: It is strongly recommended that you use IBM Informix Server Administrator (ISA), rather than **regedt32**, to set up the SQLHOSTS registry key and database server group registry key on your Windows system. In addition, ISA allows you to administer your replication system from a web browser.

Hierarchical Routing Topologies and SQLHOSTS

For hierarchical routing (HR) topologies:

- Root and nonroot servers must each have complete SQLHOSTS server group information for the entire enterprise.
- Each leaf server must have SQLHOSTS connectivity information only for itself and its parent (hub).

Root and nonroot servers contain the complete global catalog; leaf servers do not. For more information, see "HR Topology Terminology" on page 3-12 and "Global Catalog" on page 2-4.

Network Encryption and SQLHOSTS

Client/server network communication is encrypted by specifying the ENCCSM module with the communications support module (CSM) option in the SQLHOSTS file. However, Enterprise Replication can only be encrypted by setting encryption configuration parameters. The ENCRYPT_CDR configuration parameter must be set to 1 or 2 to allow encryption.

Important: Enterprise Replication cannot use a connection configured with a CSM.

To combine client/server network encryption with Enterprise Replication encryption, configure two network connections for each database server. The configuration in the SQLHOSTS file would look like the following example.

dbservername	nettype	hostname	servicename	options
g_group1	group	-	-	i=1
cdr1	ontlitcp	texpdx	mp.cdr1	g=g_group1
serv1	ontlitcp	texpdx	mp.serv1	csm=(ENCCSM)

In this example, **cdr1** and **serv1** are two connection ports on the same database server. Encrypted client/server communications uses the **serv1** port, while encrypted Enterprise Replication uses the **cdr1** port.

For more information on encrypting client/server network communications, see the *IBM Informix Dynamic Server Administrator's Guide*.

For more information on encrypting Enterprise Replication, see "Setting Configuration Parameters" on page 4-13 and Appendix B, "Configuration Parameter and Environment Variable Reference," on page B-1.

Using the Connection Security Option (s=6)

If you are using the connection security option, s=6, your SQLHOSTS file must contain a regular connection (without s=6) within the same group. To do this, you can add an alias server definition that includes the server group name. For example:

```
g_serv1 group - - i=10
serv1 ontlitcp lxsun02 ertest1 g=g_serv1, s=6
a_serv1 ontlitcp lxsun02 ertest10 g=g_serv1
```

For more information about the connection security option, see the *IBM Informix Administrator's Guide*.

Testing the Network Environment

Once you have verified the network setup information, test the network environment.

To test the network environment:

1. Verify the network connection.

   Use the **ping** command to test the connection between two systems. For example, from **sydney**, test the connection to **melbourne**:

   ```
   ping melbourne
   ```
2. Test the trusted environment.
   a. Run **dbaccess**.
   b. Select the **Connection** menu option.
   c. Select the **Connect** menu option.
   d. Connect to the server group name and the server name of the other hosts.

      For example, if you are running **dbaccess** on **sydney**, and you are testing the connection to a database server on **melbourne**, select **paul** and **g_paul**.
   e. When prompted for the USER NAME, press `Enter`.

   If you can connect to the host database server, the host server is trusted for user **informix**.

   For more information, see the *IBM Informix DB–Access User's Guide*.

Preparing the Disk

Preparing your disk for Enterprise Replication includes the following:

- Planning for Disk Space Requirements
- Setting Up Send and Receive Queue Spool Areas
- Creating ATS and RIS Directories

Planning for Disk Space Requirements

Enterprise Replication requires additional disk space for storing the logical logs and, depending on your conflict-resolution configuration, delete tables and shadow columns.

Logical Log Configuration Disk Space

The database server uses the logical log to store a record of changes to the data since the last archive. Enterprise Replication requires the logical log to contain entire row images for updated rows, including deleted rows.

The database server normally logs only columns that have changed. This behavior is called the logical-log record reduction option. Enterprise Replication deactivates this option for tables that participate in replication. (The logical-log record reduction option remains enabled for tables that do *not* participate in Enterprise Replication.) Enterprise Replication logs all columns, not only the columns that have changed, which increases the size of your logical log.

To determine the size of your logical log, examine your data activity for normal operations and for the replication system you defined. Keep in mind that defining replication on a table causes Enterprise Replication to deactivate log reduction for that table, and that your transactions might log more data.

Important: Enterprise Replication performs internal cleanup tasks based on how often the log files switch. If the log files switch too frequently, Enterprise Replication might perform excessive cleanup work.

Logical Log Configuration Guidelines

Use the following guidelines when configuring your logical log files:

- Make sure that all logical log files are approximately the same size.
- Make the size of the logical log files large enough so that the database server switches log files no more than once every 15 minutes during normal processing.
- Plan to have sufficient logical-log space to hold at least four times the maximum transaction size.
- Set LTXEHWM (long-transaction, exclusive-access, high-watermark) 30 percent larger than LTXHWM (long-transaction high-watermark).

Important: If you specify that the database server allocate logical log files dynamically (DYNAMIC_LOGS), it is recommended that you set LTXEHWM to no higher than 70 when using Enterprise Replication.

For more information about logical logs and these configuration parameters, see *IBM Informix Administrator's Reference* and *IBM Informix Dynamic Server Administrator's Guide*.

The database server can add logs dynamically when Enterprise Replication enters blockout mode if the CDR_MAX_DYNAMIC_LOGS configuration parameter is set to a non-zero integer. For more information, see "Preventing DDRBLOCK Mode" on page 8-10.

Delete Table Disk Space

If you use the time stamp or time stamp and SPL routine conflict-resolution rules, *Enterprise Replication* creates *delete tables* to keep track of modified rows for conflict resolution. (Enterprise Replication creates delete tables only for tables that have replicates defined with a conflict-resolution rule other than *ignore*.) Delete tables handle conflicts such as when a DELETE or UPDATE finds no corresponding row on the target. The DTCleaner thread removes a row from the delete tables after all the servers have progressed beyond that row. For more information, see "Conflict-Resolution Rule" on page 3-6.

Delete tables are created on the database server where the data originates and on all the database servers to which data gets replicated. Delete tables are stored in the same dbspaces, using the same fragmentation strategy, as their base tables.

To determine the disk space requirements to accommodate delete tables, estimate how many rows will be deleted or modified. For example, if the base table has 100 megabytes of data, but only half the rows might be deleted or modified, then 50 megabytes is a reasonable estimate for the size of the delete table.

Important: Do not remove the delete tables created by Enterprise Replication. The delete table is automatically removed when the last replicate defined with conflict resolution is deleted.

Shadow Column Disk Space

When you define a replicate that uses any conflict-resolution rule except *ignore*, you must define *shadow columns* (CRCOLS) with the WITH CRCOLS clause. The shadow columns, **cdrserver** and **cdrtime**, store server and time-stamp information that Enterprise Replication uses for conflict resolution. The two shadow columns are integers, which adds a total of 8 bytes to each row in the table involved in a replicate that uses conflict resolution.

Tip: If you plan to use only the ignore conflict-resolution rule, you do not need to define the **cdrserver** and **cdrtime** shadow columns.

For more information, see “Conflict-Resolution Rule” on page 3-6 and “Preparing Tables for Conflict Resolution” on page 4-16.

Setting Up Send and Receive Queue Spool Areas

The term *data queue* refers to both the *send queue* and the *receive queue*. Enterprise Replication collects information from the logical logs and places the data to be transferred in the send queue. Then Enterprise Replication transfers the contents of the send queue to the receive queue on the target server. Enterprise Replication on the target reads the data from the receive queue and applies the changes to the tables on the target server.

The send and receive queues reside in memory and are managed by the Reliable Queue Manager (RQM). The CDR_QUEUEMEM configuration parameter (“CDR_QUEUEMEM Configuration Parameter” on page B-6) specifies the amount of memory space that is available for the data queues.

When a queue in memory fills (for the receive queue, this only occurs with large transactions), the transaction buffers are written (*spooled*) to disk. Spooled transactions consist of *transaction records* (headers that contain internal information for Enterprise Replication), *replicate information* (summaries of the replication information for each transaction), and *row data* (the actual replicated data). Spooled transaction records and replication records are stored in transaction tables and replication tables in a single dbspace. Spooled row data is stored in one or more sbspaces.

Important: To prevent the send and receive queues from spooling to disk, see “Preventing Memory Queues from Overflowing” on page 8-9.

Transaction Record dbspace

By default, the transaction records and replication records are stored in the root dbspace. Because Enterprise Replication and other database servers become unavailable if the root dbspace fills, you should define a single, separate dbspace for the send and receive queue transaction records and replication records before you define the replication server.

To determine the size of your transaction record dbspace, you must determine the estimated number of transactions in a given period. You should allocate 110 bytes per transaction to the dbspace and allocate enough disk space to store 24 hours of transaction records. For example, if your network is down for 24 hours, and you estimate that you will log 1000 transactions each day, the size of the transaction record dbspace should be at least 108 kilobytes (110 bytes * 1000 transactions / 1024).

To create the transaction record dbspace, use **onspaces -c**. For example, to create a 110 kilobyte dbspace called **er_dbspace** using raw disk space on UNIX with an offset of 0, enter:

```
onspaces -c -d er_dbspace -p /dev/raw_dev1 -o 0 -s 110
```

The pathname for the dbspace cannot be longer than 256 bytes.

Set the CDR_QHDR_DBSPACE configuration parameter ("CDR_QHDR_DBSPACE Configuration Parameter" on page B-5) in the ONCONFIG file to the location of the transaction record dbspace (er_dbspace, in this example).

Warning: Do not change the value of CDR_QHDR_DBSPACE after you initialize Enterprise Replication on a server.

For information on creating dbspaces, see the chapter on managing disk space in the *IBM Informix Dynamic Server Administrator's Guide* and the utilities chapter in the *IBM Informix Administrator's Reference*.

Row Data sbspaces

Replicated data might include UDT and CLOB or BLOB data types. Therefore, the spooled row data is stored as smart large objects in one or more sbspaces.

Important: Before starting Enterprise Replication, you must create at least one sbspace for spooled row data and set the CDR_QDATA_SBSPACE configuration parameter to its location.

The CDR_QDATA_SBSPACE configuration parameter accepts multiple sbspaces, up to a maximum of 32 sbspaces. Enterprise Replication can support a combination of logging and non-logging sbspaces for storing spooled row data. If CDR_QDATA_SBSPACE is configured for multiple sbspaces, then Enterprise Replication uses all appropriate sbspaces in round-robin order. For more information, see "CDR_QDATA_SBSPACE Configuration Parameter" on page B-5.

Creating sbspaces for Spooled Row Data: Follow these guidelines when creating sbspaces for spooled row data:

- Create all the sbspaces of same default log mode type with the same size.
- Do not use Enterprise Replication row data sbspaces for non-Enterprise Replication activity.
- Ensure that the sbspaces are sufficiently large.

  To determine the size of your spooled row data sbspaces, determine your log usage and then consider how much data you can collect if your network goes down. For example, assume that you usually log 40 megabytes of data each day, but only 10 percent of that is replicated data. If your network is down for 24 hours and you estimate that you will log 4 megabytes of replicated data each day, the size of the sbspaces you identify for the spooled row data must be a total of at least 4 megabytes.

Windows Only

On Windows, increase the resulting size of the sbspace by approximately a factor of two. (The default page size, the way that data maps onto a page, and the number of pages written to disk differs on Windows.)

End of Windows Only

Warning: When the row data sbspaces fill, Enterprise Replication hangs until you either resolve the problem that is causing Enterprise Replication to spool or allocate additional disk space to the sbspaces. For more information, see "Preventing Memory Queues from Overflowing" on page 8-9.

To create row data sbspaces, use the **onspaces -c** utility. For example, to create a 4-megabyte sbspace, called **er_sbspace**, using raw disk space on UNIX with an offset of 0, enter:

```
onspaces -c -S er_sbspace -p /dev/rdsk/c0t1d0s4 -o 0 -s 4000\
    -m /dev/rdsk2/c0t1d0s4 0 \
    -Df "AVG_LO_SIZE=2,LOGGING=OFF"
```

The pathname for an sbspace cannot be longer than 256 bytes.

The **-m** option specifies the location and offset of the sbspace mirror. The **-Df** option specifies default behavior of the smart large objects stored in the sbspace:

- AVG_LO_SIZE (average large object size)

  Set this parameter to the expected average transaction size (in kilobytes). The database server uses this value to calculate the metadata size. The minimum value for AVG_LO_SIZE is 2 kilobytes, which is appropriate for Enterprise Replication in most cases. (The default value of AVG_LO_SIZE is 32 kilobytes.) If you set AVG_LO_SIZE to larger than the expected transaction size, you might run out of metadata space. If you set AVG_LO_SIZE too small, you might waste space on metadata.
- LOGGING

  Set this parameter to OFF to create an sbspace without logging. Set this parameter to ON to create an sbspace with logging. It is recommended that you use a combination of logging and non-logging sbspaces for Enterprise Replication. For more information, see "Logging Mode for sbspaces" on page 4-10.

Set the CDR_QDATA_SBSPACE configuration parameter in the ONCONFIG file to the location of the row data sbspace (**er_sbspace**, in this example). For more information, see "CDR_QDATA_SBSPACE Configuration Parameter" on page B-5.

Warning: Do not change the value of CDR_QDATA_SBSPACE after you initialize Enterprise Replication.

Logging Mode for sbspaces: Enterprise Replication uses the default log mode that the sbspace was created with for spooling row data.

Create sbspaces with a default logging mode of ON or OFF according to the types of transactions Enterprise Replication replicates:

- **LOGGING=ON**

  Create sbspaces with LOGGING set to ON to support these situations:
  - Replicated systems with HDR

    Enterprise Replication must use logging sbspaces for transactions involved in HDR.
  - Small transactions

    Enterprise Replication uses logging sbspaces for transactions that are less than a page size (2K or 4K) of replicated data.

  For logging sbspaces, performance might be enhanced because logging mode enables asynchronous IO. However, a logging sbspace consumes additional logical-log space.

- **LOGGING=OFF**

  Create sbspaces with LOGGING set to OFF to support replication of large transactions (greater than a page size of replicated data).

  It is recommended that you mirror non-logging sbspaces. For more information, see the chapter on managing disk space in the *IBM Informix Dynamic Server Administrator's Guide* and the utilities chapter in the *IBM Informix Administrator's Reference*.

  For non-logging sbspaces, performance is enhanced on the database server when Enterprise Replication spools to disk because Enterprise Replication writes less data to disk.

Warning: Do not change the Enterprise Replication sbspace default log mode while Enterprise Replication is running. To change the default log mode, follow the procedure below.

You can change the default logging mode of the row data sbspace if you have more than one sbspace specified by the CDR_QDATA_SBSPACE configuration parameter.

To change the default logging mode of a row data sbspace:

1. Shut down the database server.
2. Remove the sbspace from the CDR_QDATA_SBSPACE configuration parameter value list.
3. Start the database server in recovery mode.
4. Wait for all the smart large objects to get deleted from the sbspace. Use the **onstat -g smb lod** command to check for smart large objects stored in an sbspace.
5. Change the default logging mode for the sbspace.
6. Add the sbspace name to the CDR_QDATA_SBSPACE configuration parameter value list.
7. Shut down and restart the database server using the **onmode -ky** and **oninit** commands.

Dropping a Spooled Row Data sbspace: You can drop a row data sbspace if you have more than one sbspace specified by the CDR_QDATA_SBSPACE configuration parameter.

Dropping a row data sbspace:

1. Shutdown the database server.
2. Remove the sbspace from the CDR_QDATA_SBSPACE configuration parameter value list.
3. Start the database server in recovery mode.
4. Wait for all the smart large objects to get deleted from the sbspace. Use the **onstat -g smb lod** command to check for smart large objects stored in a sbspace.
5. Drop the sbspace.

Warning: Do not drop an Enterprise Replication row data sbspace using the **onspaces -d -f** (force) command.

Setting Up the Grouper Paging File

Enterprise Replication uses a grouper paging mechanism for evaluating large transactions. A transaction is large if the portion to be replicated meets at least one of the following conditions:

- It has greater than 5,000 log records.
- It exceeds one fifth the size of the value of the CDR_QUEUEMEM onconfig variable.
- It exceeds one tenth the size of the value of the SHMVIRTSIZE configuration variable.

The location of the sbspace used for the paging file is determined by the first of the following ONCONFIG configuration parameters that is set:

- SBSPACETEMP
- SBSPACENAME
- CDR_QDATA_SBSPACE

The best solution is to set up an unlogged sbspace, as specified by the SBSPACETEMP configuration parameter. All updates to the paging files are unlogged.

The size of the paging sbspace should be at least three time the size of the largest transaction to be processed. This sbspace is also used by the database server for other tasks; consider its overall usage when determining size requirements.

Warning: If the paging sbspace fills, Enterprise Replication hangs until you allocate additional disk space to the sbspace. If additional space is unavailable, use the **cdr stop** command to stop replication.

Creating ATS and RIS Directories

The Aborted Transactions Spooling (ATS) and Row Information Spooling (RIS) files contain information about failed transactions and aborted rows. You can repair data after replication has failed by using ATS and RIS files. Enterprise Replication examines the specified ATS or RIS file and attempts to reconcile the rows that failed to be applied. This method is fast, but does not allow as much flexibility as a repair job allows in defining how the repair should be done. See “Repairing Failed Transactions with ATS and RIS Files” on page 7-15 for more information. For information about repair jobs, see “Resynchronizing Data Among Replication Servers” on page 7-12

If you set up ATS and RIS, Enterprise Replication writes ATS and RIS files to directories on the system:

9 • ATS files
9 If you are using primary-target replication, create the ATS directory on the target
9 system. If you are using update-anywhere replication (“Update-Anywhere
9 Replication System” on page 3-5) and have conflict resolution role other than
9 *ignore* or *always-apply*(“Conflict Resolution” on page 3-6) enabled, create the ATS
9 directory on all participating replication systems.
9 • RIS files
9 If you have a conflict resolution role other than *ignore* or *always-apply* enabled,
9 create the RIS directory on all participating replication systems.

The default location for these directories is **/tmp** (UNIX) or **\tmp** (Windows). Specify a location other than **/tmp** or **\tmp** for the spooling directories.

Create the new location for these directories before you define the server for replication. The pathnames for the ATS and RIS directories cannot be longer than 256 characters.

For information about ATS and RIS, refer to Chapter 8, "Monitoring and Troubleshooting Enterprise Replication," on page 8-1.

Preparing the Database Server Environment

To prepare the database server environment, complete the following tasks:
- Setting Environment Variables
- Setting Configuration Parameters

If you are using High-Availability Data (HDR) replication with Enterprise Replication, set up your HDR servers according to the instructions in the section "HDR Requirements" on page 5-4.

Setting Environment Variables

To configure the database server environment, verify that the following environment variables are set correctly:
- INFORMIXDIR is set to the full path of the Informix directory.
- INFORMIXSERVER is set to the name of the default database server.

  For more information, see also "Connect Option" on page A-123.
- INFORMIXSQLHOSTS is set to the full path to the SQLHOSTS file (UNIX) or the SQLHOSTS registry host machine (Windows).

For more information, see the *IBM Informix Administrator's Reference*.

Setting Configuration Parameters

In the ONCONFIG file for each database server, make sure that the following configuration parameters are set:
- DBSERVERNAME is set to the correct database server.

  If you use both DBSERVERNAME and DBSERVERALIASES, DBSERVERNAME should refer to the *TCP* connection and not to a shared-memory connection. For information about database server aliases, refer to the *IBM Informix Dynamic Server Administrator's Guide*.
- CDR_DBSPACE is set to the dbspace for the **syscdr** database. If not set, the root dbspace is used.
- CDR_QUEUEMEM is set to the maximum amount of memory to be used for the send and receive queues.
- CDR_QHDR_DBSPACE is set to the location of the transaction record dbspace.

  For more information, see "Transaction Record dbspace" on page 4-8.
- CDR_QDATA_SBSPACE is set to the location of the row data sbspace.

  If the CDR_QDATA_SBSPACE configuration parameter is not set in ONCONFIG or the sbspace name specified by CDR_QDATA_SBSPACE is invalid, Enterprise Replication fails to define the server.

  For more information, see "Row Data sbspaces" on page 4-9.

- CDR_SERIAL is set to generate non-overlapping (unique) values for SERIAL columns across all database servers in the replication environment.

  For more information, see “Serial Data Types and Primary Keys” on page 2-7.

If you want to suppress certain Datasync error and warning codes from appearing in ATS and RIS files, you can set the CDR_SUPPRESS_ATSRISWARN configuration parameter. See “CDR_SUPPRESS_ATSRISWARN Configuration Parameter” on page B-7 for more information.

If you want to encrypt network communications, make sure that the following configuration parameters are set in the ONCONFIG file for each database server:
- ENCRYPT_CDR is set to `1` or `2` to enable encryption. The default value is `0`, which prevents encryption.
- ENCRYPT_CIPHERS specifies which ciphers and cipher modes are used for encryption.
- ENCRYPT_MAC controls the level of Message Authentication Code (MAC) used to ensure message integrity.
- ENCRYPT_MACFILE is set to the full path and filenames of the MAC files.
- ENCRYPT_SWITCH is set to the number of minutes between automatic renegotiations of ciphers and keys. (The cipher is the encryption methodology. The secret key is the key used to build the encrypted data using the cipher.)

These configuration parameters are documented in Appendix B, “Configuration Parameter and Environment Variable Reference,” on page B-1.

Preparing Data for Replication

The goal of data replication is to provide identical, or at least consistent, data on multiple database servers. This section describes how to prepare the information in your databases for replication.

When you define a new replicate on tables with existing data on different database servers, the data might not be consistent. Similarly, if you add a participant to an existing replicate, you must ensure that all the databases in the replicate have consistent values.

For more information, see “Data Preparation Example” on page 4-19.

Preparing Consistent Data

In most cases, preparing consistent data simply requires that you decide which of your databases has the most accurate data and then that you copy that data onto the target database. If the target database already has data, for data consistency, you must remove that data before adding the copied data. For information on loading the data, see “Loading and Unloading Data” on page 4-17.

Blocking Replication

You might need to put data into a database that you do not want replicated, perhaps for a new server or because you had to drop and re-create a table.

To block replication while you prepare a table, use the BEGIN WORK WITHOUT REPLICATION statement. This starts a transaction that does not replicate to other database servers.

The following code fragment shows how you might use this statement:

```
BEGIN WORK WITHOUT REPLICATION
LOCK TABLE office
DELETE FROM office WHERE description = 'portlandR_D'
COMMIT WORK
```

The following list indicates actions that occur when a transaction starts with BEGIN WORK WITHOUT REPLICATION:

- SQL does not generate any values for the shadow columns (**cdrserver** and **cdrtime**) for the rows that are inserted or updated within the transaction. You must supply values for these columns with the explicit column list. You must supply these values even if you want the column values to be NULL.
- To modify a table with shadow columns that is already defined in Enterprise Replication, you must explicitly list the columns to be modified. The following two examples show an SQL statement and the correct changes to the statement to modify columns:
  - If **table_name1** is a table defined for replication, you must change the following statement:

  ```
  LOAD FROM filename INSERT INTO table_name1;
  ```

  to:

  ```
  LOAD FROM filename INSERT INTO table_name1 \
     (list of columns);
  ```

The list of columns must match the order and the number of fields in the load file.

- If **table_name3** and **table_name4** are tables defined for replication with the same schema, you must change the following statement:

```
INSERT INTO table_name3 SELECT * FROM table_name4;
```

to an explicit statement, where *col1*, *col2*,..., *colN* are the columns of the table:

```
INSERT INTO table_name3 VALUES
      (cdrserver, cdrtime, col1, ..., colN)
   cdrserver, cdrtime *
   FROM table_name4;
```

The shadow columns (**cdrserver** and **cdrtime**) are not included in an * list.

For more information about these statements, refer to the *IBM Informix Guide to SQL: Syntax*.

Using DB-Access to Begin Work Without Replication

The following example shows how to use DB–Access to begin work without replication as well as update the Enterprise Replication shadow columns **cdrserver** and **cdrtime**:

```
DATABASE adatabase;
BEGIN WORK WITHOUT REPLICATION
INSERT into mytable (cdrserver, cdrtime, col1, col2, ....)
   VALUES (10, 845484154, value1, value2, ....);
UPDATE mytable
   SET cdrserver = 10, cdrtime = 945484154
   WHERE col1 > col2;
COMMIT WORK
```

Using ESQL/C to Begin Work Without Replication

The following example shows how to use ESQL/C to begin work without replication as well as update the Enterprise Replication shadow columns **cdrserver** and **cdrtime**:

```
MAIN (argc, argv)
   INT      argc;
   CHAR      *argv[];
{
   EXEC SQL CHAR      stmt[256];
   EXEC SQL database mydatabase;

   sprintf(stmt, "BEGIN WORK WITHOUT REPLICATION");
   EXEC SQL execute immediate :stmt;

   EXEC SQL insert into mytable (cdrserver, cdrtime,
   col1, col2, ...)
   values (10, 845494154, value1, value2, ...);

   EXEC SQL update mytable
   set cdrserver = 10, cdrtime = 845494154
   where col1 > col2;
   EXEC SQL commit work;
}
```

Important: You must use the following syntax when you issue the BEGIN WORK WITHOUT REPLICATION statement from ESQL/C programs. Do not use the '$' syntax.

```
sprintf(stmt, "BEGIN WORK WITHOUT REPLICATION");
EXEC SQL execute immediate :stmt;
```

Preparing to Replicate User-Defined Types

You must install and register user-defined types on all database servers prior to starting replication.

If you are using HDR with Enterprise Replication, follow the instructions in the section "Preparing to Replicate UDTs, UDRs, and DataBlade Modules" on page 5-6.

For Enterprise Replication to be able to replicate opaque user-defined types (UDTs), the UDT designer must provide two support functions, **streamwrite()** and **streamread()**. For more information, see "Replicating Opaque User-Defined Data Types" on page 2-15.

Preparing to Replicate User-Defined Routines

You must install and register user-defined routines on all database servers prior to starting replication.

If you are using HDR with Enterprise Replication, follow the instructions in the section "Preparing to Replicate UDTs, UDRs, and DataBlade Modules" on page 5-6.

Preparing Tables for Conflict Resolution

To use any conflict-resolution rule other than *ignore*, you must define the shadow columns, **cdrserver** and **cdrtime**.

Tip: If you plan to use only the ignore conflict-resolution rule, you do not need to define the **cdrserver** and **cdrtime** shadow columns.

For more information about update-anywhere and conflict resolution, see "Update-Anywhere Replication System" on page 3-5.

To define the shadow columns in your table, use the following statements:

- For new tables, use:

```
CREATE TABLE table_name WITH CRCOLS;
```

- For existing tables, use:

```
ALTER TABLE table_name ADD CRCOLS;
```

Important: If a table already participates in Enterprise Replication, you must stop replication before altering it with the ADD CRCOLS clause. For more information, see "Stopping a Replicate" on page 7-6.

To drop the **cdrserver** and **cdrtime** shadow columns, use:

```
ALTER TABLE table_name DROP CRCOLS;
```

Tip: The ADD CRCOLS and DROP CRCOLS clauses to the ALTER TABLE statement are now processed as in-place alters in most cases. For more information, see the section on in-place alters in the *IBM Informix Performance Guide*. For more information on CREATE TABLE and ALTER TABLE, see the sections in the *IBM Informix Guide to SQL: Syntax*.

Preparing Logging Databases

Databases on all server instances involved in replication must be created with logging. For best results, use unbuffered logging. For more information, see "Unbuffered Logging" on page 2-6.

Loading and Unloading Data

If you are adding a table to your already existing replication environment, Enterprise Replication provides an initial synchronization feature that allows you to easily bring a new table up-to-date with replication. You can synchronize the new table with data on the source server you specify when you start the new replicate, or when you add a new participant to an existing replicate. You do not need to suspend any servers that are replicating data while you add the new replicate and synchronize it. See "Initially Synchronizing Data Among Database Servers" on page 6-11 for more information.

Otherwise, if you have not yet set up your replication environment, for loading data, you can use the following tools:

- High-Performance Loader
- onunload and onload Utilities
- dbexport and dbimport Utilities
- UNLOAD and LOAD Statements

When you unload and load data, you must use the same type of utility for both the unload and load operations. For example, you cannot unload data with the **onunload** utility and then load the data with a LOAD statement.

If you are using HDR with Enterprise Replication, follow the instructions in the section "Loading and Unloading Data" on page 5-7.

If the table that you are preparing for replication is in a database that already uses replication, you might need to block replication while you prepare the table. For information on how to do this, see "Blocking Replication" on page 4-14.

If a table that you plan to replicate includes the shadow columns, **cdrserver** and **cdrtime**, the statements that you use for unloading the data must explicitly name the shadow columns. If you use the SELECT statement with * FROM *table_name* to the data to unload, the data from the shadow columns will not be unloaded. To include the shadow columns in the unloaded data, use a statement like the following:

```
SELECT cdrserver, cdrtime, * FROM table_name
```

For more information, see "Shadow Columns" on page 2-7.

High-Performance Loader

The High-Performance Loader (HPL) provides a high-speed tool for moving data between databases.

How you use the HPL depends on how you defined the tables to replicate. If the table definition included the WITH CRCOLS clause, you must take special steps when you unload the data.

If the table contains shadow columns, you must:

- Include the **cdrserver** and **cdrtime** columns in your map when you load the data.
- Use express mode to load data that contains the **cdrserver** and **cdrtime** columns. You must perform a level-0 archive after completion.

You can also use deluxe mode without replication to load data. After a deluxe mode load, you do not need to perform a level-0 archive. Deluxe mode also allows you to load TEXT and BYTE data and opaque user-defined types.

For information about HPL, refer to the *IBM Informix High-Performance Loader User's Guide*.

onunload and onload Utilities

You can use the **onunload** and **onload** utilities only to unload and load an entire table. If you want to unload selected columns of a table, you must use either the UNLOAD statement or the HPL.

Important: You can only use **onunload** and **onload** in identical (homogeneous) environments.

For more information about **onunload** and **onload**, see the *IBM Informix Migration Guide.*

dbexport and dbimport Utilities

If you need to copy an entire database for replication, you can use the **dbexport** and **dbimport** utilities. These utilities unload an entire database, including its schema, and then re-create the database. If you want to move selected tables or selected columns of a table, you must use some other utility.

For more information about **dbexport** and **dbimport**, see the *IBM Informix Migration Guide.*

UNLOAD and LOAD Statements

The UNLOAD and LOAD statements allow you to move data within the context of an SQL program.

If the table contains shadow columns, you must:

- Include the **cdrserver** and **cdrtime** columns explicitly in your statement when you unload your data.
- List the columns that you want to load in the INSERT statement and explicitly include the **cdrserver** and **cdrtime** columns in the list when you load your data.

For more information about the UNLOAD and LOAD statements, see the *IBM Informix Guide to SQL: Syntax.*

Data Preparation Example

The following examples show how to add a new participant (**delta**) to an existing replicate by two different methods:

- Using the **cdr start replicate** command

  This method is simple and can be done while replication is online.
- Using the LOAD, UNLOAD, and BEGIN WORK WITHOUT REPLICATION statements.

  If you use HPL, this method can be faster for a large table.

Replicate **zebra** replicates data from table **table1** for the following database servers: **alpha**, **beta**, and **gamma**.

The servers **alpha**, **beta**, and **gamma** belong to the server groups **g_alpha**, **g_beta**, and **g_gamma**, respectively. Assume that **alpha** is the database server from which you want to get the initial copy of the data.

Using the cdr start replicate Command

To add a new participant to an existing replicate:

1. Declare server **delta** to Enterprise Replication. For example:
   ```
   cdr def ser -c delta -I -S g_alpha g_delta
   ```
   At the end of this step, all servers in the replication environment include information in the **syscdr** database about **delta**, and **delta** has information about all other servers.
2. Add **delta** as a participant to replicate **zebra**. For example:
   ```
   cdr cha rep -a zebra "dbname@g_delta:owner.table1"
   ```
   This step updates the replication catalog. The servers **alpha**, **beta**, and **gamma** do not queue any qualifying replication data for **delta** because the replicate on **delta**, although defined, has not been started.
3. Start replication for replicate **zebra** on **delta**.
   ```
   cdr sta rep zebra g_delta -S g_alpha -e delete
   ```
   The **-S g_alpha** option specifies that the server **alpha** be used as the source for data synchronization.

   The **-e delete** option indicates that if there are rows on the target server, **delta**, that are not present on the synchronization data server (**alpha**) then those rows are deleted

   Do not run any transactions on **delta** that affect table **table1** until you finish the synchronization process.

Using LOAD, UNLOAD, and BEGIN WORK WITHOUT REPLICATION

To add a new participant to an existing replicate:

1. Declare server **delta** to Enterprise Replication. For example:

   ```
   cdr def ser -c delta -I -S g_alpha g_delta
   ```

   At the end of this step, all servers in the replication environment include information in the **syscdr** database about **delta**, and **delta** has information about all other servers.
2. Add **delta** as a participant to replicate **zebra**. For example:

   ```
   cdr cha rep -a zebra "dbname@g_delta:owner.table1"
   ```

   This step updates the replication catalog. The servers **alpha**, **beta**, and **gamma** do not queue any qualifying replication data for **delta** because the replicate on **delta**, although defined, has not been started.
3. Suspend server to **delta** on **alpha**, **beta**, and **gamma**.

   ```
   cdr sus ser g_alpha g_beta g_gamma
   ```

   As a result of this step, replication data is queued for **delta**, but no data is delivered.
4. Start replication for replicate **zebra** on **delta**.

   ```
   cdr sta rep zebra g_delta
   ```

   This step causes servers **alpha**, **beta**, and **gamma** to start queueing data for **delta**. No data is delivered to **delta** because **delta** is suspended. Then, **delta** queues and delivers qualifying data (if any) to the other servers.

   Do not run any transactions on **delta** that affect table **table1** until you finish the synchronization process.
5. Unload data from table **table1** using the UNLOAD statement or the **unload** utility on HPL.
6. Copy the unloaded data to **delta**.
7. Start transactions with BEGIN WORK WITHOUT REPLICATION, load the data using the LOAD statement, and commit the transactions.

   If you used the HPL to unload the data in step 5, then use the HPL Deluxe load without replication to load the data into **table1** on **delta**.
8. Resume server **delta** on **alpha**, **beta**, and **gamma**.

   This step starts the flow of data from **alpha**, **beta**, and **gamma** to **delta**.

   At this point, you might see some transactions aborted because of conflict. Transactions can abort because **alpha**, **beta**, and **gamma** started queueing data from **delta** in step 4. However, those same transactions might have been moved in steps 5 and 7.

You must declare replication on server **delta** and then immediately suspend replication because, while you are preparing the replicates and unloading and loading files, the other servers in the replicate (**alpha**, **beta**, and **gamma**) might be collecting information that needs to be replicated. After you finish loading the initial data to **delta** and resume replication, the information that was generated during the loading process can be replicated.

Chapter 5. Using High-Availability Data Replication with Enterprise Replication

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High-Availability Replication System 5-1
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Using HDR in a Forest of Trees Topology 5-3
Preparing HDR Database Servers 5-4
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In This Chapter

This chapter covers how to include High-Availability Data Replication (HDR) in your Enterprise Replication system. The following topics are covered:

- The design of a high-availability replication system using HDR
- Preparing HDR database server
- Managing Enterprise Replication with HDR

For a complete description of HDR, see the *IBM Informix Dynamic Server Administrator's Guide*.

High-Availability Replication System

You can combine Enterprise Replication and HDR to create a high-availability replication system in which a critical read-write database server in an Enterprise Replication system maintains a backup server with HDR.

An HDR system consists of two database servers: the primary database server, which receives updates, and the secondary, read-only copy of the primary database server. The secondary server is a mirror image of the primary system and is in perpetual recovery mode, applying logical-log records from the primary server to its dbspaces and sbspaces.

The HDR secondary server does not participate in Enterprise Replication; it receives updates through HDR. When the HDR primary server receives an update through Enterprise Replication, the transaction is not committed until the log records containing that transaction are sent to the secondary server. If the primary server becomes unavailable, you replace it with the secondary server by switching the secondary server into standard mode and redirecting connections to it.

High-availability replication systems are most useful for replication systems in which the failure of a critical server prevents other servers from participating in replication. Figure 5-1 illustrates the combination of a primary-target replication system with a high-availability replication system.

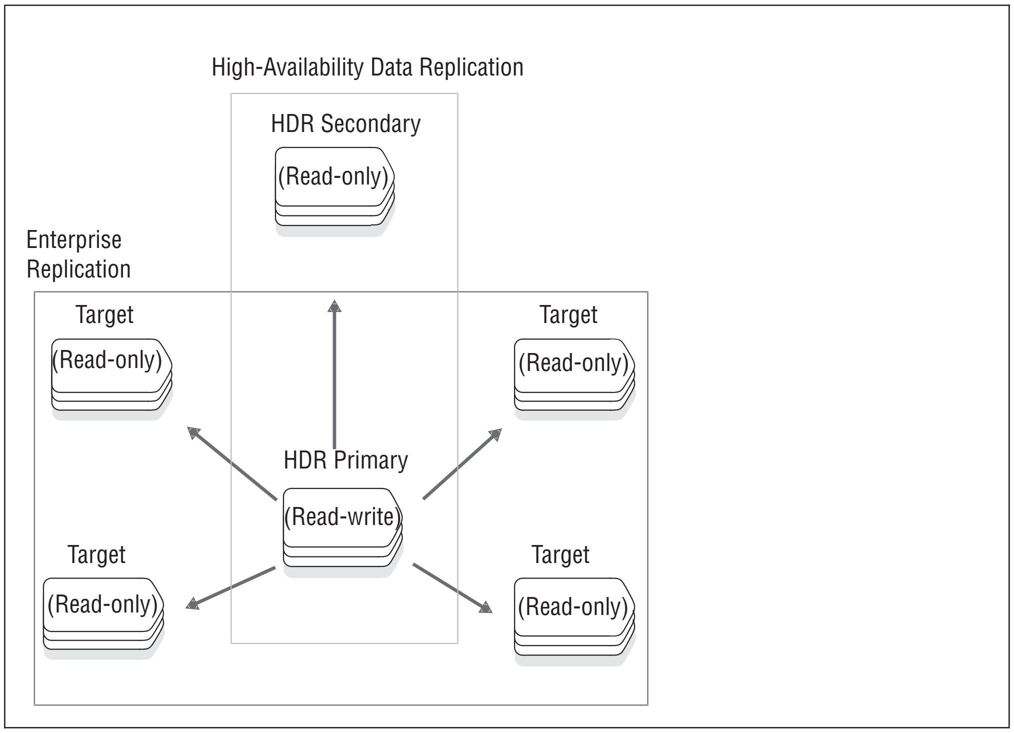

Figure 5-1. Using High-Availability with a Primary-Target Replication System

If the primary server fails, the secondary server is set to standard mode, the target database connections are redirected to it, and Enterprise Replication continues, as illustrated in Figure 5-2.

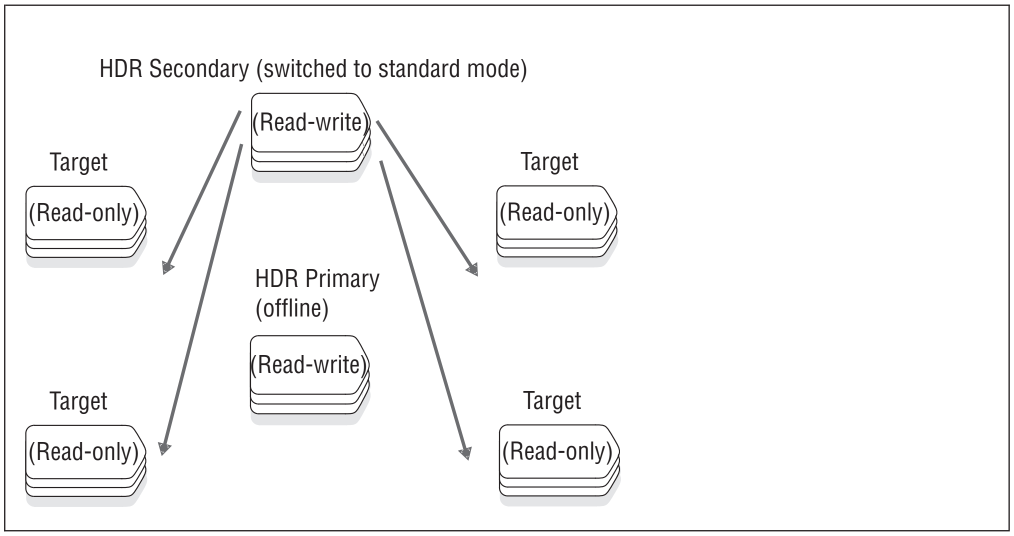

Figure 5-2. Redirection to the Secondary Database Server

In an update-anywhere replication system, you can use HDR with any server for which you need high availability, as illustrated in Figure 5-3.

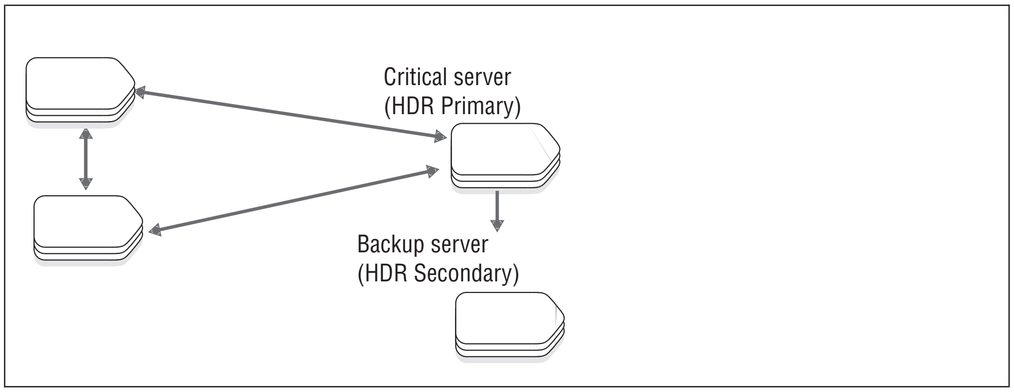

Figure 5-3. Using High Availability with an Update-Anywhere Replication System

Using HDR with Enterprise Replication is particularly effective when you use a hierarchical or a forest of trees topology.

Using HDR in a Hierarchical Tree Topology

With a hierarchical tree topology, parent servers are good candidates for using HDR to provide backup servers. The following example is based on the example in Figure 3-7 on page 3-14.

If **China** fails, then **Beijing** and **Shanghai** can no longer replicate with other servers in the replication system; **Guangzhou** and **Hong Kong** can only replicate with each other. However, if **China** participated in HDR, when it failed, the secondary server would replace it and replication could continue, as illustrated in Figure 5-4.

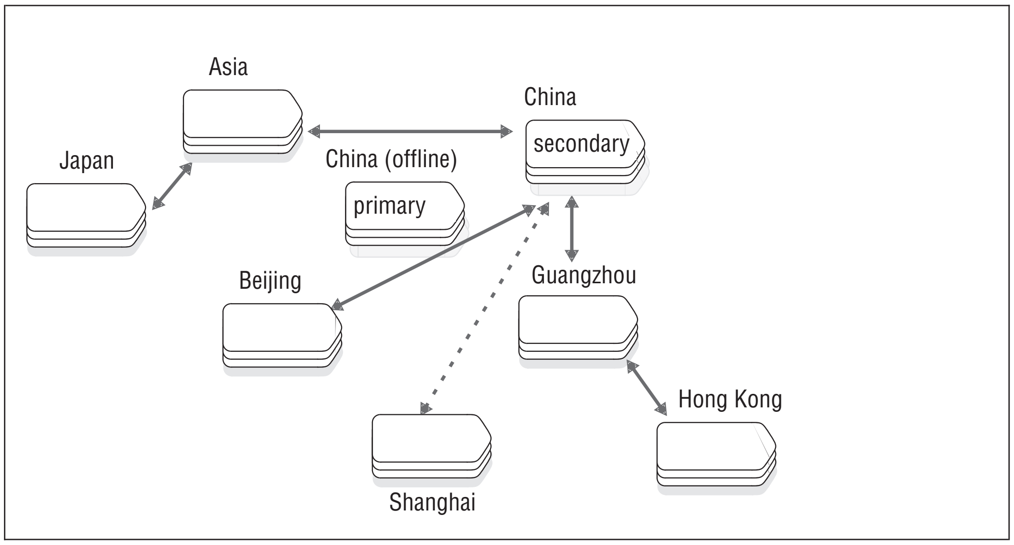

Figure 5-4. Hierarchical Tree Topology with HDR

In this example, **Asia** and **Guangzhou**, which are also parent servers, could also benefit from using HDR to ensure high availability.

Using HDR in a Forest of Trees Topology

Use HDR to ensure that all servers retain access to the replication system in a forest of trees topology.

For example, in Figure 3-8 on page 3-15, **Asia**, **Europe**, **China**, and **Guangzhou** should use HDR to provide backup servers, as illustrated in Figure 5-5.

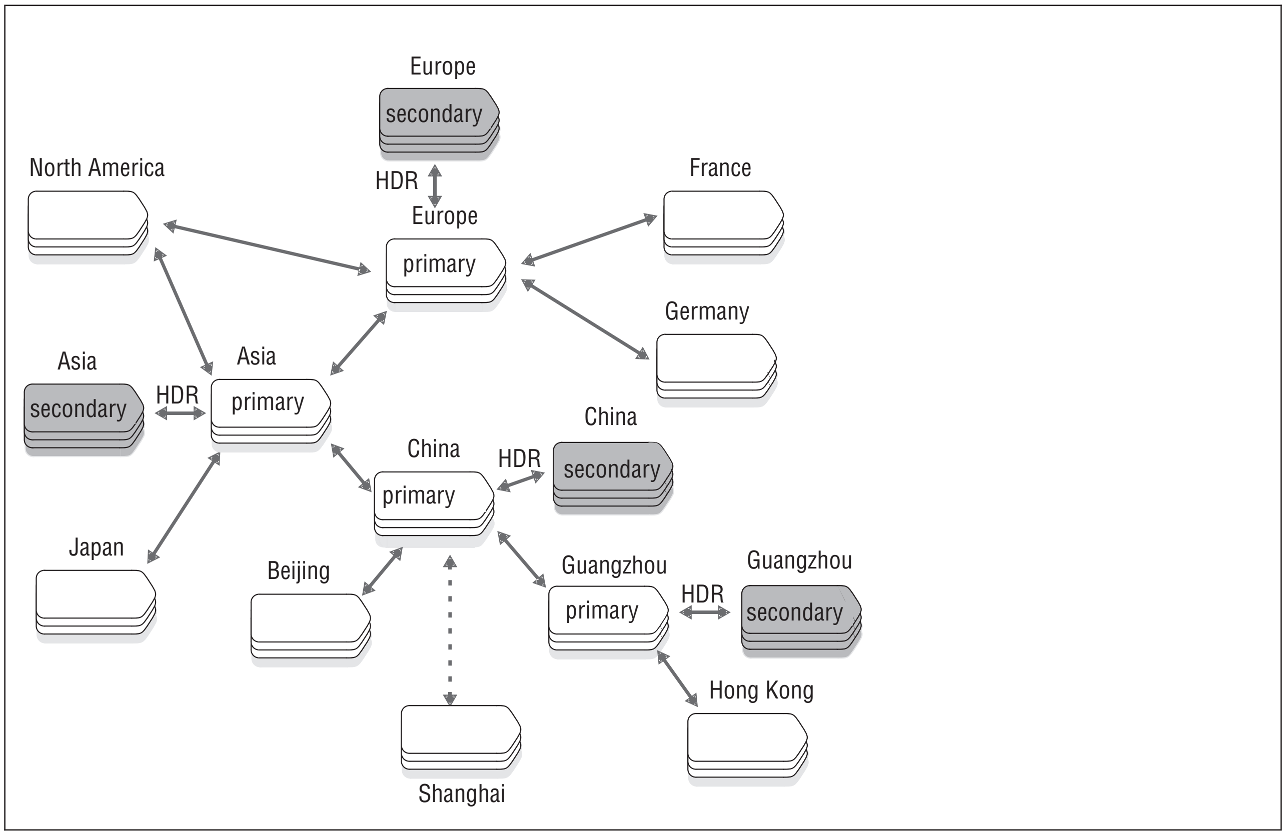

Figure 5-5. HDR in a Forest-of-Trees Topology

Preparing HDR Database Servers

To prepare HDR database server for Enterprise Replication, perform the following tasks:

- Configure HDR database servers according to HDR requirements.
- Set up the SQLHOSTS file with both the primary and secondary HDR servers as members of the same database server group.
- Install and register user-defined data types, user-defined routines, and DataBlade modules.
- Load data using backup and restore procedures.

Important: HDR does not support encryption. If you combine Enterprise Replication with HDR, communication between Enterprise Replication servers and the HDR primary server can be encrypted, but the communication between the HDR primary server and the HDR secondary server cannot be encrypted. For more information, see "ENCRYPT_CDR Configuration Parameter" on page B-7.

HDR Requirements

Make sure the HDR database servers meet HDR requirements in the following categories:

- Hardware and operating-system requirements

For example, the hardware and operating system of the computers running the primary and secondary database servers must be identical.

- Database and data requirement

  For example, all databases must have logging turned on and all data must reside in logged dbspaces or sbspaces.
- Database server configuration requirements

  For example, the database server version, storage space and chunk configuration, and many other configurations must be identical.
- Connectivity

  For example, the connectivity information on each of the computers must identify the database server running on it and the other database server in the HDR pair.

For a complete list of configuration requirements, see the *IBM Informix Dynamic Server Administrator's Guide*.

Setting Up Database Server Groups

When defining an HDR server pair within Enterprise Replication, the HDR server pair must appear to be a single logical entity within the replication domain. To accomplish this, define the two HDR servers within the same database server group in the SQLHOSTS file. For example, Figure 5-6 illustrates two Enterprise Replication nodes, one of which is an HDR pair.

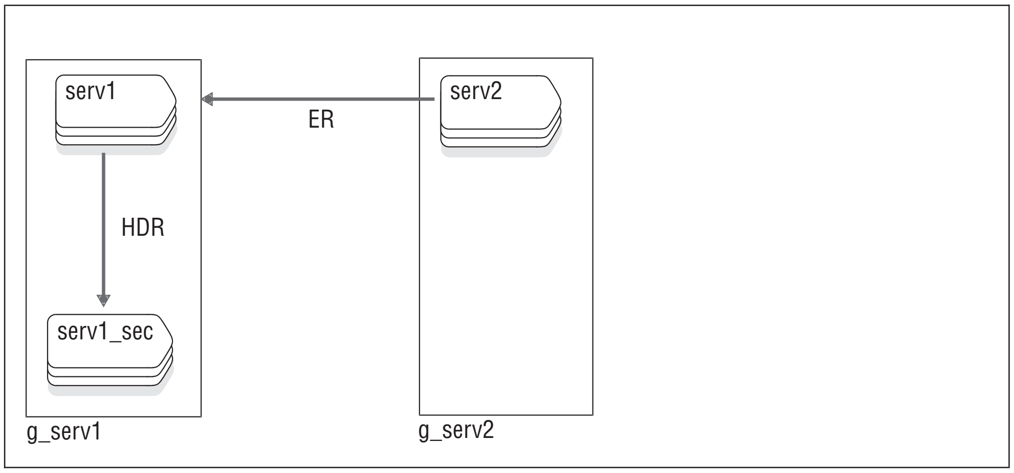

Figure 5-6. Database Server Groups for Enterprise Replication with HDR

In this example, the HDR pair consists of the primary server, **serv1**, and the secondary server, **serv1_sec**. These two servers belong to the same database server group, **g_serv1**. The non-HDR server, **serv2**, belongs to the database server group **g_serv2**. The following example displays the SQLHOSTS file for this configuration.

dbservername	nettype	hostname	servicename	options
g_serv1	group	-	-	i=1
serv1	ontlitcp	machine1pri	port1	g=g_serv1
serv1_sec	ontlitcp	machine1sec	port1	g=g_serv1
g_serv2	group	-	-	i=2
serv2	ontlitcp	machine2	port1	g=g_serv2

For more information on setting up the SQLHOSTS file, see "Verifying SQLHOSTS" on page 4-3.

Either HDR or Enterprise Replication can be set up first on the HDR pair **serv1** and **serv1_sec**, but Enterprise Replication **cdr** commands must be executed only on the primary server. If any **cdr** commands are attempted on the secondary server, a –117 error is returned: `Attempting to process a cdr command on an HDR secondary server`.

Hardware and Operating System Requirements for HDR

For an HDR database server pair to function, it must meet the following hardware requirements:

- Must use the same hardware and software for the system where the primary server resides and for the system where secondary system resides. If the system where the secondary server resides has fewer resources than the system where the primary server resides, it is possible that the standby server will be unable to keep up with the transaction load generated by the primary server.
- The computers that run the primary and secondary database servers must be identical. They must be from the same vendor and have the same architecture.
- The operating systems on the computers that run the primary and secondary database servers must be identical. They must have the same version, including patches.

  Note: You can violate this rule for a short time during a rolling upgrade, but take extreme caution.
- The hardware that runs the primary and secondary database servers must support network capabilities.
- The amount of disk space allocated to dbspaces for the primary and secondary database servers must be equal. The type of disk space is irrelevant.

Preparing to Replicate UDTs, UDRs, and DataBlade Modules

If you are using HDR with Enterprise Replication with user-defined types, user-defined routines, or DataBlade modules, perform the tasks shown in Table 5-1 on the primary and secondary database servers.

Table 5-1. Preparing to Replicate UDTs, UDRs, and DataBlade Modules

Step	On the Primary	On the Secondary
1.	Install the user-defined types, user-defined routines, or DataBlade modules.	Install the user-defined types, user-defined routines, or DataBlade modules.
2.	Register the user-defined types, user-defined routines, or DataBlade modules.	

When you start HDR, the user-defined types, user-defined routines, or DataBlade modules are registered on the secondary database server. For instructions on starting HDR, see the *IBM Informix Dynamic Server Administrator's Guide*.

Loading and Unloading Data

After you load data onto the HDR primary database server, use backup and restore procedures to load the data onto the HDR secondary database server. For instructions, see the *IBM Informix Dynamic Server Administrator's Guide*.

Managing Enterprise Replication with High-Availability Data Replication

This section describes how to manage Enterprise Replication with HDR in the following areas:

- Row data sbspace logging
- HDR failure
- Performance

Row Data Sbspace Logging

All sbspaces used by Enterprise Replication with HDR for spooled transaction row data must be created with logging enabled. For more information, see "Row Data sbspaces" on page 4-9.

HDR Failure

If the primary server within an HDR pair fails, the secondary server can be switched to standard mode by executing the **onmode –d standard** command. However, you must manually start Enterprise Replication by executing the **cdr start** command on that server. This is necessary to prevent Enterprise Replication from starting on both servers in an HDR pair. Table 5-2 shows how to switch the secondary server to standard mode.

Table 5-2. Switching the Secondary Server to Standard Mode

Step	On the Primary	On the Secondary
1.	The server becomes unavailable.	
2.		**onmode command** onmode -d standard
3.		**cdr command** cdr start

If you need to start the primary server while Enterprise Replication is running on the secondary server, use the **oninit –D** command to prevent Enterprise Replication and HDR from starting on the primary server.

If the problem has been resolved on the primary server and you wish to reestablish it as the primary server, then first stop Enterprise Replication on the secondary server. Otherwise, Enterprise Replication attempts to restart on the primary server while it is still active on the secondary server. Table 5-3 shows how to reestablish the primary server.

Table 5-3. Reestablishing the Primary Server

Step	On the Primary	On the Secondary
1.		**cdr command** cdr stop
2.		**onmode command** onmode -s
3.		**onmode command** onmode -d secondary
4.	oninit	
5.	**cdr command** cdr start	

If you want to split an active HDR pair into two stand-alone servers, then you must be careful to avoid Enterprise Replication starting on either server after they are split. To prevent Enterprise Replication and HDR from running, start the database servers with the **oninit –D** command.

If you remove a server from an HDR pair, use the **cdr remove** command to eliminate Enterprise Replication from that server. For example, the two HDR servers are being split and the secondary server is to be used for reporting purposes. After the report processing is complete, HDR can be reestablished. Table 5-4 shows how to remove a secondary server from HDR and Enterprise Replication.

Table 5-4. Removing the Secondary Server from HDR and ER

Step	On the Primary	On the Secondary
1.	**onmode command** onmode -d standard	**onmode command** onmode -d standard
2.		**cdr command** cdr remove

If the HDR primary server has problems communicating to its secondary server, Enterprise Replication is in a suspended state until one of the following actions is taken:

- Resolve the connection problem between HDR pairs.
- Convert the primary server to standard mode.

For more information on managing HDR servers, see the *IBM Informix Dynamic Server Administrator's Guide*.

Performance Considerations

When Enterprise Replication is running on an HDR pair, some operations cannot be performed until the logs are shipped to the secondary server. This delay prevents possible inconsistency within the Enterprise Replication domain during an HDR switch-over to a secondary server. Consequently, there is a slight increase in replication latency when Enterprise Replication is used with HDR. You can control this latency increase by setting the DRINTERVAL configuration parameter to a low value.

Chapter 6. Defining Replication Servers, Replicates, Participants, and Replicate Sets

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Defining Replication Servers . . . 6-2
  Customizing the Replication Server Definition . . . 6-3
Defining Replicates . . . 6-3
  Defining Participants . . . 6-4
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In This Chapter

This chapter describes the steps for declaring a database server for Enterprise Replication.

To define a replication server:

1. Initialize the database server.

   For information, see “Initializing Database Servers” on page 6-2.
2. Declare the database server to Enterprise Replication.

   For information, see “Defining Replication Servers” on page 6-2.

   After you define the server for replication, the server is known as a *replication server*.
3. Define replicates.

   The *replicate* definition includes information about the participants, replication options, frequency, and conflict-resolution rules and scope.

   For information, see “Defining Replicates” on page 6-3.
4. Define participants.

A *participant* definition specifies the data (database, table, and columns) that should be replicated. Although you can define a replicate with fewer, a replicate should contain two or more participants to be useful.

For information, see "Defining Participants" on page 6-4.

This chapter also covers the following topics:
- Defining replicate sets
- Initial data synchronization

For information on managing your replication servers and replicates, see Chapter 7, "Managing Replication Servers and Replicates," on page 7-1.

Initializing Database Servers

The database server must be online before you can declare it for replication.

To bring the server from offline to online, issue the following command for your operating system.

Operating System	Command
UNIX	**oninit**
Windows	**start** *dbservername*

To bring the server from quiescent mode to online on either UNIX or Windows, enter **onmode -m**.

For more information on initializing the database server, see the chapter on database operating modes in the *IBM Informix Administrator's Guide*.

Defining Replication Servers

After you bring the database server online, the next step is to declare the server to Enterprise Replication.

Important: You must be the Enterprise Replication server administrator to define the replication server. For more information about the server administrator, see "Enterprise Replication Server Administrator" on page 2-2.

To define the replication server, use the **cdr define server** command. For example:

```
cdr define server  [--connect=server_name] \
   options --init server_group_name
```

The **--init** option initializes the server. If the INFORMIXSERVER environment variable is not set to the server that you are defining, specify the **--connect=*server_name*** option. For more information, see "Connecting to Another Replication Server" on page 7-2.

Tip: All Enterprise Replication commands and options use the name of the database server group, also known as a server group, instead of the more familiar database server name for all references to database servers (except the **--connect** option, which can use either). This manual uses the convention that the name of a server group begins with **g_** .

Important: If the CDR_SBSPACE configuration parameter is not set in ONCONFIG or specifies an invalid sbspace, Enterprise Replication fails to define the server. For more information, see "Row Data sbspaces" on page 4-9.

Customizing the Replication Server Definition

When you define a replication server, you can change the following aspects of the server in the replication environment:

- Synchronize the new server's global catalog with another Enterprise Replication server. For information on the global catalog, see "Global Catalog" on page 2-4.

  For all servers except the first server you define in your Enterprise Replication system, you must use the **--sync=*sync_server*** option in your server definition to synchronize the global catalog with an existing server.

  For Hierarchical Routing (HR) topologies, Enterprise Replication also uses the synchronization server as the parent of the new server in the current topology. For example, if you add a new server **kauai** and synchronize its global catalog with **hawaii**, **kauai** is connected to **hawaii** in the Enterprise Replication topology. For information on topologies, see "Choosing a Replication Network Topology" on page 3-11.
- Set the idle timeout.

  To specify the time (in minutes) that you want to allow the connection between two Enterprise Replication servers to remain idle before disconnecting, use the **--idle=*timeout*** option.
- Specify the location of the ATS and RIS directories.

  9 To use ATS or RIS files, specify the directory for the files for the server using
  9 **--ats=*dir*** or**--ris=*dir*** . To prevent either ATS or RIS file generation, set the
  9 directory to **/dev/null** (UNIX) or **NUL** (Windows).

  For more information, see "Creating ATS and RIS Directories" on page 4-12.
- Specify the type of server if you are using hierarchical replication:
  - To specify the server as a nonroot server, use **--nonroot.**
  - To specify the server as a leaf server, use **--leaf**.

  If neither **--leaf** nor **--nonroot** is specified, the server is defined as a root server.

For more information, see "cdr define server" on page A-30.

Defining Replicates

To define a replicate, use the **cdr define replicate** command.

You can provide the following information in the replicate definition:

- Participants
- Create as a master replicate
- Conflict resolution rules and scope
- Replication frequency
- Error logging
- Replicate full rows or only changed columns
- IEEE or canonical message formats
- Database triggers

After you define the replicate and participants, you must manually start the replicate using the command.

Defining Participants

You must define a participant for each server involved in the replicate in the replicate definition using the **cdr define replicate** command. Each participant in a replicate must specify a different database server.

Important: You cannot start and stop replicates that have no participants.

Each participant definition includes the following information:

- Database server group name
- Database in which the table to be replicated resides
- Table name
- Table owner

  See "Table Owner" on page A-125.
- SELECT statement and optional WHERE clause

  See "Participant Modifier" on page A-125.

  If you use a SELECT * FROM *table_name* statement, the tables must be identical on all database servers defined for the replicate.

Important: Do not create more than one participant definition for each row and column to replicate. If the participant is the same, Enterprise Replication attempts to insert or update duplicate values during replication. For example, if one participant modifier includes WHERE x < 50 and another includes WHERE x < 100, Enterprise Replication sends the data for when x is between 50 and 100 twice.

In addition, for a primary-target replication system, you can specify the participant type as either *primary* or *target* (receive-only). If you do not specify the participant type, Enterprise Replication defines the participant as update-anywhere, by default. For more information, see "Primary-Target Replication System" on page 3-1 and "Participant Type" on page A-125.

For example, in the following participant definition, the `P` indicates that in this replicate, **hawaii** is a primary server:

```
"P db1@g_hawaii:informix.mfct" "select * from mfct" \
```

If any data in the selected columns changes, that changed data is sent to the secondary servers.

In the following example, the `R` indicates that in this replicate, **maui** is a secondary server:

```
"R db2@g_maui:informix.mfct" "select * from mfct"
```

The specified table and columns receive information sent from the primary server. Changes to those columns on **maui** are *not* replicated.

Important: The **R** in the participant definition indicates that the table is *receive-only* mode, not that the table is in read-only mode.

If you do not specify the participant type, Enterprise Replication defines the participant as update-anywhere by default. For example:

```
"db1@g_hawaii:informix.mfct" "select * from mfct" \
"db2@g_maui:informix.mfct" "select * from mfct"
```

For more information, see “Participant” on page A-124.

Defining Replicates on Table Hierarchies

When you define replicates on inherited table hierarchies, use the following guidelines to replicate operations:

- For both the parent and child tables, define a replicate on each table.
- For only the parent table (not the child table), define a replicate on the parent table only.
- For only the child table (not the parent table), define a replicate on the child table only.

Defining Master Replicates

To guarantee consistency between the nodes in your Enterprise Replication environment, you can define *master replicates* using the **cdr define replicate** command with the **--master** option. Dictionary information is then stored about replicated column attributes for the participant you specify. This enables Enterprise Replication to check for consistency between this master definition and local participant definitions. Checks are performed when the replicate is defined and each time a new participant is added to the replicate, thus avoiding runtime errors. Verification also occurs each time the master replicate is started on a server.

Defining a replicate as a master replicate provides several advantages:

- Ensures data integrity by verifying that all participants in the replicate have table and replicated column attributes that match the master replicate definition.
- Provides automatic table generation on participants that do not already contain the table specified in the master replicate. However, Enterprise Replication cannot create tables with user-defined data types.
- Allows alter operations on the replicated tables. For more information, see “Performing Alter Operations on Replicated Tables” on page 7-16.

When you define a master replicate, you must specify a participant that is on the server for which you are running the command. This participant is used to create the dictionary information for the master replicate. If you specify additional participants in the **cdr define replicate** command, they are verified against the master definition and added to the replicate if they pass validation. If any participant fails validation, the **cdr define replicate** command fails and that participant is disabled.

The master replicate options, described in subsections below, are:

- **--name**

  Use this option to create a strict master replicate that supports alter operations and remastering.
- **--empty**

  Use this option to create an empty master replicate and add participants later.

Master Replicate Verification

Enterprise Replication verifies the following information about a participant when the participant is added to the master replicate:

- The participant contains all replicated columns.
- The replicated columns in the participant have the correct data types. For columns that are user-defined data types, only the names of the data types are verified.

- Optionally, the replicated columns in the participant have the same column names as the master replicate.

Creating Strict Master Replicates

You can create a strict master replicate in which all participants have the same replicated column names by using the **--name=y** option. This option specifies that when the master replicate verification is done for a new participant, that the column names on the participant must be identical to the column names of the master replicate. Strict master replicates allow you to perform the following tasks:

- Alter operations on replicated tables. For more information, see "Performing Alter Operations on Replicated Tables" on page 7-16.
- Remastering by using the **cdr remaster** command. For more information, see "Remastering a Replicate" on page 7-20.

You can modify an existing master replicate to remove name verification by using the **--name=n** option of the **cdr modify replicate** command.

Creating Empty Master Replicates

You can create an empty master replicate by using the **--empty** option. This option allows you to specify a participant as the basis of the master replicate but not include that participant in the replicate. Creating an empty replicate can be convenient in large environments in which you later add all participants using scripts.

When you define an empty master replicate, you must specify only one participant in the **cdr define replicate** command. This participant is used to create the master dictionary information but is not added to the replicate.

The **--empty** option is only supported for master replicates, you cannot use it without the **--master** option.

Defining Shadow Replicates

A *shadow replicate* is a copy of an existing, or primary, replicate. Enterprise Replication uses shadow replicates to manage alter and repair operations on replicated tables. You must create a shadow replicate to perform a manual remastering of a replicate that was defined with the **-n** option. See "Resynchronizing Data Manually" on page 7-16 for information about how you can repair, or remaster, your replicated data. After creating the shadow replicate, the next step in manual remastering is to switch the primary replicate and the shadow replicate using the **cdr swap shadow** command.

You create a shadow replicate using the **cdr define replicate** command with the **--mirrors** option, as described in "cdr define replicate" on page A-21.

When you define a shadow replicate, its state is always set to the same state as the primary replicate. If you change the state of the primary replicate, all its shadow replicates' states are also changed to the same state.

You cannot delete a primary replicate if it has any shadow replicates defined. You must first delete the shadow replicates, and then the primary replicate.

You cannot modify a primary replicate (using the **cdr modify replicate** command) if it has any shadow replicates defined. Also, you cannot modify shadow replicates directly.

You cannot suspend or resume a primary replicate (using the **cdr suspend replicate** or **cdr resume replicate** command) if it has any shadow replicates defined. Also, you cannot suspend or resume shadow replicates directly. If the primary replicate and its shadow replicates are part of an exclusive replicate set, you can suspend or resume the entire replicate set using the **cdr suspend replicate** or **cdr resume replicate** command.

You cannot add a participant to a shadow replicate:
- If the participant is not part of the primary replicate's definition
- After remastering the replicate

If the primary replicate is part of an exclusive replicate set, any shadow replicates you define are automatically added to that replicate set.

If you add a primary replicate to an exclusive replicate set, all its shadow replicates are also automatically added. If you delete a primary replicate from an exclusive replicate set, all its shadow replicates are also automatically deleted.

Specifying Conflict Resolution Rules and Scope

For update-anywhere replication systems, you must specify the conflict-resolution rules in the replicate definition using the **--conflict=*rule*** option. The conflict resolution rules are:
- **always-apply**
- **ignore**
- **timestamp**
- ***routine_name***

  If you use an SPL routine for your conflict-resolution rule, you can also use the **--optimize** option to specify that the routine is optimized.

For more information, see the following:
- "Update-Anywhere Replication System" on page 3-5
- "Conflict-Resolution Rule" on page 3-6
- "Conflict Options" on page A-23

You can also specify the scope using the **--scope=*scope*** option:
- **transaction** (default)
- **row**

For more information, see "Scope" on page 3-11, and "Scope Options" on page A-24.

Specifying Replication Frequency

The replication frequency options allow you to specify the interval between replications, or the time of day when an action should occur. If you do not specify the frequency, the default action is that replication always occurs immediately when data arrives.

The frequency options are:
- **--immed**
- **--every=*interval***
- **--at=*time***

For more information, see "Frequency Options" on page A-126.

Important: If you use time-based replication and two tables have referential constraints, the replicates must belong to the same exclusive replicate set. For more information, see "Exclusive Replicate Sets" on page 6-10.

Setting Up Error Logging

The Aborted Transaction Spooling (ATS) files and Row Information Spooling (RIS) files contain information about failed transactions and aborted rows. You can use this information to help you diagnose problems that arise during replication. For more information about these files, refer to Chapter 8, "Monitoring and Troubleshooting Enterprise Replication," on page 8-1.

Recommendation:: Until you become thoroughly familiar with the behavior of the replication system, you select both ATS and RIS options.

To configure your replicate to use ATS and RIS:

1. Set up the ATS and RIS directories. For instructions, see "Creating ATS and RIS Directories" on page 4-12.
2. Specify the location of the ATS and RIS directories when you define your server. For instructions, see "Defining Replication Servers" on page 6-2.
3. Specify that the replicate use ATS and RIS when you define the replicate by including the **--ats** and **--ris** options in the replicate definition.

For more information, see "Special Options" on page A-24.

Replicating Only Changed Columns

By default, Enterprise Replication replicates the entire row, even if only one column changed, however, any data that is stored out-of-row, such as a smart large object, is replicated only when it is modified. (For more information on how Enterprise Replication evaluates data for replication, see "Evaluating Data for Replication" on page 1-8.)

You can change the default behavior to replicate only the columns that changed. To replicate only changed columns, include the **--fullrow n** option in the replicate definition.

Tip: Enterprise Replication always sends the primary key column, even if you specify to replicate only changed columns.

Replicating only the columns that changed has the following advantages:

- Sends less data

  For example, when you replicate a row with a large column that changes infrequently and a small column that changes frequently, Enterprise Replication sends significantly less data each time it updates the row if it only replicates the changed columns.
- Uses fewer Enterprise Replication resources, such as memory

If Enterprise Replication replicates an entire row from the source, and the corresponding row does not exist on the target, Enterprise Replication applies the update as an insert, also known as an *upsert*, on the target. By replicating the entire row, Enterprise Replication corrects any errors during replication. If any errors occur in an update of the target database server (for example, a large object is deleted before Enterprise Replication can send the data), the next update from the source database server (a complete row image) corrects the data on the target server.

Replicating only the columns that changed has the following disadvantages:

- Enterprise Replication does not apply upserts.

  If the row to replicate does not exist on the target, Enterprise Replication does not apply it. If you set up error logging ("Setting Up Error Logging" on page 6-8), Enterprise Replication logs this information as a failed operation.
- You cannot use the SPL routine or time stamp with SPL routine conflict-resolution rules. For more information, see "Conflict Resolution" on page 3-6.
- You cannot use update-anywhere replication; doing so can result in inconsistent conflict resolution.
- All database servers in the enterprise must be Version 9.3 or later.

  Enterprise Replication does not enforce this restriction. If you attempt to replicate only changed columns to a pre-Version 9.3 database server, you will corrupt the data on that database server.

Enterprise Replication logs bitmap information about the updated columns in the logical-log file. For more information, see the CDR record type in the logical-logs chapter in the *IBM Informix Administrator's Reference*.

For more information on the **--fullrow** option, see "Special Options" on page A-24.

Using the IEEE Floating Point or Canonical Format

The FLOAT and SMALLFLOAT data types are handled inconsistently across different platforms. You can specify sending this data in either IEEE floating point format or machine-independent decimal representation:

- Enable IEEE floating point format to send all floating point values in either 32-bit (for SMALLFLOAT) or 64-bit (for FLOAT) IEEE floating point format.

  To use IEE floating point format, include the **--floatieee** option in your replicate definition.

  It is recommended that you define all new replicates with the **--floatieee** option.
- Enable canonical format to send floating-point values in a machine-independent decimal representation when you replicate data between dissimilar hardware platforms.

  To use canonical format, include the **--floatcanon** option in your replicate definition. The **--floatcanon** option is provided for backward compatibility only; it is recommended that you use the **--floatieee** option when defining new replicates.
- If you specify neither IEEE or canonical formats, Enterprise Replication sends FLOAT and SMALLFLOAT data types as a straight copy of machine representation. If you are replicating across different platforms, replicated floating-point numbers will be incorrect.

For more information, see "Special Options" on page A-24.

Important: You cannot modify the replicate to change the **--floatieee** or **--floatcanon** options.

Enabling Triggers

By default, when a replicate causes an insert, update, or delete on a target table, triggers associated with the table are not executed. However, you can specify that triggers are executed when the replicate data is applied by enabling triggers in the replicate definition.

To enable triggers, include the **--firetrigger** option in your replicate definition.

For information, refer to "Triggers" on page 2-8 and "Special Options" on page A-24.

Defining Replicate Sets

To create a replicate set, use the **cdr define replicateset** command.

Enterprise Replication supports two types of replicate sets: *exclusive* and *non-exclusive*.

Exclusive Replicate Sets

To maintain referential integrity between replicates that include tables that have referential constraints placed on columns, you must create an *exclusive replicate set* and add the replicate to it.

An exclusive replicate set has the following characteristics:

- All replicates in an exclusive replicate set have the same state and frequency settings. For more information, see "Displaying Information About Replicates" on page A-51.
- When you create the replicate set, Enterprise Replication sets the initial state of the replicate set to active.
- You can manage the replicates in an exclusive replicate set only as part of the set. Enterprise Replication does not support the following actions for the individual replicates in an exclusive replicate set:
  - Starting a Replicate
  - Stopping a Replicate
  - Suspending a Replicate
  - Resuming a Suspended Replicate
- Replicates that belong to an exclusive replicate set cannot belong to any other replicate sets.

To create an exclusive replicate set, use the **--exclusive** option with **cdr define replicateset**.

Important: You cannot change an exclusive replicate set to non-exclusive.

Non-Exclusive Replicate Sets

By default, the **cdr define replicateset** command creates *non-exclusive* replicate sets.

A non-exclusive replicate set has the following characteristics:

- You can manage replicates that belong to a non-exclusive replicate set both individually and as part of the set.
- Because individual replicates in a non-exclusive replicate set can have different states, the non-exclusive replicate set itself has no state.

- You should not use non-exclusive replicate sets for replicates that include tables that have referential constraints placed on columns.
- A replicate can belong to more than one non-exclusive replicate set.

Important: You cannot change a non-exclusive replicate set to exclusive.

Use non-exclusive replicate sets if you want to add a replicate to more than one replicate set. For example, you might want to create replicate sets to manage replicates on the target server, table, or entire database. To do this, create three non-exclusive replicate sets:

- A set that contains the replicates that replicate to the target server
- A set that contains the replicates on a particular table
- A set that contains all the replicates

In this scenario, each replicate belongs to three non-exclusive replicate sets.

Customizing the Replicate Set Definition

You can specify the replication frequency ("Specifying Replication Frequency" on page 6-7) for all the replicates when you define the replicate set. For example, to define the non-exclusive replicate set **sales_set** with the replicates **sales_fiji** and **sales_tahiti** and specify that the members of **sales_set** replicate at 4:00 A.M. every day, enter:

```
cdr define replicateset --at 4:00 sales_set sales_fiji \
   sales_tahiti
```

To define the exclusive replicate set **dev_set** with the replicates **dev_pdx** and **dev_lenexa** and specify that the members of **dev_set** replicate at 5:00 P.M. every day, enter:

```
cdr define replicateset -X --at 17:00 dev_set dev_pdx\
   dev_lenexa
```

Important: For replicates that belong to an exclusive replicate set, you cannot specify the frequency individually for replicates in the set.

For more information, see "cdr define replicateset" on page A-28.

Initially Synchronizing Data Among Database Servers

Enterprise Replication provides an initial synchronization feature that allows you to easily bring a new table up-to-date with replication when you start a new replicate, or when you add a new participant to an existing replicate.

You do not need to suspend any servers that are replicating data while you add the new replicate and synchronize it.

The **cdr start replicate** and **cdr start replicateset** commands provide options to perform an initial synchronization for the replicates you are starting. All of the rows that match the replication criteria will be transferred from the source server to the target servers. If you are starting a replicate set, Enterprise Replication synchronizes tables in an order that preserves referential integrity constraints (for example, child tables are synchronized after parent tables).

Use the **--syncdatasource** (**-S**) option of the **cdr start replicate** or **cdr start replicateset** command to specify the source server for synchronization. Any existing rows in the specified replicates are deleted from the remote tables and replaced by the data from the node you specify using **-S**.

The **--extratargetrows** option of the **cdr start replicate** or **cdr start replicateset** commands specifies how to handle rows found on the target servers that are not present on the source server. You can specify to remove rows from the target, keep extra rows on the target, or replicate extra rows from the target to other participants.

If you use the **cdr start replicate** or **cdr start replicateset** command to specify a subset of servers on which to start the replicate (or replicate set), that replicate (or replicate set) must already be active on the source server. The source server is the server you specify with the **-S** option. For example, for the following command, **repl1** must already be active on **serv1**:

```
cdr start repl repl1 ... -S serv1 serv2 serv3
```

When you start a replicate (or replicate set) for participants on all servers, the replicate does not need to be active on the source server. So, for the following command, **repl1** does not need to be active:

```
cdr start repl1 ... -S serv1
```

4 When Enterprise Replication performs initial data synchronization, it keeps track of
4 discrepancies between the constraints set up on source and target server tables.
4 Rows that fail to be repaired due to these discrepancies are recorded in the ATS
4 and RIS files.

4 If replication fails for some reason and data becomes inconsistent, there are
4 different ways to correct data mismatches between replicated tables while
4 replication is active. The recommended method is direct synchronization. You can
4 also repair data based on an ATS or RIS file. Both of these methods are described
4 in “Resynchronizing Data Among Replication Servers” on page 7-12

9 Control Memory Consumption During Synchronization

9 Enterprise Replication can automatically increases the size of the send queue
9 (specified by the value of the CDR_QUEUEMEM configuration parameter) during
9 a synchronization operation to optimize performance. To limit the size that the
9 send queue can grow during synchronization, use the **--memadjust** option to
9 specify the number of kilobytes or megabytes to increase the send queue. Limiting
9 the size of the send queue might result in longer synchronization time.

9 In addition to controlling memory during initial synchronization, you can also
9 control memory consumption when you realize a template and perform a direct
9 synchronization.

9 For more information, see:
9 • “cdr start replicate” on page A-82 or “cdr start replicateset” on page A-85
9 • “cdr realize template” on page A-66
9 • “cdr sync replicate” on page A-105 or “cdr sync replicateset” on page A-108

Using Templates to Set Up Replication

Enterprise Replication provides templates to allow easy set up and deployment of replication for clients with large numbers of tables to replicate. A template uses schema information about a database, a group of tables, columns, and primary keys to define a group of master replicates and a replicate set.

First, you create a template using the **cdr define template** command; then, you instantiate it on the servers where you want to replicate data by running the **cdr realize template** command.

Important: If you want to use time-based replication, you must set up replication manually.

Important: Templates set up replication for full rows of tables (all the columns in the table), because they are designed to facilitate setting up large scale replication environments.
If you want a participant to contain a partial row (just some columns in the table), you can either set up replication manually, or, after you realize a template you can use the **cdr remaster** command to restrict the query.

All options of the **cdr define template**, **cdr list template**, **cdr realize template**, and **cdr delete template** commands are described in detail in Appendix A, "Command-Line Utility Reference," on page A-1.

Defining Templates

You define a template using the **cdr define template** command, with which you can specify which tables to use, the database and server they are located in, and whether to create an exclusive or non-exclusive replicate set. Table names can be listed on the command line or accessed from a file using the **--file** option, or all tables in a database can be selected.

Important: A template cannot define tables from more than one database.

Specify that the replicate set is exclusive if you have referential constraints on the replicated columns. Also, if you create an exclusive replicate set using a template, you do not need to stop the replicate set to add replicates. For more information about exclusive replicate sets, see "Defining Replicate Sets" on page 6-10.

A template defines a group of master replicates and a replicate set.

You can use the **cdr list template** command from a non-leaf node to view details about the template, including the internally generated names of the master replicates. These are unique names based on the template, the server, and table names.

Realizing Templates

After you define a template using the **cdr define template** command, use the **cdr realize template** command to instantiate the template on your Enterprise Replication database servers. The **cdr realize template** command first verifies that the tables on each node match the master definition used to create the template. Then, on each node, it adds the tables defined in the template as participants to master replicates created by the template.

If a table on a server has additional columns to those defined in the template, those columns are not considered part of the replicate.

If a table does not already exist on a server where you realize the template, you can choose to create it, and it is also added to the replicate.

Also, at realization time, you can also choose to synchronize data among all servers.

Verifying Participants without Applying the Template

The **--verify** option allows you to check that a template's schema information is correct on all servers before actually instantiating the template.

Synchronizing Data Among Database Servers

9 Use the **--syncdatasource** option to specify a server to act as the source for data
9 synchronization on all servers where you are realizing the template. If necessary,
9 limit the size the send queue can grow during synchronization with the
9 **–memadjust** option.

Creating Tables Automatically

The **--autocreate** option allows you to choose to automatically create tables in the template definition if they do not already exist on a server. (This cannot be done for tables that contain user-defined data types.)

Tables created with the **--autocreate** option do not automatically include non-primary key indices, defaults, constraints (including foreign constraints), triggers, or permissions. If the tables you create with the **--autocreate** option require the use of these objects, you must explicitly create the objects manually.

Use the **--dbspace** option to specify a dbspace for table creation.

Other Options

You can use the **--applyasowner** option to realize a table by its owner rather than the user **informix**.

The **--extratargetrows** option specifies whether to delete, keep, or merge rows found on target servers that are not present on the source server during the synchronization operation.

The **--target** option defines whether target servers are receive-only (when target servers are defined as receive-only, updates made on those servers are not propagated).

Changing Templates

You cannot update a template. To adjust a template, you must delete it with the **cdr delete template** command and then re-create it with the **cdr define template** command.

Chapter 7. Managing Replication Servers and Replicates

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In This Chapter

This chapter covers how to manage your Enterprise Replication system, including managing replication servers, replicates and participants, replicate sets, templates, replication server network connections, and resynchronizing data, and performing alter operations on replicated tables.

Managing Replication Servers

The *state* of the server refers to the relationship between the source server and the target server. To determine the current state of the server, use the **cdr list server** ***server_name*** command. For more information about the possible server states, see "The STATE Column" on page A-55.

Modifying Replication Servers

To modify a replication server, use the **cdr modify server** command. With this command, you can change the following attributes of the server:

- Idle timeout
- Location of the directory for the Aborted Transaction Spooling (ATS) files
- Location of the directory for the Row Information Spooling (RIS) files

For information about each of these attributes, see "Defining Replication Servers" on page 6-2. For more information about the **cdr modify server** command, see "cdr modify server" on page A-64.

Viewing Replication Server Attributes

After you define a server for replication, you can view information about the server using the **cdr list server** command. If you do not specify the name of a defined server on the command line, Enterprise Replication lists all the servers that are visible to the current server. If you specify a server name, Enterprise Replication displays information about the current server, including server ID, server state, and attributes.

For more information, see "cdr list server" on page A-55.

Connecting to Another Replication Server

By default, when you view information about a server, Enterprise Replication connects to the global catalog of the database server specified by the **INFORMIXSERVER** environment variable. You can connect to the global catalog of another database server using the **--connect** option.

For example, to connect to the global catalog of the database server **idaho**, enter:

```
cdr list server --connect=idaho
```

For more information, see "Global Catalog" on page 2-4 and "Connect Option" on page A-123.

Stopping Replication on a Server

Enterprise Replication starts automatically when you use **cdr define server** to declare the server for replication. The replication threads continue running until you shut the database server down or you remove the server with **cdr delete server**. If you shut down the database server while Enterprise Replication is running, replication begins again when you restart the database server. For more information about managing the database server, see the chapter on database operating modes in the *IBM Informix Dynamic Server Administrator's Guide*.

Generally, to stop Enterprise Replication on a server, you should shut down the server. However, you might want to temporarily stop the Enterprise Replication threads without stopping the server. To stop replication, use the **cdr stop** command.

When you use **cdr stop**, Enterprise Replication stops capturing data to be replicated. To ensure consistency, verify that no database update activity occurs while Enterprise Replication is stopped. Replication threads remain stopped (even if the database server is stopped and restarted) until you issue a **cdr start** command.

Warning: When you stop replication on a server, you must ensure that the send queues on the other Enterprise Replication servers participating in replication do not fill.

For more information, see "cdr stop" on page A-92.

Restarting Replication on a Stopped Server

To restart replication on a stopped server, use the **cdr start** command. When you restart the server, the Enterprise Replication threads start and continue.

Enterprise Replication resumes evaluating the logical logs at the replay position (where Enterprise Replication stopped evaluating the logical log when the server was stopped).

Warning: If the logical log corresponding to the replay position no longer exists, then the restart partially fails and no database updates performed on the local database server are replicated.

For more information, see "cdr start" on page A-79.

Suspending Replication for a Server

If you do not want to completely shut down the Enterprise Replication threads, you can suspend replication of data to the server using the **cdr suspend server** command. When replication is suspended to the server, the source server queues replicated data but suspends delivery of replicated data to the target server. Note that this command does not affect the network connection to the suspended server. The source server continues to send other messages, such as acknowledgement and control messages.

For example, to suspend replication of data to the server group **g_papeete** from the server group **g_raratonga**, enter:

```
cdr suspend server g_papeete g_raratonga
```

To suspend replication to **g_papeete** from all servers in the enterprise, enter:

```
cdr suspend server g_papeete
```

Warning: When you suspend replication on a server, you must ensure that the send queues on the other Enterprise Replication servers participating in replication do not fill.

For more information, see "cdr suspend server" on page A-101.

Resuming a Suspended Replication Server

To resume replication to a suspended server, use the **cdr resume server** command. When you resume the server, the queued data is delivered.

For example, to resume replication to the **g_papeete** server group, enter:

```
cdr resume server g_papeete
```

The **cdr resume server** command must have a server group name (such as **g_papeete**) to which to resume delivery of replication data.

For more information, see "cdr resume server" on page A-78.

Deleting a Replication Server

To delete a replication server, use the **cdr delete server** command. You must run the **cdr delete server** command twice.

For example, to remove the server group **g_papeete** from Enterprise Replication, set the **INFORMIXSERVER** environment variable to **papeete** and run the following commands:

```
cdr delete server g_papeete
cdr delete server --connect=raratonga g_papeete
```

The first command deletes the local server group (**g_papeete**) from Enterprise Replication, and the second connects to another server in the replication environment (**raratonga**) and deletes **g_papeete** from that server. The change then replicates to the other servers in the replication environment.

Warning: Avoid deleting an Enterprise Replication server and immediately re-creating it with the same name. If you re-create the objects immediately (before the operation finishes propagating to the other Enterprise Replication database servers in the network), failures might occur in the Enterprise Replication system at the time of the operation or later. For more information, see "Operational Considerations" on page 2-5.

For more information, see "cdr delete server" on page A-40.

Managing Replicates

You can perform the following tasks on existing replicates:

- Modify replicate attributes or participants
- View replicate properties and state
- Change the state of a replicate (whether replication is being performed)
- Delete a replicate

Modifying Replicates

You can modify replicates in two ways:

- Adding or Deleting Participants
- Changing Replicate Attributes

Adding or Deleting Participants

To be useful, a replicate must include at least two participants. You can define a replicate that has fewer than two participants, but before you can use that replicate, you must add more participants.

To add a participant to an existing replicate, use the **cdr change replicate --add** command. For example, to add two participants to the **sales_data** replicate, enter:

```
cdr change replicate --add sales_data \
   "db1@hawaii:jane.table1" "select * from table1" \
   "db2@maui:john.table2" "select * from table2"
```

To delete a participant from the replicate, use the **cdr change replicate --delete** command.

For example, to delete these two participants from the replicate, enter:

```
cdr change replicate --delete sales_data \
   "db1@hawaii:jane.table1" "db2@maui:john.table2"
```

For more information, see "cdr change replicate" on page A-4.

Changing Replicate Attributes

You can change the following attributes of a replicate using the **cdr modify replicate** command:

- Conflict-resolution rules and scope
- Replication frequency
- Error logging
- Replicate full rows or only changed columns
- Database triggers
- Participant type

You cannot change the conflict resolution from ignore to a non-ignore option (time stamp, SPL routine, or time stamp and SPL routine). You cannot change a non-ignore conflict resolution option to ignore.

For information on each of these attributes, see "Defining Replicates" on page 6-3.

For example, to change the replication frequency for the **sales_data** replicate to every Sunday at noon, enter:

```
cdr modify replicate sales_data Sunday.12:00
```

For more information, see "cdr modify replicate" on page A-60.

Viewing Replicate Properties

After you define a replicate, you can view the properties of the replicate using the **cdr list replicate** command. If you do not specify the name of a defined replicate on the command line, Enterprise Replication lists detailed information on all the replicates defined on the current server. If you use the **brief** option, Enterprise

Replication lists participant information about all the replicates. If you specify a replicate name, Enterprise Replication displays participant information about the replicate.

For information about this command, see “cdr list replicate” on page A-50.

Starting a Replicate

When you define a replicate, the replicate does not begin until you explicitly change its state to *active*. When a replicate is active, Enterprise Replication captures data from the logical log and transmits it to the participants.

Important: You cannot start replicates that have no participants.

To change the replicate state to active, use the **cdr start replicate** command. For example, to start the replicate **sales_data** on the servers **server1** and **server23**, enter:

```
sales_data server1 server23
```

This command causes **server1** and **server23** to start sending data for the **sales_data** replicate.

If you omit the server names, this command starts the replicate on all servers that are included in that replicate.

When you start a replicate, you can choose to perform an initial data synchronization, as described in “Initially Synchronizing Data Among Database Servers” on page 6-11.

Warning: Run the **cdr start replicate**command on an idle system (no transactions are occurring) or use the BEGIN WORK WITHOUT REPLICATION statement until after you successfully start the replicate.

If a replicate belongs to an exclusive replicate set, you must start the replicate set to which the replicate belongs. For more information, see “Starting a Replicate.”

For more information, see “cdr start replicate” on page A-82.

Stopping a Replicate

To stop the replicate, use the **cdr stop replicate** command. This command changes the replicate state to *inactive* and deletes any data in the send queue for that replicate. When a replicate is inactive, Enterprise Replication does not capture, transmit, or process any database changes.

In general, you should only stop replication when no replication activity is likely to occur for that table or on the advice of IBM support. If database activity does occur while replication is stopped for a prolonged period of time, the replay position in the logical log might be overrun. If a message that the replay position is overrun appears in the message log, you must resynchronize the data on the replication servers. For more information on resynchronizing data, see “Resynchronizing Data Among Replication Servers” on page 7-12.

You cannot stop replicates that have no participants.

For example, to stop the **sales_data** replicate on the servers **server1** and **server23**, enter:

```
cdr stop replicate sales_data server1 server23
```

This command causes **server1** and **server23** to purge any data in the send queue for the **sales_data** replicate and stops sending data for that replicate. Any servers not listed on the command line continue to capture and send data for the **sales_data** replicate (even to **server1** and **server23**).

If you omit the server names, this command stops the replicate on all servers that are included in that replicate.

If a replicate belongs to an exclusive replicate set, you must stop the replicate set to which the replicate belongs. For more information, see “Exclusive Replicate Sets” on page 6-10 and “Stopping a Replicate Set” on page 7-9.

4 Stopping a replicate also stops any direct synchronization, consistency checking, or
4 repair jobs that are in progress. To complete synchronization or consistency
4 checking, you must rerun the **cdr sync replicateset** or **cdr check replicateset**
4 command. To restart a repair job, use the **cdr start repair** command.

For more information, see “cdr stop replicate” on page A-94.

Suspending a Replicate

If you do not want to completely halt all processing for a replicate, you can suspend a replicate using the **cdr suspend replicate** command. When a replicate is in a suspended state, the replicate captures and accumulates changes to the source database, but does not transmit the captured data to the target database.

Warning: Enterprise Replication does not support referential integrity if a replicate is suspended. Instead, you should suspend a server. For more information, see “Suspending Replication for a Server” on page 7-3.

For example, to suspend the **sales_data** replicate, enter:

```
cdr suspend replicate sales_data
```

If a replicate belongs to an exclusive replicate set, you must suspend the replicate set to which the replicate belongs. For more information, see “Exclusive Replicate Sets” on page 6-10 and “Suspending a Replicate Set” on page 7-10.

For more information, see “cdr suspend replicate” on page A-98.

Resuming a Suspended Replicate

To return the state of a suspended replicate to active, use the **cdr resume replicate** command. For example:

```
cdr resume replicate sales_data
```

If a replicate belongs to an exclusive replicate set, you must resume the replicate set to which the replicate belongs. For more information, see “Exclusive Replicate Sets” on page 6-10 and “Resuming a Replicate Set” on page 7-10.

For more information, see “cdr resume replicate” on page A-76.

Deleting a Replicate

To delete the replicate from the global catalog, use the **cdr delete replicate** command. When you delete a replicate, Enterprise Replication purges all replication data for the replicate from the send queue at all participating database servers.

For example, to delete **sales_data** from the global catalog, enter:

```
cdr delete replicate sales_data
```

Warning: Avoid deleting a replicate and immediately re-creating it with the same name. If you re-create the objects immediately (before the operation finishes propagating to the other Enterprise Replication database servers in the network), failures might occur in the Enterprise Replication system at the time of the operation or later. For more information, see "Operational Considerations" on page 2-5.

For more information, see "cdr delete replicate" on page A-37.

Managing Replicate Sets

When you create a replicate set, you can manage the replicates that belong to that set together or individually. If the replicate set is exclusive, you can only manage the individual replicates as part of the set.

Performing an operation on a replicate set (except **cdr delete replicateset**) is equivalent to performing the operation on each replicate in the replicate set individually.

For more information, see "Managing Replicates" on page 7-4.

Modifying Replicate Sets

You can modify replicate sets in two ways:

- Add or Delete Replicates
- Change Replication Frequency

Adding or Deleting Replicates From a Replicate Set

To add a replicate to an existing replicate set, use the command **cdr change replicateset --add**. For example, to add two replicates to **sales_set**, enter:

```
cdr change replicateset --add sales_set sales_kauai \
   sales_moorea
```

The state of the replicate when you add it to a replicate set depends on the type of replicate set:

- For a non-exclusive replicate set, the state of the new replicate remains as it was when you added it to the set. To bring all the replicates in the non-exclusive set to the same state, use one of the commands described in "Managing Replicate Sets" on page 7-8.
- For an exclusive replicate set, Enterprise Replication changes the existing state and replication frequency settings of the replicate to the current properties of the exclusive replicate set.

To delete a replicate from the replicate set, use **cdr change replicate --delete**.

For example, to delete the two replicates, **sales_kauai** and **sales_moorea**, from the replicate set, enter:

```
cdr change replicateset --delete sales_set sales_kauai\
   sales_moorea
```

When you add or remove a replicate from an exclusive replicate set that is suspended or that is defined with a frequency interval, Enterprise Replication transmits all the data in the queue for the replicates in the replicate set up to the point when you added or removed the replicate. For more information, see "Suspending a Replicate Set" on page 7-10 and "Frequency Options" on page A-126.

For more information, see "cdr change replicateset" on page A-6.

Changing Replication Frequency For the Replicate Set

You can change the replication frequency for the replicates in an exclusive or non-exclusive replicate set using the **cdr modify replicateset** command. For more information, see "Specifying Replication Frequency" on page 6-7.

For example, to change the replication frequency for each of the replicates in the **sales_set** to every Monday at midnight, enter:

```
cdr modify replicateset sales_set Monday.24:00
```

For more information, see "cdr change replicateset" on page A-6.

Viewing Replicate Sets

To view the properties of the replicate set, use the **cdr list replicateset** command. The **cdr list replicateset** command displays the replicate set name and a list of the replicates that are members of the set. To find out more about each replicate in the replicate set, see "Viewing Replicate Properties" on page 7-5.

For more information, see "cdr list replicateset" on page A-53.

Starting a Replicate Set

To change the state of all the replicates in the replicate set to active, use the **cdr start replicateset** command. For example, to start the replicate set **sales_set**, enter:

```
set sales_set
```

When you start a replicate set, you can choose to perform an initial data synchronization, as described in "Initially Synchronizing Data Among Database Servers" on page 6-11.

Warning: Run the **cdr start replicateset** command on an idle system (when no transactions are occurring) or use the BEGIN WORK WITHOUT REPLICATION statement after you successfully start the replicate.

For more information, see "cdr start replicateset" on page A-85 and "cdr start replicate" on page A-82.

Stopping a Replicate Set

To stop the replicates in the replicate set, use the **cdr stop replicateset** command. This command changes the state of all the replicates in the set to inactive.

For example, to stop the **sales_set** replicate set, enter:

```
cdr stop replicateset sales_set
```

4 Stopping a replicate set also stops any direct synchronization, consistency checking,
4 or repair jobs that are in progress. To complete synchronization or consistency
4 checking, you must rerun the **cdr sync replicateset** or **cdr check replicateset**
4 command. To restart a repair job, use the **cdr start repair** command.

For more information, see "cdr stop replicateset" on page A-96 and "cdr stop replicate" on page A-94.

Suspending a Replicate Set

If you do not want to completely halt all processing for the replicates in a replicate set, you can suspend the replicates in the set using the **cdr suspend replicateset** command.

For example, to suspend the **sales_set** replicate set, enter:

```
cdr suspend replicateset sales_set
```

For more information, see "cdr suspend replicateset" on page A-99 and "cdr suspend replicate" on page A-98.

Resuming a Replicate Set

To return the suspended replicates in the replicate set to active, use the **cdr resume replicateset** command. For example:

```
cdr resume replicateset sales_set
```

For more information, see "cdr resume replicateset" on page A-77 and "cdr resume replicate" on page A-76.

Deleting a Replicate Set

To delete the replicate set, use the **cdr delete replicateset** command.

Tip: When you delete a replicate set, Enterprise Replication does not delete the replicates that are members of the replicate set. The replicates remain in the state they were in when the set was deleted.

For example, to delete **sales_set**, enter:

```
cdr delete replicateset sales_set
```

Warning: Avoid deleting a replicate set and immediately re-creating it with the same name. If you re-create the objects immediately (before the operation finishes propagating to the other Enterprise Replication database servers in the network), failures might occur in the Enterprise Replication system at the time of the operation or later. For more information, see "Operational Considerations" on page 2-5.

For more information, see "cdr delete replicateset" on page A-38.

Managing Templates

You can use the **cdr list template** and **cdr delete template** commands to view information about your templates and to clean up obsolete templates. The commands are described in detail, including examples and sample output, in Appendix A, "Command-Line Utility Reference."

You cannot update a template. To modify a template, you must delete it with the **cdr delete template** command and then re-create it with the **cdr define template** command.

Viewing Template Definitions

Use the **cdr list template** command to view detailed information about the template and the servers, databases and tables for which the template defines replication.

Deleting Templates

Use the **cdr delete template** command to delete any templates that you no longer want to use to set up replication. The command also deletes any replicate sets associated with the template which exist if the template has been realized.

Important: Deleting a template does not delete replicates that have been created by realizing a template.

Managing Replication Server Network Connections

This section explains how you can view network connections status, drop network connections, and reestablish dropped network connections.

Viewing Network Connection Status

To determine the current status of the network connection to each of the servers participating in replication, use the **cdr list server** command and look at the STATUS column of the output.

For more information, see “cdr list server” on page A-55.

Dropping the Network Connection

To drop the Enterprise Replication network connection for a server, use the **cdr disconnect server** command. When you drop the connection, Enterprise Replication continues to function and queue transactions. For example, to disconnect the network connection between the current replication server and the server **g_papeete**, enter:

```
cdr disconnect server g_papeete
```

Warning: When you disconnect a server from Enterprise Replication, you must ensure that the send queues on **all** other Enterprise Replication servers participating in replication do not fill.

For more information, see “cdr disconnect server” on page A-44.

Reestablishing the Network Connection

To reestablish a dropped network connection, use the **cdr connect server** command.

For example, to reestablish the network connection between the current replication server and the server **g_papeete**, enter:

```
cdr connect server g_papeete
```

For more information, see “cdr connect server” on page A-17.

Resynchronizing Data Among Replication Servers

If replication has failed for some reason and data is not synchronized, there are different ways to correct data mismatches between replicated tables.

The following table compares each of the methods. All methods except manual table unloading and reloading can be performed while replication is active.

Table 7-1. Resynchronization methods

Method	Description
Direct synchronization	• Replicates all rows from the specified reference server to all specified target servers for a replicate or replicate set • Runs as a foreground process
Checking consistency and then repairing inconsistent rows	• Compares all rows from the specified target servers with the rows on the reference server, prepares a consistency report, and optionally repairs inconsistent rows • Runs as a foreground process • Requires preparation of checksum support functions
Repair job	• Replicates all rows from the specified reference server to one target server for a replicate or replicate set • Two-step process: define a job and then start it • A job can only be used one time • Runs as a background process • Optionally filters a job so that only specific rows or columns are repaired
ATS or RIS file repairs	• Used to repair rows that other synchronization methods could not repair. • Repairs a single transaction at a time. • Replicates or replication server must have been configured with the ATS or RIS option.
Manual table unloading and reloading	• Manual process of unloading the target table, copying the reference table, and then loading the reference table into the target database • Requires that replication be suspended

Performing Direct Synchronization

Direct synchronization replicates every row in the specified replicate or replicate set from the reference server to all the specified target servers.

To perform direct synchronization, use the **cdr sync replicate** or **cdr sync replicateset** command.

You can synchronize a single replicate or a replicate set. When you synchronize a replicate set, Enterprise Replication synchronizes tables in an order that preserves referential integrity constraints (for example, child tables are synchronized after parent tables).

Important: Running direct synchronization can consume a large amount of space in your log files. Ensure you have sufficient space before running this command, or limit the amount of memory the send queue can grow during synchronization by using the **–memadjust** option with the **cdr sync replicate** or **cdr sync replicateset** command. Limiting the send queue memory can increase the synchronization time.

The following restrictions apply to performing direct synchronization:

- The Enterprise Replication network connection must be active between the Connect server, reference server and the target servers while performing direct synchronization.
- The replicate must not be in a suspended or stopped state during direct synchronization.
- The replicate must not be set up for time based replication.

If direct synchronization cannot repair a row, the inconsistent row is recorded in an ATS or RIS file. For more information, see "Repairing Failed Transactions with ATS and RIS Files" on page 7-15.

Checking Consistency and Repairing Inconsistent Rows

To perform a consistency check, use the **cdr check replicate** or **cdr check replicateset** command. Use the **–repair** option to repair the inconsistent rows. A consistency report is displayed for your review.

You can perform a consistency check and synchronization on a single replicate or a replicate set. When you synchronize a replicate set, Enterprise Replication synchronizes tables in an order that preserves referential integrity constraints (for example, child tables are synchronized after parent tables).

Important: Running a consistency check can consume a large amount of space in your log files. Ensure you have sufficient space before running this command.

The following restrictions apply to performing consistency checking:

- The Enterprise Replication network connection must be active between the Connect server, reference server and the target servers while performing consistency checking and repair.
- The replicate must not be in a suspended or stopped state during consistency checking.
- The replicate must not be set up for time based replication.

If synchronization during a consistency check cannot repair a row, the inconsistent row is recorded in an ATS or RIS file. For more information, see "Repairing Failed Transactions with ATS and RIS Files" on page 7-15.

Preparing the checksum Support Functions

Before you can use the **cdr check replicate** command, you must register the Enterprise Replication checksum support functions in each replicated database. For each database, run the following command from DB-Access while connected to that database:

```
$INFORMIXDIR/etc/idschecksum.sql
```

Interpreting the Consistency Report

Inconsistencies listed in the consistency report do not necessarily indicate a failure of replication. Data on different database servers is inconsistent while replicated transactions are in progress. For example, the following consistency report indicates that two rows are missing on the server **g_serv2**:

```
------   Statistics for repl1 ------
Node                  Rows     Extra   Missing  Mismatch Processed
---------------- --------- --------- --------- --------- ---------
g_serv1                 67         0         0         0         0
g_serv2                 65         0         2         0         0

WARNING: replicate is not in sync
```

The missing rows could be in the process of being replicated from **g_serv1** to **g_serv2**.

If you choose to repair inconsistent rows during a consistency check, the report shows the condition of the replicate at the time of the check, plus the actions taken to make the replicate consistent. For example, the following report shows two missing rows on **g_serv2** and that two rows were replicated from **g_serv1** to correct this inconsistency:

```
------   Statistics for repl1 ------
Node                  Rows     Extra   Missing  Mismatch Processed
---------------- --------- --------- --------- --------- ---------
g_serv1                 67         0         0         0         2
g_serv2                 65         0         2         0         0

WARNING: replicate is not in sync
```

The warning indicates that inconsistencies were discovered. The report does not indicate whether the replicate became consistent after the repair process.

The verbose form of the consistency report also displays the primary key for each inconsistent row.

For more information about the contents of the consistency report, see "cdr check replicate" on page A-8.

Performing a Repair Job

Repair jobs are named background processes that synchronize two database servers for a specific replicate or replicate set.

Repair jobs can be run online while replication is active. First, you create the repair job using the **cdr define repair** command. Then, run the job using the **cdr start repair** command.

You can define a repair job for a single replicate or for a replicate set. When you repair a replicate set, Enterprise Replication synchronizes tables in an order that preserves referential integrity constraints (for example, child tables are synchronized after parent tables).

3 During the execution of the repair process, lock contention is possible. The repair
3 process performs dummy updates on a block of rows at a time, however, the
3 whole table is not locked.

3 Transaction log consumption increases during a repair process due to operations
3 on repair control tables as well as dummy updates on the user table.

4 **Important:** Running a repair job can consume a large amount of space in your log
4 files. Ensure you have sufficient space before starting the repair job.

4 The following restrictions apply to running repair jobs:

- 4 The Enterprise Replication network connection must be active between the
4 Connect server, reference server and the target servers while performing a repair
4 job.
- 4 The replicate must not be in a suspended or stopped state when you start a
4 repair job or while the job is running.
- 4 The replicate must not be set up for time based replication.

4 If a repair job cannot repair a row, the inconsistent row is recorded in an ATS or
4 RIS file. For more information, see "Repairing Failed Transactions with ATS and
4 RIS Files" on page 7-15.

4 Filtering a Repair Job

4 If you have a situation where just part of the table needs to be repaired, for
4 example when one fragment in a partitioned table has incorrect data, you can use
4 the **--filter** (**-f**) option of the **cdr define repair** command. With the **--filter** option
4 you specify a WHERE clause for the source participant and a WHERE clause for
4 the target participant that restrict the columns for which the repair job runs.

4 **Important:** In the WHERE clauses, only specify columns that are exactly the same
4 on the source and target nodes and only specify columns that are *not*
4 updated.

4 Stopping Repair Jobs

4 You can stop a repair job using the **cdr stop repair** command. You can restart from
4 where it left off by running the **cdr start repair** command again. If you have
4 defined a new repair job of the same name, the new job is started from the
4 beginning. The old, partially run job is not started again.

4 Viewing Information About Repair Jobs

4 You can view information about repair jobs by using the **cdr list repair** command.

4 Deleting Repair Jobs

4 Repair job definitions are not automatically removed from the global catalog;
4 delete them using the **cdr delete repair** command.

4 **Warning:** If the repair job is active when you issue the **cdr delete repair** command,
4 the repair data in the send queue of the source server is purged.

4 Repairing Failed Transactions with ATS and RIS Files

4 You can perform a repair using an ATS or RIS file if you defined the replicate or
4 replication server with the **–ats** or **–ris** option.

4 A repair using an ATS or RIS file repairs the rows associated with the single
4 transaction that is recorded in the specified ATS or RIS file. To apply repairs based

on an ATS or RIS file, use the **cdr repair** command, as described in Appendix A, “Command-Line Utility Reference.” The **cdr repair** command processes one ATS or RIS file each time you specify the command. The following table shows how failed operations are handled.

Failed Operation	**Action Taken on Target Server**
Delete	Delete
Insert or Update	• If the row is found on the source server, does an update • If the row is not found on the source server, does a delete

Each operation is displayed to stderr, unless you use the **–quiet** option with the **cdr repair** command. You can preview the operations without performing them by using the **–check** option with the **cdr repair** command.

Resynchronizing Data Manually

Manual resynchronization involves replacing the inconsistent table in the target database with a copy of the correct table from the reference database. Manual resynchronization is the least preferred method to repair your replicated tables because you must suspend replication to avoid producing further inconsistencies.

The following example shows how to manually resynchronize two replication database servers.

To synchronize the replication server g_papeete with the server g_raratonga:

1. Suspend replication to the replication server group **g_papeete.**

   See “Suspending Replication for a Server” on page 7-3.
2. Unload the table from the server group **g_raratonga.**

   See “Loading and Unloading Data” on page 4-17.
3. Load the table on **g_papeete** and specify BEGIN WORK WITHOUT REPLICATION.

   See “Loading and Unloading Data” on page 4-17 and “Blocking Replication” on page 4-14.
4. Resume replication to **g_papeete**.

   See “Resuming a Suspended Replication Server” on page 7-4.

Important: If tables that you are synchronizing include shadow columns, you must explicitly unload and load these columns. If these values are not included, Enterprise Replication inserts NULL values. For more information, see “Shadow Column Disk Space” on page 4-8 and “Loading and Unloading Data” on page 4-17.

Performing Alter Operations on Replicated Tables

When Enterprise Replication is active and data replication is in progress, you can perform many types of alter operations on replicated tables. Most of the supported alter operations do not require any special steps when performed on replicated tables; some, however, do require special steps for replicated tables.

You can perform the following alter operations on active, replicated tables without performing extra steps:

- Add or drop fragments

- Move a non-fragmented table from one dbspace to another dbspace
- Convert a fragmented table to a non-fragmented table
- Convert a non-fragmented table to a fragmented table
- Convert from one fragmentation strategy to another
- Change an existing fragment expression on an existing dbspace
- Move a fragment expression from one dbspace to another dbspace
- Create a clustered index
- Recluster an existing index
- Add or drop default values and SQL checks
- Add or drop unique, distinct, and foreign keys
- Alter the locking granularity
- Alter the next extent size

You can perform the following alter operations on active, replicated tables, but you must perform extra steps, which are described in following sections:
- Add a column to a replicated table
- Drop a column from a replicated table
- Modify a replicated column
- Attach a fragment to a replicated table

Enterprise Replication uses shadow replicates to manage alter operations on replicated tables without causing any interruption to replication. By using shadow replicates, the replicate participants SELECT clause can be modified seamlessly while replication is active. For example, a new column can be brought into the replicate definition, an existing replicated column can be removed from the replicate definition and the data type or size of a replicated column can be changed without interrupting replication. See "Defining Shadow Replicates" on page 6-6 for more information about shadow replicates.

Before altering a replicated table, ensure that you have sufficient log space allocated for long transactions, a sufficient number of locks available, and sufficient space available for the queue sbspace.

When you issue a command to alter a replicated table, Enterprise Replication places the table in *alter* mode before performing the alter operation. Alter mode is a state in which only DDL (data-definition language) and SELECT operations are allowed but DML (data-manipulation language) operations are not allowed. After the transaction that initiated the alter operation completes, Enterprise Replication unsets alter mode.

The following restrictions apply when you use alter operations on replicated tables.
- Enterprise Replication must be in an active state, unless you are only adding or dropping check constraints and default values.
- Tables must have a master replicate defined.
- The RENAME TABLE and RENAME COLUMN statements are not supported.
- The DROP TABLE statement is not supported.

For a list of common alter operation problems and how to solve them, see "Troubleshooting Tips for Alter Operations" on page 8-13.

Adding a Replicated Column

You can alter a replicated table to add a new column to be replicated.

To add a new replicated column:

1. Use the ALTER TABLE statement to add the column to the replicated table at all participating nodes.
2. Remaster the replicate to include the newly added column in the replicate definition, as described in "Remastering a Replicate" on page 7-20.

Dropping a Replicated Column

You can alter a replicated table to drop an existing column that is replicated.

To drop a replicated column:

1. Remaster the replicate and modify the replicate's SELECT statement to remove the column being dropped, as described in "Remastering a Replicate" on page 7-20.
2. If the master replicate has shadow replicates defined, remove the column being dropped from their definitions as well.
3. Wait for the shadow replicate created by the remastering process to be cleaned up automatically.

   To check when the shadow replicate has been deleted, look in the server log file for a message similar to this:

   ```
   CDR CDRRTBCleaner: Deleted obsolete replicate
   Shadow_4_Repl1_GMT1090373046_GID10_PID28836
   ```

   The second line shows the name of the shadow replicate. See "cdr remaster" on page A-71 for information about the format of shadow replicate names.

   Alternatively, you can use either the **cdr list replicate** or **onstat -g cat repls** command to view the status of the shadow replicate. After the shadow replicate has been deleted, these commands will no longer show information about it.
4. Use the ALTER TABLE statement to drop the columns from the replicated table at all participating nodes.

Modifying a Replicated Column

You can modify the size or type of a column for all basic data types and for the BOOLEAN and LVARCHAR extended types. Modification of other extended types is not supported.

When you modify a replicated column, do not insert data into the modified column that will not fit into the old column definition until all participants have been altered, because the data might be truncated or data conversion to and from the master dictionary format to the local dictionary format might fail. Enterprise Replication handles the data type mismatch by having the source server convert data that is in the local dictionary format to the master dictionary format, and the target server convert data from the master dictionary format to the local dictionary format. If Enterprise Replication detects a mismatch in data type or size between the master replicate definition and the local table definition, a warning is printed in the log file.

If Enterprise Replication is not able to convert the replicated row data into the master dictionary format on the source server while queuing replicated data into the send queue, the replicate is stopped for the local participant. If this occurs, you must correct the problem and then restart the replicate from the local participant with the **--syncdatasource** option. If the correction is to delete the problematic row data, delete the row using the BEGIN WORK WITHOUT REPLICATION statement. Otherwise, the deleted row is moved from the replicated table to the associated delete table, which might cause problems for the subsequent alter operation on the replicated table.

If Enterprise Replication cannot convert row data from the master dictionary format to local table dictionary format at the target server after receiving replicated data, the replicated transaction is spooled to ATS and RIS files. For example, if you modify a SMALLINT column to an INTEGER column, make sure that you do not insert data that is too large for the SMALLINT data type until the alter operation is performed at all replicate participants, and remastering is performed so that the master dictionary reflects the INTEGER data type.

3 **Warning:** While modifying a replicated column, sometimes it is possible that the
3 alter operation on the base table succeeds, but the delete table
3 modification might fail when Enterprise Replication unsets alter mode. If
3 this happens, you will see a message similar to the following in the
3 server message log file:

```
3 CDRGC: cannot populate data into the new delete table
3 SQL error=-1226, ISAM error=0
```

3 This situation can happen while modifying a replicated column from a data type
3 larger in length or size to a data type smaller in length or size, for example, from
3 an INTEGER column to a SMALLINT column, and if the delete table has data
3 which cannot fit in the new type column.

3 To avoid this situation, do not convert between data types that cause data
3 truncation or produce cases where data cannot fit into the new type. If the above
3 situation has already occurred, carefully update or delete the problematic rows
3 from the delete table and attempt to unset alter mode manually by using the **cdr**
3 **alter** command. If you cannot resolve the problem, contact IBM Informix technical
3 support.

To modify a replicated column:

1. Issue the alter command to modify the replicated column.
2. Perform the alter operation at all the replicate participants.
3. Optionally remaster the replicate to update the column definition in the replicate definition, as described in "Remastering a Replicate" on page 7-20.

After an alter operation, the master dictionary no longer matches the replicated table dictionary. Because data transfer is always done in master dictionary format, data conversion between the local dictionary format and the master dictionary format is performed. Data conversion can slow the performance of your replication system. The remastering process changes the master dictionary to match the altered replicated table dictionary. Therefore, after remastering, data conversion is not necessary.

Attaching a New Fragment to a Replicated Table

To attach a new fragment, you must first manually place the replicated table in alter mode using the **cdr alter** command (described in Appendix A, "Command-Line Utility Reference," on page A-1). Enterprise Replication cannot automatically set alter mode for this operation due to an SQL restriction that requires attaching a fragment to be performed in multiple steps.

To attach a new fragment to a replicated table:

1. Set alter mode on the replicate using the **cdr alter** command.
2. Drop the primary key of the table.
3. Attach the new fragment.
4. Re-create the primary key.
5. Unset alter mode using the **cdr alter** command.

Remastering a Replicate

The **cdr remaster** command redefines an existing master replicate, or turns an existing non-master replicate into a master replicate. You must run the **cdr remaster** command if you add a new replicated column or drop a replicated column. If you modify a replicated column, you should remaster, however, remastering is not mandatory.

Automatic Remastering

To use automatic remastering simply run the **cdr remaster** command for the replicate for which you want to update the definition.

To use automatic remastering, the master replicate definition must have been created with name verification turned on (**--name** option of the **cdr define replicate** command set to **y**). See Appendix A, "Command-Line Utility Reference," on page A-1 for details about the **cdr remaster** command and the **cdr define replicate** command.

Manual Remastering

You must use manual remastering if your participants to not have matching column names and they were created with name verification turned off (**--name** option of the **cdr define replicate** command set to **n**).

To manually remaster a replicate:

1. Use the **cdr define replicate** command to create a shadow replicate with the same attributes as the primary replicate and with the **--mirrors** option, but with a SELECT statement that is correct for the table after the alter operation. The SELECT statement can include newly added columns or omit newly dropped columns.
2. Use the **cdr swap shadow** command to exchange the existing primary replicate and the newly created shadow replicate.

While performing the **cdr swap shadow** operation, Enterprise Replication stores the BEGIN WORK position of the last known transaction sent to the grouper as a *swap log position* for the current swap operation. Any transaction begun prior to the swap log position will use the original (old) replicate definition. Any transaction begun after the swap log position will use the new replicate definition.

The old replicate definition will be cleaned up automatically after the replicate definition is no longer required by Enterprise Replication.

Chapter 8. Monitoring and Troubleshooting Enterprise Replication

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In This Chapter

Enterprise Replication provides tools to help diagnose and correct problems that arise during replications. This chapter contains methods for monitoring replication, tips for solving common problems, and methods to prevent problems.

9 Monitoring Enterprise Replication

9 You can monitor the Enterprise Replication system with several different methods,
9 depending on your needs.

9 To monitor the status of every Enterprise Replication server from any one of those
9 servers, use the **cdr view** command. Specify one or more subcommands,
9 depending on what information you want to monitor. For more information, see
9 "cdr view" on page A-112.

To monitor individual Enterprise Replication servers by using SQL queries from the local or from a remote server, use the system monitoring tables. For more information, see Appendix D, “SMI Table Reference,” on page D-1.

To view information about the local Enterprise Replication server, use **onstat** commands. For more information, see Appendix C, “onstat Command Reference,” on page C-1.

Solving Replication Processing Problems

This topic lists some possible problems that can occur while Enterprise Replication is running, how to diagnose or monitor these problems, and how to solve them.

You should understand the typical behavior of your Enterprise Replication system. There are many factors that contribute to the performance and other behaviors, including: hardware configuration, network load and speed, type of replication, and number of replicated transactions.

Use the **cdr view** command or the SMI tables to understand the typical behavior of your system, establish benchmarks, and track trends. Deviations from typical behavior do not necessarily indicate a problem. For example, transactions might take longer to replicate during peak usage times or during end-of-month processing.

The following table describes some replication processing problems that might occur.

Table 8-1. Potential Replication Problems and Solutions

Problem	How to diagnose	How to solve
Enterprise Replication is not running	• Run the **cdr view state** command • Query the **syscdr_state** SMI table	Start replication with the **cdr start** command.
One or more Enterprise Replication servers are not running or connected to the network	• Run the **cdr view servers** command • Run the **cdr view nif** command • Query the **syscdr_nif** SMI table	Start the database server or fix the connection problem.
Replicated transactions failed	Determine if there are ATS or RIS files: • Look at the ATS and RIS directories on the local server for the existance of ATS or RIS files • Run the **cdr view atsdir risdir** command to see the number of ATS and RIS files for each server • Query the **syscdr_atsdir** or **syscdr_risdir** SMI table for a specific server	Run the **cdr repair** command. See “Aborted Transaction Spooling Files” on page 8-3 and “Row Information Spooling Files” on page 8-6.

Table 8-1. Potential Replication Problems and Solutions (continued)

Problem	How to diagnose	How to solve
Transactions are spooling to disk	Determine how much spool memory is being used: • Run the **cdr view profile** command to see the status of all queues on all servers • Run the **cdr view sendq** command to see the status of the send queue on all servers • Run the **cdr view rcv** command to see the status of the receive queue on all servers	See "Increasing the Sizes of Storage Spaces" on page 8-11.
At risk of transactions being blocked (DDRBLOCK mode)	Determine how many log pages must be used before transaction blocking occurs: • Run the **cdr view ddr** command to see the number of unused log pages for all servers • Query the **syscdr_ddr** SMI table to see the number of unused log pages for a specific server	See "Preventing DDRBLOCK Mode" on page 8-10.

If you do need to call IBM Support, find the version of IDS that is running Enterprise Replication with the **cdr -V** command.

Aborted Transaction Spooling Files

ATS files can be generated under the following circumstances:

- ATS generation is enabled for a replicate, the replicate uses a conflict resolution rule other than *ignore* or *always-apply*, and a conflict is detected on a target server.
- Under some error conditions, ATS files can be generated on a source server, regardless if ATS generation is enabled or the conflict resolution rule.

You can prevent the generation of both ATS and RIS files by setting the CDR_DISABLE_SPOOL environment variable to 1. Also, you can prevent the generation of either ATS or RIS files by setting the ATS or RIS directory to **/dev/null** (UNIX) or **NUL** (Windows).

When ATS is active, all failed replication transactions are recorded in ATS files. Each ATS file contains all the information pertinent to a single failed transaction. If a replicated transaction fails for any reason (constraint violation, duplication, and so forth), all the buffers in the replication message that compose the transaction are written to a local operating-system file. You can use the ATS files to identify problems or as input to custom utilities that extract or reapply the aborted rows.

Aborted-transaction spooling only occurs if the entire transaction is aborted. Transactions defined with row scope that have aborted rows but are successfully committed on the target tables are not logged.

All rows that fail conflict resolution for a transaction that has row scope defined are also written to the RIS file ("Row Information Spooling Files" on page 8-6), if defined.

In some cases, such as with long transactions, the database server itself aborts transactions. In these cases, Enterprise Replication does *not* generate an ATS file.

Preparing to Use ATS

Failed transactions are not automatically recorded in ATS files.

To collect ATS information:

1. Create a directory for Enterprise Replication to store ATS files.
   - If you are using primary-target replication, create the directory on the target system.
   - If you are using update-anywhere replication and have conflict resolution enabled, create the directory on all participating replication systems.

   For more information, see "Creating ATS and RIS Directories" on page 4-12.
2. When you define a server for Enterprise Replication, specify the location of the ATS directory you created in step 1.

   To do this, include the **--ats** option with the **cdr define server** command.

   If you do not specify an ATS directory, Enterprise Replication stores the ATS files in the following directory:

UNIX	**/tmp**
Windows	**\tmp** directory of the drive that contains **%INFORMIXDIR%**

   For more information, see "Creating ATS and RIS Directories" on page 4-12.
3. When you define a replicate, specify that ATS is active.

   To do this, include the **--ats** option with the **cdr define replicate** command.

   For more information, see "Setting Up Error Logging" on page 6-8.

About ATS Filenames

When ATS is active, each aborted transaction is written to a file in the specified directory.

The following table provides the naming convention for ATS files:

ats.*target.source.threadId.timestamp.sequence*

Name	Description
target	The name of the database server receiving this replicate transaction
source	The name of the database server that originated the transaction
threadId	The identifier of the thread that processed this transaction
timestamp	The value of the internal time stamp at the time that this ATS instance was started
sequence	A unique integer, incremented by ATS each time a transaction is spooled

The naming convention ensures that all filenames that ATS generates are unique, and therefore name collision is unlikely. However, when ATS opens a file for writing, any previous file contents will be overwritten. (ATS does not append to a spool file; if a name collision does occur with an existing file, the original contents of the file will be lost.)

The following is an example ATS filename for a transaction sent by server **g_amsterdam** to server **g_beijing**:

```
ats.g_beijing.g_amsterdam.D_2.000529_23:27:16.6
```

About ATS File Information

The first three characters in each line of the ATS spool file describe the type of information for the line, as the following table defines.

Label	Name	Description
TXH	Transaction heading	This line contains information from the transaction header, including the sending server ID and the commit time, the receiving server ID and the received time, and any Enterprise Replication, SQL, or ISAM error information for the transaction.
RRH	Replicated row heading	This line contains header information from the replicated rows, including the row number within the transaction, the group ID, the replicate ID (same as replicate group ID if replicate is not part of any replicate group), the database, owner, table name, and the database operation.
RRS	Replicated row shadow columns	This line contains shadow column information from replicated rows, including the source server ID and the time when the row is updated on the source server. This line is printed only if the replicate is defined with a conflict-resolution rule.
RRD	Replicated row data	This line contains the list of replicated columns in the same order as in the SELECT statement in the define replicate command. Each column is separated by a '`|`' and displayed in ASCII format. When the spooling program encounters severe errors (for example, cannot retrieve replicate ID for the replicated row, unable to determine the replicated column's type, size, or length), it displays this row data in hexadecimal format. The spooling program also displays the row data in hexadecimal format if a row includes replicated UDT columns.

BYTE and TEXT Information in ATS Files

When the information recorded in the ATS file includes BYTE or TEXT data, the replicated row data (RRD) information is reported, as the following examples show.

Example 1

```
<1200, TEXT, PB 877(necromsv) 840338515(00/08/17 20:21:55)>
```

In this example:

- `1200` is the size of the data.
- `TEXT` is the data type (it is either BYTE or TEXT).
- `PB` is the storage type (`PB` when the BYTE or TEXT is stored in the tablespace, `BB` for blobspace storage).
- The next two fields are the server identifier and the time stamp for the column if the conflict-resolution rule is defined for this replicate and the column is stored in a tablespace.

Example 2

```
<500 (NoChange), TEXT, PB 877(necromsv) 840338478(00/08/17 20:21:18)>
```

In this example, (NoChange) after the 500 indicates that the TEXT data has a size of 500, but the data has not been changed on the source server. Therefore the data is not sent from the source server.

Example 3

```
<(Keep local blob),75400, BYTE, PB 877(necromsv) 840338515(00/08/17 20:21:55>")
```

In this example, (Keep local blob) indicates that the replicated data for this column was not applied on the target table, but instead the local BYTE data was kept. This usually happens when time-stamp conflict resolution is defined and the local column has a time stamp greater than the replicated column.

Changed Column Information in ATS Files

If you define a replicate to only replicate columns that changed, the RRD entry in the ATS and RIS files show a ? for the value of any columns that are not available. For example:

```
RRD 427|amsterdam|?|?|?|?|?|?|?|?|?|?|?
```

For more information, see “Replicating Only Changed Columns” on page 6-8.

BLOB and CLOB Information in ATS Files

If a replicate includes one or more BLOB or CLOB columns, the RRD entry in the ATS file displays the smart blob metadata (the in-row descriptor of the data), not the smart blob itself, in hexadecimal format in the ATS file. See UDT Information in ATS Files for an example.

UDT Information in ATS Files

If a replicate includes one or more UDT columns, the RRD entry in the ATS file displays the row data in delimited format as usual, except the string <skipped> is put in place of UDT column values. For example, for a table with columns of type INTEGER, UDT, CHAR(10), UDT, the row may look like this:

```
RRD 334|<skipped>|amsterdam|<skipped>
```

Suppressing Datasync Errors and Warnings in ATS Files

You prevent certain Datasync errors and warnings from appearing in ATS files by using the CDR_SUPPRESS_ATSRISWARN configuration parameter.

For more information on the CDR_SUPPRESS_ATSRISWARN configuration parameter, see “CDR_SUPPRESS_ATSRISWARN Configuration Parameter” on page B-7.

For a list of error and warning messages that you can suppress, see Appendix G, “Datasync Warning and Error Messages,” on page G-1.

Row Information Spooling Files

Row Information Spooling files are similar to Aborted Transaction Spooling files. For more information, see “Aborted Transaction Spooling Files” on page 8-3.

Row Information Spooling logs the following types of information in RIS files:

- Individual aborted row errors
- Replication exceptions (such as when a row is converted by Enterprise Replication from insert to update, or from update to insert, and so forth)

- Special SPL routine return codes, as defined by the application (if an SPL routine is called to resolve a conflict)

9 You can prevent the generation of both ATS and RIS files by setting the
9 CDR_DISABLE_SPOOL environment variable to 1. Also, you can prevent the
9 generation of either ATS or RIS files by setting the ATS or RIS directory to
9 **/dev/null** (UNIX) or **NUL** (Windows).

Preparing to Use RIS

Failed transactions are not automatically recorded in RIS files.

To collect RIS information:

1. Create a directory for Enterprise Replication to store RIS files.

   If you have conflict resolution enabled, create the directory on all participating replication systems.

   For more information, see "Creating ATS and RIS Directories" on page 4-12.
2. When you define a server for Enterprise Replication, specify the location of the RIS directory you created in step 1.

   To do this, include the **--ris** option with the **cdr define server** command.

   If you do not specify an RIS directory, Enterprise Replication stores the RIS files in the following directory:

UNIX	**/tmp**
Windows	**\tmp** directory of the drive that contains **%INFORMIXDIR%**

   If the default directory does not exist, Enterprise Replication returns an error.

   For more information, see "Creating ATS and RIS Directories" on page 4-12.
3. When you define a replicate, specify that RIS is active.

   To do this, include the **--ris** option with the **cdr define replicate** command.

   For more information, see "Setting Up Error Logging" on page 6-8.

About RIS Filenames

The RIS row information is written at the time that the data-synchronization component finishes processing the replicated row and can therefore also provide the local row information. The RIS filename algorithm is analogous to the one that ATS uses, with the *ats* prefix replaced by *ris*. The RIS file that corresponds to the ATS file described in the previous section is, for example:

```
ris.g_beijing.g_amsterdam.D_2.000529_23:27:16.5
```

For more information, see "About ATS Filenames" on page 8-4.

In addition to the four types of records printed in ATS, the RIS file also includes the following information.

Label	Name	Description
LRH	Local-row header	Indicates if the local row is found in the delete table and not in the target table
LRS	Local-row shadow columns	Contains the server ID and the time when the row is updated on the target server This line is printed only if the replicate is defined with a conflict-resolution rule.
LRD	Local-row data	Contains the list of replicated columns extracted from the local row and displayed in the same order as the replicated row data Similar to the replicated row data, each column is separated by a '|' and written in ASCII format. When the spooling program encounters severe errors (for example, cannot retrieve replicate ID for the replicated row, unable to determine the replicated column's type, size, or length) or the table includes UDT columns (whether defined for replication or not), it displays the replicated row data in hexadecimal format. In this case, the local row data is not spooled.

BYTE and TEXT Information in RIS Files

When the information recorded in the RIS file includes BYTE or TEXT data, the RRD information is reported as the following examples show.

Example 1

```
<1200, TEXT, PB 877(necromsv) 840338515(00/08/17 20:21:55)>
```

In this example:

- `1200` is the size of the TEXT data.
- `TEXT` is the data type (it is either BYTE or TEXT).
- `PB` is the storage type (PB for storage in the tablespace, BB for blobspace storage).
- The next two fields are the server identifier and the time stamp for the column if the conflict-resolution rule is defined for this replicate and the column is stored in a blobspace.

Example 2

```
<500 (NoChange), TEXT, PB 877(necromsv) 840338478(0000/08/17 20:21:18)>
```

In this example, `(NoChange)` after `500` indicates the TEXT data has size of 500 but the data has not been changed on the source server. Therefore the data is not sent from the source server.

Changed Column Information in RIS Files

See "Changed Column Information in ATS Files" on page 8-6.

BLOB and CLOB Information in RIS Files

See "BLOB and CLOB Information in ATS Files" on page 8-6.

UDT Information in RIS Files

See "UDT Information in ATS Files" on page 8-6.

Suppressing Datasync Errors and Warnings in RIS Files

You prevent certain Datasync errors and warnings from appearing in RIS files by using the CDR_SUPPRESS_ATSRISWARN configuration parameter.

For more information on the CDR_SUPPRESS_ATSRISWARN configuration parameter, see "CDR_SUPPRESS_ATSRISWARN Configuration Parameter" on page B-7.

For a list of error and warning messages that you can suppress, see Appendix G, "Datasync Warning and Error Messages," on page G-1.

Preventing Memory Queues from Overflowing

In a well-tuned Enterprise Replication system, the send queue and receive queue should not regularly overflow from memory to disk. However, if the queues in memory fill, the transaction buffers are written (*spooled*) to disk. Spooled transactions consist of *transaction records*, *replicate information*, and *row data*. Spooled transaction records and replicate information are stored in the transaction tables and the replicate information tables in a single dbspace. Spooled row data is stored in one or more sbspaces.

For more information, see "Setting Up Send and Receive Queue Spool Areas" on page 4-8.

The following situations can cause Enterprise Replication to spool to disk:

- Receiving server is down or suspended.
- Network connection is down.

  If the receiving server or network connection is down or suspended, Enterprise Replication might spool transaction buffers to disk.

  To check for a down server or network connection, run **cdr list server** on a root server. This command shows all servers and their connection status and state.

  For more information, see "Viewing Replication Server Attributes" on page 7-2 and "cdr list server" on page A-55.
- Replicate is suspended.

  If a replicate is suspended, Enterprise Replication might spool transaction buffers to disk.

  To check for a suspended replicate, run **cdr list replicate**. This command shows all replicates and their state.

  For more information, see "Viewing Replicate Properties" on page 7-5 and "cdr list replicate" on page A-50.
- Enterprise Replication is replicating large transactions.

  Enterprise Replication is optimized to handle small transactions efficiently. Very large transactions or batch jobs force Enterprise Replication into an exceptional processing path that results in spooling. For best results, avoid replicating these types of transactions.

  For more information, see "Large Transactions" on page 2-9.
- Logical log files are too small or too few.

  If the logical log files are too small or the number of logical log files is too few, Enterprise Replication is more likely to spool transaction buffers to disk.

  To increase the size of the logical logs, see the chapter on logical logs in the *IBM Informix Dynamic Server Administrator's Guide*. For more information on configuring your logical log files for use with Enterprise Replication, see "Logical Log Configuration Guidelines" on page 4-7.

- Server is overloaded.

  If a server is low on resources, Enterprise Replication might not be able to hold all transactions replicating from a source server in memory during processing, and the transactions spool to disk.

  If this happens, check the system resources; in particular, check disk speed, RAM, and CPU resources.

Preventing DDRBLOCK Mode

If the database server comes close to overwriting a logical log that Enterprise Replication has not yet processed (*log wrap*), Enterprise Replication enters *DDRBLOCK mode*. In DDRBLOCK mode, user transactions are blocked and you see the following error in the message log:

```
DDR Log Snooping - DDRBLOCK phase started, userthreads blocked
```

Although user transactions are blocked while the server is in DDRBLOCK mode, Enterprise Replication activity is allowed to continue. During this time, Enterprise Replication attempts process transactions to advance the replay position and remove the risk of a log overrun. Enterprise Replication can usually resolve the cause of the DDRBLOCK state. However, in more extreme cases, the replay position can be overrun. If the replay position is overrun, the following message appears in the message log file:

```
WARNING:  The replay position was overrun, data may not be replicated.
```

If this occurs, you must resynchronize the source and target servers. For more information, see "Resynchronizing Data Among Replication Servers" on page 7-12.

DDRBLOCK mode is usually caused by the logical logs being misconfigured for the current transaction activity or by the Enterprise Replication system having to spool more than usual. More-than-usual spooling could be caused by one of the following situations:

- A one-time job might be larger than normal and thus require more log space.
- If one of the target servers is currently unavailable, more spooling of replicated transactions can be required.
- The spool file or paging space could be full and needs to be expanded. For more information, see "Preventing Memory Queues from Overflowing" on page 8-9.

If Enterprise Replication detects that the log files are configured too small for the current database activity, then the following message might appear in the message log file:

```
Warning - The log space appears to be configured too small for use
with Enterprise Replication (ER). ER may require additional logical
logs to avoid a DDRBLOCK state and/or replay position log wrap.
It is recommended that the logical log configuration be expanded.
```

Enterprise Replication can be configured to dynamically add a logical log file instead of placing the database server in DDRBLOCK mode. Set the CDR_MAX_DYNAMIC_LOGS configuration parameter to enable Enterprise Replication to dynamically add a logical log file when the system is in danger of a log wrap. This allows the system to better adjust to unusual activity. Set CDR_MAX_DYNAMIC_LOGS to one of the following values:

A positive number	Enterprise Replication is allowed to dynamically add up to that number of logical log files.
-1	Enterprise Replication is allowed to dynamically add an unlimited number of logical log files.
0	Enterprise Replication does not dynamically add logical log files, and the system can enter DDRBLOCK mode.

3 You can execute **cdr list** commands, such as **cdr list repl**, while the replication
3 server is in DDRBLOCK mode. You must create a temporary dbspace with the
3 onspaces utility and set the DBSPACETEMP configuration parameter before
3 executing the **cdr list** command.

Monitoring Disk Usage for Send and Receive Queue Spool

You should periodically monitor disk usage for the dbspace. For more information on disk usage for dbspace and sbspace that Enterprise Replication uses to spool the queues to disk, see "CDR_QHDR_DBSPACE Configuration Parameter" on page B-5 and the sbspace "CDR_QDATA_SBSPACE Configuration Parameter" on page B-5.

To check disk usage for:

- **dbspaces**

  Use **onstat -d**.

  For more information, see the section on monitoring disk usage in the *IBM Informix Dynamic Server Administrator's Guide* and the utilities chapter of the *IBM Informix Administrator's Reference*.
- **sbspaces**

  Use **cdr view profile**, **onstat -d** or **oncheck -cs**,**-cS**, **-ce**, **-pe**, **-ps**, and **-pS**.

  For more information, see the section on monitoring sbspaces in the *IBM Informix Dynamic Server Performance Guide* and the utilities chapter of the *IBM Informix Administrator's Reference*.

Tip: When you use **onstat -d** to monitor disk usage, the S flag in the **Flags** column indicates an sbspace. For each sbspace chunk, the first row displays information about the whole sbspace and user-data area. The second row displays information about the metadata area.

Increasing the Sizes of Storage Spaces

If you notice that the Enterprise Replication dbspace or sbspace is running out of disk space, you can increase the size of the space by adding chunks to the space.

To add a chunk to a dbspace, use **onspaces -a**. For example, to add a 110 kilobyte chunk with an offset of 0 to the **er_dbspace** dbspace, enter:

```
onspaces -a er_dbspace -p /dev/raw_dev2 -o 0 -s 110
```

To add a chunk to an sbspace, use the same **onspaces** command above, however you can specify more information about the chunk that you are adding. After you add a chunk to the sbspace, you must perform a level-0 backup of the root dbspace and the sbspace.

For more information, see the sections on adding chunks to dbspaces and sbspaces in the *IBM Informix Administrator's Guide* and the utilities chapter of the *IBM Informix Administrator's Reference*.

Recovering when Storage Spaces Fill

When the Enterprise Replication dbspace runs out of disk space, Enterprise Replication raises an alarm and writes a message to the log. When the sbspace runs out of disk space, Enterprise Replication hangs. In either case, you must resolve the problem that is causing Enterprise Replication to spool ("Preventing Memory Queues from Overflowing" on page 8-9) or you must allocate additional disk space ("Increasing the Sizes of Storage Spaces" on page 8-11) before you can continue replication.

Solving Common Configuration Problems

If you experience problems setting up Enterprise Replication, check the following:

- Make sure that you created an sbspace for the row data and set the CDR_QDATA_SBSPACE in the ONCONFIG file.

  For more information, see "Setting Up Send and Receive Queue Spool Areas" on page 4-8 and "CDR_QDATA_SBSPACE Configuration Parameter" on page B-5.
- Verify that the trusted environment is set up correctly.

  For more information, see "Setting Up the Trusted Environment" on page 4-3.
- Verify that your SQLHOSTS file is set up properly on each server participating in replication. You must set up database server groups in the SQLHOSTS file.

  For more information, see "Verifying SQLHOSTS" on page 4-3.
- Verify the format of the SQLHOSTS file.

  The network connection (not the shared memory connection) entry should appear immediately after the database server group definition. If the network connection does not appear immediately after the database server group definition, you might see the following error when you run **cdr define server**:

  ```
  command failed -- unable to connect to server specified (5)
  ```

  You might also see a message like the following in the message log for the target server:

  ```
  Reason: ASF connect error (-25592)
  ```
- Make sure that the unique identifier for each database server (*i*= in the **options** field of the SQLHOSTS information) is consistent across all nodes in the enterprise.

  For more information, see "Database Server Groups on UNIX" on page 4-3 and Appendix F, "SQLHOSTS Registry Key (Windows)," on page F-1.
- Verify that the operating system times of the database servers that participate in the replicate are synchronized.

  For more information, see "Time Synchronization" on page 2-11.
- Make sure that the database server has adequate logical log disk space. If the database server does not have enough logical log space at initialization, you will see the following error:

  ```
  command failed -- fatal server error (100)
  ```
- Check the **$INFORMIXDIR/etc/buildsmi.xxx** files to see if a problem occurred when the databases server built the SMI tables.
- Make sure that the databases on all database server instances involved in replication are set to logging (unbuffered logging is recommended).

  For more information, see "Unbuffered Logging" on page 2-6.
- For replicates that use any conflict-resolution rule except *ignore*, make sure that you define *shadow columns* (CRCOLS) for each table involved in replication.

For more information, see “Preparing Tables for Conflict Resolution” on page 4-16.

- If you defined a participant using SELECT * from *table_name*, make sure that the tables are identical on all database servers defined for the replicate.

  For more information, see “Defining Participants” on page 6-4 and “Participant Type” on page A-125.
- Verify that each replicated column in a table on the source database server has the same data type as the corresponding column on the target server.

  Enterprise Replication does not support replicating a column with one data type to a column on another database server with a different data type.

  The exception to this rule is cross-replication between simple large objects and smart large objects.

  For more information, see “Enterprise Replication Data Types” on page 2-12.
- Verify that all tables defined in a replicate have one PRIMARY KEY.

  For more information, see “Primary Key Constraint” on page 2-7, the *IBM Informix Database Design and Implementation Guide*, and *IBM Informix Guide to SQL: Syntax*.
- If HDR is enabled in the replication system, then all row data sbspaces must be created with logging by using the **-Df LOGGING=ON** option of the **onspaces** command.

  For more information, see “Row Data sbspaces” on page 4-9 and the *IBM Informix Dynamic Server Administrator's Guide*.

Troubleshooting Tips for Alter Operations

The following problems illustrate common issues with performing alter operations on replicated tables:

- **Problem:** You receive an error that the replicate is not defined after running the following command:

  ```
  cdr alter -o test:tab
  Error:Replicate(s) not defined on table test:.tab
  ```

  The owner name is missing from the table name, **test:tab**.

  Solution: Include the table owner name, for example:

  ```
  cdr alter -o test:nagaraju.tab
  ```
- **Problem:** You receive an error that the replicated table is in alter mode after running the following command:

  ```
  > insert into tab values(1,1);

  19992: Cannot perform insert/delete/update operations on a replicated table
  while the table is in alter mode
  Error in line 1 Near character position 27
  >
  ```

  The table (**tab**) is in alter mode. DML operations cannot be performed while the table is in alter mode.

  Solution: Wait for the table to be altered and then issue the DML operation. If no alter statement is in progress against the table, then unset alter mode on the table using the **cdr alter --off** command. For example:

  ```
  cdr alter --off test:nagaraju.tab
  ```

  You can check the alter mode status using the **oncheck -pt** command. For example:

  ```
  oncheck -pt test:nagaraju.tab
  ```
- **Problem:** How can you tell if a replicate is a mastered replicate?

Solution: Wait for the table to be altered and then issue the DML operation. If no alter statement is in progress against the table, then unset alter mode on the table using the **cdr alter --off** command. For example:

```
cdr alter --off test:nagaraju.tab
```

You can check the alter mode status using the **oncheck -pt** command. For example:

```
oncheck -pt test:nagaraju.tab
```

- **Problem:** How can you tell if a replicate is a mastered replicate?

  Solution: When you execute the **cdr list repl** command, it shows that the REPLTYPE is Master for master replicates. For example:

```
$cdr list repl
CURRENTLY DEFINED REPLICATES
-------------------------------
REPLICATE: rep2
STATE: Active ON:delhi
CONFLICT: Timestamp
FREQUENCY: immediate
QUEUE SIZE: 0
PARTICIPANT: test:nagaraju.tab12
OPTIONS: transaction,ris,ats,fullrow
REPLTYPE: Master

REPLICATE: rep1
STATE: Active ON:delhi
CONFLICT: Timestamp
FREQUENCY: immediate
QUEUE SIZE: 0
PARTICIPANT: test:nagaraju.tab
OPTIONS: transaction,ris,ats,fullrow
```

  In the above output, **rep1** is defined as a non-master replicate and **rep2** is defined as master replicate.

- **Problem:** An alter operation on a replicated table fails.

  For example:

```
$dbaccess test -

Database selected.

> alter table tab add col4 int;

19995: Enterprise Replication error encountered while setting alter mode. See
message log file to get the Enterprise Replication error code
Error in line 1Near character position 27
>
```

  The message log output is:

```
12:36:09 CDRGC: Classic replicate rep1 found on the table test:nagaraju.tab
12:36:09 CDRGC:Set alter mode for replicate rep1
12:36:09 GC operation alter mode set operation on a replicated table failed:
Classic replicate(s) (no mastered dictionary) found on the table.
```

  Solution: The above message shows that there is a classic replicate, **rep1**, defined on the table (**tab**). Adding a new column to a replicated table is allowed when only master replicates are defined for the table.

  To perform the above alter operation, first convert the classic replicate to a master replicate. You can convert the replicate definition of **rep1** to a master replicate by issuing the following command:

```
cdr remaster -M g_delhi rep1 "select * from tab"
```

  Now look at the **cdr list repl** output:

```
$cdr list repl
CURRENTLY DEFINED REPLICATES
-------------------------------
REPLICATE: rep1
STATE: Active ON:delhi
CONFLICT: Timestamp
FREQUENCY: immediate
QUEUE SIZE: 0
PARTICIPANT: test:nagaraju.tab
OPTIONS: transaction,ris,ats,fullrow
REPLTYPE: Master

REPLICATE: rep2
STATE: Active ON:delhi
CONFLICT: Timestamp
FREQUENCY: immediate
QUEUE SIZE: 0
PARTICIPANT: test:nagaraju.tab12
OPTIONS: transaction,ris,ats,fullrow
REPLTYPE: Master

REPLICATE: Shadow_4_rep1_GMT1112381058_GID100_PID29935
STATE: Active ON:delhi
CONFLICT: Timestamp
FREQUENCY: immediate
QUEUE SIZE: 0
PARTICIPANT: test:nagaraju.tab
OPTIONS: transaction,ris,ats,fullrow
REPLTYPE: Shadow
PARENT REPLICATE: rep1
```

You can see that **repl1** has been converted to a master replicate. You can also see that a new replicate definition, **Shadow_4_rep1_GMT1112381058_GID100_PID29935**, was also created against the table (**tab1**). Notice the last two fields of the output for **Shadow_4_rep1_GMT1112381058_GID100_PID29935**:

```
REPLTYPE: Shadow
PARENT REPLICATE: rep1
```

The Shadow attribute indicates that this replicate is a shadow replicate, and PARENT REPLICATE: **rep1** shows that this is a shadow replicate for the primary replicate **rep1**. Notice that the Master attribute is not present for this replicate definition. This shadow replicate is actually the old non-master replicate. The **cdr remaster** command created a new master replicate, **rep1**, for the table **tab** and converted the old non-master replicate (**rep1**) to a shadow replicate for the new master replicate.

This table is not yet ready to be altered because there is still a non-master replicate, **Shadow_4_rep1_GMT1112381058_GID100_PID29935**, defined for the table, **tab**. You must wait for **Shadow_4_rep1_GMT1112381058_GID100_PID29935** to be deleted automatically by Enterprise Replication after all the data queued for this shadow replicate is applied at all the replicate participants. This process can take some time. Alternatively, if you are sure that there is no data pending for this old non-master replicate, then you can issue the **cdr delete repl** command against **Shadow_4_rep1_GMT1112381058_GID100_PID29935**.

After making sure that **Shadow_4_rep1_GMT1112381058_GID100_PID29935** no longer exists, you can attempt the **ALTER TABLE tab add col4 int;** statement against the table.

Enterprise Replication Event Alarms

Starting with Version 10.0 of Informix Dynamic Server, you can use event alarms specific to Enterprise Replication to automate many administrative tasks. You can set your ALARMPROGRAM script to capture Enterprise Replication Class IDs and messages and initiate corrective action or notification for each event. For example, you can add a new chunk to the queue data sbspace or dbspace if you detect (using Class ID 31) that the storage space is full.

For information on setting ALARMPROGRAM scripts to capture events, see the appendix on event alarms in the *IBM Informix Administrator's Reference*.

If you were already using an ALARMPROGRAM script prior to Version 10.0 to manage Enterprise Replication administrative work, you need to modify the script to detect and take action on the Enterprise Replication events documented in this section.

The following table lists the Class IDs and Class Messages for the alarms that are raised by Enterprise Replication.

Class ID	Class Message
30	DDR subsystem [failure | notification]
31	ER stable storage [queue sbspace | queue dbspace | pager sbspace] is full
32	ER: error detected in grouper sub component
33	ER: error detected in data sync sub component
34	ER: error detected in queue management sub component
36	ER: network interface sub component notification
35	ER: error detected in global catalog sub component
37	ER: error detected while recovering Enterprise Replication
38	ER: resource allocation problem detected
39	Please contact IBM Informix Technical Support

4

The following tables show for each Class ID the error strings that can be returned, their severity, and the situations that trigger them. In the **Situation** column, *snoopy* refers to **ddr_snoopy**, an internal component of Enterprise Replication that reads the log buffers and passes information to the grouper.

Table 8-2. Events for Class ID 30

Error String	Severity	Situation
`Log corruption detected or read error occurred while snooping logs.`	ALRM_ EMERGENCY	Snoopy receives a bad buffer during a log read.
`WARNING: The replay position was overrun, data may not be replicated.`	ALRM_ EMERGENCY	Snoopy detects that the replay position has been overwritten (page 8-10)
`CDR: Unexpected log record type` *record_type* `for subsystem` *subsystem* `passed to DDR.`	ALRM_ EMERGENCY	A log record of unexpected type was passed to snoopy.
`DDR Log Snooping - Catchup phase started, userthreads blocked`	ALRM_ ATTENTION	Snoopy sets DDRBLOCK ("Preventing DDRBLOCK Mode" on page 8-10)

Table 8-2. Events for Class ID 30 (continued)

Error String	Severity	Situation
`DDR Log Snooping - Catchup phase completed, userthreads unblocked`	ALRM_ ATTENTION	Snoopy unsets DDRBLOCK ("Preventing DDRBLOCK Mode" on page 8-10)

Table 8-3. Events for Class ID 31

Error String	Severity	Situation
`CDR QUEUER: Send Queue space is FULL - waiting for space in sbspace_name.`	ALRM_ EMERGENCY	An RQM queue runs out of room to spool ("Recovering when Storage Spaces Fill" on page 8-12)
`CDR Pager: Paging File full: Waiting for additional space in sbspace_name`	ALRM_ EMERGENCY	Grouper paging sbspace has run out of space ("Increasing the Sizes of Storage Spaces" on page 8-11)

Table 8-4. Events for Class ID 32

Error String	Severity	Situation
`CDR Grouper Fanout/Evaluator thread is aborting.`	ALRM_ EMERGENCY	Grouper fanout or evaluator is aborting.
`CDR: Could not copy transaction at log id log_unique_id position log_position. Skipped.`	ALRM_ EMERGENCY	Grouper is unable to copy the transaction into send queue.
`CDR: Paging error detected.`	ALRM_ EMERGENCY	Grouper detected paging error.
`CDR Grouper: Local participant (%s) stopped for the replicate %s (or exclusive replicate set), table (%s:%s.%s). Data may be out of sync. If replicated column definition was modified then please perform the alter operation at all the replicate participants, remaster the replicate definition then restart the replicate (or exclusive replicate set) definition for the local participant with the data sync option (-S).`	ALRM_ EMERGENCY	If the grouper sub-component is not able to convert the replicated row data from the local dictionary format to the master dictionary format, the grouper stops the local participant from the corresponding replicate (or exclusive replicate set) definition and invokes the alarm event handler.
`CDR CDR_subcomponent_name: Could not apply undo properly. SKIPPING TRANSACTION.   TX Begin Time: datetime   TX Restart Log Id: log_id   TX Restart Log Position: log_position   TX Commit Time: datetime   TX End Log Id: log_id   TX End Log Position: log_position`	ALRM_ ATTENTION	Grouper was unable to apply an undo (rollback to savepoint) to a transaction.

Table 8-5. Events for Class ID 33

Error String	Severity	Situation
`CDR DS thread_name thread is aborting.`	ALRM_ EMERGENCY	Data sync is aborting.
`Received aborted transaction, no data to spool.`	ALRM_ INFO	Datasync received transaction that was aborted in first buffer, so there is nothing to spool to ATS/RIS.

Table 8-6. Events for Class ID 34

Error String	Severity	Situation
`CDR CDR_subcomponent_name: bad replicate ID replicate_id`	ALRM_ ATTENTION	RQM cannot find the replicate in the global catalog for which it has a transaction.

Table 8-7. Events for Class ID 35

Error String	Severity	Situation
`CDR: Could not drop delete table.  SQL code sql_error_code, ISAM code isam_error_code. Table 'database_name:table_name'.  Please drop the table manually.`	ALRM_ ATTENTION	Could not drop delete table while deleting the replicate from the local participant.
`CDR GC peer request failed: command: command_string, error error_code, CDR server CDR_server_ID`	ALRM_ ATTENTION	Execution of the control command requested by the peer server failed at the local server.
`CDR GC peer processing failed: command: command_string, error error_code, CDR server CDR_server_ID`	ALRM_ ATTENTION	Control command execution at the peer server failed.

4 *Table 8-8. Events for Class ID 36*

Error String	Severity	Situation
CDR NIF connection terminated to *servergroupname*; connection request received from an unknown server.	ALRM_ ATTENTION	Enterprise Replication received a re-connect connection request from an unknown server.

Table 8-9. Events for Class ID 37

Error String	Severity	Situation
`CDR CDR_subcomponent_name: bad replicate ID replicate_id`	ALRM_ ATTENTION	

Table 8-10. Events for Class ID 38

Error String	Severity	Situation
`CDR CDR_subcomponent_name memory allocation failed (reason).`	ALRM_INFO	The specified Enterprise Replication component could not allocate memory.

Table 8-11. Events for Class ID 39

Error String	Severity	Situation
(blank)	ALRM_ EMERGENCY	An internal error has occurred that requires assistance from Technical Support.

Part 3. Appendixes

Appendix A. Command-Line Utility Reference

The command-line utility (CLU) lets you configure and control Enterprise Replication from the command line on your UNIX or Windows operating system.

This appendix covers the following topics:
- Command Summary
- Command Syntax
- Interpreting the Command-Line Utility Syntax

Command Summary

The following table shows the commands and the page where the command is documented.

Command	Page
cdr alter	A-3
cdr change replicate	A-4
cdr change replicateset	A-6
4 **cdr check replicate**	A-8
4 **cdr check replicateset**	A-13
cdr cleanstart	A-16
cdr connect server	A-17
cdr define repair	A-18
cdr define replicate	A-21
cdr define replicateset	A-28
cdr define server	A-30
cdr define template	A-33
cdr delete repair	A-36
cdr delete replicate	A-37
cdr delete replicateset	A-38
cdr delete server	A-40
cdr delete template	A-43
cdr disconnect server	A-44
cdr error	A-45
cdr finderr	A-47
cdr list repair	A-48
cdr list replicate	A-50
cdr list replicateset	A-53
cdr list server	A-55
cdr list template	A-58
cdr modify replicate	A-60
cdr modify replicateset	A-63

	Command	Page
	cdr modify server	A-64
	cdr realize template	A-66
	cdr remaster	A-71
	cdr remove	A-66
	cdr repair	A-74
	cdr resume replicate	A-76
	cdr resume replicateset	A-77
	cdr resume server	A-78
	cdr start	A-79
	cdr start repair	A-80
	cdr start replicate	A-82
	cdr start replicateset	A-85
3	**cdr stat recv**	A-92
3	**cdr stat rqm**	A-92
	cdr stop	A-92
	cdr stop repair	A-93
	cdr stop replicate	A-94
	cdr stop replicateset	A-96
	cdr suspend replicate	A-98
	cdr suspend replicateset	A-99
	cdr suspend server	A-101
	cdr swap shadow	A-103
4	**cdr sync replicate**	A-105
3	**cdr sync replicateset**	A-108
9	**cdr -V**	A-111
9	**cdr view**	A-112

Command Syntax

The next sections show the syntax for all the variations of the **cdr** commands.

cdr alter

The **cdr alter** command puts the specified tables in alter mode.

Syntax

```
>>--cdr alter--+--------------------------+--+--on---+------------------------------->
               |                      (1) |  '--off--'
               '--| Connect Option |------'

    .----------------------.
    V                      |
>----database:owner.table--+----------------------------------------------------------><
```

Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
database	The name of the database that contains the table	The database server must be registered with Enterprise Replications.	"Long Identifiers" on page A-123
owner	User ID of the owner of the table		"Long Identifiers" on page A-123
table	Specifies the name of the table to put in alter mode	The table must be an actual table. It cannot be a synonym or a view.	"Long Identifiers" on page A-123

The following table describes the options to **cdr alter**.

Long Form	Short Form	Meaning
--on	**-o**	Sets alter mode on.
--off	**-f**	Unsets alter mode.

Usage

Use this command to place a table in or out of alter mode. Use alter mode when you need to alter an attached fragment to the table or you want to perform other alter operations manually. For more information, see "Performing Alter Operations on Replicated Tables" on page 7-16.

Examples

The following example puts **table1** and **table2** in alter mode:

```
cdr alter --on db1:owner1.table1 db2:owner2.table2
```

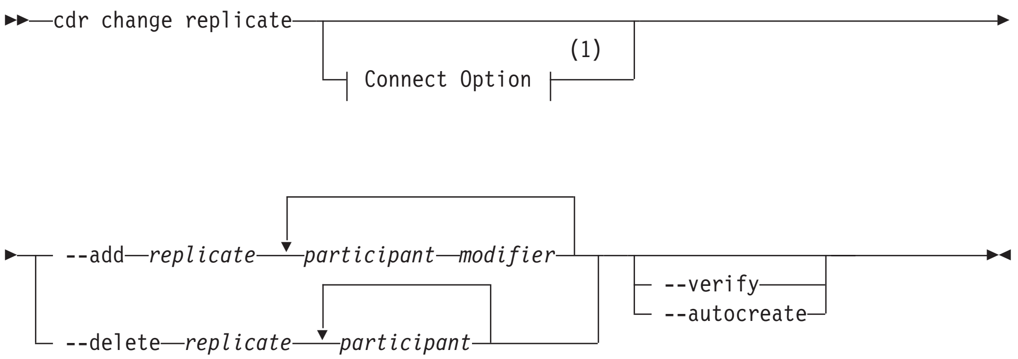
See Also

- "cdr swap shadow" on page A-103
- "cdr remaster" on page A-71

cdr change replicate

The **cdr change replicate** command allows you to modify an existing replicate by adding or deleting one or more participants.

Syntax



Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
modifier	Specifies the rows and columns to replicate		"Participant Modifier" on page A-125
participant	Specifies the database server and table for replication	The participant must exist.	"Participant" on page A-124
replicate	Name of the replicate to change	The replicate must exist.	"Long Identifiers" on page A-123

The following table describes the options to **cdr change replicate**.

Long Form	Short Form	Meaning
--add	**-a**	Add participants to a replicate.
--autocreate	**-u**	For use with master replicates only. Specifies that if the tables in the master replicate definition do not exist in the databases on the target servers, then they are created automatically. However, the table cannot contain columns with user-defined data types. The tables are created in the same dbspace as the database.
--delete	**-d**	Remove participants from a replicate.
--verify	**-v**	For use with master replicates only. Specifies that the **cdr change template** command verifies the database, tables, and column data types against the master replicate definition on all listed servers

Usage

Use this command to add or delete a participant from a replicate. You can define a replicate that has zero or one participants, but to be useful, a replicate must have at least two participants. You cannot start and stop replicates that have no participants.

Important: Enterprise Replication adds the participant to the replicate in an inactive state, regardless of the state of the replicate. To activate the new participant, run with the name of the server group. See "cdr start replicate" on page A-82.

Examples

The following example adds two participants to the replicate named **repl_1**: **db1@server1:antonio.table** with the modifier `select * from table1`, and **db2@server2:carlo.table2** with the modifier `select * from table2`:

```
cdr change repl -a repl_1 \
   "db1@server1:antonio.table1" "select * from table1" \
   "db2@server2:carlo.table2" "select * from table2"
```

The following example removes the same two participants from replicate **repl_1**:

```
cdr change repl -d repl_1 \
   "db1@server1:antonio.table1" \
   "db2@server2:carlo.table2"
```

See Also

- "cdr define replicate" on page A-21
- "cdr delete replicate" on page A-37
- "cdr list replicate" on page A-50
- "cdr modify replicate" on page A-60
- "cdr resume replicate" on page A-76
- "cdr start replicate" on page A-82
- "cdr stop replicate" on page A-94
- "cdr suspend replicate" on page A-98

cdr change replicateset

The **cdr change replicateset** command changes a replicate set by adding or deleting replicates.

Syntax

```
►►─cdr change replicateset─┬──────────────────────────┬─┬─--add────┬──────────►
                           │                     (1)  │ └─--delete─┘
                           └─┤ Connect Option ├───────┘

            ┌──────────┐
            ▼          │
►─repl_set───replicate─┴─────────────────────────────────────────────────────►◄
```

Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
repl_set	Name of the replicate set to change	The replicate set must exist.	“Long Identifiers” on page A-123
replicate	Name of the replicates to add to or delete from the set	The replicates must exist.	“Long Identifiers” on page A-123

The following table describes the options to **cdr change replicateset**

Long Form	Short Form	Meaning
--add	**-a**	Add replicates to a replicate set.
--delete	**-d**	Remove replicates from a replicate set.

Usage

Use this command to add replicates to a replicate set or to remove replicates from an exclusive or non-exclusive replicate set:

- If you add a replicate to an exclusive replicate set, Enterprise Replication changes the existing state and replication frequency settings of the replicate to the current properties of the exclusive replicate set.

  If you remove a replicate from an exclusive replicate set, the replicate retains the properties of the replicate set at the time of removal (not the state the replicate was in when it joined the exclusive replicate set).

  When you add or remove a replicate from an exclusive replicate set that is suspended or that is defined with a frequency interval, Enterprise Replication transmits all the data in the queue for the replicates in the replicate set up to the point when you added or removed the replicate. For more information, see “Suspending a Replicate Set” on page 7-10 and “Frequency Options” on page A-126.
- If you add or remove a replicate to a non-exclusive replicate set, the replicate retains its individual state and replication frequency settings.

Examples

The following example adds the replicates **house** and **barn** to replicate set **building_set**:

```
cdr change replicateset --add building_set house barn
```

The following example removes the replicates **teepee** and **wigwam** from replicate set **favorite_set**:

```
cdr change replset --delete favorite_set teepee wigwam
```

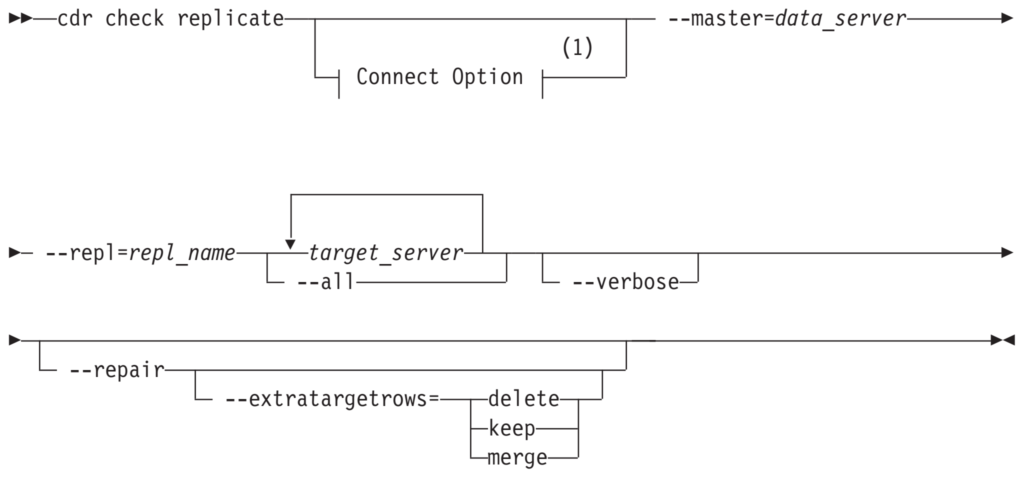
See Also

- “cdr define replicate” on page A-21
- “cdr delete replicateset” on page A-38
- “cdr list replicateset” on page A-53
- “cdr modify replicateset” on page A-63
- “cdr resume replicateset” on page A-77
- “cdr start replicateset” on page A-85
- “cdr stop replicateset” on page A-96
- “cdr suspend replicateset” on page A-99

cdr check replicate

The **cdr check replicate** command compares the data on replication servers to create a report listing data inconsistencies and optionally can repair the inconsistent data within a replicate.

Syntax



Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
data_server	Name of the database server to use as the reference copy of the data	Must be the name of an existing database server group in SQLHOSTS. See "Setting up Database Server Groups" on page 4-3.	"Long Identifiers" on page A-123
repl_name	Name of the replicate to check		"Long Identifiers" on page A-123
target_server	Name of a database server group to check	Must be the name of an existing database server group in SQLHOSTS. See "Setting up Database Server Groups" on page 4-3.	"Long Identifiers" on page A-123

The following table describes the **cdr check replicate** options.

Long Form	Short Form	Meaning
--all	**-a**	Specifies that all servers defined for the replicate are checked

Long Form	Short Form	Meaning
--extratargetrows=	**-e**	Specifies how to handle rows found on the target servers that are not present on the server from which the data is being copied (*data_server*): • **delete**: (default) remove rows and dependent rows, based on referential integrity constraints, from the target servers • **keep**: retain rows on the target servers • **merge**: retain rows on the target servers and replicate them to the data source server
--master=	**-m**	Specifies the database server to use as the reference copy of the data
--repair	**-R**	Specifies that rows that are found to be inconsistent are repaired
--repl=	**-r**	Specifies the name of the replicate to check
--verbose	**-v**	Specifies that the consistency report shows specific inconsistent rows, identified by their primary key values

Usage

Use the **cdr check replicate** command to check the consistency of data between multiple database servers for a specific replicate. The **cdr check replicate** command compares all rows on all specified database servers against the data in the reference server and produces a consistency report. If you include the **--verbose** option, the report lists every inconsistent row; otherwise, the report summarizes inconsistent rows.

The **cdr check replicate** command requires that its associated user-defined routines are installed and registered in each database that is involved in the checking process. For instructions about registering these routines, see "Preparing the checksum Support Functions" on page 7-14.

If you include the **--repair** option, the **cdr check replicate** command repairs inconsistent rows so that they match the rows on the reference server. When repairing inconsistent rows, the **cdr check replicate** command uses direct synchronization as a foreground process.

The **cdr check replicate** command with the **–repair** option performs the following tasks:

1. Creates a shadow replicate with the source server and target server as participants. The conflict resolution rule for the shadow replicate is **always apply**.
2. Performs an index scan using the primary key index at both the source server and the target server to create a checksum and identify inconsistent rows.
3. Replicates inconsistent rows from the source server to the target server by performing a dummy update of the source server, which might result in increase logging activity.
4. Deletes the shadow replicate.

The following table describes the columns of the consistency report.

Table A-1. Consistency Report Description

Column name	**Description**
Node	The name of the replication server
Rows	The number of rows in the participant
Extra	The number of rows on the target server that do not exist on the reference server For the reference server, this number is always 0.
Missing	The number of rows on the reference server that do not exist on the target server For the reference server, this number is always 0.
Mismatch	The number of rows on the target server that are not consistent with the corresponding rows on the reference server For the reference server, this number is always 0.
Processed	The number of rows processed to correct inconsistent rows The number of processed rows on the reference server is equal to the number of mismatched rows plus missing rows on the target servers. The number of processed rows for a target server is usually equal to the number of extra rows it has. If a row has child rows, then the number of processed rows can be greater than the number of extra rows because the child rows must be deleted as well. If the **--extratargetrows** option is set to **keep**, then extra rows are not deleted from the target and those rows are not added to the Processed column. If the **--extratargetrows** option is set to **merge**, then those rows are replicated to the reference server and are listed in the Processed column for the target server.

Examples

The following command generates a consistency report for a replicate named **repl1**, comparing the data on the server **serv2** with the data on the server **serv1**:

```
cdr check replicate --master g_serv1 --repl=repl_1 g_serv2
```

The summary consistency report for the previous command might be:

```
------   Statistics for repl1 ------
Node                  Rows     Extra   Missing  Mismatch Processed
---------------- --------- --------- --------- --------- ---------
g_serv1                 52         0         0         0         0
g_serv2                 52         0         0         0         0
```

This report indicates that the replicate is consistent on these servers.

If the replicate has inconsistencies, the consistency report for the previous command might be:

```
------   Statistics for repl1 ------
Node                  Rows     Extra   Missing  Mismatch Processed
---------------- --------- --------- --------- --------- ---------
g_serv1                 67         0         0         0         0
g_serv2                 65         0         2         1         0

WARNING: replicate is not in sync
```

This report indicates that the server **g_serv2** is missing two rows and has one inconsistent row.

The following command generates a consistency report and repairs inconsistent rows on all servers for a replicate named **repl1**:

```
cdr check replicate --master g_serv1 --repl=repl_1 --all --repair
```

The consistency report for the previous command might be:

```
------   Statistics for repl1 ------
Node                  Rows     Extra   Missing  Mismatch Processed
---------------- --------- --------- --------- --------- ---------
g_serv1                 67         0         0         0         3
g_serv2                 65         0         2         1         0
g_serv3                 67         0         0         0         0

WARNING: replicate is not in sync
```

This report indicates that three rows were replicated from **g_serv1** to **g_serv2**: two missing rows plus one inconsistent row.

If a target server has extra rows, the consistency report for the previous command might be:

```
------   Statistics for repl1 ------
Node                  Rows     Extra   Missing  Mismatch Processed
---------------- --------- --------- --------- --------- ---------
g_serv1                 67         0         0         0         2
g_serv2                 67         2         2         0         2
g_serv3                 67         0         0         0         0

WARNING: replicate is not in sync
```

This report indicates that **g_serv2** has two extra rows and is missing two rows. Two rows were processed on **g_serv1** to replicate the missing rows to **g_serv2**. Also, two rows were processed on **g_serv2** to delete the extra rows. Because the **--extratargetrows** option is not specified, the default behavior of deleting rows on the target servers that are not on the reference server occurs.

The following command generates a verbose consistency report for a replicate named **repl1**:

```
cdr check replicate --master g_serv1 --repl=repl1 g_serv2 --all --verbose
```

The verbose consistency report for the previous command might be:

```
------   Statistics for repl1 ------
data mismatch between g_serv1 and g_serv2
item_num:1
order_num:1011
          lname
```

```
g_serv1   Pauly
g_serv2   Pauli
---------------------------------------------------
row missing on g_serv2
item_num:1
order_num:1014
---------------------------------------------------
row missing on g_serv2
item_num:2
order_num:1014
---------------------------------------------------
Node                  Rows     Extra   Missing  Mismatch Processed
---------------- --------- --------- --------- --------- ---------
g_serv1                 67         0         0         0         0
g_serv2                 65         0         2         1         0

WARNING: replicate is not in sync
```

This report indicates that there is one inconsistent row on **g_serv2**. The primary key for that row is the combination of the **item_num** column and the **order_num** column. The row that is inconsistent is the one that has the item number 1 and the order number 1011. The inconsistency is in the **lname** column where the name is spelled "Pauly" on **g_serv1** and "Pauli" on **g_serv2**. There are two rows that are missing on **g_serv2**, each identified by its primary key value.

See Also

- "cdr sync replicate" on page A-105

cdr check replicateset

The **cdr check replicateset** command compares the data on replication servers to create a report listing data inconsistencies and optionally can repair the inconsistent data within a replicate set.

Syntax

```
►►──cdr check replicateset──┬──────────────────────────┬── --master=data_server──────►
                            │                    (1)   │
                            └─┤ Connect Option ├───────┘


                        ┌────────────────┐
                        ▼                │
►─ --replset=repl_set───┬─target_server──┴─┬──┬─────────────┬────────────────────────►
                        └─ --all───────────┘  └─ --verbose──┘

►─┬──────────────────────────────────────────────────────┬───────────────────────────►◄
  └─ --repair──┬──────────────────────────────────────┬──┘
               └─ --extratargetrows=──┬─delete─┬──────┘
                                      ├─keep───┤
                                      └─merge──┘
```

Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
data_server	Name of the database server to use as the reference copy of the data	Must be the name of an existing database server group in SQLHOSTS. See “Setting up Database Server Groups” on page 4-3.	“Long Identifiers” on page A-123
repl_set	Name of the replicate set to synchronize		“Long Identifiers” on page A-123
target_server	Name of a database server group to check	Must be the name of an existing database server group in SQLHOSTS. See “Setting up Database Server Groups” on page 4-3.	“Long Identifiers” on page A-123

The following table describes the **cdr check replicateset** options.

Long Form	Short Form	Meaning
--all	**-a**	Specifies that all servers defined for the replicate are checked

Long Form	Short Form	Meaning
--extratargetrows=	**-e**	Specifies how to handle rows found on the target servers that are not present on the server from which the data is being copied (*data_server*): • **delete**: (default) remove rows and dependent rows, based on referential integrity constraints, from the target servers • **keep**: retain rows on the target servers • **merge**: retain rows on the target servers and replicate them to the data source server
--master	**-m**	Specifies the database server to use as the reference copy of the data
--repair	**-R**	Specifies that rows that are found to be inconsistent are repaired
--replset	**-s**	Specifies the name of the replicate set to check
--verbose	**-v**	Specifies that the consistency report shows specific rows that are inconsistent instead of a summary of inconsistent rows

Usage

Use the **cdr check replicateset** command to check the consistency of data between multiple database servers for a replicate set. The **cdr check replicateset** command compares all rows on all specified database servers against the data in the reference server and produces a consistency report. If you include the **–verbose** option, the report lists every inconsistent row; otherwise, the report summarizes inconsistent rows.

The **cdr check replicateset** command requires that its associated user-defined routines are installed and registered in each database that is involved in the checking process. For instructions about installing and registering these routines, see “Preparing the checksum Support Functions” on page 7-14.

If you include the **–repair** option, the **cdr check replicateset** command repairs inconsistent rows so that they match the rows on the reference server. When repairing inconsistent rows, the **cdr check replicateset** command uses direct synchronization as a foreground process.

The **cdr check replicateset** command with the **–repair** option performs the following tasks:

1. Determines the order in which to repair tables if they have referential relationships.
2. Creates a shadow replicate with the source server and target server as participants. The conflict resolution rule for the shadow replicate is **always apply**.
3. Performs an index scan using the primary key index at both the source server and the target server to create a checksum and identify inconsistent rows.
4. Replicates inconsistent rows from the source server to the target server by performing a dummy update of the source server, which might result in increase logging activity.
5. Deletes the shadow replicate.
6. Repeats steps 2 through 5 for each replicate in the replicate set.

Examples

The following command generates a consistency report for a replicate set named **replset1**, comparing the data on the server **serv2** with the data on the server **serv1**:

```
cdr check replicateset --master g_serv1 --replset=replset1 g_serv2
```

The summary consistency report for the previous command might be:

```
------   Statistics for replset1 ------
Node                  Rows     Extra   Missing  Mismatch Processed
---------------- --------- --------- --------- --------- ---------
g_serv1                 52         0         0         0         0
g_serv2                 52         0         0         0         0
```

This report indicates that the replicate set is consistent on these servers.

The consistency report for replicate sets shows a series of consistency reports for individual replicates. For more examples of consistency reports and a description of the report, see the examples in "cdr check replicate" on page A-8.

See Also

- "cdr sync replicateset" on page A-108

cdr cleanstart

The **cdr cleanstart** command starts an Enterprise Replication server with empty queues.

Syntax

```
►►──cdr cleanstart──┬──────────────────────┬──────────────────────────────►◄
                    │               (1)    │
                    └─┤ Connect Option ├───┘
```

Notes:

1 See page A-123.

Usage

The **cdr cleanstart** command starts an Enterprise Replication server, but first empties replication queues of pending transactions. Use this command if synchronizing the server using the **cdr sync** command would be quicker than letting the queues process normally.

See Also

- “cdr start” on page A-79

cdr connect server

The **cdr connect server** command reestablishes a connection to a database server that has been disconnected with a **cdr disconnect server** command.

Syntax

```
►►──cdr connect server──┬───────────────────────────┬──server_group─────────────►◄
                        │                     (1)   │
                        └─┤ Connect Option ├────────┘
```

Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
server_group	Name of database server group to resume	The database server group must be defined for replication and be disconnected.	"Long Identifiers" on page A-123

Usage

The **cdr connect server** command reestablishes a connection to the server *server_group*.

See Also

- "cdr define server" on page A-30
- "cdr delete server" on page A-40
- "cdr disconnect server" on page A-44
- "cdr list server" on page A-55
- "cdr modify server" on page A-64
- "cdr resume server" on page A-78
- "cdr suspend server" on page A-101

cdr define repair

The **cdr define repair** command defines a repair job.

Syntax

```
►►──cdr define repair──┬──────────────────────┬──job──┬─--replicate=replicate─┬──────────►
                       │                  (1) │       └─--replset=repl_set────┘
                       └─┤ Connect Option ├───┘

4  ►──┬─────────────────────────────────┬─--syncdatasource=data_server──┬──────────────────┬──►
      └─--extratargetrows=──┬─delete─┬──┘                               └─--blocksize=size─┘
                            ├─keep───┤
                            └─merge──┘

►──┬─--filter──source_participant──source_modifier──target_participant──target_modifier─┬──►◄
   └─target_server────────────────────────────────────────────────────────────────────────┘
```

Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
data_server	The database server to use a reference copy of the data	The database server must be currently active in Enterprise Replication.	"Long Identifiers" on page A-123
job	Name of the repair job		"Long Identifiers" on page A-123
replicate	Name of the replicate	The replicate must exist.	"Long Identifiers" on page A-123
repl_set	Name of the replicate set	The replicate set must exist.	"Long Identifiers" on page A-123
size	The number of user table rows to process together during a repair		Must be a positive integer
source_modifier	Specifies the rows and columns on the source server to use as the basis of the repair	The WHERE clause must select the same columns on both the source and target servers. Use key columns or columns with static values.	"Participant Modifier" on page A-125
source_participant	Name of the participant on the source server to use as the basis of the repair	The participant must exist in the specified replicate. The **P**, **R**, **O**, and **I** options are ignored.	"Participant" on page A-124
target_modifier	Specifies the rows and columns to repair on the target server	The WHERE clause must select the same columns on both the source and target servers. Use key columns or columns with static values.	"Participant Modifier" on page A-125
target_participant	Name of the participant to repair	The participant must exist in the specified replicate. The **P**, **R**, **O**, and **I** options are ignored.	"Participant" on page A-124

Element	Purpose	Restrictions	Syntax
target_server	The database server on which the data is updated	The database server must be currently active in Enterprise Replication.	"Long Identifiers" on page A-123

The following table describes the **cdr define repair** options.

Long Form	Short Form	Meaning
--blocksize=	**-b**	Specifies the number of user table rows to process together during a repair. Set this option to a lower number to increase concurrency. If not set, then the blocksize is calculated internally depending on the primary key size of the table being repaired.
--extratargetrows=	**-e**	Specifies how to handle rows found on the target servers that are not present on the data source server (*data_server*): • **delete**: (default) remove rows and dependent rows, based on referential integrity constraints, from the target servers • **keep**: retain rows on the target server • **merge**: retain rows on the target server and replicate them to the data source server
--filter	**-f**	Specifies the job uses a filter to choose which columns to repair. This option requires a participant and modifier from both the source and target servers. The WHERE clauses in the modifiers must select the same set of rows on both the source and target servers. In the WHERE clauses, only reference columns that are exactly the same on the source and target nodes, and only columns that are not updated.
--replicate=	**-r**	Specifies the name of the replicate on which to perform the repair job.
--replset=	**-R**	Specifies the name of the replicate set on which to perform the repair job.
--syncdatasource=	**-S**	Specifies the name of the database server to use as the reference copy of the data.

Usage

Use the **cdr define repair** command to define a repair job to repair inconsistent data between two Enterprise Replication servers. You can choose the level of granularity for the job by specifying the whole participant, or a specific portion of it defined by a SELECT statement.

While defining repair job, the Enterprise Replication network connection must be active between the Connect server, the reference server, and the target servers. The server specified in the Connect Option must be a non-leaf server.

To start the repair job, use the **cdr start repair** command.

You can only use a specific repair job one time.

Examples

The following example defines a repair job, **repair_1**, on the server **utah** for a specified portion of the participant:

```
cdr define repair repair_1\
--replicate=rep1 --syncdatasource=iowa\
--extratargetrows=delete\
--filter "db2@iowa.carlo.table2" \
"SELECT * FROM table2 WHERE customerid BETWEEN 100 AND 200" \
"db2@utah.carlo.table2" \
"SELECT * FROM table2 WHERE customerid BETWEEN 100 AND 200"
```

Line 2 of this example indicates that the replicate to repair is named **rep1** and that the synchronization data source server containing the correct data is **iowa**.

Line 3 indicates that if there are rows on the target server, **utah**, that are not present on the synchronization data server (**iowa**) then those rows are deleted during the repair job.

Lines 4 through 7 show that the specific rows to repair on the **utah** server are those that have a **customerid** between 100 and 200.

The following example starts a repair job, **repair_2**, on the server **utah** for the whole participant:

```
cdr define repair repair_2\
--replicate=rep1 --syncdatasource=iowa\
--extratargetrows=keep \
utah
```

Line 3 of this example indicates that if rows are found on the **utah** server that do not exist on the **iowa** server, then those rows should remain.

Line 4 indicates that the target server is **utah**.

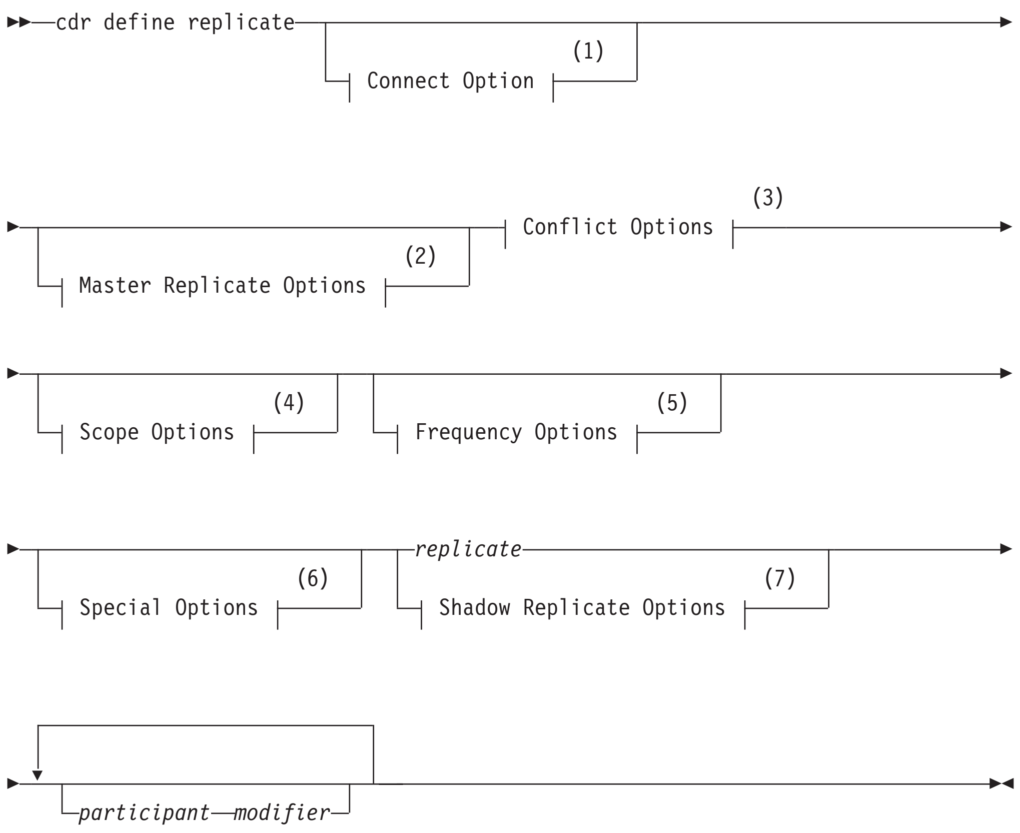
See Also

- "cdr delete repair" on page A-36
- "cdr start repair" on page A-80
- "cdr stop repair" on page A-93
- "cdr list repair" on page A-48
- "cdr repair" on page A-74

cdr define replicate

The **cdr define replicate** command defines a replicate in the global catalog.

Syntax



Notes:

1 See page A-123.

2 See page A-22.

3 See page A-23.

4 See page A-24.

5 See page A-126.

6 See page A-24.

7 See page A-25.

Element	Purpose	Restrictions	Syntax
modifier	Specifies the rows and columns to replicate		"Participant Modifier" on page A-125
participant	Name of a participant in the replication	The participant must exist.	"Participant" on page A-124
replicate	Name of the new replicate	The replicate name must be unique.	"Long Identifiers" on page A-123

Usage

To be useful, a replicate must include at least two participants. You can define a replicate that has one or no participant, but before you can use that replicate, you must use **cdr change replicate** to add more participants. You cannot start and stop replicates that have no participants.

When you define a replicate, the replicate does not begin until you explicitly change its state to *active*. For more information, see "cdr start replicate" on page A-82.

Important: Do not create more than one replicate definition for each row and column set of data to replicate. If the participant is the same, Enterprise Replication attempts to insert duplicate values during replication.

Master Replicate Options

The master replicate options specify whether Enterprise Replication defines the replicate as a master replicate. A master replicate uses saved dictionary information about the attributes of replicated columns to verify that participants conform to the specified schema. You must specify at least one participant when creating a master replicate. All participants specified are verified when the **cdr define replicate** or **cdr change replicate** command is executed. If any participant does not conform to the master definition, then the command fails and that local participant is disabled. If a participant you specify does not contain the master replicate table, Enterprise Replication automatically creates the table on the participant based on the master replicate dictionary information. All database servers containing master replicates must be able to establish a direct connection with the master replicate database server. For more information, see "Defining Master Replicates" on page 6-5.

Master Replicate Options:

```
├── --master=server──┬─────────┬──┬──────────────┬──┬──────────────┬──────────┤
                     └─ --empty─┘  │         ┌y┐ │  ├─ --verify────┤
                                   └─ --name=─┴n┴─┘  └─ --autocreate┘
```

Element	Purpose	Restrictions	Syntax
server	Name of the database server from which to base the master replicate definition	The name must be the name of a database server.	"Long Identifiers" on page A-123

The following table describes the master replicate options.

Long Form	Short Form	Meaning
--master=	**-M**	Specifies that the replicate being created is a master replicate.
--empty	**-t**	Specifies that the participant on the server specified with the **--master** option is used as the basis of the master replicate, but is not added to the replicate.
--name=	**-n**	Specifies whether the master replicate has column name verification in addition to column data type verification. The default is to have column name verification (**-n y**).

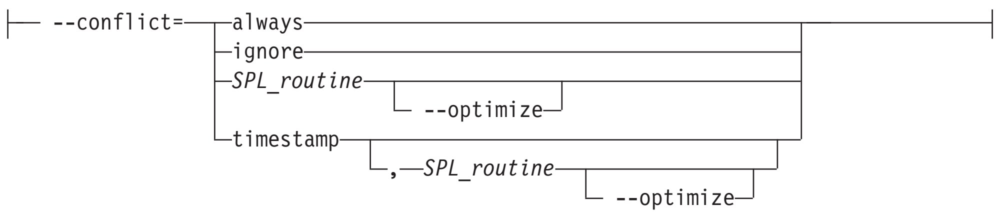
Long Form	Short Form	Meaning
--verify	**-v**	Specifies that the **cdr define replicate** command verifies the database, tables, and column data types against the master replicate definition on all listed servers.
--autocreate	**-u**	Specifies that if the tables in the master replicate definition do not exist in the databases on the target servers, then they are created automatically. However, the table cannot contain columns with user-defined data types. The tables are created in the same dbspace as the database.

Conflict Options

The **--conflict** options specify how Enterprise Replication should resolve conflicts with data arriving at the database server.

For more information, see “Conflict Resolution” on page 3-6.

Conflict Options:



Element	Purpose	Restrictions	Syntax
SPL_routine	SPL routine for conflict resolution	The SPL routine must exist.	“Long Identifiers” on page A-123

The following table describes the **conflict** options.

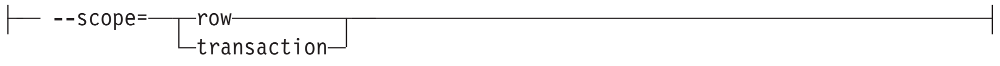
Long Form	Short Form	Meaning
--conflict=	**-C**	Specifies the rule that will be used for conflict resolution. The action that Enterprise Replication takes depends upon the scope. If scope is not specified, the default scope is transaction. Use the **always** option if you do not want Enterprise Replication to resolve conflicts, but you do want replicated changes to be applied even if the operations are not the same on the source and target servers. Use the **ignore** option if you do not want Enterprise Replication to resolve conflicts. Use the **timestamp** option to have the row or transaction with the most recent timestamp take precedence in a conflict.

Long Form	Short Form	Meaning
--optimize	**-O**	Specifies that the SPL routine is *optimized*. An optimized SPL routine is called only when a collision is detected and the row to be replicated fails to meet one of the following two conditions: • It is from the same database server that last updated the local row on the target table. • It has a time stamp greater than or equal to that of the local row. When this option is not present, Enterprise Replication always calls the SPL routine defined for the replicate when a conflict is detected.

Scope Options

The **--scope** options specify the scope of Enterprise Replication conflict resolution.

Scope Options:

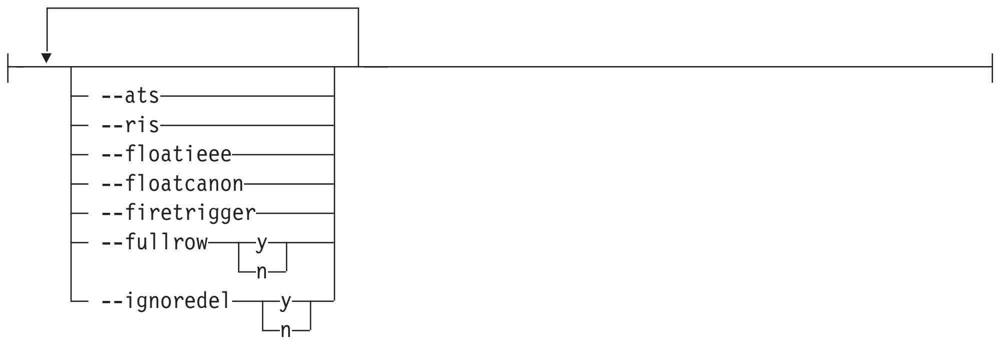


The following table describes the **--scope** option.

Long Form	Short Form	Meaning
--scope=	**-S**	Specifies the scope that will be invoked when Enterprise Replication encounters a problem with data or a conflict occurs. For more information, see "Scope" on page 3-11. If scope is not specified, the default scope is transaction. When specifying the scope, you can abbreviate **transaction** to **tra**.

Special Options

Special Options:



The following table describes the special options to **cdr define replicate**.

Long Form	Short Form	Meaning
--ats	**-A**	Activates aborted transaction spooling for replicate transactions that fail to be applied to the target database. For more information, see "Setting Up Error Logging" on page 6-8 and Chapter 8, "Monitoring and Troubleshooting Enterprise Replication," on page 8-1.
--firetrigger	**-T**	Specifies that the rows that this replicate inserts fire triggers at the destination. For more information, see "Enabling Triggers" on page 6-10.
--floatieee	**-I**	Transfers replicated floating-point numbers in either 32-bit (for SMALLFLOAT) or 64-bit (for FLOAT) IEEE floating-point format. Use this option for all new replicate definitions. For more information, see "Using the IEEE Floating Point or Canonical Format" on page 6-9.
--floatcanon	**-F**	Transfers replicated floating-point numbers in machine-independent decimal representation. This format is portable, but can lose accuracy. This format is provided for backward-compatibility only; use **--floatieee** for all new replicate definitions. For more information, see "Using the IEEE Floating Point or Canonical Format" on page 6-9.
--fullrow y | n	**-f y | n**	Specifies to (y) replicate the full row and enable upserts or (n) replicate only changed columns and disable upserts. By default, Enterprise Replication always replicates the entire row and enables upserts. For more information, see "Replicating Only Changed Columns" on page 6-8.
--ignoredel y | n	**-D y | n**	Specifies that rows are retained if they are deleted on other nodes in the Enterprise Replication system.
9 **--ris**	**-R**	Activates row-information spooling for replicate row data that fails conflict resolution or encounters replication order problems, if the conflict resolution rule is other than *ignore* or *always-apply*. For more information, see "Setting Up Error Logging" on page 6-8 and Chapter 8, "Monitoring and Troubleshooting Enterprise Replication," on page 8-1.

Shadow Replicate Options

A shadow replicate is a copy of an existing, or primary, replicate. You must create a shadow replicate to perform a manual remastering of a replicate that was defined with the **-n** option. After creating the shadow replicate, the next step in manual remastering is to switch the primary replicate and the shadow replicate using the **cdr swap shadow** command.

Shadow Replicate Options:

```
|--+---------------------------------------------------+--------------------------|
   '-- --mirrors--primary_replicate--shadow_replicate--'
```

Element	**Purpose**	**Restrictions**	**Syntax**
primary_replicate	Name of the replicate on which to base the shadow replicate	The replicate must exist. The replicate name must be unique.	"Long Identifiers" on page A-123
shadow_replicate	Name of the shadow replicate to create	The replicate name must be unique.	"Long Identifiers" on page A-123

The following table describes the shadow replicate option to **cdr define replicate**.

Long Form	Short Form	Meaning
--mirrors	**-m**	Specifies that the replicate created is a shadow replicate based on an existing primary replicate.

Examples

The following example illustrates the use of **cdr define replicate**:

```
cdr define repl --conflict=timestamp,sp1 \
--scope=tran --ats --fullrow n --floatieee newrepl \
"db1@iowa:antonio.table1" "select * from table1" \
"db2@utah:carlo.table2" "select * from table2"
```

Line 1 of the example specifies a primary conflict-resolution rule of *timestamp*. If the primary rule fails, the SPL routine **sp1** will be invoked to resolve the conflict. Because no database server is specified here (or on any later line), the command connects to the database server named in the **INFORMIXSERVER** environment variable.

Line 2 specifies that the replicate has a transaction scope for conflict-resolution scope and enables aborted transaction spooling. Enterprise Replication will only replicate the rows that changed and uses the IEEE floating point format to send floating-point numbers across dissimilar platforms. The final item specifies the name of the replicate, **newrepl**.

Line 3 defines the first participant, `"db1@iowa:antonio.table1"`, with the select statement `"select * from table1"`.

Line 4 defines a second participant, `"db2@utah:carlo.table2"`, with the select statement `"select * from table2"`.

The next example is the same as the preceding example with the following exceptions:

- Line 1 instructs Enterprise Replication to use the global catalog on database server **ohio**.
- Line 2 specifies that the data should be replicated every five hours.

```
cdr def repl -c ohio -C timestamp,sp1 \
-S tran -A -e 5:00 -I newrepl \
"db1@iowa:antonio.table1" "select * from table1" \
"db2@utah:carlo.table2" "select * from table2"
```

The following example illustrates creating a master replicate:

```
cdr def repl -c iowa -M iowa \
-C timestamp -S tran -D y newrepl \
"db1@iowa:antonio.table1" "select * from table1"
```

Line 1 instructs Enterprise Replication to create a master replicate based on the replicate information from the database server **iowa**. Line 2 specifies the conflict and scope options, that delete operations are ignored, and that the name of the replicate is **newrepl**. Line 3 specifies the table and columns included in the master replicate.

The next example is the same as the previous example except that it specifies a second participant in Line 4. The second participant (**utah**) does not have the table **table1** specified in its participant and modifier syntax; the execution of the **cdr define replicate** command creates **table1** on the **utah** server.

```
cdr def repl -c iowa -M iowa \
-C timestamp -S tran -D y newrepl \
"db1@iowa:antonio.table1" "select * from table1 \
"db2@utah:carlo.table1" "select * from table1"
```

See Also

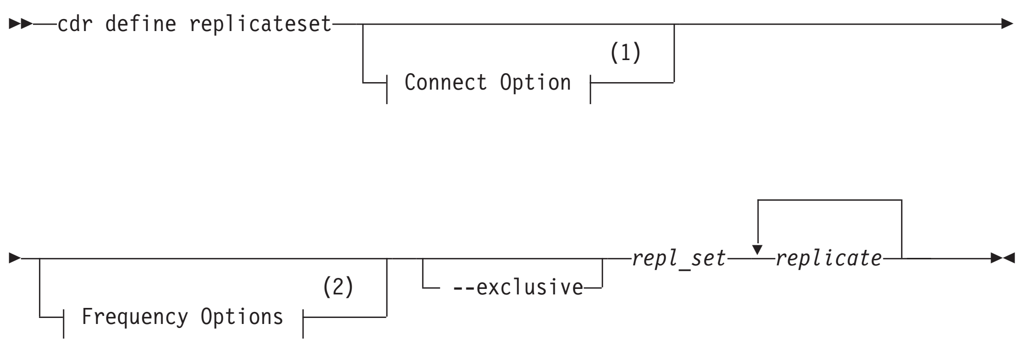
- “cdr change replicate” on page A-4
- “cdr delete replicate” on page A-37
- “cdr list replicate” on page A-50
- “cdr modify replicate” on page A-60
- “cdr resume replicate” on page A-76
- “cdr start replicate” on page A-82
- “cdr stop replicate” on page A-94
- “cdr suspend replicate” on page A-98
- “cdr swap shadow” on page A-103

cdr define replicateset

The **cdr define replicateset** command defines a replicate set. A replicate set is a collection of several replicates to be managed together.

Important: Enterprise Replication supports replicate sets for IBM Informix Dynamic Server, Version 9.3 and later only. You cannot define or modify replicate sets to include replicates with participants that are Version 9.2 and earlier. In addition, replicate sets are different from and are incompatible with replicate groups (in Version 9.2 and earlier).

Syntax



Notes:

1 See page A-123.

2 See page A-126.

Element	Purpose	Restrictions	Syntax
repl_set	Name of replicate set to create	The name must be unique and cannot be the same as a replicate name.	"Long Identifiers" on page A-123
replicate	Name of a replicate to be included in the replicate set	The replicate must exist.	"Long Identifiers" on page A-123

The following table describes the option to **cdr define replicateset**.

Long Form	Short Form	Meaning
--exclusive	**-X**	Creates an exclusive replicate set. For more information, see "Exclusive Replicate Sets" on page 6-10.

Usage

Use the **cdr define replicateset** command to define a replicate set.

Any valid replicate can be defined as part of a replicate set. A replicate can belong to more than one non-exclusive replicate set, but to only one exclusive replicate set. For details on the differences between exclusive and non-exclusive replicate sets, see "Defining Replicate Sets" on page 6-10.

When you create an exclusive replicate set, the state is initially set to inactive. For more information, see “Displaying Information About Replicates” on page A-51.

To create an exclusive replicate set and set the state to active:

1. Create an empty replicate set.
2. Stop the replicate set.
3. Add replicates to the replicate set.
4. Set the state of the replicate set to active by running **cdr start replicateset**.

Because individual replicates in a non-exclusive replicate set can have different states, the non-exclusive replicate set itself has no state. You cannot change whether a replicate set is exclusive or not.

Examples

The following example connects to the default server and defines the non-exclusive replicate set **accounts_set** with replicates **repl1**, **repl2**, and **repl3**:

```
cdr def replset accounts_set repl1 repl2 repl3
```

The following example connects to the server **olive** and defines the exclusive replicate set **market_set** with replicates **basil** and **thyme**:

```
cdr def replset --connect=olive --exclusive market_set basil thyme
```

See Also

- “cdr change replicateset” on page A-6
- “cdr delete replicateset” on page A-38
- “cdr list replicateset” on page A-53
- “cdr modify replicateset” on page A-63
- “cdr resume replicateset” on page A-77
- “cdr start replicateset” on page A-85
- “cdr stop replicateset” on page A-96
- “cdr suspend replicateset” on page A-99

cdr define server

The **cdr define server** command defines a database server group and all its members (that is, all database servers that are members of the database server group) for Enterprise Replication.

Syntax

```
►►──cdr define server──┬────────────────────────┬──┬──────────────────┬──────►
                       │                   (1)  │  │             (2)  │
                       └─┤ Connect Option ├─────┘  └─┤ Options ├──────┘

►──┬─────────────┬──┬────────────────────────┬── --init──server_group──────►◄
   ├─ --nonroot──┤  └─ --sync=sync_server────┘
   └─ --leaf─────┘
```

Notes:

1 See page A-123.

2 See page A-31.

Element	Purpose	Restrictions	Syntax
server_group	Name of a database server group to declare for Enterprise Replication	Must be the name of an existing database server group in SQLHOSTS. See "Setting up Database Server Groups" on page 4-3.	
sync_server	Name of server to use for synchronization for all subsequent server definitions to an existing replication system	Must be a server that is registered with Enterprise Replication. The server must be online.	"Long Identifiers" on page A-123

The following table describes the options to **cdr define server**.

Long Form	Short Form	Meaning
--init	**-I**	Adds *server_group* to the replication system. The *server_group* must be the same as the connection server.
--leaf	**-L**	Defines the server as a leaf server. If neither leaf nor nonroot is specified, the server is defined as a root server.
--nonroot	**-N**	Defines the server as a nonroot server. If neither leaf nor nonroot is specified, the server is defined as a root server.
--sync=	**-S**	Uses the global catalog on *sync_server* as the template for the global catalog on the new replication server, *server_group*. Use this option for adding subsequent *server_groups* to an existing replication system. For Hierarchical Routing (HR) topologies, Enterprise Replication also uses the *sync_server* as the new server's parent in the current topology.

Usage

The **cdr define server** command creates the Enterprise Replication global catalog and adds the database server from the *server_group*.

Options

The options allow you to modify the default behavior of **cdr define server**.

Options:

```
      ┌─────────────────┐
      ▼                 │
├──┬──┴─────────────────┴──────────────────────────────────────┤
      ├─ --ats=ats_dir───┤
      ├─ --ris=ris_dir───┤
      └─ --idle=timeout──┘
```

Element	Purpose	Restrictions	Syntax
ats_dir	Name of the directory for Aborted Transaction Spooling	Must be a full pathname. The path for the directory can be no longer than 256 bytes. A value of **/dev/null** (UNIX) or **NUL** (Windows) prevents ATS file generation.	Follows naming conventions on your operating system
ris_dir	Name of the directory for Row Information Spooling	Must be a full pathname. The path for the directory can be no longer than 256 characters. A value of **/dev/null** (UNIX) or **NUL** (Windows) prevents RIS file generation.	Follows naming conventions on your operating system
timeout	Idle time-out for this replication server	Must be an integer number of minutes. 0 indicates no time-out. The maximum value is 32,767.	Integer

The following table describes the options to **cdr define server.**

Long Form	Short Form	Meaning
--ats=	**-A**	Specifies the directory to store aborted transaction spooling files for replicate transactions that fail to be applied. For more information, see Chapter 8, "Monitoring and Troubleshooting Enterprise Replication," on page 8-1.

9

Long Form	Short Form	Meaning
--ris=	**-R**	Specifies the directory to store row information spooling files for replicate row data that fails conflict resolution or encounters replication-order problems. For more information, see Chapter 8, "Monitoring and Troubleshooting Enterprise Replication," on page 8-1.
--idle=	**-i**	Causes an inactive connection to be terminated after *timeout* minutes. If time-out is `0`, the connection does not time out. The default value is `0`.

Examples

The first example defines the first database server in a replication environment. The command connects to the database server **stan**, initializes Enterprise Replication, and sets the idle time-out to 500 minutes. The example also specifies that any files that ATS generates will go into the **/cdr/ats** directory.

```
cdr define server --connect=stan \
--idle=500 --ats=/cdr/ats --init g_stan
```

The following example adds a database server to the replication environment in the first example. The command connects to the database server **oliver**, initializes Enterprise Replication, synchronizes its catalogs with the catalogs on the existing database server **stan**, and defines the database server **oliver** with an idle time-out of 600 minutes. This command also specifies that any files that ATS generates will go into the **/cdr/ats** directory.

```
cdr define server -c oliver -i 600 -A /cdr/ats -S g_stan -I g_oliver
```

See Also

- "cdr connect server" on page A-17
- "cdr delete server" on page A-40
- "cdr disconnect server" on page A-44
- "cdr list server" on page A-55
- "cdr modify server" on page A-64
- "cdr resume server" on page A-78
- "cdr suspend server" on page A-101

cdr define template

The **cdr define template** command creates a template for replicates and a replicate set. Because templates define replicates, many of the syntax options for the **cdr define template** command are the same as for the **cdr define replicate** command.

Syntax

```
                                                                    (2)
>>--cdr define template--template--+------------------------+--| Conflict Options |------->
                                   |                  (1)   |
                                   '--| Connect Option |----'

>--+-----------------------+--+---------------------------+--+-------------------------+-->
   |                (3)    |  |                    (4)    |  |                  (5)    |
   '--| Scope Options |----'  '--| Frequency Options |----'  '--| Special Options |----'

                                                             .-------.
                                                             V       |
>-- --master=server_group--+---------------+-- --database=database--+---table---+----------><
                           '--exclusive----'                        +- --all----------+
                                                                    '- --file=filename-'
```

Notes:

1 See page A-123.

2 See page A-23.

3 See page A-24.

4 See page A-126.

5 See page A-24.

Element	**Purpose**	**Restrictions**	**Syntax**
template	Name of the template to create	The template name must be unique and cannot be the same as a replicate or replicate set name.	"Long Identifiers" on page A-123
database	Name of the database used to define the template attributes	The database server must be registered with Enterprise Replication.	"Long Identifiers" on page A-123
table	Name of the table to be included in the template	The table must be an actual table. It cannot be a synonym or a view. For ANSI databases, you must specify *owner.tablename*.	"Long Identifiers" on page A-123
filename	The directory and filename of the file containing a list of tables to be included in the template	Must be a full pathname and filename. The path and filename can be no longer than 256 bytes. Within the file, the table names can be separated by a space or placed on different lines.	Follows naming conventions on your operating system.

Element	Purpose	Restrictions	Syntax
server_group	Name of a database server group to declare for Enterprise Replication	Must be the name of an existing database server group in SQLHOSTS. See "Setting up Database Server Groups" on page 4-3.	"Long Identifiers" on page A-123

The following table describes the options to **cdr define template**.

Long Form	Short Form	Meaning
--all	**-a**	Specifies that all tables in the database are included in the template.
--database=	**-d**	Specifies which database the template is based on. If no tables or table list filename are listed after this option, then all tables in the database are included in the template.
--exclusive	**-X**	Creates an exclusive replicate set. The state of the replicate set is inactive until you apply the template. This option is required if you have referential integrity constraints on a table. For more information, see "Exclusive Replicate Sets" on page 6-10.
--file=	**-f**	Specifies the path and filename of a file that lists the tables to be included in the template. The file must contain only table names, either separated by spaces or each on its own line.
--master=	**-M**	Specifies the server that contains the database to be used as the basis of the template. If this option is not specified, then the server specified in the connect option is used. For more information on master replicates, see "Defining Master Replicates" on page 6-5.

Usage

A template consists of schema information about a database, a group of tables, column attributes, and the primary keys that identify rows. A template defines a group of master replicates and a replicate set.

The replicate set can be exclusive or non-exclusive. Specify that the replicate set is exclusive if you have referential constraints placed on the replicated columns. If you create an exclusive replicate set using a template, you do not need to stop the replicate set to add replicates. The **cdr define template** command performs this task automatically.

After you define a template using the **cdr define template** command, use the **cdr realize template** command to apply the template to your Enterprise Replication database servers.

You cannot update a template. To modify a template, you must delete it and then re-create it with the **cdr define template** command.

Examples

The following example illustrates the **cdr define template** command:

```
cdr define template tem1 -c detroit\
-C timestamp -S tran \
--master=chicago\
--database=new_cars table1 table2 table3
```

Line 1 of the example specifies a template name of **tem1** and that the connection is made to the server **detroit**. Line 2 specifies a conflict-resolution rule of **timestamp** and a transaction scope for conflict resolution. Line 3 specifies that the master replicate information is obtained from the server **chicago**. Line 4 specifies to use the **new_cars** database on the **chicago** server and to include only the tables **table1**, **table2**, and **table3**.

The next example is the same as the first except that it has additional options and uses a file instead of a list of tables:

```
cdr define template tem1 -c detroit\
-C timestamp -S tran --master=chicago\
--ignoredel y\
--database=new_cars --file=tabfile.txt
```

Line 3 indicates that delete operations are not replicated. Retaining deleted rows on target servers is useful for consolidation models.

Line 4 specifies a filename for a file that contains a list of tables to include in the template. The **tabfile.txt** file has the following contents:

```
table1
table2
table3
table4
```

See Also

- "cdr list template" on page A-58
- "cdr realize template" on page A-66
- "cdr delete template" on page A-43
- "cdr define replicate" on page A-21

cdr delete repair

The **cdr delete repair** command deletes a repair job.

Syntax

```
►►──cdr delete repair──┬──────────────────────┬──job──────────────────►
                       │                  (1) │
                       └──┤ Connect Option ├──┘

►── --syncdatasource=source_server──────────────────────────────────►◄
```

Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
job	Specifies the name of the repair job to delete	The repair job must exist and must not be running	"Long Identifiers" on page A-123

The following table describes the option to the **cdr delete repair** command.

Long Form	Short Form	Meaning
--syncdatasource=	**-S**	Specifies the name of the database server designated as the reference copy of the data in the **cdr define repair** command.

Usage

Use the **cdr delete repair** command to delete an existing repair job. You cannot delete a repair job that is running.

The server specified in the Connect Option must be a non-leaf server.

Examples

The following example deletes a repair job named **parts_repair**:

```
cdr delete repair parts_repair
```

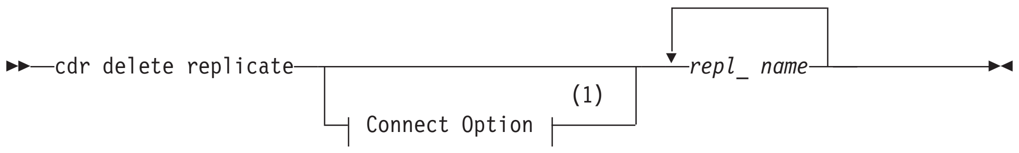
See Also

- "cdr define repair" on page A-18
- "cdr start repair" on page A-80
- "cdr stop repair" on page A-93
- "cdr list repair" on page A-48

cdr delete replicate

The **cdr delete replicate** command deletes a replicate from the global catalog.

Syntax



Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
repl_name	Name of the replicate to delete	The replicate must exist.	"Long Identifiers" on page A-123

Usage

The **cdr delete replicate** command deletes the replicate *repl_name* from the global catalog. All replication data for the replicate is purged from the send queue at all participating database servers.

Warning: Avoid deleting a replicate and immediately re-creating it with the same name. If you re-create the objects immediately (before the operation finishes propagating to the other Enterprise Replication database servers in the network), failures might occur in the Enterprise Replication system at the time of the operation or later. For more information, see "Operational Considerations" on page 2-5.

Examples

The following command connects to the default database server specified by the **INFORMIXSERVER** environment variable and deletes the replicate **smile**:

```
cdr del rep smile
```

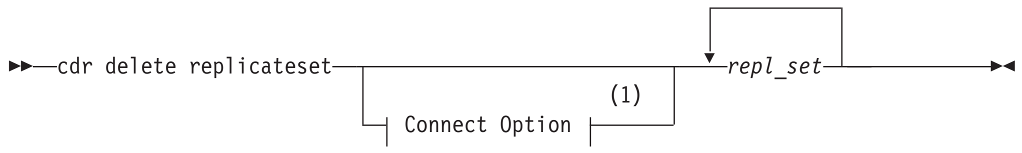
See Also

- "cdr change replicate" on page A-4
- "cdr define replicate" on page A-21
- "cdr list replicate" on page A-50
- "cdr modify replicate" on page A-60
- "cdr resume replicate" on page A-76
- "cdr start replicate" on page A-82
- "cdr stop replicate" on page A-94
- "cdr suspend replicate" on page A-98

cdr delete replicateset

The **cdr delete replicateset** command deletes a replicate set.

Syntax



Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
repl_set	Name of replicate set to delete	The replicate set must exist.	"Long Identifiers" on page A-123

Usage

The **cdr delete replicateset** command deletes the exclusive or non-exclusive replicate set *repl_set* from the global catalog.

The **cdr delete replicateset** command does not affect the replicates or associated data. When a replicate set is deleted, the individual replicates within the replicate set are unchanged.

Warning: Do not delete time-based exclusive replicate sets. Doing so might result in inconsistent data.

Warning: Avoid deleting a replicate set and immediately re-creating it with the same name. If you re-create the objects immediately (before the operation finishes propagating to the other Enterprise Replication database servers in the network), failures might occur in the Enterprise Replication system at the time of the operation or later. For more information, see "Operational Considerations" on page 2-5.

Examples

The following example connects to the default database server and deletes the replicate set **accounts_set**:

```
cdr del replset accounts_set
```

See Also

- "cdr change replicateset" on page A-6
- "cdr define replicate" on page A-21
- "cdr list replicateset" on page A-53
- "cdr modify replicateset" on page A-63
- "cdr resume replicateset" on page A-77
- "cdr start replicateset" on page A-85
- "cdr stop replicateset" on page A-96

- “cdr suspend replicateset” on page A-99

cdr delete server

The **cdr delete server** command deletes a database server from the global catalog.

Syntax

```
>>─cdr delete server─┬──────────────────────┬─server_group───────────────><
                     │                 (1)  │
                     └─┤ Connect Option ├───┘
```

Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
server_group	Name of database server group to remove from the global catalog	The database server group must be currently defined in Enterprise Replication.	"Long Identifiers" on page A-123

Usage

The **cdr delete server** command deletes the database server in *server_group* from the global catalog, removes the database server from all participating replicates, and purges all replication data from the send queues for the specified database server. The command shuts down Enterprise Replication on the database server and removes the global catalog from the database server.

When you delete an Enterprise Replication server, you must issue the **cdr delete server** command *twice*: once on the server being deleted and once on another server in the enterprise. The first **cdr delete server** removes the Enterprise Replication server from the local global catalog and removes the Enterprise Replication connection to other hosts. The second **cdr delete server** removes the Enterprise Replication server from the other replication servers in the system. For more information, see the "Examples" on page A-41.

You can issue the **cdr delete server** command from any replication server. The only limitation is that you cannot delete a server with children. You must delete the children of a server before deleting the parent server.

You cannot delete a server from the enterprise if it is stopped. To delete a server with **cdr delete server**, you must issue a **cdr start** command first.

Warning: Avoid deleting a replication server and immediately re-creating it with the same name. If you re-create the objects immediately (before the operation finishes propagating to the other Enterprise Replication database servers in the network), failures might occur in the Enterprise Replication system at the time of the operation or later. For more information, see "Operational Considerations" on page 2-5.

9 Accurately executing **cdr delete server** returns both Error 25582 and a random
9 operating system error. This is expected behavior and does not require re-executing
9 the **cdr delete server** utility or any other action.

Error 22582 is valid when it is not returned after executing **cdr delete server**.

Examples

This example removes the server **g_italy** from the replication environment (assume that you issue the commands from the replication server **g_usa**):

```
cdr delete server -c usa g_italy
cdr delete server -c italy g_italy
```

The first command performs the following actions:

- Removes **g_italy** from the **usa** global catalog
- Drops the connection from **g_usa** to **g_italy**
- Removes **g_italy** from all participating replicates
- Purges the replication data destined for **g_italy** from send queues
- Broadcasts this delete server command to all other servers (other than **g_italy**) so that they can perform the same actions

The second command connects to server **italy** and removes Enterprise Replication from **italy**. That is, it removes the **syscdr** database and removes or stops other components of Enterprise Replication.

Figure A-1 shows a replication environment with three replication servers, **g_usa**, **g_italy**, and **g_japan**.

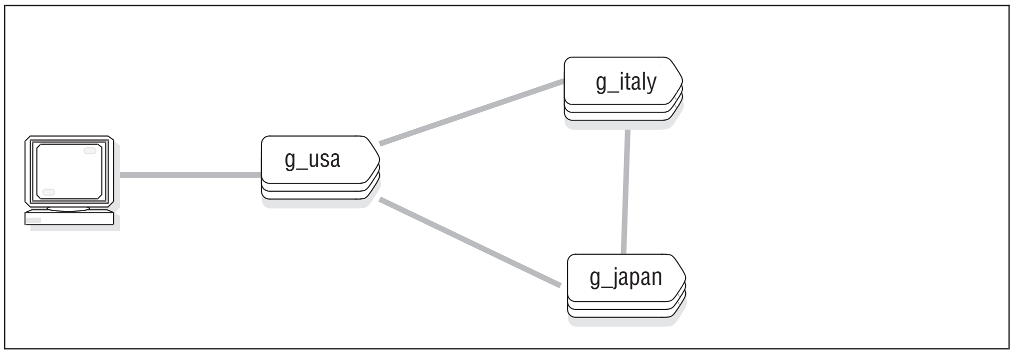


Figure A-1. Three Replication Servers

To remove Enterprise Replication from this environment, issue the following commands from the computer where the **usa** replication server resides.

To remove Enterprise Replication from this environment:

1. Execute:

   ```
   cdr delete server g_italy
   ```

   This command removes connections between the **italy** replication server and all other servers in the replication system (**usa** and **japan**) and removes any queued data.
2. Execute:

   ```
   cdr delete server -c italy g_italy
   ```

   This command removes all replication information (including the **syscdr** database) from the **italy** database server.
3. Execute:

   ```
   cdr delete server g_japan
   cdr delete server -c japan g_japan
   ```

   These commands remove the **japan** replication server.
4. Execute:

```
cdr delete server g_usa
```

This command removes the replication information from the **usa** replication server itself.

See Also

- “cdr connect server” on page A-17
- “cdr define server” on page A-30
- “cdr disconnect server” on page A-44
- “cdr list server” on page A-55
- “cdr modify server” on page A-64
- “cdr resume server” on page A-78
- “cdr suspend server” on page A-101

cdr delete template

The **cdr delete template** command deletes a template from the replication domain. It also deletes any underlying replicate sets associated with the template (these will exist if the template has been realized). No replicates are deleted.

Syntax

```
►►──cdr delete template──┬──────────────────────┬──template──────────────►◄
                         │                 (1)  │
                         └─┤ Connect Option ├───┘
```

Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
template	Name of the template to delete	The template must exist.	"Long Identifiers" on page A-123

Usage

Use the **cdr delete template** command to delete the template definition and the replicate set realized from the template. Any replicates created by realizing the template to a database server are unaffected by this command.

Examples

The following command deletes the template and replicate set **tem1**:

```
cdr delete template tem1
```

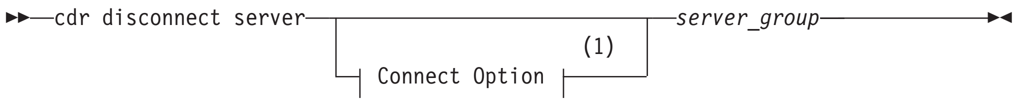
See Also

- "cdr define template" on page A-33
- "cdr realize template" on page A-66

cdr disconnect server

The **cdr disconnect server** command stops a server connection.

Syntax



Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
server_group	Name of the database server group to disconnect	The database server group must be currently active in Enterprise Replication.	"Long Identifiers" on page A-123

Usage

The **cdr disconnect server** command drops the connection (for example, for a dialup line) between *server_group* and the server specified in the **--connect** option. If the **--connect** option is omitted, the command drops the connection between *server_group* and the default database server (the one specified by the **INFORMIXSERVER** environment variable).

Examples

The following example drops the connection between the default database server (the one specified by the **INFORMIXSERVER** environment variable) and the server group **g_store1**:

```
cdr disconnect server g_store1
```

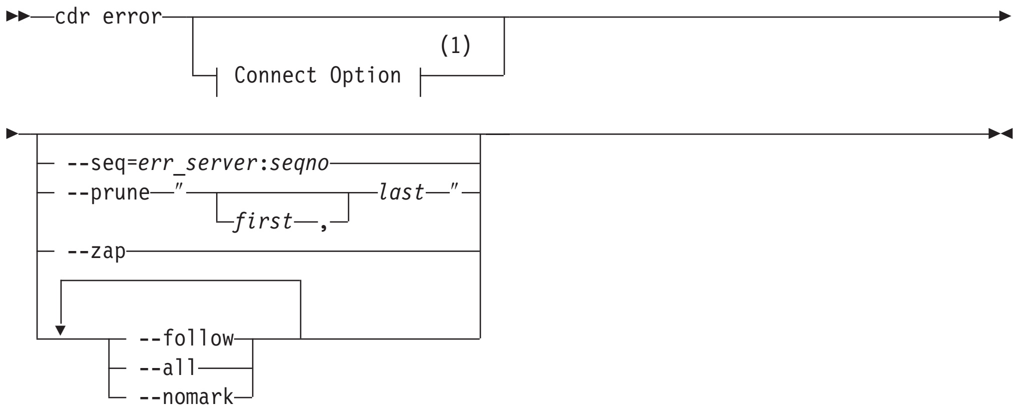
See Also

- "cdr connect server" on page A-17
- "cdr define server" on page A-30
- "cdr delete server" on page A-40
- "cdr list server" on page A-55
- "cdr modify server" on page A-64
- "cdr resume server" on page A-78
- "cdr suspend server" on page A-101

cdr error

The **cdr error** command manages the error table and provides convenient displays of errors.

Syntax



Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
err_server	Name of database server group that holds the error table	The server must be registered for Enterprise Replication.	"Long Identifiers" on page A-123
first	Start date for a range	You must provide a valid date and time.	"Time of Day" on page A-127
last	Ending date for range	You must provide a later date and time than *first*.	"Time of Day" on page A-127
seqno	Sequence number of a specific error	You must provide the number of an error in the error table.	Integer

The following table describes the options to **cdr error**:

Long Form	Short Form	Meaning
(no options specified)		Print the current list of errors and then mark them as *reviewed*. Enterprise Replication does not display errors marked as reviewed.
--all	**-a**	Print all errors, including those already reviewed.
--follow	**-f**	Continuously monitor the error table.
--nomark	**-n**	Do not mark errors as *reviewed*.
--prune	**-p**	Prune the error table to those times in the range from *first* to *last*. If *first* is omitted, then all errors earlier than *last* are removed.
--seq	**-s**	Remove the (single) error specified by *server:seqno* from the error table.
--zap	**-z**	Remove all errors from the error table.

Usage

The **cdr error** command allows you to examine replication errors on any replication server. Sometimes a command succeeds on the server on which it is executed but fails on one of the remote servers. For example, if you execute **cdr define replicate** on **server1**, but the table name is misspelled on **server2**, the command succeeds on **server1** and appears to have completed successfully. You can use **cdr error -c server2** to see why replication is failing.

The **cdr error** command also allows you to administer the **cdr error** table remotely. The reviewed flag lets you watch for new errors while keeping the old errors in the table. For example, you could run **cdr error** periodically and append the output to a file.

Examples

The following command displays the current list of errors on database server **hill**:

```
cdr error --connect=hill
```

After the errors are displayed, Enterprise Replication marks the errors as *reviewed*.

The following command connects to the database server **lake** and removes from the error table all errors that occurred before the time when the command was issued:

```
cdr error -c lake --zap
```

The following command deletes all errors from the error table that occurred at or before 2:56 in the afternoon on May 1, 2000:

```
cdr error -p "2000-05-01 14:56:00"
```

The following command deletes all errors from the error table that occurred at or after noon on May 1, 2000 and before or at 2:56 in the afternoon on May 1, 2000:

```
cdr error -p "2000-05-01 14:56:00,2000-05-01 12:00:00"
```

cdr finderr

The **cdr finderr** command looks up a specific Enterprise Replication error number and displays the corresponding error text.

Syntax

```
►►──cdr finderr──ER_error_number──────────────────────────────────────────►◄
```

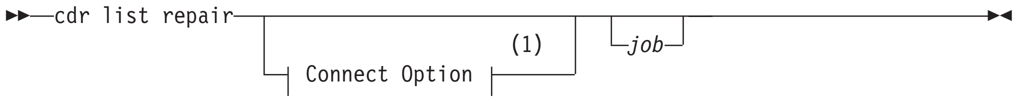
Element	Purpose	Restrictions
ER_error_number	Enterprise Replication error number to look up.	Must be a positive integer.

You can also view the Enterprise Replication error messages in the file **$INFORMIXDIR/incl/esql/cdrerr.h**.

cdr list repair

The **cdr list repair** command displays information about repair jobs.

Syntax



Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
job	Name of the repair job	The job must exist	"Long Identifiers" on page A-123

Usage

Use the **cdr list repair** command to display information about repair jobs. If no repair jobs are named, the command lists all repair jobs on the current server. If one or more repair jobs are named, the command displays detailed information about those jobs.

3 The **cdr list** command can be used while the replication server is in DDRBLOCK
3 mode. Before using the **cdr list** command you must set the DBSPACETEMP
3 configuration parameter and create a temporary dbspace with the onspaces utility.

Examples

The following command displays a list of repair jobs:

```
cdr list repair
```

The output from the previous command might be the following:

```
RESYNCHJOB         REPLICATE/REPLSET                  STATE
-----------------------------------------------------------------------
tell_rsnc          tell_repl1                         Defined
acct_rsnc          acct_repl1                         Completed
```

The following command lists details of the **acct_rsnc** job:

```
cdr list repair acct_rsnc
```

The output from the previous command might be the following:

```
RESYNCHJOB             REPLICATE/REPLSET                  STATE
-----------------------------------------------------------------------
acct_rsnc              acct_repl1                         Completed

SOURCE
------
bank@g_serv1:rajakum.account
        select acct_id,branch_name,acct_addr,acct_balance,
                  last_tran_date from 'rajakum'.account

TARGET
-------
bank@g_serv2:rajakum.account
```

```
       select acct_id,branch_name,acct_addr,acct_balance,
                  last_tran_date from 'rajakum'.account

BLOCK SIZE:          20
TARGET ROW OPTION:   Delete
PROCESSED ROWS:      400
START TIME:          2004-02-28 17:06:29
END TIME:            2004-02-28 17:07:34
```

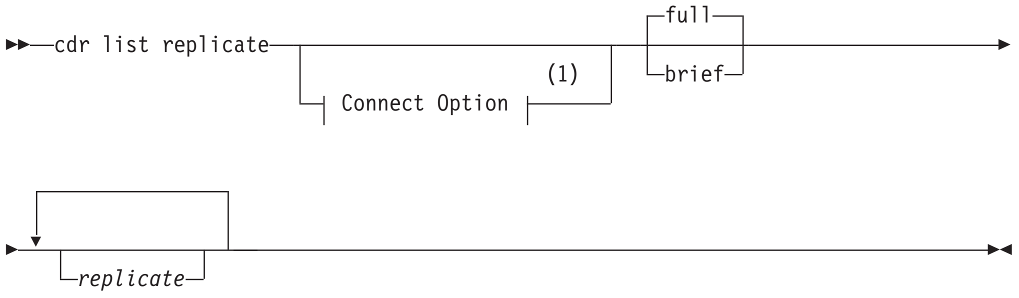
See Also

- “cdr define repair” on page A-18
- “cdr delete repair” on page A-36
- “cdr stop repair” on page A-93
- “cdr list repair” on page A-48

cdr list replicate

The **cdr list replicate** command displays information about the replicates on the current server.

Syntax



Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
replicate	Name of the replicates	The replicates must exist.	"Long Identifiers" on page A-123

Usage

The **cdr list replicate** command displays information about replicates (the **full** option). If no replicates are named, the command lists all replicates on the current server. If one or more replicates are named, the command displays detailed information about those replicates.

To display only replicate names and participant information, use the **brief** option.

You do not need to be user **informix** to use this command.

In hierarchical topology, leaf servers have limited information about other database servers in the Enterprise Replication domain. Therefore, when **cdr list replicate** is executed on a leaf server, it displays incomplete information about the other database servers.

3 The **cdr list replicate** command can be used while the replication server is in
3 DDRBLOCK mode. Before using the **cdr list replicate** command you must set the
3 DBSPACETEMP configuration parameter and create a temporary dbspace with the
3 onspaces utility.

Examples

The following example displays a list of the replicates on the current server with full details:

```
cdr list replicate
```

The output from the previous command might be the following:

```
CURRENTLY DEFINED REPLICATES
---------------------------------------------
REPLICATE:        Repl1
STATE:            Inactive
CONFLICT:         Ignore
FREQUENCY:        immediate
QUEUE SIZE:       0
PARTICIPANT:      bank:joe.teller
OPTIONS:          row,ris,ats
REPLTYPE:         Master

REPLICATE:        Repl2
STATE:            Inactive
CONFLICT:         Ignore
FREQUENCY:        immediate
QUEUE SIZE:       0
PARTICIPANT:      bank:joe.account
OPTIONS:          row,ris,ats
REPLTYPE:         Master,Shadow
PARENT REPLICATE: Repl1
```

The `PARENT REPLICATE` field only appears if the replicate is a shadow replicate.

The following example displays a list of the replicates on the current server with brief details:

```
cdr list replicate brief
```

The output from the previous command might be the following:

```
REPLICATE   TABLE                              SELECT
-----------------------------------------------------------------
Repl1       bank@g_newyork:joe.teller          select * from joe.teller
Repl1       bank@g_sanfrancisco:joe.teller     select * from joe.teller
Repl2       bank@g_portland:joe.teller         select * from joe.teller
Repl2       bank@g_atlanta:joe.teller          select * from joe.teller
```

The following example specifies the names of replicate:

```
cdr list repl brief Repl1
```

The following output might result from the previous command:

```
REPLICATE   TABLE                              SELECT
-----------------------------------------------------------------
Repl1       bank@g_newyork:joe.teller          select * from joe.teller
Repl1       bank@g_sanfrancisco:joe.teller     select * from joe.teller
```

Displaying Information About Replicates

The `STATE` field can include the following values.

Value	Description
`Active`	Specifies that Enterprise Replication captures data from the logical log and transmits it to participants
`Definition Failed`	Indicates that the replication definition failed on a peer server
`Inactive`	Specifies that no database changes are captured, transmitted, or processed
`Pending`	Indicates that a **cdr delete replicate** command has been issued and the replicate is waiting for acknowledgement from the participants
`Quiescent`	Specifies that no database changes are captured for the replicate or participant
`Suspended`	Specifies that the replicate captures and accumulates database changes but does not transmit any of the captured data

The `CONFLICT` field can include the following values.

Value	Description
`Ignore`	Specifies that the replicate uses the ignore conflict-resolution rule
`Timestamp`	Specifies that the replicate uses the time stamp conflict-resolution rule
`Procedure`	Specifies that the replicate uses an SPL routine as the conflict-resolution rule

The `FREQUENCY` field can include the following values.

Value	Description
`immediate`	Specifies that replication occurs immediately
`every` *hh*:*mm*	Specifies that replications occur at intervals (for example, 13:20 specifies every thirteen hours and 20 minutes)
`at` *day*.*hh*:*mm*	Specifies that replications occur at a particular time on a particular day (for example, 15.18:30 specifies on the 15th day of the month at 6:30 P.M.)

The `REPLTYPE` field can include the following values. If the REPLTYPE is not shown, the replicate is a classic replicate (neither a master or a shadow replicate).

Value	Description
`Master`	Indicates that the replicate is defined as a master replicate.
`Shadow`	Indicates that the replicate is a shadow replicate. A shadow replicate can also be a master replicate.

The `PARENT REPLICATE` field appears only for shadow replicates. It shows the name of the replicate on which the shadow replicate is based.

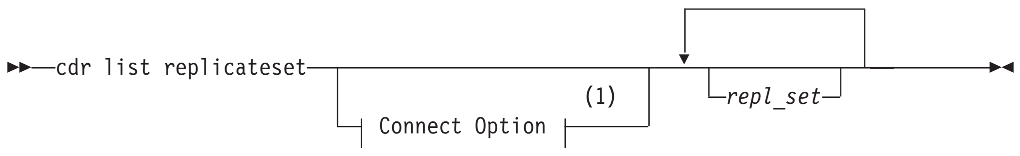
See Also

- "cdr change replicate" on page A-4
- "cdr define replicate" on page A-21
- "cdr delete replicate" on page A-37
- "cdr modify replicate" on page A-60
- "cdr resume replicate" on page A-76
- "cdr start replicate" on page A-82
- "cdr stop replicate" on page A-94
- "cdr suspend replicate" on page A-98

cdr list replicateset

The **cdr list replicateset** command displays information about the replication sets defined on the current server.

Syntax



Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
repl_set	Name of the replicates	The replicates must exist.	"Long Identifiers" on page A-123

Usage

The **cdr list replicateset** command displays a list of the replicate sets that are currently defined. To list the information about each of the replicates within the replicate set, use **cdr list replicateset** *repl_set*. For more information, see "Displaying Information About Replicates" on page A-51.

In hierarchical topology, leaf servers have limited information about other database servers in the Enterprise Replication domain. Therefore, when **cdr list replicateset** is executed against a leaf server, it displays incomplete information about the other database servers.

You do not need to be user **informix** to use this command.

3 The **cdr list replicateset** command can be used while the replication server is in
3 DDRBLOCK mode. Before using the **cdr list replicateset** command you must set
3 the DBSPACETEMP configuration parameter and create a temporary dbspace with
3 the onspaces utility.

Examples

The following example displays a list of the replicate sets on the current server:

```
cdr list replicateset
```

The following output might result from the previous command:

```
Ex T REPLSET                PARTICIPANTS
-----------------------------------------------
N  Y  g1                      Repl1, Repl4
N  Y  g2                      Repl2, Repl3, Repl5
```

The `Ex` field shows whether the replicate set is exclusive. The `T` field shows whether the replicate set was created from a template.

This example displays information for all the replicates in the replicate set **g1**:

```
cdr list replset g1
```

The following output might result from the previous command:

```
REPLICATE SET:g1 [Exclusive]
CURRENTLY DEFINED REPLICATES
----------------------------------------------------------------------
REPLICATE:     Repl1
STATE:         Inactive
CONFLICT:      Ignore
FREQUENCY:     immediate
QUEUE SIZE:    0
PARTICIPANT:   bank:arthur.account
OPTIONS:       row,ris,ats
REPLTYPE:      Master

REPLICATE:     Repl4
STATE:         Inactive
CONFLICT:      Ignore
FREQUENCY:     immediate
QUEUE SIZE:    0
PARTICIPANT:   bank:arthur.teller
OPTIONS:       row,ris,ats
REPLTYPE:      Master
```

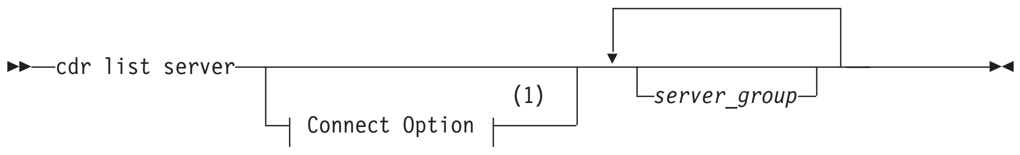
See Also

- "cdr change replicateset" on page A-6
- "cdr define replicate" on page A-21
- "cdr delete replicateset" on page A-38
- "cdr modify replicateset" on page A-63
- "cdr resume replicateset" on page A-77
- "cdr start replicateset" on page A-85
- "cdr stop replicateset" on page A-96
- "cdr suspend replicateset" on page A-99

cdr list server

The **cdr list server** command displays a list of the Enterprise Replication servers that are visible to the server on which the command is run.

Syntax



Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
server_group	Name of the server group	The database server groups must be defined for Enterprise Replication.	

Usage

The **cdr list server** command displays information about servers. You do not need to be user **informix** to use this command.

3 The **cdr list server** command can be used while the replication server is in
3 DDRBLOCK mode. Before using the **cdr list server** command you must set the
3 DBSPACETEMP configuration parameter and create a temporary dbspace with the
3 onspaces utility.

Listing All Enterprise Replication Servers

When no server-group name is given, the **cdr list server** command lists all database server groups that are visible to the current replication server.

In hierarchical topology, leaf servers only have information about their parent database servers in the Enterprise Replication domain. Therefore, when **cdr list server** is executed against a leaf server, it displays incomplete information about the other database servers.

The following example shows possible output for the **cdr list server** command:

```
SERVER         ID STATE    STATUS     QUEUE CONNECTION CHANGED
---------------------------------------------------------------
g_newyork      1 Active   Local      0
g_portland     2 Active   Connected  0     Mar 19 13:48:44
g_sanfrancisco 3 Active   Connected  0     Mar 19 13:48:40
```

The SERVER and ID Columns: The **SERVER** and **ID** columns display the name and unique identifier of the Enterprise Replication server group.

The STATE Column: The **STATE** column can have the following values.

`Active`	Indicates that the server is active and replicating data
`Deleted`	Indicates that the server has been deleted and that it is not capturing or delivering data and the queues are being drained

`Quiescent`	Indicates that the server is in the process of being defined
`Suspended`	Indicates that delivery of replication data to the server is suspended

The STATUS Column: The **STATUS** column can have the following values.

`Connected`	Indicates that the server connection is up
`Connecting`	Indicates that the server is attempting to connect
`Disconnect`	Indicates that the server connection is down in response to an explicit disconnect
`Dropped`	Indicates that the server connection is down due to a network error because the server is unavailable
`Error`	Indicates that an error has occurred (check the log and contact customer support, if necessary)
`Local`	Identifies that this server is the local server as opposed to a remote server
`Timeout`	Indicates that the connection is down due to an idle time-out

The QUEUE Column: The **QUEUE** column displays the size of the queue for the server group.

The CONNECTION CHANGED Column: The **CONNECTION CHANGED** column displays the most recent time that the status of the server connection was changed.

Displaying Details about a Single Replication Server

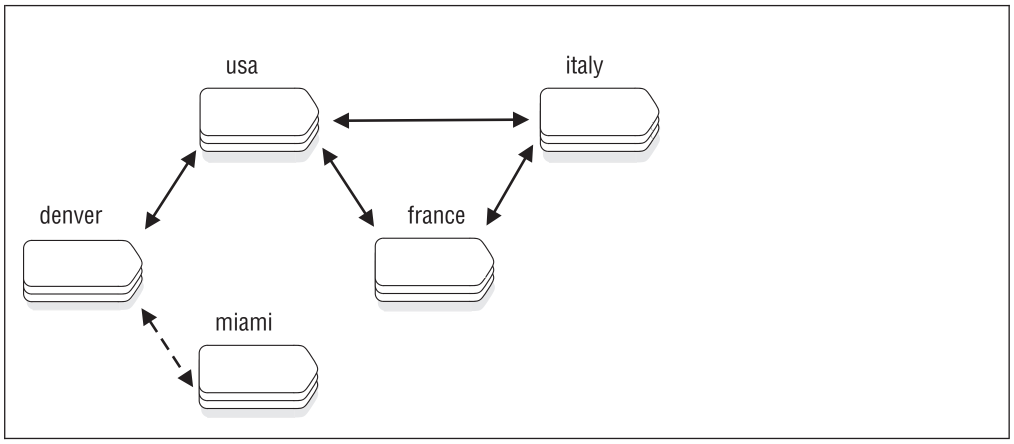
When the **cdr list server** command includes the name of a database server group, the command displays the attributes of that database server. For example, **cdr list server g_usa** might give the following output:

```
NAME      ID     ATTRIBUTES
------------------------------------------------------
g_usa      3   timeout=15,atsdir=/w/ats risdir=/w/ris
```

Examples

In Figure A-2 and in the following examples, **usa**, **italy**, and **france** are root servers, **denver** is a nonroot server, and **miami** is a leaf server. The **usa** server is the parent of **denver**, and **denver** is the parent of **miami**.

4



4
4
4
4

Figure A-2. cdr list server example

The following commands and example output illustrate how the **cdr list server** command displays server information:

```
cdr list server g_usa
g_usa     1 timeout=15 hub

cdr list server -c denver g_denver
g_denver  27 root=g_usa

cdr list server -c italy g_denver
g_denver  27 root=g_usa forward=g_usa

cdr list server g_miami
g_miami   4 root=g_denver leaf
```

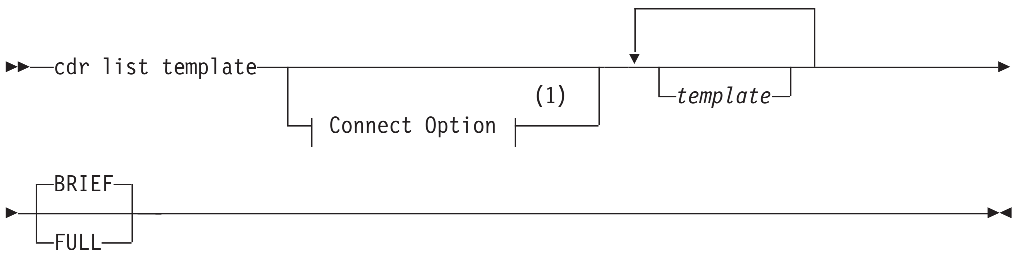
See Also

- "cdr connect server" on page A-17
- "cdr define server" on page A-30
- "cdr delete server" on page A-40
- "cdr disconnect server" on page A-44
- "cdr modify server" on page A-64
- "cdr resume server" on page A-78
- "cdr start" on page A-79
- "cdr suspend server" on page A-101

cdr list template

The **cdr list template** command displays information about the templates on the server on which the command is run.

Syntax



Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
template	Name of the template	The template must exist.	"Long Identifiers" on page A-123

Usage

The **cdr list template** command displays information about templates. If no templates are named, the command lists all templates in the Enterprise Replication domain. If one or more templates are named, the command displays the names, database names, and table names for those templates.

To display detailed information for your templates, use the **FULL** option.

You do not need to be user **informix** to use this command.

In hierarchical topology, leaf servers have limited information about other database servers in the Enterprise Replication domain. Therefore, when **cdr list template** is executed against a leaf server, it displays incomplete information about the other database servers.

3 The **cdr list template** command can be used while the replication server is in
3 DDRBLOCK mode. Before using the **cdr list template** command you must set the
3 DBSPACETEMP configuration parameter and create a temporary dbspace with the
3 onspaces utility.

Examples

The following example displays detailed information about the templates on the current server:

```
cdr list template
```

The output from the previous command might be the following:

```
TEMPLATE            DATABASE            TABLES
==============================================
tem1                newcars             table1
                    newcars             table2
                    newcars             table3
tem2                carparts            table1
                    carparts            table3
```

The following example displays detailed information about the template **tem1**:

```
cdr list template tem1
```

The output from the previous command might be the following:

```
CURRENTLY DEFINED TEMPLATES
===========================
TEMPLATE:    tem1
TEMPLATE ID: 6553605
SERVER:      utah
DATABASE:    newcars
REPLICATE:   tem1_utah_2_1_table1
OWNER:       pravin
TABLE:       table1

TEMPLATE:    tem1
TEMPLATE ID: 6553605
SERVER:      utah
DATABASE:    newcars
REPLICATE:   tem1_utah_2_2_table2
OWNER:       pravin
TABLE:       table2

TEMPLATE:    tem1
TEMPLATE ID: 6553605
SERVER:      utah
DATABASE:    newcars
REPLICATE:   tem1_utah_2_3_table3
OWNER:       pravin
TABLE:       table3
```

Generated Replicate and Replicate Set Names

When you apply a template, Enterprise Replication generates the replicate and replicate set names. The generated replicate set name is the same as the template name.

The generated replicate name has the following format:

template_server_cdrserverid_n_table

template	The name of the template
server	The name of the database
cdrserverid	The server ID as set in the SQLHOSTS file
n	A unique sequence number
table	The name of the table

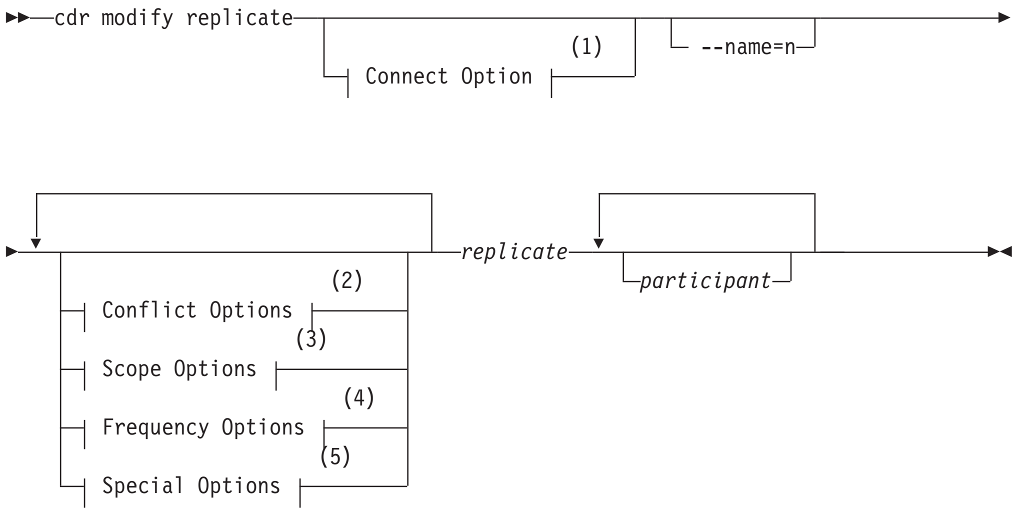
See Also

- "cdr define template" on page A-33
- "cdr realize template" on page A-66

cdr modify replicate

The **cdr modify replicate** command modifies replicate attributes.

Syntax



Notes:

1 See page A-123.

2 See page A-23.

3 See page A-24.

4 See page A-126.

5 See page A-24.

Element	Purpose	Restrictions	Syntax
participant	Name of a participant in the replication	The participant must be a member of the replicate.	"Participant" on page A-124
replicate	Name of the replicate to modify	The replicate name must exist.	"Long Identifiers" on page A-123

The following table describes the option to **cdr modify replicate**.

Long Form	Short Form	Meaning
--name=n	**-n n**	Removes the name verification attribute from a master replicate. For more information, see "Creating Strict Master Replicates" on page 6-6.

Usage

The **cdr modify replicate** command modifies the attributes of a replicate or of one or more participants in the replicate. You can also change the mode of a participant. If the command does not specify participants, the changes apply to all participants in the replicate.

For attribute information, see "cdr define replicate" on page A-1.

To add or delete a participant, see "cdr change replicate" on page A-4.

If you change the conflict-resolution rule with **cdr modify replicate**, you must also specify the scope with the**---scope** option, even if you are not changing the scope.

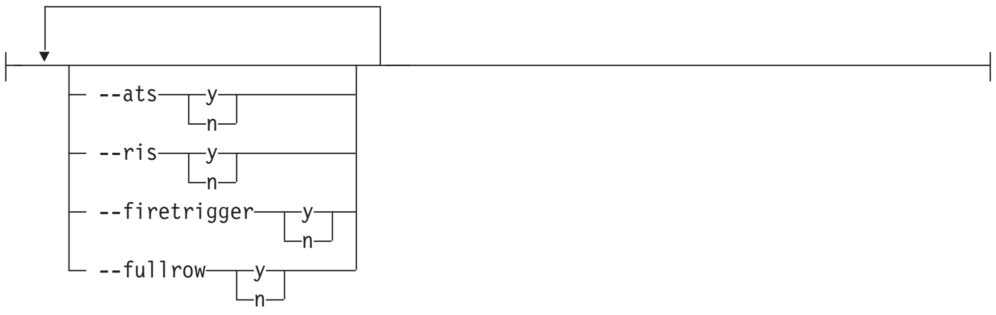
The attributes for **cdr modify replicate** are the same as the attributes for **cdr define replicate**, with the following exceptions:

- You cannot change the machine-independent decimal representation (**--floatcanon**) or IEEE floating point (**--floatieee**) formats.
- You cannot change the conflict resolution from ignore to a non-ignore option (time stamp, SPL routine, or time stamp and SPL routine). You cannot change a non-ignore conflict resolution option to ignore.

  However, you can change from time stamp resolution to SPL routine resolution or from SPL routine resolution to time stamp.
- The **--ats**, **--ris**, --**firetrigger**, and **--fullrow** options require a yes (y) or no (n) argument.

Special Options

Special Options:



The following table describes the special options to **cdr modify replicate**. For more information on these options, see "Special Options" on page A-24.

Long Form	Short Form	Meaning
--ats y | n	**-A y | n**	Activates (y) or deactivates (n) aborted-transaction spooling for replicate transactions that fail to be applied to the target database.
--firetrigger y | n	**-T y | n**	Causes the rows inserted by this replicate to fire (y) or not fire (n) triggers at the destination.
--fullrow y | n	**-f y | n**	Specifies to (y) replicate the full row and enable upserts or (n) replicate only changed columns and disable upserts.
--ris y | n	**-R y | n**	Activates (y) or deactivates (n) row-information spooling for replicate row data that fails conflict resolution or encounters replication-order problems.

Examples

The following example modifies the frequency attributes of replicate **smile** to replicate every five hours:

```
cdr modify repl --every=300 smile
```

The following example modifies the frequency attributes of replicate **smile** to replicate daily at 1:00 A.M.:

```
cdr modify repl -a 01:00 smile
```

The following example modifies the frequency attributes of replicate **smile** to replicate on the last day of every month at 5:00 A.M., to generate ATS files, and not to fire triggers:

```
cdr modify repl -a L.5:00 -A y -T n smile
```

The following example changes the mode of the first participant listed to receive-only and the mode of the second to primary:

```
cdr mod repl smile "R db1@server1:antonio.table1" \
                   "P db2@server2:carlo.table2"
```

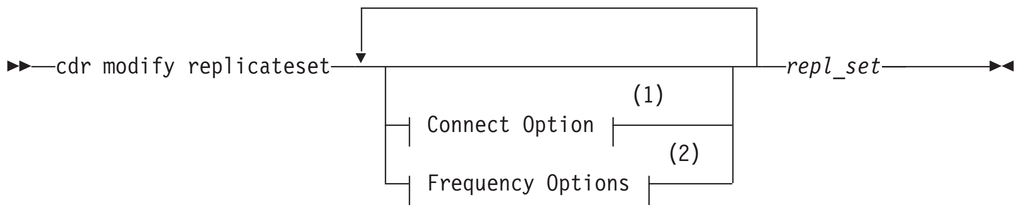
See Also

- "cdr change replicate" on page A-4
- "cdr define replicate" on page A-21
- "cdr delete replicate" on page A-37
- "cdr list replicate" on page A-50
- "cdr resume replicate" on page A-76
- "cdr start replicate" on page A-82
- "cdr stop replicate" on page A-94
- "cdr suspend replicate" on page A-98

cdr modify replicateset

The **cdr modify replicateset** command modifies all the replicates in a replicate set.

Syntax



Notes:

1 See page A-123.

2 See page A-126.

Element	Purpose	Restrictions	Syntax
repl_set	Name of replicate set to modify	The replicate set must exist.	"Long Identifiers" on page A-123

Usage

The **cdr modify replicateset** command modifies the attributes of all the replicates in the replicate set *repl_set*. To add or delete replicates from a replicate set, use the **cdr change replicateset** command ("cdr change replicateset" on page A-6).

You cannot change whether a replicate set is exclusive or not.

Examples

The following example connects to the default server (the server specified by the **INFORMIXSERVER** environment variable) and modifies the replicate set **sales_set** to process replication data every hour:

```
cdr mod replset --every 60 sales_set
```

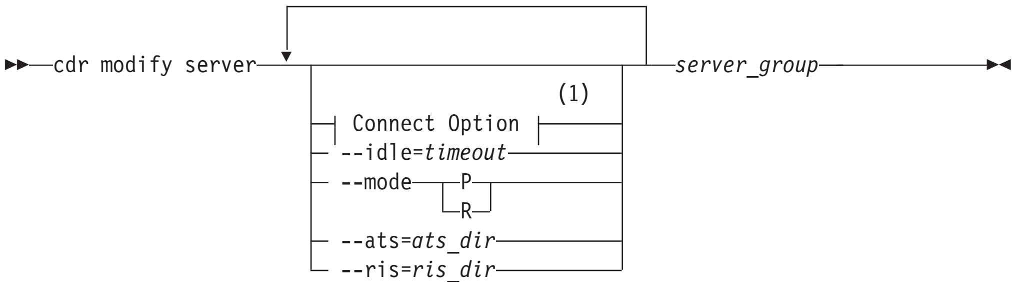
See Also

- "cdr change replicateset" on page A-6
- "cdr define replicate" on page A-21
- "cdr delete replicateset" on page A-38
- "cdr list replicateset" on page A-53
- "cdr resume replicateset" on page A-77
- "cdr start replicateset" on page A-85
- "cdr stop replicateset" on page A-96
- "cdr suspend replicateset" on page A-99

cdr modify server

The **cdr modify server** command modifies the Enterprise Replication attributes of a database server.

Syntax



Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
server_group	Name of a database server group to modify	The database server group must be defined in Enterprise Replication.	
timeout	Idle time-out for this server	Must be an integer number of minutes. 0 indicates no time-out. The maximum value is 32,767.	Integer.
ats_dir	Name of Aborted Transaction Spooling directory	Must be a full pathname. The path for the directory can be no longer than 256 bytes. A value of **/dev/null** (UNIX) or **NUL** (Windows) prevents ATS file generation.	Follows naming conventions on your operating system.
ris_dir	Name of the Row Information Spooling directory	Must be a full pathname. The path for the directory can be no longer than 256 bytes. A value of **/dev/null** (UNIX) or **NUL** (Windows) prevents RIS file generation.	Follows naming conventions on your operating system.

Usage

The **cdr modify server** command modifies the replication server *server_group*.

The following table describes the options to **cdr modify server**.

Long Form	Short Form	Meaning
--ats=	**-A**	Specifies the directory to store aborted transaction spooling files for replicate transactions that fail to be applied. For more information, see Chapter 8, "Monitoring and Troubleshooting Enterprise Replication," on page 8-1.
--idle=	**-i**	Causes an inactive connection to be terminated after *timeout* minutes. If time-out is 0, the connection does not time out. The default value is 0.
--mode	**-m**	Changes the mode of all replicates using this server to primary (**P**) or to receive-only (**R**).
--ris=	**-R**	Specifies the directory to store row information spooling files for replicate transactions that fail to be applied. For more information, see Chapter 8, "Monitoring and Troubleshooting Enterprise Replication," on page 8-1.

Examples

The following example connects to the database server **paris** and modifies the idle time-out of server group **g_rome** to 10 minutes. ATS files go into the directory **/cdr/atsdir**.

```
cdr modify server -c paris -i 10 -A /cdr/atsdir g_rome
```

The following example connects to the default database server and sets the modes of all participants on **g_geometrix** to primary:

```
cdr mod ser -m P g_geometrix
```

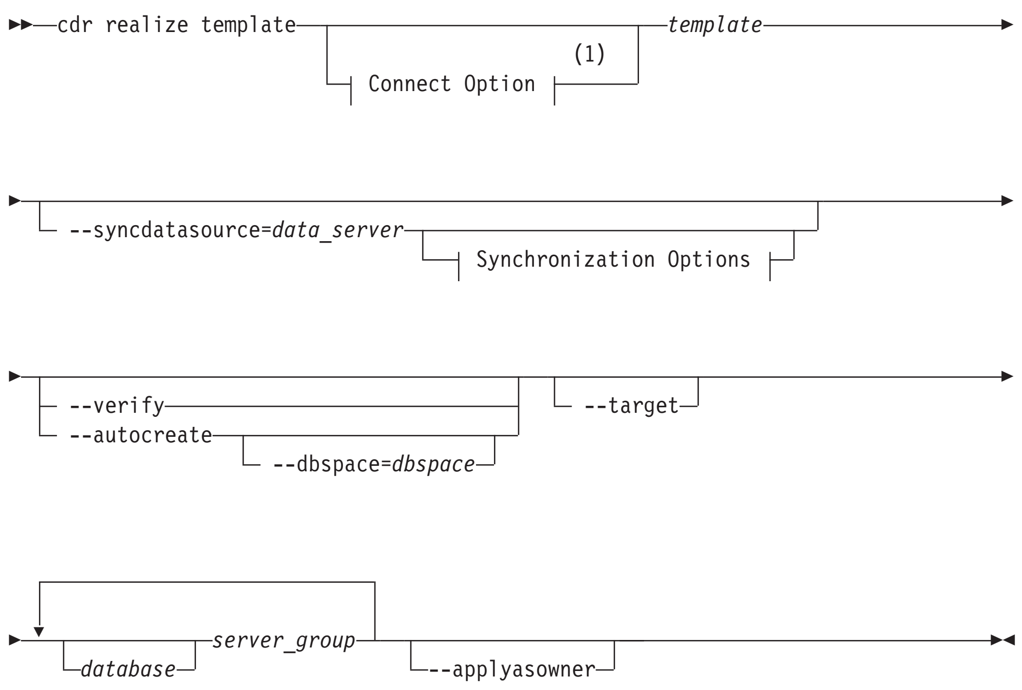
See Also

- "cdr connect server" on page A-17
- "cdr define server" on page A-30
- "cdr delete server" on page A-40
- "cdr disconnect server" on page A-44
- "cdr list server" on page A-55
- "cdr resume server" on page A-78
- "cdr suspend server" on page A-101

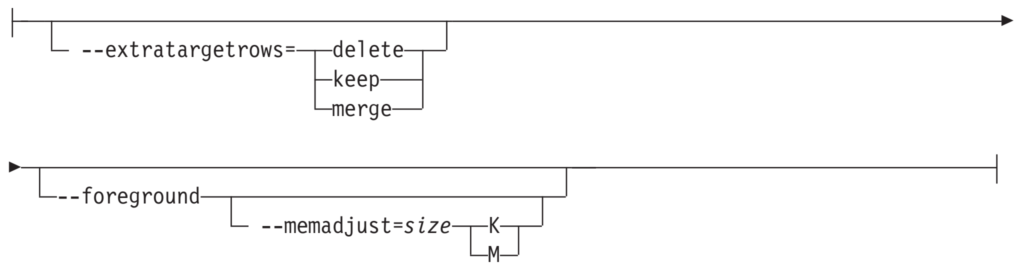
cdr realize template

The **cdr realize template** command realizes a template on all or a subset of the database servers within the replication domain.

Syntax



9 **Synchronization Options:**



Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
database	Name of the database that includes the table to be replicated	The database server must be registered with Enterprise Replication.	"Long Identifiers" on page A-123
data_server	The database server from which the data is copied to all other database servers listed	The database server must be defined in Enterprise Replication.	

Element	Purpose	Restrictions	Syntax
dbspace	The name of the dbspace for Enterprise Replication to use when creating tables	The dbspace must exist on all the database servers listed. If you do not specify a dbspace name and new tables are created, they are created in the default dbspace.	
server_group	Name of the database server group that includes the server to connect to	The database server group name must be the name of an existing Enterprise Replication server group in SQLHOSTS.	"Long Identifiers" on page A-123
9 *size***K** | **M**	Size, in either kilobytes (**K**) or megabytes (**M**), of the increase in memory used by the send queue during synchronization	Must be a positive integer and must not be greater than the amount of available memory	
template	The name of the template	The template must exist. Use the **cdr define template** command to create the template. For more information, see "cdr define template" on page A-33.	"Long Identifiers" on page A-123

The following table describes the special options to the **cdr realize template** command.

Long Form	Short Form	Meaning
--applyasowner	**-o**	Specifies that the template is realized by the owner of the table specified when the template was defined. By default, the template is realized by the user **informix**.
--autocreate	**-u**	Specifies that if the tables in the template definition do not exist in the databases on the target servers, then they are created automatically. However, the table cannot contain columns with user-defined data types.
--dbspace=	**-D**	Specifies the dbspace in which the automatically created objects are placed. If not specified, then the default dbspace is used. (default)

Long Form	Short Form	Meaning
--extratargetrows=	**-e**	Specifies how to handle rows found on the target servers that are not present on the data source server from which the data is being copied (*data_server*): • **delete**: (default) remove rows and dependent rows, based on referential integrity constraints, from the target servers • **keep**: retain rows on the target servers • **merge**: retain rows on the target servers and replicate them to the data source server This option applies to the initial data synchronization operation only; it does not affect the behavior of the replicate.
--foreground	**-F**	Specifies that the synchronization operation is performed as a foreground process
--memadjust=	**-J**	Limits the amount of memory to increase the send queue during synchronization to the number of kilobytes or megabytes specified by the *size* element
--syncdatasource=	**-S**	Specifies which server is the source of the data that is used to synchronize all the other servers listed in the **cdr realize template** command.
--target	**-t**	Specifies that all of the servers listed in the command become receive-only servers, including the source server, unless the template has already been realized on the source server. If you use this option, you must run the **cdr realize template** command twice: once to realize the template on the source server and other primary servers, and again to realize the template on receive-only servers.
--verify	**-v**	Specifies that the **cdr realize template** command verifies that the database, tables, column data types are correct on all listed servers, but does not realize the template.

Usage

Templates provide an efficient way to create replicates and a replicate set, create the participant tables, and synchronize data. The **cdr realize template** and **cdr define template** commands are an alternative to using the **cdr define replicate** and commands once each for every replicate, plus the **cdr define replicateset** command.

Before you can use the **cdr realize template** command, you must define Enterprise Replication servers using the **cdr define server** command and define the template using the **cdr define template** command. You should also create the database to be replicated on all database servers in the replication domain. However, only the database on the synchronization data source server needs to be populated with data.

The **cdr realize template** command performs the following tasks:

- If you specify the **--autocreate** option, it creates database tables on the target servers.

  Recommendation: if you use **--autocreate**, specify a dbspace name. If you do not, tables are created in the root dbspace, which is not recommended.
- If you specify the **--verify** option, it verifies the database, tables, column data types, and primary keys on all participating servers; however, the template is not realized.
- 9 If you specify the **--syncdatasource** option, it synchronizes the data from the
  9 source database with the databases specified by this command. If you specify
  9 the **--foreground** option, runs synchronization as a foreground process. If you
  9 specify the **--memadjust** option, limits the growth of the send queue.
- Verifies the database and table attributes to ensure that proper replication can be performed on each database.
- Creates replicates as master replicates.
- Creates a replicate set for the new replicates.
- Starts the replicates.

The replicates and replicate set created from a template have generated names. Use the **cdr list template** command to see the names of the replicates and replicate set associated with a particular template.

Examples

The following example illustrates the **cdr realize template** command:

```
cdr realize template tem1 -c detroit\
new_cars@detroit new_cars0@chicago new_cars1@newark\
new_cars2@columbus
```

Line 1 specifies that the template name is **tem1** and the server to connect to is the **detroit** server. Line 2 lists the names of the databases and database servers on which to realize the template.

The following example illustrates realizing the template on the source server, and then, creating the databases and tables, and loading data on the target receive-only database servers:

```
9
9 cdr realize template tem1 -c detroit detroit\
9 cdr realize template tem1 -c detroit\
9 --syncdatasource=detroit --extratargetrows=keep\
9 --foreground --memadjust=50K\
9 --target chicago newark columbus
```

Line 1 realizes the template on the **detroit** server, as a primary server by default.

Line 3 specifies to use the **detroit** server as the source of the data to replicate to all other participating servers. If Enterprise Replication encounters any rows on the **chicago**, **newark**, or **columbus** servers that do not exist on the **detroit** server, those rows are kept.

9 Line 4 specifies that the synchronization operation is done in the foreground, and
9 the growth of the send queue is limited to 50 KB.

Line 5 specifies the participant type for each server. The **--target** option makes all servers receive-only participants.

The following example verifies the database and table attributes on the **chicago**, **newark**, and **columbus** servers; the template is not realized on these servers:

```
cdr realize template tem1 -c detroit\
--verify chicago newark columbus
```

See Also

- “cdr define template” on page A-33
- “cdr define server” on page A-30
- “cdr list template” on page A-58
- “cdr delete template” on page A-43

cdr remaster

The **cdr remaster** command changes the SELECT clause or the server from which to base the master replicate definition of an existing master replicate. You can also use this command to convert a classic (non-master) replicate to a master replicate.

Syntax

```
►►──cdr remaster──┬──────────────────────┬── --master=server──replicate──────►
                  │                 (1)  │
                  └─┤ Connect Option ├───┘

►──┬──────────┬──────────────────────────────────────────────────────────────►◄
   └─modifier─┘
```

Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
modifier	Specifies the rows and columns to replicate		"Participant Modifier" on page A-125
replicate	Name of the replicate to be mastered	The replicate must exist.	"Long Identifiers" on page A-123
server	Name of the database server from which to base the master replicate definition	The name must be the database server group name.	"Long Identifiers" on page A-123

The following table describes the option to **cdr remaster**.

Long Form	Short Form	Meaning
--master=	**-M**	Specifies that the replicate being created is a master replicate.

Usage

Use the **cdr remaster** command to perform one of the following tasks:

- Convert a classic replicate to a master replicate. Master replicates ensure schema consistency among the participants in the replicates.
- Update the definition of a master replicate whose participant was changed in an alter operation. You can change the SELECT clause or the server from which to base the master replicate definition.
- The *basereplicatename* is the name of the replicate being remastered (up to 64 characters of this name are used).
- The *localCDRID* is the CDR group ID of the server you specified with the **--connect** option. You can obtain this ID using the **onstat -g cat servers** command or by looking in the SQLHOSTS file. Alternatively, you can query the **syscdrserver** view in the **sysmaster** database.
- The *pid* is the process ID of the client computer.

  An example of a shadow replicate name is:

```
Shadow_4_Repl1_GMT1090373046_GID10_PID28836
```

To use the **cdr remaster** command, the master replicate definition must have been created with name verification turned on (**--name** option of the **cdr define replicate** command set to **y**).

As part of its processing, the **cdr remaster** command creates a shadow replicate. The shadow replicate is named as follows:

Shadow_4_*basereplicatename*_GMT*time*_GID*localCDRID*_PID*pid*

Examples

The following example shows the original definition of the master replicate before the alter operation:

```
cdr define repl --master=delhi -C timestamp\
newrepl "test@delhi.tab" "select col1, col2 from tab"\
```

This example shows the **cdr remaster** command adding a new column, **col3**, in the **newrepl** participant:

```
cdr remaster --master=delhi newrepl\
"select col1, col2, col3 from tab"
```

cdr remove

The **cdr remove** command removes Enterprise Replication from an HDR database server.

Syntax

```
►►──cdr remove──────────────────────────────────────────────────────────►◄
```

Usage

Use this command to remove Enterprise Replication from an HDR primary server after it has been started using the **oninit -D** command. For more information, see "HDR Failure" on page 5-7.

The **cdr remove** command removes Enterprise Replication from a database server by deleting its global catalog information. Unlike the **cdr delete** command, this command can only be issued when Enterprise Replication is not active. The database server this command affects is the one specified by the value of the **INFORMIXSERVER** environment variable.

Warning: Do not use this command on a database server that does not participate in HDR.

cdr repair

The **cdr repair** command synchronizes data based on ATS or RIS files.

Syntax

```
►►─cdr repair──┬─ats─ats_file─┬─┬──────────────────┬──────────────────────────►◄
               └─ris─ris_file─┘ ├─--check──────────┤
                                │ ┌─--verbose─┐    │
                                └─┴─--quiet───┴────┘
```

Element	Purpose	Restrictions	Syntax
ats_file	Name of the file for Aborted Transaction Spooling	Must be a full pathname and filename. The path for the directory can be no longer than 256 bytes.	Follows naming conventions on your operating system
ris_file	Name of the file for Row Information Spooling	Must be a full pathname and filename. The path for the directory can be no longer than 256 characters.	Follows naming conventions on your operating system

Long Form	Short Form	Meaning
--check	**-C**	Check the consistency between the database server and the ATS or RIS file. Display repair operations to stderr, but do not perform the repair operations. In an active system, operations displayed with this option will not necessarily match those performed later during an actual repair.
--quiet	**-q**	Quiet mode. Repair operations are not displayed to stderr.
--verbose	**-v**	Verbose mode (default). All repair operations are displayed to stderr.

Usage

The **cdr repair** command reconciles rows that failed to be applied based on the information in the specified ATS or RIS file. If a row does not exist on the source database server, then it is deleted from the target database server.

Run the **cdr repair** command on the server where the ATS or RIS file is located. Enterprise Replication must be able to connect to the source server of the ATS or RIS file.

Before you run a repair, preview the repair to make sure the operations that would be performed are correct. To preview the repair operations, use the **--check** option. All repair operations are displayed to stderr, but not performed. In an active system, however, the operations displayed by the **--check** option might not be the same as the operations performed when you later run the repair.

The server on which you run the **cdr repair** command must have a copy of the ATS or RIS file and be able to connect to the source and target database servers involved in the failed transaction. In a hierarchical routing environment where the

9 source and target database servers are not directly connected you might need to
9 run the **cdr repair** command from an intermediate server. If necessary, copy the
9 ATS or RIS file to the intermediate server.

9 ATS and RIS files do not include codeset information, therefore, the codesets
9 associated with the locales specified by the DB_LOCALE and CLIENT_LOCALE
9 environment variables must be the same.

Examples

The following example repairs inconsistencies found in the ATS file generated for an inconsistency found between the **g_beijing** and **g_amsterdam** servers:

```
cdr repair ats\
ats.g_beijing.g_amsterdam.D_2.000529_23:27:16.6
```

See Also

- “cdr define repair” on page A-18

cdr resume replicate

The **cdr resume replicate** command resumes delivery of replication data.

Syntax

```
                                                 ┌───────────┐
                                                 ▼           │
►►──cdr resume replicate──┬──────────────────────┬───repl_name─┴────────►◄
                          │                 (1)  │
                          └─┤ Connect Option ├───┘
```

Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
repl_name	Name of the replicate to change to active state.	The replicate must be suspended.	"Long Identifiers" on page A-123

Usage

The **cdr resume replicate** command causes all participants in the replicate *repl_name* to enter the active state.

For more information on replicate states, refer to "The STATE Column" on page A-55.

If a replicate belongs to an exclusive replicate set ("Exclusive Replicate Sets" on page 6-10), you cannot run **cdr resume replicate** to resume that individual replicate. You must use **cdr resume replicateset** to resume all replicates in the exclusive replicate set. If a replicate belongs to a non-exclusive replicate set, you can resume the individual replicates in the set.

Examples

The following example connects to the default database server (the one specified by the **INFORMIXSERVER** environment variable) and resumes the replicate **smile**:

```
cdr res repl smile
```

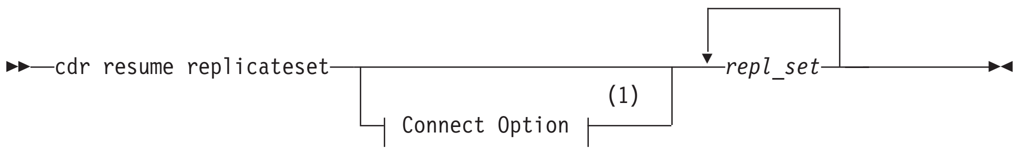
See Also

- "cdr change replicate" on page A-4
- "cdr define replicate" on page A-21
- "cdr delete replicate" on page A-37
- "cdr list replicate" on page A-50
- "cdr modify replicate" on page A-60
- "cdr start replicate" on page A-82
- "cdr stop replicate" on page A-94
- "cdr suspend replicate" on page A-98

cdr resume replicateset

The **cdr resume replicateset** command resumes delivery of replication data for all the replicates in a replicate set.

Syntax



Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
repl_set	Name of replicate set to resume	None	"Long Identifiers" on page A-123

Usage

The **cdr resume replicateset** command causes all replicates contained in the replicate set *repl_set* to enter the active state for all participants.

For more information on replicate states, refer to "The STATE Column" on page A-55.

If not all the replicates in a non-exclusive replicate set are suspended, the **cdr resume replicateset** command displays a warning and only resumes the replicates that are currently suspended.

Examples

The following example connects to the default database server (the one specified by the **INFORMIXSERVER** environment variable) and resumes the replicate set **accounts_set**:

```
cdr res replset accounts_set
```

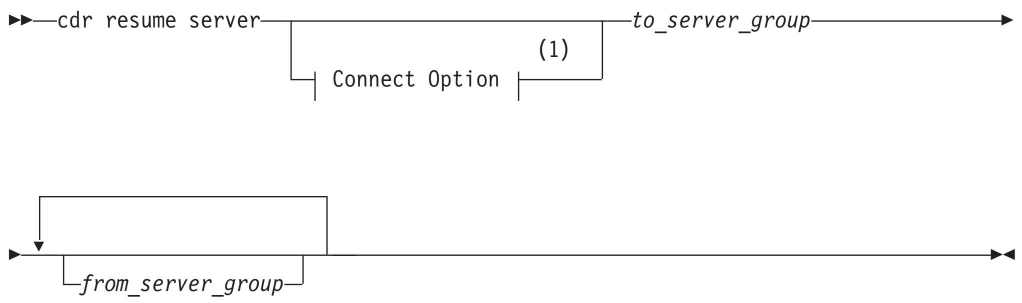
See Also

- "cdr change replicateset" on page A-6
- "cdr define replicate" on page A-21
- "cdr delete replicateset" on page A-38
- "cdr list replicateset" on page A-53
- "cdr modify replicateset" on page A-63
- "cdr start replicateset" on page A-85
- "cdr stop replicateset" on page A-96
- "cdr suspend replicateset" on page A-99

cdr resume server

The **cdr resume server** command resumes delivery of replication data to a suspended database server.

Syntax



Notes:

1 See page A-123.

Element	Purpose	Restrictions
to_server_group	Name of the database server group to which to resume delivery of replication data	The database server group must be currently active in Enterprise Replication.
from_server_group	Name of the database server group from which to resume sending data to *to_server_group*	The database server group must be currently active in Enterprise Replication.

Usage

The **cdr resume server** command resumes delivery of replication data to the *to_server_group* database server from the database servers included in the *from_server_group* list. If the *from_server_group* list is omitted, the command resumes replication of data from all database servers participating in the Enterprise Replication system to the *to_server_group*. Replication data must have previously been suspended to the server with the **cdr suspend server** command.

Examples

The following example connects to the default server (the one specified by the **INFORMIXSERVER** environment variable) and resumes replication of data to the server **g_iowa** from the servers **g_ohio** and **g_utah**:

```
cdr sus serv g_iowa g_ohio g_utah
```

See Also

- "cdr connect server" on page A-17
- "cdr define server" on page A-30
- "cdr delete server" on page A-40
- "cdr disconnect server" on page A-44
- "cdr list server" on page A-55
- "cdr modify server" on page A-64
- "cdr suspend server" on page A-101

cdr start

The **cdr start** command starts Enterprise Replication processing.

Syntax

```
►►──cdr start──┬──────────────────────┬──────────────────────────────────►◄
               │               (1)    │
               └─┤ Connect Option ├───┘
```

Notes:

1 See page A-123.

Usage

Use **cdr start** to restart Enterprise Replication after you stop it with **cdr stop**. When you issue **cdr start**, Enterprise Replication activates all connections to other connected replication servers. Replication servers, replicates, and replicate sets that were suspended before the **cdr stop** command was issued remain suspended; no data is sent for the suspended servers, replicates, or sets.

Enterprise Replication resumes evaluation of the logical log (if required for the instance of Enterprise Replication) at the *replay* position. The replay position is the position where Enterprise Replication stops evaluating the logical log when **cdr stop** is executed. If the evaluation process is running and the logical log ID for the replay position no longer exists when Enterprise Replication is started, then the restart partially fails (the database server log contains an error message stating that the replay position is invalid). If the restart partially fails, no database updates performed on the local database server are replicated.

Warning: Issue **cdr start** and **cdr stop** with extreme caution.

Examples

The following example restarts Enterprise Replication processing on database server **utah**:

```
cdr sta -c utah
```

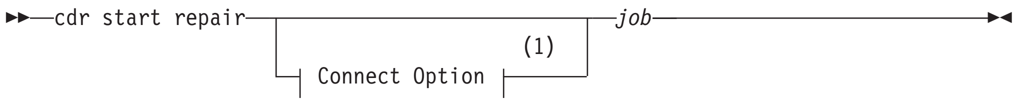
See Also

- "cdr stop" on page A-92

cdr start repair

The **cdr start repair** command starts a repair job to repair inconsistent data.

Syntax



Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
job	Name of the repair job	The job must exist	"Long Identifiers" on page A-123

Usage

Use the **cdr start repair** command to start a repair job that was previously defined with the **cdr define repair** command. You must run this command while connected to the source server for the job, as specified in the **cdr define repair** command by the **--syncdatasource** option.

If you specify a server in the Connect Option, it must be must be a non-leaf server and must be the source server for the repair job. The source server and the target server must be able to establish a direct connection.

Repair jobs have the following limitations:
- The replicate must be in online mode during a repair.
- You cannot suspend, stop, or place the replicate in alter mode during a repair.
- You cannot start a repair job for a replicate that uses timestamp conflict resolution.
- You cannot run a specific repair job more than one time because the job contains procedures based on referential constraints as they exist at the time the job is defined with the **cdr define repair** command.

If Enterprise Replication stops during a repair job, the job is automatically restarted with Enterprise Replication restarts.

To stop a repair job that is in progress, use the **cdr stop repair** command.

Examples

The following example runs a repair job named **parts_repair**:

```
cdr start repair parts_repair
```

See Also

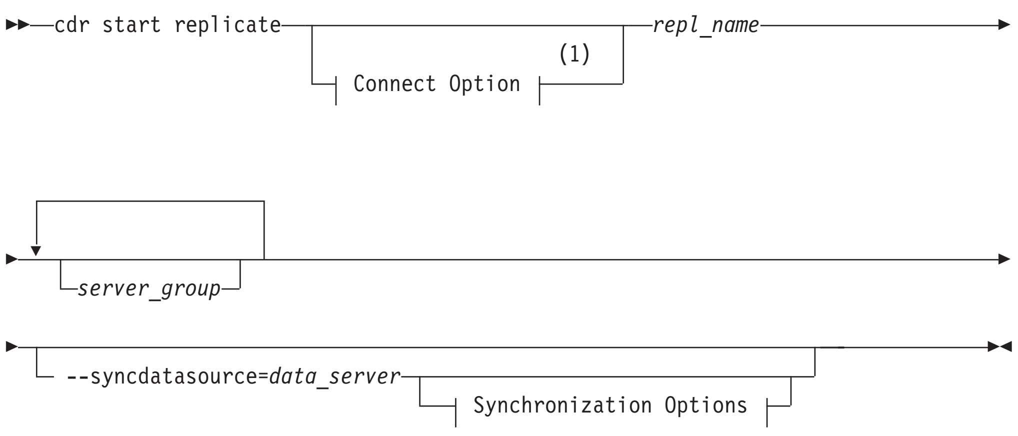
- "cdr define repair" on page A-18
- "cdr delete repair" on page A-36
- "cdr stop repair" on page A-93

- “cdr list repair” on page A-48

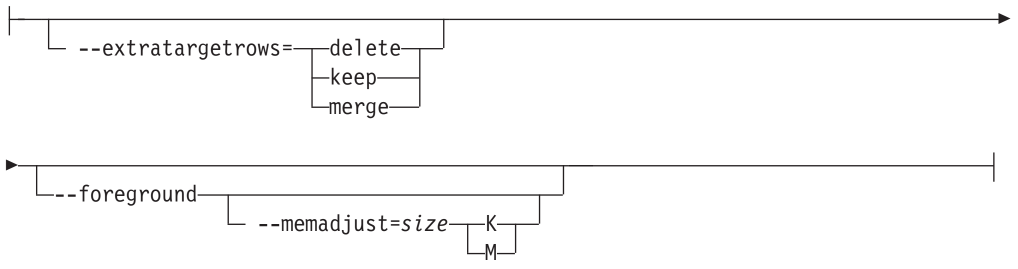
cdr start replicate

The **cdr start replicate** command starts the capture and transmittal of replication transactions.

Syntax



Synchronization Options:



Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
data_server	The database server from which the data is copied to all other database servers listed	The database server must be defined in Enterprise Replication.	
repl_name	Name of the replicate to start	The replicate must exist.	"Long Identifiers" on page A-123
server_group	Name of database server groups on which to start the replicate	The database server groups must be defined for Enterprise Replication.	
*size***K**|**M**	Size, in either kilobytes (**K**) or megabytes (**M**), of the increase in memory used by the send queue during synchronization	Must be a positive integer and must not be greater than the amount of available memory	

The following table describes the **cdr start replicate** options.

Long Form	Short Form	Meaning
--extratargetrows=	**-e**	Specifies how to handle rows found on the target servers that are not present on the data source server from which the data is being copied (*data_server*): • **delete**: (default) remove rows and dependent rows, based on referential integrity constraints, from the target servers • **keep**: retain rows on the target servers • **merge**: retain rows on the target servers and replicate them to the data source server This option applies to the initial data synchronization operation only; it does not affect the behavior of the replicate.
--foreground	**-F**	Specifies that the synchronization operation is performed as a foreground process
--memadjust=	**-J**	Limits the amount of memory to increase the send queue during synchronization to the number of kilobytes or megabytes specified by the *size* element
--syncdatasource=	**-S**	Specifies the name of the database server to use as the reference copy of the data. This server is started even if it is not listed as one of the servers to start.

Usage

9 The **cdr start replicate** command causes the replicate to enter the active state
9 (capture-send) on the specified database servers and the source database server
9 specified by the **--syncdatasource** option.

9 If you would like the synchronization operation to be run as in the foreground, use
9 the **--foreground** option. If you need to limit the amount of memory that the send
9 queue can use during synchronization, use the **--memadjust** option to specify the
9 growth limit of the send queue.

If no server is specified, the *repl_name* starts on all servers that are included in the replicate. A replicate can have both active and inactive participants. When at least one participant is active, the replicate is active. You cannot start replicates that have no participants.

If a replicate belongs to an exclusive replicate set, you cannot run **cdr start replicate** to start that individual replicate. You must use **cdr start replicateset** to start all replicates in the exclusive replicate set.

Because Enterprise Replication does not process log records that were produced before the **cdr start replicate** command was run, transactions that occur during this period might be partially replicated. To avoid problems, either issue the **cdr start replicate** command on an idle system (no transactions are occurring) or use the BEGIN WORK WITHOUT REPLICATION statement until after you successfully start the replicate.

Examples

The following command starts the replicate named **accounts** on the server groups **g_svr1** and **g_svr2**:

```
cdr sta rep accounts g_svr1 g_svr2
```

9 The following example starts the replicate named **accounts** on the server **g_svr1**
9 with **g_svr2** as the source server:

```
9 cdr start replicate accounts g_svr1 --syncdatasource=g_svr2\
9 --foreground --memadjust=50K
```

9 The second line indicates that the synchronization happens in the foreground and
9 the send queue is allowed to grow only by 50 KB.

See Also

- "cdr change replicate" on page A-4
- "cdr define replicate" on page A-21
- "cdr delete replicate" on page A-37
- "cdr list replicate" on page A-50
- "cdr modify replicate" on page A-60
- "cdr resume replicate" on page A-76
- "cdr stop replicate" on page A-94
- "cdr suspend replicate" on page A-98

cdr start replicateset

The **cdr start replicateset** command starts the capture and transmittal of replication transactions for all the replicates in a replicate set.

Syntax

```
>>--cdr start replicateset--+--------------------------+--repl_set------------>
                            |                   (1)    |
                            '-| Connect Option |-------'

    .----------------.
    V                |
>---+--server_group--+-------------------------------------------------------->

>--+-----------------------------------------------------------------+------><
   '- --syncdatasource=data_server--+---------------------------+---'
                                    '-| Synchronization Options |-'
```

Synchronization Options:

```
|--+--------------------------------------+------------------------------------>
   '- --extratargetrows=--+-delete-+------'
                          +-keep---+
                          '-merge--'

>--+-----------------------------------------+---------------------------------|
   '--foreground--+------------------------+-'
                  '- --memadjust=size--+-K-+-'
                                       '-M-'
```

Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
data_server	The database server from which the data is copied to all other database servers listed	The database server must be defined in Enterprise Replication.	
repl_set	Name of replicate set to start	The replicate set must exist.	"Long Identifiers" on page A-123
server_group	Names of database server groups on which to start the replicate set	The database server groups must be defined for Enterprise Replication.	
*size***K** | **M**	Size, in either kilobytes (**K**) or megabytes (**M**), of the increase in memory used by the send queue during synchronization	Must be a positive integer and must not be greater than the amount of available memory	

The following table describes the **cdr start replicateset** options.

Long Form	Short Form	Meaning
--extratargetrows=	**-e**	Specifies how to handle rows found on the target servers that are not present on the data source server from which the data is being copied (*data_server*): • **delete**: (default) remove rows and dependent rows, based on referential integrity constraints, from the target servers • **keep**: retain rows on the target servers • **merge**: retain rows on the target servers and replicate them to the data source server This option applies to the initial data synchronization operation only; it does not affect the behavior of the replicate.
9 9 **--foreground**	**-F**	Specifies that the synchronization operation is performed as a foreground process
9 9 9 **--memadjust=**	**-J**	Limits the amount of memory to increase the send queue during synchronization to the number of kilobytes or megabytes specified by the *size* element
--syncdatasource=	**-S**	Specifies the name of the database server to use as the reference copy of the data. This server is started even if it is not listed as one of the servers to start.

Usage

The **cdr start replicateset** command causes the replicates defined in the specified replicate set to enter the active state (capture-send) on the specified database servers and the source database server specified by the **--syncdatasource** option.

9 If you would like the synchronization operation to be run as in the foreground, use
9 the **--foreground** option. If you need to limit the amount of memory that the send
9 queue can use during synchronization, use the **--memadjust** option to specify the
9 growth limit of the send queue.

If the *server_group* list is omitted, the replicate set *repl_set* enters the active state for all database servers participating in the replicate set.

Because Enterprise Replication does not process log records that were produced before the **cdr start replicateset** command took place, transactions that occur during this period might be partially replicated. To avoid problems, either issue the **cdr start replicateset** command on an idle system (no transactions are occurring) or use the BEGIN WORK WITHOUT REPLICATION statement until after you successfully start the replicates in the replicate set.

If not all the replicates in a non-exclusive replicate set are inactive, the **cdr start replicateset** command displays a warning and only starts the replicates that are currently inactive.

Examples

The following example connects to the default database server specified by the **INFORMIXSERVER** environment variable and starts the replicate set **accounts_set** on the server groups **g_hill** and **g_lake**:

```
cdr sta replset accounts_set g_hill g_lake
```

9 The following example starts the replicate set **accounts_set** on the server **g_hill**
9 with **g_lake** as the source server:

```
9 cdr start replicateset accounts_set g_hill --syncdatasource=g_lake\
9 --foreground --memadjust=50K
```

9 The second line indicates that the synchronization happens in the foreground and
9 the send queue is allowed to grow only by 50 KB.

See Also

- “cdr change replicateset” on page A-6
- “cdr define replicate” on page A-21
- “cdr delete replicateset” on page A-38
- “cdr list replicateset” on page A-53
- “cdr modify replicateset” on page A-63
- “cdr resume replicateset” on page A-77
- “cdr stop replicateset” on page A-96
- “cdr suspend replicateset” on page A-99

cdr stats rqm

The **cdr stats rqm** command displays information about the reliable queue manager (RQM) queues used for Enterprise Replication.

Syntax

```
►►──cdr stats rqm──┬────────────────────────┬──────────────────────────►
                   │                   (1)  │
                   └─┤ Connect Option ├─────┘

►──┬────────────────────────────────────────────┬───────────────────────►◄
   └─--ackq──--cntrlq──--recvq──--syncq──--sendq─┘
```

Notes:

1 See page A-123.

The following table describes the **cdr stats rqm** options.

Long Form	Short Form	Meaning
--ackq	**-A**	Prints the statistics for the ack send queue.
--cntrlq	**-C**	Prints the statistics for the control send queue.
--recvq	**-R**	Prints the statistics for the receive queue.
--syncq	**-S**	Prints the statistics for the sync send queue.
--sendq	**-T**	Prints the statistics for the send queue.

Usage

The **cdr stats rqm** command displays the RQM (reliable queue manager) statistics for the queues used by Enterprise Replication. These queues are the ack send, control send, send, sync send, and the receive queue. If no queue is specified, the **cdr stats rqm** command displays statistics for all Enterprise Replication queues.

The **cdr stats rqm** command shows, among other things, how many transactions are currently queued in memory and spooled, the size of the data in the queue, how much real memory is being used, pending transaction buffers and data, the maximum memory used for data and headers (overhead), and totals for the number of transactions queued, the number of transactions, the number of deleted transactions, and the number of transaction lookups that have occurred.

If the Connect option is specified, Enterprise Replication connects to the specified remote server and retrieves the statistics for its Enterprise Replication queues.

Examples

The following example shows the output for **cdr stats rqm --ackq**:

```
RQM Statistics for Queue number: 1 name:  ack_send
 Flags:                      ACKSEND_Q, SENDQ_MASK
 Txns in queue:              0
 Txns in memory:             0
 Txns in spool only:         0
 Txns spooled:               0
 Unspooled bytes:            0
 Size of Data in queue:      0 Bytes
 Real memory in use:         0 Bytes
 Pending Txn Buffers:       0
 Pending Txn Data:          0 Bytes
 Max Real memory data used: 44 Bytes
 Max Real memory hdrs used: 320 Bytes
 Total data queued:         120 Bytes
 Total Txns queued:         0
 Total Txns                 3
 Total Txns spooled:        0
 Total Txns restored:       0
 Total Txns recovered:      0
 Spool Rows read:           0
 Total Txns deleted:        3
 Total Txns duplicated:     0
 Total Txn Lookups:         8
```

The following example shows the output for **cdr stats rqm --cntrlq**:

```
RQM Statistics for Queue number: 2 name:  control_send
 Transaction Spool Name:    control_send_stxn
 Flags:                     CTRL_SEND_Q, STABLE, USERTXN, PROGRESS_TABLE,
                            NEED_ACK, SENDQ_MASK
 Txns in queue:             0
 Txns in memory:            0
 Txns in spool only:        0
 Txns spooled:              0
 Unspooled bytes:           0
 Size of Data in queue:     0 Bytes
 Real memory in use:        0 Bytes
 Pending Txn Buffers:       0
 Pending Txn Data:          0 Bytes
 Max Real memory data used: 185 Bytes
 Max Real memory hdrs used: 320 Bytes
 Total data queued:         185 Bytes
 Total Txns queued:         0
 Total Txns                 1
 Total Txns spooled:        1
 Total Txns restored:       0
 Total Txns recovered:      0
 Spool Rows read:           0
 Total Txns deleted:        1
 Total Txns duplicated:     0
 Total Txn Lookups:         4
```

The following example shows the output for **cdr stats rqm --recvq**:

```
RQM Statistics for Queue number: 4 name:  trg_receive
 Transaction Spool Name:    trg_receive_stxn
 Flags:                     RECV_Q, SPOOLED, PROGRESS_TABLE
 Txns in queue:             0
 Txns in memory:            0
 Txns in spool only:        0
 Txns spooled:              0
 Unspooled bytes:           0
 Size of Data in queue:     0 Bytes
 Real memory in use:        0 Bytes
 Pending Txn Buffers:       0
 Pending Txn Data:          0 Bytes
 Max Real memory data used: 0 Bytes
 Max Real memory hdrs used: 0 Bytes
 Total data queued:         0 Bytes
 Total Txns queued:         0
 Total Txns                 0
 Total Txns spooled:        0
 Total Txns restored:       0
 Total Txns recovered:      0
 Spool Rows read:           0
 Total Txns deleted:        0
 Total Txns duplicated:     0
 Total Txn Lookups:         0
```

The following example shows the output for **cdr stats rqm --syncq**:

```
RQM Statistics for Queue number: 3 name:  sync_send
 Flags:                     SYNC_Q, NEED_ACK, SENDQ_MASK
 Txns in queue:             0
 Txns in memory:            0
 Txns in spool only:        0
 Txns spooled:              0
 Unspooled bytes:           0
 Size of Data in queue:     0 Bytes
 Real memory in use:        0 Bytes
 Pending Txn Buffers:       0
 Pending Txn Data:          0 Bytes
 Max Real memory data used: 0 Bytes
 Max Real memory hdrs used: 0 Bytes
 Total data queued:         0 Bytes
 Total Txns queued:         0
 Total Txns                 0
 Total Txns spooled:        0
 Total Txns restored:       0
 Total Txns recovered:      0
 Spool Rows read:           0
 Total Txns deleted:        0
 Total Txns duplicated:     0
 Total Txn Lookups:         1131
```

The following example shows the output for **cdr stats rqm --sendq**:

```
RQM Statistics for Queue number: 0 name:  trg_send
 Transaction Spool Name:    trg_send_stxn
 Flags:                     SEND_Q, SPOOLED, PROGRESS_TABLE, NEED_ACK,
                            SENDQ_MASK, SREP_TABLE
 Txns in queue:             12
 Txns in memory:            12
 Txns in spool only:        0
 Txns spooled:              0
 Unspooled bytes:           24960
 Size of Data in queue:     24960 Bytes
 Real memory in use:        24960 Bytes
 Pending Txn Buffers:       0
 Pending Txn Data:          0 Bytes
 Max Real memory data used: 24960 Bytes
 Max Real memory hdrs used: 22080 Bytes
 Total data queued:         27560 Bytes
 Total Txns queued:         0
 Total Txns                 14
 Total Txns spooled:        0
 Total Txns restored:       0
 Total Txns recovered:      0
 Spool Rows read:           0
 Total Txns deleted:        2
 Total Txns duplicated:     0
 Total Txn Lookups:         28
```

cdr stats recv

The **cdr stats recv** command displays receiver parallelism statistics and latency statistics by source node.

Syntax

```
►►──cdr stats recv──┬─────────────────────────┬──────────────────────►◄
                    │                    (1)  │
                    └─┤ Connect Option ├──────┘
```

Notes:

1 See page A-123.

Usage

The **cdr stats recv** command displays the parallelism statistics for the receiver, including transaction count, number of pending and active transactions, the maximum that have been pending and active, the average number of pending and active transactions, and the commit rate. Totals and averages are calculated for pending and active transactions for the servers listed.

The Statistics by Source report shows the breakdown of transactions (number of inserts, updates, and deletes) and the latest source commit time and target apply time per server. The replication latency is the difference between the time when the transaction was committed on the source server and the time when the same transaction is applied on the target.

If the Connect option is specified, Enterprise Replication connects to the specified remote server and retrieved the statistics from it.

Examples

The following output is an example of the **cdr stats recv** command:

```
cdr stats recv

Receive Parallelism Statistics
Server Tot.Txn. Pending Active MaxPnd MaxAct  AvgPnd  AvgAct CommitRt
   144     11         0      0      3      2    1.27    1.36    0.01

Tot Pending:0       Tot Active:0    Avg Pending:0.00    Avg Active:0.00

Avg Commit Rate:0.01


Statistics by Source

Server  Repl     Txn   Ins   Del   Upd   Last Target Apply    Last Source Commit
144     9371650   11     0     0   220   2005/03/30 09:36:25  2005/03/30 09:36:25
```

cdr stop

The **cdr stop** command stops Enterprise Replication processing.

Syntax

```
                                   (1)
►►──cdr stop──┤ Connect Option ├────────────────────────────────────────────►◄
```

Notes:

1 See page A-123.

Usage

In most situations, Enterprise Replication starts when **cdr define server** is first executed. The replication threads remain running until the database server is shut down or until the local database server is deleted with the **cdr delete server** command. If you shut down the database server while Enterprise Replication is running, replication begins again when you restart the database server.

Under rare conditions, you might want to temporarily stop the Enterprise Replication processing without stopping the database server. The **cdr stop** command shuts down all Enterprise Replication threads in an orderly manner; however no data to be replicated is captured. When the shutdown of Enterprise Replication is complete, the message `CDR shutdown complete` appears in the database server log file.

9 After issuing the **cdr stop** command, replication threads remain stopped (even if
9 the database server is stopped and restarted) until you issue a **cdr start** command.
9 When replication resumes, all appropriate database transactions that occurred
9 while replication was stopped are replicated. If replication is stopped for a
9 prolonged period of time, the replay position in the logical log might be overrun. If
9 a message that the replay position is overrun appears in the message log, you must
9 resynchronize the data on the replication servers. For more information on
9 resynchronizing data, see "Resynchronizing Data Among Replication Servers" on
9 page 7-12.

You cannot delete a server from the enterprise if it is stopped. To delete a server with **cdr delete server**, you must issue a **cdr start** command first.

Warning: If you issue **cdr stop** and database activity continues, the database server from which the command is issued and the other database servers participating in replicates will become inconsistent. To ensure consistency, verify that no database update activity occurs while Enterprise Replication is stopped.

Examples

The following example stops Enterprise Replication processing on database server **paris**. Processing does not resume until a **cdr start** command restarts it:

```
cdr stop -c paris
```

See Also

- "cdr start" on page A-79

cdr stop repair

The **cdr stop repair** command stops a repair job that is in progress.

Syntax

```
►►──cdr stop repair──┬─────────────────────┬──job─────────────────────►◄
                     │              (1)    │
                     └─┤ Connect Option ├──┘
```

Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
job	Name of the repair job	The job must exist	"Long Identifiers" on page A-123

Usage

Use the **cdr stop repair** command to stop a repair job that is in progress. To restart the repair job, use the **cdr start repair** command. You must run this command while connected to the source server for the job, as specified in the **cdr define repair** command by the **--syncdatasource** option.

If you specify the Connect Option, it must be the source server.

Examples

The following example stops a repair job named **parts_repair**:

```
cdr stop repair parts_repair
```

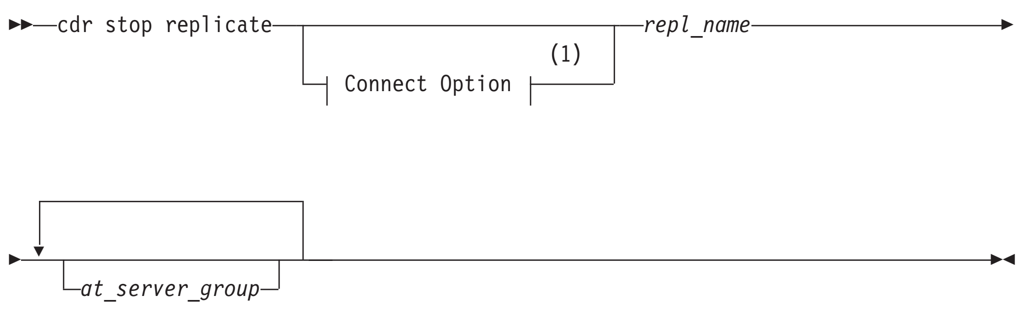
See Also

- "cdr define repair" on page A-18
- "cdr delete repair" on page A-36
- "cdr start repair" on page A-80
- "cdr list repair" on page A-48

cdr stop replicate

The **cdr stop replicate** command stops the capture and transmittal of transactions for replication.

Syntax



Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
repl_name	Name of the new replicate	The replicate must be active and not in an exclusive replicate set.	"Long Identifiers" on page A-123
at_server_group	List of database server groups on which to stop the replicate	The database server groups must be defined for Enterprise Replication.	

Usage

The **cdr stop replicate** command changes the state of the replicate *repl_name* to inactive (no capture, no send) on the replication servers in the specified *at_server_group* list. In addition, this command deletes any data in the send queue for the stopped replicate. You cannot stop replicates that have no participants.

9 If replication is stopped for a prolonged period of time, the replay position of the
9 logical log might be overrun. If a message that the replay position is overrun
9 appears in the message log, you must resynchronize the data on the replication
9 servers. For information on resynchronizing replication servers, see
9 "Resynchronizing Data Among Replication Servers" on page 7-12.

If you omit the *at_server_group* list, the replicate enters the inactive state on all database servers participating in the replicate and all send queues for the replicate are deleted.

If a replicate belongs to an exclusive replicate set, you cannot run **cdr stop replicate** to stop that individual replicate. You must use **cdr stop replicateset** to stop all replicates in the exclusive replicate set.

4 If you run this command while direct synchronization, a repair job, or consistency
4 checking with repair is in progress, that repair process will stop. (Consistency
4 checking continues; only the repair stops.) Direct synchronization and consistency

4 checking repair cannot be resumed; you must rerun **cdr sync replicate** or **cdr**
4 **check replicate** command with the **--repair** option. Restart the repair job with the
4 **cdr start repair** command.

Examples

The following command connects to the database server **lake** and stops the replicate **aRepl** on server groups **g_server1** and **g_server2**:

```
cdr sto rep -c lake aRepl g_server1 g_server2
```

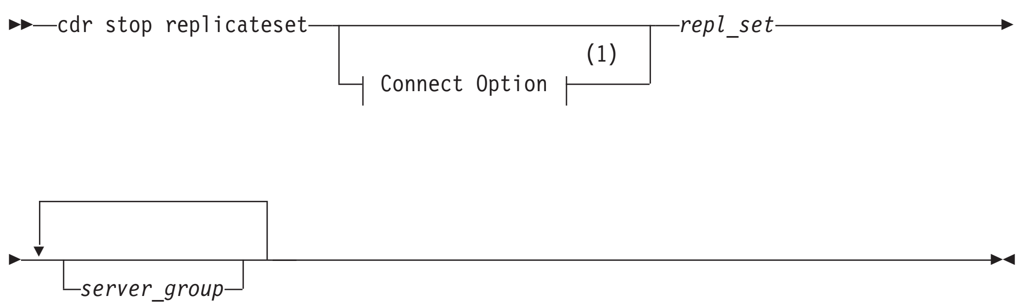
See Also

- "cdr change replicate" on page A-4
- "cdr define replicate" on page A-21
- "cdr delete replicate" on page A-37
- "cdr list replicate" on page A-50
- "cdr modify replicate" on page A-60
- "cdr resume replicate" on page A-76
- "cdr start replicate" on page A-82
- "cdr suspend replicate" on page A-98

cdr stop replicateset

The **cdr stop replicateset** command stops capture and transmittal transactions for all the replicates in a replicate set.

Syntax



Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
repl_set	Name of replicate set to stop	The replicate set must exist	"Long Identifiers" on page A-123
server_group	Name of database server group on which to stop the replicate group	The database server groups must be defined for Enterprise Replication.	

Usage

The **cdr stop replicateset** command causes all replicates in the replicate set *repl_set* to enter the *inactive* state (no capture, no send) on the database servers in the *server_group* list.

If the *server_group* list is omitted, the replicate set *repl_set* enters the inactive state for all database servers participating in the replicate set.

If not all the replicates in the non-exclusive replicate set are active, the **cdr stop replicateset** command displays a warning and only stops the replicates that are currently active.

4 If you run this command while direct synchronization, a repair job, or consistency
4 checking with repair is in progress, that repair process will stop. (Consistency
4 checking continues; only the repair stops.) Direct synchronization and consistency
4 checking repair cannot be resumed; you must rerun **cdr sync replicate** or **cdr**
4 **check replicate** command. Restart the repair job with the **cdr start repair** command
4 with the **--repair** option.

Examples

The following example connects to the database server **paris** and stops the replicate set **accounts_set** on server groups **g_utah** and **g_iowa**:

```
cdr sto replset --connect=paris accounts_set g_utah g_iowa
```

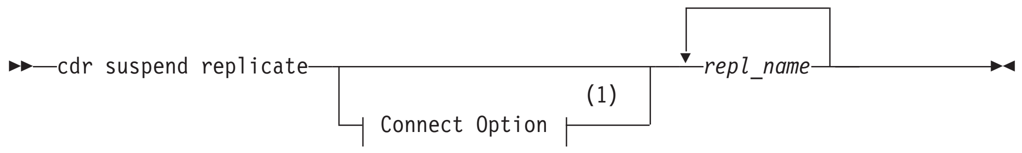
See Also

- “cdr change replicateset” on page A-6
- “cdr define replicate” on page A-21
- “cdr delete replicateset” on page A-38
- “cdr list replicateset” on page A-53
- “cdr modify replicateset” on page A-63
- “cdr resume replicateset” on page A-77
- “cdr start replicateset” on page A-85
- “cdr suspend replicateset” on page A-99

cdr suspend replicate

The **cdr suspend replicate** command suspends delivery of replication data.

Syntax



Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
repl_name	Name of the replicate	The replicate must be active.	"Long Identifiers" on page A-123

Usage

The **cdr suspend replicate** command causes the replicate *repl_name to* enter the suspend state (capture, no send) for all participants.

Warning: When a replicate is suspended, Enterprise Replication holds the replication data in the send queue until the replicate is resumed. If a large amount of data is generated for the replicate while it is suspended, the send queue space can fill, causing data to be lost. Enterprise Replication does not synchronize transactions if a replicate is suspended. For example, a transaction that updates tables X and Y will be split if replication for table X is suspended.

If a replicate belongs to an exclusive replicate set, you cannot run **cdr suspend replicate** to suspend that individual replicate. You must use **cdr suspend replicateset** to suspend all replicates in the exclusive replicate set.

Examples

The following example connects to the database server **stan** and suspends the replicate **house**:

```
cdr sus repl --connect=stan house
```

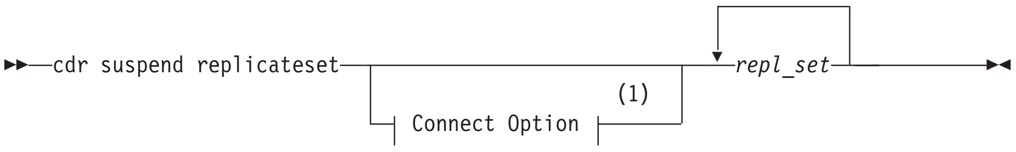
See Also

- "cdr change replicate" on page A-4
- "cdr define replicate" on page A-21
- "cdr delete replicate" on page A-37
- "cdr list replicate" on page A-50
- "cdr modify replicate" on page A-60
- "cdr resume replicate" on page A-76
- "cdr start replicate" on page A-82
- "cdr stop replicate" on page A-94

cdr suspend replicateset

The **cdr suspend replicateset** command suspends delivery of replication data for all the replicates in a replicate set.

Syntax



Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
repl_set	Name of replicate set to suspend	The replicate set must exist	"Long Identifiers" on page A-123

Usage

The **cdr suspend replicateset** command causes all the replicates in the replicate set *repl_set* to enter the suspend state. Information is captured, but no data is sent for any replicate in the set. The data is queued to be sent when the set is resumed.

Warning: When a replicate set is suspended, Enterprise Replication holds the replication data in the send queue until the set is resumed. If a large amount of data is generated for the replicates in the set while it is suspended, the send queue space can fill, causing data to be lost. Enterprise Replication does not synchronize transactions if a replicate in a replicate set is suspended. For example, a transaction that updates tables X and Y will be split if replication for table X is suspended.

If not all the replicates in the non-exclusive replicate set are active, the **cdr suspend replicateset** command displays a warning and only suspends the replicates that are currently active.

Examples

The following example connects to the default database server specified by **$INFORMIXSERVER** and suspends the replicate set **accounts_set**:

```
cdr sus replset account_set
```

See Also

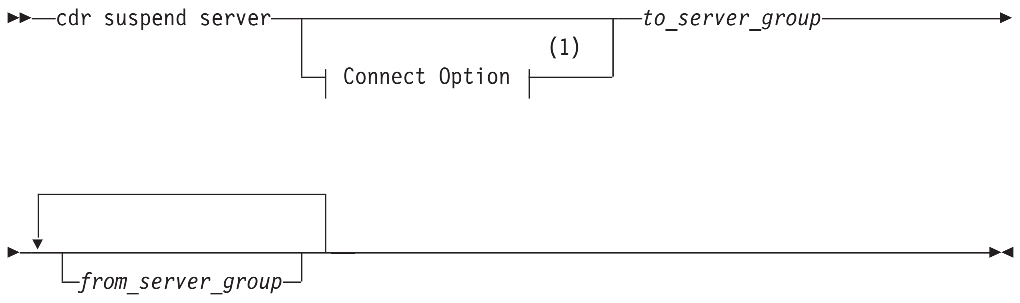
- "cdr change replicateset" on page A-6
- "cdr define replicate" on page A-21
- "cdr delete replicateset" on page A-38
- "cdr list replicateset" on page A-53
- "cdr modify replicateset" on page A-63
- "cdr resume replicateset" on page A-77
- "cdr start replicateset" on page A-85

- “cdr stop replicateset” on page A-96

cdr suspend server

The **cdr suspend server** command suspends the delivery of replication data to a database server from either a specified list of database servers or from all database servers in the enterprise.

Syntax



Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
to_server_group	Name of database server group to which to suspend delivery of replication data	The database server group must be currently active in Enterprise Replication.	
from_server_group	Name of the database server group from which to stop sending data to *to_server_group*	The database server group must be currently active in Enterprise Replication.	

Usage

The **cdr suspend server** command suspends delivery of replication data to the *to_server_group* database server from the database servers included in the *from_server_group* list. If the *from_server_group* list is omitted, the command suspends replication of data from all database servers participating in the Enterprise Replication system to the *to_server_group*.

The connection to the suspended server is unaffected, and control and acknowledge messages continue to be sent to that server. Enterprise Replication continues to replicate data between all database servers unaffected by the **cdr suspend server** command.

Examples

The following example connects to the default server (the one specified by the **INFORMIXSERVER** environment variable) and suspends replication of data to the server **g_iowa** from the servers **g_ohio** and **g_utah**:

```
cdr sus serv g_iowa g_ohio g_utah
```

See Also

- “cdr connect server” on page A-17
- “cdr define server” on page A-30
- “cdr delete server” on page A-40
- “cdr disconnect server” on page A-44
- “cdr list server” on page A-55
- “cdr modify server” on page A-64
- “cdr resume server” on page A-78

cdr swap shadow

The **cdr swap shadow** command switches a replicate with its shadow replicate during manual remastering.

Syntax

```
►►──cdr swap shadow──┬─────────────────────┬── --primaryname=repl_name────────►
                     │                 (1) │
                     └─┤ Connect Option ├──┘

►─ --primaryid=repl_ID── --shadowname=shadow_name── --shadowid=shadow_ID──────►◄
```

Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
repl_name	Name of the primary replicate	The primary replicate participant attributes state, type (**P** or **R**), and table owner (**O** or **I**) must match the shadow replicate participant attributes. See "Participant" on page A-124 for information about the **P**, **R**, **O** and **I** options.	"Long Identifiers" on page A-123
repl_ID	Internal Enterprise Replication identification code for the primary replicate		
shadow_name	Name of the shadow replicate	The shadow replicate state must match the primary replicate state. Shadow replicate participants must match the primary replicate participants.	"Long Identifiers" on page A-123
shadow_ID	Internal Enterprise Replication identification code for the shadow replicate		

The following table describes the **cdr swap shadow** options.

Long Form	Short Form	Meaning
--primaryname=	**-p**	Specifies the name of the primary replicate
--primaryid=	**-P**	Specifies the ID of the primary replicate
--shadowname=	**-s**	Specifies the name of the shadow replicate
--shadowid=	**-S**	Specifies the ID of the shadow replicate

Usage

Use the **cdr swap shadow** command to switch a replicate with its shadow replicate as the last step in manually remastering a replicate that was created with the **--name=n** option. You create a shadow replicate using the **cdr define replicate** command with the **--mirrors** option. For more information on manual remastering, see “Remastering a Replicate” on page 7-20.

Use the **onstat -g cat repls** command to obtain the *repl_ID* and *shadow_ID*. Alternatively, you can query the **syscdrrepl** view in the **sysmaster** database.

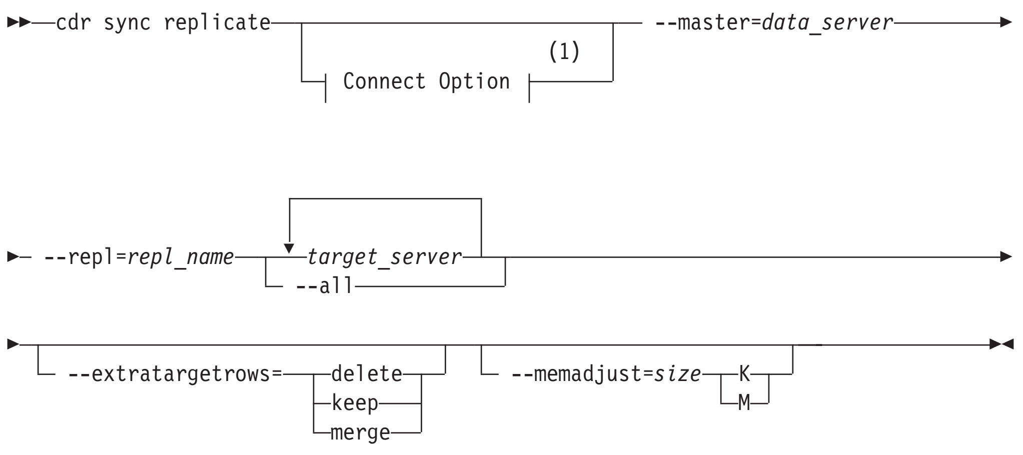
See Also

- “cdr define replicate” on page A-21
- “cdr list replicate” on page A-50

cdr sync replicate

The **cdr sync replicate** command synchronizes data among replication servers to repair inconsistent data within a replicate.

Syntax



Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
data_server	Name of the database server to use as the reference copy of the data	Must be the name of an existing database server group in SQLHOSTS. See “Setting up Database Server Groups” on page 4-3.	“Long Identifiers” on page A-123
repl_name	Name of the replicate to synchronize		“Long Identifiers” on page A-123
*size***K** | **M**	Size, in either kilobytes (**K**) or megabytes (**M**), of the increase in memory used by the send queue during synchronization	Must be a positive integer and must not be greater than the amount of available memory	
target_server	Name of a database server group on which to perform synchronization	Must be the name of an existing database server group in SQLHOSTS. See “Setting up Database Server Groups” on page 4-3.	“Long Identifiers” on page A-123

The following table describes the **cdr sync replicate** options.

Long Form	Short Form	Meaning
--all	**-a**	Specifies that all servers defined for the replicate are synchronized

Long Form	Short Form	Meaning
--extratargetrows=	**-e**	Specifies how to handle rows found on the target servers that are not present on the server from which the data is being copied (*data_server*): • **delete**: (default) remove rows and dependent rows, based on referential integrity constraints, from the target servers • **keep**: retain rows on the target servers • **merge**: retain rows on the target servers and replicate them to the data source server
--master=	**-m**	Specifies the database server to use as the reference copy of the data
--memadjust=	**-J**	Limits the amount of memory to increase the send queue during synchronization to the number of kilobytes or megabytes specified by the *size* element
--repl=	**-r**	Specifies the name of the replicate to synchronize

Usage

Use the **cdr sync replicate** command to synchronize data between multiple database servers for a specific replicate. This command performs direct synchronization as a foreground process.

If you need to limit the amount of memory that the send queue can use during synchronization, use the **--memadjust** option to specify the growth limit of the send queue.

The **cdr sync replicate** command performs the following tasks:

1. Creates a shadow replicate with the source server and target server as participants. The conflict resolution rule for the shadow replicate is **always apply**.
2. Performs a sequential scan of the replicated table on the source server.
3. Replicates the all rows in the table from the source server to the target server by copying the data directly into the send queue, bypassing the logical logs.
4. Deletes the shadow replicate.

Examples

The following example illustrates synchronizing all replication servers for the replicate named **repl_1**:

```
cdr sync replicate --master=g_serv1 --repl=repl_1\
--all --extratargetrows=keep
```

The data on the server group **g_serv1** is used as the reference for correcting the data on the other servers. Line 2 indicates that all servers associated with the replicate are synchronized and that if the synchronization process detects rows on the target servers that do not exist on the reference server (**g_serv1**), that those rows should remain on the other servers.

The following example illustrates synchronizing three servers for the replicate named **repl_2**:

```
cdr sync replicate -m g_serv1 -r repl_2\
g_serv2 g_serv3
```

4 The reference server is **g_serv1** and the target servers are **g_serv2** and **g_serv3**.
4 Because the **--extratargetrows** option is not specified, the default behavior occurs:
4 rows, and any dependent rows that are based on referential integrity constraints,
4 that are on the target servers but not on the reference server, are deleted.

9 The following example illustrates limiting the growth of the send queue to 50 KB:

4
4
```
cdr sync replicate --master=g_serv1 --repl=repl_1\
--memadjust=50K
```

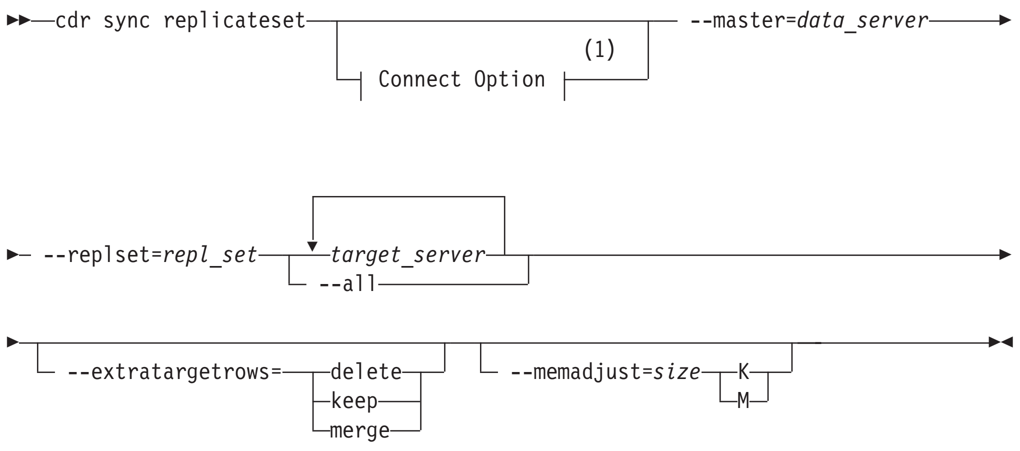
4 See Also

4 • “cdr check replicate” on page A-8

cdr sync replicateset

The **cdr sync replicateset** command synchronizes data among replication servers to repair inconsistent data within a replicate set.

Syntax



Notes:

1 See page A-123.

Element	Purpose	Restrictions	Syntax
data_server	Name of the database server to use as the reference copy of the data	Must be the name of an existing database server group in SQLHOSTS. See "Setting up Database Server Groups" on page 4-3.	"Long Identifiers" on page A-123
repl_set	Name of the replicate set to synchronize		"Long Identifiers" on page A-123
*size***K**|**M**	Size, in either kilobytes (**K**) or megabytes (**M**), of the increase in memory used by the send queue during synchronization	Must be a positive integer and must not be greater than the amount of available memory	
target_server	Name of a database server group on which to perform synchronization	Must be the name of an existing database server group in SQLHOSTS. See "Setting up Database Server Groups" on page 4-3.	"Long Identifiers" on page A-123

The following table describes the **cdr sync replicateset** options.

Long Form	Short Form	Meaning
--all	**-a**	Specifies that all servers defined for the replicate are synchronized

Long Form	Short Form	Meaning
--extratargetrows=	**-e**	Specifies how to handle rows found on the target servers that are not present on the server from which the data is being copied (*data_server*): • **delete**: (default) remove rows and dependent rows, based on referential integrity constraints, from the target servers • **keep**: retain rows on the target servers • **merge**: retain rows on the target servers and replicate them to the data source server
--master=	**-m**	Specifies the database server to use as the reference copy of the data
--memadjust=	**-J**	Limits the amount of memory to increase the send queue during synchronization to the number of kilobytes or megabytes specified by the *size* element
--replset=	**-s**	Specifies the name of the replicate set to synchronize

Usage

Use the **cdr sync replicateset** command to synchronize data between multiple database servers for a replicate set. This command performs direct synchronization as a foreground process.

If you need to limit the amount of memory that the send queue can use during synchronization, use the **--memadjust** option to specify the growth limit of the send queue.

The **cdr sync replicateset** command performs the following tasks:

1. Determines the order in which to repair tables if they have referential relationships.
2. Creates a shadow replicate with the source server and target server as participants. The conflict resolution rule for the shadow replicate is **always apply**.
3. Performs a sequential scan of the replicated table on the source server.
4. Replicates the all rows in the table from the source server to the target server by copying the data directly into the send queue, bypassing the logical logs.
5. Deletes the shadow replicate.
6. Repeats steps 2 through 5 for the each replicate in the replicate set.

Examples

The following example illustrates synchronizing all replication servers for the replicate set **replset_1** using **g_serv1** as the reference server:

```
cdr sync replicateset --master=g_serv1 --replset=replset_1\
--all --extratargetrows=keep
```

Line 2 indicates that all servers associated with the replicate set are synchronized and that if the synchronization process detects rows on the target servers that do not exist on the reference server (**g_serv1**), that those rows should remain on the other servers.

The following example illustrates synchronizing three servers for the replicate set named **replset_2**:

```
4    cdr sync replicateset -m g_serv1 -s replset_2\
4    g_serv2 g_serv3
```

4 The reference server is **g_serv1** and the target servers are **g_serv2** and **g_serv3**.
4 Because the **--extratargetrows** option is not specified, the default behavior occurs:
4 rows, and any dependent rows that are based on referential integrity constraints,
4 that are on the target servers but not on the reference server, are deleted.

9 The following example illustrates limiting the growth of the send queue to 50 KB:

```
4    cdr sync replicateset --master=g_serv1 --replset=replset_1\
4    --memadjust=50K
```

4 See Also

4 • "cdr check replicateset" on page A-13

cdr -V

The **cdr -V** command displays the version of Dynamic Server that is currently running.

Syntax

```
►►──cdr -V───────────────────────────────────────────────────────────────►◄
```

Usage

Use the **cdr -V** command if you need to obtain the version of the database server, usually at the request of IBM Support.

Examples

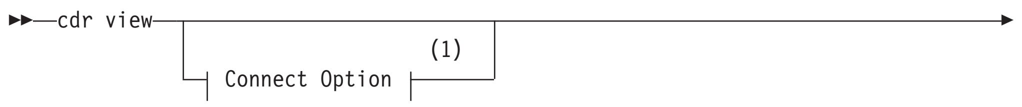
The following example shows an example output of the **cdr -V** command:

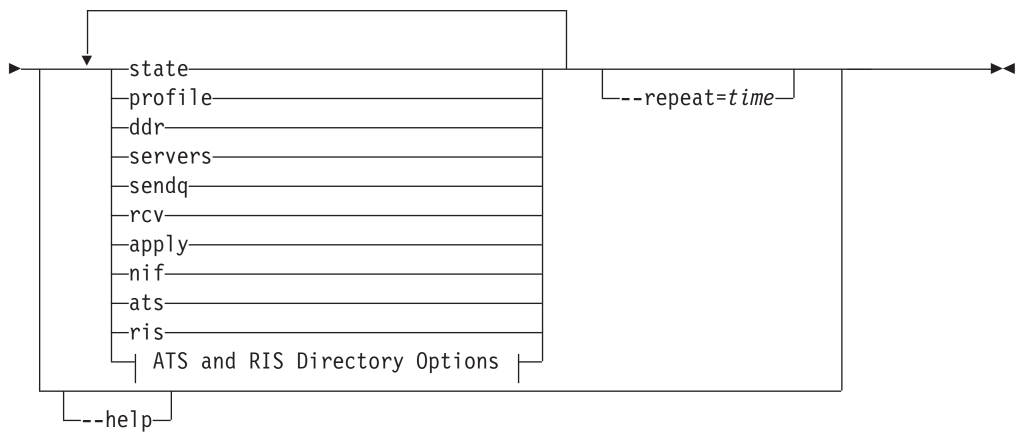
```
IBM Informix Dynamic Server Version 10.00.UC9    Software Serial Number RDS#N000000
```

cdr view

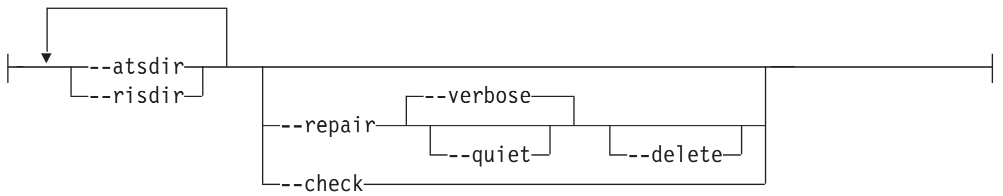
The **cdr view** command displays information about every Enterprise Replication server in the domain.

Syntax





ATS and RIS Directory Options:



Notes:

1 See page A-123.

Element	Purpose	Restrictions
time	The number of seconds before the **cdr view** command is repeated	Must be a positive integer

The following table describes the **cdr view** subcommands.

Long Form	Meaning
apply	Display a summary of how data is being applied on each of the target servers, including the latency of each target server
ats	Display a portion of each ATS file

Long Form	Meaning
atsdir	Display the names of the files in the ATS directory and optionally run repair operations based on those files
ddr	Display the state, key log positions, and the proximity to transaction blocking for each server in the replication domain
nif	Display information about the network connections between Enterprise Replication servers, including the number of transactions that are waiting to be transmitted to target servers
profile	Display a summary of that state, data capture, data apply, errors, connectivity, queues, and the size of spooling files for every Enterprise Replication server
rcv	Display information about the receive statistics for each target server, including the number of transaction failures and the rate at which transactions are applied
ris	Display a portion of each RIS file
risdir	Display the names of the files in the RIS directory and optionally run repair operations based on those files
sendq	Display information about the send queues for each Enterprise Replication server
servers	Display information about the state, connection status to each peer server, and queue size for each Enterprise Replication server
state	Display the Enterprise Replication state and the state of data capture, network connections, and data apply for each Enterprise Replication server

The following table describes the **cdr view** options.

Long Form	Short Form	Meaning
--check	**-C**	Check the consistency between the database server and the ATS or RIS file. Display repair operations to stderr, but do not perform the repair operations.
--delete	**-d**	Delete ATS or RIS files after processing them with the repair operation
--help	**-h**	Display the **cdr view** command usage
--quiet	**-q**	Quiet mode. Repair operations are not displayed to stderr.
--repair	**-R**	Synchronize data based on ATS or RIS files
--repeat=	**-r**	Repeat the **cdr view** command after the number of seconds specified by the *time* element
--verbose	**-v**	Verbose mode (default). All repair operations are displayed to stderr.

Usage

Use the **cdr view** command to monitor the Enterprise Replication domain. Each subcommand results in different output information.

You can choose to display the output of multiple subcommands sequentially by including them in the same **cdr view** command. You can choose to automatically repeat the command by using the **--repeat** option to specify the seconds in between commands.

You can repair inconsistencies listed in ATS or RIS files on every server by using the **--repair** option. Use the **--delete** option to delete the ATS or RIS files after the repair is complete.

Tip: Using the **--repair** option is equivalent to running the **cdr repair** command. The **--check** option is equivalent to the **cdr repair --check** command.

The cdr view state Command Output

The following example of the output of the **cdr view state** command shows the state of Enterprise Replication and each of its main components for every server in the Enterprise Replication domain.

```
STATE
Source      ER              Capture         Network         Apply
            State           State           State           State
-----------------------------------------------------------------------------
cdr1        Active          Running         Running         Running
cdr2        Active          Running         Running         Running
cdr3        Active          Running         Running         Running
cdr4        Active          Running         Running         Running
```

In this example, Enterprise Replication is active and running normally on all servers.

Possible values in the ER State column include:

Active Enterprise Replication is running normally

Shut Down
Enterprise Replication has been shut down

Uninitialized
The server does not have Enterprise Replication defined on it

Possible values in the Capture State, Network State, and Apply State columns include:

Running
The Enterprise Replication component is running normally

Down The Enterprise Replication component is not running

Uninitialized
The server is not a source server for replication

The cdr view profile Command Output

The following example of the output of the **cdr view profile** command shows a summary of the other **cdr view** commands and information about the sbspaces designated for spooled transaction data.

```
ER PROFILE for Node cdr2             ER State Active

DDR - Running                        SPOOL DISK USAGE
  Current       4:16879616             Total                 100000
  Snoopy        4:16877344             Metadata Free           5025
  Replay        4:24                   Userdata Free          93193
  Pages from DDRBLOCK    43879
                                     RECVQ
SENDQ                                  Txn In Queue               0
  Txn In Queue              0          Txn In Pending List        0
  Txn Spooled               0
  Acks Pending              0        APPLY - Running
                                       Txn Processed           1838
NETWORK - Running                      Commit Rate            76.58
```

```
Currently connected to 3 out of 3       Avg. Active Apply        1.16
Msg Sent                 1841           Fail Rate                0.00
Msg Received             5710           Total Failures              0
Throughput            1436.94           Avg Latency              0.00
Pending Messages            0           Max Latency                 0
                                        ATS File Count              0
                                        RIS File Count              0
```

In this example, only the output for a single server, **cdr2**, is shown. The actual output of the **cdr view profile** command includes a similar profile for every server.

The DDR section is a summary of the **cdr view ddr** command.

The SPOOL DISK USAGE section shows the total amount of memory, in bytes, in the sbspaces that Enterprise Replication uses to store spooled transaction row data, and the amount of available metadata and user data space.

The SENDQ section is a summary of the **cdr view sendq** command.

The RECVQ section is a summary of the **cdr view rcv** command.

The NETWORK section is a summary of the **cdr view nif** command.

The APPLY section is a summary of the **cdr view apply** command.

The cdr view ddr Command Output

The following example of the output of the **cdr view ddr** command shows the status of log capture.

```
DDR
Server Snoopy       Replay       Current      total        log pages to
       log page     log page     log page     log pages    DDRBLOCK
-----------------------------------------------------------------------------
cdr1   11:693       11:479       11:694       60000        47306
cdr2   5:272        5:0          5:273        60000        47727
cdr3   5:419        5:0          5:420        60000        47580
cdr4   5:127        5:0          5:128        60000        47872
```

In this example, transactions are being captured one log page from where they are being committed. Transaction are being applied further back in the same log. Over 47 000 additional log pages need to be used before transaction blocking would occur.

The columns in the output of the **cdr view ddr** command provide the following information:

Server The name of the Enterprise Replication server

Snoopy log page
The current log ID and position at which transactions are being captured for replication. For more information, see "onstat -g ddr" on page C-3.

Replay log page
The current log ID and position at which transactions have been applied. This is the position from which the log would need to be replayed to recover Enterprise Replication if Enterprise Replication or the database server shut down. For more information, see "onstat -g ddr" on page C-3.

Current log page
The log page on which replicated transactions are being captured

total log pages
: The total number of log pages on the server

log pages to DDRBLOCK
: The number of log pages that would have to be used before transaction blocking occurs

For more information on interpreting this output, see “onstat -g ddr” on page C-3.

The cdr view servers Command Output

The following example of the output of the **cdr view servers** command shows the state of the Enterprise Replication servers and their connections to each other.

```
SERVERS
Server Peer   ID   State    Status     Queue  Connection Changed
---------------------------------------------------------------------------
cdr1   cdr1   1    Active   Local      0
       cdr2   2    Active   Connected  0      Apr 15 10:46:16
       cdr3   3    Active   Connected  0      Apr 15 10:46:16
       cdr4   4    Active   Connected  0      Apr 15 10:46:15
cdr2   cdr1   1    Active   Connected  0      Apr 15 10:46:16
       cdr2   2    Active   Local      0
       cdr3   3    Active   Connected  0      Apr 15 10:46:16
       cdr4   4    Active   Connected  0      Apr 15 10:46:16
cdr3   cdr1   1    Active   Connected  0      Apr 15 10:46:16
       cdr2   2    Active   Connected  0      Apr 15 10:46:16
       cdr3   3    Active   Local      0
       cdr4   4    Active   Connected  0      Apr 15 10:46:16
cdr4   cdr1   1    Active   Connected  0      Apr 15 10:46:16
       cdr2   2    Active   Connected  0      Apr 15 10:46:16
       cdr3   3    Active   Connected  0      Apr 15 10:46:16
       cdr4   4    Active   Local      0
```

In this example, each of the four servers are connected to each other.

The output of this command is similar to the output of the **cdr list servers** command, except that the **cdr view servers** command shows all servers in the Enterprise Replication domain, not just the servers connected to the one from which the command is run. For information about the columns in this output, see “Listing All Enterprise Replication Servers” on page A-55.

The cdr view sendq Command Output

The following example of the output of the **cdr view sendq** command shows information about the send queue for each server.

```
RQM SENDQ
Server    Trans.    Trans.    Trans.      Data    Memory      ACKS
          in que    in mem   spooled  in queue    in use   pending
---------------------------------------------------------------------------
cdr1         594       594         0     49896     49896         0
cdr2           0         0         0         0         0         0
cdr3           0         0         0         0         0         0
cdr4           0         0         0         0         0         0
```

In this example, only the server **cdr1** has transactions in the send queue, all of which are in memory.

The columns of the **cdr view sendq** command provide the following information in addition to the server name:

Trans. in que
: The number of transactions in the send queue

Trans. in mem
: The number of transactions in the send queue that are currently in memory

Trans. spooled
: The number of transactions in the send queue that have been spooled to disk

Data in queue
: The number of bytes of data in the send queue, including both in-memory and spooled transactions

Memory in use
: The number of bytes of data in the send queue that resides in memory

ACKS pending
: The number of acknowledgements that have been received but have not yet been processed

The cdr view rcv Command Output

The following example of the output of the **cdr view rcv** command shows information about the receive queue for each server.

```
RCV
Server Received Spooled    Memory Pending Waiting
           Txn.    Txn.    In Use    Txn.    Txn.
---------------------------------------------------------------------------
cdr1          0       0         0       0       0
cdr2        372       0    871164     372       0
cdr3        220       0     18480     220       0
cdr4          0       0         0       0       0
```

In this example, the servers **cdr2** and **cdr3** have transactions in the receive queue, all of which have been preprocessed and are in the pending state waiting to be applied.

The columns of the **cdr view rcv** command provide the following information in addition to the server name:

Received Txn.
: The number of transactions in the receive queue

Spooled Txn.
: The number of transactions in the receive queue that have been spooled to disk

Memory In Use
: The size, in bytes, of the receive queue

Pending Txn.
: The number of transactions that have been preprocessed but not yet applied

Waiting Txn.
: The number of acknowledgements waiting to be sent back to the source server

The cdr view apply Command Output

The following example of the output of the **cdr view apply** command shows how replicated data is being applied.

```
APPLY
Server   Pl  Failure       Num     Num   Apply  --Latency--  ATS  RIS
       Rate    Ratio       Run  Failed    Rate  Max    Avg.    #    #
```

```
----------------------------------------------------------------------------
cdr1      0    0.000         0       0   0.000    0   0.000    0    0
cdr2      0    0.000     10001       0   0.112    0   0.000    0    0
cdr3      0    0.000     10001       0   0.112    0   0.000    0    0
cdr4      0    0.000     10001       0   0.112    0   0.000    0    0
```

In this example, the servers **cdr2**, **cdr3**, and **cdr4** each applied 10 001 transactions.

The columns of the **cdr view apply** command provide the following information in addition to the server name:

Pl Rate
Indicates the degree of parallelism used when data is being applied. Zero indicates the highest possible rate of parallelism.

Failure Ratio
The ratio of the number of times data could not be applied in parallel because of deadlocks or lock timeouts

Num Run
The number of transactions processed

Num Failed
The number of failed transactions because of deadlocks or lock timeouts

Apply Rate
The number of transactions that have been applied divided by the amount of time that replication has been active. The Apply Rate is equal to the Commit Rate in the **cdr view profile** command.

Max. Latency
The maximum number of seconds for processing any transaction

Avg. Latency
The average number of seconds of the life cycle of a replicated transaction

ATS # The number of ATS files

RIS # The number of RIS files

The cdr view nif Command Output

The following example of the output of the **cdr view nif** command shows the status and statistics of connections between servers.

```
NIF
Source Peer   State        Messages  Messages Messages  Transmit
                               Sent  Received  Pending      Rate

----------------------------------------------------------------------------
cdr1   cdr2   Connected       24014       372        6 21371.648
       cdr3   Connected       24020        17        0 20527.105
       cdr4   Connected       24014        23        6 21925.727
cdr2   cdr1   Connected         392     24015        0 21380.879
       cdr3   Connected          14        14        0    10.857
       cdr4   Connected          14        14        0    11.227
cdr3   cdr1   Connected          17     24021        0 20310.611
       cdr2   Connected          14        14        0    10.739
       cdr4   Connected          14        14        0    11.227
cdr4   cdr1   Connected         236     24015        0 21784.225
       cdr2   Connected          14        14        0    11.101
       cdr3   Connected          14        14        0    11.101
```

In this example, all servers are connected to each other. The server **cdr1** has six messages that have not yet been sent to server **cdr2** and server **cdr4**.

The columns of the **cdr view nif** command provide the following information in addition to the source server name:

Peer The name of the server to which the source server is connected

State The connection state. Values include:

Connected
The connection is active

Disconnected
The connection was explicitly disconnected

Timeout
The connection attempt has timed out, but will be reattempted

Logic error
The connection disconnected due to an error during message transmission

Start error
The connection disconnected due to an error while starting a thread to receive remote messages

Admin close
Enterprise Replication was stopped by user by issuing the **cdr stop** command

Connecting
The connection is being established

Never Connected
The servers have never had an active connection

Messages Sent
The number of messages sent from the source server to the target server

Messages Received
The number of messages received by the source server from the target server

Messages Pending
The number of messages that the source server needs to send to the target server

Transmit Rate
The total bytes of messages sent and received by the server divided by the amount of time that Enterprise Replication has been running. Same as the Throughput field in the **cdr view profile** command.

The cdr view ats and cdr view ris Command Output

The following example of the output of the **cdr view ats** command shows that there are no ATS files.

```
ATS for cdr1 - no files
---------------------------------------------------------------------------

ATS for cdr2 - no files
---------------------------------------------------------------------------

ATS for cdr3 - no files
---------------------------------------------------------------------------

ATS for cdr4 - no files
```

The following example of the **cdr view ris** command shows two RIS files.

```
RIS for cdr1 - no files
----------------------------------------------------------------------------

RIS for cdr2 - 1 files
Source Txn. Commit        Receive
       Time               Time
----------------------------------------------------------------------------
cdr1   08-04-15 11:56:13 | 08-04-15 11:56:14
File:ris.cdr2.cdr1.D_4.080415_11:56:14.1

Row:2 / Replicate Id: 262146 / Table: stores_demo@user.customer / DbOp:Update
CDR:6 (Error: Update aborted, row does not exist in target table) / SQL:0 / ISAM:0
----------------------------------------------------------------------------

RIS for cdr3 - no files
----------------------------------------------------------------------------

RIS for cdr4 - 1 files
Source Txn. Commit        Receive
       Time               Time
----------------------------------------------------------------------------
cdr1   08-04-15 11:56:13 | 08-04-15 11:56:14
File:ris.cdr4.cdr1.D_1.080415_11:56:14.1

Row:3 / Replicate Id: 262146 / Table: stores_demo@user.customer / DbOp:Update
CDR:6 (Error: Update aborted, row does not exist in target table) / SQL:0 / ISAM:0
```

In this example, the servers **cdr2** and **cdr4** each have one RIS file.

For more information on ATS and RIS files, see Chapter 8, “Monitoring and Troubleshooting Enterprise Replication,” on page 8-1.

The cdr view atsdir and cdr view risdir Command Output

The **cdr view atsdir** command and **cdr view risdir** command outputs have the same format. The following example of the output of the **cdr view risdir** command shows the names of two RIS files.

```
RISDIR
Server File                                  Size             Create
       Name                                                     Time
----------------------------------------------------------------------------
cdr2   ris.cdr2.cdr1.D_4.080415_11:56:14.1    465  2008-04-15 11:56:15
cdr4   ris.cdr4.cdr1.D_1.080415_11:56:14.1    475  2008-04-15 11:56:15
```

In this example, both server **cdr2** and server **cdr4** have a single RIS file. The Size column shows the size of the file, in bytes.

Examples

The following command would display information about the send queue and the network every 10 seconds:

```
cdr view sendq nif --repeat=10
```

The following command could be used to in a daemon or script that runs every five minutes to check all servers for ATS and RIS files, repair inconsistencies, and delete the processed ATS and RIS files:

```
cdr view atsdir risdir --repair --delete --repeat=300
```

See Also

- “cdr repair” on page A-74

Interpreting the Command-Line Utility Syntax

This section defines the terminology and conventions used in the descriptions of the command-line utility (CLU).

Each command follows the same approximate format, with the following components:

- Command and its variation

  The command specifies the action that should be taken.
- Options

  The options modify the action of the command. Each option starts with a minus (-) or a double-minus (--).
- Target

  The target specifies the Enterprise Replication object that should be acted upon.
- Other objects

  Other objects specify objects that are affected by the change to the target.

If you enter an incorrect **cdr** command at the command-line prompt, the database server returns a usage message that summarizes the **cdr** commands. For a more detailed usage message, enter **cdr** ***variation*** **-h**. For example, **cdr list server -h**.

Important: You must be the Enterprise Replication server administrator to execute any of the CLU commands except the **cdr list** options. For more information, see "Enterprise Replication Server Administrator" on page 2-2.

Command Abbreviations

For most commands, each of the words that make up a **cdr** command variation can be abbreviated to three or more characters. For example, the following commands are all equivalent:

```
cdr define replicate
cdr define repl
cdr def rep
```

The exceptions to this rule are the **replicateset** commands, which can be abbreviated to **replset**. For example, the following commands are equivalent:

```
cdr define replicateset
cdr def replset
```

Option Abbreviations

Each option for a command has a long form and a short form. You can use either form, and you can mix long and short forms within a single command.

On UNIX, a long form example might look like:

```
cdr define server --connect=ohio --idle=500 \
   --ats=/cdr/ats --initial utah
```

On WINDOWS, the same long form example would look like:

```
cdr define server --connect=ohio --idle=500 \
   --ats=D:\cdr\ats --initial utah
```

Using short forms, you can write the previous examples as follows:

UNIX:

```
cdr def ser -c ohio -i 500 -A /cdr/ats -I utah
```

WINDOWS:

```
cdr def ser -c ohio -i 500 -A D:\cdr\ats -I utah
```

The long form is always preceded by a double minus (--). Most (but not all) long forms require an equal sign (=) between the option and its argument. The short form is preceded by a single minus (-) and is usually the first letter of the long form. The short form never requires an equal sign. However, sometimes the short form is capitalized and sometimes it is not. To find the correct syntax for the short form, check the table that accompanies each command variation.

Tip: Use the long forms of options to increase readability.

With the exception of the keyword **transaction**, all keywords (or letter combinations) that modify the command options must be written as shown in the syntax diagrams. For example, in the “Conflict Options” on page A-23, the option (**conflict**) can be abbreviated, but the keyword **ignore** cannot be abbreviated. Both of the following forms are correct:

```
--conflict=ignore
-C ignore
```

Option Order

You can specify the options of the CLU commands in any order. Some of the syntax diagrams in this chapter show the options in a specific order because it makes the diagram easier to read.

Do not repeat any options. The following fragment is incorrect because **-c** appears twice. In most cases, the CLU will catch this inconsistency and flag it as an error. However, if no error is given, the database server uses the last instance of the option. In the following example, the database server uses the value `-c utah`:

```
-c ohio -i 500 -c utah
```

Tip: For ease of maintenance, always use the same order for your options.

Long Command-Line Examples

The examples in this guide use the convention of a backslash (\) to indicate that a long command line continues on the next line. The following two commands are equivalent. The first command is too long to fit on a single line, so it is continued on the next line. The second example, which uses short forms for the options, fits on one line.

On UNIX, the command line might look like:

```
cdr define server --connect=katmandu --idle=500 \
   --ats=/cdrfiles/ats

cdr def ser -c katmandu -i 500 -A /cdrfiles/ats
```

On Windows, these command lines might look like:

```
cdr define server --connect=honolulu --idle=500 \
   --ats=D:\cdrfiles\ats

cdr def ser -c honolulu -i 500 -A D:\cdr\ats
```

For information on how to manage long lines at your command prompt, check your operating system documentation.

Long Identifiers

Identifiers are the names of objects, such as database servers, databases, columns, replicates, replicate sets, and so on, that Dynamic Server and Enterprise Replication use.

An identifier is a character string that must start with a letter or an underscore. The remaining characters can be letters, numbers, or underscores. On IBM Informix Dynamic Server, all identifiers, including replicates and replicate sets, can be 128 bytes long. However, if you have any database servers in your replication environment that are an earlier version, you must follow the length restrictions for that version.

For more information about identifiers, see the *IBM Informix Guide to SQL: Syntax*.

The location of files, such as the location of the ATS files, can be 256 bytes.

User login IDs can be a maximum of 32 bytes. The owner of a table is derived from a user ID and is thus limited to 32 bytes.

Connect Option

The **--connect** option causes the command to use the global catalog that is on the specified server. If you do not specify this option, the connection defaults to the database server specified by the **INFORMIXSERVER** environment variable.

```
►►──┬─ -c─server──────────────┬──────────────────────────────────────────►◄
    ├─ --connect=server───────┤
    ├─ -c─server_group────────┤
    └─ --connect=server_group─┘
```

Element	Purpose	Restrictions	Syntax
server	Name of the database server to connect to	The name must be the name of a database server.	"Long Identifiers" on page A-123
server_group	Name of the database server group that includes the database server to connect to	The name must be the name of an existing database server group.	"Long Identifiers" on page A-123

You must use the **--connect** option when you add a database server to your replication environment with the **cdr define server** command.

You might use the **--connect** option if the database server to which you would normally attach is unavailable.

For more information about the global catalog, refer to "Global Catalog" on page 2-4.

Participant

A *participant* defines the data (database, table, and columns) to be replicated on a specific database server. Each participant in a replicate must specify a different database server. The participant definition includes the following information:

- Database server group ("Setting up Database Server Groups" on page 4-3)
- Database in which the table resides
- Table name
- Table owner ("Table Owner" on page A-125)
- Participant type ("Participant Type" on page A-125)
- SELECT statement ("Participant Modifier" on page A-125)

You must include the server group, database, table owner, and table name when defining a participant, and enclose the entire participant definition in quotation marks.

```
►►─"─┬───┬──┬───┬─database@server_group:owner.table─"──────────────────►◄
     ├─P─┤  ├─O─┤
     └─R─┘  └─I─┘
```

Element	Purpose	Restrictions	Syntax
database	Name of the database that includes the table to be replicated	The database server must be registered with Enterprise Replication.	"Long Identifiers" on page A-123
owner	User ID of the owner of the table to be replicated		"Long Identifiers" on page A-123
server_group	Name of the database server group that includes the server to connect to	The database server group name must be the name of an existing Enterprise Replication server group in SQLHOSTS and must be used only once in the same replicate.	"Long Identifiers" on page A-123
table	Name of the table to be replicated	The table must be an actual table. It cannot be a synonym or a view.	"Long Identifiers" on page A-123

Important: Do not create more than one replicate definition for each row and column set of data to replicate. If the participant overlaps, Enterprise Replication attempts to insert duplicate values during replication.

You can define participants with the following commands:

- **cdr define replicate**
- **cdr modify replicate**
- **cdr change replicate**
- **cdr define template**

The **P**, **R**, **O**, and **I** options are described in the sections below.

Table Owner

The **O** (owner) option causes permission checks for *owner* to be applied to the operation (such as insert or update) that is to be replicated and to all actions fired by any triggers. When the **O** option is omitted, all operations are performed with the privileges of user **informix**.

On UNIX, if a trigger requires any system-level commands (as specified using the **system( )** command in an SPL statement), the system-level commands are executed as the table owner, if the participant includes the **O** option.

On Windows, if a trigger requires any system-level commands, the system-level commands are executed as a less privileged user because you cannot impersonate another user without having the password, whether or not the participant includes the **O** option.

Use the **I** option to disable the table-owner option.

Participant Type

In a primary-target replicate, specify the participant type using the **P** (primary) and **R** (receive-only or target) options in the participant definition:

- A primary participant both sends and receives replicate data.
- A target participant only receives data from primary participants.

The replicate can contain multiple primary participants.

In an update-anywhere replicate, do not specify either **P** or **R** for the participant. Enterprise Replication defines the participant as primary in an update-anywhere replication system.

For example, in the following definition, replicate **Rone** is update-anywhere:

```
cdr define repl -c serv1 -C timestamp -S tran Rone \
"db@serv1:owner.table" "select * from table" \
"db@serv2:owner.table" "select * from table"
```

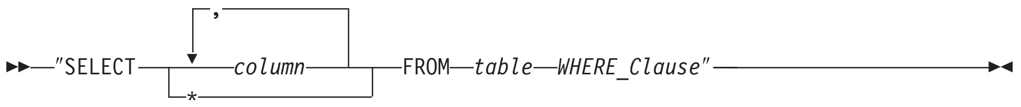
In replicate **Rtwo**, **serv2** is the primary and **serv1** is receive-only.

```
cdr define repl -c serv1 -C ignore -S tran Rtwo \
"R db@serv1:owner.table" "select * from table" \
"P db@serv2:owner.table" "select * from table"
```

For more information, see “Primary-Target Replication System” on page 3-1.

Participant Modifier

The participant *modifier* is a restricted SELECT statement. The participant modifier specifies the rows and columns that will be replicated. The participant modifier must be enclosed in quotation marks.



Element	Purpose	Restrictions	Syntax
column	Name of a column in the table specified by the participant	The column must exist.	“Long Identifiers” on page A-123

Element	Purpose	Restrictions	Syntax
table	The table specified by the participant	This must be the table name only. You cannot specify an owner or a database server. You cannot specify a synonym or a view.	"Long Identifiers" on page A-123
WHERE_Clause	Clause that specifies a subset of table rows to be replicated		WHERE clause syntax; refer to *IBM Informix Guide to SQL: Syntax*

The following guidelines apply to a SELECT statement that is used as a participant modifier:

- The statement cannot include a join or a subquery.
- The FROM clause of the SELECT statement can reference only a single table.
- The table in the FROM clause must be the table specified by the participant.
- The columns selected must include the primary key.
- The columns selected can include any columns in the table, including those that contain smart large objects and TEXT and BYTE data.
- The statement cannot perform operations on the selected columns.
- The statement can include an optional WHERE clause.

  The WHERE clause of the SELECT statement of the participant modifier can reference an opaque UDT, as long as the UDT is always stored in row. For more information, see "Considerations for Replicating Opaque Data Types" on page 2-16.

Recommendation: Only replicate between like data types. For example, do not replicate between the following:

- CHAR(40) to CHAR(20)
- INT to FLOAT

You can replicate between the following types with caution:

- SERIAL and INT
- BYTE and TEXT
- BLOB and CLOB

For detailed information about the SELECT statement and WHERE clause, refer to the *IBM Informix Guide to SQL: Syntax*.

Return Codes

If the command encounters an error, the database server returns an error message and a return-code value. The message briefly describes the error. For information on interpreting the return code, use the **cdr finderr** command.

Frequency Options

The following commands allow you to specify the interval between replications or the time of day when an action should occur. If you do not specify a time, the action occurs immediately:

- **cdr define replicate**
- **cdr define replicateset**
- **cdr define template**
- **cdr modify replicate**
- **cdr modify replicateset**

Frequency Options:

```
├──┬───────────────┬──────────────────────────────────────────────────┤
   ├─ --immed──────┤
   ├─ --every=interval─┤
   └─ --at=time────┘
```

Element	Purpose	Restrictions	Syntax
interval	Time interval for replication	The smallest interval in minutes.	"Intervals" on page A-128
time	Specific time for replication	Time is given with respect to a 24-hour clock.	"Time of Day" on page A-127

The following table describes the frequency options.

Long Form	Short Form	Meaning
--immed	**-i**	Action occurs immediately.
--every	**-e**	Action occurs immediately and repeats at the frequency specified by interval.
--at	**-a**	Action occurs at the specified day and time.

Time of Day

Enterprise Replication always gives the time of day in 24-hour time. For example, 19:30 is 7:30 P.M. Enterprise Replication always gives times with respect to the local time, unless the **TZ** environment variable is set. However, Enterprise Replication stores times in the global catalog in Greenwich Mean Time (GMT).

The **-a** *time* option lets you specify the day on which an action should occur. The string *time*can have the following formats:

- Day of week

  To specify a specific day of the week, give either the long or short form of the day, followed by a period and then the time. For example, `--at=Sunday.18:40` or `-a Sun.18:40` specifies that the action should occur every Sunday at 6:40 P.M.

  The day of the week is given in the locale of the client. For example, with a French locale, you might have `--at=Lundi.3:30` or `-a Lun.3:30`. The time and day are in the time zone of the server.
- Day of month

  To specify a specific day in the month, give the date, followed by a period, and then the time. For example, `1.3:00` specifies that the action should occur at 3:00 A.M. on the first day of every month.

  The special character `L` represents the last day of the month. For example, `L.17:00` is 5:00 P.M. on the last day of the month.
- Daily

To specify that replication should occur each day, give only the time. For example, 4:40 specifies that the action should occur every day at 4:40 A.M.

Intervals

The **-e** *interval* option lets you specify the interval between actions. The *interval* of time between replications can be either of the following formats:

- The number of minutes

  To specify the number of minutes, specify an integer value. For example, `-e 60` indicates 60 minutes between replications.

  If you specify the interval of time between replications in minutes, the longest interval allowed is 1966020.
- The number of hours and minutes

  To specify hours and minutes, give the number of hours, followed by a colon, and then the number of minutes. For example, `-e 5:45` indicates 5 hours and 45 minutes between replications.

If you specify the length of time in hours and minutes, the longest interval allowed is 32767:59.

Appendix B. Configuration Parameter and Environment Variable Reference

The database server configuration file (**$ONCONFIG**) includes the following configuration parameters that affect the behavior of Enterprise Replication:

- CDR_DBSPACE
- CDR_DSLOCKWAIT
- CDR_ENV
- CDR_EVALTHREADS
- CDR_MAX_DYNAMIC_LOGS
- CDR_NIFCOMPRESS
- CDR_QDATA_SBSPACE
- CDR_QHDR_DBSPACE
- CDR_QUEUEMEM
- CDR_SERIAL
- CDR_SUPPRESS_ATSRISWARN
- ENCRYPT_CDR
- ENCRYPT_CIPHERS
- ENCRYPT_MAC
- ENCRYPT_MACFILE
- ENCRYPT_SWITCH

Important: If you use both DBSERVERNAME and DBSERVERALIASES, DBSERVERNAME should refer to the network connection and not to a shared-memory connection. For information about database server aliases, refer to the *IBM Informix Dynamic Server Administrator's Guide*.

Use the CDR_ENV configuration parameter to set the following environment variables that affect the behavior of Enterprise Replication:

- CDR_ATSRISNAME_DELIM
- CDR_DISABLE_SPOOL
- CDR_LOGDELTA
- CDR_PERFLOG
- CDR_ROUTER
- CDR_RMSCALEFACT

CDR_DBSPACE Configuration Parameter

units	any valid dbspace
9 *takes effect*	When the database server is shut down and restarted

The CDR_DBSPACE configuration parameter specifies the dbspace where the **syscdr** database is created. If it is not set, then **syscdr** is created in the root dbspace.

CDR_DSLOCKWAIT Configuration Parameter

default value	5
units	seconds
takes effect	When the database server is shut down and restarted

The CDR_DSLOCKWAIT configuration parameter specifies the number of seconds the Datasync (data synchronization) component waits for database locks to be released. The CDR_DSLOCKWAIT parameter behaves similarly to the SET LOCK MODE statement. Although the SET LOCK MODE is set by the end user application, CDR_DSLOCKWAIT is used by Enterprise Replication while applying data at the target database. This parameter is useful in conditions where different sources require locks on the replicated table. These sources could be a replicated transaction from another server or a local application operating on that table.

Transactions that receive updates and deletes from another server in the replicate can abort because of locking problems. If you experience transaction aborts in the Datasync due to lock timeouts like this, you might want to increase the value of this parameter.

CDR_ENV Configuration Parameter

9	*takes effect*	When the database server is shut down and restarted

The CDR_ENV configuration parameter sets the Enterprise Replication environment variables CDR_LOGDELTA, CDR_PERFLOG, CDR_ROUTER, or CDR_RMSCALEFACT. The ONCONFIG file can contain multiple entries for CDR_ENV. You can specify only one environment variable per CDR_ENV entry.

For example, to set the CDR_LOGDELTA environment variable to 30 and the CDR_ROUTER environment variable to 1, include the following lines in the ONCONFIG file:

```
CDR_ENV CDR_LOGDELTA=30
CDR_ENV CDR_ROUTER=1
```

Important: Use the CDR_LOGDELTA, CDR_PERFLOG, CDR_ROUTER, and CDR_RMSCALEFACT environment variables only if instructed to do so by Technical Support.

CDR_EVALTHREADS Configuration Parameter

default value	1,2
units	evaluator thread instances
range of values	1 to 129 * the number of CPU VPs for each *value*
takes effect	When the database server is shut down and restarted

Enterprise Replication evaluates the images of a row in parallel to assure high performance. Figure B-1 illustrates how Enterprise Replication uses parallel processing to evaluate transactions for replication.

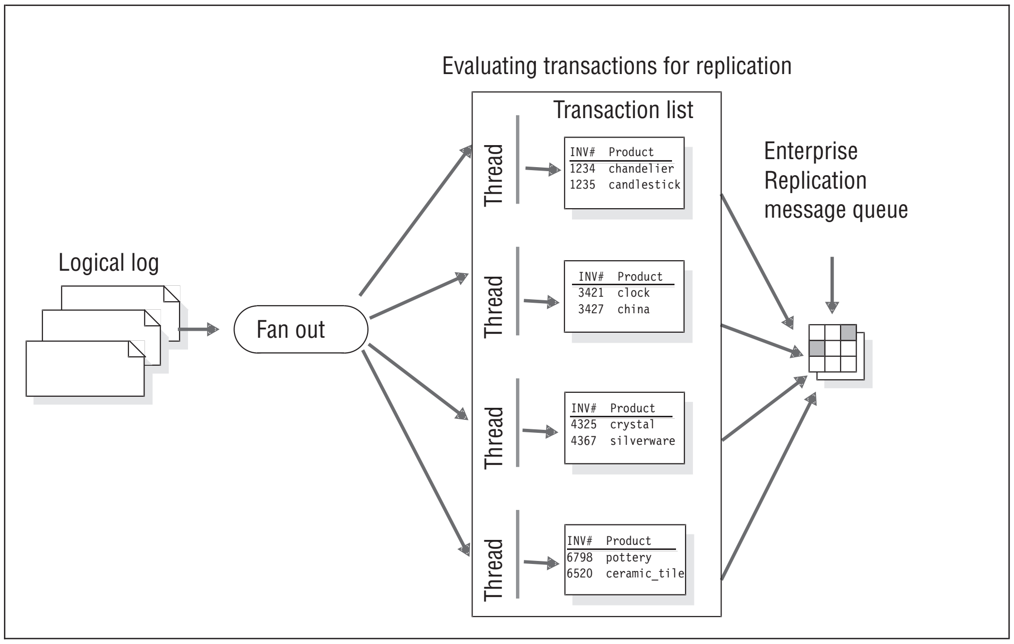


Figure B-1. Processing in Parallel for High Performance

The CDR_EVALTHREADS configuration parameter specifies the number of grouper evaluator threads to create when Enterprise Replication starts and enables parallelism. The format is:

```
(per-cpu-vp,additional)
```

The following table provides four examples of CDR_EVALTHREADS.

Number of Threads	Explanation	Example
1,2	1 evaluator thread per CPU VP, plus 2	For a 3 CPU VP server: (3 * 1) + 2 = 5
2	2 evaluator threads per CPU VP	For a 3 CPU VP server: (3 * 2) = 6
2,0	2 evaluator threads per CPU VP	For a 3 CPU VP server: (3* 2)+0 = 6
0,4	4 evaluator threads for any database server	For a 3 CPU VP server: (3 * 0) +4 = 4

Warning: Do not configure the total number of evaluator threads to be smaller than the number of CPU VPs in the system.

CDR_MAX_DYNAMIC_LOGS Configuration Parameter

default value `0`

range of values

- `-1` add dynamic log files indefinitely
- `0` disable dynamic log addition
- `>0` number of dynamic logs that can be added

9 *takes effect* when the database server is shut down and restarted, and the
9 DYNAMIC_LOGS configuration parameter is set to 2. For more
9 information on the DYNAMIC_LOGS configuration parameter, see
9 the *IBM Informix Dynamic Server Administrator's Reference*.

The CDR_MAX_DYNAMIC_LOGS configuration parameter specifies the number of dynamic log file requests that Enterprise Replication can make in one server session.

For more information, see "Preventing DDRBLOCK Mode" on page 8-10.

CDR_NIFCOMPRESS Configuration Parameter

default value `0`

range of values

- `-1` specifies no compression
- `0` specifies to compress only if the target server expects compression
- `1 - 9` specifies increasing levels of compression

9 *takes effect* When the database server is shut down and restarted

The CDR_NIFCOMPRESS (network interface compression) configuration parameter specifies the level of compression that the database server uses before sending data from the source database server to the target database server. Network compression saves network bandwidth over slow links but uses more CPU to compress and decompress the data.

The values have the following meanings.

Value	**Meaning**
`-1`	The source database server never compresses the data, regardless of whether or not the target site uses compression.
0	The source database server compresses the data only if the target database server expects compressed data.
1	The database server performs a minimum amount of compression.
9	The database server performs the maximum possible compression.

When Enterprise Replication is defined between two database servers, the CDR_NIFCOMPRESS values of the two servers are compared and changed to the higher compression values.

The compression values determine how much memory can be used to store information while compressing, as follows:

```
0 = no additional memory
1 = 128k + 1k    = 129k
2 = 128k + 2k    = 130k
...
6 = 128k + 32k  = 160k
...
8 = 128k + 128k = 256k
9 = 128k + 256k = 384k
```

Higher levels of CDR_NIFCOMPRESS cause greater compression.

Different sites can have different levels. For example, Figure B-2 shows a set of three root servers connected with LAN and a nonroot server connected over a modem. The CDR_NIFCOMPRESS configuration parameter is set so that connections between A, B, and C use no compression. The connection from C to D uses level 6.

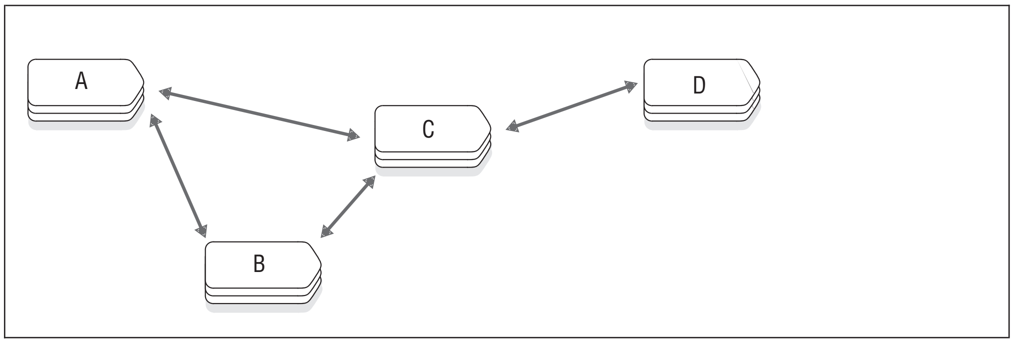


Figure B-2. Database Servers with Different Compression Levels

Important: Do not disable NIF compression if the network link performs compression in hardware.

CDR_QDATA_SBSPACE Configuration Parameter

default value	none
separators	comma
range of values	up to 128 characters for each sbspace name; up to 32 sbspace names. Use a comma to separate each name in the list. At least one sbspace name must be specified.
9 *takes effect*	when the database server is shut down and restarted

The CDR_QDATA_SBSPACE configuration parameter specifies the list of up to 32 names of sbspaces that Enterprise Replication uses to store spooled transaction row data. Enterprise Replication creates one smart large object per transaction. If CDR_QDATA_SBSPACE is configured for multiple sbspaces, then Enterprise Replication uses all appropriate sbspaces in round-robin order.

Important: You must set the CDR_QDATA_SBSPACE configuration parameter and create the sbspaces specified by CDR_QDATA_SBSPACE before defining a server for replication. If the configuration parameter is not set in ONCONFIG or the sbspace names specified by CDR_QDATA_SBSPACE are invalid, Enterprise Replication fails to define the server. For more information, see "Row Data sbspaces" on page 4-9 and "Defining Replication Servers" on page 6-2.

Warning: Do not change the value of CDR_QDATA_SBSPACE while Enterprise Replication is running.

CDR_QHDR_DBSPACE Configuration Parameter

default value	the name of the dbspace specified by the ROOTNAME configuration parameter For more information, see the *IBM Informix Administrator's Reference*.
9 *takes effect*	When the database server is shut down and restarted

The CDR_QHDR_DBSPACE configuration parameter specifies the location of the dbspace that Enterprise Replication uses to store the transaction record headers spooled from the send and receive queues. By default, Enterprise Replication stores the transaction record headers in the root dbspace. For more information, see "Transaction Record dbspace" on page 4-8.

Warning: Do not change the value of *CDR_QHDR_DBSPACE* after you initialize Enterprise Replication.

CDR_QUEUEMEM Configuration Parameter

	default value	`4096`
	units	kilobytes
	range of values	`>; = 500`
9	*takes effect*	When the database server is shut down and restarted

The CDR_QUEUEMEM configuration parameter specifies the maximum amount of memory that is used for the send and receive queues. If your logical logs are large, the Enterprise Replication reads a large amount of data into queues in memory. You can use CDR_QUEUEMEM to limit the amount of memory devoted to the queues.

The maximum memory used for queued elements on a replication server is the total number of database servers involved in replication, multiplied by the value of CDR_QUEUEMEM.

When you increase the value of CDR_QUEUEMEM, you reduce the number of elements that must be written to disk, which can eliminate I/O overhead. Therefore, if elements are frequently stored on disk, increase the value of CDR_QUEUEMEM. Conversely, if you set the value of CDR_QUEUEMEM too high, you might adversely impact the performance of your system. High values for CDR_QUEUEMEM also increase the time necessary for recovery. Tune the value of CDR_QUEUEMEM for the amount of memory available on your computer.

CDR_SERIAL Configuration Parameter

	default value	`0,0`
	units	*delta*, *offset*
9	*range of values*	`0` disable control of serial column value generation
9 9		`two positive integers separated by a comma` enable control of serial column value generation
9	*takes effect*	When the database server is shut down and restarted

9 The CDR_SERIAL configuration parameter enables control over generating values
9 for SERIAL and SERIAL8 primary key columns in replicated tables so that no
9 conflicting values are generated across multiple Enterprise Replication servers.
9 CDR_SERIAL is necessary if the serial column is the primary key column and no
9 other primary key column, such as a server ID, guarantees the uniqueness of the
9 primary key. When you set CDR_SERIAL, only tables that are marked as the
9 source of a replicate use this method of serial column generation. By default,
9 CDR_SERIAL is set to `0` to disable control over generating serial values.

The format is:

```
CDR_SERIAL delta,offset
```

where:

delta	Determines the incremental size of the serial column values. This value must be the same on all replication servers and must be at least the number of expected servers in the Enterprise Replication domain.
offset	Determines the offset of the serial value that will be generated. This value must be different on all replication servers and must be between 0 and one less than the value of *delta*, inclusive.

For example, suppose you have two primary servers, **g_usa** and **g_japan**, and one read-only target server, **g_italy**. You plan to add three additional servers in the future. You might set CDR_SERIAL to the values shown in the following table.

Table B-1. CDR_SERIAL Example Settings and Results

Server	Example CDR_SERIAL Value	Resulting Values for the Serial Column
g_usa	5,0	5, 10, 15, 20, 25, and so on
g_japan	5,1	6, 11, 16, 21, 26, and so on
g_italy	0	no local inserts into the serial column

The CDR_SERIAL setting of `5,2`, `5,3`, and `5,4` are reserved for the future servers.

If you need to add more servers than the *delta* value of CDR_SERIAL, you must reset CDR_SERIAL on all servers simultaneously and ensure that the serial values on the new servers are unique.

For more information, see "Serial Data Types and Primary Keys" on page 2-7.

CDR_SUPPRESS_ATSRISWARN Configuration Parameter

default value	none
separators	commas or as range of values specified with a hyphen
takes effect	when the database server is shut down and restarted

The CDR_SUPPRESS_ATSRISWARN configuration parameter specifies the Datasync error and warning code numbers to be suppressed in ATS and RIS files. For example, you can set CDR_SUPPRESS_ATSRISWARN to 2-5, 7 to suppress the generation of error and warning messages 2, 3, 4, 5, and 7. For a list of error and message numbers see Appendix G, "Datasync Warning and Error Messages," on page G-1.

ENCRYPT_CDR Configuration Parameter

default value	`0`
range of values	`0` do not encrypt
	`1` encrypt when possible
	`2` always encrypt

9 *takes effect* When the database server is shut down and restarted

The ENCRYPT_CDR configuration parameter sets the level of encryption for Enterprise Replication.

If the ENCRYPT_CDR configuration parameter is set to 1, then encryption is used for Enterprise Replication transactions only when the database server being connected to also supports encryption. This option allows unencrypted communication with versions of Dynamic Server prior to 9.40.

If the ENCRYPT_CDR configuration parameter is set to 2, then only connections to encrypted database servers are allowed.

If you use both encryption and compression (by setting the CDR_NIFCOMPRESS configuration parameter), then compression occurs before encryption.

ENCRYPT_CIPHERS Configuration Parameter

syntax `ENCRYPT_CYPHERS all|allbut:<`*`list of ciphers and modes`*`>|`*`cipher`*`:`*`mode`*`{,`*`cipher`*`:`*`mode`*` ...}`

- `all`

  Specifies to include all available ciphers and modes, except ECB mode. For example: `ENCRYPT_CIPHERS all`
- `allbut:<`*`list of ciphers and modes`*`>`

  Specifies to include all ciphers and modes except the ones in the list. Separate ciphers or modes with a comma. For example: `ENCRYPT_CIPHERS allbut:<cbc,bf>`
- *`cipher`*`:`*`mode`*

  Specifies the ciphers and modes. Separate cipher-mode pairs with a comma. For example: `ENCRYPT_CIPHERS des3:cbc,des3:ofb`

default value `allbut:<ecb>`

takes effect When the database server is shut down and restarted

The ENCRYPT_CIPHERS configuration parameter defines all ciphers and modes that can be used by the current database session.

The cipher list for **allbut** can include unique, abbreviated entries. For example, **bf** can represent bf-1, bf-2, and bf-3. However, if the abbreviation is the name of an actual cipher, then only that cipher is eliminated. Therefore, **des** eliminates only the des cipher, but **de** eliminates des, des3, and desx.

Important: The encryption cipher and mode used is randomly chosen among the ciphers common between the two servers. It is strongly recommended that you do not specify specific ciphers. For security reasons, all ciphers should be allowed. If a specific cipher is discovered to have a weakness, then that cipher can be eliminated by using the **allbut** option.

The following ciphers are supported. For an updated list, see the Release Notes.

	des	DES (64-bit key)	bf-1	Blow Fish (64-bit key)
	des3	Triple DES	bf-2	Blow Fish (128-bit key)
	desx	Extended DES (128-bit key)	bf-3	Blow Fish (192-bit key)
3	aes	AES 128bit key	aes128	AES 128bit key
3	aes192	AES 192bit key	aes256	aes 256bit key

The following modes are supported.

ecb	Electronic Code Book (ECB)
cbc	Cipher Block Chaining
cfb	Cipher Feedback
ofb	Output Feedback

All ciphers support all modes, except the **desx** cipher, which only supports the **cbc** mode.

Because **cdb** mode is considered weak, it is only included if specifically requested. It is not included in the **all** or the **allbut** list.

ENCRYPT_MAC Configuration Parameter

default value `medium`

range of values One or more of the following options, separated by commas:

- `off` does not use MAC generation.
- `low` uses XOR folding on all messages.
- `medium` uses SHA1 MAC generation for all messages greater than 20 bytes long and XOR folding on smaller messages.
- `high` uses SHA1 MAC generation on all messages.

For example: `ENCRYPT_MAC medium,high`

9 *takes effect* when the database server is shut down and restarted

The ENCRYPT_MAC configuration parameter controls the level of message authentication code (MAC) generation.

The level is prioritized to the highest value. For example, if one node has a level of **high** and **medium** enabled and the other node has only **low** enabled, then the connection attempt fails. Use the **off** entry between servers only when a secure network connection is guaranteed.

ENCRYPT_MACFILE Configuration Parameter

default value `builtin`

units pathnames, up to 1536 bytes in length

range of values One or more full path and filenames separated by commas, and the optional **builtin** keyword. For example: `ENCRYPT_MACKFILE /usr/local/bin/mac1.dat, /usr/local/bin/mac2.dat,builtin`

9 *takes effect* when the database server is shut down and restarted

The ENCRYPT_MACFILE configuration parameter specifies a list of the full path names of MAC key files.

To specify the built-in key, use the keyword **builtin**. Using the **builtin** option provides limited message verification (some validation of the received message and determination that it appears to have come from a Dynamic Server client or server). The strongest verification is done by a site-generated MAC key file.

To generate a MAC key file:

1. Execute the following command from the command line:

   GenMacKey –o *filename*

   The ***filename*** is the name of the MAC key file.
2. Update the ENCRYPT_MACFILE configuration parameter on all Enterprise Replication servers to include the location of the new MAC key file.
3. Distribute the new MAC key file.

Each of the entries for the ENCRYPT_MACFILE configuration parameter is prioritized and negotiated at connect time. The prioritization for the MAC key files is based on their creation time by the **GenMacKey** utility. The **builtin** option has the lowest priority. Because the MAC key files are negotiated, you should periodically change the keys.

ENCRYPT_SWITCH Configuration Parameter

syntax	`ENCRYPT_SWITCH` *`cipher_switch_time`*`,` *`key_switch_time`* • *cipher_switch_time* specifies the minutes between cipher renegotiation • *key_switch_time* specifies the minutes between secret key renegotiation
default value	`60,60`
units	minutes
range of values	positive integers
takes effect	when the database server is shut down and restarted

9

The ENCRYPT_SWITCH configuration parameter defines the frequency at which ciphers or secret keys are renegotiated. The longer the secret key and encryption cipher remains in use, the more likely the encryption rules might be broken by an attacker. To avoid this, cryptologists recommend changing the secret keys on long-term connections. The default time that this renegotiation occurs is once an hour.

Environment Variables

The following environment variables affect the behavior of Enterprise Replication. For a complete list of environment variables, and how to set them, see the *IBM Informix Guide to SQL: Reference*.

- CDR_ATSRISNAME_DELIM
- CDR_DISABLE_SPOOL
- CDR_LOGDELTA
- CDR_PERFLOG
- CDR_RMSCALEFACT

- CDR_ROUTER
- CDRSITES_731
- CDRSITES_92X

CDR_ATSRISNAME_DELIM Environment Variable

default value	On UNIX: `:`
	On Windows: `.`
range of values	a single character
takes effect	when Enterprise Replication is initialized

The CDR_ATSRISNAME_DELIM environment variable specifies the delimiter to use to separate the parts of the time portion of ATS and RIS filenames. For example, the default filename for an ATS file on UNIX might look like this: **ats.g_beijing.g_amsterdam.D_2.000529_23:27:16.6**. If CDR_ATSRISNAME_DELIM is set to `.` (a period), then the same filename would look like this: **ats.g_beijing.g_amsterdam.D_2.000529_23.27.16.6**.

CDR_DISABLE_SPOOL Environment Variable

default value	`0`
range of values	`0` Allow ATS and RIS file generation
	`1` Prevent ATS and RIS file generation
takes effect	when Enterprise Replication is initialized

The CDR_DISABLE_SPOOL environment variable controls whether ATS and RIS files are generated. Set CDR_DISABLE_SPOOL to 1 if you do not want ATS or RIS files to be generated under any circumstances. For more information on when ATS and RIS files are generated, see "Aborted Transaction Spooling Files" on page 8-3.

CDR_LOGDELTA Environment Variable

default value	`30`
range of values	positive numbers
takes effect	when Enterprise Replication is initialized

The CDR_LOGDELTA environment variable determines when the send and receive queues are spooled to disk as a percentage of the logical log size. Use the CDR_ENV configuration parameter to set this environment variable. For more information, see "CDR_ENV Configuration Parameter" on page B-2.

Important: Do not use the CDR_LOGDELTA environment variable unless instructed to do so by Technical Support.

CDR_PERFLOG Environment Variable

default value	`0`
range of values	positive number
takes effect	when Enterprise Replication is initialized

The CDR_PERFLOG environment variable enables queue tracing, which can be displayed with the **onstat -g que perf** command. Use the CDR_ENV configuration parameter to set this environment variable. For more information, see "CDR_ENV Configuration Parameter" on page B-2.

Important: Do not use the CDR_PERFLOG environment variable unless instructed to do so by Technical Support.

CDR_RMSCALEFACT Environment Variable

default value	4
range of values	positive number
takes effect	when Enterprise Replication is initialized

The CDR_RMSCALEFACT environment variable sets the number of DataSync threads started for each CPU VP. Specifying a large number of threads can result in wasted resources. Use the CDR_ENV configuration parameter to set this environment variable. For more information, see "CDR_ENV Configuration Parameter" on page B-2.

Important: Do not use the CDR_RMSCALEFACT environment variable unless instructed to do so by Technical Support.

CDR_ROUTER Environment Variable

default value	0
range of values	any number
takes effect	when Enterprise Replication is initialized

When set to 1, the CDR_ROUTER environment variable disables intermediate acknowledgements of transactions in hierarchical topologies. The normal behavior for intermediate servers is to send acknowledgements if they receive an acknowledgment from the next server in the replication tree (can be a leaf server) or if the transaction is stored in the local queue. Use the CDR_ENV configuration parameter to set this environment variable. For more information, see "CDR_ENV Configuration Parameter" on page B-2.

If CDR_ROUTER is set at the hub server, an acknowledgement will be sent only if the hub server receives acknowledgement from all of its leaf servers. Transactions will not be acknowledged even if they are stored in the local queue of the hub server.

If CDR_ROUTER is not set at hub server, the hub server will send an acknowledgement if the transaction is stored in the local queue at the hub server or if the hub server received acknowledgement from all of its leaf servers.

Important: Do not use the CDR_ROUTER environment variable unless instructed to do so by Technical Support.

CDRSITES_10X Environment Variable

units	***cdrIDs***, which are the unique identifiers for the database server in the Options field of the SQLHOSTS file (**i** = ***unique_ID***)

range of values	positive numbers
takes effect	when Enterprise Replication is initialized

In mixed-version Enterprise Replication environments that involve Versions 10.00.xC1 or 10.00.xC3 servers, the NIF does not properly report its version when it responds to a new server with a fixpack version of 10.00.xC4 or later. When a new server sends an initial protocol message to a sync server, the sync server, instead of properly giving its version, gives back the version of the new server.

To prevent this malfunction:

If you have Version 10.00.xC1 or 10.00.xC3 servers in your Enterprise Replication environment, set the **CDRSITES_10X** environment variable for these servers.

The ***cdrID*** is the unique identifier for the database server in the Options field of the SQLHOSTS file (**i** = ***unique_ID***).

For example, suppose that you have 5 Informix Dynamic Servers, Version 10.00.xC1, whose ***cdrID*** values range from 2 through 10 (***cdrID*** = 2, 3, 8, 9, and 10).

If you upgrade database server ***cdrID*** 8 to Version 10.00.xC4, you must set the **CDRSITES_10X** environment variable for the other server ***cdrIDs*** before bringing the Version 10.00.xC4 database server online by using the following command:

```
setenv CDRSITES_10x "2,3,9,10"
```

CDRSITES_731 Environment Variable

units	***cdrIDs***, which are the unique identifiers for the database server in the Options field of the SQLHOSTS file (**i** = ***unique_ID***)
range of values	positive numbers
takes effect	when Enterprise Replication is initialized

In mixed-version Enterprise Replication environments that involve post 7.3x/7.20x/7.24x servers, the NIF does not properly report its version when it responds to a new server. When a new server sends an initial protocol message to a sync server, the sync server, instead of properly giving its version, gives back the version of the new server. If a 10.0/9.40/9.30 server tries to synchronize with a 7.3x/7.20x/7.24x server, the older server responds to the 10.0/9.40/9.30 server that it is a 10.0/9.40/9.30 server and will subsequently fail.

To prevent this malfunction:

If you have Version 7.3x/7.20x/7.24x servers in your Enterprise Replication environment, set the CDRSITES_731 environment variable, as appropriate, for 9.30, 9.40, or 10.0 database servers by setting the **CDRSITES_731** ***cdrID*** for these Version 7.x database servers.

The ***cdrID*** is the unique identifier for the database server in the Options field of the SQLHOSTS file (**i** = ***unique_ID***).

For example, suppose that you have 5 Informix Dynamic Servers, Version 7x servers whose ***cdrID*** values range from 1 through 7 (*cdrIDs* = 1, 4, 5, 6, and 7)

If you upgrade database server *cdrID* 6 to Version 10.0/9.40/9.30, you must set the CDRSITES_731 environment variable for the other server **cdrID**s before bringing the Version 10.0/9.40/9.30 database server online:

setenv CDRSITES_731 ″1,4,5,7″

CDRSITES_92X Environment Variable

units	***cdrIDs***, which are the unique identifiers for the database server in the Options field of the SQLHOSTS file (**i =** ***unique_ID***)
range of values	positive numbers
takes effect	when Enterprise Replication is initialized

In mixed-version Enterprise Replication environments that involve 9.21/9.20 servers, the NIF does not properly report its version when it responds to a new server. When a new server sends an initial protocol message to a sync server, the sync server, instead of properly giving its version, gives back the version of the new server. If a 10.0/9.40/9.30 server tries to synchronize with a 9.21/9.20 server, the older server responds to the 10.0/9.40/9.30 server that it is a 10.0/9.40/9.30 server and will subsequently fail.

To prevent this malfunction:

If you have Version 9.21/9.20 servers in your Enterprise Replication environment, set the CDRSITES_92X environment variable, as appropriate, for 9.30, 9.40, or 10.0 database servers by setting the **CDRSITES_92x** ***cdrID*** for these Version 9.20 and 9.21 servers.

The ***cdrID*** is the unique identifier for the database server in the Options field of the SQLHOSTS file (**i =** ***unique_ID***).

For example, suppose that you have 5 Informix Dynamic Servers, Version 9.21/9.20 whose ***cdrID*** values range from 2 through 10 (*cdrIDs* = 2, 3, 8, 9, and 10)

If you upgrade database server *cdrID* 8 to Version 10.0/9.40/9.30, you must set the CDRSITES_92X environment variable for the other server *cdrIDs* before bringing the Version 10.0/9.40/9.30 database server online:

setenv CDRSITES_92x ″2,3,9,10″

Appendix C. onstat Command Reference

This appendix describes forms of the **onstat** command that are relevant to Enterprise Replication. The **onstat** utility reads shared-memory structures and provides statistics about the database server that are accurate at the instant that the command executes. The *system-monitoring interface* (SMI) also provides information about the database server. For general information about **onstat** and SMI, refer to the *IBM Informix Administrator's Reference*. For information specific to Enterprise Replication, see Appendix D, "SMI Table Reference," on page D-1

onstat -g Command Summary

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onstat -g ath	C-1
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onstat -g sync	C-19

The **onstat -g** commands are provided for support and debugging only. You can include only one of these options with each **onstat -g** command. This appendix describes the following **onstat -g** commands:

onstat -g ath

The **onstat -g ath** command prints information about all threads.

The following table summarizes the threads that Enterprise Replication uses. You can use this information about threads when you evaluate memory use. For more information, see the utilities chapter of the *IBM Informix Administrator's Reference*.

Number of Threads	Thread Name	Thread Description
1	ddr_snoopy	Performs physical I/O from logical log, verifies potential replication, and sends applicable log-record entries to Enterprise Replication
1	preDDR	Runs during queue recovery to monitor the log and sets blockout mode if the log position advances too far before replication resumes
1	CDRGfan	Receives log entries and passes entries to evaluator thread

Number of Threads	Thread Name	Thread Description
n	CDRGeval*n*	Evaluates log entry to determine if it should be replicated (*n* is the number of evaluator threads specified by CDR_EVALTHREADS) This thread also performs transaction compression on the receipt of COMMIT WORK and queues completed replication messages.
1 per large transaction	CDRPager	Performs the physical IO for the temporary smart large object that holds paged transaction records Grouper paging is activated for a transaction when its size is 10 percent of the value of SHMVIRTSIZE or CDR_QUEUEMEM or when it includes more than 100,000 records.
1	CDRCparse	Parses all SQL statements for replicate definitions
1 per connection	CDRNsT*n*CDRNsA*n*	Sending thread for site
1 per connection	CDRNr*n*	Receiving thread for site
2...*n*	CDRACK_*n*	Accepts acknowledgments from site At least 2, up to a maximum of the number of active connections
# CPUs...	CDRD_*n*	Replays transaction on the target system (DataSync thread) At least one thread is created for each CPU virtual processor (VP). The maximum number of threads is 4*(number of CPU VPs).
1	CDRSchedMgr	Schedules internal Enterprise Replication events
0 or 1	CDRM_Monitor	Monitors and adjusts DataSync performance for optimum performance (on the target)
0 or 1	CDRDTCleaner	Deletes (cleans) rows from the deleted rows shadow table when they are no longer needed

onstat -g cat

The **onstat -g cat** command prints information from the Enterprise Replication global catalog. The global catalog contains a summary of information about the defined servers, replicates, and replicate sets on each of the servers within the enterprise. If a replicated table is undergoing an alter operation, the **onstat -g cat** command shows that it is in alter mode. For example, use this command to determine:

- How many servers and how many replicates are configured
- Which table matches a given replicate
- Whether a server is a root or leaf server
- The current bitmap mask for a given server. You can use the bitmap mask with the output from the **onstat -g rqm** command to determine which server Enterprise Replication is waiting on for an acknowledgement.

The **onstat -g cat** command has the following formats:

```
onstat -g cat
onstat -g cat scope
onstat -g cat replname
```

The following table describes *replname* and *scope*.

Modifier	Description
replname	The name of a replicate
scope	One of the following values: **servers**—Print information on servers only **repls**—Print information on replicates only **full**—Print expanded information for both replicate servers and replicates

This sample output from the **onstat -g cat repls** command shows that the table **tab** is in alter mode. The replicate **rep1** is defined on this table, its replicate ID is 6553601.

```
IBM Informix Dynamic Server Version 10.00.UC1
-- On-Line -- Up 00:01:39 -- 28672 Kbytes
GLOBAL-CATALOG CACHE STATISTICS
REPLICATES
-------------------
Parsed statements:
    Id 6553601 table tab
    Id 6553602 table tab12
Inuse databases: test(2)
  Name: rep1, Id: 6553601 State: ACTIVE Flags: 0x800000 ALTERMODE
          use 0 lastexec Wed Dec 31 18:00:00 1969
    Local Participant: test:nagaraju.tab
    Attributes: TXN scope, Enable ATS, Enable RIS, all columns
          sent in updates
    Conflict resolution: [TIMESTAMP]
    Column Mapping: ON, columns INORDER, offset 8, uncomp_len 12
    Column Name Verifcation: ON
    No Replicated UDT Columns
  Name: rep12, Id: 6553602 State: ACTIVE Flags: 0x800000 use 0
          lastexec Wed Dec 31 18:00:00 1969
    Local Participant: test:nagaraju.tab12
    Attributes: TXN scope, Enable ATS, Enable RIS, all columns
          sent in updates
    Conflict resolution: [TIMESTAMP]
    Column Mapping: ON, columns INORDER, offset 8, uncomp_len 2064
    Column Name Verifcation: ON
    No Replicated UDT Columns
```

onstat -g ddr

The **onstat -g ddr** command prints the status of the Enterprise Replication database log reader. The **ddr**, or **ddr_snoopy**, is an internal component of Enterprise Replication that reads the log buffers and passes information to the grouper.

You can use the information from the **onstat -g ddr** command to monitor *replay position* in the log file and ensure replay position is never overwritten (which can cause loss of data). The replay position is the point from where, if a system failure occurs, Enterprise Replication starts re-reading the log information into the log update buffers. All the transactions generated before this position at all the target servers have been applied by Enterprise Replication or safely stored in stable queue space.

The **onstat -g ddr** output shows you a snapshot of the replay position, the *snoopy position*, and the *current position*. The snoopy position identifies the position of the

ddr_snoopy thread in the logical logs. The **ddr_snoopy** has read the log records up until this point. The current position is the position where the server has written its last logical log record.

The *log needs* position is based on replay position and is set at a certain distance from replay position, for example, at seventy percent of the log file. The remainder of the circular log file comprises the DDR BLOCK zone. As messages are acknowledged or stored in the stable queue, the replay position, and hence also the log needs position, should advance. If you notice that replay position is not advancing, this can mean that the stable queue is full or a remote server is down.

If log reading is blocked, data might not be replicated until the problem is resolved. If the block is not resolved, the database server might overwrite the read (**ddr_snoopy**) position, which means that data will not be replicated. If this occurs, you must manually resynchronize the source and target databases.

If you are running servers prior to Version 9.3, to avoid these problems, IBM recommends that you:

- Have 24 hours of online log space available
- Keep the log file size consistent. Instead of having a single large log file, implement several smaller ones.
- Avoid switching logical logs more than once per hour.
- Keep some distance between LTXHWM (long-transaction high-watermark) and LTXEHWM (long-transaction, exclusive-access, high-watermark).

For servers of Version 9.4, and later, you can enable dynamic log creation by setting the CDR_MAX_DYNAMIC_LOGS configuration parameter in the ONCONFIG file. If the current position reaches the log needs position, instead of going into a blocked state, Enterprise Replication automatically adds another log file. If this option is set, the **onstat -g ddr** command prints the number of dynamic log requests made.

The following sample output from the **onstat ddr** command shows the replay position, snoopy position, and current position highlighted.

```
DDR -- Running

# Event  Snoopy   Snoopy    Replay   Replay    Current  Current
Buffers  ID       Position  ID       Position  ID       Position

528      24       165018    24       6a018     24       166000

Log Pages Snooped:      From      From      Tossed
                        Cache     Disk      (LBC full)

                        247       111        0

Total dynamic log requests: 0

DDR events queue

Type   TX id    Partnum  Row id
```

onstat -g dss

The **onstat -g dss** command prints detailed statistical information about the activity of individual data sync threads. The data sync thread applies the transaction on the target server. Statistics include the number of applied transactions and failures and when the last transaction from a source was applied.

The **onstat -g dss** command has the following formats:

```
onstat -g dss
onstat -g dss modifier
```

The following table describes the values for *modifier*.

Modifier	Action
UDR	Prints summary information about any UDR invocations by the data sync threads.
UDRx	Prints expanded information (including a summary of error information) about any UDR invocations by the data sync threads. The `Procid` column lists the UDR procedure ID.

In the following example, only one data sync thread is currently processing the replicated data. It has applied a total of one replicated transaction and the transaction was applied at 2004/09/13 18:13:10. The Processed Time field shows the time when the last transaction was processed by this data sync thread.

```
IBM Informix Dynamic Server Version 10.00.UC1   -- On-Line
-- Up 00:00:28 -- 28672 Kbytes
DS thread statistic
cmtTime      Tx       Tx        Tx       Last Tx
Name         < local  Committed Aborted  Processed  Processed Time
------------ -------  --------- -------  ---------  -----------------

CDRD_1       0        1         0        1          (1095117190) 2004/09/13
18:13:10
            Tables (0.0%):

            Databases: test

CDR_DSLOCKWAIT = 1

CDR_DSCLOSEINTERVAL = 60
```

onstat -g dtc

The **onstat -g dtc** command prints statistics about the delete table cleaner. The delete table cleaner removes rows from the delete table when they are no longer needed.

The **-g dtc** option is used primarily as a debugging tool and by Technical Support.

In the following example, the thread name of the delete table cleaner is **CDRDTCleaner**. The total number of rows deleted is **1**. The last activity on this thread occurred at 2004/09/13 18:47:19. The delete table for replicate **rep1** was last cleaned at 2004/09/13 18:28:25.

```
IBM Informix Dynamic Server Version 10.00.UC1   -- On-Line
-- Up 00:59:15 -- 28672 Kbytes

-- Delete Table Cleanup Status as of (1095119368) 2004/09/13 18:49:28

      thread           = 49 <CDRDTCleaner>

      rows deleted     = 1

      lock timeouts    = 0

      cleanup interval = 300

      list size        = 3

      last activity    = (1095119239) 2004/09/13 18:47:19

Id      Database                        Last Cleanup Time

        Replicate           Server              Last Log Change

=========================================================
000001  test                          (1095118105) 2004/09/13
  18:28:25
        rep1                g_bombay           (1095118105) 2004
        /09/13 18:28:25
        rep1                g_delhi            (1095118105) 2004
        /09/13 18:28:25
000002  test                          <never cleaned>
```

onstat -g grp

The **onstat -g grp** command prints statistics about the grouper. The grouper evaluates the log records, rebuilds the individual log records into the original transaction, packages the transaction, and queues the transaction for transmission.

The **-g grp** option is used primarily as a debugging tool and by Technical Support.

The **onstat -g grp** command has the following formats:

```
onstat -g grp
onstat -g grp modifier
```

The following table describes the values for *modifier*.

Modifier	Action
A	Prints all the information printed by the G, T, P, E, R, and S modifiers
E	Prints grouper evaluator statistics
Ex	Prints grouper evaluator statistics, expands user-defined routine (UDR) environments
G	Prints grouper general statistics
L	Prints grouper global list
Lx	Prints grouper global list, expands open transactions
M	Prints grouper compression statistics
Mz	Clears grouper compression statistics
P	Prints grouper table partition statistics
pager	Prints grouper paging statistics
R	Prints grouper replicate statistics
S	Prints grouper serial list head (The serial list head is the first transaction in the list, that is, the next transaction that will be placed in the send queue.)
Sl	Prints grouper serial list (The serial list is the list of transactions, in chronological order.)
Sx	Prints grouper serial list, expands open transactions
T	Prints grouper transaction statistics
UDR	Prints summary information about any UDR invocations by the grouper threads
UDRx	Prints expanded information (including a summary of error information) about any UDR invocations by the grouper threads The `Procid` column lists the UDR procedure ID.

The rest of this section contains sample output from various **onstat -g grp** *modifier* commands. The following sample shows output for the **onstat -g grp** command.

```
IBM Informix Dynamic Server Version 10.00.UC1   -- On-Line
-- Up 01:47:07 -- 28672 Kbytes
```

```
Grouper at 0xb014018:
Last Idle Time: (1095122236) 2004/09/13 19:37:16
RSAM interface ring buffer size: 528
RSAM interface ring buffer pending entries: 0
Eval thread interface ring buffer size: 48
Eval thread interface ring buffer pending entries: 0
Log update buffers in use: 0
Max log update buffers used at once: 5
Log update buffer memory in use: 0
Max log update buffer memory used at once: 320
Updates from Log: 16
Log update links allocated: 512
Blob links allocated: 0
Conflict Resolution Blocks Allocated: 0
Memory pool cache: Empty
Last Tx to Queuer began : (1095118105) 2004/09/13 18:28:25
Last Tx to Queuer ended : (1095118105) 2004/09/13 18:28:25
Last Tx to Queuer log ID, position: 12,23
Open   Tx: 0
Serial Tx: 0
Tx not sent: 0
Tx sent to Queuer: 2
Tx returned from Queuer: 2
Events sent to Queuer: 7
Events returned from Queuer: 7
Total rows sent to Queuer: 2
Open Tx array size: 1024
Table 'tab' at 0xae8ebb0 [ CDRShadow ]
Table 'tab12' at 0xae445e0 [ CDRShadow ]
Grouper Table Partitions:
  Slot  312...
    'tab' 1048888
  Slot  770...
    'tab12' 3145730
  Slot 1026...
    'tab12' 4194306
Repl links on global free list: 2
Evaluators: 3
  Evaluator at 0xb03d030 ID 0 [Idle:Idle] Protection:unused
    Eval iteration: 1264
    Updates evaluated: 0
    Repl links on local free list: 256
    UDR environment table at 0xb03d080
        Number of environments:          0
        Table memory limit    :      25165
        Table memory used     :          0
        SAPI memory limit     :     131072
        SAPI memory used      :          0
        Count failed UDR calls:          0
  Evaluator at 0xb03d0d8 ID 1 [Idle:Idle] Protection:unused
    Eval iteration: 1265
    Updates evaluated: 2
    Repl links on local free list: 254
    UDR environment table at 0xb03d128
        Number of environments:          0
        Table memory limit    :      25165
        Table memory used     :          0
        SAPI memory limit     :     131072
        SAPI memory used      :          0
        Count failed UDR calls:          0
  Evaluator at 0xb03d180 ID 2 [Idle:Idle] Protection:unused
    Eval iteration: 1266
    Updates evaluated: 4
    Repl links on local free list: 256
    UDR environment table at 0xb03d1d0
        Number of environments:          0
        Table memory limit    :      25165
        Table memory used     :          0
        SAPI memory limit     :     131072
        SAPI memory used      :          0
        Count failed UDR calls:          0
Total Free Repl links 768
Replication Group 6553601 at 0xb0a8360
  Replication at 0xb0a82b0 6553601:6553601 (tab)
    [ NotifyDS FullRowOn ]
    Column Information [ CDRShadow VarUDTs InOrder Same ]
      CDR Shadow: offset 0, size 8
      In Order: offset 8, size 10
Replication Group 6553602 at 0xb0a8480
  Replication at 0xb0a83d0 6553602:6553602 (tab12)
    [ Ignore Stopped NotifyDS FullRowOn ]
    Column Information [ CDRShadow VarUDTs InOrder Same ]
      CDR Shadow: offset 0, size 8
      In Order: offset 8, size 16
```

The following example shows output for the **onstat -g grp E** command. The field **Evaluators: 4** indicates that there are four evaluation threads configured for the system.

```
IBM Informix Dynamic Server Version 10.00.UC1 -- On-Line
-- Up 02:07:10 -- 36864 Kbytes
Repl links on global free list: 0
Evaluators: 4
  Evaluator at 0xba71840 ID 0 [Idle:Idle] Protection: unused
    Eval iteration: 1007
    Updates evaluated: 0
    Repl links on local free list: 256
    UDR environment table at 0xba71890
        Number of environments:          0
        Table memory limit    :      16777
        Table memory used     :          0
        SAPI memory limit     :     131072
        SAPI memory used      :          0
        Count failed UDR calls:          0
  Evaluator at 0xba718f0 ID 1 [Idle:Idle] Protection: unused
    Eval iteration: 1007
    Updates evaluated: 0
    Repl links on local free list: 256
    UDR environment table at 0xba71940
        Number of environments:          0
        Table memory limit    :      16777
        Table memory used     :          0
        SAPI memory limit     :     131072
        SAPI memory used      :          0
        Count failed UDR calls:          0
  Evaluator at 0xba8c260 ID 2 [Idle:Idle] Protection: unused
    Eval iteration: 1007
    Updates evaluated: 0
    Repl links on local free list: 256
    UDR environment table at 0xba8c2b0
        Number of environments:          0
        Table memory limit    :      16777
        Table memory used     :          0
        SAPI memory limit     :     131072
        SAPI memory used      :          0
        Count failed UDR calls:          0
  Evaluator at 0xbaac2a0 ID 3 [Idle:Idle] Protection: unused
    Eval iteration: 1007
    Updates evaluated: 0
    Repl links on local free list: 256
    UDR environment table at 0xbaac2f0
        Number of environments:          0
        Table memory limit    :      16777
        Table memory used     :          0
        SAPI memory limit     :     131072
        SAPI memory used      :          0
        Count failed UDR calls:          0
Total Free Repl links 1024
```

The following example shows output for the **onstat -g grp G** command.

```
IBM Informix Dynamic Server Version 10.00.UC1     -- On-Line
-- Up 02:08:56 -- 36864 Kbytes
Grouper at 0xb8ab020:
Last Idle Time: (1095115397) 2004/09/13 17:43:17
RSAM interface ring buffer size: 1040
RSAM interface ring buffer pending entries: 0
Eval thread interface ring buffer size: 64
Eval thread interface ring buffer pending entries: 0
```

```
Log update buffers in use: 0

Max log update buffers used at once: 1

Log update buffer memory in use: 0

Max log update buffer memory used at once: 64

Updates from Log: 1

Log update links allocated: 512

Blob links allocated: 0

Conflict Resolution Blocks Allocated: 0

Memory pool cache: Empty
```

The following example shows output for the **onstat -g grp P** command. In the following example, the grouper is evaluating rows for the **account**, **teller** and **customer** tables.

```
IBM Informix Dynamic Server Version 10.00.UC1     -- On-Line
-- Up 02:11:39 -- 36864 Kbytes

Table 'teller' at 0xb851480 [ CDRShadow VarChars ]

Table 'account' at 0xb7faad8 [CDRShadow VarChars VarUDTs Floats
       Blobs]

Table 'customer' at 0xbbe67a8 [CDRShadow VarChars VarUDTs]

Grouper Table Partitions:

  Slot  387...

    'account' 1048707

  Slot  389...

    'teller' 1048709

  Slot  394...

    'customer' 1048714
```

The following example shows output for the **onstat -g grp pager** command. The sample output shows the grouper large transaction evaluation statistics.

```
IBM Informix Dynamic Server Version 10.00.UC1   -- On-Line
-- Up 00:20:42 -- 28672 Kbytes

Grouper Pager statistics:

Number of active big transactions: 0

Total number of big transactions processed: 0

Spool size of the biggest transaction processed: 0 Bytes
```

The following example shows output for the **onstat -g grp R** command. In this example, the grouper is configured to evaluate rows for replicates with IDs **6553601** and **6553602** (you can use the **onstat -g cat repls** command to obtain the replicate names). The **Ignore** attribute of replicate ID **6553602** shows that the grouper is currently not evaluating rows for this replicate. This can happen if the replicate state is not ACTIVE. You can obtain the replicate state using the **onstat -g cat repls** command.

```
IBM Informix Dynamic Server Version 10.00.UC1   -- On-Line
-- Up 00:04:47 -- 28672 Kbytes

Replication Group 6553601 at 0xb0a8360

  Replication at 0xb0a82b0 6553601:6553601 (tab) [ NotifyDS
      FullRowOn ]

    Column Information [ CDRShadow VarUDTs InOrder Same ]

      CDR Shadow: offset 0, size 8

      In Order: offset 8, size 10

Replication Group 6553602 at 0xb0a8480
```

```
  Replication at 0xb0a83d0 6553602:6553602 (tab12) [ Ignore
      Stopped NotifyDS FullRowOn ]
    Column Information [ CDRShadow VarUDTs InOrder Same ]
      CDR Shadow: offset 0, size 8
      In Order: offset 8, size 16
```

The following example shows output for the **onstat -g grp T** command. In this example, the grouper evaluated and queued 1 transaction to the send queue. The **Tx sent to Queuer** field shows the total number of transactions evaluated and queued to the send queue for propagating to all the replicate participants. The **Total rows sent to Queuer** field shows the total number of rows queued to the send queue for propagating to all the replicate participants.

```
IBM Informix Dynamic Server Version 10.00.UC1 -- On-Line
-- Up 00:14:51 -- 28672 Kbytes
Last Tx to Queuer began : (1095116676) 2004/09/13 18:04:36
Last Tx to Queuer ended : (1095116676) 2004/09/13 18:04:36
Last Tx to Queuer log ID, position: 5,3236032
Open   Tx: 0
Serial Tx: 0
Tx not sent: 0
Tx sent to Queuer: 1
Tx returned from Queuer: 0
Events sent to Queuer: 0
Events returned from Queuer: 0
Total rows sent to Queuer: 1
Open Tx array size: 1024
```

onstat -g nif

The **onstat -g nif** command prints statistics about the network interface. The output shows which sites are connected and provides a summary of the number of bytes sent and received by each site. This can help you determine that a site is in a hung state, if it is not sending or receiving bytes.

The **-g nif** option is used primarily as a debugging tool and by Technical Support.

The **onstat -g nif** command has the following formats:

```
onstat -g nif
onstat -g nif modifier
```

The following table describes the values for *modifier*.

Modifier	Action
all	Prints the sum and the sites
sites	Prints the NIF site context blocks
serverid	Prints information about the replication server whose groupID is serverID
sum	Prints the sum of the number of buffers sent and received for each site

The following example shows output for the **onstat -g nif** command. In this example, the local server is connected to the server group **g_bombay** and its CDR ID is **200**. The connection status is set to running. The server group **g_bombay** NIF version is **7**. The local server has sent three messages to the server g_bombay and it has received two messages from g_bombay.

```
IBM Informix Dynamic Server Version 10.00.UC1     -- On-Line
-- Up 00:02:34 -- 28672 Kbytes

NIF anchor Block: af01610

       nifGState         RUN

          RetryTimeout   300

CDR connections:

 Id    Name       State    Version    Sent   Received

 -----------------------------------------------------

 200 g_bombay      RUN        7         3        2
```

onstat -g que

The **onstat -g que** command prints statistics that are common to all queues. The queuer manages the logical aspects of the queue. The RQM (reliable queue manager) manages the physical queue.

The **-g que** option is used primarily as a debugging tool and by Technical Support.

In the following example, **Element high water mark** shows the maximum size of the transaction buffer header data (metadata) allowed in memory, shown in kilobytes. **Data high water mark** shows the maximum size of transactions for user data allowed in memory, shown in kilobytes.

```
IBM Informix Dynamic Server Version 10.00.UC1   -- On-Line
-- Up 00:40:28 -- 28672 Kbytes

CDR Queuer Statistics:

  Queuer state           : 2

  Local server           : 100

  Element high water mark : 131072

  Data high water mark    : 131072

  # of times txns split   : 0

  Total # of split txns   : 0

  allowed log delta       : 30

  maximum delta detected  : 4

  Control Key            : 0/00000007

  Synchronization Key    : 0/00000003

Replay Table:

  Replay Posn (Disk value): 12/00000018 (12/00000018)

  Replay save interval    : 10

  Replay updates          : 10

  Replay # saves          : 17

  Replay last save time   : (1095118157) 2004/09/13 18:29:17

Send Handles

  Server ID              : 200

  Send state,count       : 0,0

  RQM hdl for trg_send:  Traverse handle (0xaf8e018) for
    thread CDRACK_0 at Head_of_Q,  Flags: None

  RQM hdl for control_send:  Traverse handle (0xaf74018)
    for thread CDRACK_0 at Head_of_Q,  Flags: None

  RQM hdl for sync_send:  Traverse handle (0xadc6018) for
    thread CDRACK_0 at Head_of_Q,  Flags: None
```

```
Server ID             : 200
Send state,count      : 0,0
RQM hdl for trg_send:  Traverse handle (0xac8b018) for
  thread CDRACK_1 at Head_of_Q,  Flags: None
RQM hdl for control_send:  Traverse handle (0xb1ce018)
  for thread CDRACK_1 at Head_of_Q,  Flags: None
RQM hdl for sync_send:  Traverse handle (0xadc5018) for
  thread CDRACK_1 at Head_of_Q,  Flags: None
Server ID             : 200
Send state,count      : 0,0
RQM hdl for trg_send:  Traverse handle (0xaea71d8) for
  thread CDRNsA200 at Head_of_Q,  Flags: None
RQM hdl for ack_send:  Traverse handle (0xae8c1d8) for
  thread CDRNsA200 at Head_of_Q,  Flags: None
RQM hdl for control_send:  Traverse handle (0xae9e1d8)
  for thread CDRNsA200 at Head_of_Q,  Flags: None
```

onstat -g rcv

The **onstat -g rcv** command prints statistics about the receive manager. The receive manager is a set of service routines between the receive queues and data sync.

The **onstat -g rcv** command has the following formats:

```
onstat -g rcv
onstat -g rcv serverid
onstat -g rcv full
```

The *serverID* modifier causes the command to print only those output messages received from the replication server whose groupID is *serverid*. The *full* modifier causes the command to print all statistics.

The **onstat -g rcv** command includes the Receive Manager global section. In this section, the following fields have the meanings shown:

Field	Description
cdrRM_DSParallelPL	Shows the current level of Apply Parallelism, 0 (zero) being the highest
cdrRM_DSNumLockTimeout cdrRM_DSNumLockRB cdrRM_DSNumDeadLocks	Indicate the number of collisions between various apply threads
cdrRM_acksinList	Shows acknowledgements that have been received but not yet processed

The **onstat -g rcv** command includes the Receive Parallelism Statistics section, a summary of the data sync threads by source server.

Field	Description
Server	Source server ID
Tot.Txn.	Total number of transactions applied from this source server
Pending	Number of current transactions in the pending list for this source server
Active	Number of current transactions currently being applied from this source server
MaxPnd	Maximum number of transactions in the pending list queue
MaxAct	Maximum number of transaction in the active list queue
AvgPnd	Average depth of the pending list queue
AvgAct	Average depth of the active list queue
CommitRt	Commit rate of transaction from this source server based on transactions per second

The Statistics by Source section of the **onstat -g rcv** command shows the following information for each source server. For each replicate ID:

- The number of transactions applied from the source servers
- The number of inserts, deletes, and updates within the applied transactions
- The timestamp of the most recently applied transaction on the target server
- The timestamp of the commit on the source server for the most recently applied transaction

The **-g rcv** option is used primarily as a debugging tool and by Technical Support. If you suspect that acknowledgement messages are not being applied, you can use this option to check.

The following example shows output for the **onstat -g rcv full** command.

```
Receive Manager global  block 0D452018
    cdrRM_inst_ct:                5
    cdrRM_State:            00000000
    cdrRM_numSleepers:      3
    cdrRM_DsCreated:        3
    cdrRM_MinDSThreads:     1
    cdrRM_MaxDSThreads:     4
    cdrRM_DSBlock           0
    cdrRM_DSParallelPL      0
    cdrRM_DSFailRate        0.000000
    cdrRM_DSNumRun:         35
    cdrRM_DSNumLockTimeout  0
    cdrRM_DSNumLockRB       0
    cdrRM_DSNumDeadLocks    0
    cdrRM_DSNumPCommits     0
    cdrRM_ACKwaiting        0
    cdrRM_totSleep:         77
    cdrRM_Sleeptime:        153
    cdrRM_Workload:         0
    cdrRM_optscale:         4
    cdrRM_MinFloatThreads:  2
    cdrRM_MaxFloatThreads:    7
    cdrRM_AckThreadCount:     2
    cdrRM_AckWaiters:         2
    cdrRM_AckCreateStamp:Wed Sep 08 11:47:49 2004
    cdrRM_DSCreateStamp: Wed Sep 08 14:16:35 2004
    cdrRM_acksInList:         0
    cdrRM_BlobErrorBufs:      0
Receive Parallelism Statistics
Srvr Tot.Txn. Pnding Active MaxPnd MaxAct AvgPnd AvgAct CommitRt
   1     35        0      0     21      3   7.00   1.63    0.00
   5      3        0      0      1      1   1.00   1.00    0.02
   6      6        0      0      1      1   1.00   1.00    0.21
Tot Pending:0 Tot Active:0 Avg Pending:5.77 Avg Active:1.50
Commit Rate:0.01
Time Spent In RM Parallel Pipeline Levels
Lev. TimeInSec  Pcnt.
   0     17405 100.00%
   1         0   0.00%
   2         0   0.00%
Statistics by Source
Server 1
Repl  Txn Ins Del Upd Last Target Apply   Last Source Commit
65541  23   0   1 616 2004/09/08 14:20:15 2004/09/08 14:20:15
65542  11   0   0 253 2004/09/08 14:19:33 2004/09/08 14:19:33
65545   1   0  67   0 2004/09/08 14:20:37 2004/09/08 14:20:37
Server 5
Repl  Txn Ins Del Upd Last Target Apply   Last Source Commit
65541   3   0   0  81 2004/09/08 16:36:10 2004/09/08 16:36:09
Server 6
Repl  Txn Ins Del Upd Last Target Apply   Last Source Commit
65548   6   0   0  42 2004/09/08 16:37:59 2004/09/08 16:37:58
```

4 onstat -g rep

4 The **onstat -g rep** command prints events that are in the queue for the schedule
4 manager. The **-g rep** option is used primarily as a debugging tool and by Technical
4 Support.

4 The **onstat -g rep** command has the following formats:

```
4 onstat -g rep
4 onstat -g rep replname
```

4 The *repl_name* modifier limits the output to those events originated by the replicate
4 named *repl_name*.

4 The following example shows sample output for the **onstat -g rep** command:

```
4 IBM Informix Dynamic Server Version 10.00.UC1   -- On-Line
4 -- Up 00:30:10 -- 28672 Kbytes
4 Schedule manager Cb: add7e18 State: 0x8100 <CDRINIT,CDRRUNNING>
4 Event        Thread             When
4 ============================================
CDRDS         CDREvent      00:00:20
```

onstat -g rqm

The **onstat -g rqm** command prints statistics and contents of the low-level queues (send queue, receive queue, ack send queue, sync send queue, and control send queue) managed by the Reliable Queue Manager (RQM). The RQM manages the insertion and removal of items to and from the various queues. The RQM also manages spooling of the in-memory portions of the queue to and from disk. The **-g rqm** option displays the contents of the queue, size of the transactions in the queue, how much of the queue is in memory and on disk, the location of various handles to the queue, and the contents of the various progress tables. You can choose to print information for all queues or for just one queue by using one of the modifiers described below.

If a queue is empty, no information is printed for that queue.

The **onstat -g rqm** command has the following formats:

```
onstat -g rqm
onstat -g rqm modifier
```

The following table describes the values for *modifier*.

Modifier	Action
ACKQ	Prints the ack send queue
CNTRLQ	Prints the control send queue
RECVQ	Prints the receive queue
SENDQ	Prints the send queue
SYNCQ	Prints the sync send queue
FULL	Prints full information about every in-memory transaction for every queue
BRIEF	Prints a brief summary of the number of transactions in each of the queues and the replication servers for which the data is queued Use this modifier to quickly identify sites where a problem exists. If large amounts of data are queued for a single server, then that server is probably down or off the network.
VERBOSE	Prints all the buffer headers in memory
SBSPACES	Prints detailed statistical information about the sbspaces configured for CDR_QDATA_SBSPACE

When you specify a modifier to select a specific queue, the command prints all the statistics for that queue and information about the first and last in-memory transactions for that queue.

The other modifiers of the **onstat -g rqm** command are used primarily as a debugging tool and by Technical Support.

The output for the SENDQ modifier contains the following sections:

- RQM Statistics for Queue—a summary of current and historical information for the queue. This includes the number of transactions in the queue, how many are spooled, how many bytes they are using, some maximum statistics, and the high water marks that will trigger stably storing transactions in the **syscdr** tables.
- First Txn—information about the first transaction in the queue. To check if the queue is draining, you can run **onstat -g rqm** several times and see if the first

transaction's RQM key is changing. The RQM key has the following format: *Server_ID/Commit_unique_logID/Commit_log_position/Sequence*. If it is not draining, the target server may be offline or some other problem is occurring. The NeedAck field shows from which server the transaction is waiting for an acknowledgement. You can use this bitmap mask with the output from the **onstat -g cat** command to determine the name of the server which server Enterprise Replication is waiting on for an acknowledgement.

- Last Txn—information about the last transaction in the queue
- Traverse handle—lists the handles used for threads
- Progress table—provides information about the progress of each replicate under the headers: Server, Group, Bytes Queued, Acked, and Sent. The Group field shows the replicate ID. The Acked field shows what has been acknowledged. The Sent field shows which entries are now in transit. Both the Acked and the Sent field show the RQM key, which has the following format: *Server_ID/Commit_unique_logID/Commit_log_position/Sequence*.

The following example shows output for the **onstat -g rqm SENDQ** command.

```
RQM Statistics for Queue (0x0D3DF018) trg_send
 Transaction Spool Name: trg_send_stxn
 Insert Stamp: 35/0
 Flags: SEND_Q, SPOOLED, PROGRESS_TABLE, NEED_ACK
 Txns in queue:             35
 Log Events in queue:       0
 Txns in memory:            35
 Txns in spool only:        0
 Txns spooled:              0
 Unspooled bytes:           176206
 Size of Data in queue:     176206 Bytes
 Real memory in use:        176206 Bytes
 Pending Txn Buffers:       0
 Pending Txn Data:          0 Bytes
 Max Real memory data used: 176206 (2457600) Bytes
 Max Real memory hdrs used  65988 (2457600) Bytes
 Total data queued:         176206 Bytes
 Total Txns queued:         35
 Total Txns spooled:        0
 Total Txns restored:       0
 Total Txns recovered:      0
 Spool Rows read:           0
 Total Txns deleted:        0
 Total Txns duplicated:     0
 Total Txn Lookups:         363
First Txn (0x0D60C018) Key:  1/9/0x000d4bb0/0x00000000
 Txn Stamp: 1/0, Reference Count: 0.
 Txn Flags: Notify
 Txn Commit Time: (1094670993) 2004/09/08 14:16:33
 Txn Size in Queue: 5908
 First Buf's (0x0D31C9E8) Queue Flags: Resident
 First Buf's Buffer Flags: TRG, Stream
 NeedAck: Waiting for Acks from <[0004]>
```

```
4                     No open handles on txn.
4                     Last Txn (0x0D93A098) Key:  1/9/0x00138ad8/0x00000000
4                     Txn Stamp: 35/0, Reference Count: 0.
4                     Txn Flags: Notify
4                     Txn Commit Time: (1094671237) 2004/09/08 14:20:37
4                     Txn Size in Queue: 6298
4                     First Buf's (0x0D92FFA0) Queue Flags: Resident
4                     First Buf's Buffer Flags: TRG, Stream
4                     NeedAck: Waiting for Acks from <[0004]>
4                     Traverse handle (0x0D045018) for thread CDRNsA3 at txn
4                        (0x0D93A098) End_of_Q,Flags: None
4                     Traverse handle (0x0D08E018) for thread CDRNsA4 at txn
4                        (0x0D93A098) End_of_Q,Flags: None
4                     Traverse handle (0x0D523018) for thread CDRNsA5 at txn
4                        (0x0D93A098) End_of_Q,Flags: None
4                     Traverse handle (0x0D0D9018) for thread CDRNsA6 at txn
4                        (0x0D93A098) End_of_Q,Flags: None
4                     Traverse handle (0x0D4041D8) for thread CDRNsA2 at Head_of_Q,
4                        Flags: None
4                     Traverse handle (0x0D3F01D8) for thread CDRNrA2 at
4                        Head_of_Q,  Flags: None
4                     Traverse handle (0x0D045018) for thread CDRNsA3 at
4                        txn (0x0D93A098) End_of_Q,Flags: None
4                     Traverse handle (0x0D31C018) for thread CDRNrA3 at
4                        Head_of_Q,  Flags: None
4                     Traverse handle (0x0D08E018) for thread CDRNsA4 at
4                        txn (0x0D93A098) End_of_Q,Flags: None
4                     Traverse handle (0x0D4C8018) for thread CDRNrA4 at
4                        Head_of_Q,  Flags: None
4                     Traverse handle (0x0D523018) for thread CDRNsA5 at
4                        txn (0x0D93A098) End_of_Q,Flags: None
4                     Traverse handle (0x0D57F018) for thread CDRNrA5 at
4                        Head_of_Q,  Flags: None
4                     Traverse handle (0x0D0D9018) for thread CDRNsA6 at
4                        txn (0x0D93A098) End_of_Q,Flags: None
4                    Server    Group Bytes Queued      Acked    Sent
4                    ----------------------------------------------------------
4                        6  0x10009          0 1/9/138ad8/0   -    1/9/138ad8/0
4                        5  0x10009          0 1/9/138ad8/0   -    1/9/138ad8/0
4                        4  0x10009          0 1/9/138ad8/0   -    1/9/138ad8/0
4                        3  0x10009          0 1/9/138ad8/0   -    1/9/138ad8/0
4                        2  0x10009       4154 efffffff/efffffff/efffffff/efffffff
4                    - 1//138ad8/0
4                        6  0x10006          0 1/9/12d8f8/0   -    1//12d8f8/0
4                        5  0x10006          0 1/9/12d8f8/0   -    1//12d8f8/0
4                        4  0x10006          0 1/9/12d8f8/0   -    1/9/12d8f8/0
4                        3  0x10006          0 1/9/12d8f8/0   -    1/9/12d8f8/0
4                        2  0x10006       31625 efffffff/efffffff/efffffff/efffffff
4                    – 1/9/12d8f8/0
```

onstat -g sync

The **onstat -g sync** command shows which sync is active.

The following example shows output for the **onstat -g sync** command.

```
IBM Informix Dynamic Server Version 10.00.U --On-Line-- Up 00:10:16 -- 44084 Kbytes
Prim   Sync   St.  Shadow Flag Stat Block  EndBlk
Repl   Source      Repl             Num    Num

655361 20     0    1310729 2    0    592    600
```

Output Description:

Prim Repl
: Replicate number of the replicate being synchronized

Sync Source
: Source server of the sync

St
: Sync replicate state

Shadow Repl
: The shadow replicate used to perform the sync

Flag
: Internal flags:
- 0x02 = external sync
- 0x04 = shutdown request has been issued
- 0x08 = abort has occurred
- 0x010 = a replicate stop has been requested
- 0X020 = shadow or primary replicate has been deleted

Stat
: Resync job state

Block num
: Last block applied on targets (on source always 0)

EndBlock Num
: Last block in resync process. Marks the end of the sync scan on the target. A value of’ -2 indicates that the scan is still in progress, and the highest block number is not yet known.

Additional fields for forwarded rows:

ServID
: Server where forwarded row originated

fwdLog ID
: Originator's log ID of the forwarded row

fwdLog POS
: Originator's log position of the forwarded row

endLog ID
: Operation switches back to normal at this point

endLog POS
: Operation switches back to normal at this log position

complete flag
: Set to 1 after normal processing resumes for the originating source

onstat -k

The **onstat -k** command displays information about active locks.

The following example shows output from the **onstat -k** command:

```
Locks
address  wtlist   owner    lklist   type     tblsnum  rowid    key#/bsiz
a095f78  0        a4d9e68  0        HDR+S    100002   203         0
```

In the following output, the number 2 in the last row shows an Enterprise Replication pseudo lock:

```
Locks
address  wtlist    owner    lklist   type    tblsnum  rowid    key#/bsiz
a197ff8  0         5c2db4a8 0           S    100002   204              0
a198050  0         5c2db4a8 a197ff8     S    100002   205              0
a198260  0         5c2f2248 0           S    100002   204              0
a198470  0         5c2e6b78 a198520     S    100002   205              0
a198520  0         5c2e6b78 0           S    100002   204              0
a1986d8  0         5c2ec6e0 a198ba8     S    100002   205              0
a198ba8  0         5c2ec6e0 0           S    100002   204              0
a1993e8  0         5c2f03d0 a19be30     S         2   1c05a            0
```

You can interpret output from this option as follows:

address	Is the address of the lock in the lock table If a user thread is waiting for this lock, the address of the lock appears in the **wait** field of the **onstat -u** (users) output.
wtlist	Is the first entry in the list of user threads that is waiting for the lock, if there is one
owner	Is the shared-memory address of the thread that is holding the lock This address corresponds to the address in the **address** field of **onstat -u** (users) output.
lklist	Is the next lock in a linked list of locks held by the owner just listed
type	Uses the following codes to indicate the type of lock:

HDR	Header
B	Bytes
S	Shared
X	Exclusive
I	Intent
U	Update
IX	Intent-exclusive
IS	Intent-shared
SIX	Shared, intent-exclusive

tblsnum	Is the tblspace number of the locked resource. If the number is less than 10000, it indicates Enterprise Replication pseudo locks.
rowid	Is the row identification number The rowid provides the following lock information: • If the rowid equals zero, the lock is a table lock.

- If the rowid ends in two zeros, the lock is a page lock.
- If the rowid is six digits or fewer and does not end in zero, the lock is probably a row lock.
- If the rowid is more than six digits, the lock is probably an index key-value lock.

key#/bsiz	Is the index key number, or the number of bytes locked for a VARCHAR lock If this field contains 'K-' followed by a value, it is a key lock. The value identifies which index is being locked. For example, K-1 indicates a lock on the first index defined for the table.

The maximum number of locks available is specified as LOCKS in the **ONCONFIG** file.

Appendix D. SMI Table Reference

The system-monitoring interface (SMI) tables in the **sysmaster** database provide information about the state of the database server. Enterprise Replication uses the SMI tables listed in SMI Table Summary to access information about database servers declared to Enterprise Replication.

9 Ten new SMI tables are available with version 10.00.xC9. To create these new SMI tables in the **sysmaster** database, run the following script as user **informix** when the server is online:

```
9 $INFORMIXDIR/etc/buildcdrsmi
```

9 To revert to the older server version after creating these new SMI tables, run the following script to drop the tables prior to reversion:

```
9 $INFORMIXDIR/etc/dropcdrmi
```

SMI Table Summary

Table	Description
"The syscdr_ats Table" on page D-2	First ten lines of the transaction headers in the ATS files
"The syscdr_atsdir Table" on page D-3	ATS file names
"The syscdr_ddr Table" on page D-3	Status of log capture and the proximity of DDRBLOCK
"The syscdr_nif Table" on page D-4	Status of network connections
"The syscdr_rcv Table" on page D-5	Information about transactions being applied
"The syscdr_ris Table" on page D-6	First ten lines of the transaction headers in the RIS files
"The syscdr_risdir Table" on page D-7	RIS file names
"The syscdr_rqm Table" on page D-7	Statistics and contents of the low-level queues
"The syscdr_rqmhandle Table" on page D-8	Information about transactions being processed in each queue
"The syscdr_rqmstamp Table" on page D-9	Information about transactions being added to each queue
"The syscdr_state Table" on page D-9	State of Enterprise Replication
"The syscdrack_buf Table" on page D-9	Buffers for the acknowledge queue
"The syscdrack_txn Table" on page D-10	Transactions in the acknowledge queue
"The syscdrctrl_buf Table" on page D-10	Buffers for the control queue
"The syscdrctrl_txn Table" on page D-10	Transactions in the control queue

Table	Description
"The syscdrerror Table" on page D-10	Enterprise Replication error information
"The syscdrlatency Table" on page D-10	Statistics about Enterprise Replication latency
"The syscdrpart Table" on page D-11	Participant information
"The syscdrprog Table" on page D-11	Contents of the Enterprise Replication progress tables
"The syscdrq Table" on page D-12	Queued data information (brief)
"The syscdrqueued Table" on page D-12	Queued data information (detailed)
"The syscdrrecv_buf Table" on page D-12	Buffers in the receive queue
"The syscdrrecv_stats Table" on page D-13	Statistics about the receive manager
"The syscdrrecv_txn Table" on page D-13	Transactions in the receive queue
"The syscdrrepl Table" on page D-13	Replicate information
"The syscdrreplset Table" on page D-14	Replicate set information
"The syscdrs Table" on page D-15	Server information
"The syscdrsend_buf Table" on page D-16	Buffers in the send queue
"The syscdrsend_txn Table" on page D-16	Transactions in the send queue
"The syscdrserver Table" on page D-16	Database server information
"The syscdrsync_buf Table" on page D-17	Buffers in the synchronization queue
"The syscdrsync_txn Table" on page D-17	Transactions in the synchronization queue
"The syscdrtx Table" on page D-17	Transaction information

SMI Tables for Enterprise Replication

The following sections describe the individual tables of the **sysmaster** database that refer to Enterprise Replication.

9 The syscdr_ats Table

9 The **syscdr_ats** table contains the first ten lines of the transaction header for each
9 ATS file.

Column	Type	Description
ats_ris	integer	Pseudo row ID

Column	Type	Description
ats_file	char(128)	ATS file name
ats_sourceid	integer	CDRID of source server
ats_source	char(128)	Source server name
ats_committime	char(20)	Time when the transaction was committed on the source server
ats_targetid	integer	CDRID of the target server
ats_target	char(128)	Target server name
ats_receivetime	char(20)	Time when the transaction was received on the target server
ats_risfile	char(128)	Corresponding RIS file name
ats_line1	char(200)	10 lines of the transaction header information
ats_line2	char(200)	
ats_line3	char(200)	
ats_line4	char(200)	
ats_line5	char(200)	
ats_line6	char(200)	
ats_line7	char(200)	
ats_line8	char(200)	
ats_line9	char(200)	
l**ats_line10**	char(200)	

The syscdr_atsdir Table

The **syscdr_atsdir** table contains information about the contents of the ATS directory.

Column	Type	Description
atsd_rid	integer	Pseudo row ID
atsd_file	char(128)	ATS file name
atsd_mode	integer	File mode
atsd_size	integer	File size in bytes
atsd_atime	datetime	Last access time
atsd_mtime	datetime	Last modified time
atsd_ctime	datetime	Create time

The syscdr_ddr Table

The **syscdr_ddr** table contains information about the status of log capture and the proximity or status of transaction blocking (DDRBLOCK) or transaction spooling.

Column	Type	Description
ddr_state	char(24)	The current state of log capture: • Running = Log capture is running normally • Down = Log capture is not running • Uninitialized = The server is not a source server for replication
ddr_snoopy_loguniq	integer	The current log ID at which transactions are being captured for replication
ddr_snoopy_logpos	integer	The current log position at which transactions are being captured for replication
ddr_replay_loguniq	integer	The current log ID at which transactions have been applied
ddr_replay_logpos	integer	The current log position at which transactions have been applied. This is the position from which the log would need to be replayed to recover Enterprise Replication if Enterprise Replication or the database server shut down.
ddr_curr_loguniq	integer	The current log ID
ddr_curr_logpos	integer	The current log position
ddr_logsnoop_cached	integer	The number of log pages that log capture read from its cache
ddr_logsnoop_disk	integer	The number of times that log capture had to read log pages from disk
ddr_log_tossed	integer	The number of log pages that could not be stored in the cache because the log capture buffer cache was full
ddr_logs_ignored	integer	The number of log records that were ignored because they were extensible log records unknown to Enterprise Replication
ddr_dlog_requests	integer	The number of times that a dynamic log was requested to be created to prevent DDRBLOCK state
ddr_total_logspace	integer	The total number of log pages in the replication system
ddr_logspage2wrap	integer	The number of log spaces until log capture runs into a log wrap
ddr_logspage2block	integer	The number of log pages until log capture runs into a DDRBLOCK state
ddr_logneeds	integer	The number of log pages necessary to prevent a log wrap to avoid a DDRBLOCK state
ddr_logcatchup	integer	The number of log pages necessary to process before going out of a DDRBLOCK state

The syscdr_nif Table

The **syscdr_nif** table contains information about network connections and the flow of data between Enterprise Replication servers.

Column	Type	Description
nif_connid	integer	The CDRID of the peer node
nif_connname	char(24)	The name (group name) of the peer node
nif_state	char(24)	The status of the Enterprise Replication network: • Running = Communication is running normally • Down = Communication is not running • Uninitialized = The server is not a source server for replication

Column	Type	Description
nif_connstate	char(24)	The connection state: • Connected = The connection is active • Disconnected = The connection was explicitly disconnected • Timeout = The connection attempt has timed out, but will be reattempted • Logic Error = The connection disconnected due to an error during message transmission • Start Error = The connection disconnected due to an error while starting a thread to receive remote messages • Admin Close = Enterprise Replication was stopped by user by issuing the **cdr stop** command • Connecting = The connection is being established • Never Connected = The servers have never had an active connection
nif_version	integer	The network protocol of this connection used to convert the message formats between dissimilar releases of the server, for example, IDS 7 and IDS 9
nif_msgsent	integer	Number of messages sent to the peer server
nif_bytessent	integer	Number of bytes sent to the peer server
nif_msgrcv	integer	Number of messages received from the peer server
nif_bytesrcv	integer	Number of bytes received from the peer server
nif_compress	integer	Compression level for communications • -1 = no compression • 0 = compress only if the target server expects compression • 1 - 9 = increasing levels of compression
nif_sentblockcnt	integer	Number of times a flow block request was sent to the peer server
nif_rcvblockcnt	integer	Number of times a flow block request was received from the peer server
nif_trgsend_stamp1	integer	Stamp 1 of the last transaction sent to the peer server
nif_trgsend_stamp2	integer	Stamp 2 of the last transaction sent to the peer server
nif_acksend_stamp1	integer	Stamp 1 of the last acknowledgement sent to the peer server
nif_acksend_stamp2	integer	Stamp 2 of last acknowledgement sent to the peer server
nif_ctrlsend_stamp1	integer	Stamp 1 of the last control message sent to the peer server
nif_ctrlsend_stamp2	integer	Stamp 2 of the last control message sent to the peer server
nif_syncsend_stamp1	integer	Stamp 1 of the last sync message sent to the peer server
nif_syncsend_stamp2	integer	Stamp 2 of the last sync message sent to the peer server
nif_starttime	datetime	Time that the connection was established
nif_lastsend	datetime	Time of the last message sent to the peer server

The syscdr_rcv Table

The **syscdr_rcv** table contains information about transactions being applied on target servers and acknowledgements being sent from target servers.

Column	Type	Description
rm_state	char(100)	The status of the receive manager and apply threads: • Running = Transaction apply is running normally • Down = Transaction apply is not running • Uninitialized = The server is not a source server for replication
rm_num_sleepers	integer	Number of Data Sync threads currently suspended
rm__num_dsthreads	integer	Current number of Data Sync threads
rm_min_dsthreads	integer	Minimum number of Data Sync threads
rm_max_dsthreads	integer	Maximum number of Data Sync threads
rm_ds_block	integer	If 1, the Data sync is currently blocked to try to avoid causing a DDRBLOCK state
rm_ds_parallel	integer	The degree to which transactions are applied in parallel (0 through 3, inclusive): • `0` = the highest degree of parallelism • `3` = serial apply (no parallelism)
rm_ds_failrate	float	A computed weighted ratio that is used to determine when to change the degree of apply parallelism based on the rate of transactions that could not be applied
rm_ds_numrun	integer	Number of transactions run
rm_ds_lockout	integer	Number of lock timeouts encountered
rm_ds_lockrb	integer	Number of forced rollbacks due to having to switch to serial apply
rm_ds_num_deadlocks	integer	Number of deadlocks encountered
rm_ds_num_pcommits	integer	Number of out-of-order commits that have occurred
rm_ack_waiting	integer	Number of acknowledgements that are waiting for a log flush to return to the source server
rm_tosleep	integer	Total times that the data sync threads have become suspended
rm_sleeptime	integer	Total time that the data sync threads have been suspended
rm_workload	integer	Current workload
rm_optscale	integer	Factor determining how many Data Sync threads will be allowed per CPU VP
rm_min_fthreads	integer	Minimum float threads (acknowledgement threads)
rm_max_fthreads	integer	Maximum float threads (acknowledgement threads)
rm_ack_start	char(64)	Time when the acknowledgement threads started
rm_ds_start	char(64)	Time when the Data sync threads started
rm_pending_acks	integer	Number of acknowledgements on the source that have not yet been processed
rm_blob_error_bufs	integer	Number of smart large objects that could not be successfully applied

The syscdr_ris Table

The **syscdr_ris** table contains the first ten lines of the transaction header for each RIS file.

Column	Type	Description
ris_rid	integer	Pseudo row ID

Column	Type	Description
ris_file	char(128)	RIS file name
ris_sourceid	integer	CDRID of source server
ris_source	char(128)	Source server name
ris_committime	char(20)	Time when the transaction was committed on the source server
ris_targetid	char(128)	CDRID of the target server
ris_target	integer	Target server name
ris_receivetime	char(20)	Time when the transaction was received on the target server
ris_atsfile	char(128)	Corresponding ATS file
ris_line1	char(200)	10 lines of the transaction header information
ats_line2	char(200)	
ats_line3	char(200)	
ats_line4	char(200)	
ris_line5	char(200)	
ris_line6	char(200)	
ris_line7	char(200)	
ris_line8	char(200)	
ris_line9	char(200)	
ris_line10	char(200)	

The syscdr_risdir Table

The **syscdr_risdir** table contains information about the contents of the RIS directory.

Column	Type	Description
risd_rid	integer	Pseudo row ID
risd_file	char(128)	RIS file name
risd_mode	integer	File mode
risd_size	integer	File size in bytes
risd_atime	datetime	Last access time
risd_mtime	datetime	Last modified time
risd_ctime	datetime	Create time

The syscdr_rqm Table

The **syscdr_rqm** table contains statistics and contents of the low-level queues (send queue, receive queue, ack send queue, sync send queue, and control send queue) managed by the Reliable Queue Manager (RQM). The RQM manages the insertion and removal of items to and from the various queues. The RQM also manages spooling of the in-memory portions of the queue to and from disk.

Column	Type	Description
rqm_idx	integer	Index number
rqm_name	char(128)	Queue name
rqm_flags	integer	Flags
rqm_txn	integer	Transactions in queue
rqm_event	integer	Events in queue
rqm_txn_in_memory	integer	Transaction in memory
rqm_txn_in_spool_only	integer	Spool-only transactions
rqm_txn_spooled	integer	Spooled transactions
rqm_unspooled_bytes	int8	Unspooled bytes
rqm_data_in_queue	int8	Data in queue
rqm_inuse_mem	int8	Real memory in use
rqm_pending_buffer	integer	Pending buffers
rqm_pending_data	int8	Pending bytes of data
rqm_maxmemdata	int8	Maximum memory in use by data
rqm_maxmemhdr	int8	Maximum memory in use by headers
rqm_totqueued	int8	Total data queued
rqm_tottxn	integer	Total transactions queued
rqm_totspooled	integer	Total transactions spooled
rqm_totrestored	integer	Total transactions stored
rqm_totrecovered	integer	Total transactions recovered
rqm_totspoolread	integer	Total rows read from spool
rqm_totdeleted	integer	Total transactions deleted
rqm_totduplicated	integer	Total transactions duplicates
rqm_totlookup	integer	Total transaction lookups

9 The syscdr_rqmhandle Table

9 The **syscdr_rqmhandle** table contains information about which transaction is being
9 processed in each queue. The handle marks the position of the thread in the queue.

Column	Type	Description
rqmh_qidx	integer	The queue associated with this handle
rqmh_thread	char(18)	Thread owning the handle
rqmh_stamp1	integer	Stamp 1 of the last transaction this handle accessed
rqmh_stamp2	integer	Stamp 2 of the last transaction this handle accessed
rqmh_servid	integer	Part 1 of the transaction key
rqmh_logid	integer	Part 2 of the transaction key
rqmh_logpos	integer	Part 3 of the transaction key
rqmh_seq	integer	Part 4 of the transaction key

The syscdr_rqmstamp Table

The **syscdr_rqmstamp** table contains information about which transaction is being added to each queue.

Column	Type	Description
rqms_qidx	integer	Queue index corresponding to the queues: • `0` = Transaction Send Queue • `1` = Acknowledgement Send Queue • `2` = Control Send Queue • `3` = CDR Metadata Sync Send Queue • `4` = Transaction Receive Queue
rqms_stamp1	integer	Stamp 1 of the next transaction being put into the queue
rqms_stamp2	integer	Stamp 2 of the next transaction being put into the queue
rqms_cstamp1	integer	Communal stamp 1 used to identify the next transaction read from the receive queue
rqms_cstamp2	integer	Communal stamp 2 used to identify the next transaction read from the receive queue

The syscdr_state Table

The **syscdr_state** table contains status on Enterprise Replication, data capture, data apply, and the network between the servers.

Column	Type	Description
er_state	char(24)	The status of Enterprise Replication: • Active = Enterprise Replication is running normally • Shut Down = Enterprise Replication is stopped • Uninitialized = The server does not have Enterprise Replication defined on it
er_capture_state	char(24)	The current state of log capture: • Running = Log capture is running normally • Down = Log capture is not running • Uninitialized = The server is not a source server for replication
er_network_state	char(64)	The status of the Enterprise Replication network: • Running = Communication is running normally • Down = Communication is not running • Uninitialized = The server is not a source server for replication
er_apply_state	char(24)	The status of the receive manager and apply threads: • Running = Transaction apply is running normally • Down = Transaction apply is not running • Uninitialized = The server is not a source server for replication

The syscdrack_buf Table

The **syscdrack_buf** table contains information about the buffers that form the acknowledgment queue. When the target database server applies transactions, it sends an acknowledgment to the source database server. When the source database server receives the acknowledgment, it can then delete those transactions from its send queue.

For information on the columns of the **syscdrack_buf** table, refer to “Columns of the Buffer Tables” on page D-18.

The syscdrack_txn Table

The **syscdrack_txn** table contains information about the acknowledgment queue. When the target database server applies transactions, it sends an acknowledgment to the source database server. When the source database server receives the acknowledgment, it can then delete those transactions from its send queue.

The acknowledgment queue is an in-memory only queue. That is, it is a volatile queue that is lost if the database server is stopped.

For information on the columns of the **syscdrack_txn** table, refer to “Columns of the Transaction Tables” on page D-18.

The syscdrctrl_buf Table

The **syscdrctrl_buf** table contains buffers that provide information about the control queue. The control queue is a stable queue that contains control messages for the replication system.

For information on the columns of the **syscdrctrl_buf** table, refer to “Columns of the Buffer Tables” on page D-18.

The syscdrctrl_txn Table

The **syscdrctrl_txn** table contains information about the control queue. The control queue is a stable queue that contains control messages for the replication system.

For information on the columns of the **syscdrctrl_txn** table, refer to “Columns of the Transaction Tables” on page D-18.

The syscdrerror Table

The **syscdrerror** table contains information about errors that Enterprise Replication has encountered.

Column	Type	Description
errornum	integer	Error number
errorserv	char(128)	Database server name where error occurred
errorseqnum	integer	Sequence number that can be used to prune single-error table
errortime	datetime year to second	Time error occurred
sendserv	char(128)	Database server name, if applicable, that initiated error behavior
reviewed	char(1)	• `Y` if reviewed and set by DBA • `N` if not reviewed
errorstmnt	text	Error description

The syscdrlatency Table

The **syscdrlatency** table contains statistics about Enterprise Replication latency (the time it takes to replicate transactions).

Column	Type	Description
source	integer	Source of transaction (**cdrid**)
replid	integer	Replicate ID
txncnt	integer	The number of transactions on this source replicate
inserts	integer	Number of INSERT statements
deletes	integer	Number of DELETE statements
updates	integer	Number of UPDATE statements
last_tgt_apply	integer	The time of the last transaction to be applied to the target (**cdrtime**)
last_src_apply	integer	The time of the last transaction to be applied on the source (**cdrtime**)

The syscdrpart Table

The **syscdrspart** table contains participant information.

Column	Type	Description
replname	lvarchar	Replicate name
servername	char(128)	Database server name
partstate	char(50)	Participant state: ACTIVE, INACTIVE
partmode	char(1)	• `P` = primary database server (read-write) • `R` = target database server (receive only)
dbsname	lvarchar	Database name
owner	lvarchar	Owner name
tabname	lvarchar	Table name

The syscdrprog Table

The **syscdrprog** table lists the contents of the Enterprise Replication progress tables. The progress tables keep track of what data has been sent to which servers and which servers have acknowledged receipt of what data. Enterprise Replication uses the transaction keys and stamps to keep track of this information.

The progress table is two dimensional. For each server to which Enterprise Replication sends data, the progress tables keep progress information on a per-replicate basis.

Column	Type	Description
dest_id	integer	Server ID of the destination server
repl_id	integer	The ID that Enterprise Replication uses to identify the replicate for which this information is valid
source_id	integer	Server ID of the server from which the data originated
key_acked_srv	integer	Last key for this replicate that was acknowledged by this destination
key_acked_lgid	integer	Logical log ID
key_acked_lgpos	integer	Logical log position
key_acked_seq	integer	Logical log sequence
tx_stamp_1	integer	Together with tx_stamp2, forms the stamp of the last transaction acknowledged for this replicate by this destination
tx_stamp_2	integer	Together with tx_stamp1, forms the stamp of the last transaction acknowledged for this replicate by this destination

The syscdrq Table

The **syscdrq** table contains information about Enterprise Replication queues.

Column	Type	Description
srvid	integer	The identifier number of the database server
repid	integer	The identifier number of the replicate
srcid	integer	The server ID of the source database server In cases where a particular server is forwarding data to another server, *srvid* is the target and *srcid* is the source that originated the transaction.
srvname	char(128)	The name of the database server
replname	char(128)	Replicate name
srcname	char(128)	The name of the source database server
bytesqueued	integer	Number of bytes queued

The syscdrqueued Table

The **syscdrqueued** table contains data-queued information.

Column	Type	Description
servername	char(128)	Sending to database server name
name	char(128)	Replicate name
bytesqueued	decimal(32,0)	Number of bytes queued for the server servername

The syscdrrecv_buf Table

The **syscdrrecv_buf** table contains buffers that provide information about the data-receive queue. When a replication server receives replicated data from a source database server, it puts this data on the receive queue for processing. On the target side, Enterprise Replication picks up transactions from this queue and applies them on the target.

For information on the columns of the **syscdrrecv_buf** table, refer to “Columns of the Buffer Tables” on page D-18.

The syscdrrecv_stats Table

The **syscdrrecv_stats** table contains statistics about the receive manager. The receive manager is a set of service routines between the receive queues and Datasync.

Column	Type	Description
source	integer	The source server (**cdrid**)
txncnt	integer	Number of transactions from this source
pending	integer	The transaction currently pending on this source
active	integer	The transaction currently active on this source
maxpending	integer	Maximum pending transactions on this source
maxactive	integer	Maximum active transactions on this source
avg_pending	float	Average pending transactions on this source
avg_active	float	Average active transactions on this source
cmtrate	float	Average commit rate from this source

The syscdrrecv_txn Table

The **syscdrrecv_txn** table contains information about the data receive queue. The receive queue is an in-memory queue.

When a replication server receives replicated data from a source database server, it puts this data on the receive queue, picks up transactions from this queue, and applies them on the target.

For information on the columns of the **syscdrrecv_txn** table, refer to “Columns of the Transaction Tables” on page D-18.

The syscdrrepl Table

The **syscdrrepl** table contains replicate information.

Column	Type	Description
replname	lvarchar	Replicate name
replstate	char(50)	Replicate state For possible values, refer to "The STATE Column" on page A-55.
freqtype	char(1)	Type of replication frequency: • C = continuous • I = interval • T = time based • M = day of month • W = day of week
freqmin	smallint	• Minute (after the hour) refresh should occur • Null if continuous
freqhour	smallint	• Hour refresh should occur • Null if continuous
freqday	smallint	Day of week or month refresh should occur
scope	char(1)	Replication scope: • T = transaction • R = row-by-row
invokerowspool	char(1)	• Y = row spooling is invoked • N = no row spooling is invoked
invoke transpool	char(1)	• Y = transaction spooling is invoked • N = no transaction spooling is invoked
primresolution	char(1)	Type of primary conflict resolution: • I = ignore • T = time stamp • S = SPL routine
secresolution	char(1)	Type of secondary conflict resolution: • S = SPL routine • Null = not configured
storedprocname	lvarchar	• Name of SPL routine for secondary conflict resolution • Null if not defined.
floattype	char(1)	• C= converts floating point numbers to canonical format • I= converts floating point numbers to IEEE format • N = does not convert floating point numbers (sends in native format)
istriggerfire	char(1)	• Y = triggers are invoked • N = triggers are not invoked
isfullrow	char(1)	• Y = sends the full row and enables upserts • N = sends only changed columns and disables upserts.

The syscdrreplset Table

The **syscdrreplset** table contains replicate set information.

Column	Type	Description
replname	lvarchar	Replicate name
replsetname	lvarchar	Replicate set name

The syscdrs Table

The **syscdrs** table contains information about database servers that have been declared to Enterprise Replication.

Column	Type	Description
servid	integer	Server identifier
servname	char(128)	Database server name
cnnstate	char(1)	Status of connection to this database server: • `C` = Connected • `D` = Connection disconnected (will be retried) • `T` = Idle time-out caused connection to terminate • `X` = Connection closed by user command. Connection unavailable until reset by user.
cnnstatechg	integer	Time that connection state was last changed
servstate	char(1)	Status of database server: • `A` = Active • `S` = Suspended • `Q` = Quiescent (initial sync state only)
ishub	char(1)	A hub is any replication server that forwards information to another replication server. • `Y` = Server is a hub • `N` = Server is not a hub
isleaf	char(1)	• `Y` = Server is a leaf server • `N` = Server is not a leaf server
rootserverid	integer	The identifier of the root server
forwardnodeid	integer	The identifier of the parent server
timeout	integer	Idle timeout

Although not directly connected, a nonroot server is similar to a root server except it forwards all replicated messages through its parent (root) server. All nonroot servers are known to all root servers and other nonroot servers. A nonroot server can be a terminal point in a tree or it can be the parent for another nonroot server or a leaf server. Nonroot and root servers are aware of all replication servers in the replication environment, including all the leaf servers.

A leaf server is a nonroot server that has a partial catalog. A leaf server has knowledge only of itself and its parent server. It does not contain information about replicates of which it is not a participant. The leaf server must be a terminal point in a replication hierarchy.

The syscdrsend_buf Table

The **syscdrsend_buf** table contains buffers that give information about the send queue. When a user performs transactions on the source database server, Enterprise Replication queues the data on the send queue for delivery to the target servers.

For information on the columns of the **syscdrsend_buf** table, refer to "Columns of the Buffer Tables" on page D-18.

The syscdrsend_txn Table

The **syscdrsend_txn** table contains information about the send queue. When a user performs transactions on the source database server, Enterprise Replication queues the data on the send queue for delivery to the target servers.

For information on the columns of the **syscdrsync_txn** table, refer to "Columns of the Transaction Tables" on page D-18.

The syscdrserver Table

The **syscdrserver** table contains information about database servers declared to Enterprise Replication.

Column	Type	Description
servid	integer	Replication server ID
servername	char(128)	Database server group name
connstate	char(1)	Status of connection to this database server: • C = Connected • D = Connection disconnected (will be retried) • T = Idle time-out caused connection to terminate • X = Connection closed by user command. Connection unavailable until reset by user.
connstatechange	integer	Time that connection state was last changed
servstate	char(50)	Status of database server: • A = Active • S = Suspended • Q = Quiescent (initial sync state only)
ishub	char(1)	• Y = Server is a hub • N = Server is not a hub
isleaf	char(1)	• Y = Server is a leaf server • N = Server connection is not a leaf server
rootserverid	integer	The identifier of the root server
forwardnodeid	integer	The identifier of the parent server
idletimeout	integer	Idle time-out
atsdir	lvarchar	ATS directory spooling name
risdir	lvarchar	RIS directory spooling name

The syscdrsync_buf Table

The **syscdrsync_buf** table contains buffers that give information about the synchronization queue. Enterprise Replication uses this queue only when defining a replication server and synchronizing its global catalog with another replication server.

For information on the columns of the **syscdrsync_buf** table, refer to “Columns of the Buffer Tables” on page D-18.

The syscdrsync_txn Table

The **syscdrsync_txn** table contains information about the synchronization queue. This queue is currently used only when defining a replication server and synchronizing its global catalog with another replication server. The synchronization queue is an in-memory-only queue.

For information on the columns of the **syscdrsync_txn** table, refer to “Columns of the Transaction Tables” on page D-18.

The syscdrtx Table

The **syscdrtx** table contains information about Enterprise Replication transactions.

Column	Type	Description
srvid	integer	Server ID
srvname	char(128)	Name of database server from which data is received
txprocssd	integer	Transaction processed from database server *srvname*
txcmmtd	integer	Transaction committed from database server *srvname*
txabrtd	integer	Transaction aborted from database server *srvname*
rowscmmtd	integer	Rows committed from database server *srvname*
rowsabrtd	integer	Rows aborted from database server *srvname*
txbadcnt	integer	Number of transactions with source commit time (on database server *srvname*) greater than target commit time

Enterprise Replication Queues

One group of **sysmaster** tables shows information about Enterprise Replication queues. The **sysmaster** database reports the status of these queues in the tables that have the suffixes **_buf** and **_txn**.

The name of each table that describes an Enterprise Replication queue is composed of the following three pieces:

- **syscdr**, which indicates that the table describes Enterprise Replication
- An abbreviation that indicates which queue the table describes
- A suffix, either **_buf** or **_txn**, which specifies whether the table includes buffers or transactions

Selecting from these tables provides information about the contents of each queue. For example, the following SELECT statement returns a list of all transactions queued on the send queue:

```
SELECT * FROM syscdrsend_txn
```

The following example returns a list of all transactions queued on the in-memory send queue and returns the number of buffers and the size of each buffer for each transaction on the send queue:

```
SELECT cbkeyserverid,cbkeyid,cbkeypos,count(*),sum(cbsize)
   from syscdrsend_buf
   group by cbkeyserverid, cbkeyid, cbkeypos
   order by cbkeyserverid, cbkeyid, cbkeypos
```

All queues are present on all the replication servers, regardless of whether the replication server is a source or a target for a particular transaction. Some of the queues are always empty. For instance, the send queue on a target-only server is always empty.

Each queue is two-dimensional. Every queue has a list of transaction headers. Each transaction header in turn has a list of buffers that belong to that transaction.

Columns of the Transaction Tables

All the tables whose names end with **_txn** have the same columns and the same column definitions. The information in the tables represents *only* transactions in memory and not those spooled to disk.

The **ctstamp1** and **ctstamp2** columns combine to form the primary key for these tables.

Column	Type	Description
ctkeyserverid	integer	Server ID of the database server where this data originated This server ID is the group ID from the sqlhosts file or the SQLHOSTS registry key.
ctkeyid	integer	Logical log ID
ctkeypos	integer	Position in the logical log on the source server for the transaction represented by the buffer
ctkeysequence	integer	Sequence number for the buffer within the transaction
ctstamp1	integer	Together with **ctstamp2**, forms an insertion stamp that specifies the order of the transaction in the queue
ctstamp2	integer	Together with **ctstamp1**, forms an insertion stamp that specifies the order of the transaction in the queue
ctcommittime	integer	Time when the transaction represented by this buffer was committed
ctuserid	integer	Login ID of the user who committed this transaction
ctfromid	integer	Server ID of the server that sent this transaction Used only in hierarchical replication

Columns of the Buffer Tables

The tables whose names end with **_buf** give information about the buffers that form the transactions listed in the **_txn** table. All the **_buf** tables have the same columns and the same column definitions.

Column	Type	Description
cbflags	integer	Internal flags for this buffer
cbsize	integer	Size of this buffer in bytes
cbkeyserverid	integer	Server ID of the database server where this data originated This server ID is group ID from the sqlhosts file or the SQLHOSTS registry key.
cbkeyid	integer	Login ID of the user who originated the transaction represented by this buffer
cbkeypos	integer	Log position on the source server for the transaction represented by this buffer
cbkeysequence	integer	Sequence number for this buffer within the transaction
cbreplid	integer	Replicate identifier for the data in this buffer
cbcommittime	integer	Time when the transaction represented by this buffer was committed

The following columns combine to form the primary key for this table: **cbkeyserverid**, **cbkeyid**, **cbkeypos**, **cbkeysequence**.

The columns **cbkeyserverid**, **cbkeyid**, and **cbkeypos** form a foreign key that points to the transaction in the **_txn** table that the buffer represents.

Appendix E. Replication Examples

This appendix contains simple examples of replication using the command-line utility (CLU). Appendix A, "Command-Line Utility Reference," on page A-1 documents the CLU.

Replication Example Environment

To run the replication examples in this chapter, you need three Informix database servers. Each database server must be in a database server group.

This example uses the following environment:

- Three computers (**s1**, **s2**, and **s3**) are hosts for the database servers **usa**, **italy**, and **japan**, respectively. Each computer has active network connections to the other two computers.
- The database servers **usa**, **italy**, and **japan** are members of the database server groups **g_usa**, **g_italy**, and **g_japan**, respectively.

For information about database server groups, see "Setting up Database Server Groups" on page 4-3.

UNIX Only

The UNIX **sqlhosts** file for each database server contains the following connectivity information.

g_usa	group	-	-	i=1
usa	ontlitcp	s1	techpubs1	g=g_usa
g_italy	group	-	-	i=8
italy	ontlitcp	s2	techpubs2	g=g_italy
g_japan	group	-	-	i=6
japan	ontlitcp	s3	techpub6	g=g_usa

End of UNIX Only

Windows Only

See Appendix F, "SQLHOSTS Registry Key (Windows)," on page F-1 for information on how to prepare the SQLHOSTS connectivity information using the information shown in the above UNIX **sqlhosts** file.

End of Windows Only

The ONCONFIG file contains the following CDR_QDATA_SBSPACE entry:

```
CDR_QDATA_SBSPACE sbspace #CDR queue smart blob space
```

You must create an sbspace for the row data and set the CDR_QDATA_SBSPACE parameter to the location of that sbspace. For more information, see "Setting Up Send and Receive Queue Spool Areas" on page 4-8 and "CDR_QDATA_SBSPACE Configuration Parameter" on page B-5.

All commands in this example, except for creation of the sample databases on **italy** and **japan**, are issued from the computer **s1**.

The databases for the examples in this chapter are identical **stores_demo** databases with logging, as follows:

- Create a database named **stores** on the **usa** database server:
  ```
  s1> dbaccessdemo -log stores
  ```
- Create a database named **stores** on the **italy** database server:
  ```
  s1> rlogin s2
  s2> dbaccessdemo -log stores
  ```
- Create a database named **stores** on the **japan** database server:
  ```
  s1> rlogin s3
  s2> dbaccessdemo -log stores
  ```

For information on preparing data for replication, see "Data Preparation Example" on page 4-19.

Primary-Target Example

This section contains a simple example of *primary-target* replication. In primary-target replication, only changes to the primary table are replicated to the other tables in the replicate. Changes to the secondary tables are not replicated.

Preparing for a Primary-Target Replication

In this example, define the **g_usa** and **g_italy** database server groups as Enterprise Replication servers and create a replicate, **repl1**.

To define the database server groups and create the replicate:

1. Create and populate the database that defines the **usa** database server as a replication server:
   ```
   cdr define server --init g_usa
   ```
   Before replicating data, you must define the database servers as *replication servers*. A replication server is a database server that has an extra database that holds replication information.

   The **--init** option specifies that this server is a new replication server. When you define a replication server, you *must* use the name of the database server group (**g_usa**) rather than the database server name.
2. Display the replication server that you defined to verify that the definition succeeded:
   ```
   cdr list server
   ```
   The command returns the following information:
   ```
   SERVER    ID STATE    STATUS    QUEUE   CONNECTION CHANGED
   -----------------------------------------------------------
   g_usa      1 Active   Local     0
   ```
3. Define the second database server, **italy**, as a replication server:
   ```
   cdr define server --connect=italy --init \
   --sync=g_usa g_italy
   ```
   The **--connect** option allows you to define **italy** (on the **s2** computer) while working at the **s1** (**usa**) computer. The **--sync** option instructs the command to use the already-defined replication server (**g_usa**) as a pattern for the new definition. The **--sync** option also links the two replication servers into a replication environment.

Tip: In all options except the **--connect** option, Enterprise Replication uses the name of the database server group to which a database server belongs, instead of the name of the database server itself.

4. Verify that the second definition succeeded:

   ```
   cdr list server
   ```

   The command returns the following information:

SERVER	ID	STATE	STATUS	QUEUE	CONNECTION CHANGED
--					
g_italy	8	Active	Connected	0	JUN 14 14:38:44 2000
g_usa	1	Active	Local	0	

5. Define the replicate **repl1**:

   ```
   cdr define replicate --conflict=ignore repl1 \
   "P stores@g_usa:informix.manufact" \
   "select * from manufact" \
   "R stores@g_italy:informix.manufact" \
   "select * from manufact"
   ```

   These lines are all one command. The backslashes (\) at the end of the lines indicate that the command continues on the next line.

   This step specifies that conflicts should be ignored and describes two participants, **usa** and **italy**, in the replicate:

   - The P indicates that in this replicate **usa** is a primary server. That is, if any data in the selected columns changes, that changed data should be sent to the secondary servers.
   - The R indicates that in this replicate **italy** is a secondary server (receive-only). The specified table and columns receive information that is sent from the primary server. Changes to those columns on **italy** are *not* replicated.

6. Display the replicate that you defined, so that you can verify that the definition succeeded:

   ```
   cdr list replicate
   ```

   The command returns the following information:

   ```
   CURRENTLY DEFINED REPLICATES
   ------------------------------------------------
   REPLICATE:     repl1
   STATE:         Inactive
   CONFLICT:      Ignore
   FREQUENCY:     immediate
   QUEUE SIZE:    0
   PARTICIPANT:   g_usa:informix.manufact
                  g_italy:informix.manufact
   ```

   Step 5 *defines* a replicate but does not make the replicate active. The output of step 6 shows that the STATE of the replicate is INACTIVE.

7. Make the replicate active:

   ```
    repl1
   ```

8. Display the replicate so that you can verify that the STATE has changed to ACTIVE:

   ```
   cdr list replicate
   ```

   The command returns the following information:

   ```
   CURRENTLY DEFINED REPLICATES
   ------------------------------------------------
   REPLICATE:     repl1
   STATE:         Active
   ```

```
CONFLICT:      Ignore
FREQUENCY:     immediate
QUEUE SIZE:    0
PARTICIPANT:   g_usa:informix.manufact
               g_italy:informix.manufact
```

If any changes are made to the **manufact** table, the changes will be replicated to the other participants in the replicate.

Cause a Replication

Now you can modify the **manufact** table on the **usa** database server and see the change reflected in the **manufact** table on the **italy** database server.

To cause a replication:

1. Use DB–Access to insert a value into the **manufact** table on **usa**:

   ```
   INSERT INTO stores@usa:manufact \
   VALUES ('AWN','Allwyn','8');
   ```

2. Observe the changes on **usa** and on **italy**:

   ```
   SELECT * from stores@usa:manufact
   SELECT * from stores@italy:manufact
   ```

To Not Cause a Replication

In **repl1**, **usa** is the primary database server and **italy** is the target. Changes made to the **manufact** table on **italy** do not replicate to **usa**.

To not cause a replication:

1. Use DB–Access to insert a value into the **manufact** table on **italy**:

   ```
   INSERT INTO stores@italy:manufact \
   VALUES ('ZZZ','Zip','9');
   ```

2. Verify that the change occurred on **italy** but did not replicate to the **manufact** table on **usa**:

   ```
   SELECT * from stores@usa:manufact
   SELECT * from stores@italy:manufact
   ```

Update-Anywhere Example

This example builds on the previous example and creates a simple *update-anywhere* replication. In update-anywhere replication, changes to *any* table in the replicate are replicated to *all* other tables in the replicate. In this example, any change to the **stock** table of the **stores** database on any database server in the replicate will be replicated to the **stock** table on the other database servers.

Preparing for an Update-Anywhere Replication

In this example, define the **repl2** replicate.

To prepare for update-anywhere replication:

1. Define the replicate, **repl2**:

   ```
   cdr define replicate --conflict=ignore repl2 \
   "stores@g_usa:informix.stock" "select * from stock" \
   "stores@g_italy:informix.stock" "select * from stock"
   ```

   These lines are all one command. The backslashes (\) at the end of the lines indicate that the command continues on the next line.

This step specifies that conflicts should be ignored and describes two participants, **usa** and **italy** (including the table and the columns to replicate) in the replicate.

Because neither P (primary) nor R (receive-only) is specified, the replicate is defined as update-anywhere. If any data in the selected columns changes, on either participant, that changed data should be sent to the other participants in the replicate.

2. Display all the replicates so that you can verify that your definition of **repl2** succeeded:

   ```
   cdr list replicate
   ```

   The command returns the following information:

   ```
   CURRENTLY DEFINED REPLICATES
   ---------------------------------------------------------
   REPLICATE:     repl1
   STATE:         Active
   CONFLICT:      Ignore
   FREQUENCY:     immediate
   QUEUE SIZE:    0
   PARTICIPANT:   g_usa:informix.manufact
                  g_italy:informix.manufact

   REPLICATE:     repl2
   STATE:         Inactive
   CONFLICT:      Ignore
   FREQUENCY:     immediate
   QUEUE SIZE:    0
   PARTICIPANT:   g_usa:informix.stock
                  g_italy:informix.manufact
   ```

   Although this output shows that **repl2** exists, it does not show the *participant modifiers* (the SELECT statements) for **repl2**.

3. Display the participant modifiers for **repl2**:

   ```
   cdr list replicate repl2
   ```

   This command returns the following information:

REPLICATE	TABLE	SELECT
--		
repl2	stores@g_usa:informix.stock	select * from stock
repl2	stores@g_italy:informix.stock	select * from stock

4. Add the **japan** database server to the replication system already defined in the previous example:

   ```
   cdr define server --connect=japan --init \
   --sync=g_usa g_japan
   ```

   You can use either **g_usa** or **g_italy** in the **--sync** option.

   Enterprise Replication maintains identical information on all servers that participate in the replication system. Therefore, when you add the **japan** database server, information about that server is propagated to all previously-defined replication servers (**usa** and **italy**).

5. Display the replication servers so that you can verify that the definition succeeded:

   ```
   cdr list server
   ```

The command returns the following information:

SERVER	ID	STATE	STATUS	QUEUE	CONNECTION CHANGED
---					
g_italy	8	Active	Connected	0	JUN 14 14:38:44 2000
g_japan	6	Active	Connected	0	JUN 14 14:38:44 2000
g_usa	1	Active	Local		

6. Add the participant and participant modifier to **repl2**:

   ```
   cdr change replicate --add repl2 \
   "stores@g_japan:informix.stock" "select * from stock"
   ```

7. Display detailed information about **repl2** after adding the participant in step 6:

   ```
   cdr list replicate repl2
   ```

   The command returns the following information:

REPLICATE	TABLE	SELECT
---		
repl2	stores@g_usa:informix.stock	select * from stock
repl2	stores@g_italy:informix.stock	select * from stock
repl2	stores@g_japan:informix.stock	select * from stock

8. Make the replicate active:

   ```
    repl2
   ```

   Changes made to the **stock** table on **usa** are reflected in the **stock** tables on both **italy** and **japan**.

9. Display a list of replicates so that you can verify that the STATE of **repl2** has changed to ACTIVE:

   ```
   cdr list replicate
   ```

   The command returns the following information:

   ```
   CURRENTLY DEFINED REPLICATES
   -------------------------------------------------------
   REPLICATE:     repl1
   STATE:         Active
   CONFLICT:      Ignore
   FREQUENCY:     immediate
   QUEUE SIZE:    0
   PARTICIPANT:   g_usa:informix.manufact
                  g_italy:informix.manufact

   REPLICATE:     repl2
   STATE:         Active
   CONFLICT:      Ignore
   FREQUENCY:     immediate
   QUEUE SIZE:    0
   PARTICIPANT:   g_usa:informix.stock
                  g_italy:informix.manufact
                  g_japan:informix.manufact
   ```

Cause a Replication

Now you can modify the **stock** table on one database server and see the change reflected on the other database servers.

To cause a replication:

1. Use DB–Access to insert a line into the **stock** table on **usa**:

   ```
   INSERT INTO stores@usa:stock VALUES (401, "PRC", "ski boots", 200.00, "pair", "pair");
   ```
2. Observe the change on the **italy** and **japan** database servers:

   ```
   SELECT * from stores@italy:stock;
   SELECT * from stores@japan:stock;
   ```

To update the stock table on the japan database server:

1. Use DB–Access to change a value in the **stock** table on **japan**:

   ```
   UPDATE stores@japan:stock SET unit_price = 190.00
   WHERE stock_num = 401;
   ```
2. Verify that the change has replicated to the **stock** table on **usa** and on **italy**:

   ```
   SELECT * from stores@usa:stock WHERE stock_num = 401;
   SELECT * from stores@italy:stock WHERE stock_num = 401;
   ```

Hierarchy Example

The example in this section adds a replication tree to the fully-connected environment of the **usa**, **italy**, and **japan** replication servers. The nonroot servers **boston** and **denver** are children of **usa**. (The leaf server **miami** is a child of **boston**.) Figure E-1 shows the replication hierarchy.

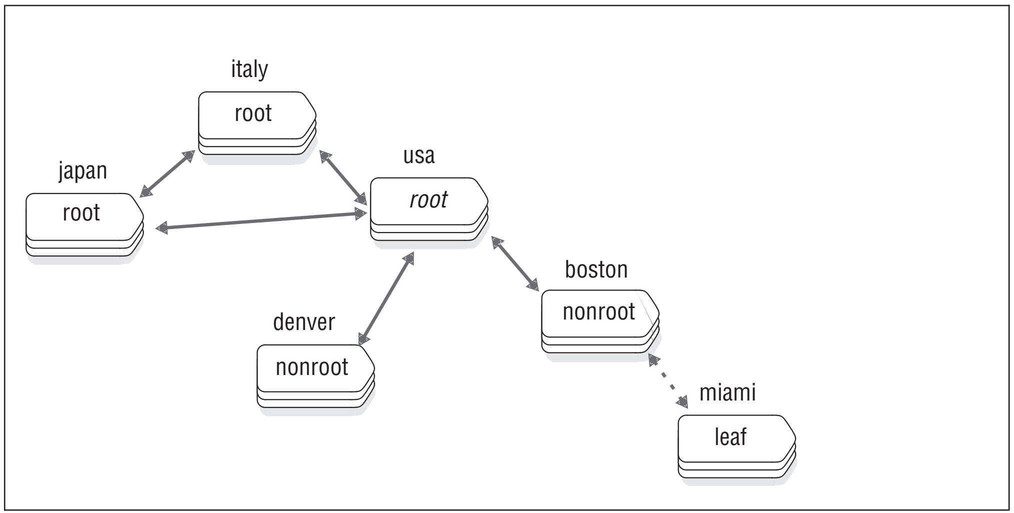


Figure E-1. Hierarchical Tree Example

Preparing for a Hierarchy Example

To try this example, you need to prepare three additional database servers: **boston**, **denver**, and **miami**. To prepare the database servers, use the techniques described in “Replication Example Environment” on page E-1.

Defining a Hierarchy

The following example defines a replication hierarchy that includes **denver**, **boston**, and **miami** and, whose root is **usa**.

To define a hierarchy:

1. Add **boston** to the replication hierarchy as a nonroot server attached to the root server **usa**:

   ```
   cdr define server --connect=boston --nonroot --init \
   --sync g_usa g_boston
   ```

The backslash (\) indicates that the command continues on the next line.

2. Add **denver** to the replication hierarchy as a nonroot server attached to the root server **usa**:

   ```
   cdr define server -c denver -I -N --ats=/ix/myats \
   -S g_usa g_denver
   ```

   This command uses short forms for the **connect**, **init**, and **sync** options. (For information about the short forms, refer to "Option Abbreviations" on page A-121.) The command also specifies a directory for collecting information about failed replication transactions, **/ix/myats**.

3. List the replication servers as seen by the **usa** replication server:

   ```
   cdr list server
   ```

   The root server **usa** is fully connected to all the other root servers. Therefore **usa** knows the connection status of all other root servers and of its two child servers, **denver** and **boston**. The command returns the following information:

```
SERVER     ID    STATE            STATUS       QUEUE      CONNECTION CHANGED
----------------------------------------------------------------------
g_boston   3     Active           Connected    0          Aug 19 14:20:03 2000
g_denver   27    Active           Connected    0          Aug 19 14:20:03 2000
g_italy    8     Active           Connected    0          Aug 19 14:20:03 2000
g_japan    6     Active           Connected    0          Aug 19 14:20:03 2000
g_usa      1     Active           Local        0
```

4. List the replication servers as seen by the **denver** replication server:

   ```
   cdr list server --connect=denver
   ```

   The nonroot server **denver** has a complete global catalog of replication information, so it knows all the other servers in its replication system. However, **denver** knows the connection status only of itself and its parent, **usa**.

   The command returns the following information:

```
SERVER     ID    STATE            STATUS       QUEUE      CONNECTION CHANGED
----------------------------------------------------------------------
g_boston   3     Active                        0
g_denver   27    Active           Local        0
g_italy    8     Active                        0
g_japan    6     Active                        0
g_usa      1     Active           Connected    0          Aug 19 14:20:03 2000
```

5. Define **miami** as a leaf server whose parent is **boston**:

   ```
   cdr define server -c miami -I --leaf -S g_boston g_miami
   ```

6. List the replication servers as seen by **miami**:

   ```
   cdr list server -c miami
   ```

   As a leaf replication server, **miami** has a limited catalog of replication information. It knows only about itself and its parent.

The command returns the following information:

SERVER	ID	STATE	STATUS	QUEUE	CONNECTION CHANGED
---					
g_boston	3	Active	Connected	0	Aug19 14:35:17 2000
g_miami	4	Active	Local	0	

7. List details about the **usa** replication server:

   ```
   cdr list server g_usa
   ```

   The server is a *hub*; that is, it forwards replication information to and from other servers. It uses the default values for idle timeout, send queue, receive queue, and ATS directory.

   The command returns the following information:

NAME	ID	ATTRIBUTES
---		
g_usa	1	timeout=15 hub sendq=rootdbs recvq=rootdbs atsdir=/tmp

Appendix F. SQLHOSTS Registry Key (Windows)

When you install the database server, the **setup** program creates the following key in the Windows registry:

```
HKEY_LOCAL_MACHINE\SOFTWARE\INFORMIX\SQLHOSTS
```

This branch of the HKEY_LOCAL_MACHINE subtree stores the **sqlhosts** information. Each key on the SQLHOSTS branch is the name of a database server. When you click the database server name, the registry displays the values of the HOST, OPTIONS, PROTOCOL, and SERVICE fields for that particular database server.

Each computer that hosts a database server or a client must include the connectivity information either in the sqlhosts registry key or in a central registry. When the client application runs on the same computer as the database server, they share a single sqlhosts registry key.

The Location of the SQLHOSTS Registry Key

When you install the database server on Windows, the installation program asks where you want to store the SQLHOSTS registry key. You can specify one of the following two options:

- The local computer where you are installing the database server
- Another computer in the network that serves as a central, shared repository of **sqlhosts** information for multiple database servers in the network

Local SQLHOSTS Registry Key

If you use the SQLHOSTS registry key on the local computer, for all database servers, the correct SQLHOSTS registry key must exist on *all* computers involved in replication. In addition, the **hosts** and **services** files on each computer must include information about all database servers.

For example, to set up replication between the server instance **srv1** on the computer **host1** and the server instance **srv2** on **host2**, you must ensure the following:

- Both **host1** and **host2** include SQLHOSTS registry key entries for **srv1** and **srv2**.
- The **services** file on both computers includes the details of the services used by both database server instances.

Shared SQLHOSTS Registry Key

If you use a shared SQLHOSTS registry key, you do not need to maintain the same **sqlhosts** information on multiple computers. However, the **hosts** and **services** files on *each* computer must contain information about all computers that have database servers.

If you specify a shared sqlhosts registry key, you must set the environment variable **INFORMIXSQLHOSTS** on your local computer to the name of the Windows computer that stores the registry. The database server first looks for the sqlhosts registry key on the INFORMIXSQLHOSTS computer. If the database server does not find an sqlhosts registry key on the INFORMIXSQLHOSTS computer, or if **INFORMIXSQLHOSTS** is not set, the database server looks for an sqlhosts registry key on the local computer.

You must comply with Windows network-access conventions and file permissions to ensure that the local computer has access to the shared sqlhosts registry key. For information about network-access conventions and file permissions, see your Windows documentation.

Preparing the SQLHOSTS Connectivity Information

Preparing the SQLHOSTS connectivity information consists of setting up registry keys on each computer that hosts a database server that participates in a replicate.

To prepare the SQLHOSTS connectivity information:

1. Set up the SQLHOSTS registry key on the local computer.
2. Set up the database server group registry key on the local computer.

   See "Setting Up the Database Server Group Registry Key" on page F-3.
3. Set up the SQLHOSTS and group registry keys on all computers that are participants in the replicate.

   See "Setting up the Registry Keys on All Computers" on page F-5.
4. Ensure that the services files on each computer include entries for all database servers that are participants in the replicate.

   See "Verifying the services Files on All Computers" on page F-5.

Setting up the SQLHOSTS Registry with ISA

Important: It is strongly recommended that you use IBM Informix Server Administrator (ISA), rather than **regedt32**, to set up the SQLHOSTS registry key and database server group registry key on your Windows system. In addition, ISA allows you to administer your replication system from a web browser.

See the online help for ISA for details on setting up the SQLHOSTS registry key and database server group registry key.

Setting up the SQLHOSTS Registry Key with regedt32

It is recommended that you use ISA to set up the SQLHOSTS registry key.

Important: Use extreme caution with **regedt32**. If you make mistakes when editing the registry, you can destroy the configurations, not only of your IBM Informix products, but of your other applications.

To set up SQLHOSTS with regedt32:

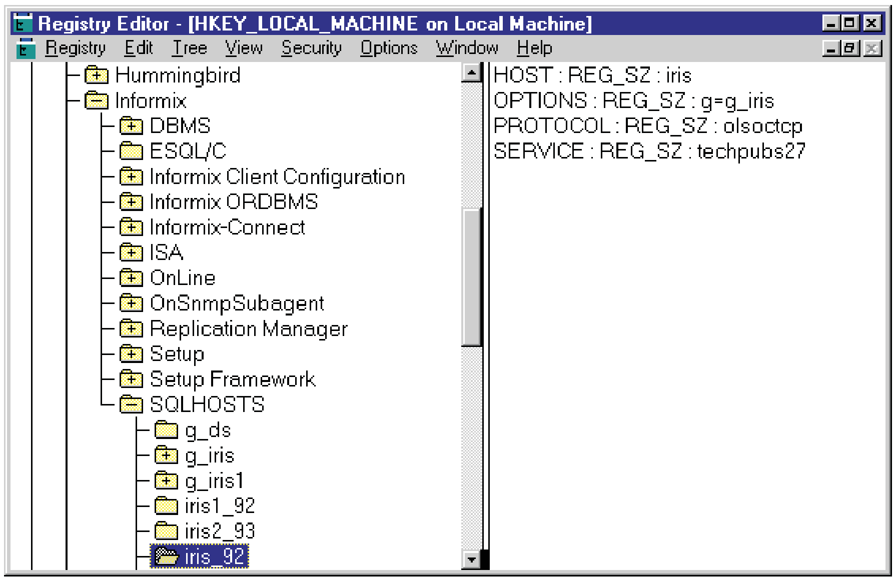
1. Run the Windows program, **regedt32**.
2. In the Registry Editor window, select the window for the HKEY_LOCAL_MACHINE subtree.
3. Click the folder icons to select the \SOFTWARE\INFORMIX\ SQLHOSTS branch.
4. With the SQLHOSTS key selected, choose **Edit > Add Key**.
5. In the Add Key dialog box, type the name of the database server in the Key Name dialog box.

   Leave the Class dialog box blank. Click **OK**.

6. Select the new key that you just made (the key with the database server name).
7. Choose **Edit > Add Value.**
8. In the Add Value dialog box, type one of the fields of the **sqlhosts** information (HOST, OPTIONS, PROTOCOL, SERVICE) in the Value Name dialog box.

   Do not change the Data Type box. Click **OK**.
9. In the String Editor dialog box, type the value for the field that you selected and click **OK**.
10. Repeat steps 8 and 9 for each field of the **sqlhosts** information.

Figure F-1 illustrates the location and contents of the SQLHOSTS registry key.



```
HOST : REG_SZ : iris
OPTIONS : REG_SZ : g=g_iris
PROTOCOL : REG_SZ : olsoctcp
SERVICE : REG_SZ : techpubs27
```

Figure F-1. sqlhosts Information in the Windows Registry

Setting Up the Database Server Group Registry Key

After you create the registry key for the database server, you must make a registry key for the database server group that includes the database server. For more information, refer to “Verifying SQLHOSTS” on page 4-3.

Tip: In this manual (and in Figure F-2 on page F-4), each of the names of the database server groups are the database server names prefixed by g_. The g_ prefix is not a requirement; it is just the convention that this manual uses.

To set up the database server group registry key:

1. With the SQLHOSTS key selected, choose **Edit > Add Key**.
2. In the Add Key dialog box, type the name of the database server group in the Key Name dialog box.

   This value must correspond to the Options value in the database server name key.

   Leave the Class dialog box blank. Click **OK**.
3. Select the new key that you just made (the key with the database server group name).
4. Choose **Edit > Add Value.**

5. In the Add Value dialog box, type one of the fields of the **sqlhosts** information (HOST, OPTIONS, PROTOCOL, SERVICE) in the Value Name dialog box.

   Do not change the Data Type dialog box. Click **OK**.

6. In the String Editor dialog box, type the value for the field that you selected and click **OK**.

   For a database server group, enter the following values:

   ```
   HOST        -
   OPTIONS     i=unique-integer-value
   PROTOCOL    group
   SERVICE     -
   ```

   Each database server group must have an associated identifier value (**i=**) that is unique among all database servers in your environment. Enter a minus (-) for HOST and SERVICE to indicate that you are not assigning specific values to those fields.

7. With the database server group key selected, choose **Edit > Add Key**.

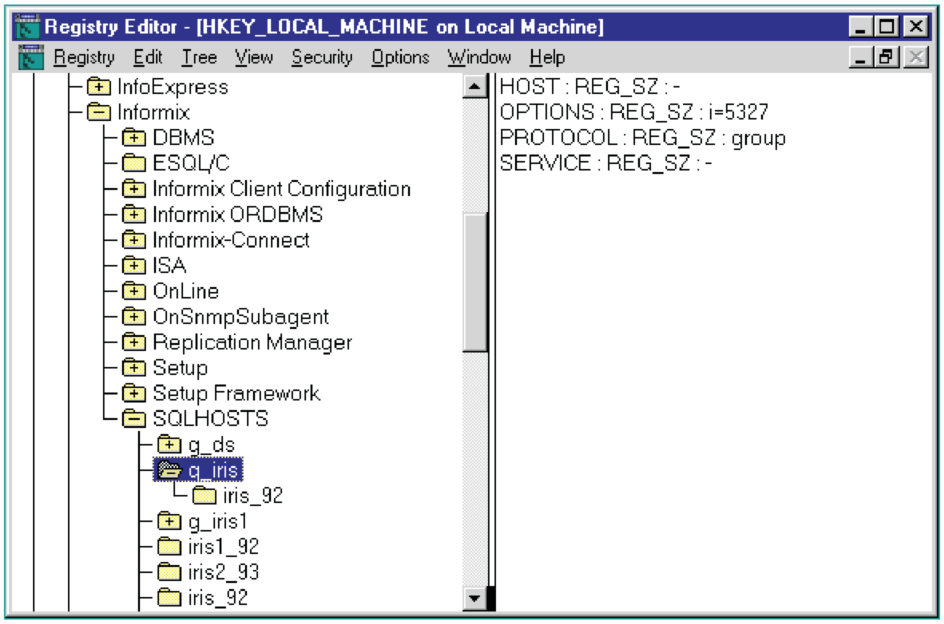
8. In the Add Key dialog box, type the name of the database server in the **Key Name** field.

   This value must correspond to the database server key, whose OPTIONS value was set to the database server group key selected in step 7.

   If you are combining Enterprise Replication with HDR, create keys for primary and secondary HDR servers under the same database server group.

9. Repeat steps 1 to 8 for each field of the **sqlhosts** information.

   Figure F-2 illustrates the contents of the database server group registry key after you add the values to the keys.



```
HOST : REG_SZ : -
OPTIONS : REG_SZ : i=5327
PROTOCOL : REG_SZ : group
SERVICE : REG_SZ : -
```

Figure F-2. Database Server Group Information in the Windows Registry

10. Exit from the Registry Editor.

Setting up the Registry Keys on All Computers

Now, update the registry keys on all computers that participate in replication.

To update the registry keys on all computers:

1. Set up the SQLHOSTS registry key on all computers that participate in replication.

   See “Setting up the SQLHOSTS Registry Key with regedt32” on page F-2.
2. Set up the database server group registry key on all computers that participate in replication.

   See “Setting Up the Database Server Group Registry Key” on page F-3.

Verifying the services Files on All Computers

Finally, on each computer that participates in replication, make sure that the **services** file (located in the **C:\Windows/system32/drivers/etc/** directory) contains entries for all the database servers.

To verify the services files on all computers:

1. Check the **services** file on the first host (for example, **host1**).

   The file might look like this:

   ```
   techpubs27     4599/tcp     # service for online instance denver
   techpubs28     4600/tcp     # service for online instance boston
   ```
2. Check the **services** file on the second host (for example, **host2**).

   The file might should look the same as the file on **host1**:

   ```
   techpubs27     4599/tcp     # service for online instance denver
   techpubs28     4600/tcp     # service for online instance boston
   ```

Appendix G. Datasync Warning and Error Messages

This appendix lists Datasync warning and error messages that you can suppress from being written to the ATS and RIS files. To specify which warnings and errors to suppress, use the CDR_SUPPRESS_ATSRISWARN configuration parameter. For more information, see "CDR_SUPPRESS_ATSRISWARN Configuration Parameter" on page B-7.

Warning or Error Code	Number	Description
`DSROWCOMMITTED`	0	
`DSEROW`	1	
`DSEReplInsertOrder`	2	Warning: Insert exception, row already exists in target table, converted to update
`DSEReplUpdateOrder`	3	Warning: Update exception, row does not exist in target table, converted to insert
`DSEReplDeleteOrder`	4	Warning: Delete exception, row does not exist in target table, saved in delete table
`DSEReplInsert`	5	Error: Insert aborted, row already exists in target table
`DSEReplUpdate`	6	Error: Update aborted, row does not exist in target table
`DSEReplDelete`	7	Error: Delete aborted, row does not exist in target table
`DSERowLength`	8	Error: Length of replicated row is greater than row size in target table
`DSEDbopType`	9	Error: Unknown db operation
`DSENoServerTimeCol`	10	Error: Missing cdrserver and/or cdrtime columns in target table
`DSEConflictRule`	13	Error: Unknown conflict resolution rule defined
`DSELostConflictRes`	14	Error: Failed conflict resolution rule
`DSENoServerName`	15	Error: Global catalog cannot translate replicate server id to name
`DSEColMap`	16	Error: Unable to remap columns selected for replication
`DSEColUncomp`	17	Error: Invalid char/length in VARCHAR column
`DSESPRetTypeOp`	18	Error: Invalid data type or unknown operation returned by stored procedure
`DSESPAbortRow`	19	Error: Row aborted by stored procedure
`DSESPSelCols`	20	Error: Number of columns returned by stored procedure not equal to the number of columns in select statement
`DSESPColTypeLen`	21	Error: Invalid data type or length for selected columns returned by stored procedure
`DSESPError`	22	Error: Error returned by user's stored procedure
`DSESPInternal`	23	Error: Internal error (buffer too small for stored procedure arguments
`DSENoMatchKeyInsert`	24	Error: No matching key delete row for key insert
`DSESql`	25	Error: SQL error encountered
`DSEIsam`	26	Error: ISAM error encountered
`DSELocalDReExist`	27	Warning: Local delete row has been reinserted on local server
`DSELocalDOddState`	28	Warning: Unable to determine if the local delete row should be updated to the delete table

Warning or Error Code	Number	Description
DSELocalDInDelTab	29	Warning: Row already exists in delete table for the given local delete row
DSEBlobOrder	30	Warning: Row failed conflict resolution rule but one or more blob columns were accepted
DSEBlobSetToNull	31	Warning: One or more blob columns were set to NULL because data could not be sent
DSEBlobKeepLocal	32	Warning: One or more blob columns were not changed because data could not be sent
DSEBlobInvalidFlag	33	Error: Invalid user action defined for blob columns
DSEBlobAbortRow	34	Error: Row aborted by user's stored procedure due to unsent blobs
DSESPBlobRetOp	35	Error: Invalid action returned by user's stored procedure on blob columns
DSEReplDel	36	
DSENoUDTHeader	37	
DSENoUDTTrailer	38	
DSEStreamHandle	39	
DSEAttachUDREnv	40	
DSECdrreceiveSetup	41	
DSECdrreceiveCall	42	
DSECdrreceiveRetCode	43	cdrreceive returned error
DSECdrreceiveRetGarbage	44	cdrreceive returned garbage
DSEStream	45	Error reading from stream
DSEStreamAborted	46	Stream aborted by sender
DSEValStore	47	
DSECdrreceiveRetType	48	cdrreceive returned wrong type
DSEStreamOptType	49	Unrecognized stream option
DSEStreamOptLen	50	Stream option has bad length
DSEStreamOptBitmap	51	Error in changed col bitmap
DSEUnStreamColl	52	Error while unstreaming collection
DSEUnStreamRowType	53	Error while unstreaming rowtype
DSEStreamFormat	54	Unexpected or invalid data in stream
DSEStack	55	Out of stack space
DSEInternal	56	Generic internal problem
DSESmartBlobCreate	57	Error creating sblob
DSESmartBlobWrite	58	Error writing sblob
DSEStreamColConv	59	Error converting column data from the master dictionary formats to the local dictionary format

Appendix H. Accessibility

The syntax diagrams in the HTML version of this manual are available in dotted decimal syntax format, which is an accessible format that is available only if you are using a screen reader.

Dotted Decimal Syntax Diagrams

In dotted decimal format, each syntax element is written on a separate line. If two or more syntax elements are always present together (or always absent together), the elements can appear on the same line, because they can be considered as a single compound syntax element.

Each line starts with a dotted decimal number; for example, `3` or `3.1` or `3.1.1`. To hear these numbers correctly, make sure that your screen reader is set to read punctuation. All syntax elements that have the same dotted decimal number (for example, all syntax elements that have the number `3.1`) are mutually exclusive alternatives. If you hear the lines `3.1 USERID` and `3.1 SYSTEMID`, your syntax can include either `USERID` or `SYSTEMID`, but not both.

The dotted decimal numbering level denotes the level of nesting. For example, if a syntax element with dotted decimal number `3` is followed by a series of syntax elements with dotted decimal number `3.1`, all the syntax elements numbered `3.1` are subordinate to the syntax element numbered `3`.

Certain words and symbols are used next to the dotted decimal numbers to add information about the syntax elements. Occasionally, these words and symbols might occur at the beginning of the element itself. For ease of identification, if the word or symbol is a part of the syntax element, the word or symbol is preceded by the backslash (\) character. The `*` symbol can be used next to a dotted decimal number to indicate that the syntax element repeats. For example, syntax element `*FILE` with dotted decimal number 3 is read as `3 \* FILE`. Format `3* FILE` indicates that syntax element `FILE` repeats. Format `3* \* FILE` indicates that syntax element `* FILE` repeats.

Characters such as commas, which are used to separate a string of syntax elements, are shown in the syntax just before the items they separate. These characters can appear on the same line as each item, or on a separate line with the same dotted decimal number as the relevant items. The line can also show another symbol that provides information about the syntax elements. For example, the lines `5.1*`, `5.1 LASTRUN`, and `5.1 DELETE` mean that if you use more than one of the `LASTRUN` and `DELETE` syntax elements, the elements must be separated by a comma. If no separator is given, assume that you use a blank to separate each syntax element.

If a syntax element is preceded by the `%` symbol, this identifies a reference that is defined elsewhere. The string following the `%` symbol is the name of a syntax fragment rather than a literal. For example, the line `2.1 %OP1` means that you should refer to a separate syntax fragment `OP1`.

The following words and symbols are used next to the dotted decimal numbers:

? Specifies an optional syntax element. A dotted decimal number followed by the ? symbol indicates that all the syntax elements with a corresponding dotted decimal number, and any subordinate syntax elements, are optional. If there is only one syntax element with a dotted decimal number, the ? symbol is displayed on the same line as the syntax element (for example, 5? NOTIFY). If there is more than one syntax element with a dotted decimal number, the ? symbol is displayed on a line by itself, followed by the syntax elements that are optional. For example, if you hear the lines 5 ?, 5 NOTIFY, and 5 UPDATE, you know that syntax elements NOTIFY and UPDATE are optional; that is, you can choose one or none of them. The ? symbol is equivalent to a bypass line in a railroad diagram.

! Specifies a default syntax element. A dotted decimal number followed by the ! symbol and a syntax element indicates that the syntax element is the default option for all syntax elements that share the same dotted decimal number. Only one of the syntax elements that share the same dotted decimal number can specify a ! symbol. For example, if you hear the lines 2? FILE, 2.1! (KEEP), and 2.1 (DELETE), you know that (KEEP) is the default option for the FILE keyword. In this example, if you include the FILE keyword but do not specify an option, default option KEEP is applied. A default option also applies to the next higher dotted decimal number. In this example, if the FILE keyword is omitted, default FILE(KEEP) is used. However, if you hear the lines 2? FILE, 2.1, 2.1.1! (KEEP), and 2.1.1 (DELETE), the default option KEEP only applies to the next higher dotted decimal number, 2.1 (which does not have an associated keyword), and does not apply to 2? FILE. Nothing is used if the keyword FILE is omitted.

* Specifies a syntax element that can be repeated zero or more times. A dotted decimal number followed by the * symbol indicates that this syntax element can be used zero or more times; that is, it is optional and can be repeated. For example, if you hear the line 5.1* data-area, you know that you can include more than one data area or you can include none. If you hear the lines 3*, 3 HOST, and 3 STATE, you know that you can include HOST, STATE, both together, or nothing.

Notes:

1. If a dotted decimal number has an asterisk (*) next to it and there is only one item with that dotted decimal number, you can repeat that same item more than once.
2. If a dotted decimal number has an asterisk next to it and several items have that dotted decimal number, you can use more than one item from the list, but you cannot use the items more than once each. In the previous example, you could write HOST STATE, but you could not write HOST HOST.
3. The * symbol is equivalent to a loop-back line in a railroad syntax diagram.

+ Specifies a syntax element that must be included one or more times. A dotted decimal number followed by the + symbol indicates that this syntax element must be included one or more times. For example, if you hear the line 6.1+ data-area, you must include at least one data area. If you hear the lines 2+, 2 HOST, and 2 STATE, you know that you must include HOST, STATE, or both. As for the * symbol, you can only repeat a particular item if it is the only item with that dotted decimal number. The + symbol, like the * symbol, is equivalent to a loop-back line in a railroad syntax diagram.

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Printed in USA

G251-2279-02

Spine information:

IBM Informix **Version 10.0**

IBM Informix Dynamic Server Enterprise Replication Guide