SYBASE®

Heterogeneous Replication Guide

# Replication Server

15.2

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# Contents

# About This Book

Replication Server® maintains replicated data at multiple sites on a network. Organizations with geographically distant sites can use Replication Server to create distributed database applications with better performance and data availability than a centralized database system can provide.

This book introduces heterogeneous replication concepts, and it addresses the issues peculiar to heterogeneous replication with Sybase replication technology.

In this book, the term *heterogeneous replication* refers to replication between different types of data servers, for example, replicating from an Oracle database to a Sybase™ Adaptive Server® Enterprise (ASE) database.

This book also addresses the issues involved with replication between non-ASE data servers of the same type, for example, replicating from one Oracle database to another Oracle database.

## Audience

The *Replication Server Heterogeneous Replication Guide* is to be used to plan, design, implement, or maintain a Sybase replication system that uses heterogeneous or non-ASE data servers.

If you are new to Replication Server, refer to the *Replication Server Design Guide* for an introduction to basic data replication concepts and Sybase replication technology.

## How to use this book

This book is divided into four parts:

- Part 1, "Introduction," provides an overview of data replication concepts and Sybase replication technology, and it introduces the issues specific to replication systems with heterogeneous or non-ASE data servers. It contains these chapters:
    - Chapter 1, "Replication System Overview," introduces replication system concepts, with a focus on heterogeneous replication using Sybase replication technology.

    - Chapter 2, “Replication Components Detail,” introduces the Sybase software products that you can use to implement a replication system with heterogeneous or non-ASE data servers.
- Part 2, “Non-ASE Primary Data Server Topics” describes component-specific issues for primary data servers and considerations peculiar to a replication system with heterogeneous or non-ASE primary data servers. It contains these chapters:
    - Chapter 3, “DB2 UDB Primary Data Server Issues for z/OS,” describes the issues specific to the IBM DB2 UDB primary data server on IBM z/OS in a Sybase replication system.
    - Chapter 4, “DB2 UDB Primary Data Server on UNIX, Windows, and Linux,” describes the issues specific to the IBM DB2 UDB primary data server on UNIX, Windows, and Linux in a Sybase replication system.
    - Chapter 5, “Microsoft SQL Server Primary Data Server Issues,” describes the issues specific to the Microsoft SQL Server primary data server in a Sybase replication system.
    - Chapter 6, “Oracle Primary Data Server Issues,” describes the issues specific to the Oracle primary data server in a Sybase replication system.
    - Chapter 7, “SQL Anywhere Primary Data Servers,” describes the issues specific to SQL Anywhere primary data server in a Sybase replication system.
- Part 3, “Non-ASE Replicate Data Server Topics,” describes how to set up replicate targets and to maintain a replication system using Replication Server with heterogeneous or non-ASE data servers. It contains the following chapters:
    - Chapter 8, “DB2 UDB for z/OS Replicate Data Server Issues,” describes the issues specific to the IBM DB2 UDB on IBM z/OS replicate data server in a Sybase replication system.
    - Chapter 9, “DB2 UDB Replicate Data Server Issues for UNIX, Windows, and Linux,” describes the issues specific to the IBM DB2 UDB on UNIX, Windows, and Linux replicate data server in a Sybase replication system.
    - Chapter 10, “Microsoft SQL Server Replicate Data Server Issues,” describes the issues specific to the Microsoft SQL Server replicate data server in a Sybase replication system.

    - Chapter 11, “Oracle Replicate Data Server Issues,” describes the issues specific to the Oracle replicate data server in a Sybase replication system.
    - Chapter 12, “SQL Anywhere Replicate Data Servers,” describes the issues specific to SQL Anywhere replicate data servers in a Sybase replication system.
- Part 4, “Appendixes,” contain supplemental information:
    - Appendix A, “Datatype Translation and Mapping,” lists the class-level datatype translations for all non-ASE data servers supported by Replication Server. It also lists Replication Server datatype names for non-ASE datatypes.
    - Appendix B, “Materialization Issues,” describes the materialization issues to consider when implementing a replication system with heterogeneous or non-ASE data servers.
    - Appendix C, “Heterogeneous Database Reconciliation,” describes the issues involved with reconciling data from different databases in a replication system with heterogeneous or non-ASE data servers.
    - Appendix D, “Troubleshooting Heterogeneous Replication Systems,” describes common problems and troubleshooting procedures for Sybase replication systems with heterogeneous or non-ASE data servers.

**Related documents**

The Replication Server documentation set consists of the following:

- The *Replication Server Release Bulletin* for your platform – contains last-minute information that was too late to be included in the books.

  A more recent version of the *Replication Server Release Bulletin* may be available on the World Wide Web. To check for critical product or document information that was added after the release of the product CD, use the Product Manuals Web site.
- *Installation Guide* for your platform – describes installation and upgrade procedures for all Replication Server and related products.
- *What’s New in Replication Server?* – describes the new features in Replication Server version 15.2 and the system changes added to support those features.

- *Administration Guide* – contains an introduction to replication systems. This manual includes information and guidelines for creating and managing a replication system, setting up security, recovering from system failures, and improving performance.
- *Configuration Guide* for your platform – describes configuration procedures for all Replication Server and related products, and explains how to use the rs_init configuration utility.
- *Design Guide* – contains information about designing a replication system and integrating heterogeneous data servers into a replication system.
- *Getting Started with Replication Server* – provides step-by-step instructions for installing and setting up a simple replication system.
- *Reference Manual* – contains the syntax and detailed descriptions of Replication Server commands in the Replication Command Language (RCL); Replication Server system functions; Sybase Adaptive Server commands, system procedures, and stored procedures used with Replication Server; Replication Server executable programs; and Replication Server system tables.
- *System Tables Diagram* – illustrates system tables and their entity relationships in a poster format. Available only in print version.
- *Troubleshooting Guide* – contains information to aid in diagnosing and correcting problems in the replication system.
- Replication Server plug-in help, which contains information about using Sybase Central to manage Replication Server.
- Additional Replication Server Options documents that may be helpful:
    - *Replication Server Options Overview Guide* – describes components used for replicating to and from ASE and non-ASE databases.
    - *Release Bulletin Replication Server Options* Version 15.2 for Linux, Microsoft Windows, and UNIX – describes issues for the Replication Server Options.
    - *Release Bulletin Replication Agent* Version 15.2 for Linux, Microsoft Windows, and UNIX – describes features and issues for Replication Agent™.
    - *Installation Guide Replication Agent* Version 15.2 – describes how to install Replication Agent.

- *Replication Agent Administration Guide* – describes how to extend the capabilities of Replication Server to replicate from non-ASE primary data servers in a Sybase replication system.
- *Replication Agent Primary Database Guide* – describes the specific issues related to the non-ASE primary data servers in a Sybase replication system.
- *Replication Agent Reference Manual* – contains the syntax and detailed descriptions of the Replication Agent commands and configuration parameters.
- *Enterprise Connect™ Data Access Option for Oracle Server Administration and Users Guide* – describes how to configure ECDA Option for Oracle.
- *Enterprise Connect Data Access Options Users Guide* for Access Services – describes how to configure a DirectConnect™ access service to extend the capabilities of Replication Server to replicate into non-ASE data servers in a Sybase replication system.
- *Enterprise Connect Data Access and Mainframe Connect™ Server Administration Guide* – describes how to use a Sybase DirectConnect server.

**Other sources of information**

Use the Getting Started CD, the SyBooks CD, and the Product Manuals Web site to learn more about your product:

- The Getting Started CD contains release bulletins and installation guides in PDF format, and may also contain other documents or updated information not included on the SyBooks CD. It is included with your software. To read or print documents on the Getting Started CD, you need Adobe Acrobat Reader, which you can download at no charge from the Adobe Web site using a link provided on the CD.
- The SyBooks CD contains product manuals and is included with your software. The Eclipse-based SyBooks browser allows you to access the manuals in an easy-to-use, HTML-based format.

  Some documentation may be provided in PDF format, which you can access through the PDF directory on the SyBooks CD. To read or print the PDF files, you need Adobe Acrobat Reader.

  Refer to the *SyBooks Installation Guide* on the Getting Started CD, or the *README.txt* file on the SyBooks CD for instructions on installing and starting SyBooks.

- The Sybase Product Manuals Web site is an online version of the SyBooks CD that you can access using a standard Web browser. In addition to product manuals, you will find links to EBFs/Maintenance, Technical Documents, Case Management, Solved Cases, newsgroups, and the Sybase Developer Network.

  To access the Sybase Product Manuals Web site, go to Product Manuals at http://www.sybase.com/support/manuals/.

**Sybase certifications on the Web**

Technical documentation at the Sybase Web site is updated frequently.

**❖ Finding the latest information on product certifications**

1. Point your Web browser to Technical Documents at http://www.sybase.com/support/techdocs/.
2. Click Certification Report.
3. In the Certification Report filter select a product, platform, and timeframe and then click Go.
4. Click a Certification Report title to display the report.

**❖ Finding the latest information on component certifications**

1. Point your Web browser to Availability and Certification Reports at http://certification.sybase.com/.
2. Either select the product family and product under Search by Base Product; or select the platform and product under Search by Platform.
3. Select Search to display the availability and certification report for the selection.

**❖ Creating a personalized view of the Sybase Web site (including support pages)**

Set up a MySybase profile. MySybase is a free service that allows you to create a personalized view of Sybase Web pages.

1. Point your Web browser to Technical Documents at http://www.sybase.com/support/techdocs/.
2. Click MySybase and create a MySybase profile.

## Sybase EBFs and software maintenance

❖ **Finding the latest information on EBFs and software maintenance**

1 Point your Web browser to the Sybase Support Page at http://www.sybase.com/support.

2 Select EBFs/Maintenance. If prompted, enter your MySybase user name and password.

3 Select a product.

4 Specify a time frame and click Go. A list of EBF/Maintenance releases is displayed.

   Padlock icons indicate that you do not have download authorization for certain EBF/Maintenance releases because you are not registered as a Technical Support Contact. If you have not registered, but have valid information provided by your Sybase representative or through your support contract, click Edit Roles to add the “Technical Support Contact” role to your MySybase profile.

5 Click the Info icon to display the EBF/Maintenance report, or click the product description to download the software.

## Conventions

The following style conventions are used in this manual:

- In a sample screen display, commands that you should enter exactly as shown are in:

  ```
  this font
  ```

- In a sample screen display, words that you should replace with the appropriate value for your installation are shown in:

  *`this font`*

- In the regular text of this document, the names of files and directories appear like this:

  */usr/u/sybase*

- In the regular text of this document, the names of programs, utilities, procedures, and commands appear like this:

  bcp

The conventions for syntax statements in this manual are as follows:

**Table 1: SQL syntax conventions**

| Key | Definition |
|---|---|
| command | Command names, command option names, utility names, utility flags, and other keywords. |
| *variable* | Variables, or words that stand for values that you fill in. |
| { } | Curly braces indicate that you must choose at least one of the enclosed options. Do not include braces in your option. |
| [ ] | Brackets mean that choosing one or more of the enclosed options is optional. Do not include brackets in your option. |
| ( ) | Parentheses are to be typed as part of the command. |
| \| | The vertical bar means you can select only one of the options shown. |
| , | The comma means you can choose as many of the options shown as you like, separating your choices with commas that you type as part of the command. |

**Accessibility features**

This document is available in an HTML version that is specialized for accessibility. You can navigate the HTML with an adaptive technology such as a screen reader or view it with a screen enlarger.

Replication Server 15.2 and the HTML documentation have been tested for compliance with U.S. government Section 508 Accessibility requirements. Documents that comply with Section 508 generally also meet non-U.S. accessibility guidelines, such as the World Wide Web Consortium (W3C) guidelines for Web sites.

**Note** You might need to configure your accessibility tool for optimal use. Some screen readers pronounce text based on its case; for example, they pronounce ALL UPPERCASE TEXT as initials, and MixedCase Text as words. You might find it helpful to configure your tool to announce syntax conventions. Consult the documentation for your tool.

For information about how Sybase supports accessibility, see Sybase Accessibility at http://www.sybase.com/accessibility. The Sybase Accessibility site includes links to information on Section 508 and W3C standards.

For a Section 508 compliance statement for Replication Server 15.2, see Sybase Accessibility at http://www.sybase.com/detail_list?id=52484.

**If you need help**

Each Sybase installation that has purchased a support contract has one or more designated people who are authorized to contact Sybase Technical Support. If you cannot resolve a problem using the manuals or online help, please have the designated person contact Sybase Technical Support or the Sybase subsidiary in your area.

PART 1

# Introduction

Chapters in this part introduce some data replication concepts and the Sybase replication technology that supports replication systems with heterogeneous or non-ASE data servers.

- Chapter 1, “Replication System Overview,” introduces basic replication system concepts, with a focus on heterogeneous replication using Sybase replication technology.
- Chapter 2, “Replication Components Detail,” introduces the Sybase software products that enable you to implement a heterogeneous replication system using Sybase replication technology.

# CHAPTER 1 Replication System Overview

This chapter introduces a basic replication system, with a focus on heterogeneous replication using Sybase replication technology.

## Basic replication system

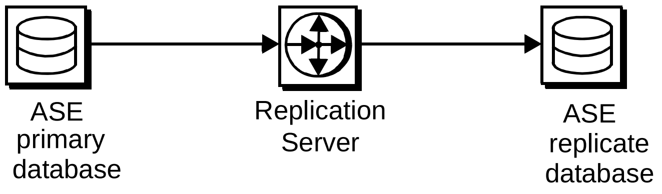
A basic Sybase replication system consists of three components:

- **Primary database** – a database in which original data-changing operations (or transactions) are performed. Only completed transactions are captured for replication.
- **Replication Server** – a Sybase Open Client™ and Open Server™ product that receives transactions to be replicated from a primary database, and delivers them to a replicate database.
- **Replicate database** – a database that receives replicated transactions from a Replication Server and applies those transactions to its own "copy" of the primary data.

If both primary and replicate data servers are Adaptive Server Enterprise (ASE), you can implement a replication system with only these three components. Adaptive Server Enterprise includes all the features necessary to support a Sybase replication system, with no additional components other than the Replication Server.

Figure 1-1 illustrates a basic Sybase replication system, showing the flow of data between two Adaptive Servers and a Replication Server.

***Figure 1-1: Basic Sybase replication system***



For more information about basic Sybase replication system concepts and Replication Server features, see the first two chapters of the Replication Server *Administration Guide*.

## Heterogeneous replication system

The term **heterogeneous replication** refers to replicating data-changing operations between two databases of different vendors. For example:

- A replication system in which Adaptive Server Enterprise (ASE) is either the primary or the replicate data server, and a non-ASE data server (such as IBM DB2 UDB) is the other data server.
- A replication system in which the primary and replicate data servers are both non-ASE data servers (for example, Oracle is the primary data server and IBM DB2 UDB is the replicate data server, or Microsoft SQL Server is the primary server and Microsoft SQL Server is the replicate server).

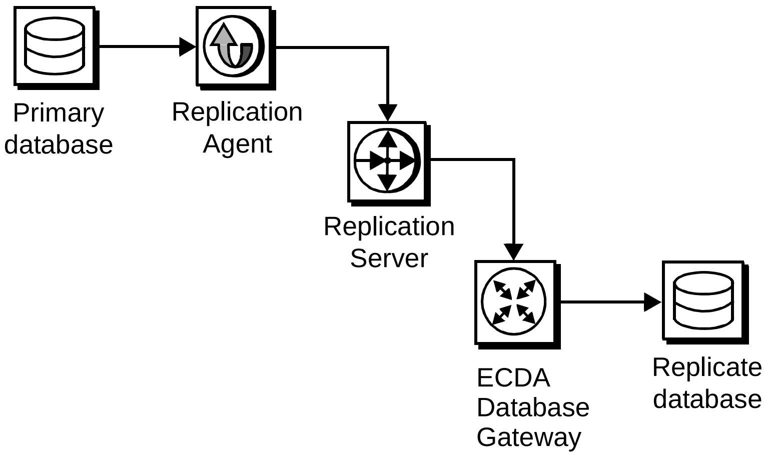
Adaptive Server Enterprise was enhanced to support Replication Server. All of the data server elements required to support Replication Server (that is, a data-change capture mechanism in the primary database, and system tables and stored procedures in the replicate database) are either built into Adaptive Server Enterprise or enabled by utilities that are provided with the Replication Server or Adaptive Server software.

Two additional components provided are required to implement a Sybase replication system with non-ASE data servers:

- A Replication Agent
- Enterprise Connect Data Access (ECDA) or a data server whose connectivity requirements are compatible with Replication Server

Figure 1-2 illustrates a typical Sybase replication system with non-ASE data servers, showing the flow of data between the data servers, through the Replication Agent, Replication Server, and Enterprise Connect Data Access database gateway.

***Figure 1-2: Sybase replication system with non-ASE data servers***



Replication Agents support non-ASE data servers by reading the completed transactions in the primary database and sending them to Replication Server for distribution.

ECDA database gateways support IBM DB2 UDB, Microsoft SQL Server, and Oracle data servers by providing connectivity between Sybase Open Client and Open Server and either ODBC or the native protocol of the replicate data server, and by providing SQL transformation and other services. Replication Server also includes datatype support for non-ASE data servers.

## Replication system components

The following components are described by their function and role in a Sybase replication system:

- Primary data server
- Replication Agent

- Replication Server
- Database gateway
- Replicate data server

For a more complete description of the Sybase software products (Replication Server, Replication Agents, and Enterprise Connect Data Access gateways), see Chapter 2, “Replication Components Detail.”

## Primary data server

A **primary data server** manages one or more primary databases, which are the sources of the data-changing operations or transactions in a replication system. The primary data server is configured to capture information needed for replication.

All primary data servers are supported by Replication Agents. ASE has an internal Replication Agent. The non-ASE servers require an external Replication Agent.

### Supported primary database servers

In addition to Adaptive Server Enterprise, Sybase replication technology actively supports transaction replication from the following relational database servers:

- IBM DB2 UDB on z/OS
- IBM DB2 UDB on UNIX/Windows
- Microsoft SQL Server
- Oracle
- SQL Anywhere

To find out about the most current, supported versions of these data servers, see the documentation for the Replication Agent that supports a particular non-ASE data server.

### General issues for non-ASE primary data servers

There are several issues related to non-ASE primary data servers in a Sybase replication system. A successful replication system must address all of the issues for each primary data server.

Non-ASE primary data server issues include:

- The requirements of the Replication Agent, including any limitations, intrusions, and impacts on the data server's operation
- The access and permissions necessary for the Replication Agent to obtain transactions from the primary database
- The connectivity requirements to support communication between the primary data server and other replication system components
- The limitations imposed on the replication system by the non-ASE data server
- The datatype conversions (or translations) that may be required to replicate transactions from one type of data server to another
- The replication system management issues specific to the non-ASE data server

The following sections describe the specific primary data server issues for each actively supported type of non-ASE data server.

## Replication Agent

A **Replication Agent** transfers transaction information, which represents changes made to data schemas and execution of stored procedures, from a primary data server to a Replication Server, for distribution to other (replicate) databases.

In Adaptive Server Enterprise, an embedded Replication Agent is provided with the database management system software. The Replication Agent for ASE is called Replication Agent, and it is an Adaptive Server thread.

For non-ASE data servers, Sybase provides Replication Agent products:

- Replication Agent for DB2 UDB – provides primary data server support for IBM DB2 UDB servers that run on IBM z/OS platforms.
- Replication Agent – provides primary data server support for DB2 UDB, Microsoft SQL Server, and Oracle data servers that run on Linux, UNIX, or Microsoft Windows platforms.
- Replication Agent for SQL Anywhere – is designed specifically for high-performance OLTP (online transaction processing) and mixed-workload enterprise computing. It is designed for embedded database applications, mobile computing applications, and workgroup server applications.

Replication Agents read the primary database transaction log. The primary Replication Server reconstructs the transaction and forwards it to replicate sites that have subscriptions for the data.

A Replication Agent is required for each database that contains primary data or for each database where replicated stored procedures are executed.

## Replication Server

A **Replication Server** at each primary or replicate site coordinates data replication activities for local data servers and exchanges data with Replication Servers at other sites.

Replication Server performs the following major tasks:

- Receives transactions from primary databases through a Replication Agent and distributes them to replicate database sites that have subscriptions for the data
- Receives transactions from other Replication Servers and applies them to local replicate databases or forwards them to other replication servers that have subscriptions for the data
- Provides guaranteed delivery of transactions to each replicate site

The information needed to accomplish these tasks is stored in Replication Server system tables. The system tables include descriptions of the replicated data and replication objects, such as replication definitions and subscriptions, security records for Replication Server users, routing information for other Replication Server sites, access methods for local databases, and other administrative information.

Replication Server system tables are stored in a database called the *Replication Server System Database* (RSSD). Alternately, the Replicate Server can use an embedded RSSD (ERSSD). Each Replication Server has its own RSSD.

For more information about Replication Server, see “Replication Server” on page 8, and Chapter 5, “Microsoft SQL Server Primary Data Server Issues.”

## Database gateway

A **database gateway** allows clients using one communication protocol to connect with data servers that use a different protocol.

The Sybase Enterprise Connect Data Access product line consists of database gateway servers that allow clients using the Sybase Open Client and Open Server protocol (such as Replication Server) to connect with non-Sybase data servers, using either the data server's native communication protocol or the standard, ODBC protocol.

Sybase Enterprise Connect Data Access products also allow for the retrieval of metadata from non-ASE replicate data servers.

For more information about Enterprise Connect Data Access database gateways, see "ECDA" on page 42.

Gatewayless connections

Sybase also provides the Mainframe Connect DB2 UDB Option for CICS product that allows "gatewayless" connections to IBM DB2 UDB data servers on IBM z/OS platforms. In some environments, a gatewayless connection to the DB2 data server may be more efficient than a gateway server connection.

Replication Server does not need an additional gateway to communicate with ASE and SQL Anywhere, which are both Sybase products.

## Replicate data server

A **replicate data server** manages a database that contains replicate data, which is data that is a "copy" of the data in a primary database.

Replication Server maintains the data in a replicate data server by logging in as a database user. In the case of non-ASE data servers, Replication Server logs in to the replicate data server through a database gateway server or directly to the data server.

Replication Server can treat any server as a data server if it supports a set of required data operations and transaction processing directives, either directly (such as Adaptive Server Enterprise) or indirectly (such as a Enterprise Connect Data Access database gateway server).

### Supported replicate database servers

In addition to Adaptive Server Enterprise, Sybase replication technology supports transaction replication into the following relational database servers:

- IBM DB2 UDB
- Microsoft SQL Server
- Oracle

- SQL Anywhere (Replication Server can connect directly to any supported version of SQL Anywhere)

For more information regarding the current supported versions of Oracle, Microsoft SQL Server, and DB2 UDB data servers, refer to the documentation for the ECDA database gateway associated with a particular non-ASE data server.

### General issues for non-ASE replicate data servers

There are several issues related to non-ASE replicate data servers in a Sybase replication system. A successful replication system must address all of the issues for each replicate data server.

Non-ASE replicate data server issues include:

- The requirements of the ECDA database gateway for the non-ASE data server
- The access and permissions required in the replicate data server for the replication system to apply transactions to the replicate database
- The connectivity requirements for communication between the replicate data server and other components of the replication system
- The limitations on replication into the non-ASE data server
- The intrusion and impact of the database objects required to support Replication Server operations
- The replication system management issues specific to the non-ASE data server

## Non-ASE replication issues

The biggest challenge in implementing a successful heterogeneous replication system is accommodating the unique characteristics of data servers that are supplied by different vendors. Regardless of the type or brand of a data server, there are issues that are specific to the data server’s role in the replication system. When a single data server acts as both a primary data server and a replicate data server (bidirectional replication), there are still more issues to consider.

## Primary database issues

The following primary database issues must be addressed in a successful heterogeneous replication system:

- The requirements of the Replication Agent and the intrusions and impacts of the Replication Agent on the data server. For example, some Replication Agents create and use database objects in the primary database to support replication.
- The access and permissions required in the data server for other replication system components. Both the primary Replication Server and the Replication Agent for a database must have user IDs and passwords defined in the database with appropriate permissions to access primary database objects.
- The connectivity required to support communication between the data server and other replication system components. Replication Agents use the native communication protocol of the data server, ODBC protocols, or JDBC protocols to communicate with the primary database. Replication Server may require a database gateway to communicate with a data server.
- The specific limitations on replication from the particular data server. For example, some Replication Agents restrict the configuration options of some data servers. Replication Server may impose size limitations on some native datatypes in some databases.
- How replication definitions stored in the RSSD are used by the Replication Agent for the particular data server. For example, both Replication Server and Replication Agents are case-sensitive in identifying database object names, but some databases are not.
- The datatype conversions that may be required when replicating transactions from one particular data server to another type of data server. For example, almost every type of data server has a unique way of representing temporal data. The TIMESTAMP datatype in one database may need to be “translated” to be stored as a datetime datatype in another database.
- The replication system management issues specific to the particular data server. For example, different data servers allow different system management options.

For more information about specific primary database issues for specific databases, see the appropriate chapter for your database.

## Replicate database issues

The following replicate database issues must be addressed in a successful heterogeneous replication system:

- The requirements of the ECDA database gateway for the particular database server. Configure the DirectConnect access services to work with the replicate database server and Replication Server.
- The access and permissions required in the data server for the replication system to apply transactions to the replicate database. Both the replicate Replication Server and the ECDA gateway for a database must have user IDs and passwords defined in the database, with appropriate permissions to access replicate database objects.
- The connectivity required to support communication between the replicate data server and other replication system components. ECDA gateways use either the native communication protocol of a data server, or standard ODBC or JDBC protocols to communicate with a replicate database. Replication Server generally requires a database gateway to communicate with a non-ASE data server.

  **Note** In the case of DB2 UDB on IBM z/OS, Replication Server can use the Mainframe Connect DirectConnect for z/OS Option to connect directly to the mainframe in a gatewayless system, eliminating the need for a database gateway. Replication through a gatewayless connection requires a TCP/IP connection to the mainframe. See Chapter 8, “DB2 UDB for z/OS Replicate Data Server Issues,” and the *Mainframe Connect Server Option for IBM IMS and MVS Installation and Administration Guide*.

- The limitations on replication into the particular data server. For example, Replication Server imposes limitations on some native datatypes in some databases.
- The intrusion and impact of the database objects required to support Replication Server operations. Replication Server requires two tables and may require some stored procedures to manage a replicate database.
- The replication system management issues specific to the particular data server. For example, different data servers allow different system management options.

For more information about specific replicate database issues for specific databases, see the appropriate chapter for your database.

## Setting character sets

In a heterogeneous replication system, in which the primary and replicate data servers are different types, servers may not support all the same character sets. In such cases, replication system components must perform at least one character set conversion (from the primary data server's character set to the replicate data server's character set).

Even in a homogeneous replication system, in which both primary and replicate data servers are the same type, character set conversions might be required if replication system components reside on more than one type of platform.

Character set problems can produce data inconsistencies between the primary database and the replicate database. To avoid character set problems, you must either:

- Use the same character set on all servers and platforms in the replication system, or
- Use compatible character sets on all servers and platforms in the replication system, and configure replication system components to perform the appropriate character set conversions.

For more information about setting and overriding the default character set, see the appropriate Replication Agent documentation.

## Heterogeneous replication limitations

There are some limitations of a heterogeneous replication system based on Sybase replication technology:

- Stored procedure replication
- Owner-qualified object names
- Large object replication
- Setup for replicate databases
- Replication Server support for encrypted columns
- Subscription materialization
- Replication Server rs_dump command

- Replication Server rs_marker command
- Replication Server rs_dumptran command
- Replication Server rs_subcmp utility

## Stored procedure replication

Stored procedure replication allows the execution call of a stored procedure to be replicated, including the parameter values passed as arguments to the primary stored procedure call.

The availability of stored procedure replication depends on the capabilities of the primary and replicate databases, as well as support from the associated Replication Agent and ECDA database gateway. Refer to the documentation for the specific Replication Agent and ECDA components to determine if stored procedure replication is available for your databases.

## Owner-qualified object names

Access to replicate tables and stored procedures in a non-ASE database often requires that the reference to the replicate table or stored procedure be owner-qualified.

For example, suppose the Replication Server maintenance user assigned to apply transactions to an Oracle replicate database is orauser. A replicate insert command to table table1 may fail with a “table not found” error if the owner of table1 is bob. When attempting to find table1, Oracle looks for orauser.table1, not bob.table1. To properly identify the replicate table to be updated, you can:

- Create an alias at the Oracle replicate database that refers to the correct replicate table. For example, create a synonym object in Oracle named table1, which refers to the fully qualified name of “bob.table1.”
- When creating the replication definition, use the with replicate table named [table_owner.['table_name']] clause. Continuing with the same example, the clause is:

```
with replicate table named bob.table1
```

### Owner qualifying with multiple replicate databases

The problem becomes a little more complicated when table1 is to be replicated to more than one replicate database (for example, Oracle replicate table bob.table1). The option of using the with replicate table named clause in the replication definition supports only one replicate table name.

To work around this issue, create multiple replication definitions, one for each unique replicate table name required. Make sure each subscription refers to the correct replication definition and each replication definition uses the with replicate table named clause.

## Large object replication

Large object (LOB) datatypes (such as BLOB, CLOB, IMAGE, and TEXT) provide support for the longest streams of character and binary data in a single column. The size of the LOB datatypes poses unique challenges, both as primary and replicate data.

### Primary database LOB replication issues

At the primary database, the impact of LOB datatypes is on the transaction logging function. For Replication Agents, the log resources must be adequate to support retention of the changes in LOB data, only after images of LOB data are logged. The ability of LOB replication depends on the capabilities of the Replication Agent.

### Replicate database LOB replication issues

Adaptive Server Enterprise uses a text pointer to identify the location of text and image column data. The text pointer is passed to system functions that perform the actual updates to data in these large columns. The same technique is used internally in Replication Server to apply LOB datatypes. Replication Server obtains a text pointer, and data server function calls are made to apply the data to replicate databases.

When a non-Sybase database is the replicate database, the database gateway used to communicate with the replicate database must be able to emulate the Adaptive Server text pointer processing. The ECDA Option for ODBC, ECDA Option for Oracle, and the Mainframe Connect DirectConnect for z/OS Option gateways provide this feature.

ECDA Option for ODBC

The ECDA Option for ODBC provides support for LOB replication into Microsoft SQL Server databases. See Chapter 10, “Microsoft SQL Server Replicate Data Server Issues.”

**Mainframe Connect DirectConnect for z/OS Option**

In a replicate database in IBM DB2 UDB for z/OS, you can use the Mainframe Connect DirectConnect for z/OS option to provide a "gatewayless" connection to the replicate database, and use modified rs_get_textptr and rs_writetext function strings to support LOB replication into DB2. See Chapter 9, "DB2 UDB Replicate Data Server Issues for UNIX, Windows, and Linux."

**Text pointers**

You might be able to remove the dependency on text pointers from the Replication Server (or the ECDA database gateway) by modifying the Replication Server text pointer function strings and creating a stored procedure in the replicate database.

## Setup for replicate databases

Replication Server provides a utility named rs_init, which sets up an Adaptive Server database as a primary or replicate database as follows:

- Creates the Replication Server database connection
- Creates the required tables and stored procedures in the replicate database
- Defines the Replication Server maintenance user ID

Heterogeneous replication support does not include a utility that is equivalent to rs_init. Instead, Replication Server commands for creating connections, and primary and replicate data server commands for creating objects that did support replication including a maintenance user, may be used. In Replication Server 15.2, the introduction of the "using profile" clause of the create connection command may be used to accomplish many of these tasks.

## Replication Server support for encrypted columns

Replication Server supports replication of encrypted column data between Adaptive Server databases. However, replication of encrypted column data to any non-ASE replicate database is not supported.

To replicate non-encrypted data to an ASE database containing an encrypted column, disable the rs_set_ciphertext function string for the Adaptive Server connection.

**Function string**

rs_set_ciphertext

**Description**

Controls replication of encrypted columns to an Adaptive Server table.

Example

Alter function string rs_set_ciphertext to turn off execution of the ASE-specific command "set ciphertext on."

```
alter function string rs_set_ciphertext
for some_function_string_class
output language
''
```

## Subscription materialization

Materialization is creating and activating subscriptions, and copying data from the primary database to the replicate database, thereby initializing the replicate database.

Before you can replicate data from a primary database, you must set up and populate each replicate database so that it is in a state consistent with that of the primary database. There are two types of subscription materialization supported by Replication Server:

- Bulk materialization – manually creating and activating a subscription and populating a replicate database using data unload and load utilities outside the control of the replication system.
- Automatic materialization – creating a subscription and populating a replicate database using Replication Server commands.

Heterogeneous replication supports bulk materialization methods with varying complexity based on the specific Replication Agent capabilities.

See the *Replication Server Administration Guide* for a general discussion of subscription materialization, and see the appropriate Replication Agent documentation for details regarding a particular Replication Agent and its materialization support.

## Replication Server *rs_dump* command

The Replication Server rs_dump command is typically used to coordinate database dump activities across a replication system. When a replicate connection receives an rs_dump transaction, Replication Server executes the rs_dump function string for that connection. You can customize the rs_dump function string to execute whatever commands are required.

For non-ASE primary database replication, some Replication Agents provide a method to invoke the rs_dump command from a non-Sybase primary database. Refer to the appropriate Replication Agent documentation to determine if rs_dump execution from the primary database is supported.

For replicate databases, no default function string for rs_dump is provided.

For more information about the rs_dump command, its use, and function-string modifications, see the *Replication Server Reference Manual*.

## Replication Server *rs_marker* command

The Replication Server rs_marker command is a primary database transaction log marker mechanism assists with the materialization process. An rs_marker execution passes activate subscription and validate subscription commands to a primary Replication Server. Most Replication Agents support an rs_marker invocation to assist with materialization.

For more information about rs_marker usage, see the *Replication Server Reference Manual*. For more information about the use and availability of rs_marker for a particular database, see the appropriate Replication Agent documentation.

## Replication Server *rs_dumptran* command

The Replication Server rs_dumptran command is typically used to coordinate database transaction dump activities across a replication system. When a replicate connection receives an rs_dumptran transaction, the Replication Server executes the rs_dumptran function string for that connection. You can customize the rs_dumptran function string to execute whatever commands are required.

Heterogeneous replication does not support rs_dumptran for non-Sybase primary databases.

For replicate databases, no default function string for rs_dumptran is provided.

For more information about the rs_dumptran command, its use, and function-string modifications, see the *Replication Server Reference Manual*.

## Replication Server *rs_subcmp* utility

Replication Server provides an rs_subcmp executable program that you can use to compare primary and replicate tables, optionally reconciling any differences found.

For non-Sybase database support, you may use rs_subcmp, providing you have connectivity to the primary and replicate databases. You must also develop custom SELECT commands for the primary and replicate databases to generate comparable outputs for both. Additional options are to buy third-party tools that provide such functionality, or build your own application.

For more information about comparing and reconciling databases in a heterogeneous replication system, see Appendix C, “Heterogeneous Database Reconciliation.”

## Replication system non-ASE configurations

This section discusses several replication system configurations with heterogeneous or non-ASE data servers, and describes the issues with each configuration.

### Non-ASE primary to Adaptive Server replicate

The simplest heterogeneous replication scenario is replicating one-way from a non-ASE primary database to an Adaptive Server replicate database. The only unique requirements are a Replication Agent designed to extract transaction data from the non-ASE primary database, and the application of the Heterogeneous Datatype Support (HDS) feature of Replication Server to translate primary database native datatypes to Adaptive Server datatypes. See “Translating Datatypes using HDS” in the *Replication Server Administration Guide*.

#### Replication system components

The following components are required for a non-ASE primary to Adaptive Server replicate configuration:

- Non-ASE primary data server (for example, Oracle)

- Replication Agent designed for the primary data server
- Replication Server
- Adaptive Server replicate data server

### Replication system issues

In a non-ASE primary to Adaptive Server replicate configuration, the Replication Server database connection for the primary database may require a valid user ID and password for the primary database (validated only for Replication Agent), even though this user ID does not apply transactions to the primary database.

## ASE server primary to non-ASE server replicate

A simple heterogeneous replication scenario is replicating one-way from an Adaptive Server primary database to a non-ASE replicate. The only unique requirements are an ECDA database gateway to apply transaction data to the replicate database, except SQL Anywhere, and the application of the HDS feature of Replication Server to translate Adaptive Server datatypes to the native datatypes of the replicate database. For more detailed information about HDS, see “Translating Datatypes using HDS” in the *Replication Server Administration Guide*.

### Replication system components

The following components are required for an Adaptive Server primary to non-ASE replicate configuration:

- Adaptive Server primary database
- Replication Server
- ECDA database gateway designed for the replicate data server (for example, ECDA Option for Oracle
- Non-ASE replicate data server (for example, Oracle)

### Replication system issues

Consider the following issues in an Adaptive Server primary to non-ASE replicate configuration:

- The Replication Server database connection for the replicate database must include a valid user ID and password (the maintenance user) for the replicate database. This user ID must have authority to apply replicate transactions in the replicate database.
- The Replication Server replicate database connection must be created using the correct profile for the replicate database. The connection profile must specify function-string class and error class, and additionally may contain class-level translation definitions and replicate database object creation, to support replication.

## Non-ASE primary to non-ASE replicate

This scenario varies in complexity, depending on the mix of non-ASE data servers.

### Replication system components

The following components are required for a non-ASE primary to non-ASE replicate configuration:

- Non-ASE primary data server (for example, Oracle)
- Replication Agent designed for the primary data server (for example, Replication Agent for Oracle)
- Replication Server
- ECDA database gateway designed for the replicate data server, (for example, ECDA Option for ODBC), with the exception of SQL Anywhere
- Non-ASE replicate data server (for example, Microsoft SQL Server)

### Replication system issues

Consider the following issues in a non-ASE primary to non-ASE replicate configuration:

- The Replication Server primary database connection may require a valid user ID and password for the primary database. This user ID must have authority to apply replicate transactions (even if no transactions will be replicated to the primary database).

- The Replication Server replicate database connection must be created using the correct profile for the replicate database. The connection profile specifies function string classes and error classes, and additionally may contain class-level translation definitions and replicate database object creation, to support replication.

## Bidirectional non-ASE to non-ASE replication

In this scenario, replication occurs both to and from each database. Each non-ASE database must have both a Replication Agent *and* an ECDA database gateway.

### Replication system components

The following components are required for a bidirectional non-ASE primary to non-ASE replicate configuration:

- Non-ASE primary data server (for example, Oracle)
- Replication Agent designed for the primary data server (for example, Replication Agent for Oracle, Microsoft SQL Server, and DB2 UDB)
- ECDA database gateway designed for the “primary” data server acting as a replicate database (for example, ECDA Option for Oracle)
- Replication Server
- ECDA database gateway designed for the replicate data server (for example, ECDA Option for Oracle)
- Replication Agent designed for the “replicate” data server acting as a primary database (for example, Replication Agent for Linux, Microsoft Windows, and UNIX)
- Non-ASE replicate data server (for example, Oracle)

## Replication system issues

From a technical standpoint, you can set up a bidirectional replication scenario using only two Replication Server database connections (one “primary-and-replicate” connection for each database).

**Note** In the following description of bidirectional replication issues, the two databases are referred to as Database #1 and Database #2, because both databases take on both “primary” and “replicate” roles in the replication system.

Consider the following issues in a bidirectional non-ASE primary to non-ASE replicate configuration:

- The Replication Server primary database connection for Database #1 must include a valid user ID and password for the primary database. This user ID must be the same user ID specified in the Replication Server replicate database connection for Database #2 (the maintenance user). This user ID must have authority to apply transaction operations to replicate tables in Database #1.
- The Replication Agent for Database #1 must be configured to bypass maintenance user transactions to prevent a transaction from returning from the replicate tables in Database #2. See the appropriate Replication Agent documentation for details on configuring the Replication Agent to bypass maintenance user transactions.
- The Replication Server primary database connection for Database #2 must include a valid user ID and password for the primary database. This user ID must be the same user ID specified in the Replication Server replicate database connection for Database #1 (the maintenance user). This user ID must have authority to apply transaction operations to replicate tables in Database #2.
- The Replication Agent for Database #2 must be configured to bypass maintenance user transactions to prevent a transaction from returning from the replicate tables in Database #1. Refer to the appropriate Replication Agent documentation for details on configuring the Replication Agent to bypass maintenance user transactions.
- The Replication Server replicate database connections to Database #1 and Database #2 must be created using the correct profile for the replicate database. The connection profile specifies function-string classes and error classes, and additionally may contain class-level translation definitions and replicate database object creation, to support replication.

# CHAPTER 2 Replication Components Detail

This chapter describes in greater detail the Sybase software products that allow you to implement a Sybase replication system with heterogeneous or non-ASE data servers.

## Sybase replication products

Sybase offers product lines that specifically support replication systems with heterogeneous or non-ASE data servers, based on Sybase replication technology:

- Replication Server, which is the centerpiece of Sybase advanced replication technology and incorporates several features specifically to support non-ASE data servers in a Sybase replication system.
- Replication Server Options that consist of a Replication Agent and an Enterprise Connect Data Access (ECDA):
    - Replication Agents support Replication Server by providing a way to obtain replication data from non-ASE primary databases. Replication Agents provide this support for DB2 UDB, Microsoft SQL Server, and Oracle data servers.
    - ECDA database gateways support Replication Server by providing access to a variety of non-ASE databases, allowing them to function as replicate databases in a Sybase replication system.
- Replication Agent for IBM DB2 UDB that replicates data from IBM DB2 UDB on the mainframe.

- Replication Agent for SQL Anywhere that replicates data from a SQL Anywhere database.

# Replication Server

Replication Server can access data locally instead of from remote, centralized databases. Compared to a centralized data system, a replication system improves system performance and data availability, and reduces communication overhead. Replication Server provides a cost-effective, fault-tolerant system for replicating data.

Because Replication Server replicates transactions—incremental changes instead of data copies—and stored procedure invocations, rather than the operations that result from execution of the stored procedures, it enables a high-performance distributed data environment while maintaining transactional integrity of replicated data across the system.

## How Replication Server works

Replication Server works to distribute data over a network by:

- Providing application developers and system administrators with a flexible publish-and-subscribe model for marking data and stored procedures to be replicated
- Managing replicated transactions while retaining transaction integrity across the network

A Replication Server at each primary or replicate site coordinates the data replication activities for the local data servers and exchanges data with Replication Servers at other sites.

A Replication Server:

- Receives transactions from primary databases through Replication Agents and distributes them to sites with subscriptions for the data
- Receives transactions from other Replication Servers and applies them to local databases

Replication Server system tables store the information needed to accomplish these tasks. The system tables include descriptions of the replicated data and the following replication objects:

- Replication definitions and subscriptions
- Security records for Replication Server users
- Routing information for other sites
- Access methods for local databases
- Other administrative information

Replication Server system tables are stored in a database called the Replication Server System Database (RSSD).

To manage replication information in Replication Server, use Replication Command Language (RCL). You can execute RCL commands, which resemble SQL commands, on Replication Server using isql, the Sybase interactive SQL utility. For a complete reference for RCL, see the *Replication Server Reference Manual*.

## Publish-and-subscribe model

Transactions that occur in a primary database are detected by a Replication Agent and transferred to the local Replication Server, which distributes the information across a network to Replication Servers at destination sites. In turn, these Replication Servers update the replicate database according to the requirements of the remote client.

The primary data is the source of the data that Replication Server replicates in other databases. You publish data at primary sites to which Replication Servers at other (replicate) sites subscribe. To do so, you first create a *replication definition* to designate the scope and location of the primary data. The replication definition describes the structure of the table. A database replication definition can replicate individual tables, functions, and DDLs. A table replication definition describes the structure of the table and states the key that is to be used to query the table for updates and deletes.

Creating a replication definition does not, by itself, cause Replication Server to replicate data. You must also create a *subscription* against the replication definition to instruct Replication Server to replicate the data in another database. A subscription resembles a SQL select statement: It can include a where clause to specify the rows of a table you want to replicate in the local database.

You can have multiple replication definitions for a primary table to filter different objects. Replicate tables can subscribe to different replication definitions to obtain different views of the data.

After you have created subscriptions to replication definitions or publications, Replication Server replicates transactions to databases with subscriptions for the data.

## Replicated functions

With some data servers, Replication Server allows you to replicate stored procedure invocations asynchronously between databases. By encapsulating many changes in a single replicated function, you can improve performance over normal data replication. Because they are not associated with table replication definitions, replicated functions can execute stored procedures that may or may not modify data directly.

**Note** Replication Server does not support stored procedure replication on all types of data servers. For more information about replicating stored procedures on a particular data server, refer to the appropriate Replication Agent documentation.

With replicated functions, you can execute a stored procedure in another database. A replicated function allows you to:

- Replicate the execution of a stored procedure to subscribing sites
- Improve performance by replicating only the name and parameters of the stored procedure rather than the actual database changes

Replication Server supports both *applied functions* and *request functions*:

- An *applied function* is replicated from a primary to a replicate database. Create subscriptions at replicate sites for the function replication definition and mark the stored procedure for replication in the primary database.
- A *request function* is replicated from a replicate to a primary database. There is no subscription for a request function. Mark the stored procedure for replication in the replicate database.

## Transaction management

Replication Server depends on data servers to provide the transaction processing services needed to protect stored data. To guarantee the integrity of distributed data, data servers must comply with such transaction-processing conventions as atomicity and consistency.

Data servers that store primary data provide most of the concurrency control needed for the distributed database system. If a transaction fails to update a table with primary data, Replication Server does not distribute the transaction to other sites. When a transaction does update primary data, Replication Server distributes the changes, and unless a failure occurs, the update succeeds at all sites that have subscribed to the data.

## Relationship with other system components

Replication Server interacts with other components of a replication system as either a *server* or a *client*.

As a server, Replication Server supports connections from:

- Replication Agents, across which database commands are sent from primary databases
- Other Replication Servers, thus distributing the processing involved in message delivery and providing a degree of scalability in a replication system
- Users or management tools for administration, data server identification, message publication and subscription, and so on

As a client, Replication Server connects to:

- A Replication Server System Database (RSSD) which can be on an external Adaptive Server Enterprise database, or the internal embedded RSSD (ERSSD).
- A database gateway to connect to the replicate non-ASE database.

## Replication Server communication protocols

Replication Server is an Open Client and Open Server application that uses Sybase Tabular Data Stream™ (TDS) as the underlying communication protocol. Any clients that request services from Replication Server must implement an Open Client interface. This includes Replication Agents, system management tools, and user interface tools such as isql.

As a client distributing messages to other Replication Servers or to replicate data servers, Replication Server uses an Open Client interface. Therefore, when Replication Server needs to send a message to a data server, either that data server must support an Open Server interface running on TDS, or there must be an Open Server/TDS bridge or gateway application between Replication Server and the replicate data server.

Replication to SQL Anywhere does not require additional gateway software because it appears as an Open Server to Replication Server. However, to replicate to DB2 UDB, Microsoft SQL Server, and Oracle, the gateway software is in the form of a Sybase ECDA database gateway. Some ECDA gateways bridge from Open Server/TDS to the native interface of the replicate data server (for example, ECDA Option for Oracle), while others bridge from Open Server/TDS to an ODBC or JDBC driver for the data server. Replication Server configurations vary, depending on the gateway used.

## Replication Server user IDs and permissions

Replication Server requires several different user IDs. Some user IDs are required for other components (or users) to access the Replication Server, and others are required for the Replication Server to have access to other components in a replication system.

Define user IDs in the Replication Server using the Replication Server create connection command.

**Note** Depending on how your replication system is configured, some of the user IDs in the following list might not be required. For example, if you have separate Replication Servers for primary and replicate databases, the primary Replication Server does not require a user ID to access a replicate database.

The following user IDs are defined in a Replication Server:

- Replication Agent user – used by a Replication Agent to log in to a primary Replication Server. This user ID must have connect source permission to deliver database commands through the LTL interface.

- Replication Server user – used by other Replication Servers to log in to a Replication Server and forward messages. This user ID must have connect source permission to forward database commands through the RCL interface.
- SysAdmin user – used by system administrators or system administration tools to perform administration activities. Depending on the task, this user ID must have sa, create object, or primary subscribe permission.
- Maintenance user – used by Replication Server to deliver messages to a replicate data server. This user ID must have the necessary permissions in the replicate data server to execute the commands to which messages to be delivered are mapped to a primary database. Work performed by the maintenance user is not replicated.
- Replicate user – used by a replicate Replication Server to deliver messages to a primary data server. For delivery for "request" messages, that is, messages from a replicate data server that are selected for delivery to the primary data server, Replication Server uses the user ID of the user who executes the command in the replicate database. This user ID must have the necessary permissions in the primary data server to execute the commands to which messages to be delivered are mapped.
- RSI user – used by Replication Server to log in to other Replication Servers to forward messages to be delivered. This user ID must have connect source permission in the replicate Replication Server.
- RSSD user – used by Replication Server to log in to the Replication Server System Database (RSSD) that manages its operational data. This user ID must have full control in the RSSD to create and drop objects, execute procedures, and query and update tables.

## Relationship with Replication Agents

While Replication Server is extensible (customizable function strings and error handling, custom datatype definitions, and translations between datatypes) to meet the needs of replicate data servers, Replication Server support of primary data servers is limited.

The Replication Server interface for primary data servers is its proprietary Log Transfer Language (LTL). Transactions from a primary data server must be translated to LTL to be delivered to a primary Replication Server. Therefore, primary data servers are limited to those for which Sybase provides a Replication Agent to perform the translation to LTL for primary database operations.

Replication Server interfaces on both the primary and replicate sides are supported by the underlying Open Client/Open Server interface running on TDS.

### LTM locator updates

The primary Replication Server maintains a “locator” value (LTM locator) that identifies the last point in a transaction log from which all data has been successfully received by the primary Replication Server. The Replication Agent periodically requests this value from the Replication Server connection to identify a position in the transaction log, which can then be used to identify where older data can be released or removed from the log.

There is a performance trade-off in determining how often to request an LTM locator update. Frequent queries of the LTM locator value from a Replication Server can slow down replication (the Replication Agent must stop sending LTL commands long enough to request and receive the LTM locator value) while it provides more frequent opportunities to release data from the primary database transaction log. When restarting, the Replication Agent must re-send all data in the log that exists since the last LTM locator value was received from Replication Server.

Generally, if replication throughput performance is a priority, acquire enough log resource to allow less frequent log truncation and less frequent retrieval of the LTM locator value. If log resources are scarce, more frequent retrieval of the LTM locator value and more frequent truncation may be necessary.

For more information about using the LTM locator, see the appropriate Replication Agent documentation.

### LTL generation

The number of bytes of information sent to Replication Server has a direct impact on the performance of the replication system; more data and commands received by Replication Server require more work and time to process. In addition, more data also requires more network resources. There are several configuration options available for the Replication Agent that you can use to minimize this impact:

- Using the RSSD. By reading replication definitions from the RSSD, the Replication Agent can send the column data in the same column order as specified by the replication definition. This allows Replication Server to bypass sorting the column information before processing. Furthermore, column names are not sent with the data, which reduces the number of bytes of information required.

- Sending minimal columns. When an update operation occurs on a table, only a portion of the columns may have been altered. By sending the before and after images of only those columns that changed, the Replication Agent sends less information.

  **Note** Do not use minimal columns if the data in the replicate database involves custom function strings.

- Batch mode. A Replication Agent must “wrap” transactions in a limited amount of administrative LTL for the Replication Server. In batch mode, the Replication Agent can wrap multiple commands in the same set of administrative commands, which reduces the overall LTL generated and processed by the network and the Replication Server.

  In addition to batch mode, most Replication Agents have a “batch timeout” parameter, which allows a partial batch to be sent to the Replication Server after the Replication Agent waits a specified period of time and no additional transactions are received to fill the batch.

  **Note** Do not use Replication Agent batch mode if you use any Replication Server user-defined datatype (UDD) translations, either column-level or class-level.

- Origin time. Each transaction sent to Replication Server has an *origin queue ID*. The origin queue ID may include the time that the transaction was committed at the primary database. If the origin time is not sent by the Replication Agent, the processing effort is reduced somewhat, but the quantity of LTL sent to the Replication Server is the same.

For a complete description of the Replication Agent configuration parameters that affect LTL output, see the appropriate *Replication Agent Administration Guide*.

## Database connections

Replication Server keeps track of other components in a replication system using *connections* that identify primary and replicate databases and *routes* that identify other Replication Servers.

Since Replication Server was originally designed for Adaptive Server Enterprise database replication, the definition of a connection in Replication Server follows the Sybase standard of <*server name*>.<*database name*>. For example, a Replication Server connection to an Adaptive Server named ASE1 and database PUBS is named ASE1.PUBS.

The Replication Server cannot directly connect to a non-ASE data server. For a primary database, Replication Server allows a connection from a Replication Agent on behalf of the non-ASE primary database. For a replicate database, Replication Server connects to an ECDA database gateway, which in turn connects to the non-ASE replicate data server. Since Replication Agents and ECDA gateways are not data servers themselves, the Replication Server connection properties for those components may have different meanings than they do for a database server connection.

A single Replication Server connection can support data flow in either one or two directions. Data flows *in* through a Replication Server connection by way of the Replication Agent user thread. Data flows *out* through a Replication Server connection by way of the Data Server Interface (DSI) thread. Each Replication Server connection can support either outbound data flow only (through the DSI thread), or both inbound and outbound data flow (through the Replication Agent User and DSI threads).

## Replication Agent User thread

Replication Server receives all data-change operations or transactions to be replicated from a primary data server through the Replication Agent User thread of the database connection for that data server. Every primary database that supplies transactions to be replicated must be represented by a Replication Server database connection with an enabled Replication Agent User thread.

Replication Server establishes a connection directly with the primary database, if it resides in an Adaptive Server. If the primary database resides in a non-ASE data server, a separate Replication Agent component communicates with the Replication Server, using a Replication Agent User thread connection, on behalf of the primary database.

**Note** Replication Server never attempts to connect to the Replication Agent User thread of a connection. The only entity that can initiate communication to a Replication Agent User thread is the primary data server or the Replication Agent.

On a Replication Agent User thread, the primary data server or Replication Agent is the client, and the primary Replication Server is the server.

## DSI thread

The DSI thread of a Replication Server connection is where the replicated transaction is delivered by Replication Server. Every replicate database expected to receive replicated transactions must be represented by a Replication Server connection with an enabled DSI thread.

Replication Server establishes a connection directly with the replicate database, if it resides in an Adaptive Server or SQL Anywhere. If the replicate database resides in a non-Sybase data server, Replication Server communicates with an ECDA database gateway (or Mainframe Connect DirectConnect for DB2 UDB in a gatewayless environment), by way of the connection's DSI thread.

**Note** A replicate data server or database gateway never attempts to connect to the DSI thread of a connection. The only entity that can initiate communication to a DSI thread is the Replication Server.

On a DSI thread, the Replication Server is the client, and the replicate data server or database gateway is the server.

## Maintenance user purpose

To update replicated data, Replication Server logs in to the replicate data server as the maintenance user. The database owner (or the system administrator) must grant to the maintenance user the permissions required to insert, delete, and update rows in replicated tables, and to execute replicated stored procedures. In an Adaptive Server replicate database, Sybase Central or rs_init automatically creates the user ID for the Replication Server maintenance user and adds the user to the replicate database.

The maintenance user ID and password are defined to Replication Server automatically with the Replication Server create connection command for the replicate database. If you change the password for the maintenance user ID in the data server, you can use Sybase Central or the Replication Server alter connection command to change the password for the Replication Server connection.

The Replication Server maintenance user must also have permission to access the rs_lastcommit and rs_info system tables in the replicate database, and any stored procedures that use those tables.

Neither Sybase Central nor rs_init grants database permissions to the maintenance user for user tables and stored procedures. You must grant database permissions on replicated tables and stored procedures before you can replicate transactions for replicated tables or replicate executions of the replicated stored procedures. For each table replicated in the database, and for each stored procedure executed due to replication run:

```
grant all on table_name to maint_user
```

Alternatively, you can assign the maintenance user ID (maint_user) to a database administrator role, if that role has the required authority on all replicate objects.

## DDL user purpose

Replication for Microsoft SQL Server and Oracle can replicate DDL commands that are entered at the primary database to the subscribers database. This capability is supported only where the primary and replicate data servers are identical, for example Oracle to Oracle. For more information, see the *Replication Agent Administration Guide*.

## Datatypes and datatype definitions

Datatype definitions for a particular data server datatype are grouped in a *datatype class*.

For more information about datatype definitions (user-defined datatypes), see the description of the RSSD rs_datatype table in the *Replication Server Reference Manual*.

## Restricted datatype

You cannot use the rs_address datatype as either the source or target of column-level or class-level translations.

## Error and function-string classes for non-ASE data servers

Sybase provides function-string classes and associated function strings for all supported non-ASE replicate data servers. Non-ASE error classes are created by Replication Server and error actions are defined for different non-ASE error classes. You can create a connection to a non-ASE database with a corresponding error class by using the appropriate connection profile.

## Object publication and subscriptions

The following limitations apply to object publications and subscriptions in a Sybase replication system:

- When declaring columns in a replication definition for a non-ASE primary database, use the Replication Server datatype that matches the datatype of the column in the primary database. If there is no matching native Replication Server datatype, find a datatype definition that matches the primary database datatype.
- When creating subscriptions with where clauses predicated on a column involved in column-level translation, specify the predicate value in "declared" format (that is, before translation).

## Replication Agent

Replication Agent extends the capabilities of Replication Server by supporting non-ASE data servers as primary data servers in a Sybase replication system.

### How Replication Agent works

A Replication Agent is a Replication Server client that retrieves information from a primary database transaction log and formats it for the primary Replication Server.

Begin by marking for replication the desired primary tables and stored procedures in the Replication Agent,.The Replication Agent detects any changes to primary data and, using Log Transfer Language (LTL), which is a subset of Replication Control Language (RCL), sends primary data changes to the primary Replication Server.

A Replication Agent:

1. Logs in to the Replication Server.
2. Sends a connect source command to identify the session as a log transfer source and to specify the database for which transaction information will be transferred.
3. Retrieves the name of the maintenance user for the database from the Replication Server.
4. Requests the secondary truncation point for the database from the Replication Server.
5. Retrieves records from the transaction log, beginning at the record following the secondary truncation point, and formats the information into LTL commands.

## Replication Agent connections

A Replication Agent sends data to Replication Server. Replication Agent logs in to the Replication Server, connects to the Replication Agent User thread of a Replication Server connection, and communicates with Replication Server over that connection. This has the following implications:

- A valid user ID, which the Replication Agent uses to log in to the Replication Server, must be defined at the Replication Server.
- The Replication Agent user ID must be granted connect source permission in Replication Server. connect source permission allows the Replication Agent to send commands that are valid only on a Replication Agent User thread.
- The Replication Agent must record this user ID and associated password.
- The Replication Agent must record the *server* and *database* portions of the Replication Server connection definition to identify and connect to the correct Replication Agent User thread.
- The user_name and password defined in the Replication Server create connection command must be

  The Replication Agent validates that the connection user_name exists in the primary database. However, Replication Server does not know if (or when) a DSI thread will be used. Therefore, the user ID and password must be valid in case the DSI thread is active.

**Note** The requirement for a valid primary database user ID varies by Replication Agent. Some Replication Agents do not require (nor do they check for) a valid user ID on the Replication Server connection.

## Interfaces file

For the interaction between a Replication Agent and a Replication Server, the only *interface* file entry that may be required is one that identifies the Replication Server.

The Replication Agent for DB2 UDB does not require an *interface* file. The Replication Server and RSSD location, if needed, is in the *LTMCFG* file.

The Replication Agent (for DB2 UDB on UNIX and Windows platforms, Microsoft SQL Server, and Oracle) does not require an *interface* file entry, as it records the Replication Server host name and port number in configuration parameters.

Replication Agent for SQL Anywhere requires either an *interface* file or a *sql.ini* file entry.

## Replication Agent maintenance user processing

When the Replication Agent connects to a Replication Server connection, the Replication Agent requests the maintenance user ID and may validate that the user ID exists in the primary database. This validation requires that the maintenance user ID defined in any Replication Server connection be valid for the database the connection represents, regardless of whether that connection is for primary transactions only, replicate transactions only, or both.

The Replication Agent does not use the maintenance user ID to log in to the primary database. Other than validating that the user ID exists, the only reference the Replication Agent makes to the maintenance user ID is to filter out primary database transactions created by the maintenance user.

The Replication Agent filters out maintenance user transactions to avoid having a transaction applied more than once to the primary database. In a bidirectional replication scheme, replication can occur both to and from the same database (which may have both a primary and a replicate role). When a primary transaction is applied to a replicate database, the applying user ID is the maintenance user for the replicate database. A Replication Agent scanning transactions at the replicate database must ignore the transactions applied by the Replication Server maintenance user to prevent those transactions from being sent back and applied to the primary database.

The Replication Agent accesses the database using a user ID defined at the primary database (or for DB2, a user ID that can access the DB2 log files). This user ID is not the same as the maintenance user defined in the Replication Server connection. The Replication Agent user ID used to access the primary database has a different role and purpose than the maintenance user defined to apply replicated transactions.

There may also be another user ID defined to the Replication Agent that is used to administer the Replication Agent. This user ID is also separate from the Replication Server maintenance user that applies replicate transactions.

A Replication Agent can use three different users:

- A user ID defined at the primary database, which the Replication Agent uses to log in to the primary data server and manipulate primary replication objects or read the database transaction log.
- A user ID that can log in to the Replication Agent and issue Replication Agent commands and configure Replication Agent parameters.
- A maintenance user ID, defined at the primary database and recorded in the primary Replication Server connection. The Replication Agent validates this user ID on behalf of the Replication Server, and the Replication Agent can be configured to ignore transactions that are created by this user ID.

## DDL user processing

If DDL replication is available, this user is defined at the primary database. This user name is included in the LTL in all DDL commands sent by the Replication Agent. The DSI thread of the Replication Server uses this user name to apply the DDL to the replicate database.

## Replication Agents

Sybase offers the following non-ASE Replication Agents:

- Replication Agent for DB2 UDB – provides primary data server support for a DB2 UDB server running on IBM z/OS platforms.
- Replication Agent – provides primary data server support for DB2 UDB, Microsoft SQL Server, and Oracle data servers running on Linux, UNIX, and Microsoft Windows platforms.
- Replication Agent for SQL Anywhere – is designed specifically to replicate data from a SQL Anywhere database.

### Replication Agent for DB2 UDB

Replication Agent for DB2 UDB product fits into a replication system as follows:

- The primary data server is DB2 UDB, which runs as a subsystem in IBM z/OS. The transaction logs are DB2 logs.
- Replication Agent for DB2 UDB runs as a started task or job in IBM z/OS. It reads the DB2 logs and retrieves the relevant DB2 active and archive log entries for the tables marked for replication for one or more DB2 subsystems. It transfers that data to Replication Server using the TCP/IP communication protocol.

The DB2 data server logs any changes to rows in DB2 tables as they occur. The information written to the transaction log includes copies of the data before and after the changes. In DB2, these records are known as “undo” and “redo” records. Control records are written for commits and aborts; These records are translated to commit and rollback operations.

The DB2 log consists of a series of data sets, which Sybase Log Extract uses to identify DB2 data changes. Because DB2 writes change records to the active log as they occur, Sybase Log Extract can process the log records immediately after they are entered.

### Replication Agent

Replication Agent is a product that reads the database transaction logs in DB2 UDB, Microsoft SQL Server, or Oracle primary databases on Linux, UNIX, and Microsoft Windows platforms.

Replication Agent is implemented in the Java programming language. When you install Replication Agent, a Java Runtime Environment (JRE) is installed on the computer that is designated as the Replication Agent host machine.

Replication Agent uses the Java Database Connectivity (JDBC) protocol for all of its communication. It uses a single instance of the Sybase JDBC driver (jConnect™ for JDBC™) to manage all of its connections to Open Client and Open Server applications, including the primary Replication Server. In the case of the primary data server, Replication Agent connects to the primary database using the appropriate JDBC driver for that database.

### Replication Agent for SQL Anywhere

As a primary data server in a replication system, Replication Agent SQL Anywhere, packaged with the database, interacts with the Replication Agent. The Replication Agent for SQL Anywhere identifies and transfers transactions from the Replication Agent SQL Anywhere primary database to a primary Replication Server.

In Replication Agent for SQL Anywhere, all database object identifiers are case-insensitive (that is, uppercase and lowercase are treated as the same). In Adaptive Server Enterprise, database object identifiers are by, default, case-sensitive. With Replication Agent for SQL Anywhere, to ensure compatibility with ASE, verify that the case of database object identifiers matches in all parts of the SQL statements.

One of the differences between the Replication Agent for Adaptive Server Enterprise and the Replication Agent for SQL Anywhere is that while the ASE depends on a temporary recovery database to access old transactions, the SQL Anywhere Replication Agent accesses old transaction logs. No temporary recovery database exists for the Replication Agent for SQL Anywhere.

## ECDA

The Enterprise Connect Data Access (ECDA) products are Open Server-based software gateways that support DB-Library and CT-Library application programming interfaces (APIs), and Java Database Connectivity (JDBC) and Open Database Connectivity (ODBC) protocols. ECDA products serve as fundamental building blocks for database middleware applications that allow you to access mainframe and LAN-based non-ASE data sources.

ECDA products provide:

- Access services that provide access to non-ASE data sources
- Administrative services (through DirectConnect Manager) that provide server-side system management

## How ECDA works

All Sybase ECDA Options provide basic connectivity to non-ASE data services. In particular, they provide access management, copy management, and remote systems management.

Each ECDA Option consists of a DirectConnect server and one or more access service libraries. The server provides the framework in which the service libraries operate. From the server, each access service library accesses data from a particular target database, such as DB2 UDB, Microsoft SQL Server, or Oracle.

Each access service library contains one or more access services that are specific sets of configuration properties. An access service transfers data between Replication Server and the target databases.

The DirectConnect server listens for, validates, and accepts incoming client connections, such as language events or remote procedure calls (RPCs). These events are routed to the target data source (replicate database) through access services, which provide target-specific connectivity features, including datatype conversion, network connectivity, and SQL transformation.

### Interface file

Replication Server is an Open Server application; the preferred method for determining the location (host and port number) of another Open Server application is to look up the location in an file. The *interface* file contains a list of labels, typically server names, each of which has a corresponding host name and port number, where the identified server should be "listening" for login requests.

In the interaction between an ECDA database gateway and a Replication Server, the *interface* file is important. Because the Replication Server attempts to log in to the service identified by the server name in the Replication Server connection, that service name must exist in the Replication Server *interface* file. In addition, the *interface* file entry must also exist as a service name in the ECDA gateway configuration file entries.

A single ECDA can act as a gateway for one or many different database instances. In the ECDA configuration, each database to be accessed by the ECDA is configured as a unique *service name*. For the Replication Server to know which configured service name to connect to, it uses the server name passed at login time and expects to find a matching service name to use to complete the connection. The connection must match an *interface* file entry. For Microsoft SQL Server and SQL Anywhere the database name must be a valid database for that service. For more information about the role of service names and their configurations, refer to the *ECDA Access Service Users Guide*.

### Connection shared by Replication Agent and ECDA

A single Replication Server connection can support both an ECDA gateway and a Replication Agent, because each of these components connects to the Replication Server on a different thread. If you replicate information both into and out of the same database, having a common connection for both a database gateway and a Replication Agent can make the replication system network topology less resource intensive.

To create a Replication Server connection to a database that is both primary and replicate, you must define the connection to correctly support the ECDA database gateway, then configure the Replication Agent appropriately:

- In the Replication Server, use the create connection command to define the server_name and database_name for the connection. The server_name value must match a configured service name in the ECDA.
- In the Replication Agent, set the value of the rs_source_ds parameter to that server_name, and set the value of the rs_source_db parameter to the desired database_name.

## ECDA database gateways

In a Sybase replication system, the purpose of an ECDA database gateway is to apply transactions from a Replication Server to a non-ASE replicate database.

To accomplish this, Replication Server logs in to the ECDA gateway using the information specified for a Replication Server connection. Replication Server logs in to the server using the user_name and password, and issues a use database command for the database defined in the connection.

For Replication Server, there is nothing to distinguish an ECDA gateway from an Adaptive Server replicate database. Replication Server delivers the same commands—and expects the same results—from any DSI thread it communicates with.

This has the following implications:

- A valid user ID, which the Replication Server uses to log in to the replicate database, must be defined in a Replication Server connection.
- This user ID must be granted permissions to update replicate tables and execute replicate procedures.
- The replicate database must be able to maintain a RS_LASTCOMMIT table and a RS_TICKET_HISTORY table and support rs_get_lastcommit functionality.

  Replication Server provides sample connection profiles to set up the tables and functions required for a replicate database in DB2 UDB, Microsoft SQL Server, and Oracle databases.

  For an overview of the expectations of a replicate data server and gateway, see Chapter 6, "Replicating Data into Foreign Data Servers," in the *Replication Server Design Guide*.
- Datatype representations must be translated to match the native datatypes of the replicate database. Replication Server provides sample connection profiles to set up the function strings, function-string classes, and base datatype definitions and translations necessary to support replication into DB2 UDB, Microsoft SQL Server, and Oracle data servers.
- The Replication Server command resume connection attempts to initiate activity with the DSI thread of the specified connection. For an ECDA, this is logging in to the DirectConnect server, accessing the RS_LASTCOMMIT table in the replicate database, and then applying transactions to the replicate database. Any failure in this sequence is recorded as a failure in the Replication Server log.

## ECDA Options

There are three options available for ECDA:

- ECDA Option for ODBC
- ECDA Option for Oracle
- Mainframe Connect DirectConnect for z/OS Option

## ECDA Option for ODBC

ECDA Option for ODBC provides Replication Server with an Open client interface to DB2 UDB, Microsoft SQL Server, and ODBC-accessible databases.

**Note** The ODBC driver for the ECDA Option for ODBC (the back-end driver connecting to the target) is not provided by Sybase; you must obtain, install, and configure it.

ECDA Option for ODBC provides access to non-ASE data sources, using the ODBC back-end (server-side) driver that you obtain for your target database, such as IBM DB2 or Microsoft SQL Server. Following the vendor's instructions, install the ODBC driver on the same server as ECDA Option for ODBC, then configure ECDA Option for ODBC to use that ODBC driver to access your database.

**Note** Verify that your ODBC driver is compatible with Sybase driver manager software or that it contains a driver manager.

Because ODBC drivers have varying degrees of functionality, it is important that when working with non-ASE-provided, third-party ODBC drivers, you carefully integrate and test them to be sure they meet your needs.

## ECDA Option for Oracle

ECDA Option for Oracle provides Replication Server with an Open Client interface to Oracle databases. To Replication Server, ECDA Option for Oracle appears as an Open Server application that understands Oracle SQL.

## Mainframe Connect DirectConnect for z/OS Option

Mainframe Connect DirectConnect for z/OS Option provides Replication Server with an Open client interface to DB2 running on a mainframe.

PART 2

# Non-ASE Primary Data Server Topics

Chapters in this part describe data server issues and considerations for primary data servers in a replication system with non-ASE data servers.

- Chapter 3, “DB2 UDB Primary Data Server Issues for z/OS,” describes the issues specific to IBM DB2 UDB primary data server on IBM z/OS in a Sybase replication system.
- Chapter 4, “DB2 UDB Primary Data Server on UNIX, Windows, and Linux,” describes the issues specific to IBM DB2 UDB primary data server on UNIX, Windows, and Linux in a Sybase replication system.
- Chapter 5, “Microsoft SQL Server Primary Data Server Issues,” describes the issues specific to Microsoft SQL Server primary data server in a Sybase replication system.
- Chapter 6, “Oracle Primary Data Server Issues,” describes the issues specific to the Oracle primary data server in a Sybase replication system.
- Chapter 7, “SQL Anywhere Primary Data Servers,” describes the issues specific to SQL Anywhere primary data servers in a Sybase replication system.

CHAPTER 3

# DB2 UDB Primary Data Server Issues for z/OS

This chapter describes the primary data server issues and considerations specific to the DB2 UDB server on a IBM z/OS platform in a Sybase replication system.

## Replication Agent for DB2 UDB

As a primary data server, the DB2 UDB interacts with the Replication Agent for DB2 UDB.

The Replication Agent identifies and transfers information about data-changing operations or transactions from a DB2 UDB primary database to a primary Replication Server.

The Replication Agent interacts with the primary Replication Server and with the RSSD of the primary Replication Server, if so configured.

## Replication intrusions and impacts

The Replication Agent DB2 libraries must be authorized by the authorized program facility (APF).

The performance and operation of DB2 UDB primary data servers in a Sybase replication system might be affected as follows:

- In the DB2 UDB transaction log:
    - Replication requires a *before* and *after* image of each row that is changed. When you mark a primary table for replication, the table is altered with the DATA CAPTURE CHANGES clause. As the number of tables marked for replication increases, so does the DASD space requirement for the DB2 UDB active log data sets.
    - Using Replication Agent for DB2 UDB increases the amount of data stored in DB2 UDB logs. The size of the increase depends on the number, type, and size of the primary tables, and the types of transactions replicated. For example, update transactions require both *before* and *after* images, and they include all of the columns in a row, even if those columns do not change. For more detailed information, see the Replication Agent for DB2 UDB documentation.
- When you install the Replication Agent, two Replication Agent system tables are created in the primary DB2 UDB:
    - LTMOBJECTS contains a row for each primary table marked for replication. Its size depends on the number of tables marked for replication.
    - LTMMARKER, when updated, can be used to aid in the materialization process.
- A task started in Replication Agent for DB2 UDB can process the log of a single DB2 subsystem, or all logs in a DB2 data sharing group. This behavior is controlled by LTMCFG parameters: DataSharingOption, DataSharingMember, Log_identifier, and BSDS.
- Primary database limitations:
    - LOB replication is not supported.
    - char and varchar maximum size is 32767.
    - DDL and stored procedure replication is not supported.
- Do not use these DB2 UDB utilities, as doing so may jeopardize replication integrity:

- LOAD LOG NO
- RECOVER
- REORG with RECOVER

## DB2 UDB primary database permissions

Create these two user IDs:

- LTMADMIN user – a TSO user, optionally named LTMADMIN, to:
  - Install, start, and stop the Replication Agent for DB2 UDB
  - Manage the Replication Agent system tables on the DB2 UDB

  The LTMADMIN user must have ALTER TABLE authority on any DB2 UDB table to be marked for replication. This user ID issues an ALTER TABLE DATA CAPTURE CHANGES command on a primary table that is marked for replication.

  The LTMADMIN user must also have TRACE, DISPLAY, and MONITOR2 permission on the DB2 UDB log files.

- Replication Server maintenance user – the user ID specified in the Replication Server create connection command for the primary database.

  Any updates applied to the primary database by the maintenance user are ignored for replication, unless the value of the LTM for z/OS LTM_process_maint_uid_trans configuration parameter is Y.

## Primary data server connectivity

To connect to a primary DB2 UDB data server in an IBM z/OS environment Replication Agent for DB2 UDB requires:

- A valid user ID (the LTADMIN user identified earlier) must be defined to IBM z/OS and granted execute permission to the correct DB2 UDB plan and package. Replication Agent for DB2 UDB uses this user ID to log in to the DB2 UDB.

- Replication Agent for DB2 UDB jobs must have their Job Control Language (JCL) modified to execute with the correct accounting, user id, DB2 UDB logs, and DB2 UDB subsystem libraries.

## Replication Server connectivity

Replication Agent for DB2 UDB does not use an *interface* file to connect to the Replication Server. The information needed to connect to the Replication Server is in the *LTMCFG* file. The Replication Server *interface* file does not require an entry for Replication Agent for DB2, unless the Replication Manager is used to create replication objects.

## RSSD connectivity

Replication Agent for DB2 UDB does not require access to the RSSD. However, you can reduce the amount of data between the Replication Agent for DB2 UDB and Replication Server by using an RSSD.

Replication definitions are loaded when Replication Agent for DB2 UDB starts. If the replication definition is changed, stop and restart the Replication Agent.

The information needed to connect to the RSSD is provided in the LTMCFG file. The parameters will all begin with RSSD, and all parameters must be entered. However, they are not verified if use_repdef is set to N.

## DB2 UDB primary database configuration issues

The Replication Agent for DB2 UDB is a mainframe z/OS application consisting of two tasks that run simultaneously in a single z/OS address space:

- **Sybase Log Extract** – continuously scans the DB2 UDB active and archive logs for data-changing operations on primary tables.

- **Replication Agent for DB2 UDB for z/OS** – receives replicated transactions from Sybase Log Extract, converts them to Log Transfer Language (LTL), and sends them to the primary Replication Server.

Replication Agent can run against a single DB2 subsystem, or all logs in a DB2 data-sharing group. LTMCFG parameters describe the DB2 environment for Replication Agent for DB2 UDB (DataSharingOption, DataSharing Member, Log-identifier, and BSDS.)

For the Replication Agent for DB2 UDB that reads multiple logs for DB2 susbsystems, the Boot Strap Data Set (BSDS) parameter identifies the BSDS for each DB2 member, which allows the member, which displays the position of the Replication Agent for DB2 UDB and the DB2 log for each member of the data-sharing group.

All Replication Agent installation and configuration issues are described in the *Replication Agent for DB2 UDB Installation Guid*e. However, in a heterogeneous replication system:

- The values of the RS_source_ds and RS_source_db parameters are case-sensitive. If you do not use same case in both Replication Agent and Replication Server parameters, the connection fails.
- The Replication Agent for DB2 UDB for z/OS LTM_process_maint_uid_trans configuration parameter controls whether the Replication Agent sends transactions executed by the maintenance user to the primary Replication Server.

  In a bidirectional replication environment (replicating both into and out of the same DB2 UDB region), set the value of the LTM_process_maint_uid_trans parameter should be set to N. If you do not, transactions replicated to another site may return to be applied at the originating site, creating an endless loop.

## Replication definitions for primary tables in DB2 for z/OS

The Replication Agent for DB2 UDB for z/OS Use_repdef configuration parameter controls whether the Replication Agent sends Log Transfer Language (LTL) that contains only the columns specified in a replication definition, or all of the columns in the DB2 UDB primary table.

When the value of the Use_repdef parameter is set to N, the Replication Agent sends LTL with data for all of the columns in the DB2 UDB primary table. When the value of the use_repdef parameter is set to Y, the Replication Agent sends LTL with data for only the columns specified in the replication definition.

By sending data for only the columns needed for the replication definition, network traffic is reduced, which may improve performance.

If you set the value of Use_repdef to Y, you can use other parameters, such as suppress_col_names, to enhance Replication Agent performance. See the *Replication Agent for DB2 UDB Installation Guide*.

The LTL_table_col_case parameter controls the case in which the Replication Agent sends table and column names to Replication Server. The default in DB2 is uppercase. However, with this parameter you can change the table and column names to uppercase, lowercase, or keep the names as defined in DB2.

Names of tables can conflict with reserved words in Replication Server or the target database.To preserve the table name, you can use "with primary table named" and "with replicate table named" clauses. However, you can have Replication Agent for DB2 change the table name prior to sending the LTL to Replication Server by using the REPLICATE_NAME option in the LTMOBJECTS table. See the "DB2 table names and reserved keywords" section in Chapter 3, "Replication Agent Setup" of the Replication Agent for DB2UDB User and Troubleshooting Guide.

## DB2 for z/OS primary datatype translation issues

The Replication Agent for DB2 UDB for z/OS Date_in_char, Time_in_char, and Timestamp_in_char configuration parameters control whether the Replication Agent sends values in character strings, or converts them to the Sybase datetime format.

See the *Replication Agent for DB2 UDB Users and Troubleshooting Guide* for a complete description of these parameters.

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**Note** If you use any date- or time-related user-defined datatypes (UDDs) in a replication definition, Sybase recommends that you configure the Replication Agent to send data to the Replication Server in the format that is native to the primary database. Sybase recommends to *not* have the Replication Agent perform any datatype translations.

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In general, the Replication Agent for DB2 UDB should not perform datatype translations. However, when all of the replicate data servers require the same translation, to save processing time, it is probably better to perform the translation once at the Replication Agent, rather than at each replicate database DSI.

IBM DB2 UDB represents midnight as 24.00. This format may not be compatible with other data servers. To change the value from 24.00 to 00.00, you can modify the datatype definition to automatically change the value.

### Character sets

Data within DB2 can be encoded with multiple character sets. Additionally, Replication Agent DB2 can be used to convert the replicated characters to the Replication Servers character set before it is sent to the Replication Server. The parameters that control character set properties in Replication Agent DB2 are codepage and RS_ccsid. For additional information on these parameters, see the *Replication Agent Install Guide*, Appendix titled “LTM for MVS Configuration Parameters.”

## Materialization

Use Replication Agent for DB2 UDB to materialize the target with the DB2 data. The DB2 unload utility produces a data file and a punch-card file that describes the data. You can use these files as input to the materialization feature of Replication Agent for DB2 UDB to initialize the replication target. See “Using Replication Agent materialization” in Chapter 2, “Replication Server Setup,” in the *Replication Server Troubleshooting Guide*.

CHAPTER 4

# DB2 UDB Primary Data Server on UNIX, Windows, and Linux

This chapter describes the primary database issues and considerations specific to the DB2 UDB server on a UNIX, Windows, and Linux platform in a Sybase replication system.

## Replication Agent for UDB

As a primary data server, DB2 UDB interacts with Replication Agent. An instance of the Replication Agent configured for the DB2 UDB is referred to as a *Replication Agent for UDB.*

The Replication Agent for UDB identifies and transfers information about data-changing operations or transactions from a DB2 UDB primary data server to a primary Replication Server.

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**Note** A separate Replication Agent for UDB instance is required for each database from which transactions are replicated.

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The Replication Agent interacts with the primary Replication Server and with the RSSD of the primary Replication Server, if so configured.

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**Note** Replication Agent is a Java program. Some operating systems may require patches to support Java. Refer to the *Replication Agent Administration Guide* and the *Replication Agent Release Bulletin*.

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## DB2 UDB system management issues

The Replication Agent provides a number of commands that return metadata information about the primary database (database names, table names, procedure names, column names, and so on). It does this by issuing specific JDBC calls designed to return this information or by querying the system tables directly.

## Replication Manager limitations

The Replication Manager plug-in cannot start, but can stop a Replication Agent instance in a primary DB2 UDB data server.

See the Replication Agent *Administration Guide* for more information about starting and stopping a Replication Agent instance.

## Replication intrusions and impacts on the DB2 UDB

The performance and operation of the DB2 UDB primary data servers in a Sybase replication system might be affected by the transaction log in the following ways:

- You must set the LOGARCHMETH1 configuration parameter to LOGRETAIN or DISK:<*path*>, where <*path*> is the directory to which the logs are archived (by using the pdb_xlog command). To determine the current LOGARCHMETH1 setting, use the following UDB command:

  ```
  get db cfg for <db-alias>
  ```

- Replication requires a *before* and *after* image of each row that is changed. When you mark a primary table for replication, the Replication Agent for UDB sets the table's DATA CAPTURE option to DATA CAPTURE CHANGES. As the number of tables marked for replication increases, so does the space requirement for the DB2 UDB transaction log.
- The primary database must have a temporary user system-managed tablespace with a page size of at least 8KB.

## Primary database limitations in the DB2 UDB

Replication Agent does not support stored procedure or DDL replication for DB2 UDB. See the *Replication Agent Primary Database Guide*.

## DB2 UDB primary database permissions

The Replication Agent for UDB requires an DB2 UDB login that has permission to access data and create new objects in the primary database.

The DB2 UDB login must have SYSADM or DBADM authority to access the primary database transaction log.

## Primary data server connectivity

Replication Agent for UDB requires the following to connect to a primary DB2 UDB data server:

- If the Replication Agent for UDB is installed on a different host machine from the DB2 UDB server, install the DB2 UDB Administration Client on the Replication Agent host machine.

  If the Replication Agent for UDB software is installed on the same host machine as the DB2 UDB server, a separate DB2 UDB Administration Client is not required.

  On a Windows system, you may configure an ODBC data source in the DB2 UDB Administration Client, then use the database name and database alias specified for that ODBC data source when you configure Replication Agent for UDB connectivity.

  On a UNIX system, instead of using ODBC, catalog the node and the primary database in UDB. Then, use the database alias specified when cataloging the primary database to set the data source Replication Agent configuration parameter.

- You can find a description of the Replication Agent configuration parameters that must be set in Chapter 1 “Preparing for Installation” in the *Replication Agent Installation Guide*.

## Replication Server connectivity

A description of the Replication Agent configuration parameters that must be set to allow Replication Agent to connect to the primary Replication Server in Chapter 1 “Preparing for Installation” in the *Replication Agent Installation Guide*.

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**Note** Replication Agent uses TCP/IP and the Sybase JDBC driver (jConnect for JDBC, which is included in Replication Agent installation) to communicate with other Sybase servers. The Replication Agent does not rely on the Sybase *interface* file for connectivity information.

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## RSSD connectivity

You can find a description of the Replication Agent configuration parameters that must be set to allow Replication Agent to connect to the primary Replication Server in Chapter 1 “Preparing for Installation” in the *Replication Agent Installation Guide*.

## Replication Agent objects

When you initialize Replication Agent using pdb_xlog init it creates objects that support replication in the primary database. For details, see the *Replication Agent Primary Database Guide*.

### Java procedure objects

Replication Agent for UDB installs *SYBRAUJAR.jar* and *SYBTRUNCJAR.jar* into the following directories:

- On Windows, the files are installed in *%DB2DIR%/SQLLIB/FUNCTION/jar/pds_username*. *$DB2DIR* is the path to the UDB installation, and *pds_username* is the name of the primary database user specified by the pds_username Replication Agent configuration parameter.
- On UNIX, the files are installed in *$HOME/sqllib/function/jar/pds_username*. *$HOME* is the home directory of the UDB instance owner and the pds_username is the name of the primary database user specified by the pds_username Replication Agent configuration parameter.

These Jar files implement several Java procedures in the UDB primary database. Table 4-1 lists the Java procedures that are created during the Replication Agent initialization and used in log truncation.

***Table 4-1: Java procedures for truncation***

| **Procedure** | **Database name** |
|---|---|
| Retrieves the name of the log file that contains the current LSN | *prefix*get_log_name_ |
| Retrieves the version of the get_log_name Java class | *prefix*get_version_str_ |
| Truncates the database log file or files from the archive log directory | *prefix*trunc_log_files_ |
| Retrieves the version of the trunc_log_files Java class | *prefix*get_trunc_ver_str_ |

Getting actual names of the Replication objects

The Replication Agent instance generates the names of its database objects. To find the names of the Replication Agent objects, at the Replication Agent administration port, invoke the pdb_xlog command with no keywords:

```
pdb_xlog
```

The pdb_xlog command returns a list of objects created by the Replication Agent in the primary database.

## DB2 UDB primary database configuration issues

All the installation issues and configuration parameter details for a primary DB2 UDB data server are in the *Replication Agent Installation Guide*. However, this section describes additional issues specific to heterogeneous replication.

### Java Runtime Environment

When you install Replication Agent, a Java Runtime Environment (JRE) that is compatible with the Replication Agent for UDB is installed. Check the *Replication Agent Release Bulletin* for any special instructions for the Java Runtime Environment.

## *rs_source_ds* and *rs_source_db* configuration parameters

All configuration parameter values in the Replication Agent configuration file are case sensitive. Be careful when specifying the values for the rs_source_ds and rs_source_db parameters, as Replication Server is also case sensitive. If the same case is not used in both Replication Agent and Replication Server parameters, no connection occurs.

## *Filter_maint_userid* configuration parameters

The Replication Agent filter_maint_userid configuration parameter controls whether the Replication Agent forwards transactions performed by the maintenance user to the primary Replication Server. The maintenance user name is defined in the Replication Server create connection command for the primary database.

In a bidirectional replication environment (replicating both into and out of the same database), set the value of the filter_maint_userid parameter to true. If you do not, transactions replicated to another site may return to be applied at the originating site, creating an endless loop.

## ltl_character_case configuration parameter

The Replication Agent ltl_character_case configuration parameter controls the character case in which the Replication Agent sends database object names to the Replication Server.

For example, if a replication definition is created for all tables named testtab, the table name sent by the Replication Agent must be testtab, or no match occurs. Because Replication Server is case sensitive, a value of TESTTAB does not match the value of testtab.

When you create replication definitions, choose a default case (for example, create all replication definitions in either all uppercase or all lowercase), and change the value of the Replication Agent ltl_character_case parameter to match.

### Object names stored in uppercase

In a DB2 UDB, object names are, by default, stored in uppercase, if no case was assigned when the object was created. That means the Replication Agent sends object names in uppercase to the primary Replication Server, unless configured to do otherwise.

For more information about the ltl_character_case parameter, see the *Replication Agent Administration Guide*.

## Replication definitions for primary tables in DB2 UDB

The Replication Agent use_rssd configuration parameter controls whether the Replication Agent sends Log Transfer Language (LTL) that contains only the columns specified in a replication definition, or all of the columns in the primary table.

When the value of the use_rssd parameter is false, the Replication Agent sends LTL with data for all of the columns in the primary table. When the value of the use_rssd parameter is true, the Replication Agent sends LTL with data for only the columns specified in the replication definition for each primary table.

By sending data for only the columns specified in the replication definition, network traffic is reduced, which may improve performance.

In addition, column names and parameter names are removed from the LTL because the Replication Agent can send information in the order identified by the replication definition. The LTL minimal columns and structured tokens options are also available when the value of the use_rssd parameter is true. For more information, see the *Replication Agent Administration Guide*.

## DB2 UDB primary datatype translation issues

The Replication Agent allows you to control how it sends the DB2 UDB DATE, TIME, and TIMESTAMP column values to the Replication Server.

For a complete list of the DB2 UDB datatype mapping, see the *Replication Agent Primary Database Guide*.

CHAPTER 5

# Microsoft SQL Server Primary Data Server Issues

This chapter describes the primary database issues and considerations specific to the Microsoft SQL Server data server in a Sybase replication system.

**Note** Replication Agent for Microsoft SQL Server must be installed on Microsoft Windows.

## Replication Agent for Microsoft SQL Server

As a primary data server, Microsoft SQL Server interacts with Replication Agent. The Replication Agent must be installed on Microsoft Windows and must have direct access to the Microsoft SQL database log. The Replication Agent identifies and transfers information about data-changing operations or transactions from a Microsoft SQL Server primary database to a primary Replication Server.

**Note** A separate Replication Agent instance is required for each database from which transactions are replicated.

The Replication Agent interacts with the primary Replication Server and with the RSSD of the primary Replication Server, if so configured.

## sybfilter driver

Replication Agent must be able to read Microsoft SQL Server log files. However, the Microsoft SQL Server process opens these log files with exclusive read permission, and the file cannot be read by any other processes, including Replication Agent. Before Replication Agent can replicate data, you must use the sybfilter driver to make the log files readable. See the *Replication Agent Primary Database Guide*.

## Microsoft SQL Server system management issue

The Replication Agent provides a number of commands that return metadata information about the primary database (such as database names, table names, procedure names, and column names). It does this by issuing specific JDBC calls designed to return this information or by querying the system tables directly.

## Replication Manager

The Replication Manager plug-in cannot start, but can stop a Replication Agent instance in a Microsoft SQL Server primary data server.

For more information about starting and stopping the Replication Agent instance, see the *Replication Agent Administration Guide*.

## Replication Agent permissions

Replication Agent for Microsoft SQL Server creates database objects to assist with replication tasks in the primary database. The user ID that the Replication Agent instance uses to log in to Microsoft SQL Server must have access to the primary database. For the list of the required permissions that are automatically granted, see the *Replication Agent Primary Database Guide*.

## Primary data server connectivity

Replication Agent requires a JDBC driver to communicate with the primary database. JDBC drivers for Microsoft SQL Server databases are provided by third-party database vendors. If the JDBC driver for your database is not already installed, obtain the appropriate driver from the vendor’s Web site.

Refer to the *Replication Agent Release Bulletin* for the latest version of the Microsoft SQL Server JDBC.

❖ **Setting the CLASSPATH environment variable**

1. Install the JDBC driver on the host machine where Replication Agent resides or where Replication Agent can access it.
2. Add the location of the JDBC driver to the CLASSPATH environment variable:

   Select Start | Settings | Control Panel | System | Environment, and add the following to the existing CLASSPATH environment variable, using the semicolon (;) as the path separator. Or create the path in the User Variables panel:

   ```
   drive:\path_name\driver
   ```

where:

- *drive* is the drive letter.
- *path_name* is where you installed the JDBC driver.
- *driver* is the name of the JDBC driver. For Microsoft SQL Server, the name is *sqljdbc.jar*.

3 Click Apply, then OK.

You can find a description of the Replication Agent configuration parameters that must be set in Chapter 1 “Preparing for Installation” in the *Replication Agent Installation Guide*.

## Replication Server connectivity

Replication Agent uses TCP/IP and jConnect for JDBC, which is included in the Replication Agent installation to communicate with other Sybase servers. The Replication Agent does not rely on the Sybase *interface* file for connectivity information.

You can find a description of the Replication Agent configuration parameters that must be set to allow Replication Agent to connect to the primary Replication Server in Chapter 1 “Preparing for Installation” in the *Replication Agent Installation Guide*.

## RSSD connectivity

You can find a description of the Replication Agent configuration parameters that must be set to allow the Replication Agent to connect to the RSSD of the primary Replication Server can be found in Chapter 1 “Preparing for Installation” in the *Replication Agent Installation Guide*.

## Replication Agent objects in the primary database

Replication Agent creates objects in the Microsoft SQL Server primary database to assist with replication tasks. The Replication Agent objects are automatically created when you invoke the pdb_xlog command with the init keyword. The existing primary database objects can be marked for replication.

For more general information, see the *Replication Agent Administration Guide.*

## Replication Agent objects

There are two variables in the transaction log component database object names:

- *prefix* – represents the one- to three-character string value of the pdb_xlog_prefix parameter (the default is ra_).
- *xxx* – represents an alphanumeric counter, a string of characters that is (or may be) added to a database object name to make that name unique in the database.

The value of the pdb_xlog_prefix parameter is the prefix string used in all Replication Agent object names. The value of the pdb_xlog_prefix_chars parameter is a list of the nonalphanumeric characters allowed in the prefix string specified by pdb_xlog_prefix. This list of allowed characters is database-specific. For example, in Microsoft SQL Server, the only nonalphanumeric characters allowed in a database object name are the $, #, @, and _ characters.

Use the pdb_xlog command to view the names of Replication Agent transaction log components in the primary database.

See the *Replication Agent Administration Guide* for details on setting up log object names.

Table objects

Insert and delete permissions are granted to Public only on the DDL shadow table for the database name *prefix*ddl_trig_xxx. No permissions are granted on other tables. Table objects that are considered Replication Agent objects are listed in the *Replication Agent Primary Database Guide*.

**Procedure objects** Procedure objects that are considered Replication Agent objects are listed in the *Replication Agent Primary Database Guide*. The sp_SybSetLogforReplTable and sp_SybSetLogforReplProc procedures are created in the Microsoft SQL Server mssqlsystemresource system database. Although execute permission on these procedures is granted to Public, only the Replication Agent pds_username user can successfully execute the procedures, because only the pds_username user is granted select permission on the sys.sysschobjs table. No permissions are granted on the other procedures when they are created.

**Marker objects** The marker procedures and marker shadow tables that are considered Replication Agent objects are listed in the *Replication Agent Primary Database Guide*. No permissions are granted when these procedures and tables are created.

**Trigger objects** The commands that are considered Replication Agent trigger objects are listed in the *Replication Agent Primary Database Guide*.

## Microsoft SQL Server primary database configuration issues

All the installation issues and configuration parameter details for a Microsoft SQL Server primary data server are in the *Replication Agent Installation Guide*. However, this section describes additional issues that are specific to heterogeneous replication.

### *rs_source_ds* and *rs_source_db* configuration parameters

All configuration parameter values in the Replication Agent configuration file are case sensitive. Be careful when specifying the values of the rs_source_ds and rs_source_db parameters, as Replication Server is also case sensitive. If the same case is not used in both Replication Agent and Replication Server parameters, no connection occurs.

## *filter_maint_userid* configuration parameters

If you use a Microsoft SQL Server login with sysadmin privilege as a maint_user, map the login to a user in the corresponding database, otherwise, the Replication Agent cannot correctly filter the transaction performed by this maint_user.

## ltl_character_case configuration parameter

The Replication Agent ltl_character_case configuration parameter controls the character case in which the Replication Agent sends database object names to the primary Replication Server.

For example, if a replication definition is created for all tables named testtab, the table name sent by the Replication Agent must be testtab, or no match occurs. Because Replication Server is case sensitive, a value of TESTTAB does not match a value of testtab.

If you create replication definitions, choose a default case (for example, create all replication definitions in either all uppercase or all lowercase), and change the value of the Replication Agent ltl_character_case parameter to match.

The following is dependent on the collation you provided when you create the database: In a Microsoft SQL Server database, object names are stored, by default, in lowercase, if no case was assigned when the object was created. Replication Agent sends object names in lowercase to the primary Replication Server, unless configured to do otherwise.

For more information about the ltl_character_case parameter, see the *Replication Agent Administration Guide*.

## Replication definitions for primary tables in Microsoft SQL Server

The Replication Agent use_rssd configuration parameter controls whether the Replication Agent sends Log Transfer Language (LTL) that contains only the columns specified in a replication definition or all of the columns in the primary table, as follows:

- When the value of the use_rssd parameter is false, the Replication Agent sends LTL with data for all of the columns in the primary table.

- When the value of the use_rssd parameter is true, the Replication Agent sends LTL with data for only the columns specified in the replication definition for each primary table.

By sending data for only the columns specified in the replication definition, network traffic is reduced, which may improve performance.

In addition, column names and parameter names are removed from the LTL because the Replication Agent can send information in the order identified by the replication definition. The LTL minimal columns and structured tokens options are also available when the value of the use_rssd parameter is true. See the *Replication Agent Administration Guide*.

## Microsoft SQL Server primary datatype translation issues

All Microsoft SQL Server datatypes are compatible with their corresponding Adaptive Server datatypes.

CHAPTER 6

# Oracle Primary Data Server Issues

This chapter describes the primary database issues and considerations specific to the Oracle data server in a Sybase replication system.

## Replication Agent for Oracle

As a primary data server, Oracle interacts with Replication Agent. The Replication Agent identifies and transfers information about data-changing operations or transactions from an Oracle primary data server to a primary Replication Server.

**Note** A separate Replication Agent instance is required for each Oracle instance from which transactions are replicated.

The Replication Agent interacts with the primary Replication Server and with the RSSD of the primary Replication Server, if so configured.

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**Note** Replication Agent is a Java program. Some operating systems may require patches to support Java. Refer to the Replication Agent *Administration Guide* and the Replication Agent *Release Bulletin* for more information.

---

## Replication definitions for primary tables in Oracle

The Replication Agent use_rssd configuration parameter controls whether the Replication Agent sends Log Transfer Language (LTL) that contains only the columns specified in a replication definition, or all of the columns in the primary table.

When the value of the use_rssd parameter is false, the Replication Agent sends LTL with data for all of the columns in the primary table. When the value of the use_rssd parameter is true, the Replication Agent sends LTL with data for only the columns specified in the replication definition for each primary table.

By sending data for only the columns specified in the replication definition, network traffic is reduced, which may improve performance.

In addition, column names and parameter names are removed from the LTL because the Replication Agent can send information in the order identified by the replication definition. The LTL minimal columns and structured tokens options are also available when the value of the use_rssd parameter is true. See the *Replication Agent Administration Guide*.

## Replication Manager limitations

The Replication Manager plug-in cannot start, but can stop a Replication Agent instance in an Oracle primary data server.

See the *Replication Agent Administration Guide* for more information about starting and stopping the Replication Agent instance.

## Oracle system management issues

The Replication Agent provides a number of commands that return metadata information about the primary database (such as database names, table names, procedure names, and column names). It does this by issuing specific JDBC calls designed to return this information, or by querying the Oracle system tables directly.

**Note** Oracle does not support multiple databases within a single server instance as Adaptive Server Enterprise does.

## Replication intrusions and impacts in Oracle

The performance and operation of Oracle primary data servers in a Sybase replication system might be affected when the Replication Agent reads the Oracle redo and archive logs to retrieve transaction information. The Replication Agent must have direct access to the Oracle logs and must run on the same platform as the Oracle server. To provide and maintain the necessary information, enable these items in Oracle:

- Archiving of redo logs
- Supplemental logging of primary key and index data

## Oracle primary database permissions

The Replication Agent requires an Oracle login ID that has permission to access data and create new objects in the primary database. For a list of the Oracle login IDs that must have these required permissions, refer to the *Replication Agent Primary Database Guide*.

**Note** In addition to the required permissions, the operating system user who starts the Replication Agent for Oracle instance must have read access to the Oracle redo and archive logs.

## Primary data server connectivity

To connect to an Oracle primary data server Replication Agent requires the following:

- The JDBC driver must be installed and referenced in the CLASSPATH system variable of the Replication Agent host machine. Java uses the contents of the CLASSPATH system variable to identify the search locations for Java classes. For the Oracle JDBC driver, the full path and file name must be included in the CLASSPATH variable, for example, *drive:\<path_name>\ojdbc14.jar*.

  For the version of the JDBC driver that is supported, see the *Replication Agent Release Bulletin*.
- For JDBC connectivity, the TNS Listener process for the Oracle primary data server must be running.
- You can find a description of the Replication Agent configuration parameters that must be set in Chapter 1 “Preparing for Installation” in the *Replication Agent Installation Guide*.

## Replication Server connectivity

You can find a description of the Replication Agent configuration parameters that must be set to allow Replication Agent to connect to the primary Replication Server in Chapter 1 “Preparing for Installation” in the *Replication Agent Installation Guide*.

**Note** Replication Agent uses TCP/IP and the Sybase JDBC driver (jConnect for JDBC, which is included in Replication Agent installation) to communicate with other Sybase servers. The Replication Agent does not rely on the Sybase i*nterfaces* file for connectivity information.

## RSSD connectivity

You can find a description of the Replication Agent configuration parameters that must be set to allow the Replication Agent to connect to the RSSD of the primary Replication Server in Chapter 1 “Preparing for Installation” in the *Replication Agent Installation Guide*.

## Replication Agent objects

There are two variables in the Replication Agent database object names:

- *prefix* – represents the one- to three-character string value of the pdb_xlog_prefix parameter (the default is ra_).
- *xxx* – represents an alphanumeric counter, a string of characters that is (or may be) added to a database object name to make that name unique in the database.

The value of the pdb_xlog_prefix parameter is the prefix string used in all Replication Agent object names.

The value of the pdb_xlog_prefix_chars parameter is a list of the non alphanumeric characters allowed in the prefix string specified by pdb_xlog_prefix. This list of allowed characters is database-specific. For example, the only non-alphanumeric characters allowed in a database object name are the $, #, and _ characters.

Use the pdb_xlog command to view the names of Replication Agent transaction log components in the primary database.

See the *Replication Agent Administration Guide* for details on setting up object names.

To find the names of the objects created, at the Replication Agent administration port, invoke the pdb_xlog command with no keywords:

```
pdb_xlog
```

The pdb_xlog command returns a list of all the Replication Agent objects.

For a list of the Replication Agent for Oracle procedures and tables objects, marker objects, and sequences, refer to the *Replication Agent Primary Database Guide*.

## Oracle primary database configuration issues

All the installation issues and configuration parameter details for an Oracle primary data server are provided in the *Replication Agent Installation Guide*. However, this section describes additional issues specific to heterogeneous replication.

### Java Runtime Environment

When you install Replication Agent, a Java Runtime Environment (JRE) that is compatible with the Replication Agent may be installed for you. For any special instructions for the Java Runtime Environment, see the *Replication Agent Release Bulletin*.

### JDBC driver required

Replication Agent requires a JDBC driver for connectivity to the primary data server. Sybase does not provide a JDBC driver for Oracle data servers. For information on how to obtain a JDBC driver for Oracle data servers, see the *Replication Agent Release Bulletin*.

### *rs_source_ds* and *rs_source_db* configuration parameters

All configuration parameter values in the Replication Agent configuration file are case sensitive. Be careful when specifying the values of the rs_source_ds and rs_source_db parameters, as Replication Server is also case sensitive. If the same case is not used in both Replication Agent and Replication Server parameters, no connection occurs.

### *filter_maint_userid* configuration parameters

The Replication Agent filter_maint_userid configuration parameter controls whether the Replication Agent forwards transactions performed by the maintenance user to the primary Replication Server. The maintenance user name is defined in the Replication Server create connection command for the primary database.

In a bidirectional replication environment (replicating both into and out of the same database), set the value of the filter_maint_userid parameter to the default true. If you do not, transactions replicated to another site may return to be applied at the originating site, creating an endless loop.

### ltl_character_case configuration parameter

The Replication Agent ltl_character_case configuration parameter controls the case in which the Replication Agent sends database object names to the primary Replication Server.

For example, if a replication definition is created for all tables named testtab, the table name sent by the Replication Agent must be testtab, or no match occurs. Because Replication Server is case sensitive, a value of TESTTAB does not match a value of testtab.

If you create replication definitions, choose a default case (for example, create all replication definitions in either all uppercase or all lowercase), and change the value of the Replication Agent ltl_character_case parameter to match.

In an Oracle database, object names are stored, by default, in all uppercase, if no case was forced when the object was created. The Replication Agent sends object names in uppercase to the primary Replication Server, unless configured to do otherwise.

For more information about the ltl_character_case parameter, see the *Replication Agent Administration Guide*.

## Oracle primary datatype translation issues

For a complete list of datatype mapping for Oracle datatypes, see “Datatype Translation and Mapping” on page 127. For more information about UDDs and their use, see the *Replication Server Administration Guide*.

## Automatic Storage Management

Replication Agent for Oracle supports the use of the Oracle Automatic Storage Management (ASM) feature for online and archive redo logs. ASM provides file system and volume management support for an Oracle database environment. You can use ASM in both Real Application Cluster (RAC) and non-RAC environments. ASM provides similar benefits as a redundant array of independent disks (RAID) or a logical volume manager (LVM). Similar to those technologies, ASM allows you to define a single disk group from a collection of individual disks. ASM attempts to balance loads across all of the devices defined in the disk group. ASM also provides striping and mirroring capabilities. Unlike RAID or LVMs, ASM only supports files created and read by the Oracle database. You cannot use ASM for a general-purpose file system and cannot store binaries or flat files. The operating system cannot access ASM files.

For more information about Replication Agent support for Oracle ASM, see the *Replication Agent Primary Database Guide*.

## Real Application Clusters

Replication Agent provides support for Oracle 10g Real Application Cluster (RAC) environments. When you initialize a Replication Agent for Oracle instance, the Oracle database is queried to determine how many nodes are supported by the cluster. Based on this information, Replication Agent automatically configures itself to process the redo log information from all nodes.

**Note** Replication of a RAC database is the same as replication from a non-RAC database.

To process the redo log data from all nodes in an Oracle RAC cluster, the Replication Agent must execute from a location that has access to the same shared storage used by the Oracle nodes to store their redo data. The Replication Agent must have read access to the shared storage where both the online and archived redo logs exist.

You can configure Replication Agent to connect to a single Oracle instance by supplying the required host, port, and Oracle SID values to the pds_host_name, pds_port_number and pds_database_name configuration parameters. In an Oracle RAC environment, Replication Agent must be able to connect to any node in the cluster in the event that a node fails or becomes unavailable. To support the configuration of multiple node locations, Replication Agent supports connectivity to all possible RAC nodes by obtaining needed information from an Oracle *tnsnames.ora* file for one specified entry. As a result, instead of configuring individual host, port, and instance names for all nodes, Replication Agent requires only the location of a tnsnames.ora file and the name of the TNS connection to use.

For more information about Replication Agent support for Oracle RAC, see the Replication Agent *Primary Database Guide*.

CHAPTER 7

# SQL Anywhere Primary Data Servers

This chapter describes the primary database issues and considerations specific to the SQL Anywhere data server in a Sybase replication system.

## SQL Anywhere applications

SQL Anywhere is a different relational database than Sybase Adaptive Server Enterprise, which is the original primary data server supported by Replication Server. Adaptive Server Enterprise is designed specifically for high-performance OLTP (online transaction processing) and mixed workload enterprise computing. By contrast, SQL Anywhere is designed for the following applications:

- Embedded database – many applications (personal information managers, document management systems—nearly any application that stores information) require a database “behind the scenes.” SQL Anywhere is intended to be the database for these applications. The UltraLite deployment option is intended for embedded environments that have limited resources.

- Mobile computing – with its SQL Remote replication, SQL Anywhere extends transaction-based computing throughout the enterprise. The UltraLite deployment option and MobiLink synchronization technology provide full database functionality on devices with limited resources.
- Workgroup server – workgroups ranging in size from a few people to a few hundred people in an organization may require a data server that can be shared. SQL Anywhere is a multiuser server that can provide a high-performance database for workgroups, well-suited for (but not limited to) environments where administration and hardware resources are limited.

## SQL Anywhere Replication Agent

As a primary data server in a replication system, SQL Anywhere interacts with the Replication Agent. The SQL Anywhere Replication Agent identifies and transfers transactions from the SQL Anywhere primary database to a primary Replication Server.

## SQL Anywhere system management issues

Replication Server Manager support for SQL Anywhere is not implemented in Replication Agent version 15.2.

## Replication intrusions and impacts in SQL Anywhere

Set REPLICATE ON for a SQL Anywhere table to place additional information in the database transaction log whenever an insert, update, or delete operation occurs on the table. The additional information significantly increases the log resources used by the server. The SQL Anywhere Replication Agent uses this information to submit the full *before image* of the row, where required, to Replication Server for replication.

SQL Anywhere replicates all columns in a table. You cannot send a subset of the columns.

## SQL Anywhere primary database permissions

SQL Anywhere includes a connection profile that sets up a SQL Anywhere database to function as a primary database. The rssetup connection profile performs the following operations to set up SQL Anywhere as a primary database for replication:

- Creates a user ID named dbmaint, with password dbmaint, with DBA permissions. This is the Replication Server maintenance user ID and password required to connect to the primary database.
- Creates a user named sa, with password sysadmin, with DBA permissions. This is the user ID used by Replication Server when materializing data.
- Adds sa and dbmaint to a group named rs_systabgroup.

## Primary database connectivity for SQL Anywhere

By default, the SQL Anywhere Replication Agent uses the sa user ID and password created by the *rssetup.sql* command file to log in to the SQL Anywhere primary database.

Create the user ID and password that the SQL Anywhere Replication Agent uses to log in to the primary Replication Server. Record these values in the rs_user and rs_pw configuration parameters in the SQL Anywhere Replication Agent configuration file. The user ID must have been defined and granted connect source permission in the primary Replication Server.

A Replication Server database connection name is made up of two parts: a data server name (server_name) and a database name (db_name). Record these values in the RS_source_ds and RS_source_db configuration parameters in the SQL Anywhere Replication Agent configuration file.

The primary Replication Server does not use the source_db portion of the Replication Server database connection. Instead, Replication Server obtains the database name from the command line of the data server identified in the source_ds portion of the Replication Server database connection. However, you must include a database name in the Replication Server create connection statement to conform to the syntax.

## Primary database limitations in SQL Anywhere

One SQL Anywhere Replication Agent is required for each SQL Anywhere primary database from which transactions are replicated.

The SQL Anywhere Replication Agent does not “pre-read” data from the RSSD of the primary Replication Server, as other Replication Agents do.

You cannot substitute a SQL Anywhere Replication Agent for an Adaptive Server Enterprise Replication Agent, because the SQL Anywhere and Adaptive Server Enterprise transaction logs have different formats.

## SQL Anywhere primary database configuration issues

In SQL Anywhere, all database object identifiers are not case sensitive (that is, uppercase and lowercase are treated as the same). In SQL Anywhere, you must ensure that the case of the database object identifiers matches in all parts with the SQL statements with Adaptive Server Enterprise.

## Replication definitions for primary tables in SQL Anywhere

The SQL Anywhere Replication Agent does not “pre-read” data from the RSSD of the primary Replication Server, the entire row for all replicated operations is sent to the primary Replication Server. By contrast, other Replication Agents can selectively send only those columns identified by the replication definition.

## SQL Anywhere primary datatype translation issues

SQL Anywhere supports data of zero length that is not NULL. However, non-null long, varchar, and long binary data of zero length are replicated to a replicate site as NULL.

If a primary table has columns with unsupported datatypes, you can replicate the data if you create a replication definition using a compatible supported datatype. For example, to replicate a double column, define the column as float in the replication definition.

## Other primary database issues for SQL Anywhere

One of the differences between the Adaptive Server Enterprise Replication Agent and the SQL Anywhere Replication Agent is that while the Adaptive Server Enterprise Replication Agent thread depends on a temporary recovery database for access to old transactions, the SQL Anywhere Replication Agent depends on access to old transaction logs. No temporary recovery database exists for the SQL Anywhere Replication Agent.

PART 3

# Non-ASE Replicate Data Server Topics

Chapters in this part describe data server issues and considerations for replicate data servers in a replication system with non-ASE data servers.

- Chapter 8, “DB2 UDB for z/OS Replicate Data Server Issues,” describes the issues specific to DB2 UDB on IBM z/OS replicate data server in a Sybase replication system.
- Chapter 9, “DB2 UDB Replicate Data Server Issues for UNIX, Windows, and Linux,” describes the issues specific to DB2 UDB on UNIX, Windows, and Linux replicate data server in a Sybase replication system.
- Chapter 10, “Microsoft SQL Server Replicate Data Server Issues,” describes the issues specific to Microsoft SQL Server replicate data server in a Sybase replication system.
- Chapter 11, “Oracle Replicate Data Server Issues,” describes the issues specific to the Oracle replicate data server in a Sybase replication system.
- Chapter 12, “SQL Anywhere Replicate Data Servers,”describes the issues specific to SQL Anywhere replicate data servers in a Sybase replication system.

CHAPTER 8

# DB2 UDB for z/OS Replicate Data Server Issues

This chapter describes only administration tasks that are unique to a Sybase replication system with non-ASE data servers. For information about basic replication system administration, see the *Replication Server Administration Guide*.

## DB2 UDB for z/OS replicate data server environment

As a replicate data server in a gateway environment, DB2 UDB for z/OS interacts with the Mainframe Connect DirectConnect for z/OS Option database gateway, which accepts commands from the replicate Replication Server and applies those commands to a replicate DB2 UDB database.

As a replicate data server in a gatewayless environment, DB2 UDB for z/OS interacts with Mainframe Connect DirectConnect for DB2 UDB through the AMD2 CICS transaction. AMD2 accepts commands from Replication Server and applies those commands to a DB2 UDB database. Then, AMD2 retrieves the results from those commands and returns the results to Replication Server.

**Note** The gatewayless environment requires a TCP/IP connection to the mainframe. See the *Mainframe Connect Server Option for IBM IMS and z/OS Installation and Administration Guide*.

## DB2 UDB for z/OS system management issues

The following system management issues are specific to a replicate DB2 UDB for z/OS data server:

- The create connection command's dsi_sql_data_style parameter was used in earlier versions of Replication Server to provide some data translations for the DB2 UDB for z/OS replicate database.

  With the introduction of heterogeneous datatype support (HDS) in Replication Server version 12.0, the create connection command's dsi_sql_data_style parameter is now invalid. Do *not* use this parameter with Replication Server version 12.0 or later. The default setting should be " "(blank space).

## Replication intrusions and impacts in DB2 UDB for z/OS

The only significant intrusions or impacts to the replicate DB2 UDB are the database objects created by the connection profile that creates three tables in the replicate database to support Replication Server operations:

- RS_INFO, which contains information about the sort order and character set used by the replicate database.

  ---

  **Note** Confirm that the INSERT statements for this table specify the proper character set and sort order for your data server.

  ---

  When using Replication Server version 12.5 or later, the replicate database sort order and character set must be recorded in the RS_INFO table. To do so, use the Replication Server rs_get_charset and rs_get_sortorder functions to retrieve the character set and sort order from the RS_INFO table in the replicate database.

- RS_LASTCOMMIT, which contains information about replicated transactions applied to the replicate database.

  Each row in the RS_LASTCOMMIT table identifies the most recent committed transaction that was distributed to the replicate database from a primary database. Replication Server uses this information to ensure that all transactions are distributed.

  The Replication Server rs_get_lastcommit function retrieves information about the last transaction committed in the replicate database. For non-ASE replicate databases, rs_get_lastcommit is replaced in the database-specific function-string class by the query required to access the RS_LASTCOMMIT table in the replicate database.

- RS_TICKET_HISTORY, which contains the execution results of Replication Server command rs_ticket.

  You can issue the rs_ticket command for the primary database to measure the amount of time it takes for a command to move from the primary database to the replicate database. You can use this information to monitor Replication Server performance, module heartbeat, replication health, and table-level quiesce. The results of each execution of rs_ticket is stored in a single row of the RS_TICKET_HISTORY table in the replicate database. You can query each row of the RS_TICKET_HISTORY table to obtain results of individual rs_ticket executions, or compare the results from different rows. The data stored in this table is not required to support replication and you may manually truncate the data in this table to reclaim space.

  ---

  **Note** The RS_TICKET_HISTORY table is available only in Replication Server 15.1 and later.

  ---

## DB2 for z/OS replicate database permissions

To apply transactions in a replicate database, Replication Server requires a maintenance user ID that you specify in the Replication Server create connection command. The maintenance user ID must be defined to the DB2 UDB for z/OS data server and granted authority to apply transactions in the replicate database. The maintenance user ID must have permissions in the replicate DB2 UDB database:

- CREATE TABLE authority to create tables used for Replication Server processing
- UPDATE authority to all replicate tables and EXECUTE authority to all replicate stored procedures

## Replicate database connectivity for DB2 UDB for z/OS

A Replication Server database connection name is made up of two parts: a data server name (server_name) and a database name (db_name).

When using the Mainframe Connect DirectConnect for z/OS Option database gateway, the server_name is the name of the database gateway server, and the db_name is the name of the replicate DB2 UDB database.

The replicate Replication Server looks for an *interface* file entry for the database gateway server_name specified in the Replication Server database connection. The replicate Replication Server logs in to the replicate data server using the user_name and password specified in the database connection.

You must make an entry in the Replication Server *interface* file to identify the host and port where the Mainframe Connect DirectConnect for z/OS Option database gateway server is listening. The *interface* file entry name must match the server_name portion of the Replication Server database connection.

## Gatewayless connections for DB2 UDB for z/OS

With a gatewayless connection from Replication Server to DB2 UDB using the Mainframe Connect DirectConnect for z/OS Option, the server_name is the mainframe host name, and the db_name is the name of the replicate DB2 UDB database. The *interface* file entry for the server_name maps to the mainframe IP address and port.

Gatewayless replication to DB2 UDB for z/OS database requires that you:

- Use Mainframe Connect version 15.0 or later.
- Define the rs_get_textptr and rs_writetext function strings using the writetext method. See the *Replication Server Reference Manual*.
- Use the *rs_xxx_to_db2* (class-level translations for the primary database) Replication Server connection profile.

## Replicate database limitations in DB2 for z/OS

The following replication limitations exist with a DB2 UDB for z/OS replicate data server:

- Replication of large object (LOB) datatypes (BLOB and CLOB) is supported over a gatewayless connection using MainframeConnect for DB2 version 15.0 or later.
- Replication of large object (LOB) datatypes (BLOB and CLOB) is supported directly by MainframeConnect DirectConnect for z/OS Option.
- Replication Server cannot send an DB2 UDB binary value as a binary string because the MainframeConnect DirectConnect for z/OS Option database gateway performs an ASCII to EBCDIC translation on the value. Therefore, all binary or varbinary datatypes replicated to DB2 UDB for z/OS must be mapped to the rs_db2_char_for_bit or rs_db2_varchar_for_bit datatype.

## DB2 for z/OS replicate database configuration issues

The heterogeneous datatype support (HDS) feature of Replication Server provides configuration information that allows you to set up the HDS feature in the replicate Replication Server and the DB2 UDB for z/OS replicate database. The configuration information is provided as part of the installation process and as part of the connection profile:

- Replication Server installation:
  - Create function strings and error classes
- Connection profile:
  - Apply class-level datatype translations to RSSD
  - Create objects in the DB2 UDB for z/OS
- Additional settings:
  - Settings in ECDA
  - Settings for Dynamic SQL
  - Settings for Command Batching

### Replication Server installation

Replication Server installation automatically installs the required function strings and classes to support replication.

#### Create function strings and error classes

The function string replaces several default Replication Server function strings with custom function strings designed to communicate with the DB2 UDB for z/OS replicate database, and access the tables and procedures that were created. These function strings are added to the Replication Server default rs_db2_function_class.

### Connection profiles

Connection profiles allow you to configure your connection with a pre-defined set of properties.

### Apply class-level datatype translations to RSSD

Class-level translations identify the primary and replicate datatypes and the replicate datatypes into which data is translated. For example, Oracle DATE should be translated to DB2 UDB replicate database TIMESTAMP.

Class-level translation is supplied for the replicate DB2 UDB for z/OS replicate database by the appropriate named connection profile:

- *rs_ase_to_db2* – translates Adaptive Server datatypes to DB2 UDB datatypes.
- *rs_udb_to_db2* – translates DB2 UDB (for UNIX and Windows) datatypes to DB2 UDB for z/OS datatypes.
- *rs_msss_to_db2* – translates Microsoft SQL Server datatypes to DB2 datatypes.
- *rs_oracle_to_db2* – translates Oracle datatypes to DB2 UDB datatypes.
- *rs_db2_connection_sample* – creates a connection to the DB2 database. (The connection may be to ECDA.)

  The connection profile provides a template for creating the Replication Server database connection for a replicate DB2 UDB for z/OS using the predefined DB2 UDB for z/OS function-string class provided with Replication Server.

  **Note** You must modify the template to include your actual server, database, and maintenance user names.

### Create objects in the DB2 UDB for z/OS

The connection profile creates the RS_INFO, RS_LASTCOMMIT, and the RS_TICKET_HISTORY tables in the replicate database.

To replicate LOB datatypes, change the parent class to rs_sqlserver_function_class.

For descriptions of the rs_writetext and rs_get_textptr function strings, see the *Replication Server Reference Manual*.

## Additional settings

The following are additional settings to support replication.

## Settings in ECDA

Use the following settings for ECDA:

```
Transaction Mode = long
allocate = connect
SQL transformation = Sybase
```

If you are using a Mainframe Connect DirectConnect for z/OS Option database gateway for replication to a DB2 UDB for z/OS replicate database, set the following properties in the DirectConnect *db2.cfg* access service configuration file:

```
SQLTransformation=passthrough
TransactionMode=long
```

## Settings for Dynamic SQL

Dynamic SQL is supported in Replication Agent 15.2.

## Settings for Command Batching

Command Batching allows Replication Server to send multiple commands to the data server as a single command batch. When set batch is “off,” Replication Server sends commands to the data server one at a time. To use command Batching, enter:

```
set batch = on
set dsi_cmd_separator = j
set batch_begin = off
use_batch_markers = on
```

CHAPTER 9

# DB2 UDB Replicate Data Server Issues for UNIX, Windows, and Linux

This chapter describes administration tasks that are unique to a Sybase replication system with non-ASE data servers. For information about basic replication system administration, see the *Replication Server Administration Guide*.

## DB2 UDB replicate data servers

As a replicate data server in a replication system, the DB2 UDB interacts with the ECDA Option for ODBC database gateway. ECDA Option for ODBC accepts commands from the replicate Replication Server, and applies the commands to a database residing in a DB2 UDB server.

## Replication intrusions and impacts in DB2 UDB

The only significant intrusions or impacts to the DB2 UDB replicate database are the database objects that are created by the connection profile that creates two tables in the replicate database to support Replication Server operations:

- RS_INFO, which contains information about the sort order and character set used by the replicate database.

  ---

  **Note** Confirm that the INSERT statements for RS_INFO specify the proper character set and sort order for your DB2 UDB server.

  ---

  When using Replication Server version 12.0 or later, the replicate database sort order and character set must be recorded in the RS_INFO table.

  The Replication Server rs_get_charset and rs_get_sortorder functions retrieve the character set and sort order from the RS_INFO table in the replicate database.

- RS_LASTCOMMIT, which contains information about replicated transactions applied to the replicate database.

  Each row in the RS_LASTCOMMIT table identifies the most recent committed transaction that was distributed to the replicate database from a primary database. Replication Server uses this information to ensure that all transactions are distributed.

  The Replication Server rs_get_lastcommit function retrieves information about the last transaction committed in the replicate database. For non-ASE replicate databases, the rs_get_lastcommit function is replaced in the database-specific function-string class by the query required to access the RS_LASTCOMMIT table in the replicate database.

- RS_TICKET_HISTORY, which contains the execution results of Replication Server command rs_ticket.

  You can issue the rs_ticket command for the primary database to measure the amount of time it takes for a command to move from the primary database to the replicate database. Yes this information to monitor Replication Server performance, module heartbeat, replication health, and table-level quiesce. The results of each execution of rs_ticket is stored in a single row of the RS_TICKET_HISTORY table in the replicate database. You can query each row of the RS_TICKET_HISTORY table to obtain results of individual rs_ticket executions, or compare the results from different rows. The data stored in this table is not required to support replication and you may manually truncate the data in this table to reclaim space.

  ---

  **Note** The RS_TICKET_HISTORY table is available only in Replication Server 15.1 and later.

  ---

## Limitations in the DB2 UDB replicate database

Replication of large object (LOB) datatypes (BLOB, CLOB, and LVARCHAR) is not supported directly from Replication Server to the ECDA Option for ODBC.

## DB2 UDB replicate database permissions

To apply transactions in a replicate database, Replication Server requires a maintenance user ID that you specify using the Replication Server create connection command. The maintenance user ID must be defined at the DB2 UDB server and granted authority to apply transactions in the replicate database. The maintenance user ID must have permissions in the DB2 UDB replicate database:

- CREATE TABLE authority to create tables used for Replication Server processing
- UPDATE authority on all replicate tables

## Connectivity for DB2 UDB replicate database

A Replication Server database connection name is made up of two parts: a data server name (server_name) and a database name (db_name). The server_name is the name of the ECDA Option for ODBC database gateway server, and the db_name is the name of the DB2 UDB replicate database.

The replicate Replication Server looks for an *interface* file entry for the database gateway server_name specified in the Replication Server database connection. The replicate Replication Server logs in to the replicate data server using the user_name and password specified in the database connection.

You must make an entry in the Replication Server *interface* file to identify the host and port where the ECDA Option for ODBC database gateway server is listening. The *interface* file entry name must match the server_name portion of the Replication Server database connection.

## DB2 UDB replicate database configuration issues

The heterogeneous datatype support (HDS) feature of Replication Server provides configuration information that allows you to set up the HDS feature in the replicate Replication Server and the DB2 UDB replicate database. You provide this configuration information as part of the installation, and as part of the connection profile:

- Replication Server installation:
    - Create function strings and error classes
- Connection profiles:
    - Apply class-level datatype translations to RSSD
    - Create objects in the DB2 UDB replicate database
- Additional settings
    - Settings in ECDA (required)
    - Settings for Dynamic SQL (optional)
    - Settings for Command Batching (optional)

### Replication Server installation

Replication Server installation automatically installs the required function strings and classes to support replication.

#### Create function strings and error classes

The function string replaces several default Replication Server function strings with custom function strings designed to communicate with the DB2 UDB replicate database and access the tables and procedures that were created. These function strings are added to the Replication Server default rs_udb_function_class.

To find the error action defined for an error class, refer to rs_helperror in the Replication Server Reference Manual.

## Connection profiles

Connection profiles allow you to configure your connection with a pre-defined set of properties.

### Apply class-level datatype translations to RSSD

Class-level translations identify primary datatypes and the replicate datatypes into which data is to be translated (for example, Microsoft SQL Server binary should be translated to DB2 UDB CHAR FOR BIT DATA).

These connection profiles supply class-level translation for the DB2 UDB replicate database:

- *rs_ase_to_udb* – translates Adaptive Server datatypes to DB2 UDB datatypes.
- *rs_db2_to_udb* – translates DB2 for z/OS datatypes to DB2 UDB datatypes.
- *rs_msss_to_udb* – translates Microsoft SQL Server datatypes to DB2 UDB datatypes.
- *rs_oracle_to_udb* – translates Oracle datatypes to DB2 UDB datatypes.

### Create objects in the DB2 UDB replicate database

The connection profile creates the RS_INFO, RS_LASTCOMMIT, and RS_TICKET_HISTORY tables in the replicate database.

## Additional settings

The following are additional settings to support replication.

### Settings in ECDA (required)

Use the following settings for ECDA:

```
Transaction Mode = long
allocate = connect
SQL transformation = Sybase
```

## Settings for Dynamic SQL (optional)

Dynamic SQL is supported as of Replication Server 15.0.1 and requires DirectConnect UDB 12.6.1 ESD #2, or later.

## Settings for Command Batching (optional)

Command Batching allows Replication Server to send multiple commands to the data server as a single command batch. When set batch is “off,” Replication Server sends commands to the data server one at a time. To use Command Batching, enter:

```
set batch = on
set dsi_cmd_separator = j
set batch_begin = off
use_batch_markers = on
```

# CHAPTER 10 Microsoft SQL Server Replicate Data Server Issues

This chapter describes the replicate database issues and considerations specific to the Microsoft SQL Server data server in a Sybase replication system.

## Microsoft SQL Server replicate data servers

As a replicate data server, Microsoft SQL Server interacts with the ECDA Option for ODBC database gateway. The ECDA Option for ODBC server accepts commands from the replicate Replication Server, and applies those commands to a Microsoft SQL Server database.

**Note** The ECDA Option for ODBC supports replication of large object (LOB) datatypes (image, ntext, and text) from Replication Server directly to a Microsoft SQL Server database.

## Replication intrusions and impacts on Microsoft SQL Server

The only significant intrusions or impacts to the Microsoft SQL Server replicate database are the database objects that are created by the connection profile to support Replication Server replicate database operations.

The connection profile creates three tables in the replicate database to support Replication Server operations:

- RS_INFO, which contains information about the sort order and character set used by the replicate database

  **Note** Confirm that the insert statements for the RS_INFO table specifies the proper character set and sort order for your Microsoft SQL Server data server.

  When using Replication Server version 12.0 or later, the replicate database sort order and character set must be recorded in the RS_INFO table.

  The Replication Server rs_get_charset and rs_get_sortorder functions retrieve the character set and sort order from the RS_INFO table in the replicate database.

- RS_LASTCOMMIT, which contains information about replicated transactions applied to the replicate database

  Each row in the RS_LASTCOMMIT table identifies the most recent committed transaction that was distributed to the replicate database from a primary database. Replication Server uses this information to ensure that all transactions are distributed.

  The Replication Server rs_get_lastcommit function retrieves information about the last transaction committed in the replicate database. For non-ASE replicate databases, the rs_get_lastcommit function is replaced in the database-specific function string class by the query required to access the RS_LASTCOMMIT table in the replicate database.

- RS_TICKET_HISTORY, which contains the execution results of Replication Server command rs_ticket.

The rs_ticket command can be issued for the primary database to measure the amount of time it takes for a command to move from the primary database to the replicate database. You can use this information to monitor Replication Server performance, module heartbeat, replication health, and table-level quiesce. The results of each execution of rs_ticket is stored in a single row of the RS_TICKET_HISTORY table in the replicate database. You can query each row of the RS_TICKET_HISTORY table to obtain results of individual rs_ticket executions, or compare the results from different rows. The data stored in this table may be manually truncated.

**Note** The RS_TICKET_HISTORY table is only available in Replication Server release 15.1 and later.

## Replicate database limitations on Microsoft SQL Server

The following replication limitations exist with a Microsoft SQL Server replicate data server:

- Microsoft SQL Server supports either 28 digits or 38 digits of precision, depending on the server's start-up options. The default precision is 28 digits. Replication Server does not provide user-defined datatypes (UDDs) to support the default 28 digits of precision.

  If you attempt to replicate numeric data to a Microsoft SQL Server database in excess of the server's configured precision, Replication Server returns the following error:

```
E. 2007/12/14 11:14:58. ERROR #1028 DSI EXEC(134(1)
   dcm_gabeat70_devdb.devdb)
   - dsiqmint.c(2888)
   Message from server: Message: 30291, State 0,
   Severity 19 --
   '[VENDORLIB] Vendor Library Error: [[Message
   Iteration=1|Data Source Name=mssql70_devdb|
   SQLState=22003|Native Error=1007|Message=
   [Microsoft] [ODBC SQL Server Driver][SQL
   Server]The number
   '9999999999999999999.9999999999999999999' is out
   of the range for numeric representation (maximum
   precision 28).
```

```
[Message Iteration=2|SQLState=22003|Native
Error=|Message=[Microsoft][ODBC SQL Server
Driver][SQL Server]The number
'0.999999999999999999999999999999999999' is out
of the range for numeric representation (maximum
precision 28).] <DCA>'
```

- Microsoft SQL Server supports identity columns in the same manner as Adaptive Server Enterprise, so the Replication Server function strings that set identity insert off and on work correctly with Microsoft SQL Server. However, to support 28-digit numeric precision, the Sybase native numeric datatype must be translated to the rs_msss_numeric datatype, and as a result of this translation, the identity characteristic is lost.

  If you choose to use the numeric to rs_msss_numeric datatype translation to support 28-digit precision in a Microsoft SQL Server replicate database, the replicate table cannot declare the numeric column receiving that data as an identity.

  If a replicate Microsoft SQL Server table declares a numeric column receiving translated data as an identity, Replication Server returns the following error:

```
E. 2007/12/14 12:05:39. ERROR #1028 DSI EXEC(134(1)
   dcm_gabeat70_devdb.devdb)
   - dsiqmint.c(2888)
   Message from server: Message: 30291, State 0,
   Severity 19 --
   '[VENDORLIB] Vendor Library Error: [[Message
   Iteration=1|Data Source Name=mssql70_devdb|SQL
   Function=INSERT|SQLState=23000|Native
   Error=544|Message=[Microsoft][ODBC SQL Server
   Driver][SQL Server]Cannot insert explicit value
   for identity column in table 'ase_alltypes' when
   IDENTITY_INSERT is set to OFF.] <DCA>'
```

## Microsoft SQL Server replicate database permissions

To apply transactions in a replicate database, Replication Server requires a maintenance user ID that you specify using the Replication Server create connection command. The maintenance user ID must be defined at the Microsoft SQL Server data server and granted authority to apply transactions in the replicate database. The maintenance user ID must have these permissions in the Microsoft SQL Server replicate database:

- create table authority to create tables used for Replication Server processing
- update authority on all replicate tables
- execute authority on all replicate stored procedures

## Replicate database connectivity for Microsoft SQL Server

A Replication Server database connection name is made up of two parts: a data server name (server_name) and a database name (db_name). The server_name is the name of the ECDA for ODBC database gateway server, and the db_name is the name of the Microsoft SQL Server replicate database.

The replicate Replication Server looks for an *interface* file entry for the database gateway server_name specified in the Replication Server database connection. The replicate Replication Server logs in to the replicate data server using the user_name and password specified in the database connection.

Make an entry in the Replication Server *interface* file to identify the host and port where the ECDA Option for ODBC database gateway server is listening. The *interface* file entry name must match the server_name portion of the Replication Server database connection.

# Microsoft SQL Server replicate database configuration

The heterogeneous datatype support (HDS) feature of Replication Server provides configuration information that allows you to set up the HDS feature in the replicate Replication Server and the Microsoft SQL Server replicate database. The configuration information is part of the installation and part of the connection profile:

- Replication Server installation:
  - Create function strings and error classes
- Connection profile:
  - Apply class-level datatype translations to RSSD
  - Create objects in the Microsoft SQL Server database
- Additional settings:
  - Settings in ECDA
  - Settings for Dynamic SQL
  - Settings for Command Batching

## Replication Server installation

Replication Server installation automatically installs the required function strings and classes to support replication.

### Create function strings and error classes

The function string replaces several default Replication Server function strings with custom function strings designed to communicate with Microsoft SQL Server and access the tables and procedures that were created. These function strings are added to the Replication Server default rs_msss_function_class.

To find the error action defined for an error class, refer to rs_helperror in the Replication Server Reference Manual.

## Connection profiles

Connection profiles allow you to configure your connection with a pre-defined set of properties.

### Apply class-level datatype translations to RSSD

Class-level translations identify primary datatypes and the replicate datatypes into which data is to be translated (for example, DB2 UDB TIMESTAMP should be translated to Microsoft SQL Server datetime).

**Note** These translations can affect Replication Server performance. Only the translations needed for your specific primary database and replicate database should be applied to the RSSD.

These connection profiles supply class-level translation for the Microsoft SQL Server replicate database:

- *rs_db2_to_msss* – translates DB2 UDB for IBM z/OS datatypes to Microsoft SQL Server datatypes.
- *rs_udb_to_msss* – translates DB2 UDB (for UNIX and Windows) datatypes to Microsoft SQL Server datatypes.
- *rs_oracle_to_msss* – translates Oracle datatypes to Microsoft SQL Server datatypes.

### Create objects in the Microsoft SQL Server database

The connection profile creates the RS_INFO, RS_LASTCOMMIT, and RS_TICKET_HISTORY tables in the replicate database.

## Additional settings

The following are additional settings to support replication.

### Settings in ECDA

Use the following settings for ECDA:

```
Transaction Mode = long
allocate = connect
SQL transformation = Sybase
```

## Settings for Dynamic SQL

Dynamic SQL is supported as of Replication Server 15.0.1 and requires ECDA Option for ODBC 12.6.1 ESD #2, or later.

## Settings for Command Batching

Command Batching allows Replication Server to send multiple commands to the data server as a single command batch. When batch is off, the Replication Server sends commands to the data server one at a time. For the data servers, use this configuration:

```
batch = on
```

```
batch_begin = on or off
```

The use of on for batch_begin reduces the number of network transfers.

```
use_batch_markers = off
```

Additional batch markers are not required.

CHAPTER 11

# Oracle Replicate Data Server Issues

This chapter describes the replicate database issues and considerations specific to the Oracle data server in a Sybase replication system.

## Oracle replicate data servers

As a replicate data server, Oracle interacts with the ECDA Option for Oracle database gateway. The ECDA Option for Oracle is responsible for accepting commands from the replicate Replication Server, and applying those commands to an Oracle database.

## Replication intrusions and impacts on Oracle

The only significant intrusions or impacts to the Oracle replicate database are the database objects created through the connection profile that creates three tables in the replicate database to support Replication Server operations:

- RS_INFO, which contains information about the sort order and character set used by the replicate database. When using Replication Server version 12.0 or later, the replicate database sort order and character set must be recorded in the RS_INFO table.

  **Note** Confirm that the INSERT statements for this table specify the proper character set and sort order for your Oracle data server.

  The Replication Server rs_get_charset and rs_get_sortorder functions retrieve the character set and sort order from the RS_INFO table in the replicate database.

- RS_LASTCOMMIT, which contains information about replicated transactions applied to the replicate database. Each row in the RS_LASTCOMMIT table identifies the most recent committed transaction that was distributed to the replicate database from a primary database. Replication Server uses this information to ensure that all transactions are distributed.

  The Replication Server rs_get_lastcommit function retrieves information about the last transaction committed in the replicate database. For non-ASE replicate databases, the rs_get_lastcommit function is replaced in the database-specific function string class by the query required to access the RS_LASTCOMMIT table in the replicate database.

- RS_TICKET_HISTORY, which contains the execution results of Replication Server command rs_ticket.

  The rs_ticket command can be issued for the primary database to measure the amount of time it takes for a command to move from the primary database to the replicate database. You can use this information to monitor Replication Server performance, module heartbeat, replication health, and table-level quiesce. The results of each execution of rs_ticket is stored in a single row of the RS_TICKET_HISTORY table in the replicate database. You can query each row of the RS_TICKET_HISTORY table to obtain results of individual rs_ticket executions, or to compare the results from different rows. The data may be manually truncated.

  **Note** The RS_TICKET_HISTORY table is only available in Replication Server version 15.1 and later.

## Oracle replicate database permissions

To apply transactions in a replicate database, Replication Server requires a maintenance user ID that you specify using the Replication Server create connection command. The maintenance user ID must be defined at the Oracle data server and granted authority to apply transactions in the replicate database. The maintenance user ID must have these permissions in the Oracle replicate database:

- CREATE TABLE authority to create tables used for Replication Server processing.
- UPDATE authority on all replicate tables and EXECUTE authority on all replicate stored procedures.

## Replicate database connectivity for Oracle

A Replication Server database connection name is made up of two parts: a data server name (server_name) and a database name (db_name). The server_name is the name of the ECDA Option for Oracle database gateway server, and the db_name is the name of the Oracle SID for the replicate database.

The replicate Replication Server looks for an *interface* file entry for the database gateway server_name specified in the Replication Server database connection. The replicate Replication Server logs in to the replicate data server using the user_name and password specified in the database connection.

Make an entry in the Replication Server *interface* file to identify the host and port where the ECDA Option for Oracle database gateway server is listening. The *interface* file entry name must match the server_name portion of the Replication Server database connection.

## Oracle replicate database configuration issues

The heterogeneous datatype support (HDS) feature of Replication Server provides configuration information that allows you to set up the HDS feature in the replicate Replication Server and the Oracle replicate database. The configuration information is provided as part of the installation and as part of the connection profile:

- Replication Server installation:
    - Create function strings and error classes
- Connection profile:
    - Apply class-level datatype translations to RSSD
    - Create objects in the Oracle replicate database
- Additional settings:
    - ECDA settings
    - Settings for Command Batching
    - Settings for Dynamic SQL

## Replication Server installation

Replication Server installation automatically installs the required function strings and classes to support replication.

### Create function strings and error classes

The function string replaces several default Replication Server function strings with custom function strings designed to communicate with an Oracle data server and access the tables and procedures. These function strings are added to the Replication Server default rs_oracle_function_class.

## Connection profiles

Connection profiles allow you to configure your connection with a pre-defined set of properties.

### Apply class-level datatype translations to RSSD

Class-level translations identify primary datatypes and the replicate datatypes the data should be translated into (for example, DB2 UDB TIMESTAMP should be translated to Oracle DATE).

Class-level translation is supplied for the Oracle replicate database by the appropriate named connection profile:

- *rs_ase_to_oracle* – translates Adaptive Server datatypes to Oracle datatypes.
- *rs_db2_to_oracle* – translates DB2 UDB for z/OS datatypes to Oracle datatypes.
- *rs_udb_to_oracle* – translates DB2 UDB (for UNIX and Windows) datatypes to Oracle datatypes.
- *rs_msss_to_oracle* – translates Microsoft SQL Server datatypes to Oracle datatypes.

### Create objects in the Oracle replicate database

The connection profile creates the RS_INFO, RS_LASTCOMMIT, and RS_TICKET_HISTORY tables in the replicate database.

## Additional settings

The following are additional settings to support replication.

### ECDA settings

The following issues must be considered when using an Oracle replicate data server:

- In ECDA Option for Oracle version 12.0 or later, an additional trace flag allows the replicate Replication Server to control transaction commit boundaries when applying transactions to an Oracle replicate database.
- Setting the value of the ECDA autocommit trace flag to 0 (zero) in the ECDA Option for Oracle configuration file allows Replication Server to control when a COMMIT command should be sent to Oracle. When the value of the autocommit trace flag is not set, ECDA Option for Oracle commits each individual operation (INSERT, UPDATE, and DELETE) sent by the replicate Replication Server.
- Having ECDA commit each operation causes a problem at the replicate database if an error occurs in the middle of a multiple operation transaction. The replicate Replication Server may attempt to re-send the entire transaction, while ECDA has already committed each individual operation. To avoid this problem, set the value of the ECDA autocommit trace flag to 0 (zero).

## Settings for Command Batching

For the Oracle data servers, use this configuration:

```
batch = on
```

```
batch_begin = off
```

As a result of a placeholder command that is used in the rs_begin function string, setting batch_begin to *on* may cause problems with starting DSI. Set batch_begin to *off* to allow the rs_begin and the rs_commit commands to be sent independently of the batches of commands, and ensures correct SQL in all transferred commands:

```
use_batch_markers = on
```

Oracle requires BEGIN and END markers for batches of commands. By configuring use_batch_markers to *on*, the markers are automatically added from the rs_batch_start and rs_batch_end function strings. For additional information on Command Batching, see the *Replication Server Administration Guide*.

## Settings for Dynamic SQL

Dynamic SQL is supported as of Replication Server 15.0.1, and requires ECDA Option for Oracle 15.0 or later.

CHAPTER 12

# SQL Anywhere Replicate Data Servers

This chapter describes the replicate database issues and considerations specific to the SQL Anywhere data server in a Sybase replication system.

## SQL Anywhere replicate data servers

As a replicate data server in a replication system, SQL Anywhere interacts directly with the replicate Replication Server. The replicate Replication Server logs in to the SQL Anywhere replicate database and applies replicated transactions.

## Replication intrusions and impacts in SQL Anywhere

The only significant intrusions or impacts to the SQL Anywhere replicate database are the database objects created through the connection profile that creates three tables in the replicate database to support Replication Server operations:

- RS_INFO contains information about the sort order and character set used by the replicate database. When using Replication Server version 12.0 or later, the replicate database sort order and character set is to be recorded in the RS_INFO table.

  **Note** Confirm that the INSERT statements for this table specify the proper character set and sort order for your data server.

  When using Replication Server version 12.0 or later, the replicate database sort order and character set must be recorded in the RS_INFO table.

  The Replication Server rs_get_charset and rs_get_sortorder functions retrieve the character set and sort order from the RS_INFO table in the replicate database.

- RS_LASTCOMMIT holds information about the last successfully committed replicate transaction applied to the replicate database.

  Each row in the RS_LASTCOMMIT table identifies the most recent committed transaction that was distributed to the replicate database from a primary database. Replication Server uses this information to ensure that all transactions are distributed.

  The Replication Server rs_get_lastcommit function retrieves information about the last transaction committed in the replicate database. For non-ASE replicate databases, the rs_get_lastcommit function is replaced in the database-specific function-string class by the query required to access the RS_LASTCOMMIT table in the replicate database.

- RS_TICKET_HISTORY contains the execution results of Replication Server command rs_ticket.

Issue rs_ticket for the primary database to measure the amount of time it takes for a command to move from the primary database to the replicate database. You can use this information to monitor Replication Server performance, module heartbeat, replication health, and table-level quiesce. The results of each execution of rs_ticket is stored in a single row of the RS_TICKET_HISTORY table in the replicate database. You can query each row of the RS_TICKET_HISTORY table to obtain results of individual rs_ticket executions, or compare the results from different rows. The data stored in this table is not required to support replication and may be manually truncated.

**Note** The RS_TICKET_HISTORY table is only available only in Replication Server version 15.1 and later.

## SQL Anywhere replicate database permissions

The rssetup connection profile is provided with SQL Anywhere to set up a SQL Anywhere database to function as a replicate database. rssetup:

- Creates a user ID named dbmaint, with password dbmaint, with DBA permissions. This is the Replication Server maintenance user ID and password required to connect to the primary database.
- Creates a user named sa, with password sysadmin, with DBA permissions. This is the user ID used by Replication Server when materializing data.
- Adds sa and dbmaint to a group named rs_systabgroup.
- Creates the system tables and stored procedures necessary in the replicate database to support Replication Server.

## Replicate database connectivity for SQL Anywhere

You do not need to use a database gateway when you use SQL Anywhere as a replicate data server; the replicate Replication Server connects directly to the SQL Anywhere replicate data server.

A Replication Server database connection name is made up of two parts: a data server name (server_name) and a database name (db_name). The replicate Replication Server looks for an *interface* file entry for the replicate database server_name specified in the database connection.

Replication Server logs in to the replicate data server using the user_name and password specified in the database connection. For SQL Anywhere replicate databases, the user_name and password should be the dbmaint user ID and password that were created when the rssetup connection profile was executed.

The replicate Replication Server does not use the source_db portion of the Replication Server database connection. Instead, Replication Server obtains the database name from the command line of the data server identified in the source_ds portion of the Replication Server database connection. However, you must include a database name in the Replication Server create connection statement to conform to the syntax.

You also must make an entry in the Replication Server *interface* file to identify the host and port where the SQL Anywhere replicate data server is listening. The *interface* file entry name must match the server_name portion of the Replication Server database connection.

## SQL Anywhere Server replicate database configuration issues

This section describes configuration issues for the SQL Anywhere server:

- Replication Server
    - Create function strings and error classes
- Connection profiles
    - Apply class-level datatype translations to RSSD
    - Create objects in the SQL Anywhere replicate databasej
- Additional settings
    - Settings for Dynamic SQL (optional)
    - Settings for Command Batching (optional)

## Replication Server installation

Replication Server installation automatically installs the required function strings and classes to support replication.

### Create function strings and error classes

The function strings and error classes are the same as ASE. These function strings and error classes are added to the Replication Server default rs_sqlserver_function_class and rs_sqlserver_error-class.

To find the error action defined for an error class, refer to rs_helperror in the *Replication Server Reference Manual*.

## Connection profiles

Connection profiles allow you to configure your connection with a pre-defined set of properties.

### Apply class-level datatype translations to RSSD

Class-level translations identify primary datatypes and the replicate datatypes into which data is to be translated. Class-level translations are the same as ASE and are provided by the connection profile.

### Create objects in the SQL Anywhere replicate database

The connection profile creates the RS_INFO, RS_LASTCOMMIT, and RS_TICKET_HISTORY tables in the replicate database.

## Additional settings

The following are additional settings to support replication.

### Settings for Dynamic SQL (optional)

Dynamic SQL is supported starting with Replication Server 15.0.1.

## Settings for Command Batching (optional)

For the data servers, use this configuration:

```
batch = on
```

```
batch_begin = on or off
```

The use of *on* for batch_begin reduces the number of network transfers.

```
use_batch_markers = off
```

Additional batch markers are not required.

PART 4

# Appendixes

Appendixes in this part provide supplemental information that can help you design and implement a replication system with heterogeneous or non-ASE data servers.

- Appendix A, “Datatype Translation and Mapping,” lists the class-level datatype translations for non-ASE data servers supported by Replication Server, and the Replication Server datatype names for non-Sybase datatypes.
- Appendix B, “Materialization Issues,” describes the issues related materializing subscriptions in a replication system with heterogeneous or non-ASE data servers.
- Appendix C, “Heterogeneous Database Reconciliation,” describes the issues related to synchronizing and reconciling databases in a replication system with heterogeneous or non-ASE data servers.
- Appendix D, “Troubleshooting Heterogeneous Replication Systems,” describes common problems and troubleshooting procedures for Sybase replication systems with heterogeneous or non-ASE data servers.

# APPENDIX A Datatype Translation and Mapping

This appendix lists the class-level datatype translations for non-ASE data servers supported by Replication Server, and the Replication Server datatype names for non-Sybase datatypes.

For each supported non-ASE data server, Replication Server provides class-level translations that define the default mapping from one datatype to another. Translations are provided for:

- Non-ASE datatypes that do not correspond directly to Adaptive Server datatypes
- Adaptive Server datatypes that do not correspond directly to the non-ASE datatypes
- Non-ASE datatypes that do not correspond directly to the datatypes of another supported non-ASE data server

**Note** Class-level translations are *not* provided for any datatype that corresponds directly to a datatype in another data server.

# DB2 datatypes

This section lists class-level translations (default datatype mapping) for DB2 datatypes and Replication Server datatype names for DB2 datatypes.

**Note** This information about datatype translation applies to DB2 UDB in either mainframe environments (such as IBM z/OS), or UNIX and Microsoft Windows environments.

## DB2 class-level translations

The following sections list the class-level translations for Adaptive Server datatypes to DB2 datatypes, DB2 datatypes to Adaptive Server datatypes, and DB2 datatypes to datatypes of other supported non-ASE data servers.

### Adaptive Server to DB2 datatypes

Table A-1 lists class-level translations from Adaptive Server datatypes to DB2 datatypes.

***Table A-1: Class-level translation from Adaptive Server to DB2 datatypes***

| Adaptive Server datatype | DB2 datatype |
|---|---|
| bigint | BIGINT |
| binary | CHAR FOR BIT DATA |
| bit | TINYINT |
| date | DATE (UNIX and Windows only) |
| datetime | TIMESTAMP |
| decimal | DECIMAL |
| int | NUMERIC |
| money | NUMERIC |
| numeric | NUMERIC |
| real | REAL (UNIX and Windows only) |
| smalldatetime | TIMESTAMP |
| smallint | NUMERIC |
| smallmoney | NUMERIC |
| time | TIME (UNIX and Windows only) |
| tinyint | NUMERIC |
| unsigned bigint | DECIMAL (20,0) |
| unsigned int | BIGINT |
| unsigned smallint | INTEGER |

| Adaptive Server datatype | DB2 datatype |
|---|---|
| unsigned tinyint | SMALLINT |
| unitext | DBCLOB |
| varbinary | VARCHAR FOR BIT DATA |

### DB2 to Adaptive Server datatypes

Table A-2 lists class-level translations from DB2 datatypes to Adaptive Server datatypes.

***Table A-2: Class-level translation from DB2 to Adaptive Server datatypes***

| DB2 datatype | Adaptive Server datatype |
|---|---|
| CHAR FOR BIT DATA | binary |
| DATE | datetime |
| DOUBLE (UNIX and Windows only) | float |
| REAL (UNIX and Windows only) | real |
| TIME | datetime |
| TIMESTAMP | datetime |
| VARCHAR FOR BIT DATA | varbinary |

### DB2 to Microsoft SQL Server datatypes

Table A-3 lists class-level translations from DB2 datatypes to Microsoft SQL Server datatypes.

***Table A-3: Class-level translation from DB2 to Microsoft SQL Server datatypes***

| DB2 datatype | Microsoft SQL Server datatype |
|---|---|
| CHAR FOR BIT DATA | binary |
| DATE | datetime |
| DOUBLE (UNIX and Windows only) | float |
| REAL (UNIX and Windows only) | real |
| TIME | datetime |
| TIMESTAMP | datetime |
| VARCHAR FOR BIT DATA | varbinary |

### DB2 to Oracle datatypes

Table A-4 lists class-level translations from DB2 datatypes to Oracle datatypes.

***Table A-4: Class-level translation from DB2 to Oracle datatypes***

| DB2 datatype | Oracle datatype |
|---|---|
| CHAR FOR BIT DATA | RAW |
| DATE | DATE |
| DOUBLE (UNIX and Windows only) | FLOAT |
| REAL (UNIX and Windows only) | REAL |
| TIME | DATE (with time) |
| TIMESTAMP | DATE (with time) |
| VARCHAR FOR BIT DATA | RAW |

## Replication Server datatype names for DB2

Table A-5 lists the Replication Server user-defined datatype (UDD) names that identify DB2 datatypes for DB2 data servers on z/OS platforms.

***Table A-5: Replication Server names for DB2 z/OS datatypes***

| DB2 z/OS datatype | Replication Server name |
|---|---|
| CHAR FOR BIT DATA | rs_db2_char_for_bit |
| DATE | rs_db2_date |
| DECIMAL | rs_db2_decimal, rs_db2_numeric |
| TIME | rs_db2_time |
| TIMESTAMP | rs_db2_timestamp |
| VARCHAR FOR BIT DATA | rs_db2_varchar_for_bit |

Table A-6 lists the Replication Server UDD names that identify DB2 datatypes for DB2 data servers on UNIX and Microsoft Windows platforms.

***Table A-6: Replication Server names for DB2 UNIX and Windows datatypes***

| DB2 UNIX and Windows datatypes | Replication Server name |
|---|---|
| CHAR FOR BIT DATA | rs_udb_char_for_bit |
| DATE | rs_udb_date |
| DOUBLE | rs_udb_double |
| INTEGER | rs_udb_bigint |
| REAL | rs_udb_real |
| TIME | rs_udb_time |
| TIMESTAMP | rs_udb_timestamp |
| VARCHAR FOR BIT DATA | rs_udb_varchar_for_bit |

## Microsoft SQL Server datatypes

This section lists class-level translations (default datatype mapping) for Microsoft SQL Server datatypes and Replication Server datatype names for Microsoft SQL Server datatypes.

### Microsoft SQL Server class-level translations

The following sections list class-level translations for Microsoft SQL Server datatypes to datatypes of other supported non-ASE data servers.

#### Adaptive Server to Microsoft SQL Server datatypes

Table A-7 lists class-level translations from Adaptive Server datatypes to Microsoft SQL Server datatypes for the unsigned datatypes.

The remaining class-level translations are not supplied for Adaptive Server datatypes to Microsoft SQL Server datatypes (or Microsoft SQL Server datatypes to Adaptive Server datatypes) because Microsoft SQL Server datatypes are directly compatible with Adaptive Server datatypes and they require no translation.

***Table A-7: Class-level translation from Adaptive Server to Microsoft SQL Server datatypes***

| Adaptive Server datatype | Microsoft SQL Server datatype |
|---|---|
| unsigned bigint | DECIMAL (20,0) |
| unsigned int | BIGINT |
| unsigned smallint | INT |
| unsigned tinyint | SMALLINT |
| unitext | NTEXT |

#### Microsoft SQL Server to DB2 datatypes

Table A-8 lists class-level translations from Microsoft SQL Server datatypes to DB2 datatypes.

***Table A-8: Class-level translation from Microsoft SQL Server to DB2 datatypes***

| Microsoft SQL Server datatype | DB2 datatype |
|---|---|
| binary | CHAR FOR BIT DATA |
| bit | TINYINT |
| datetime | TIMESTAMP |
| decimal | DECIMAL |
| money | NUMERIC |
| numeric | NUMERIC |
| smalldatetime | TIMESTAMP |
| smallmoney | NUMERIC |
| varbinary | VARCHAR FOR BIT DATA |

### Microsoft SQL Server to Oracle datatypes

Table A-9 lists class-level translations from Microsoft SQL Server datatypes to Oracle datatypes.

***Table A-9: Class-level translation from Microsoft SQL Server to Oracle datatypes***

| Microsoft SQL Server datatype | Oracle datatype |
|---|---|
| binary | RAW |
| datetime | DATE (with time) |
| money | DECIMAL |
| smalldatetime | DATE |
| smallmoney | DECIMAL |
| varbinary | RAW |

## Replication Server datatype names for Microsoft SQL Server

All Microsoft SQL Server datatypes are compatible with the corresponding Adaptive Server datatypes. Only one Microsoft SQL Server datatype has a user-defined datatype definition.

Table A-10 lists the Replication Server user-defined datatype (UDD) name that identifies a Microsoft SQL Server datatype.

***Table A-10: Replication Server names for Microsoft SQL Server datatypes***

| Microsoft SQL Server datatype | Replication Server name |
|---|---|
| integer | rs_msss_bigint |

## Oracle datatypes

This section lists class-level translations (default datatype mapping) for Oracle datatypes and Replication Server datatype names for Oracle datatypes.

### Oracle class-level translations

The following sections list class-level translations for Adaptive Server datatypes to Oracle datatypes, Oracle datatypes to Adaptive Server datatypes, and Oracle datatypes to datatypes of other supported non-ASE data servers.

#### Adaptive Server to Oracle datatypes

Table A-11 lists class-level translations from Adaptive Server datatypes to Oracle datatypes.

***Table A-11: Class-level translation from Adaptive Server to Oracle datatypes***

| Adaptive Server datatype | Oracle datatype |
|---|---|
| bigint | NUMBER |
| binary | RAW |
| date | DATE |
| datetime | DATE (with time) |
| money | DECIMAL |
| smalldatetime | DATE |
| smallmoney | DECIMAL |
| time | DATE (with time) |
| unsigned tinyint | SMALLINT |
| unsigned smallint | INTEGER |
| unsigned int | NUMBER |
| unsigned bigint | NUMBER |
| unitext | NCLOB |
| varbinary | RAW |

#### Oracle to Adaptive Server Datatypes

Table A-12 lists class-level translations from Oracle datatypes to Adaptive Server datatypes.

***Table A-12: Class-level translation from Oracle to Adaptive Server datatypes***

| Oracle datatype | Adaptive Server datatype |
|---|---|
| RAW | varbinary |
| DATE | datetime |
| TIMESTAMP (9) | datetime |

**Oracle to DB2 datatypes**

Table A-13 lists class-level translations from Oracle datatypes to DB2 datatypes.

***Table A-13: Class-level translation from Oracle to DB2 datatypes***

| Oracle datatype | DB2 datatype |
|---|---|
| RAW | CHAR FOR BIT DATA |
| DATE | DATE |
| DATE (with time) | TIMESTAMP |
| FLOAT | DOUBLE (UNIX and Windows only) |
| INTEGER | INTEGER (UNIX and Windows only) |
| TIMESTAMP (9) | TIMESTAMP (UNIX and Windows only) |

**Oracle to Microsoft SQL Server datatypes**

Table A-14 lists class-level translations from Oracle datatypes to Microsoft SQL Server datatypes.

***Table A-14: Class-level translation from Oracle to Microsoft SQL Server datatypes***

| Oracle datatype | Microsoft SQL Server datatype |
|---|---|
| RAW | varbinary |
| DATE | datetime |
| TIMESTAMP (9) | datetime |

## Replication Server datatype names for Oracle

Table A-15 lists the Replication Server user-defined datatype (UDD) names that identify Oracle datatypes.

***Table A-15: Replication Server names for Oracle datatypes***

| Oracle datatype | Replication Server name |
|---|---|
| RAW | rs_oracle_binary |
| DATE | rs_oracle_datetime |
| ROWID | rs_oracle_rowid |
| INTEGER | rs_oracle_int |
| INTERVAL | rs_oracle_interval |
| BINARY_FLOAT | rs_oracle_float |
| NUMBER | rs_oracle_decimal |
| TIMESTAMP(n) | rs_oracle_timestamp9 |
| TIMESTAMP(n) (with local time zone) | rs_oracle_timestamptz |
| UDD object type | opaque |

# APPENDIX B Materialization Issues

This appendix describes the subscription materialization issues that you must consider when implementing a replication system with heterogeneous or non-ASE data servers. It also describes how to materialize subscriptions to primary tables in a non-ASE database.

## Materialization overview

Materialization is creating and activating subscriptions and copying data from a primary database to a replicate database, thereby initializing the replicate database.

Before you can replicate data from a primary database, you must set up and populate each replicate database so that the replicate objects (such as tables) are in a state consistent with those in the primary database.

Types of materialization

Replication Server supports two types of subscription materialization:

- *Bulk materialization* – manually creating and activating a subscription and populating a replicate database using data unload and load utilities outside the control of the replication system.
- *Automatic materialization* – creating a subscription and populating a replicate database using Replication Server commands.

For more information about subscription materialization methods, see the *Replication Server Administration Guide*.

**Heterogeneous materialization issues**

To materialize subscriptions to primary data in a non-ASE data server, you may use a bulk materialization or automatic materialization, if it applies. With bulk materialization methods, you must coordinate and manually perform the following activities:

- Define, activate, and validate the subscription (or create the subscription without materialization).
- Unload the subscription data at the primary database.
- Move the unloaded data to the replicate database site.
- Load the primary data into the replicate database tables.
- Resume the database connection from the replicate Replication Server to the replicate data server so that the replicate database can receive replicated transactions.
- Resume replication at the Replication Agent instance.

**Bulk materialization options**

There are two bulk materialization options for subscriptions to primary data in a non-ASE database:

- *Atomic bulk materialization*
  - Stop updates to the primary table and dump the subscription data from the primary database.
  - In the replicate Replication Server, define the subscription.
  - In the primary database, use the rs_marker function to activate the subscription using the with suspension option. See the *Replication Server Reference Manual* for information about applying the rs_marker function.
  - Load the subscription data into the replicate table.
  - Resume the database connection from the replicate Replication Server to the replicate database.
  - In the replicate Replication Server, validate the subscription.
- *Nonatomic bulk materialization*
  - In the replicate Replication Server, use the set autocorrection command.
  - In the replicate Replication Server, define the subscription.
  - In the primary database, use the rs_marker stored procedure to activate the subscription using the with suspension option.

- Dump the subscription data from the primary database.
- In the primary database, use the rs_marker stored procedure to validate the subscription.
- Load the subscription data into the replicate table.
- Resume the database connection from the replicate Replication Server to the replicate database.
- When the subscription becomes valid at all Replication Servers, turn off autocorrection.

## Unloading data from a primary database

Part of the subscription materialization process involves unloading subscription data from the primary table so it can be loaded into the replicate table. *Subscription data* is the data in the primary table that is requested by the subscription.

Data unloading utilities are usually provided with data server software. You can use one of the OEM-supplied data unloading utilities or a database unload utility of your choice.

**Note** Once subscription data is unloaded from a primary database, you may need to perform datatype translation on the unloaded data before loading the data into the replicate database. See “Datatype translation issues.”

## Datatype translation issues

If you are not using the unload utility and are using automatic materialization, then Replication Server performs the translations.

If you use the heterogeneous datatype support (HDS) feature of Replication Server to perform either column- or class-level translations on replicated data, you must perform datatype translations on the subscription data you unload from the primary database for materialization.

## Loading data into replicate databases

Part of the subscription materialization process involves loading subscription data from the primary table into the replicate table.

---

**Note** After subscription data is unloaded from a primary database, you may need to perform datatype translation on the unloaded data before loading the data into the replicate database.

---

If you are using Adaptive Server Enterprise as the data server for the replicate database, use the ASE bcp utility to load subscription data into the replicate database.

If you are using a non-ASE data server as the data server for the replicate database, you can use the load utility of your choice to load subscription data into the replicate database.

For more information about using bcp with Adaptive Server, see *Adaptive Server Enterprise Utility Guide*.

## Atomic bulk materialization

Atomic bulk materialization assumes that all applications updating the primary table can be suspended while a copy of the table is made. The copy is then loaded at the replicate site.

You can use this atomic bulk materialization to retrieve data from the primary database if you can (at least temporarily) suspend updates to the primary data.

### Preparing for materialization

Before you start an atomic bulk materialization procedure, verify that:

- The primary table exists and contains data.
- You have access to a user ID with ownership or select privilege on the primary table (or a column to be replicated in the primary table).
- The replicate table exists and contains the appropriate columns, datatypes.

- You have successfully configured all Replication Servers in your replication system.
- You have correctly created the replication definition at the primary Replication Server.
- If you are using Replication Agent for a DB2 UDB, Microsoft SQL Server, or Oracle primary database:
    - You have successfully initialized the Replication Agent which also creates some objects in the primary database.
    - You have marked and enabled replication for the primary table in the primary database.
    - You have started the Replication Agent instance and put it in the Replicating state.

## Performing atomic bulk materialization

❖ **Performing atomic bulk materialization**

1. Use isql to log in to the replicate Replication Server as the system administrator (sa):

   ```
   isql -Usa -Psa_password -SRRS_servername
   ```

   where *sa* is the system administrator user ID, *sa_password* is the password for the system administrator user ID, and *RRS_servername* is the server name of the replicate Replication Server.

2. At the replicate Replication Server define the subscription:

   ```
   1> define subscription subscription_name
   2> for replication_definition
   3> with replicate at dataserver.database
   4> [where search_conditions]
   5> go
   ```

   The dataserver.database must match the Replication Server connection name you use for the replicate database.

3. Check the subscription at both the primary and replicate Replication Servers. To verify that the subscription status is DEFINED, enter:

   ```
   1> check subscription subscription_name
   2> for replication_definition
   3> with replicate at dataserver.database
   ```

```
4> go
```

4 Lock the primary table to prevent primary transaction activity. This prevents updates to the primary table during materialization.

5 Unload the subscription data at the primary site using your site's preferred database unload method to select or dump the data from the primary table.

**Note** When unloading subscription data from the primary table, make sure you select only the columns specified in the replication definition and the rows specified in the subscription.

6 Perform any datatype translations necessary for the subscription data.

If any column-level translation is specified in the replication definition for this data, perform the datatype translation specified in the replication definition.

If class-level translations are specified for the subscription, perform the datatype translations specified for the subscription.

7 At the replicate Replication Server, activate the subscription:

```
1> activate subscription subscription_name
2> for replication_definition
3> with replicate at dataserver.database
4> with suspension
 5> go
```

8 Wait for the subscription to become active at both the primary and replicate Replication Servers. Execute check subscription at both the primary and replicate Replication Servers to verify that the subscription status is ACTIVE.

When the subscription status is ACTIVE at the replicate Replication Server, the database connection for the replicate database is suspended.

9 Restore the primary table to read-write access (unlock).

10 Use the bcp or your site's preferred database utility to load the subscription data into the replicate database.

11 From the replicate Replication Server, resume the database connection for the replicate database:

```
1> resume connection
2> to dataserver.database
3> go
```

12 Validate the subscription at the replicate Replication Server:

```
1> validate subscription subscription_name
2> for replication_definition
3> with replicate at dataserver.database
4> go
```

13 Wait for the subscription to become valid at both the primary and replicate Replication Servers, then execute check subscription at both the primary and replicate Replication Servers to verify that the status is VALID.

When you complete this procedure, the subscription is created, the replicate data is consistent with the primary data, and replication is in progress.

If replication is not in progress when you complete this procedure, see Chapter 9, "DB2 UDB Replicate Data Server Issues for UNIX, Windows, and Linux."

See also

- *Replication Server Reference Manual* for information on Replication Command Language (RCL) commands
- *Replication Server Administration Guide* for information on configuring Replication Servers and materialization methods

## Nonatomic bulk materialization

Nonatomic bulk materialization assumes applications updating the primary table cannot be suspended while a copy of the table is made. Therefore, nonatomic materialization requires the use of the Replication Server *autocorrection* feature to get the replicate database synchronized with the primary database.

**Note** You cannot use nonatomic materialization if the replicate minimal columns feature is set for the replication definition for the primary table.

### Preparing for materialization

Before you start a nonatomic bulk materialization procedure, verify that:

- The primary table exists and contains data.

- You have access to a user ID with ownership or select privilege on the primary table (or a column to be replicated in the primary table).
- The replicate table exists and contains the appropriate columns.
- You have successfully configured all Replication Servers in your replication system.
- You created the replication definition correctly at the primary Replication Server.
- If you are using Replication Agent for a DB2 UDB, Microsoft SQL Server, or Oracle primary database:
  - You have successfully initialized the Replication Agent which also creates some objects in the primary database.
  - You have marked and enabled replication for the primary table in the primary database.
  - You have started the Replication Agent instance and put it in the Replicating state.

## Performing nonatomic bulk materialization

❖ **Performing nonatomic bulk materialization**

1. Use isql to log in to the replicate Replication Server as the system administrator (sa):

   ```
   isql -Usa -Psa_password -SRRS_servername
   ```

   where:

   - *sa* is the system administrator user ID.
   - *sa_password* is the password for the system administrator user ID.
   - *RRS_servername* is the server name of the replicate Replication Server.

2. At the replicate Replication Server, turn on the autocorrection feature:

   ```
   1> set autocorrection on
   2> for replication_definition
   3> with replicate at dataserver.database
   4> go
   ```

3 At the replicate Replication Server, define the subscription using the with suspension option:

```
1> define subscription subscription_name
2> for replication_definition
3> with replicate at dataserver.database
4> with suspension
5> go
```

The dataserver.database must match the Replication Server connection name you use for the replicate database.

4 In the primary database, invoke the rs_marker stored procedure to activate the subscription.

5 Check the subscription at both the primary and replicate Replication Servers. Verify that the subscription status is ACTIVE:

```
1> check subscription subscription_name
2> for replication_definition
3> with replicate at dataserver.database
4> go
```

When the subscription status is ACTIVE at the replicate Replication Server, the database connection for the replicate database is suspended.

6 Unload the subscription data at the primary site using your site’s preferred database unload method to select or dump the data from the primary tables.

**Note** When unloading subscription data from the primary table, make sure you select only the columns specified in the replication definition and the rows specified in the subscription.

7 Perform any datatype translations necessary for the subscription data.

If any column-level translation is specified in the replication definition for this data, perform the datatype translation specified in the replication definition.

If class-level translations are specified for the subscription, perform the datatype translations specified for the subscription.

8 In the primary database, invoke the rs_marker stored procedure to validate the subscription.

9 Wait for the subscription to become valid at both the primary and replicate Replication Servers, then execute check subscription at both the primary and replicate Replication Servers to verify that the status is VALID.

10 Use the bcp utility or your site's preferred database load utility to load the subscription data into the replicate database.

11 From the replicate Replication Server, resume the database connection for the replicate database:

```
1> resume connection
2> to dataserver.database
3> go
```

12 Wait for the subscription to become valid at both the primary and replicate Replication Servers, then execute the check subscription command at both the primary and replicate Replication Servers to verify that the status is VALID.

When the subscription's status is VALID at the replicate Replication Server, the replicate database is synchronized with the primary database and you can turn off autocorrection:

```
1> set autocorrection off
2> for replication_definition
3> with replicate at dataserver.database
4> go
```

13 When you complete this procedure, the subscription is created, the replicate data is consistent with the primary data, and replication is in progress.

If replication is not in progress when you complete this procedure, see Chapter 9, "DB2 UDB Replicate Data Server Issues for UNIX, Windows, and Linux."

See also

- *Replication Server Reference Manual* for information on Replication Command Language (RCL) commands
- *Replication Server Administration Guide* for information on configuring Replication Servers and materialization methods

APPENDIX C

# Heterogeneous Database Reconciliation

This appendix describes the issues involved with comparing and reconciling data from different databases in a heterogeneous replication system.

## Sybase rs_subcmp utility

The Sybase rs_subcmp utility allows you to compare primary and replicate tables in Adaptive Server databases, and reconcile any differences. Sybase provides the rs_subcmp executable program with Replication Server.

Some other database vendors may provide a similar "compare" utility that can perform the same function for their own databases, but there is no equivalent utility to support different types of non-ASE data servers (for example, to compare tables in an Oracle database to tables in a Microsoft SQL Server database).

For non-ASE database support, you can either acquire third-party tools that provide such functionality, or build your own application.

## Database comparison application

You can develop a custom application to perform the same functions as the rs_subcmp utility. The application's complexity depends on the number of different data server types, the complexity of the tables to be compared, the amount of data translation involved, and so forth.

The following list describes the major issues that a database comparison application must accommodate to be successful in a heterogeneous replication environment:

- Connectivity – the application must be able to communicate with both the primary and replicate databases. If multiple database vendors are involved, ODBC and JDBC protocols can provide a common interface and functionality.
- Sort order – the default sort order may be different for different databases. The application may need to force the sort order to improve comparison performance.
- Character sets – some primary and replicate databases may store character data in different character sets. Your custom application may need to support these translations.
- Object identification – primary and replicate tables may not have identical names or exactly the same schema or column names. The comparison application may need to accept very explicit instructions for location, database, and table and column names to be referenced.
- Subset comparison – the application may need to compare only a portion of a table. The ability to specify a where clause type of select for both primary and replicate tables may be important.
- Latency – in a replication system, there is always some latency (a measure of the time it takes a primary transaction to appear in a replicate table). A comparison application must include some tolerance to distinguish between rows that are "not there" and "not there yet."
- Data transformation – the application must be able to handle differences in precision and format between different databases, the same way Replication Server supports class-level translations. To simplify processing you want to allow certain columns to be excluded from the comparison process, based on datatype (for example, do not compare the DATE datatypes of different database vendors).
- Large object (LOB) data – large object (for example, LOB, CLOB, TEXT, or IMAGE) datatypes cause additional processing issues because of their size. To improve performance, limit the number of bytes used for comparison, if the likelihood of a "non-match" can still be relied on.

For more information about the rs_subcmp utility, see the *Replication Server Administration Guide* and the *Replication Server Reference Manual*.

APPENDIX D

# Troubleshooting Heterogeneous Replication Systems

This chapter describes common problems and troubleshooting procedures for Sybase replication systems with heterogeneous or non-ASE data servers.

## Troubleshooting overview

Common Replication Server troubleshooting tasks, such as dumping stable queues, debugging failures with the Data Server Interface (DSI) and Replication Server Interface (RSI), and diagnosing and correcting problems with subscriptions, are described in the *Replication Server Troubleshooting Guide*.

For non-ASE primary and replicate databases, the Replication Agent and ECDA gateway documentation provide troubleshooting information for each specific database.

This chapter describes some basic troubleshooting if replication fails in a Sybase replication system with heterogeneous or non-ASE data servers.

## Inbound and outbound queue problems

The *inbound queue* is where Replication Server stores the data it receives from a primary database (through a Replication Agent or another Replication Server). The *outbound queue* is where Replication Server stores the data it needs to send to a replicate site (either a replicate database or another Replication Server).

This section describes how to troubleshoot problems with these Replication Server queues.

### Inbound queue problems

You can tell that the Replication Server inbound queue for a primary database is not being updated if you issue the Replication Server admin who,sqm command at the primary Replication Server and the results indicate that:

- The number of blocks being written in the Replication Server inbound queue for the connection in question is not changing.
- The number of duplicate messages being detected is not increasing.

❖ **Determining the reason the inbound queue is not being updated**

1 Verify the Replication Server connection Replication Agent User thread status.

   You can issue an admin who command in the primary Replication Server to review the status of the Replication Agent User thread for the Replication Server database connection in question.

   - If there is no Replication Agent User thread for the connection, the connection was not created with the with log transfer on clause. You can alter the Replication Server database connection to turn log transfer processing on, if needed.
   - If the Replication Agent User thread status is down, the Replication Agent is not actively connected to the Replication Server. A down status is typical for Replication Agents that connect to Replication Server only when there is work to be sent, and then disconnect after a period of inactivity.

2 Verify that the expected Replication Agent is executing.

Verify that the expected Replication Agent is active, and that the values of the Replication Agent rs_source_ds and rs_source_db configuration parameters match the desired Replication Server connection name.

Refer to the appropriate Replication Agent documentation for other tests to validate that the Replication Agent is executing.

3 Verify that the expected table or procedure is marked for replication.

Replication Agent documentation describes the Replication Agent commands you can use to check replication status.

Replication Agent provides for separate enabling of replication, in addition to marking. In this case, make sure the marked object is also enabled for replication.

4 Verify that the Replication Agent is scanning new records.

If the database object is marked for replication, the log scanning process of the Replication Agent should record that additional information is being scanned.

To verify that new records are being scanned:

- Start tracing in the Replication Agent.
- Update or execute a primary database object that has been marked for replication.
- Verify that scanning occurs.

Refer to the appropriate Replication Agent documentation to determine the trace flags you can use to validate the scanning process.

## Outbound queue problems

You can tell that the Replication Server outbound queue for a replicate database is not being updated if you issue the Replication Server admin who,sqm command at the replicate Replication Server and the results indicate that:

- The number of blocks being written in the Replication Server outbound queue for the connection in question is not changing.
- The number of duplicate messages being detected is not increasing.

Problems between inbound and outbound queues are often naming problems.

### ❖ Determining the reason the outbound queue is not being updated

1. Verify that any Replication Server routes are active.

   Refer to the Replication Server *Troubleshooting Guide* for route validation techniques between primary and replicate Replication Servers.

2. Verify that the Replication Server connection DSI thread is not down.

   Issue an admin who command in the replicate Replication Server to review the status of the DSI thread for the Replication Server connection.

   If the DSI thread status is down, the Replication Server is not connected to the replicate database (or ECDA gateway). Review the Replication Server log for errors and attempt to resume the connection.

3. Verify that the DSI thread connection is not in "Loss Detected" mode by viewing the replicate Replication Server log for "Loss Detected" messages for the DSI thread in question.

   When Replication Server detects a loss, no further messages are accepted on the DSI thread connection.

   Refer to the *Replication Server Administration Guide* for information about recovering from this error.

4. Verify the primary replication definition.

   The primary Replication Server inbound queue can receive data, but when it cannot apply that data to any replication definition, the reason is that the name of the replication definition does not match the name presented in the Log Transfer Language (LTL) that was created by the Replication Agent. This becomes more likely when you are using different non-Sybase database types with different default character cases.

   Replication Server processing of replication commands is case sensitive. In a replication system with non-ASE data servers, ensure that the LTL generated by Replication Agents matches the Replication Server connection names and replication definition object names.

   Some Replication Agents always use lowercase names when they communicate with Replication Server (for example, Adaptive Server and DB2 UDB). However, the best option is to pick one character case (uppercase or lowercase) and use it consistently with all Replication Server connections, replication definitions, and subscription names.

Validating case-sensitivity is manual. You can use the rs_helprep command to verify the name of a replication definition. Then, you can then turn on LTL tracing in the Replication Agent and verify that the name provided in the LTL trace matches the spelling and character case of the name specified in the replication definition.

If the character case appears to be incorrect, review the Replication Agent documentation to verify the default character case settings and any possible configuration changes. If a name is misspelled, delete and then re-create the replication definition.

## Replicate database is not updated

If the Replication Server outbound queue is being updated but transaction data is not being applied at the replicate database, use the following procedure to determine the reason.

### ❖ Determining why replicate transactions are not applied at the replicate database

1 Determine if the subscription contains a where clause.

Verify that the transaction data expected passes any where clause in the subscription definition. Use the rs_helpsub stored procedure to list the text of the subscription.

2 Verify HDS installation.

If you are using Replication Server HDS to support replication to or from a non-ASE data server, verify that the HDS connection profiles have been properly applied.

See “Expected datatype translations do not occur” on page 159.

3 Verify that the rs_lastcommit table is set up correctly.

If you are using Replication Server HDS to support replication to or from a non-ASE data server, verify that the HDS connection profiles have been properly applied.

Refer to “Updates to rs_lastcommit fail” on page 158.

4 Review the replicate Replication Server log for errors.

5 Review the replicate database log for errors.

6 Verify manual access to replicate objects.

Log in to the replicate database (or ECDA gateway) using the Replication Server connection maintenance user ID, and verify that you have update authority to the replicate table or procedure.

7 Validate commands sent to the replicate database:

- Turn on the DSI_BUF_DUMP trace flag in the replicate Replication Server and record to the Replication Server log the commands being sent to the replicate database.
- Verify that these commands, when manually applied, produce the expected results.

---

**Note** You can use the DSI_BUF_DUMP trace flag with any Replication Server. By contrast, the similar DSI_CMD_DUMP trace flag is available only with the diagnostic version of Replication Server. Refer to the *Replication Server Troubleshooting Guide* for more information about Replication Server traces.

---

8 Turn on tracing at the ECDA gateway to see what commands are being received.

For example, these parameters in the ECDA Option for Oracle configuration file cause ECDA to write additional information to the *DCO.log* file:

- network_tracing = 1
- traces = 1,2,3,4,5,6,10

Refer to the appropriate ECDA documentation for specific trace availability and syntax.

## HDS issues and limitations

This section describes some known issues and limitations with the HDS feature in Replication Server.

## Source value exceeds target datatype bounds

The datatype translations provided by Sybase specify that the thread attempting a translation where the source value exceeds the bounds of the target datatype should be stopped with the following error message:

```
E. 2007/12/14 11:14:54. ERROR #32055 DSI EXEC(135(1)
   snickers_dco.ora805) -
   /nrm/nrm.c(7023)
   Class Level translation for column/parameter
   'datetimecol' failed.
   Source DTID is 'datetime'.
   Target DTID is 'rs_oracle_datetime'.
   Function String Class ID 'rs_oracle_function_class'.
   Value length is '21'; Maximum target length is '20';
   The value is '99991231 23:59:59:010'
```

Typically, these are the most difficult translation problems to diagnose because there appears to be no problem with either the pairing of source/target datatypes or the value to be translated.

To diagnose this type of problem, you must be familiar with the datatype value boundary limits of all the translated target datatypes. For example, to diagnose the error shown, you must know that the upper boundary of an Oracle DATE value is 12/31/9999.

There are other options for datatype translations:

- Use the maximum value of the datatype definition.
- Use the minimum value for the datatype definition.
- Use the default value for the datatype definition.

## Exact numeric datatype issues

There may be problems with exact numeric datatypes when the values replicated are at the boundaries (maximum or minimum values) of what is supported by the datatype definitions.

Microsoft SQL Server supports either 28 or 38 digits of precision, depending on how the server is started. By default, Microsoft SQL Server supports 28 digits of precision.

Sybase does not provide datatype definitions that support the Microsoft default of 28 digits of precision. Datatype definitions are not needed to support 38 digits of precision, because the Replication Server native numeric datatypes support up to 72 digits of precision.

When a number exceeds numeric precision of the Microsoft SQL Server replicate database, Replication Server returns the following error:

```
E. 2007/12/14 11:14:58. ERROR #1028 DSI EXEC(134(1)
   dcm_gabeat70_devdb.devdb)
   - dsiqmint.c(2888)
   Message from server: Message: 30291, State 0,
   Severity 19 --
   '[VENDORLIB] Vendor Library Error: [[Message
   Iteration=1|Data Source
   Name=mssql70_devdb|SQLState=22003|Native
   Error=1007|Message=[Microsoft][ODBC SQL Server
   Driver][SQL Server]The number
   '999999999999999999.999999999999999999' is out of
   the range for numeric representation (maximum
   precision 28).[Message Iteration=2|SQLState=22003|
   Native Error=|Message=[Microsoft][ODBC SQL Server
   Driver][SQL Server]The number
   '0.999999999999999999999999999999999999' is out of
   the range for numeric representation (maximum
   precision 28).] <DCA>'
```

The most difficult numeric datatype issues involve precision and scale. Replication Server does not allow the precision and scale of a decimal datatype to be specified. A datatype definition can specify the maximum precision and maximum scale to be supported. However, if this does not equate to the specified precision and scale of an individual replicate column, then as the data approaches values near or at the boundaries, you may encounter problems that are reported differently, depending on the replicate data server.

For example, suppose you have a primary column declared as decimal (8,5) (8 digits of precision and a scale of 5), and suppose the replicate column is declared as decimal (6,4), even though the replicate data server can support a maximum of 7 digits precision and a scale of 7. In the replication definition, you specify the translation for the primary data server decimal datatype and for which there is a class-level translation to the replicate data server decimal datatype. Both datatype definitions specify the associated data servers maximum precision and scale.

If the value 999.99999 comes from the primary database, and the replicate data server’s datatype definition specifies that rounding should be attempted, Replication Server attempts to apply a value of 1000.000. Even though this value satisfies the replicate database requirements for maximum precision and scale, it fails the precision and scale specified for this particular column. And if you specify for the replicate database’s datatype definition that it should replace the value with the specified maximum value for the datatype definition, Replication Server attempts to apply a value of 9999999, which also fails the specified precision and scale for this particular column.

Error messages you might see from various data servers in this case include:

- The following DB2 error:

```
E. 2007/12/14 15:03:11. ERROR #1028 DSI EXEC(129(1)
   dwm5_via_rct.dwmdbas)
   - dsiqmint.c(2888)
   Message from server: Message: 30291, State 0,
   Severity 19 --
   '[VENDORLIB] Vendor Library Error: [[Message
   Iteration=1|SQLState=22003|Native Error=
   -413|Message=[Sybase][ClearConnect ODBC][DB2]The
   decimal or numeric value had an incorrect wire
   length compared to its specified FDOCA length
   10000000000000000000.00000000000] <DCA>'.
```

- The following Microsoft SQL Server error:

```
E. 2007/12/14 12:29:16. ERROR #1028 DSI EXEC(134(1)
   dcm_gabeat70_devdb.devdb)
   - dsiqmint.c(2888)
   Message from server: Message: 30291, State 0,
   Severity 19 --
   '[VENDORLIB] Vendor Library Error: [[Message
   Iteration=1|Data Source Name=mssql70_devdb|SQL
   Function=INSERT|SQLState=22003|Native Error=
   8115|Message=[Microsoft][ODBC SQL Server Driver]
   [SQL Server]Arithmetic overflow error converting
   numeric to data type numeric.[Message Iteration=
   2|SQLState=01000|Native Error=|Message=
   [Microsoft][SQL Server]The statement has been
   terminated.] <DCA>'
```

## Numeric translation and identity columns in Microsoft SQL Server

Replication Server function strings to set identity insert off and on work in Microsoft SQL Server because it supports identity columns in the same manner as Adaptive Server. However, to support 28-digit precision in a Microsoft SQL Server database, the numeric datatype must be translated to the rs_msss_numeric datatype, and as a result, the identity characteristic is lost. To avoid this problem, the Microsoft SQL Server replicate table must not declare a translated numeric column as an identity.

If you attempt to replicate a translated numeric datatype into an identity column in Microsoft SQL Server, you receive an error similar to this:

```
E. 2007/12/14 12:05:39. ERROR #1028 DSI EXEC(134(1)
   dcm_gabeat70_devdb.devdb)
   - dsiqmint.c(2888)
   Message from server: Message: 30291, State 0,
   Severity 19 --
   '[VENDORLIB] Vendor Library Error: [[Message
   Iteration=1 |Data Source Name=mssql70_devdb|SQL
   Function=INSERT|SQLState=23000|Native Error=544
   |Message=[Microsoft][ODBC SQL Server Driver][SQL
   Server]Cannot insert explicit value for identity
   column in table 'ase_alltypes' when IDENTITY_INSERT
   is set to OFF.] <DCA>'
```

# Troubleshooting specific errors

This section describes troubleshooting for specific errors you may encounter in a Sybase replication system with heterogeneous or non-ASE data servers.

## Updates to rs_lastcommit fail

When replicating into a non-ASE replicate database, the replicate Replication Server updates the rs_lastcommit table as soon as the connection is resumed. If the replicate Replication Server error log displays a syntax error while updating the rs_lastcommit table, the following procedure may help identify the problem.

❖ **Troubleshooting rs_lastcommit update failure**

1. Verify that the table exists in the replicate database.
2. Verify access authority.

   Log in to the replicate database using the Replication Server maintenance user ID and password specified in the create connection command for that database connection.

   Verify that this user ID can update the rs_lastcommit table – you should be able to insert and delete a dummy entry without error.
3. Trace the actual command.

   Turn on tracing in the replicate Replication Server (DSI_BUF_DUMP trace) or in the ECDA gateway and resume the Replication Server connection.

   Identify the failing statement and correct as necessary.

## Expected datatype translations do not occur

The most common reason for a datatype translation failure is an incomplete installation of the necessary user-defined datatypes (UDDs) and translations.

❖ **Validating UDD and translation installation**

1. Restart the Replication Servers. Replication Server caches all function-string information at start-up.

   Subsequent changes to the function strings stored in the RSSD do not take effect until the Replication Server is restarted.
2. Verify that class-level translations have been applied to the replicate Replication Server.

   The Replication Server connection profile provides the SQL statements necessary to apply class-level translations to the RSSD of the replicate Replication Server for a specific combination of non-ASE primary databases to non-ASE replicate databases.

   **Note** The connection profile is required for any non-ASE replicate database. For example, if you are replicating from ASE to Oracle, the *rs_ase_to_oracle* connection profile for translations must be applied to ensure Replication Server updates to the rs_lastcommit table are properly translated and applied to the replicate database.

You can re-run these connection profiles without failure. Verify that your copy of the connection profiles has been updated with the correct use statement for the database name of the RSSD.

3. Verify that your replicate database Replication Server connection is associated with the appropriate function-string class.

   To take advantage of class-level translations, the replicate Replication Server connection must use the correct non-ASE function-string class.

   You can use the Replication Server rs_helpdb command to determine which function-string class is defined for a database connection.

   Function-string classes for replicate databases are:

   - Adaptive Server Enterprise – *rs_sqlserver_function_class*
   - DB2 UDB on IBM z/OS platforms – *rs_db2_function_class*
   - DB2 UDB on UNIX and Windows platforms – *rs_udb_function_class*
   - Microsoft SQL Server – *rs_msss_function_class*
   - Oracle – *rs_oracle_function_class*

   Use the Replication Server admin show_function_classes command to display a list of active function-string classes.

   Use the Replication Server alter connection command to change the function-string class of an existing database connection.

4. Verify that the non-ASE function-string classes have been updated with appropriate function strings.

   Replication Server connection profile *rs_xxx_xxx* provides the SQL statements necessary to apply function strings to the RSSD of the replicate Replication Server for a specific non-ASE replicate database.

   For each function string, the connection profile issue a delete followed by an insert. You can re-run these connection profiles without failure.

   Verify that your copy of the connection profile has been updated with the correct use statement for the database name of the RSSD.

5. Use the Replication Server admin translate command.

   The admin translate command allows you to verify the results of a specific translation. Use this command to verify that the translation engine is providing the translation results you expect.

For more information about heterogeneous datatype support (HDS) and the admin translate command, refer to the *Replication Server Administration Guide*.

## LTL generation and tracing

This section describes how to trace the Log Transfer Language (LTL) commands sent to a primary Replication Server, as well as other significant Replication Agent traces.

### Replication Agent for DB2 UDB

You can use the configuration parameters described in this section to obtain additional information that is not normally presented by Replication Agent for DB2 UDB.

To print the log record identifier for each log record, and additional messages received from the DB2 API, enter Logtrace = Y in the *LTMCFG* file.

**Note** There is usually some performance impact when you use these parameters. Review the full description of a parameter in the *Replication Agent for DB2 UDB Installation Guide* before using it.

- If you need additional tracing to help debug the information passed to a Replication Agent user exit, set the value of the API_com_test configuration parameter to Y. You can also use this trace when no exit is being used.
- The LTL_test_only configuration parameter controls whether LTM for z/OS connects to Replication Server and sends transaction operations for replication. When the value of the LTL_test_only parameter is Y, LTL that would normally be sent to Replication Server is written to the *LTLOUT* file instead.

  **Note** The Replication Agent for DB2 UDB is “not corrected to” the Replication Server when the value of the LTL_test_only parameter is Y.

- The trace=LTLebcdic configuration parameter writes EBCDIC LTL that is passed to Replication Server to *LTLOUT*. If you are replicating a table that contains ASCII data, set the trace = LTLASCII to write the ASCII characters to the *LTLOUT* data set. You must set the value of these parameters to Y to turn on this trace.
- The Use_repdef configuration parameter allows LTM for z/OS to send LTL to Replication Server that contains only the columns specified in the replication definition.

  Setting the value of the Use_repdef parameter to N may increase the amount of information provided in an LTL trace.
- The suppress_col_names configuration parameter determines whether LTM for z/OS suppresses column names from the LTL that is sent to Replication Server.

  If you are tracing LTL output, set the value of suppress_col_names to N to ensure that column names are present in the generated LTL.

## Replication Agent

You can use the trace flags and configuration parameters described in this section to obtain additional information that is not normally presented by the Replication Agent (for Microsoft SQL Server, Oracle, and UDB).

**Note** Some performance impact usually occurs when you use these trace flags and parameters. Before using a flag or parameter, review its full description in the *Replication Agent Administration Guide*.

### Trace flags

Normal trace output is sent to the Replication Agent instance log file. However, output from the LTITRACELTL trace point is sent to a separate LTL output log file (*LTITRACELTL.log*).

The following trace flags are particularly useful for troubleshooting Replication Agent problems:

- LRTRACE – traces general execution of the Log Reader component.
- LTITRACE – traces general execution of the Log Transfer Interface component.
- LTITRACELTL – enables LTL statement tracing in the *LTITRACELTL.log* file.
- RACONTRC – traces connection and query execution.

- RACONTRCSQL – traces SQL statements sent to the primary database.

## Configuration parameters

The settings of the following Replication Agent configuration parameters affect the trace information:

- compress_ltl_syntax – when set to false, provides more verbose description of LTL commands.
- connect_to_rs – when set to false, allows LTL to be generated without actual connection or sending information to Replication Server.
- log_trace_verbose – when set to true, provides more verbose description of traced components.
- use_rssd – when set to false, provides a complete generation of LTL commands without modification for replication definition information.
- column_compression – when set to false, sends complete column information (all columns in after images) in the generated LTL for update operations.

For a complete description of Replication Agent trace flags and configuration settings, refer to the Replication Agent *Administration Guide*.

# Glossary

| | |
|---|---|
| **Adaptive Server** | The Sybase version 11.5 and later relational database server. |
| **applied function** | A replicated function, associated with a function replication definition, that Replication Server delivers from a primary database to a subscribing replicate database. An applied function passes parameter values to a stored procedure that is executed at the replicate database. See also **replicated function delivery**, **request function**, and **function replication definition**. |
| **asynchronous procedure delivery** | A method of replicating, from a source to a destination database, a stored procedure that is associated with a table replication definition. |
| **asynchronous command** | A command that a client submits when the client is not prevented from proceeding with other operations before the completion status is received. Many Replication Server commands function as asynchronous commands within the replication system. |
| **atomic materialization** | A materialization method that copies subscription data from a primary database to a replicate database through the network in a single atomic operation, using a select operation with a holdlock. No changes to primary data are allowed until data transfer is complete. Replicate data may be applied either as a single transaction or in increments of ten rows per transaction, which ensures that the replicate database transaction log does not fill. Atomic materialization is the default method for the create subscription command. See also **nonatomic materialization**, **bulk materialization**, and **no materialization**. |
| **autocorrection** | A setting applied to replication definitions, using the set autocorrection command, to prevent failures caused by missing or duplicate rows in a copy of a replicated table. When autocorrection is enabled, Replication Server converts each update or insert operation into a delete followed by an insert. Enable autocorrection only for replication definitions whose subscriptions use non atomic materialization. |
| **base class** | A function-string class that does not inherit function strings from a parent class. See also **function-string class**. |

|  |  |
|---|---|
| **bitmap subscription** | A type of subscription that replicates rows based on bitmap comparisons. Create columns using the int datatype, and identify them as the rs_address datatype when you create a replication definition. When you create a subscription, compare each rs_address column to a bitmask using a bitmap comparison operator (&) in the where clause. Rows that match the subscription's bitmap are replicated. |
| **bulk materialization** | A materialization method whereby subscription data in a replicate database is initialized outside of the replication system. For example, data may be transferred from a primary database using media such as magnetic tape, CD, or optical storage disk. Bulk materialization involves a series of commands, starting with define subscription. You can use bulk materialization for subscriptions to table replication definitions or function replication definitions. See also **atomic materialization**, **nonatomic materialization**, and **no materialization**. |
| **class** | See **error class** and **function-string class**. |
| **class tree** | A set of function-string classes, consisting of two or more levels of derived and parent classes that derive from the same base class. See also **function-string class**. |
| **client** | A program connected to a server in a client/server architecture. A may be a front-end application program executed by a user, or a utility program that executes as an extension of the system. |
| **Client/Server Interfaces (C/SI)** | The Sybase interface standard for programs executing in a client/server architecture. |
| **connection** | A connection from a Replication Server to a database. See also **Data Server Interface (DSI)**. |
| **connection profiles** | Connection profiles allow you to configure your connection with a pre-defined set of properties. |
| **coordinated dump** | A set of database dumps or transaction dumps that is synchronized across multiple sites by distributing an rs_dumpdb or rs_dumptran function through the replication system. |
| **database** | A set of related data tables and other objects that is organized and presented to serve a specific purpose. |
| **database replication definition** | A description of a set of database objects—tables, transactions, functions, system stored procedures, and DDL—for which a subscription can be created. |

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| | You can also create table replication definitions and function replication definitions. See also **table replication definition** and **function replication definition**. |
| **database server** | A server program, such as Sybase Adaptive Server Enterprise, that provides database management services to clients. |
| **data definition language (DDL)** | The set of commands in a query language, such as Transact-SQL, that describes data and their relationships in a database. DDL commands in Transact-SQL include those using the create, drop, and alter keywords. |
| **data manipulation language (DML)** | The set of commands in a query language, such as Transact-SQL, that operates on data. DML commands in Transact-SQL include select, insert, update, and delete. |
| **data server** | A server whose client interface conforms to the Sybase Client/Server Interfaces and provides the functionality necessary to maintain the physical representation of a replicated table in a database. Data servers are usually database servers, but they can also be any data repository with the interface and functionality Replication Server requires. |
| **Data Server Interface (DSI)** | Replication Server threads that correspond to a connection between a Replication Server and a database. DSI threads submit transactions from the DSI outbound queue to a replicate data server. They consist of a scheduler thread and one or more executor threads. The scheduler thread groups the transactions by commit order and dispatches them to the executor threads. The executor threads map functions to function strings and execute the transactions in the replicate database. DSI threads use an Open Client connection to a database. See also **outbound queue** and **connection**. |
| **data source** | A specific combination of a database management system (DBMS) product such as a relational or non-relational data server, a database residing in that DBMS, and the communication method used to access that DBMS from other parts of a replication system. See also **database** and **data server**. |
| **declared datatype** | The datatype of the value delivered to the Replication Server from the Replication Agent: • If the Replication Agent delivers a base Replication Server datatype (such as datetime) to the Replication Server, the declared datatype is the base datatype. • Otherwise, the declared datatype must be the user-defined datatype (UDD) for the original datatype at the primary database. |

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| **default function string** | The function string that is provided by default for the system-provided classes rs_sqlserver_function_class and rs_default_function_class and classes that inherit function strings from these classes, either directly or indirectly. See also **function string**. |
| **dematerialization** | The optional process when a subscription is dropped, whereby specific rows that are not used by other subscriptions are removed from the replicate database. |
| **derived class** | A function-string class that inherits function strings from a parent class. See also **function-string class** and **parent class**. |
| **distributed database system** | A database system where data is stored in multiple databases on a network. The databases may be managed by data servers of the same type (for example, Adaptive Server) or by heterogeneous data servers. |
| **Distributor** | A Replication Server thread (DIST) that helps to determine the destination of each transaction in the inbound queue. |
| **dump marker** | A message written by Adaptive Server in a database transaction log when a dump is performed. In a warm standby application, when you are initializing the standby database with data from the active database, you can specify Replication Server to use the dump marker to determine where in the transaction stream to begin applying transactions in the standby database. |
| **Embedded Replication Server System Database (ERSSD)** | The SQL Anywhere database that stores Replication Server system tables. You can choose whether to store Replication Server system tables on the ERSSD or the Adaptive Server RSSD. See also **Replication Server System Database (RSSD)**. |
| **Enterprise Connect Data Access (ECDA)** | An integrated set of software applications and connectivity tools that allow access to data within a heterogeneous database environment, such as a variety of LAN-based, non-ASE data sources, and mainframe data sources. |
| **error action** | A Replication Server response to a data server error. Possible Replication Server error actions are ignore, warn, retry_log, log, retry_stop, and stop_replication. Error actions are assigned to specific data server errors. |
| **error class** | A name for a collection of data server error actions that are used with a specified database. |
| **function** | A Replication Server object that represents a data server operation, such as insert, delete, select, or begin transaction. Replication Server distributes such operations to other Replication Servers as functions. Each function consists of a function name and a set of data parameters. To execute the function in a destination database, Replication Server uses function strings to convert a |

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| | function to a command or set of commands for a type of database. See also **user-defined function** and **replicated function delivery**. |
| **function replication definition** | A description of a replicated function used in replicated function delivery. The function replication definition, maintained by Replication Server, includes information about the parameters to be replicated and the location of the primary version of the affected data. See also **replicated function delivery**. |
| **function scope** | The range of a function's effect. Functions have replication definition scope or function-string class scope. A function with replication definition scope is defined for a specific replication definition and cannot be applied to other replication definitions. A function with function-string class scope is defined once for a function-string class and is available only within that class. |
| **function string** | A string that Replication Server uses to map a database command to a data server API. For the rs_select and rs_select_with_lock functions only, the string contains an input template, used to match function strings with the database command. For all functions, the string also contains an output template, used to format the database command for the destination data server. |
| **function-string class** | A named collection of function strings used with a specified database connection. Function-string classes include those provided with Replication Server and those you have created. Function-string classes can share function string definitions through function-string inheritance. The three system-provided function-string classes are rs_sqlserver_function_class, rs_default_function_class, and rs_db2_function_class. See also **base class**, **class tree**, **derived class**, **function-string inheritance**, and **parent class**. |
| **function-string inheritance** | The ability to share function string definitions between classes, whereby a derived class inherits function strings from a parent class. See also **derived class**, **function-string class**, and **parent class**. |
| **function-string variable** | An identifier used in a function string to represent a value that is to be substituted at runtime. Variables in function strings are enclosed in question marks (?). They represent column values, function parameters, system-defined variables, or user-defined variables. |
| **function subscription** | A subscription to a function replication definition (used in applied function delivery). |
| **gateway** | Connectivity software that allows two or more computer systems with different network architectures to communicate. |
| **heterogeneous data servers** | Data servers that are supplied by more than one vendor used together in a distributed database system. |

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| **interface file** | A file containing entries that define network access information for server programs in a Sybase client/server architecture. Server programs may include Adaptive Servers, SQL Servers, gateways, Replication Servers, and Replication Agents such as LTM for SQL Server. The *interfaces* file entries enable clients and servers to connect to each other in a network. |
| **latency** | The measure of the time it takes to distribute to a replicate database a data modification operation first applied in a primary database. The time includes Replication Agent processing, Replication Server processing, and network overhead. |
| **locator value** | The value stored in the rs_locater table of the Replication Servers RSSD that identifies the latest log transaction record received and acknowledged by the Replication Server from each previous site during replication. |
| **login name** | The name that a user or a system component such as Replication Server uses to log in to a data server, Replication Server, or Replication Agent. |
| **Log Transfer Language (LTL)** | A subset of the Replication Command Language (RCL). A Replication Agent such as RepAgent or LTM for SQL Server uses LTL commands to submit to Replication Server the information it retrieves from primary database transaction logs. |
| **Log Transfer Manager (LTM)** | The Replication Agent program for Sybase SQL Server. See also **Replication Agent** and **Replication Agent thread**. |
| **maintenance user** | A data server login name that Replication Server uses to maintain replicate data. In most applications, maintenance user transactions are not replicated. |
| **materialization** | Copying data specified by a subscription from a primary database to a replicate database, thereby initializing the replicate table. Replicate data can be transferred over a network, or, for subscriptions involving large amounts of data, loaded initially from media. See also **atomic materialization**, **bulk materialization**, **no materialization**, and **nonatomic materialization**. |
| **materialization queue** | A stable queue used to spool messages related to a subscription being materialized or dematerialized. |
| **missing row** | A row missing from a replicated copy of a table but present in the primary table. |
| **multi-site availability (MSA)** | Methodology for replicating database objects—tables, functions, transactions, system stored procedures, and DDL from the primary to the replicate database. See also **database replication definition**. |
| **namespace** | The scope within which an object name must be unique. |

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| **nonatomic materialization** | A materialization method that copies subscription data from a primary to a replicate database through the network in a single operation, without a holdlock. Changes to the primary table are allowed during data transfer, which may cause temporary inconsistencies between replicate and primary databases. Data is applied in increments of ten rows per transaction, which ensures that the replicate database transaction log does not fill. Nonatomic materialization is an optional method for the create subscription command. See also **autocorrection**, **atomic materialization**, **no materialization**, and **bulk materialization**. |
| **network-based security** | Secure transmission of data across a network. Replication Server supports third-party security mechanisms that provide user authentication, unified login, and secure message transmission between Replication Servers. |
| **no materialization** | A materialization method that lets you create a subscription when the subscription data already exists at the replicate site. Use the create subscription command with the without materialization clause. Use the no-materialization method to create subscriptions to table replication definitions and function replication definitions. See also **atomic materialization** and **bulk materialization**. |
| **online transaction processing (OLTP) application** | A database client application characterized by frequent transactions involving data modification (inserts, deletes, and updates). |
| **origin queue ID (QID)** | Formed by the Replication Agent, the queue ID (qid) uniquely identifies each log record passed to the Replication Server. It includes the date and time from the primary data server, and the database generation number. |
| **orphaned row** | A row in a replicated copy of a table that does not match an active subscription. |
| **outbound queue** | A stable queue used to spool messages. The DSI outbound queue spools messages to a replicate database. The RSI outbound queue spools messages to a replicate Replication Server. |
| **parallel DSI** | A method of configuring a database connection so that transactions are applied to a replicate data server using multiple DSI threads operating in parallel, rather than a single DSI thread. See also **connection** and **Data Server Interface (DSI)**. |
| **parameter** | An identifier representing a value that is provided when a procedure executes. Parameter names are prefixed with an @ character in function strings. When a procedure is called from a function string, Replication Server passes the parameter values, unaltered, to the data server. See also **searchable parameter**. |
| **parent class** | A function-string class from which a derived class inherits function strings. See also **function-string class** and **derived class**. |

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| **primary data** | The definitive version of a set of data in a replication system. The primary data is maintained on a data server that is known to all of the Replication Servers with subscriptions for the data. |
| **primary database** | Any database that contains data that is replicated to another database through the replication system. |
| **primary key** | A set of table columns that uniquely identifies each row. |
| **principal user** | The user who starts an application. When using network-based security, Replication Server logs in to remote servers as the principal user. |
| **profiles** | Profiles allow you to configure your connection with a pre-defined set of properties. |
| **publication** | A group of articles from the same primary database. A publication lets you collect replication definitions for related tables and stored procedures and then subscribe to them as a group. Collect replication definitions as articles in a publication at the source Replication Server and subscribe to them with a publication subscription at the destination Replication Server. |
| **publication subscription** | A subscription to a publication. See also **publication**. |
| **published datatype** | The datatype of the column after the column-level translation (and before a class-level translation, if any) at the replicate data server. The published datatype must be either a Replication Server base datatype or a UDD for the datatype in the target data server. If the published datatype is omitted from the replication definition, it defaults to the declared datatype |
| **query** | In a database management system, a request to retrieve data that meets a given set of criteria. The SQL database language includes the select command for queries. |
| **quiescent** | A replication system in which all data-changing operations (or transactions) have been propagated to their destinations. Some Replication Server commands or procedures require that you first quiesce the replication system. |
| **remote procedure call (RPC)** | A request to execute a procedure that resides in a remote server. The server that executes the procedure be an Adaptive Server, a Replication Server, or a server created using Open Server. The request can originate from any of these servers or from a client application. The RPC request format is a part of the Sybase Client/Server Interfaces. |

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| **Replication Agent thread** | The Replication Agent for Adaptive Server Enterprise. The Replication Agent thread is an Adaptive Server thread. It sends transaction log information from the primary database to the primary Replication Server. |
| **Replication Agent User thread** | The thread on a Replication Server database connection that a Replication Agent connects with, on behalf of a primary database. See also **Data Server Interface (DSI)**. |
| **replicate database** | Any database that contains data that is replicated from another database through the replication system. |
| **replicated function delivery** | A method of replicating, from a source to a destination database, a stored procedure that is associated with a function replication definition. See also **applied function**, **request function**, and **function replication definition**. |
| **replicated stored procedure** | An Adaptive Server stored procedure that is marked as replicated using the sp_setrepproc or the sp_setreplicate system procedure. Replicated stored procedures can be associated with function replication definitions or table replication definitions. See also **replicated function delivery** and **asynchronous procedure delivery**. |
| **replicated table** | A table that is maintained by Replication Server, in part or in whole, in databases at multiple locations. There is one primary version of the table, which is marked as replicated using the sp_setreptable or the sp_setreplicate system procedure; all other versions are replicated copies. |
| **Replication Agent** | A program or module that sends transaction log information from a primary data server to a primary Replication Server. Sybase provides separate Replication Agent software products to support non-ASE data servers in a replication system. |
| **Replication Command Language (RCL)** | The commands used to manage information in Replication Server. |
| **replication definition** | Usually, a description of a table for which subscriptions can be created. The replication definition, maintained by Replication Server, includes information about the columns to be replicated and the location of the primary version of the table.<br><br>You can also create function replication definitions; sometimes the term “table replication definition” is used to distinguish between table and function replication definitions. See also **function replication definition**. |
| **Replication Server** | The Sybase server program that maintains replicated data, typically on a LAN, and processes data transactions received from other Replication Servers on the same LAN or on a WAN. |

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| **Replication Server Interface (RSI)** | A thread that logs in to a destination Replication Server and transfers commands from the RSI outbound stable queue to the destination Replication Server. There is one RSI thread for each destination Replication Server that is a recipient of commands from a primary or intermediate Replication Server. See also **outbound queue**. |
| **Replication system administrator** | The system administrator who manages routine operations in the Replication Server. |
| **Replication Server System Database (RSSD)** | The Adaptive Server database containing a Replication Server system tables. You can choose whether to store Replication Server system tables on the RSSD or the Adaptive Server Anywhere (ASA) ERSSD. See also **Embedded Replication Server System Database (ERSSD)**. |
| **Replication Server system Adaptive Server** | The Adaptive Server with the database containing a Replication Servers system tables (the RSSD). |
| **replication system** | A data processing system where data is replicated in multiple databases to provide remote users with the benefits of local data access. Specifically, a replication system that is based on Replication Server and includes other components, such as Replication Agents and data servers. |
| **replication system domain** | All replication system components that use the same ID Server. |
| **request function** | A replicated function, associated with a function replication definition, that Replication Server delivers from a replicate database to a primary database. A request function passes parameter values to a stored procedure that is executed at the primary database. See also **replicated function delivery**, **request function**, and **function replication definition**. |
| **row migration** | The process whereby column value changes in rows in a primary version of a table cause corresponding rows in a replicate version of the table to be inserted or deleted, based on comparison with values in a subscription's where clause. |
| **SQL Server** | The Sybase relational database pre-11.5 server. |
| **schema** | The structure of the database. DDL commands and system procedures change system tables stored in the database. Supported DDL commands and system procedures can be replicated to standby databases when you use Replication Server version 11.5 or later and Adaptive Server version 11.5 or later. |
| **searchable column** | A column in a replicated table that can be specified in the where clause of a subscription or article to restrict the rows replicated at a site. |

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| **searchable parameter** | A parameter in a replicated stored procedure that can be specified in the where clause of a subscription to help determine whether or not the stored procedure should be replicated. See also **parameter**. |
| **secondary truncation point** | See **truncation point**. |
| **site** | An installation consisting of, at minimum, a Replication Server, data server, and database, and possibly a Replication Agent, usually at a discrete geographic location. The components at each site are connected over a WAN to those at other sites in a replication system. |
| **site version** | The version number for an individual Replication Server. Once the site version has been set to a particular level, the Replication Server enables features specific to that level, and downgrades are not allowed. See also **software version**, and **system version**. |
| **software version** | The version number of the software release for an individual Replication Server. See also **site version** and **system version**. |
| **Stable Queue Manager (SQM)** | A thread that manages the stable queues. There is one Stable Queue Manager (SQM) thread for each stable queue accessed by the Replication Server, whether inbound or outbound. |
| **Stable Queue Transaction (SQT) interface** | A thread that reassembles transaction commands in commit order. A Stable Queue Transaction (SQT) interface thread reads from inbound stable queues, puts transactions in commit order, then sends them to the Distributor (DIST) thread or a DSI thread, depending on which thread required the SQT ordering of the transaction. |
| **stable queues** | Store-and-forward queues where Replication Server stores messages destined for a route or database connection. Messages written into a stable queue remain there until they can be delivered to the destination Replication Server or database. Replication Server builds stable queues using its disk partitions. See also **outbound queue**, and **materialization queue**. |
| **stored procedure** | A collection of SQL statements and optional control-of-flow statements stored under a name in an Adaptive Server database. Stored procedures supplied with Adaptive Server are called system procedures. Some stored procedures for querying the RSSD are included with the Replication Server software. |
| **subscription** | A request for Replication Server to maintain a replicated copy of a table, or a set of rows from a table, in a replicate database at a specified location. You can also subscribe to a function replication definition, for replicating stored procedures. |

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| **subscription dematerialization** | See **dematerialization**. |
| **subscription materialization** | See **materialization**. |
| **subscription migration** | See **row migration**. |
| **Sybase Central** | A graphical tool that provides a common interface for managing products. Replication Server uses Replication Server Manager as a Sybase Central plug-in. |
| **synchronous command** | A command that a client considers complete only after the completion status is received. |
| **system function** | A function that is predefined and part of the Replication Server product. Different system functions coordinate replication activities, such as rs_begin, or perform data manipulation operations, such as rs_insert, rs_delete, and rs_update. |
| **system-provided classes** | The error class includes non-ASE error classes and the function-string classes rs_sqlserver_function_class, rs_default_function_class, and rs_db2_function_class that Replication Server provides. Function strings are generated automatically for the system-provided function-string classes and for any derived classes that inherit from these classes, directly or indirectly. See also **error class** and **function-string class**. |
| **system version** | The version number for a replication system that represents the version for which new features are enabled, for Replication Servers of 11.0.2 or earlier, and below which no Replication Server can be downgraded or installed. For a Replication Server version 11.5, use of certain new features requires a site version of 1150 and a system version of at least 1102. See also **site version**, and **software version**. |
| **table replication definition** | See **replication definition**. |
| **table subscription** | A subscription to a table replication definition. |
| **thread** | A process running within Replication Server. Built upon Sybase Open Server, Replication Server has a multi-threaded architecture. Each thread performs a certain function such as managing a user session, receiving messages from a Replication Agent or another Replication Server, or applying messages to a database. See also **Data Server Interface (DSI)**, **Distributor**, and **Replication Server Interface (RSI)**. |

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| **transaction** | A mechanism for grouping statements so that they are treated as a unit: either all statements in the group are executed or no statements in the group are executed. |
| **Transact-SQL** | The relational database language used with Adaptive Server. Transact-SQL is based on standard SQL (Structured Query Language), with Sybase extensions. |
| **truncation point** | An Adaptive Server database that holds primary data has an active truncation point, marking the transaction log location where Adaptive Server has completed processing. This is the primary truncation point.<br><br>The Replication Agent for an Adaptive Server database maintains a secondary truncation point, marking the transaction log location separating the portion of the log successfully submitted to the Replication Server from the portion not yet submitted. The secondary truncation point ensures that each operation enters the replication system before its portion of the log is truncated. |
| **user-defined function** | A function that allows you to create custom applications that use Replication Server to distribute replicated functions or asynchronous stored procedures between sites in a replication system. In replicated function delivery, a user-defined function is automatically created by Replication Server when you create a function replication definition. |
| **variable** | See **function-string variable**. |
| **version** | See **site version**, **software version**, and **system version**. |

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