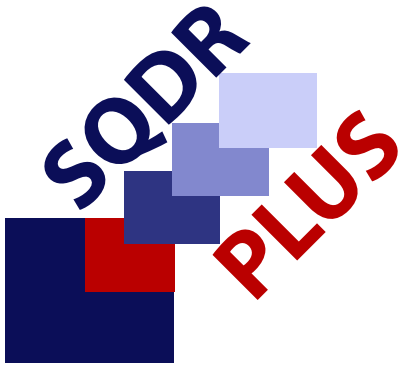

SQDR Plus for iSeries

STARQUEST

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Contacting StarQuest Ventures

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If you have suggestions for product enhancements or need more information about how StarQuest products can provide solutions for connecting Windows and UNIX applications to IBM host resources, please contact us via any of the following methods.

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Contents

Introduction

StarQuest Data Replicator (SQDR) is a software product that replicates data between IBM DB2, Oracle, and Microsoft SQL Server database environments. You can replicate any table, portion of a table, or view. You can schedule replications to take place at specified intervals or on demand. Replicating data from one database management system to another allows you to:

- make the same data available to users of different database systems
- make the same data available to multiple sites
- balance network and database server loads by making the data available from two or more database servers
- create backup copies of data

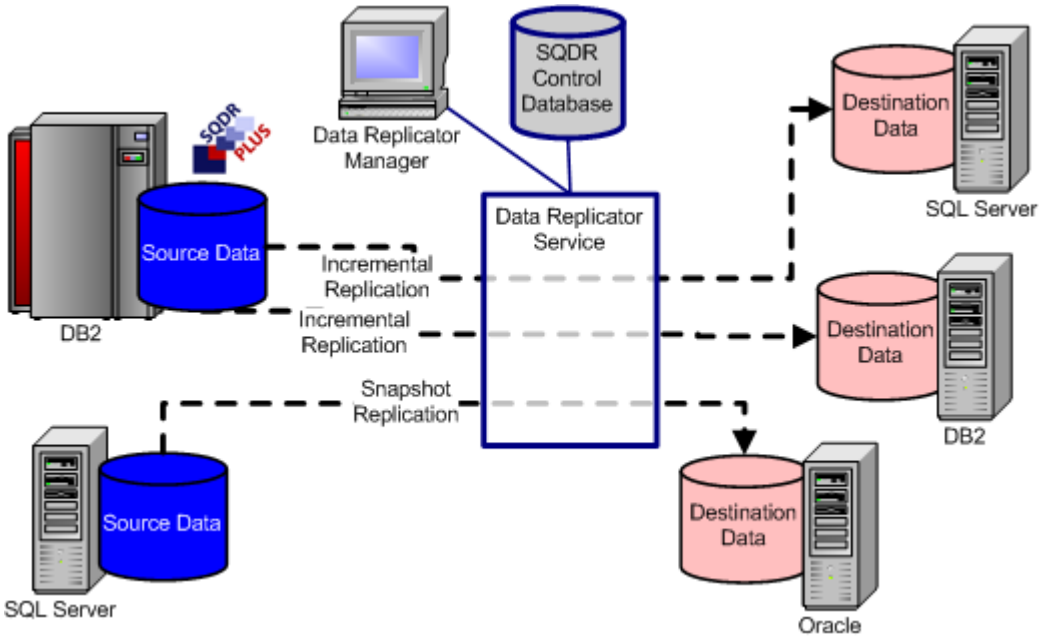
StarQuest Data Replicator and SQDR Plus

The base StarQuest Data Replicator software provides full refresh replication, which copies all the source data that is selected for replication, regardless of when that data was last replicated. This provides a “snapshot” of the specified source data at the time of replication.

StarQuest offers the separately licensed component, SQDR Plus for iSeries, one of several members of the SQDR Plus family that provides incremental replication support for SQDR users. Incremental replication copies only the data that has changed, which reduces the amount of data that is transferred and allows the replication to occur more frequently.

Incremental replication requires installing the SQDR Plus software on the host database system to monitor changes and communicate with the Data Replicator Windows-based service. Note that no host software is required to use only the base SQDR software to perform full refresh (snapshot) replication. As shown in the following illustration, snapshot replication operations require only the Data Replicator service running on a Windows-based computer and the appropriate ODBC drivers for access to the source and target databases, whereas incremental replication operations are allowed from hosts that have SQDR Plus installed.

Figure 1: Overview of SQDR and SQDR Plus



SQDR Plus Components for the iSeries

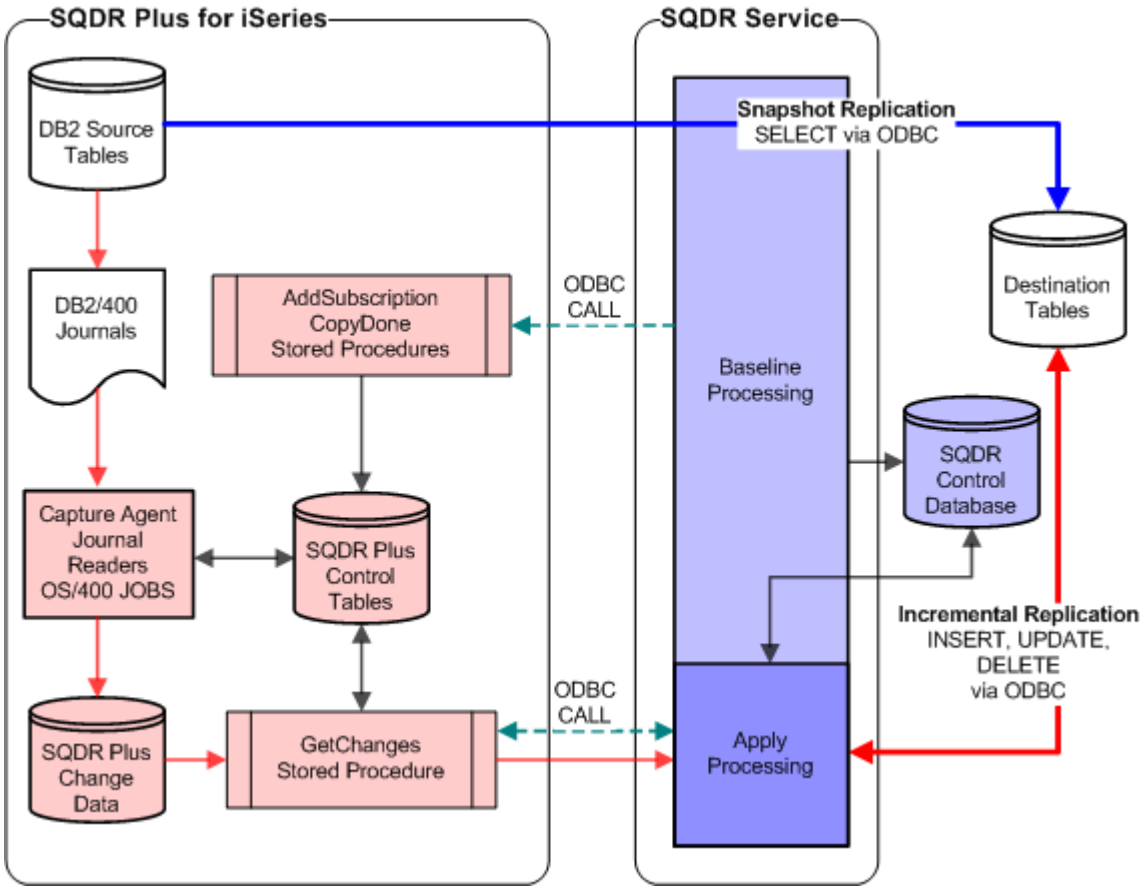
SQDR Plus for the iSeries includes the following components:

- Capture Agent
- Java and SQL Stored Procedures
- Replication Worker
- Journal Reader
- Control Tables and Change Data Tables
- Capture Agent Maintenance Utility

The Capture Agent Maintenance program is provided to help manage the Capture Agent and is described in “Using the Capture Agent Maintenance Utility” on page 42.

The following illustration shows how the SQDR Plus components work within the iSeries environment and with the base SQDR product to create a baseline snapshot replication from which point changes are tracked so they can be incrementally applied to the destination database.

Figure 2: SQDR Plus Components Enable Incremental Replication of Data



From the Data Replicator Manager, which runs on the same Windows computer as the Replicator Service, a subscription is created that defines what source data to replicate to what destination. If the source is enabled with SQDR Plus, the subscription can perform incremental replication operations.

When a subscription that performs incremental replication is added to the SQDR Control Database, the SQDR service calls the AddSubscription stored procedure and a baseline snapshot replication is performed. When the baseline snapshot replication is complete, indicated with a call to the CopyDone stored procedure, the subscription is registered with the SQDR Plus Control Tables and the SQDR Plus components begin tracking changes to the source tables. The Journal

Reader monitors the journaled files and works with the Change Propagator to report changes to the Replication Workers. The Capture Agent starts a Replication Worker for each journal that needs to be monitored.

The Capture Agent process uses the Remote Method Invocation (RMI) protocol to communicate with the Stored Procedures, which in turn communicate via ODBC calls to the SQDR Service and Apply Manager. The Change Data Tables provide the primary input to the Stored Procedures, with secondary input from the Control Tables, which are managed by the Capture Agent service programs. The SQDR Apply Manager periodically polls for the changes and inserts, updates, and deletes the destination data as appropriate to keep it synchronized with the source data. You also can configure the Capture Agent service to send notification to the SQDR client when change data is available for applying to the target database.

Features New to This Version

If you are upgrading from a prior release of SQDR Plus for iSeries, be sure to review “Updating the SQDR Plus Software” on page 25 before you install the new version of the software.

SQDR Plus Limitations

The SQDR Plus Capture Agent imposes a few limitations relative to the capabilities of the iSeries server and the base SQDR software. For incremental replication operations, please note that:

- Incremental changes cannot be replicated for multi-member files.
- The maximum length of tables that can be replicated incrementally is slightly less than the database system allows to accommodate for the mechanisms that track the change data. LOB data is replicated directly from the source instead of being stored in the change data (staging) tables. SQDR Plus needs a minimum of five columns (more if there are unique indexes) for managing the change data in the staged tables, therefore the tables cannot contain the maximum number of columns or the maximum bytes per row that are allowed by the system. The system limits vary according to which release of OS/400 you are running, so refer to your system documentation if you need to determine the maximums allowed.
- The source tables that contain any LOB data must reside in the same Auxiliary Storage Pool (ASP) as the SQDR Plus schema (library).
- Foreign constraints are not replicated for incremental operations; however, unique constraints and indexes can be optionally replicated.
- You can incrementally replicate a subset of columns to a destination, but the subset of selected columns must include at least one of the fields associated with a unique index to identify the change data. The unique index can be the Relative Record Number (RRN) column that is added by SQDR Plus.

The remainder of this document covers the installation, setup, and operation of the SQDR Plus for iSeries host software.

Installing SQDR Plus

This chapter describes how to prepare for and install the SQDR Plus for iSeries software. SQDR Plus for iSeries may be installed on any number of OS/400 platforms within an organization. Licensing is controlled by SQDR and StarLicense and is managed according to each DB2/400 source and DBMS destination pair. Incremental replication is supported only for the specific source and destination pairs that are licensed for SQDR Plus. The online help for the Data Replicator Manager and StarLicense products describe how to configure licenses for using StarQuest products.

System Requirements for the iSeries Computer

Following are the requirements for installing SQDR Plus on an iSeries computer:

- OS/400 v5r3, v5r4, v6r1, or v7r1
- recent cumulative PTF package
- recent DB2 Group PTF package (see below for version-specific information)
- Qshell (5722SS1/5761SS1/5770SS1 option 30)
- for OS/400 v5rx: Java Developer Kit v1.4 (5722JV1 option 6)
- for OS/400 v6r1 & v7r1: any version of Java (1.4 or later)
- recent Java Group PTF package (see below for version-specific information)

The OS/400 system must have the following fixes (or the superseding fixes) for the cumulative PTF, DB2 Group PTF, Java Group PTF packages, and the appropriate individual PTF applied.

OS Version	CUM PTF	DB2 Group	Java Group	Individual PTFs
V5R3	C6101530 (March 2006)	SF99503-9 (March 2006)	SF99269-10 (March 2006)	5722SS1-SI18139
V5R4	C6115540 (April 2006)	SF99504-3 (March 2006)	SF99291-2 (March 2006)	5722SS1-SI36059 5722SS1-SI36406
V6R1	C0047610 (Feb 2010)	SF99601	SF99562	5761SS1-SI39331†
V7R1	C0229710 (Aug 2010)	SF99701	SF99572	

OS Version	CUM PTF	DB2 Group	Java Group	Individual PTFs
† Install these PTF's if you are working with LOB data.				

To use the iSeries Access ODBC driver with SQDR Plus, the following PTFs must be applied to the OS/400 (v5r3).

- PTF SI18523 for APAR SE20473
- PTF SI18882 for APAR SE18947

For best results with SQDR, StarQuest recommends using the StarSQL ODBC driver for access to DB2. The StarSQL DSN must be configured to use an Isolation Level of Read Committed to support incremental replication operations.

Refer to the SQDR Plus Readme.html file for additional information about any known issues and Program Temporary Fixes (PTFs) that may be required to avoid particular problems.

Verifying the System Prerequisites

This section describes how to verify that your system meets the minimum requirments for installing and running SQDR Plus.

Verifying the OS/400 Version

To verify the version of the OS/400 software:

1. Start a 5250 session, using either emulation software or the **telnet** command, and sign on to the iSeries with a QSECOFR user profile.
2. Run the OS/400 command GO LICPGM at the command line.
3. Select option 10, "Display installed licensed programs" and press F11.

The Installed Release column displays the version of the Operating System/400 software.

Verifying Applied PTFs

To verify that an individual PTF has been installed, use the **DSPPTF** command, entering the License Program (Product) number and the PTF number to select, as in the following example.

```
DSPPTF LICPGM(5722SS1) SELECT(SI18139)
```

View the General Information for the PTF and verify that the PTF status is either Superseded, Temporarily applied, or Permanently applied.

To review the CUM PTF level, DB2 Group or Java Group PTF packages that are installed, run the **WRKPTFGRP** command and browse the list of installed PTF Groups.

Verifying Qshell Availability

To confirm that Qshell is installed:

1. Run the command **GO LICPGM** and select option 10, "Display installed licensed programs."
2. Look for Licensed Program 5722SS1 (v5rx), 5761SS1 (v6r1), or 5770SS1 (v7rx) with and Installed Status of *COMPATIBLE and a description of "Qshell, Program Option 30."

Verifying Java Version and Availability

If you have multiple versions of Java installed, make sure that you are using at least v1.4. The default JDK version typically is the latest version present. For the Classic JVM, you can specify which Java version to use by setting the java.version property in /QIBM/UserData/Java400/SystemDefault.properties to apply it system-wide, or in /home/<user>/SystemDefault.properties to have it apply to a specific user.

1. Type **java -version** at a QSH or PASE command prompt to display the active java version.

System Requirements for the SQDR Plus Installation

The SQDR Plus installer requires a GUI environment, so it is typically run on a remote system, such as on a computer that is running Windows, MacOS X, or UNIX with X Windows. The computer from which you run the installer must have TCP/IP connectivity to the target iSeries computer.

To run the SQDR Plus installation program the remote computer must have the Java JVM or JRE installed and specified in the PATH. You can obtain the Java Runtime Environment free of charge from Oracle at http://java.com/en/download/. To verify that Java is installed and can be located, enter java -version at the command line to display the version information.

To run the SQDR Plus installer directly from the iSeries computer you must configure a remote GUI environment with X or VNC (Virtual Network Computing).

Preparing the Target Database

Incremental replications rely on unique fields to identify change data. If the collation sequence of the database is Case Insensitive, character fields that are uniquely identified on the host may no longer be unique when they are replicated to the target. For example, fields named "First" and "first" that are unique on the source would not be unique if the target database is configured to be insensitive to capitalization. Certain data types that have different levels of precision in different database systems also can create non-unique fields. For example, DB2 on an OS/400 host supports micro-second timestamps whereas the SQL Server DBMS only supports milli-second precision.

To help ensure unique fields, configure the collation sequence of the target database, especially if it is a SQL Server database, to be Case Sensitive. If you have SQL Server Enterprise Manager (SQL Server 2000) or the SQL Server Management Studio (SQL Server 2005), you can verify the collation sequence by viewing the database properties.

A case-sensitive collation has the characters “CS” appended to the Collation Designator. For example, the collation SQL_Latin1_General_CP1_CS_AS is a case-sensitive collation for U.S. English systems. You can set the collation for a new database using the SQL Server Enterprise Manager or the SQL Server Management Studio. To change the collation for an existing database, use the ALTER DATABASE (Transact-SQL) command with the COLLATE clause. Refer to your database system documentation for details on specifying the collation sequence for databases it manages.

Planning the Installation

The following sections describe the user accounts that SQDR Plus is designed to work with, discusses considerations for which subsystem and journals to use, and describes the libraries and directories that SQDR Plus uses. Read these sections carefully, and then complete Table 1 on page 21 with the values appropriate for your environment. This preparation will help you install and use SQDR Plus in the most efficient manner.

Setting up User IDs

SQDR Plus fully supports the security provisions of the host computer. SQDR users and SQDR replication operations are not allowed to access data that they are not otherwise entitled to use. The base SQDR product requires only *USE authority to perform snapshot replication operations. SQDR Plus allows for using several user accounts so you can grant the different user accounts the minimum privileges required to perform their tasks.

Several user IDs are required for the installation and operation of SQDR Plus on the iSeries. These user IDs can be the same or different user accounts.

- Installing User
- Capture Agent User
- Journal Reader service program owner
- SQDR subscribing user

The authorization required for these accounts differ to provide the minimum privileges required to perform the associated tasks. For example, StarQuest recommends that the Capture Agent user ID be different from the Installing user ID since the Installing user requires Security Officer (SECOFR) authority.

Installing User

The user ID that is used during installation and setup of SQDR Plus is typically a *SECOFR or otherwise privileged user. The installing user account needs permission to:

- run RSTLIB and RST
- create users with CRTUSRPRF
  (the installer creates the Capture Agent user if necessary)
- create libraries, schemas, and IFS directories

- register stored procedures
- change ownership and permissions on the files that it installs and creates
- create and start a subsystem

Capture Agent User

The Capture Agent is an “always-on” task that is started when the subsystem into which it is installed is started. The Capture Agent user account is created during the installation if the specified user account does not already exist, and is deleted when SQDR Plus is uninstalled. Therefore, you may want to create a new user account that is dedicated to the Capture Agent user. During installation the Capture Agent user ID also is granted permission to modify the appropriate tables in the control table schema and to access the Journal Reader service program.

The Capture Agent user ID can be an unprivileged user (*USER) but it does require logon permission (PASSWORD should not be *NONE). We recommend setting its Initial Menu (INLMNU) to *SIGNOFF to prevent the use of this ID for interactive signon.

The default action of the installer is to create a new user SQDR with its Initial Menu (INLMNU) set to *SIGNOFF. The dialog to specify the Capture Agent User contains a field to enter a password. Leaving this field blank will create a user with password *USRPRF (i.e. the password matches the user name), but the Initial Menu setting will prevent interactive signon. If you enter a password, the installer will send a CHGUSRPRF command to the iSeries server; be sure to review the resulting message that is displayed, as the installer will continue whether or not the iSeries machine accepted the password change.

During a custom update, you may enter the password in this dialog to change the password for the Capture Agent user ID. As with the initial installation, the installer will continue whether or not the iSeries machine accepted the password change, so be sure to review the resulting message.

Journal Reader Service Program Owner

The Capture Agent runs as an unprivileged user, but it needs access to the journal receivers of all tables that are to be replicated. This is accomplished by invoking the JRLREADER service program. This service program is created as User profile (*OWNER), which indicates that it runs under both the user profile of the current user and the user profile of the owner.

The owner ID for the Journal Reader Service Program should be a privileged user; its PASSWORD can be set to *NONE to prevent the use of this ID for signon. It should have *ALLOBJ and *SECADM authority, or at least have read authority to all tables and journal receivers that will be replicated, regardless of who the owner of the table is and what user ID is used for the ODBC connection from the SQDR client.

The default action of the installer is to create a new user SQDRADMIN with PASSWORD set to *NONE.

 NOTE	SQDR Plus must share access to system and user objects in order to replicate data from the iSeries, but it will never delete an object such as a journal, journal receiver, files, or tables. The only system objects that SQDR Plus will delete are those associated with the product, such as the SQDR library that is created when the SQDR Plus software is installed and deleted if the software is removed

SQDR Subscriber User(s)

This is the user ID used by the ODBC data source when connecting from the SQDR service running on a Windows computer. This user ID needs the following permissions:

- read access to tables that are being replicated
- access to run the stored procedures of the Capture Agent
- read access to the Capture Agent schema and its contents

The installation process grants *PUBLIC access to the stored procedures and schema. You may need to set up multiple subscriber user accounts.

Specifying the Character Set

DB2 supports EBCDIC, ASCII, and Unicode encoding schemes, which are defined by coded character set identifiers (CCSIDs). Both the SQDR Plus Installing User and the Capture Agent User must be configured to use a CCSID other than the AS/400 default of 65535 (*HEX).

By default the SQDR Plus installer creates the Capture Agent User with a CCSID of 37 and also uses a CCSID of 37 for the installation job. You can change the CCSID for either user to any valid CCSID value from 37 to 65534 or *SYSVAL during the installation.

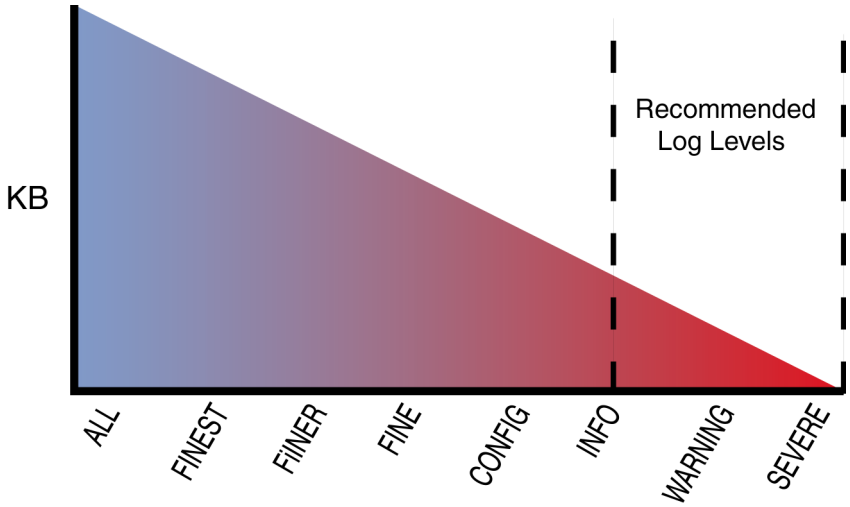
To examine the CCSID that is normally used by the installing user, use the **WRKUSRPRF** (Work with User Profiles) command to check the CCSID that is configured for the installing user. Scroll to the last page to see the value set for Coded Character Set Identifier. If the CCSID is set to *SYSVAL, use the **DSPSYSVAL** (Display System Value) command to display the QCCSID system value.

SQDR Plus Capture Agent Port and Logging Level

During the installation of SQDR Plus you specify the port number that the SQDR Plus Capture Agent components use to communicate with the DB2 for iSeries system. This port does not need to be visible from any remote computer. The default port number is 50005.

The logging level that you configure determines the amount and type of operational information that is saved to SQDR Plus log files. There are eight levels of logging, and you also can turn off the logging activity by specifying OFF. As reflected in the following illustration, the broad levels of

logging can significantly degrade performance of all computers involved in the communications. The default logging value is INFO, which logs information about when the SQDR Plus Capture Agent is started and stopped and when it encounters warning or severe error messages.



Restricting Replication of Tables

The Capture Agent Maintenance utility allows you to specify which tables in the database can be subscribed to for replication. During installation you specify whether you want to use this publishing feature. Enable the checkbox for the Restrict Subscriptions to Published Tables option during the installation process to use the table publishing feature. Leave the checkbox disabled if you want all the database tables to be available for replication operations.

Determining the Subsystem and Journals to Use

Determine in which OS/400 subsystem you want to run the Capture Agent. Using an isolated subsystem for the Capture Agent schema makes it easier to manage the Capture Agent, and allows for more control over resource allocation when tuning the system. A ***schema*** is a collection of components and database objects under the control of a given database user, which is the Capture Agent user in the case of SQDR Plus. The schema stores the components owned by the application, and it can store the database objects on which the components are based. The Capture Agent schema corresponds to an iSeries collection, which also can be thought of as a library.

Using a Dedicated or Existing Subsystem

The installer presents an option for creating a new subsystem in the schema, with a name of SQDR. The installer also creates a JOBQ, an OUTQ, and a CLS for the subsystem. If you enter a different name and location for the subsystem when you install SQDR Plus, all objects will reside in the specified library and have the same names. Note that, if a source table contains LOB data you want to replicate, the SQDR Plus schema must be located in the same ASP as the source table. You can install multiple Capture Agents—one per ASP and each with a unique schema name—if there is a need to replicate LOB data from more than one ASP.

If you want to use an existing subsystem, such as QSYS/QUSRWRK, during the isntallation you can deselect the option for creating a new subsystem and specify the values for the existing subsystem name and library you want to use. The installer will use the ADDAJE (Add Autostart Job Entry) command to add the Capture Agent to the existing subsystem. When the Autostart Job Entry is configured the Capture Agent starts whenever the corresponding subsystem starts.

Refer to the "Subsystems" chapter of the AS/400 *Work Management* manual, document number SC41-5306 in the IBM online library collection, for detailed information about creating and changing a work management environment.

Using the Autojournaling Feature

All tables that are used as a source for incremental replication operations must be journaled. SQDR Plus provides an option for automatically journaling physical files that are not already journaled. During the installation you can enable the automatic journaling feature, and specify a library and an ASP (Auxiliary Storage Pool) for the journal receiver.

An additional option "Allow SQDR to manage journal receivers" allows you to control whether SQDR Plus manages all system-managed journal receivers that are associated with subscriptions (option enabled) or just SQDR journal receivers that are used for automatic journaling (option de-selected). The option "Delete journal receivers without saving" determines whether a receiver can be deleted when it is no longer needed, even though it has not been saved (option enabled), or whether the delete operation is prevented if the journal has not been saved (option disabled).

Configuring Email Notifications

During installation of SQDR Plus you can specify that notifications be sent to an email address to inform an administrative user that an error condition is occurring. The logging level determines how severe the error condition must be to warrant sending an email notification. If the Capture Agent encounters a problem within the level of logging that you select (CONFIG, INFO, WARNING, SEVERE), it sends an email to the email address using the specified SMTP server. The recommended notification level is for SEVERE error conditions, as the more general levels of errors (WARNING, INFO, and CONFIG) can generate a large quantity of emails.

You can specify the SMTP server name or IP address of any SMTP mail server that does *not* require authentication. The SMTP mail server must be able to direct email to the user account specified in the "To" parameter and accept any value as the sender. You may want to use the "From" field to identify the Capture Agent on a particular computer, such as SQDR*@computer_name*.

Leave the SMTP Server field blank or set the notification level to OFF to disable the email notification feature.

To change the email notification properties after you install SQDR Plus you must edit the sqagent.properties file, as described in "Configuring the Capture Agent" on page 29.

Libraries and Directories for SQDR Plus

SQDR Plus for iSeries uses the following libraries and directories:

- Capture Agent Schema
  The installation program creates a schema (library) that contains control tables, change tables, and SQL stored procedures. It creates a schema with the same name as the SQDR Capture Agent user ID (SQDR is the default name).
- Target Directory
  The default home directory of the Capture Agent user is /home/<*Capture Agent User ID*>, such as /home/sqdr, in the IFS file system. It is created during installation and contains the Java .jar files, sqagent.properties file, SystemDefault.properties file, and Capture Agent log files.
- Home Directory of Installing User
  A directory /home/<*installing_user*> is created in the IFS file system during installation. Log files, which can be useful for troubleshooting and performing upgrades, are written to this directory.
- Journal Receiver Library
  During installation you can specify a library, which the installation program will create if necessary, and the ASP to use for the journal receiver if physical files are journaled automatically.
- Library or Collection
  The libraries, or collections, that contain the tables to be replicated.
- Java Stored Procedures File
  The following file is automatically created during installation when registering the Java stored procedures with the database:

  /QIBM/UserData/OS400/SQLLib/Function/jar/<*installing_user*>/CAPTUREPROCS_JAR

Gathering Configuration Information

In addition to the user accounts and subsystem, there are a few other parameters that you specify during installation. Table 1 lists all of the configuration parameters that you need to specify during installation. Make a note of the values appropriate for your environment before you start the installation program.

Table 1: Properties Configured During Installation

Configuration Parameter	Default Value	Your Value
SQDR Capture Agent user ID	SQDR	
CCSID for Capture Agent user ID	37	
CCSID for installation job	37	
Owner ID for Journal Reader Service Program	SQDRADMIN	
ASP for the SQDR Schema	1	
Capture Agent Port	50005	

Table 1: Properties Configured During Installation

Configuration Parameter	Default Value	Your Value
Logging Level	INFO (see page 18 for other valid values)	
Restrict Subscriptions to Published Tables	disabled (no checkmark)	
Use RRN-based replication only	disabled (no checkmark)	
Automatically start journaling physical files	Yes (option enabled)	
Library for journal receiver (for automatic journaling option)	<*schema_name*>, which is SQDR by default	
ASP for automatic journaling option	1	
Allow SQDR to manage journal receivers	Yes (option enabled)	
Delete journal receivers without saving	Yes (option enabled)	
Subsystem Name	<*schema_name*>, which is SQDR by default	
Subsystem Library	<*schema_name*>, which is SQDR by default	
Create the Subsystem	Yes (option enabled)	
Start Capture Agent (when installation is complete)	Yes (option enabled)	
Email Notification Information	OFF (see page 20 for description of the email notification parameters)	SMTP Server: From: To: Notification Level:
Automatically send problem reports to StarQuest Support.	Yes (option enabled)	
Target Directory	/home/<*Capture Agent user ID*>	

Running the SQDR Plus Installation Program

The SQDR Plus installer requires a GUI environment, so it is typically run on a remote system, such as on a computer that is running Windows, MacOS X, or UNIX with X Windows. The computer from which you run the installer must have TCP/IP connectivity to the target iSeries computer.

To run the SQDR Plus installation program the remote computer must have the Java JVM or JRE installed and specified in the PATH. You can obtain the Java Runtime Environment free of charge from Sun Microsystems at http://java.com/en/download/. To verify that Java is installed and can be located, enter java -version at the command line to display the version information.

To run the SQDR Plus installer directly from the iSeries computer you must configure a remote GUI environment with X or VNC (Virtual Network Computing).

The installation process has three phases: pre-installation, installation, and post-installation. The pre-installation phase tests for pre-requisites and previous installations, gathering configuration parameters. The installation phase copies files to the iSeries server and writes InstallShield data for Vital Product Data (VPD) registration and uninstallation. The post-installation phase performs setup tasks on the iSeries server.

The SQDR Plus for iSeries installer consists of data1.jar, media.inf, and the launchers setup.exe (Windows) and setup.sh (UNIX).

1. Copy the SQDR Plus distribution files to the remote computer on which you want to run the installation.

The setup launcher invokes java on data1.jar with the -os400 parameter, prompting for login to the iSeries server. As an alternative to running the setup batch or shell script, you can invoke java on the data1.jar file from a command line, supplying the appropriate system, user ID, and password, as shown below:

```
java -cp data1.jar run -os400 system userId password
```

2. Execute the **setup.exe** file if you are running the installation from a Windows computer. Execute the **setup.sh** shell script if you are running the installation from a MacOS X or UNIX computer.
3. Enter the name of the iSeries server and logon with a user ID that has *SECOFR or equivalent privileges.

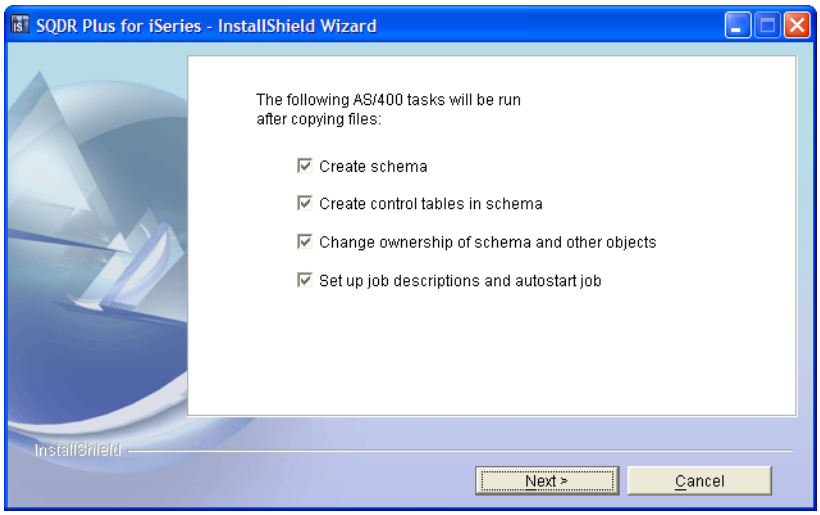
The setup script initializes the InstallShield Wizard and displays a Welcome dialog. If the iSeries server already has a VPD Registry for InstallShield, an “Initializing wizard” status dialog appears while the installer reads the VPD Registry. Click Next to proceed with the installation process after the Welcome dialog appears.

Pre-Installation Phase

During the pre-installation phase the Wizard checks for iSeries pre-requisites such as the presence of an appropriate version of Java, QShell, and PTFs (see page 13for system requirements). It also checks that the installing user has appropriate authority, and displays a warning dialog if the

requisite software and authority are not adequate. If the Wizard finds an existing installation of SQDR Plus it displays a pane asking if you want to update the SQDR Plus software. Refer to “Updating the SQDR Plus Software” on page 25 if this is not a new installation.

If the installation can proceed successfully a dialog appears to show what actions will be performed on the iSeries server after the necessary files have been copied.



For initial installations of SQDR Plus, the following tasks must be performed for the Capture Agent to start and run successfully.

- Create schema
- Create control tables in schema
- Change ownership of schema and other objects
- Setup up job descriptions and autostart job

All of these tasks should be selected by default for a new installation of SQDR Plus.

4. Make sure all the tasks are selected and click Next to proceed.
5. Review the License Agreement for using the software and, if you accept the terms, click Next to proceed.

The InstallShield Wizard then begins prompting for values that are required to configure the Capture Agent.

6. Enter the configuration values that you noted in Table 1, “Properties Configured During Installation,” on page 21, and click Next to proceed through the Wizard panes.

After you supply the configuration parameters, a Summary pane appears before the installation phase begins.

7. Click the Back button if you need to review or change any configuration values. (You can change the configuration properties after you install SQDR Plus, as described in “Configuring the Capture Agent” on page 29.)

Installation Phase

The installation phase installs the SQDR Plus service program and other objects to the specified schema, installs the Java .jar files and property files to the target directory, and creates an uninstaller and registers with the VPD.

8. After you review the installation summary information, click Install to begin the installation phase, and click Next as the Wizard displays panes that show the task results.

 NOTE	Some of the OS/400 tasks that the installer invokes, such as creating the uninstaller and registering with the VPD Registry, can take a long time to complete. You can use WRKACTJOB or review the Job Log of the QZRCSRVS (remote command) job to monitor the installation progress.

Post-installation Phase

After installing the necessary files and updating the VPD Registry, the Wizard begins performing the actions that you selected during the pre-installation phase (see “Pre-Installation Phase” on page 23). When these complete, a summary shows any errors that occurred during the installation.

9. Click Finish after you review the summary information.

If you enabled the options for creating a subsystem, an autostart job entry in the subsystem, or starting the subsystem or job, those tasks are performed.

Updating the SQDR Plus Software

If you need to re-install or update the SQDR Plus software, specify the same installing user ID that was used for the prior installation. You may want to review or save a copy of the existing sqagent.properties file prior to re-installing the software to have a record of the configuration values that were set previously.

Note that some new features and improvements provided in SQDR Plus may also require a corresponding upgrade to the SQDR client software.

Suspending Connections

If you are updating the SQDR Plus software on a host computer that has active connections to SQDR client computers, pause or stop any Incremental Replication subscriptions and delete the connection to the host from the SQDR Replicator Manager on the Windows client computer. This removes locks that the server job places on the SQDR Plus tables when caching open data paths and helps avoid errors while the host is being upgraded.

As an alternative to deleting the connections from the Replicator Manager client computers you can use the OS/400 command **WKOBJLCK** to display the locks on SQDR journal readers, such as:

```
WRKOBJLCK <schema>/SQ_READERS *FILE
```

If the **WRKOBJLCK** command returns any QRWTSRVR jobs for the specified schema, end them before you proceed to upgrade or remove the SQDR Plus software.

Updating the Host Software

The SQDR Plus for iSeries installer consists of data1.jar, media.inf, and the batch/shell scripts setup.bat and setup.sh.

1. Copy the new version of the SQDR Plus distribution files to the remote computer on which you want to run the installation.
2. Stop any active connections from SQDR client computers to the host prior to re-installing SQDR Plus.

The setup script included in the SQDR Plus distribution invokes java on data1.jar with the -os400 parameter, prompting for login to the iSeries server. As an alternative to running the setup batch or shell script, you can invoke java on the data1.jar file from a command line, supplying the appropriate system, user ID, and password, as shown below:

java -cp data1.jar run -os400 *system userId password*

3. Execute the **setup.bat** file if you are running the installation from a Windows computer. Execute the **setup.sh** shell script if you are running the installation from a MacOS X or UNIX computer.
4. Enter the name of the iSeries server and logon with a user ID that has *SECOFR or equivalent privileges.

The setup script initializes the InstallShield Wizard and displays a Welcome dialog. If the iSeries server already has a VPD Registry for InstallShield, an “Initializing wizard” status dialog appears while the installer reads the VPD Registry.

5. Click Next to proceed with the installation process after the Welcome dialog appears.

The InstallShield Wizard shows the version of SQDR Plus that is already installed on the AS/400 and a prompt for whether you want to perform a Custom Update.

6. Click Next to use the configuration values that were specified during the previous installation.
   Select the Custom Update option and click Next if you want an opportunity to change the previous configuration values as you install the new version of the software.

If you click Next with the Custom Update option disabled the installer installs the new version of the SQDR Plus software using the configuration values that were previously used to install it.

If you enable the Custom Update option and click Next, a pane appears to show the AS/400 tasks that will be run during the installation. The installation program needs to perform the task of “Change ownership of schema and other objects” to successfully upgrade the SQDR Plus software. For this task the Wizard automatically stops the Capture Agent, removes the existing stored procedure registration, and registers the new stored procedures.

7. If you are performing a Custom Update, respond to the installation prompts as appropriate (see Table 1, “Properties Configured During Installation,” on page 21), clicking Next to proceed from one pane to the next.

Resuming SQDR Plus Operations

After the new version of the SQDR Plus Capture Agent is started you can resume the incremental subscriptions. When you resume the subscriptions either the changes to the source database that occurred during the down time will be applied to the target database or a new baseline snapshot replication will be performed, depending on the extent of the change data that accumulated while the host software was not available.

If there are incremental subscriptions that used only unique indexes and no Relative Record Number to ensure uniqueness, the subscription will be flagged and you need to delete and recreate the subscription before change monitoring can resume. In the Data Replicator Manager just display the subscription properties and click OK to recreate the subscription.

Troubleshooting Installation Problems

The SQDR Plus installer program creates an installer log file in the home directory of the installing user. Review the installer log file and the log of the installing job to verify that installation was successful or to troubleshoot errors.

While the installer is still in progress, you can look at the Job Log of the **QZRCSRVS** (remote command) job. On a busy system, this can be difficult to locate with **WRKACTJOB**. One way to locate the job is to look for object locks on the user profile of the installing user, such as with the following OS/400 command:

```
WRKOBJLCK OBJ(<installing_user>) OBJTYPE(*USRPRF)
```

If the Capture Agent fails to start after the installation completes, review the capture_agent0.log file to help troubleshoot the problem.

Managing SQDR Plus

SQDR Plus is designed to operate with minimal administration after the product is installed and configured. This chapter describes how to change configuration parameters and monitor the product, should that be necessary after the software is installed on an iSeries host computer. This chapter describes:

- all of the configuration properties that you can set for SQDR Plus
- the jobs and logs that can provide insight to the SQDR Plus operations
- how to use the Capture Agent Maintenance utility
- how to upgrade or remove the SQDR Plus software
- some considerations for troubleshooting and tuning the performance of replication operations

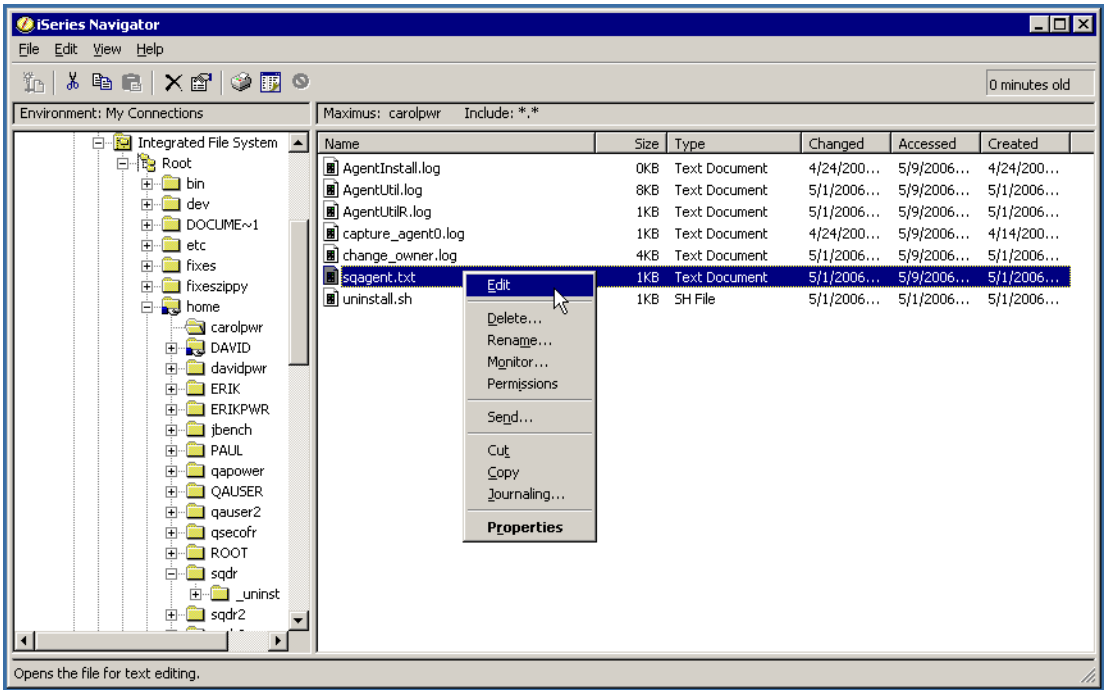
Configuring the Capture Agent

The Capture Agent is controlled by configuration parameters that are specified in a file named sqagent.properties, which is located in the home directory of the Capture Agent user (the directory specified as the Target Directory during the Pre-Installation Phase described on page 22).

The values that you specify during the installation of SQDR Plus (shown in Table 1, “Properties Configured During Installation,” on page 21) are saved to the sqagent.properties file. There are additional properties in the sqagent.properties file that are not presented during the installation of SQDR Plus.

If you want to review or change the configuration values, use a text editor to modify the sqagent.properties file. The OS/400 command EDTF invokes an editor from which you can change stream files, such as sqagent.properties, that are located in the IFS file system. You must stop and restart the Capture Agent for changes to the sqagent.properties file to take effect.

If you have access to the IBM iSeries Navigator you can use it to view or change the sqagent.properties file. Temporarily rename the file to sqagent.txt for it to be recognized as a text file, and then select the Edit command from the context menu, as shown in the following illustration.



Be sure to rename the sqagent.txt file back to sqagent.properties and restart the Capture Agent for the changes to take effect.

The configuration parameters in the sqagent.properties file, and their default values, are described in Table 2.

Table 2: Properties in the sqagent.properties File

Configuration Parameter	Default Value	Description
alwaysUseRowId	false (disabled)	Use RRN-based replication only: Enable this option to subscribe to tables whose journaling is configured with Record Images=*AFTER. For best results, we recommend that tables be journaled for Record Images=*BOTH (the system writes both before and after images to the journal for changes to records in the table), but this option is available if an existing journaling configuration cannot be changed. **Limitations**: You cannot specify "criteria" when configuring incremental subscriptions for tables whose journaling is configured with Record Images=*AFTER.
autoJournal	true (enabled)	Enable this option to have the Capture Agent automatically add journaling for physical files that are not already being journaled. Files must be journaled if they are used by subscriptions that perform incremental replication, and an error is returned if there is no journal and the autoJournal option is disabled. See “Creating Journals for Source Tables” on page 56 for more details.
batch	true	The SQDR Capture Agent uses *block insert* to improve staging performance. This feature results in significant performance improvements when many rows are updated/inserted/deleted in a single table or a small number of tables. However, it may result in poorer performance if a single row is touched in many hundreds of tables; in this case, you may choose to disable the feature by setting batch=false.
batchSize	100	the number of rows to allow in a single *insert* batch.

Table 2: Properties in the sqagent.properties File

Configuration Parameter	Default Value	Description
broadcastAddress	none	Specifies the default IP address that Capture Agent will send notification to when there is change data available for a subscription that has notifications enabled but does not specify a different IP address to send them to.
clientDeleteGrace	1 (day)	When SQDR Plus detects an inactive subscription, it sends a notification email (type SEVERE) after seven days of inactivity, then automatically deletes the subscription and subscriber after a grace period of one additional day expires, allowing purging of staged data. Setting this value extends the grace period. A value of 0 disables the automatic deletion of subscriptions and subscribers. **Note**: You can recover deleted subscriptions by using the *Reset I/R Group* function from the SQDR Data Replication Manager; a new baseline will be performed.
clientMonitoringInterval	1440 (minutes)	The default behavior of SQDR Plus is to check for inactive clients every twenty four hours (1440 minutes). You can change this interval by setting the clientMonitoringInterval in sqagent.properties; the value is specified in minutes.
controlDbSchema	SQDR	Name of the schema (library or collection) that contains the control tables that are used by a particular instance of the SQDR Plus Capture Agent.
filterUserId	none	Specifies that the Capture Agent should bypass staging transactions associated with the specified userID. The property can have a value of a single userID. With the property in place, the Capture Agent examine each commit record; if the user-id in the commit matches the "filterUserId", the commit is handled like a rollback, and any staged data is removed.

Table 2: Properties in the sqagent.properties File

Configuration Parameter	Default Value	Description
from	none	If the email notification feature is enabled (see smtpServer), the “from” parameter appears in the From field of the email. The “from” parameter can contain any string, such as the Capture Agent schema name and the computer on which it is located, to help identify the source of the email message.
grantees	none	Grants the specified users access to the Capture Agent control tables. By default the Capture Agent grants SELECT privileges to PUBLIC. Specify other users, separated by a comma, if you want to limit who can view the Capture Agent control tables and see what subscriptions are active. Note that changing the grantees does not change grants for existing control tables.
logLevel	INFO (if the default during installation is accepted)	Determines the amount and type of information that is recorded to log files. Valid values are OFF, SEVERE, WARNING, INFO, CONFIG, FINE, FINER, FINEST, and ALL. See the discussion below regarding the level of detail that is logged.
managedLogs	true	Specifies whether SQDR Plus manages all system-managed journal receivers that are associated with subscriptions (true) or just SQDR journal receivers that are used for automatic journaling (false)
minimumNotificationDelay	5000 milliseconds	Determines the minimal time interval that must pass before the Capture Agent sends notification that change data is available for subscriptions that have been enabled to receive notifications.
numControlDbConnectionsPerVm	10	Specifies the maximum number of database connections that are allowed from a Capture Agent process/job. Do not change the default value unless you are directed to do so by a StarQuest Technical Support engineer.

Table 2: Properties in the sqagent.properties File

Configuration Parameter	Default Value	Description
maxLogFileSize	512000 bytes	Specifies the maximum number of bytes of changes that the log file can contain.
maxNumLogFiles	5	Specifies the maximum number of log files that can be created to track changes.
notificationLevel	OFF	Specifies the level of logging messages that are sent via email to the specified user account. Valid values are OFF, CONFIG, INFO, WARNING, and SEVERE.
pollSleepTime	5000 milliseconds	Specifies the interval at which the Journal Reader should poll the journal for changes.
port	50005	Specifies the number of a port that the Capture Agent components can use to communicate within the iSeries system. This port does not need to be visible to any remote computer.
pruneInterval	30 minutes	Specifies the interval for examining the Capture Agent control tables to determine what change data can safely be deleted.
requirePublication	false	Specifies whether all the database tables can be subscribed to for replication (false), or only tables that have been published can be subscribed to (true).
retryPublishLock	false	Do not publish a table until an exclusive lock can be obtained. See “Publishing Database Tables” on page 49.
smInterval	0 seconds	Specifies whether to use the Storage Monitor; 0 means disabled.See “Monitoring Backlogs with the Storage Monitor” on page 60.S
smSQL	a SQL statement	See “Monitoring Backlogs with the Storage Monitor” on page 60.
smThrottleLevel	500000	See “Monitoring Backlogs with the Storage Monitor” on page 60.
smWarningLevel	450000	See “Monitoring Backlogs with the Storage Monitor” on page 60

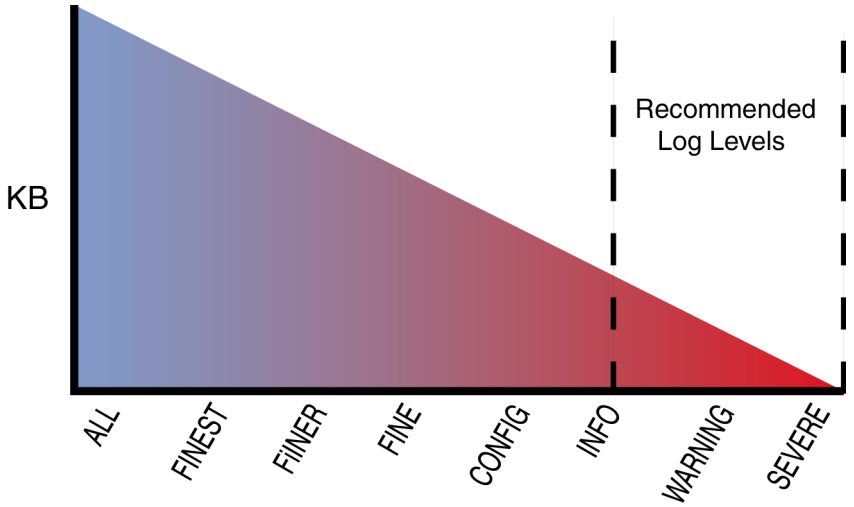
Table 2: Properties in the sqagent.properties File

Configuration Parameter	Default Value	Description
smtpServer	none	To enable email notification. specify a server name or IP address of an unauthenticated SMTP server that can direct the email to the user account specified in the “to” parameter, and specify a notificationLevel value other than OFF.
starquestNotification	SEVERE	Automatically send problem reports via email to StarQuest Support. To disable it, set starquestNotification=OFF in sqagent.properties or uncheck the checkbox during installation or custom update.
to	none	If the email notification feature is enabled (see smtpServer), the “to” parameter must contain a valid email user account in a format such as user@domain.com.
udpPort	2728	The port that Capture Agent uses to send notification that change data is available for subscriptions that have been specified to receive notifications.
useTxSequence	false	Specifies that the Capture Agent should maintain the order of transactions.See “Maintaining the Order of Transactions” on page 38.

Configuring Operational Logging and Email Notifications

The logging level that you configure determines the amount and type of information that is saved to log files. There are eight levels of logging, and you also can turn off the logging activity by specifying OFF. For sending email notifications you can specify only a value of CONFIG to SEVERE to avoid flooding the email server with notifications that would be generated with the

more detailed logging levels. SEVERE is the error level that is recommended for sending an email notification. The amount of information that is logged increases as the levels of logging become more broad, as illustrated below.



The broad levels of logging can significantly degrade performance of all computers involved in the communications. If you need to enable detailed logging to troubleshoot a problem, remember to restore the prior logging level as soon as you have collected the detailed logging information.

Configuring Database Mirroring

After changes are committed to a source database that Capture Agent is monitoring, the SQDR client retrieves the changes from the staging table on a periodic polling interval. You also can configure the SQDR Plus Capture Agent to send a notification to the client via the User Datagram Protocol (UDP) when change data is available, rather than waiting for the SQDR client to poll for changes. The UDP change data notifications are sent using the port number specified by the udpPort parameter at a frequency no greater than the number of milliseconds specified for the minimumNotificationDelay parameter.

To "mirror" the source database, achieving almost immediate update of the target database when changes are committed to the source, set a small interval for the minimumNotificationDelay and the pollSleepTime parameters in the sqagent.properties file. For example, using the default value of 5000 milliseconds for the minimumNotificationDelay and pollSleepTime parameters would typically provide less than a 5-second lag time in sending notification to the client that changes have been committed to the source, triggering the client to retrieve and apply the changes to the destination database.

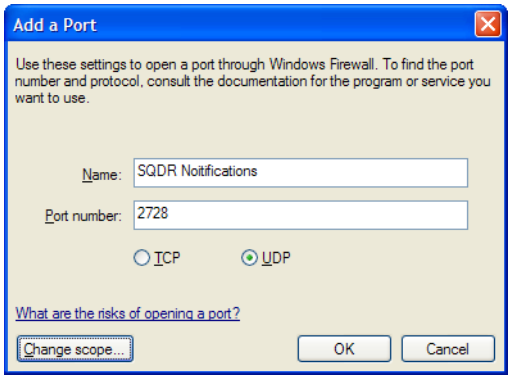
Change data notifications also can be useful if a source database is updated infrequently and you want to minimize how often the Capture Agent polls the journals for changes. In this case you could rely primarily on sending UDP notifications when the source database changes, having the SQDR client poll for changes infrequently, such as only once every hour or every day to ensure that changes are applied to the destination database with at least that frequency.

From the SQDR Replication Manager you can configure a group of incremental replication subscriptions to receive notifications at a specific IP address. If a subscription that is enabled to receive notification of change data specifies an IP address of 255.255.255.255 for the notification, the Capture Agent sends a broadcast message to the IP address specified for the broadcastAddress parameter in the sqagent.properties file.

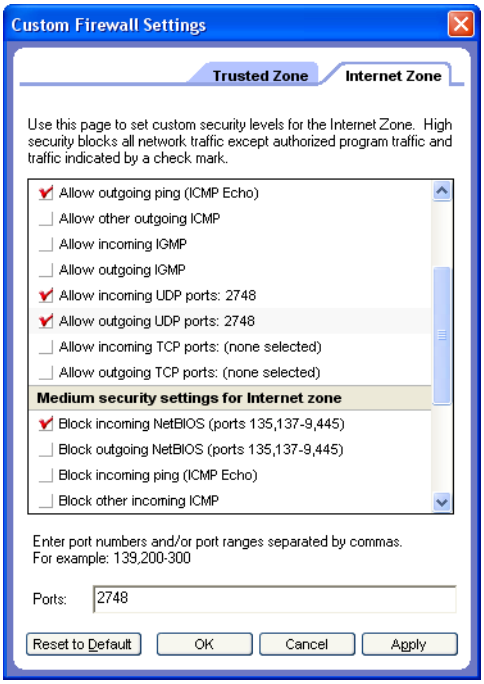
If the server on which SQDR Plus is running has a firewall, be sure the firewall is configured to allow outbound traffic through the UDP port number that you specify for SQDR Plus notifications. The SQDR Plus host computer must allow outbound traffic on the specified udpPort, and the computer that the subscription specifies for receiving the change notifications must allow inbound UDP traffic on that port.

For example, if you are using the Windows Firewall, follow the steps below to unblock port 2728,

1. Select Windows Firewall from the Control Panel and click the Exceptions tab of the Windows Firewall property window.
2. Click Add Port and enter a name, such as SQDR Notifications, and the port number you specified for the udpPort parameter.
3. Click the UDP protocol radio button and click OK to open the specified port, such as shown below for opening port 2728.



Other types of hardware and software firewalls provide different ways to specify which ports you want to block or whether you want to allow inbound or outbound traffic through them, such as shown below for Zone Alarm Pro.



Refer to the information that came with your firewall hardware or software solution if you need further information about how to configure a port to allow UDP traffic.

Configuring Pruning of Control Tables

The pruneInterval controls how frequently the Capture Agent control tables are reviewed to delete change data that is no longer needed. The default behavior is for the Capture Agent to prune the control tables every 30 minutes. The optimum pruning interval depends on how much change data is generated and the activity and available storage space of your network. The pruning operations can affect the availability of the Capture Agent such that one or more subscriptions may report an error in polling for changes. This type of error is automatically resolved when the Capture Agent is available again. If there is adequate storage space you can increase the frequency of the polling interval to allow more change data to accumulate before it is pruned.

Maintaining the Order of Transactions

The default behavior of SQR Plus is to ensure that replications are consistent at transaction boundaries. This behavior can be changed by setting **useTxSequence=true** in sqagent.properties. This property is useful if the target table has any foreign constraints defined on it, such as the target of an incremental replication defined with "unique constraints." The setting preserves the order of

the source updates on the target side and is useful if you are using triggers on the target and need updates to arrive in the order they were performed at the source. The update order is always maintained within each table; this setting is useful if the update order between tables is important.

An example is a single transaction that updates table A, then table B, then table A, then table B. Without this setting, the changes would be applied as A,A,B,B, Commit; with this setting, the order would be A,B,A,B, Commit.

Automatically Starting the SQDR Subsystem at IPL

If you want to automatically start the subsystem in which SQDR Plus resides whenever an Initial Program Load (IPL) of the iSeries server is performed, you can edit the system startup routine QSTRUP. Refer to the "Change the IPL start-up program" topic in the IBM documentation "iSeries Basic System operations" for details.

Note that TCP/IP services should be started before the SQDR subsystem.

Be extremely careful making changes to the system startup routine, as QSTRUP is the startup program for the system and errors can render the system inoperable.

1. Retrieve the source of the Start-up program by using the RTVCLSRC command, such as RTVCLSRC PGM(QSYS/QSTRUP)**.**
2. Edit the CL source with an editor such as STRSEU to add the following lines, replacing *SQDR*/*SQDR* with the name of your SQDR schema and subsystem if necessary:

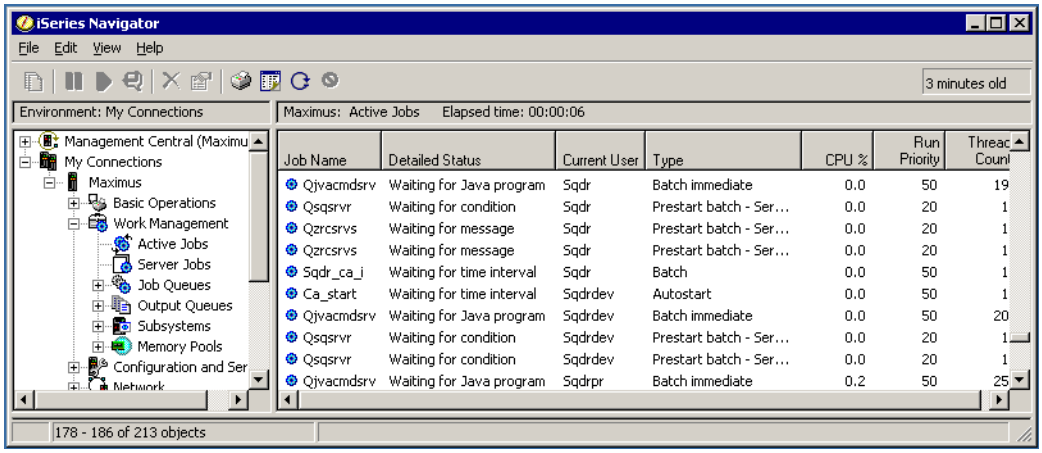
   QSYS/STRSBS SBSD(*SQDR*/*SQDR*)
   MONMSG MSGID(CPF0000)
3. Recompile this object and place it in QGPL or another library.
4. Modify the system value QSTRUPPGM to point to this new location, replacing QGPL with the library in which you placed the compiled object:

   CHGSYSVAL SYSVAL(QSTRUPPGM) VALUE(QGPL/QSTRUP)

Reviewing Capture Agent Jobs and Logs

If the logging property is enabled in the sqagent.properties configuration file (See "Configuring the Capture Agent" on page 29), the SQDR Plus service programs produce output using a printer device called "PRT01." This device often is used by many iSeries applications. For easier management and more control over the SQDR Plus output, create an output queue for the SQDR Job Logs.

There are several ways that you can review the Capture Agent jobs and logs. If you have access to the IBM iSeries Navigator, it provides a graphical interface with Work Management functions. You can search for the related SQDR Plus server jobs and sort the active server jobs by Current User to help locate the Capture Agent jobs, as shown in the following illustration.



You also can use the OS/400 command **WRKACTJOB** to review the status of the Capture Agent program. With the **WRKACTJOB** command you can specify the subsystem, such as **WRKACTJOB SBS(SQDR)**, to display only the SQDR subsystem. Initially, you will see only one Java process (the Capture Agent), and there may be one Replication Worker running inside the Capture Agent, as shown below.

```
Opt      Subsystem/Job      User     TypeCPU %     Function    Status
         SQDR               QSYS     SBS.0                     DEQW
           CA_START         SQDR     ASJ.0         CMD-RUNJVATIMW
           QJVACMDSRV       SQDR     BCI .0        JVM–/home/sqdrJVAW
```

The CA_START job is present if the Capture Agent is started as an Auto-Start Job Entry (ASJE) for a specific subsystem (the SQDR subsystem in the above example).

There is one Replication Worker job started for each journal that is being actively monitored. If you create incremental subscriptions for files or tables that use different journals than used by the initial subscription, additional Replication Worker processes/jobs will be started, as shown below with the QJVAEXEC jobs.

```
Opt      Subsystem/Job      User TypeCPU %FunctionStatus
         SQDRQSYS           SBS .0       DEQW
           CA_START         SQDRASJ.0CMD-RUNJVATIMW
           QJVACMDSRV       SQDRBCI.0JVM–/home/sqdrJVAW
           QJVAEXEC         SQDRBCI.0JVM–ReplicatioJVAW
           QJVAEXEC         SQDRBCI.0JVM–ReplicatioJVAW
```

The following table describes the SQDR jobs that may appear.

Table 3: Capture Agent Jobs and Output

Job	Type	Description
CA_START	ASJ	This job appears if the Capture Agent is started as an auto-start job entry (ASJE) for a specific subsystem. The file QPRINT contains the logging output for the Capture Agent.
CA_START_I	BATCH	This job appears if the Capture Agent is started from the Capture Agent Maintenance Utility or SQDR actions.

Table 3: Capture Agent Jobs and Output

Job	Type	Description
QJVACMDSRV	BATCHI	The Java Virtual Machine (JVM) for the Capture Agent.
QJVAEXEC	BATCHI	The JVM for the Replication Worker. There is one Replication Worker job for each journal being monitored.

Note that SQDR Plus shares access to system and user objects in order to replicate data from the iSeries, but it will never delete an object such as a journal, journal receiver, files, or tables. The only system objects that SQDR Plus will delete are those associated with the product, such as the SQDR library that is created when the SQDR Plus software is installed and deleted if the software is removed. However, the process of sharing access may result in transient locks being placed on the objects to prevent deletion while they are being used by SQDR Plus. This is a normal condition that is typical in multi-tasking environments.

Other Jobs Used by SQDR Plus

Other jobs that run on the iSeries server may produce Job Logs that are useful for troubleshooting SQDR Plus operations. These include the following Job Logs for the IBM DDM Server and the optimized SQL processor jobs that are invoked on behalf of the Capture Agent and Replication Worker:

- QSQSRVR (usually in QSYSWRK subsystem)
  This job is for local database access from Capture Agent.
- QRWTSRVR (usually in QUSRWRK subsystem)
  This job is for DRDA remote jobs from the SQDR client, used for accessing tables and stored procedures.
- QZDASOINIT (usually in QUSRWRK subsystem)
  This job is for IBM iSeries Access for Windows remote jobs.
- QZRCSRVS (can run in different subsystems)
  This OS/400 TCP Remote Command Server job allows applications to issue CL commands and distributed program calls. There may be two copies active for SQDR Plus, one to monitor the CAQ message queue and another to monitor the CALOGQ message queue.

SQDR Plus also creates SQ_* tables and CT* tables in the SQDR schema.

 WARNING	Do not manually change these control tables or remove jobs or job logs unless directed by StarQuest Technical Support.

Using the Capture Agent Maintenance Utility

The SQDR Plus software includes a Capture Agent Maintenance Utility, CAMAINT, to help with management tasks. You can use the CAMAINT utility to display and delete orphan subscriptions that can result if an SQDR client stops using SQDR Plus without cleaning up, or if the SQDR service abandons a local control database without first deleting the incremental subscriptions. You also can use CAMAINT to start and stop the Capture Agent, to control which database tables are published for replication, and to send SQDR Plus log files to StarQuest Customer Support if you need help troubleshooting a problem.

Granting Access to the Capture Agent Maintenance Utility

To run CAMAINT as a user other than the SQDR user or a user with SECOFR authority, the following grants must be made. Note that these grants will need to be repeated after an update of SQDR+/iSeries.

Note that *PUBLIC already has *USE on SQDR *LIB

1) Use WRKOBJ (option 2), or GRTOBJAUT to grant *USE for the following objects:

SQDR/CAMAINT *PGM

SQDR/CAMAINT *CMD

SQDR/CAPATH *DTAARA

e.g.

```
GRTOBJAUT OBJ(SQDR/CAMAINT) OBJTYPE(*PGM) USER(MYUSER) AUT(*USE)
GRTOBJAUT OBJ(SQDR/CAMAINT) OBJTYPE(*CMD) USER(MYUSER) AUT(*USE)
GRTOBJAUT OBJ(SQDR/CAPATH) OBJTYPE(*DTAARA) USER(MYUSER) AUT(*CHANGE)
```

2) Use WRKAUT or QSH/chmod to grant *RX (read and execute) for the following IFS objects:

/home/sqdr

/home/sqdr/AgentUtil.jar

e.g.

```
WRKAUT OBJ('/home/sqdr')
WRKAUT OBJ('/home/sqdr/AgentUtil.jar')
```

Choose 1 (Add user), enter the user name, and enter *RX for Data Authority.

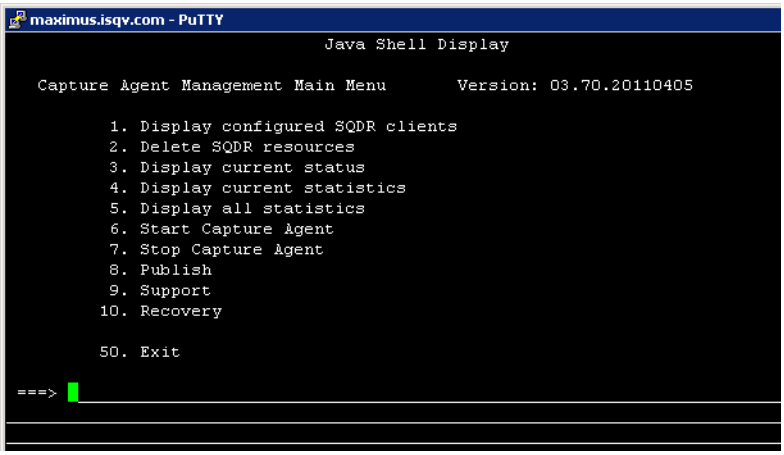
Starting the Capture Agent Maintenance Utility

You run Capture Agent Maintenance Utility, CAMAINT, from the OS/400 command line. Add the Capture Agent schema to your library list and execute the CAMAINT command, as illustrated below:

```
$ ADDLIBLE <SQDR_schema>
CAMAINT
```

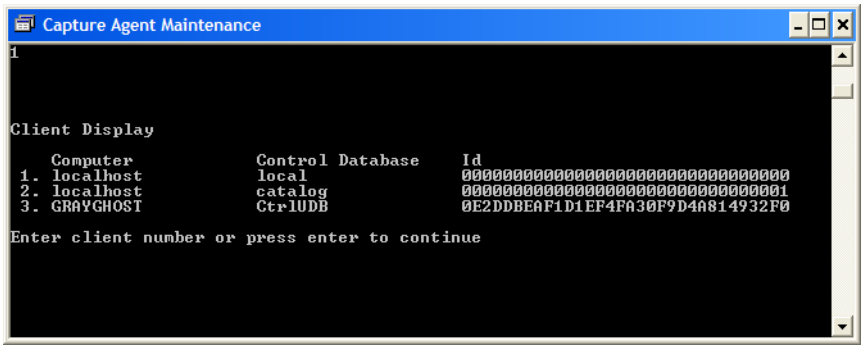
If there is more than one Capture Agent installed, a menu appears so you can enter the number that corresponds to the agent you want to manage.

The CAMAINT program starts, displaying a Main Menu from which you can select a task to perform.



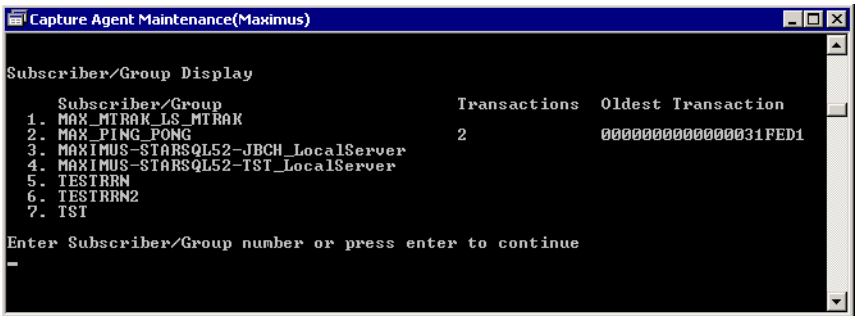
Displaying Configured SQDR Clients and Transaction Status

Select option 1 from the Capture Agent Management Main Menu to view the SQDR client computers that are configured to use the SQDR Plus Capture Agent. The utility displays a list similar to the following, which shows the computer name of the client, and the name and ID of the SQDR control database the client is using.

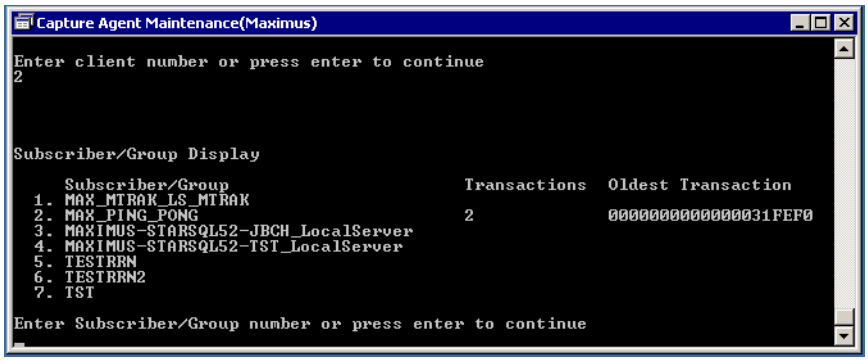


Enter the number that appears next to the SQDR client computer to display the list of incremental groups that Capture Agent is monitoring for the client. The information in the Transactions and Oldest Transaction columns can help you determine whether the client is retrieving change data

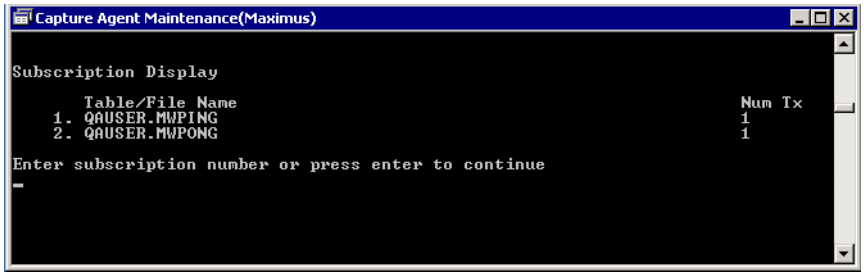
from the Capture Agent. Note that, in the following illustration the status indicates that there are 2 transactions pending for the MAX_PING_PONG group, with a hexidecimal string that shows the oldest transaction.



If you review the status again after a period of time and the value for the Oldest Transaction is different, as shown in the following illustration, the SQDR client is retrieving changes from the Capture Agent. If the value for Oldest Transaction does not change, check that the SQDR service on the client computer is running and that the incremental group has not been paused. If the Capture Agent has changes pending for subscriptions that have been orphaned, you may need to delete the resources as described in “Deleting SQDR Resources” on page 45.



Enter the number that appears next to a particular group to list the specific tables that are subscribed to and how many transactions are pending for each.



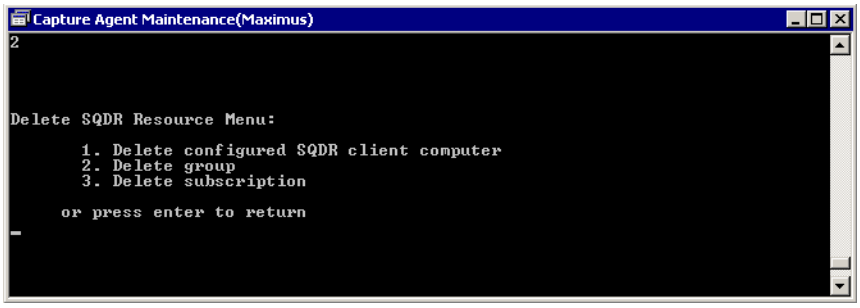
Deleting SQDR Resources

The Capture Agent automatically prunes the change data control tables and journal receivers that are no longer needed. However, incremental replication subscriptions can become "orphaned" if the subscriptions are not cleaned up correctly from the SQDR Replicator Manager on the Windows client computer. This can occur if the SQDR Replicator Manager is re-configured to use a different local control database, ceases to run the defined incremental replication subscriptions, or the client software is uninstalled prior to deleting the defined subscriptions.

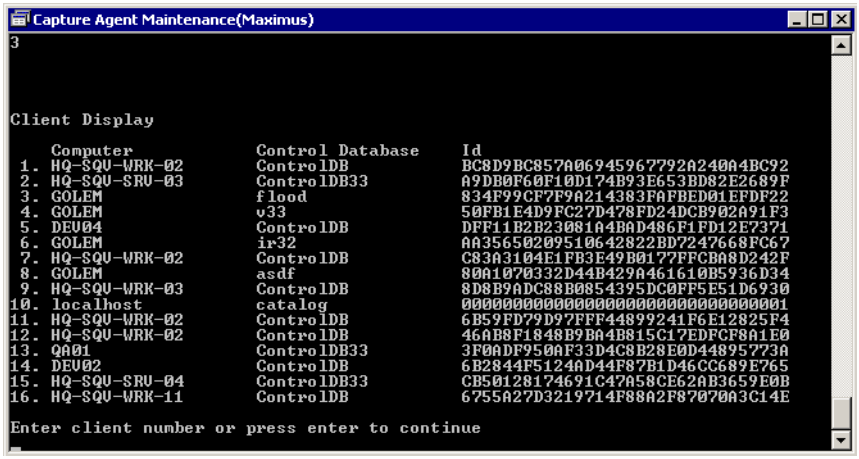
Option 2, Delete SQDR Resources, of the Capture Agent Management Main Menu allows you to delete an incremental subscription, a group, or a client computer.

 WARNING	Be sure you select the correct client computer, subscription, or group when you are deleting SQDR resources. The resource that you select will be *permanently* deleted and there is *no confirmation* for the delete operation.

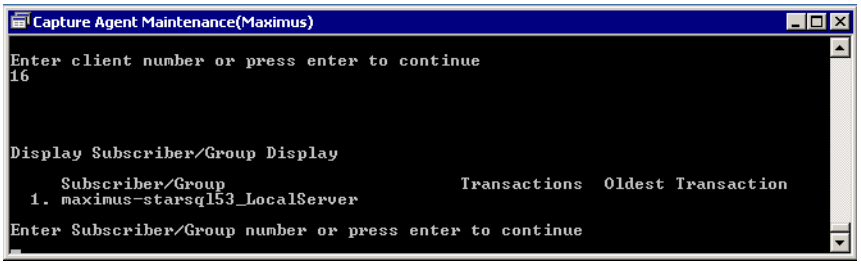
1. Select option 2, Delete SQDR Resources, from the Capture Agent Management Main Menu.
2. From the Delete SQDR Resource Menu, enter option 1, 2, or 3, depending on whether you need to delete a configured client computer, a group, or a subscription, respectively.



3. From the list of SQDR clients, enter the number that appears next to the client for which you want to delete the resource. Clients are identified by computer name, SQDR control database name, and a unique control database ID.



4. If you are deleting a group or a subscription, enter the number that appears next to the appropriate group.



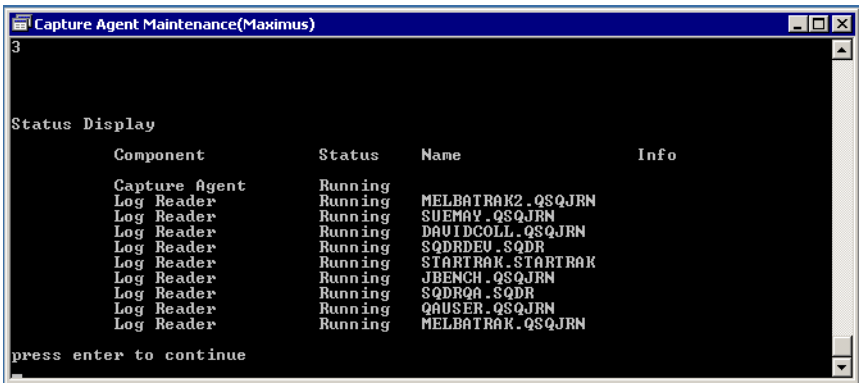
5. If you are deleting a subscription, enter the option number that appears next to the subscription you want to delete.

6. Press Enter to return to the Main Menu when you are finished deleting resources.

When you delete resource objects, SQDR Plus releases the system resources that were used by the client, group, or subscription.

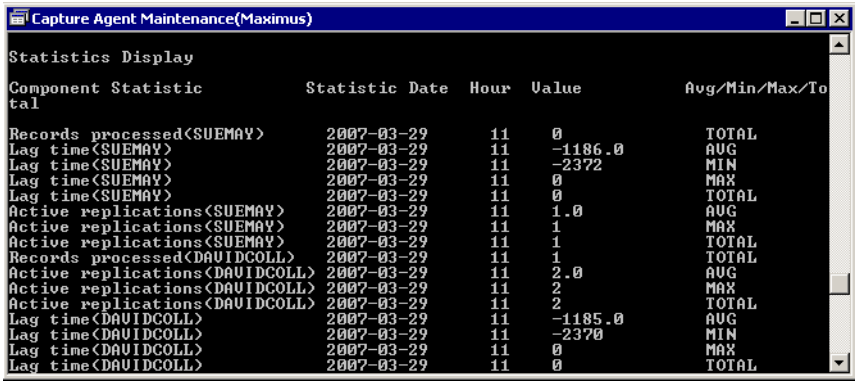
Displaying Status Information

Option 3 of the Capture Agent Management Main Menu displays the status of the SQDR Plus components for the selected Capture Agent. For example, the following screen shows that the Capture Agent and several Journal Readers are running within the selected schema.



Displaying Statistics

Options 4 and 5 of the Capture Agent Management Main Menu display current or all statistics, respectively. The current statistics reflect one hour of activity for the date and time shown. The time is reported according to 24-hour notation, such as 13 for statistics gathered between 1300 (1:00 p.m.) and 1400 (2:00 p.m.).



For active replications, the statistics show the average, maximum, and total number of active replications for the QSQJRN in the specified <*COLLECTION*>. If the collection uses a different journal, the qualified name of the journal appears in the form of SCHEMA.JOURNAL, such as SQDRDEV.SQDR for a journal named SQDR that is installed in the SQDRDEV schema.

The minimum, maximum, average, and total lag times indicate the number of elapsed seconds between reading the journal and recording the change data. A total lag time of 0 indicates that, during the hour for which the statistics were sampled, the Journal Reader was maintaining pace with the database changes, reading the journal and recording the change data with no delays. The statistics also show the average number of seconds and the maximum number of seconds in which the Journal Reader lagged behind in recording the change data.

You also can obtain the statistics by running a query on the sq_statistics table using another tool, such as Microsoft Excel. For example, you can issue a query such as SELECT * from <*schema*>.sq_statistics, and then save or print the results.

Starting the Capture Agent

The Capture Agent Management program provides options for starting and stopping the Capture Agent. Enter option 7 to stop the Capture Agent, and option 6 when you are ready to start it again.

If you are using a subsystem that is dedicated to SQDR Plus, you can manually start the subsystem used by the Capture Agent by entering the OS/400 Start Subsystem command:

```
STRSBS <schema>/SQDR
```

For example, if the schema is SQDR, you would start the subsystem by entering:

```
STRSBS SQDR/SQDR
```

Stopping the Capture Agent

SQDR Plus uses TCP for interprocess communications. TCP services must be running for SQDR Plus to shut down properly. If you run a script to automatically shut down the OS/400 system, include the ENDSBS command to shut down the SQDR subsystem early in the routine to provide adequate time for it to shut down before the TCP services are ended.

You can verify whether the SQDR subsystem has ended by attempting to allocate the *schema*/CAQ message queue within the shutdown sequence. For example, the following sequence ensures that the SQDR subsystem ends cleanly by waiting for the CA_START job to finish. It monitors for message ID 1002 if the allocate fails in 60 seconds and immediately ends the subsystem if it succeeds.

```
ENDSBS SBS(SQDR) OPTION(*CNTRLD)
ALCOBJ OBJ((&CALIB/CALIB *DTAARA *EXCL)) WAIT(60)
MONMSG MSGID(CPF1002) EXEC(ENDSBS SQDR *IMMED)
```

If you include the Allocate statement in the shutdown sequence, remember to free the allocation prior to restarting the SQDR subsystem.

NOTE

Avoid issuing the ENDTCPSVR command to end TCP services before the SQDR subsystem is shut down. If SQDR Plus detects there was an abnormal shutdown the Capture Agent may need to perform clean-up operations when it is restarted, delaying the time for updates to become available.

To end the subsystem from the OS/400 console, specify the same subsystem that was started, adding *CNTRLD for a controlled shutdown or *IMMED for an immediate shutdown, such as:

```
ENDSBS SBS(SQDR) OPTION(*CNTRLD)
```

Alternatively, if you know the job name of the Capture Agent job (such as displayed with the WRKACTJOB command), you can use the ENDJOB command to stop the Capture Agent. The following example shows ending job number 074531 for the Capture Agent user SQDR:

```
ENDJOB JOB(074531/SQDR/QJAVCMSRC) OPTION(*CNTRLD)
```

To power down the entire OS/400 system in a controlled fashion, including the Capture Agent job, you can issue the following command:

```
PWRDWNSYS OPTION(*CNTRLD)
```

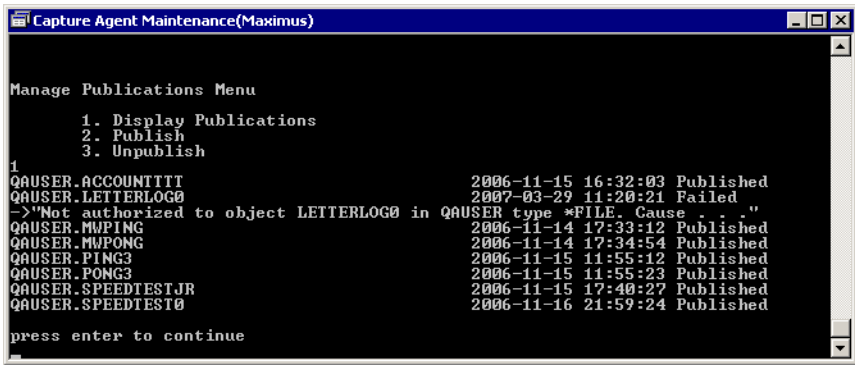
Publishing Database Tables

Option 8, Publish, on the main Capture Agent Maintenance menu allows you to specify which database tables you want to make available to SQDR clients for replication. The Publish feature provides centralized control that a database administrator can use to restrict specific database tables from being replicated to other destinations. When the requirePublication configuration parameter is set to true, only the database tables that have been published from the Capture Agent can be successfully subscribed to for replication. Note that publishing and unpublishing tables affects only new subscriptions that are created from the SQDR Replicator Manager.

The Manage Publications Menu that appears after you select option 8 includes functions for displaying the published tables, and for selecting which tables to publish or unpublish.

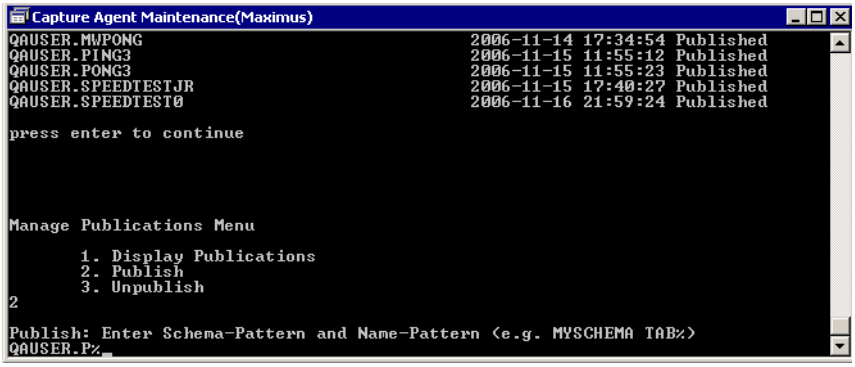
Displaying Published Tables

Select option 1 to display a list of tables that have been published. The tables are listed in the format *schema.tablename*, with a timestamp and a state of Initial, Subscribed, Published, or Failed. *Initial* indicates that the request to publish the table has been initiated. *Subscribed* means that the Capture Agent is setting up the change data table, and *Published* indicates that changes are being tracked and the source table can be subscribed to. If the table cannot be published the state shows *Failed* with additional text to explain the problem. An asterick next to *Published* indicates that an exclusive lock was not obtained prior to starting to stage changed data.



Publishing Tables

Select option 2, Publish, from the Manage Publications Menu to specify which database tables you want to make available for SQDR users to subscribe to. After you enter the option number, specify the schema and name of the table you want to publish. You can use wildcards to specify a pattern for the schema and the name to publish multiple tables at once, as shown below to publish all the tables in the QAUSER schema that begin with the letter P.



After the Capture Agent creates a staging table for the published table(s), new subscriptions for replicating the source table data can be created from the SQDR Replicator Manager. Note that the Capture Agent publishing functions affect only new, not existing, SQDR incremental replication subscriptions.

Prior to SQDR+ v3.60, the Publish function required that an exclusive lock be acquired on a table before being considered published; this is no longer necessary. If an attempt to lock the table for shared update fails, the subscription will be published with a "*" character next to the state of *Published* to indicate that a lock was not obtained prior to starting to stage changed data.

If the original more limiting behavior is desired, it can be configured by setting the keyword **retryPublishLock=true** in the sqagent.properties file; in this case the publication will be displayed as Subscribed, and the lock operation will be retried every 10 minutes. Once successfully locked (and immediately released), the state will be updated to *Published*.

Unpublishing Tables

After a table has been unpublished it cannot be subscribed to from the SQDR Replicator Manager. However, removing a table from the published list *has no affect on any existing* subscriptions to the table.

If you need to remove one or more database tables from the published list, select option 3, Unpublish, from the Manage Publications Menu. After you enter the option number, specify the schema and name of the table you want to unpublish. You can use wildcards to specify a pattern for the schema and name to remove multiple tables at once from the published list.

Recovery Menu

Option 10 of the Capture Agent Maintenance menu brings up the Recovery menu, which allows the SQDR Plus Administrator to change the startup mode for the Capture Agent and take an individual incremental replication subscriptions offline or online.

The Recovery menu is shown below.

Agent Recovery Menu
1. Set Startup Mode (Current: "Normal")
2. Take Subscription Online
3. Take Subscription Offline
4. Quiesce Capture Agent

The Startup Mode affects the behavior of the Capture Agent, the next time it is started. The Online/ Offline functions take effect immediately. The following sections detail each feature in detail.

Set Startup Mode

The default Startup Mode for the Capture Agent is Normal. Before changing the Startup Mode, the Capture Agent must be stopped.

When to change the Startup Mode

The Startup Modes are useful in situations where the source database is moved from a production system to a backup system ("fail-over") or where SQDR operations are restored on a primary server ("fall-back"). Both operations can be performed without the need for SQDR to run baseline replications. This option is termed a “Warm” startup mode. Another new startup option, “Cold” startup, will force all subscriptions to be flagged as requiring new baselines. This “Cold Start” option is useful when the host control tables are intact and in agreement with the SQDR client(s), but the User source and destination database tables are no longer be assumed to be synchronized. For example, this situation might occur in the event of unrecoverable log damage, necessitating a restore. Once the Capture Agent has completed the startup-time recovery, it resets the startup mode for the next invocation to “Normal”. The Set Startup Mode has three options:

1. Startup with fully recovered control and staging tables.
2. Force all subscriptions offline ("online" needed after restart).
3. Normal Startup.

Normal Startup

SQDR Plus assumes that the state of its log, staging tables and log positions are still current and accurate. However, at startup, the Capture Agent checks for source table structure changes. The Startup Mode should be set to Normal except when a "fail-over" or "fall-back" operation is being performed.

“Warm” Startup with fully synchronized control and staging tables

SQDR Plus assumes that logging tables and staging tables are in a working state and that it only needs to recover the current log position.

This option is useful when copying the entire SQDR Plus schema (e.g., library) to a new system, or other types of complete restore operations where the consistency of the database is guaranteed. SQDR Plus skips any journal entries showing that tables having been deleted and re-created by moving its log/journal read position to "now".

As in a Normal startup, the Capture Agent validates source table structures. If auto-journaling is enabled and SQDR Plus discovers that a source table is no longer journaled, it will automatically try to restore journaling. Also, grants to the views on the staging tables are made to match the source tables.

“Cold” Startup

SQDR Plus makes no assumption about the consistency of log and staging tables. It skips any log/journal changes and takes all subscriptions "offline". The user can then manually move subscriptions "online" in a controlled fashion once SQDR Plus is restarted. Taking a subscription online will cause a new baseline replication to be required. (See “Taking Subscriptions Offline/Online” on page 52 for more details).

As with the *Startup with fully recovered control and staging tables* mode, metadata verification occurs, journaling is restored, if necessary, and grants to the views on the staging tables are made to match the source tables.

In the latter two cases, SQDR Plus assumes that the source and destination tables are in sync at the time of the "fail-over" or "fall-back" operation, and that only its log position is to be considered invalidated.

Taking Subscriptions Offline/Online

The ability to take a subscription offline/online should be used when significant changes are made on the source tables. In this case, moving subscriptions to offline will suspend staging of changes and will require a new baseline in order to make new changes available. This option is particular useful if a set of tables is restored or loaded with a large number of new rows.

This functionality allows significant changes to be made to a source file or a set of source files (e.g., dropping/re-creating source tables or adding/removing members from tables) without requiring the user to re-create the subscriptions in SQDR.

Taking a subscription offline will flag a given source table as being unavailable for normal Capture Agent processing (e.g., staging changes), until further notice. A subscription in the offline state appears to the SQDR client as if there is no activity on the subscribed table. This allows a database administrator to restore the table to a desired version without the Capture Agent processing and staging all records, which may cause significant delay on large tables.

Once the restore operation is complete, the administrator uses the *Take Subscription Online* option to notify the Capture Agent to resume processing for the subscribed table. At this point the Capture Agent will compare its saved metadata for the table to its current state. If the structure of the subscribed table is unchanged, the SQDR client is notified that only a new baseline snapshot is required. If there have been structural changes or if the subscribed table no longer exists, a "table altered or deleted" notification is generated and the subscription must be deleted and re-created. If the subscription is already online when you issue the online request, no changes occur.

If the table is no longer journaled after the restore, SQDR Plus will attempt to restore journaling for the table. If the attempt to start journaling fails, the subscribed table will remain "offline".

The Online and Offline operations can be performed on multiple libraries (or schemas) and tables by using iSeries CL wildcards (when using the VRYSUB command) or SQL search patterns (when using CAMAINT or invoking Java directly)

The Online/Offline commands are available in the following ways:

Use the Agent Recovery Menu of CAMAINT

```
Agent Recovery Menu
    1. Set Startup Mode (Current: "Normal")
    2. Take Subscription Online
    3. Take Subscription Offline
Enter selection or press enter to continue
```

VRYSUB command

From an iSeries command line or, within a CLP, add the SQDR Plus schema to the library list and run the VRYSUB command. Provide the name of the library where the source file is located, the name of the source file, the desired status (*OFFLINE or *ONLINE) and the SQDR Plus schema (typically SQDR), as shown in the example below.

```
ADDLIBLE SQDR
VRYSUB <F4>
Vary Subscription (VRYSUB)
Type choices, press Enter.
    Library          PRODLIB      Name, generic*, *ALL
    File             CUSTLIST     Name, generic*, *ALL
    Status           OFFLINE      *OFFLINE, *ONLINE
    Install Library SQDR          Character value
```

Start AgentUtil with the –online or –offline argument

```
java –jar AgentUtil.jar [-online | -offline ] <agentSchema> <schemaPattern> <namePattern>
```

Qshell Example:

```
$ cd /home/sqdr
$ java -jar AgentUtil.jar -online SQDR MYLIB FILE%
```

"quiesce" Shutdown Option

When the Quiesce Capture Agent option of the Recovery Menu is selected, CAMAINT makes a Quiesce call to the Capture Agent. Upon receipt of the Quiesce request, the Capture Agent terminates the pruning, publishing, and client notification threads. It then notifies each replication worker (one per journal/log being processed) to quiesce its operation.

The replication worker will process any outstanding log/journal records until a call to the log/journaling API returns no records. The replication worker will then enter a quiesced state, where it will remain until the capture agent is stopped.

To monitor the state of the Capture Agent's replication workers, choose option 3 ("Display current status") from the CAMAINT menu. Once all replication workers have entered quiesced state, you can be assured that all log/journal entries have been processed and placed in the capture agent's staging tables, assuming that no new activity has been allowed on the subscribed tables after the replication worker entered quiesced state.

If a replication worker experiences a resource failure while processing in this mode, the Capture Agent will restart the worker and, barring other failures, will process any remaining log/journal entries, eventually entering quiesced state.

Sending SQDR Plus Log Files to StarQuest

StarQuest Technical Support engineers may need the Capture Agent logs to help you troubleshoot a problem. The Capture Agent Maintenance utility provides a Support option to make this task easier. If you need to provide the SQDR Plus log files to StarQuest Customer Support, select option 9, "Support," from the Capture Agent Management Main Menu to display the Support Menu.

```
Support Menu
        1. Send SQDRPlus Logs (ftp)
        2. Change ftp server (ftp.starquest.com)
        3. Change ftp userid (sqdrdrop)
        4. Change ftp password
        5. Save SQDRPlus Logs to local file system (as zip file)
        6. Set directory for saving logs locally (\temp)
        7. Specify id of user that installed SQDRPlus (QSECOFR)
    Make a selection or hit RETURN to continue.
```

You must specify the user ID that was used during installation and setup of SQDR Plus to collect and send the log files to StarQuest. The default value is the user ID for the user who is running CAMAINT, and you can select option 5 to specify a different installing user ID.

Select option 1 to transmit the SQDR Plus log files to the StarQuest FTP server using default values for the FTP server (ftp.starquest.com), user ID (sqdrdrop), and password. The Capture Agent Maintenance utility copies the SQDR Plus log and configuration files to two compressed files and sends those to the StarQuest FTP server.

If you cannot connect directly to the StarQuest FTP server, execute option 2 from the Support Menu to specify another FTP server that you have access to. Option 3 allows you to change the user ID from the default value of sqdrdrop to another user ID, and option 4 allows you to change the password that is used for the FTP connection.

If you must send the log files to a different FTP server, make a note of the .zip filenames and send the compressed files to StarQuest (contact@starquest.com) as an email attachment.

If firewall policies or other restrictions prevent access to any ftp server, use option 5 to save SQDR Plus logs to the local file system so they may be forwarded using another method. This option will save the files to the iSeries file system (when CAMAINT is run on the iSeries server) or the local workstation's file system (when running SQDR Remote Admin's CAMAINT). You may also specify the target directory for the zip files with option 6.

Creating Journals for Source Tables

All tables being used as a source for incremental replication operations must be journaled. To determine whether a file is being journaled, use the DSPFD command to display the following information:

```
File is currently journaled . . . . . :     Yes
Current or last journal . . . . . :         QSQJRN
```

Using Automatic Journaling

SQDR Plus provides an option for automatically journaling physical files that are not already journaled. The Automatically Start Journaling Physical Files option is enabled by default when you install SQDR Plus. If you disable this option during installation you can later edit the autoJournal entry of the sqagent.properties configuration file to have SQDR Plus automatically journal physical files that are not already being journaled. (See "Configuring the Capture Agent" on page 29 for more information about changing the sqagent.properties configuration file.)

When a non-journaled physical file is selected for incremental replication, the SQDR Plus Capture Agent will create a new library in the same ASP (auxiliary storage pool) as the physical file. This library will be named <*agentSchema*><*NN*>, where *agentSchema* is the name of the Capture Agent schema and userid (default SQDR) and *NN* is the ASP number. For example, if the Capture Agent schema is SQDR and the physical file is located in ASP 3, a library named SQDR03 will be created in ASP 3.

The library and its contents will be owned by the Capture Agent userid, and will contain the journal created by the Capture Agent for auto-journaling.

Journal receivers for the journal will be created in the Journal Receiver library specified during installation. If you plan to use auto-journaling, we recommend considering ASP layout before installing SQDR Plus. For best performance, the Journal Receiver library should be located in an ASP other than the ASP containing the files or tables to be replicated.

The journal used for automatic journaling is named <*schema*>/SQDR. Note that using the autoJournal feature of SQDR Plus requires that authority of *ALL be granted to *PUBLIC for access to the journal. If it is important to secure the table for access only by a particular user or users, create a journal, journal receivers, and journal receiver libraries with the appropriate security for those users, as described in the following section.

Creating Unique Journals

Instead of using SQDR-created journals and receivers, you can create your own unique journals, journal receivers, and journal receiver libraries. This offers more control in configuring access security and location of the objects.

Note that a single journal can be used for multiple physical files. You can use any valid name for the journal and receiver; however, avoid the names QSQJRN and QSQJRNnnnn, as these are the default names used when the OS/400 creates journal and journal receivers via the CREATE SCHEMA or CREATE COLLECTION SQL statements.

The following example illustrates how to create a journal called "MYLIB/MYJRN" and journal receiver "MYLIB1/MYRCV0001" and how to associate the physical file "MYLIB/MYFILE" with the journal. Often the journal is placed in the same library as the file to be journaled, but if not, both the journal and the file must reside in the same ASP. This requirement does not extend to the journal receiver library; it may be useful to place the journal receiver library in a separate ASP for performance and recovery purposes.

```
CRTJRNRCV JRNRCV(MYLIB1/MYRCV0001) TEXT('receiver for physical files')

CRTJRN JRN(MYLIB/MYJRN) JRNRCV(MYLIB1/MYRCV0001) RCVSIZOPT(*MAXOPT2
*RMVINTENT) TEXT('journal for physical files')

STRJRNPF FILE(MYLIB/MYFILE) JRN(MYLIB/MYJRN) IMAGES(*BOTH)
```

To stop journaling, issue the **ENDJRNPF** command. Once all journaling on the physical files has ended, the previously associated Journal and Journal Receiver(s) may be deleted.

Maintaining Journals and Log Files

The Capture Agent takes advantage of the standard OS/400 pruning operations to prune the SQDR control tables and journal receivers. If you have the Autojournal configuration parameter enabled (see “Configuring the Capture Agent” on page 29) there should be no need to manage the journal receivers. If you are manually managing journal receivers you can remove only journal receivers that are not currently being used by SQDR Plus. As is typical with sharing objects in a multi-tasking environment, SQDR Plus places a transient lock on objects while they are in use. SQDR Plus will never delete a system or user journal, journal receiver, file, or table.

If SQDR Plus is not running, an Exit Program named CADLTRCV (Capture Agent Delete Receiver) manages which receivers the Log Reader will need when the Capture Agent is restarted. Be careful not to delete receivers that the Capture Agent needs when it is started again. If you override the protection of the CADLTRCV exit program and delete receivers from the chain you will need to re-run a baseline snapshot before the subscription can resume tracking and replicating incremental changes.

After SQDR Plus is monitoring subscriptions for incremental changes there may be repetitive notification messages sent to the operator’s QSYSOPR message queue if there is a long delay, such as 30 minutes, between an IPL and restarting the SQDR subsystem. You can avoid flooding the message queue while the SQDR journal receivers are unavailable by issuing the following Change Journal (CHGJRN) command, replacing *SQDR*/*SQDR* with your schema and subsystem name if they are different:

```
CHGJRN JRN(SQDR/SQDR) DLTRCVDLY(1440)
```

This command changes the Delete Receiver Delay from the default value of 10 minutes to 1440 minutes so that notifications about the SQDR receivers are sent only once per day. Whatever time interval is specified for the DLTRCVDLY command option is used until the command is issued again

Removing the SQDR Plus/iSeries Exit Program

SQDR Plus installs an exit program to prevent the premature removal of journal receivers it needs when working with subscribed tables. If you wish to manage journal receivers yourself, use the following instructions to remove the exit program.

Make sure that /home/sqdr/sqagent.properties is configured as follows:

```
managedLogs=false
autoJournal=false
```

Call the CALOGMGT program to remove any current exit program registration known to the SQDR application.

```
CALL PGM(SQDR/CALOGMGT) PARM('SQDR' 'U')
```

Use the WRKREGINF command to delete any remaining occurrence of the registration program for SQDR/CADLTRCV left from a previous installation/update:

1. Enter WRKREGINF at a command line.

2. Page down to a Journal Receiver exit point:

   ```
   QIBM_QJO_DLT_JRNRCV DRCV0100
   ```

3. Enter 8 in the Opt field to the left of the exit point entry and press Enter.

4. At the Work with Exit Program display, identify the exit program entry for “CADLTRCV” in library “SQDR” and enter a 4 (Remove).

5. Press Enter.

Removing the SQDR Plus Software

If you need to remove the SQDR Plus software and will not be re-installing it on the same computer, follow the procedures in this section.

Preparation Tasks

There are some tasks that you need to perform prior to running the uninstall program to cleanly remove the software from the host computer.

1. From the SQDR Manager that is running on a Windows computer, delete any subscriptions that perform incremental replication operations from that host before you remove the SQDR Plus software from the iSeries computer.
2. Use CAMAINT to examine whether any tables remain published or subscribed to, and whether any subscribers still remain. If so, use CAMAINT to “unpublish” and to delete any remaining subscribers and subscriptions.
3. Make sure that no server jobs, such as QRWTSRVR, have any residual locks on the SQDR Plus tables. Execute the **WKOBJLCK** command, such as shown below, or use the iSeries Navigator, as described in “Troubleshooting Operational Problems” on page 60, to display locks on the SQDR journal readers. End any jobs that are returned.

   ```
   WRKOBJLCK <schema>/SQ_READERS *FILE
   ```

 WARNING	Use the **WRKOBJOWN** command to display the objects that are owned by the Capture Agent user, which is SQDR by default. Change the owner of any objects that you want to preserve before you uninstall SQDR Plus, as *all* of the objects that are owned by the Capture Agent user are deleted during the uninstall process.

4. Review the contents of the Capture Agent user directory and copy any log files or other files that you want to retain to a different directory. The Capture Agent /home/<*schema*> directory will be cleared and deleted when you run the uninstall program. If a separate journal receiver library was created during the installation, the journal receiver library and its contents also will be deleted.

Running the Uninstall Program

Specify the same installing user ID that was used for the prior installation to uninstall SQDR Plus. After you complete the preparation steps in the previous section, execute the following commands to completely remove the SQDR Plus software and environment.

1. Log on using the same installing user ID that was used to install SQDR Plus.
2. Enter the following command to execute the uninstall program, replacing <*schema*> with the name of your SQDR schema:

   SBMJOB CMD(CALL PGM(<*schema*>/RMVSQDR) PARM(<*schema*>)) JOB(RMV_CA)

For example, if you accepted the default name of SQDR for the Capture Agent user schema you would issue the command as:

SBMJOB CMD(CALL PGM(SQDR/RMVSQDR) PARM(SQDR)) JOB(RMV_CA)

The uninstall program submits a job that removes the specified SQDR Plus environment, and returns a message to inform you whether the job completed successfully.

Note: When SQDR Plus is removed, the uninstall job may not be able to remove all objects created during the course of product usage.

If any user files are still configured as auto-journaled or published when the SQDR Plus product remove job is run, the SQDR library containing the SQDR Journal and any Receiver libraries associated with User ASP(s) may remain. The associated objects will be owned by QDFTUSR. In this case, use ENDJRNPF to stop journaling the user files, and then delete the unused SQDR Journal and Receiver objects.

To avoid this situation, before running the product remove job, insure that no files remain published or subscribed to, and that no subscribers still remain. Use CAMAINT to “unpublish” and to delete remaining subscribers and subscriptions.

Troubleshooting Operational Problems

Following are some general steps for troubleshooting operational problems:

1. Use the Capture Agent Maintenance Utility to view the status of the Capture Agent and its Replication Workers. (See “Displaying Status Information” on page 47.)
2. If the status shows the Capture Agent is stopped or failed when it should be active, review the logs for SEVERE conditions in the capture_agent<*N*>.log files.
3. Use the Capture Agent Maintenance Utility to review the statistics to determine whether the Records Processed counter is updating at least every few minutes. (See “Displaying Statistics” on page 47.)
4. Use the IBM iSeries Navigator or the OS/400 command WRKACTJOB to determine if any of the SQDR Java jobs or QSQSRVR jobs are using excessive CPU resources.

Finding SQDR Plus Jobs

To find jobs that may be servicing the Capture Agent (such as QRWTSRVR for database requests) or requesting services from SQDR Plus (such as QRWTSRVR or QZDASOINIT jobs), you can use the IBM iSeries Navigator or issue OS/400 commands. Use the Work Management functions of the Navigator, as described in “Reviewing Capture Agent Jobs and Logs” on page 39, or the OS/400 WRKOBJLCK command as indicated below.

```
WRKOBJLCK OBJ(<subscribing_user>) OBJTYPE(*USRPRF)
```

Increasing the Logging Level

If you need to increase the logging level to capture more details, edit the logging level specified in the sqagent.properties file (see page 29) and restart the Capture Agent. Log files have names such as capture_agent0.log and sq_<*user_schema*>_QSQJRN0.log. They can be viewed using Notepad or any other application that can read text fiiles. If you need to send the logs to StarQuest Customer Support to help with troubleshooting a problem, use the CAMAINT utility to automatically collect and send the logs as described in “Recovery Menu” on page 51.

Remember to change the logging level back after you have captured the detailed operational information as the fine logging levels can negatively impact performance.

Monitoring Backlogs with the Storage Monitor

SQDR Plus provides a mechanism for monitoring backlogs and will send a warning notice and suspend log readers if necessary to avoid excessive usage of the table space where the staging tables reside. The default mechanism uses a simple row-count based throttling mechanism, but is user-extensible.

By default, the Storage Monitor uses a simple SQL statement to count the number of rows in complete transactions available in the staging tables. You can define alternate criteria with the **smSQL** property in sqagent.properties; this should be specified as an SQL statement which returns an integer number.

When the number of rows exceed a certain value (defined as **smWarningLevel**), then a warning notification is issued.

When the number of rows exceeds the **smThrottleLevel** value, another warning notification is issued and all log readers (replication workers) are paused. The log readers resume when the number of rows drop below the **smThrottleLevel** value. When the "storage monitor" has throttled staging, pruning runs at a higher frequency than usual (using the "storage monitor" interval).

The functionality is controlled by the following sqagent.properies settings:

SmSQL - a SQL statement used to monitor staging activity; it should return a single integer or bigint value. Note that the default SQL statement (used when **smSQL** is not specified) is valid only when SQDR Plus is monitoring only one journal.

Examples:

```
smSQL=SELECT SUM(ROWCOUNT) FROM SQDR.SQ_TRANSACTIONS WHERE TXID IS NOT NULL
AND TXID <= (SELECT MIN(MAXTX) FROM SQDR.SQ_READERS)
```

```
smSQL=select sum(number_row_pages) from qsys2.systablestat where table_schema='SQDR'
```

smInterval (default 0 (off)) – Frequency in minutes of when to run the storage monitor. 0 means "off".

smWarningLevel (default 450000) - Any integer value above this value will cause a notification/log message.

smThrottleLevel (default 500000) - Any integer value above this value will pause all log readers (replication workers) and cause a notification/log message.

Note that in some cases this feature may have undesirable side effects. For example, if staging is suspended because of the "storage monitor" condition, the storage used by the journal receivers will grow instead; this may be less desirable, especially if SQDR Plus is staging only a small portion of the data in the receivers. You should analyze your system and compare the amount of available storage for the library or container holding the SQDR storage tables with the amount of available store for the journal receivers to determine whether or not this feature is suitable for your environment.

Performance Suggestions

SQDR Plus for iSeries makes extensive use of journal receivers. For best performance, IBM recommends that journal receivers be located on a different disk than the journal and the tables that are being journaled. This includes both the journal receivers of user tables being replicated and those created in the schema for use by the autoJournal feature of the Capture Agent.

If overall performance is limited by the iSeries server disk performance and CPU utilization is low, it may improve performance to enable the iSeries “expert”/calculated paging option for the Base memory pool.

On an iSeries system that has limited disk space and a high rate of database transactions, you may want to decrease the interval in which SQDR Plus prunes change data from the control tables to free disk space more frequently. See “pruneInterval” on page 34 for details about changing the pruning interval.

If you are using SQDR Plus with physical files, you can take advantage of the High Availability option of OS/400 to improve performance. This feature is licensed separately from IBM and supports journal caching. To enable the journal caching of the High Availability option for the SQDR journal, issue the following command, replacing <*schema*> with the Capture Agent schema name and "SQDR" with the name of the journal to be cached.

```
CHGJRN <schema>/SQDR JRNCACHE(*YES)
```

Appendix A: OS/400 Authorities, Commands and API usage by SQDR Plus (iSeries)

The user "SQDR" uses the following Authorities and Locks:

Journal Authority

*OBJOPR and some data authority other than *EXECUTE

Journal Library Authority

*EXECUTE

Journal Lock

*SHRRD

The Journal Reader program (SQDR/JRNLREADER *SRVPGM) is owned by the user SQDRADMIN and uses *OWNER authority in order to execute the following commands:

QDBRTVFD

QjoRetrieveJournalInformation

QjoRtvJrnReceiverInformation

QjoRetrieveJournalEntries

QjoDeletePointerHandle

QJOSJRNE

QMHSNDM

QMHRTVM

ENDJRNPF

GRTOBJAUT OBJTYPE(*LIB) AUT(*CHANGE) … to SQDR user

GRTOBJAUT OBJTYPE(*FILE) AUT(*USE)) … to SQDR user

GRTOBJAUT OBJ(" + changeView.mSystemSchemaName + "/" + changeView.mSystemName + ") OBJTYPE(*FILE) REFOBJ(" + table.mSystemSchemaName + "/" + table.mSystemName + ") REFOBJTYPE(*OBJTYPE)"

Appendix B: sqagent.properties sample

The following is the contents of the template sqagent.properties file from which the installer creates sqagent.properties during the initial installation. Refer to /home/sqdr/sqagent.template to view the latest version of the template.

Items that are not commented out are properties that are configured by the installer based on user input during the installation; items that are commented (leading #) are advanced properties that can be configured by the user; the default value is displayed here.

```
# SQDR Plus for iSeries
# Capture Agent Config Properties
#
# CAPTURE AGENT PARAMETERS
#
controlDbSchema=SQDR
logLevel=INFO
port=50005
requirePublication=false
alwaysUseRowId=false
receiverLibrary=SQDR
# pollSleepTime=5000
# pruneInterval=30
# grantees=
# numControlDbConnectionsPerVm=10
# singleTrans=true
# useTxSequence=false
# clientDeleteGrace=1
# clientMonitoringInterval=1440
# filterUserId=myuser
#
# batch = use Block insert when updating staging tables
# batchsize = the number of rows in a single block insert
# batch=true
# batchSize=100
#
# Space Monitor Parameters
# smSQL=the sql used to monitor staging activity
# returns a single integer or bigint value that reflects usage.
# sminterval=frequency of monitor in minutes. 0 means "off".
# smInterval=0
# smwarning=issue a notification/log message if value returned by smSQL exceeds
this value
```

```
# smWarningLevel=450000
# smThrottleLevel pause all log readers (replication workers)
# and issue a notification/log message if value returned by smSQL exceeds this
value
# smThrottleLevel=500000
#
#
# OPERATIONAL NOTIFICATIONS PARAMETERS
#
notificationLevel=OFF
smtpServer=
to=admin@mydomain.com
from=sqdrplus@mydomain.com
30
starquestNotification=SEVERE
#
#
# CHANGE DATA LOGGING PARAMETERS
#
managedLogs=false
autoJournal=false
deleteLogsWithoutSave=true
# maxLogFileSize=512000
# maxNumLogFiles=5
#
#
# CHANGE DATA NOTIFICATION PARAMETERS
#
# broadcastAddress=192.1.1.255
# udpPort=2728
# minimumNotificationDelay=5000
```

Appendix C: Format of the SQ_STATISTICS control table

The SQDR Plus software maintains a table called SQ_STATISTICS which stores statistical data related to the operation of the software. Understanding how this data is collected and used can be helpful in evaluating the performance of the software on the host database.

The statistics in the SQ_STATISTICS table are periodic snapshots of in-memory statistics maintained by the SQDR Plus Capture Agent. These in-memory statistics are written/flushed to the SQ_STATISTICS table every two minutes.

The data contained in this table can be easily viewed in CAMAINT by choosing **Option 4 Display current statistics** or **Option 5 Display all statistics**. The statistics reflect the activity for the last 7 days, in hourly increments. Displaying the current statistics shows all of the statistics in the current hour. For example, if you check the statistics at 10:18 AM, the statistics shown are those that were captured in the last 18 minutes of activity (between 10:00AM and 10:18AM). If you would like to view statistics that were recorded before the current hour, use the **Display all statistics** option.

Active replications:

The TOTAL "Active replications" value is the number of source tables managed by a particular journal (and log reader). The journal name is indicated in parentheses. AVG and MAX values are also displayed.

Lag time:

The "Lag time" TOTAL represents in seconds the difference between the time when the source table received updates and the time when the data is moved to the staging table. If the lag time is close to zero, no significant backups have occurred during the hour. A large value indicates that the SQDR Plus log reader is lagging behind in processing changed data and may indicate that the source table received a very large number of changes in a short period of time and may be better suited for snapshot replication.

If "Lag time" MIN value is 2147483647and MAX value is –2147483648, then no statistics have been collected for the time period. If MIN/MAX have other values, those are the true MIN/MAX values collected for the time period covered by the statistic "bucket". An AVG value is also displayed.

Records processed:

The "Records processed" value is the number of records processed for the particular journal reader. This count includes records that were both committed and roll-backed and does not necessarily indicate the number of new updates that have occurred on the source table(s). If this value is lower than expected (e.g., the source tables for this journal received 100 new records in the last hourly unit of time, but the records processed value is only 10), it is reasonable to expect that this would be associated with a non-zero lag time.

Staged Rows:

The "Staged Rows" value is the aggregate number of rows left in the staging tables at the end of a pruning operation. The default behavior is for the Capture Agent to prune the staging tables every 30 minutes, so this value is typically updated twice every hour.

Prune Cycles:

The number of times pruning has run in the current hour. For default pruning settings (every 30 minutes), this value will be 0, 1, or 2.

Prune duration:

The shortest, longest and most recent pruning duration times (MIN, MAX and TOTAL values, in seconds) during the hour bucket.

Rows pruned:

The number of rows pruned in the current hour.

In addition to displaying statistics with CAMAINT, you can use an ODBC-enabled data analysis application and an ODBC driver such as StarSQL (or a JDBC application and a JDBC driver such as StarSQL for Java) to analyze the SQ_STATISTICS table.

The SQ_STATISTICS table contains the following fields:

Table 4:

COMPONENT	The qualified journal name or 'Pruner	VARCHAR
STATNAME	The type of statistic (Lag time, Records processed, Active replications, Staged Rows, Prune Cycles, Prune duration, Rows pruned). Note that these names are case-sensitive	VARCHAR
STATDATE	The date of the statistic entry	DATE
STATHOUR	The hour of the statistic entry (0-23)	INTEGER
STATTYPE	The type of the statistic (e.g., MIN, MAX, AVG, TOTAL)	VARCHAR
INTVALUE	The value of the statistic (except for AVG values)	INTEGER
DOUBLEVALUE	The value of the average (AVG) statistic.	DOUBLE

Index

N

O

P

Q

R

S

T

U

V