



# Setup and User Guide

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# 1 | Introduction

This section describes the main concepts of data replication and the major components of Attunity Replicate.

**Note** The term "endpoint" is used generically throughout this guide to refer to a data repository that can be used as a source and/or target in an Attunity Replicate task. Examples of such repositories include relational databases (such as Oracle) and files.

## In this chapter:

- [Replication Explained](#)
- [Attunity Replicate](#)
- [Limitations](#)
- [System Architecture](#)
- [Replication Tasks](#)
- [Full Load and CDC Processes](#)
- [Replication Topologies](#)

## Replication Explained

Replication is a process that keeps two or more collections of computerized information identically synchronized. It facilitates:

- » **Load reduction:** Keeping a complete or partial copy of a collection on a different server reduces the load on the main server.
- » **Improved service:** Accessing a copy of the data can provide better service to users than having them access the original data..
- » **Restricted data access:** If some users should only have access to a subset of data, replicating only part of a collection makes it easy to enforce security restrictions.
- » **Geographic distribution:** Making only a subset of data relevant to a specific node (or location) available is beneficial in widely distributed enterprises (such as a chain of retail stores or warehouses). You can still make all data available at a central location for less frequent use.
- » **Disaster Recovery:** Keeping a copy of the main data available allows for setting up rapid fail-over clusters (the capability to switch over to a redundant or standby computer server in case the main system fails).
- » **"Cloud" computing:** Replicating data allows for implementing what is commonly known as cloud computing (the on-demand storage, management, and processing of Internet-based data).

The information replicated is stored as files or in a database. In the case of files, the structure and content of a file are known only to the specialized programs that use the file. Databases are managed by database management systems (DBMS) that make use of standardized descriptions of the structure of the information (such as tables, columns, rows, and data types). These descriptions are known collectively as metadata and allow a general-purpose replicator to carry out relevant operations (for example filtering and data transformations) without the need to know anything about the contents or "meaning" of the data. Because file systems do not contain metadata, operations available for replication are more limited.

During replication, a collection of data is copied from system A to system B, where A is known as the source (for this collection) and B is known as the target. A system can be a source, a target, or both (with certain restrictions). A complex replication topology has a number of sources, targets, and data collections defined.

The replication process must account for the fact that source data may be changing while being copied. It is not possible to make or maintain copies instantaneously and to stop the source computer to "freeze" the information. Therefore, replication must account for:

- » **Integrity:** The target data must reflect the complete result of all changes made to the source data during the replication process.
- » **Consistency:** If a change affects different tables, rows, or files, the copy must reflect these changes consistently across all affected tables, rows, or files.
- » **Latency:** The replication process must aim at keeping latency at a minimum. Ideally, it should not exceed a few seconds.

## Attunity Replicate

Attunity Replicate is a simple, powerful, easy-to-implement solution that provides replication between various endpoints. Replicate lets you:

- » Load data efficiently and quickly to operational data stores/warehouses.
- » Create copies of production endpoints.
- » Distribute data across endpoints.

Replicate has high throughput, speed, and scale. It is designed to scale and support large scale enterprise data replication scenarios with a multi-server, multi-task, and multi-threaded architecture.

Replicate consists of a Web-based console and a replication server to replicate data across heterogeneous data sources. It provides users with instant visibility into current and historical exceptions, status, performance, and resource usage information.

Replicate can execute replication tasks between enterprise endpoints including Oracle, Microsoft SQL Server, and IBM DB2. It uses a "Click-2-Replicate" design that simplifies the replication process by automating the steps required to build a replication solution.

When you run a task in Replicate, you can select between:

- » Full Load Replication: Creates files or tables at the target endpoint, automatically defines the metadata that is required at the target, and populates the tables with data from the source
- » Change Processing, also called Change Data Capture (CDC): Captures changes in the source data or metadata as they occur and applies them to the target endpoint as soon as possible in near-real time
- » Replication is log based, which means that it reads only the changes. This reduces the impact on the source endpoints.

## Limitations

The following limitations apply:

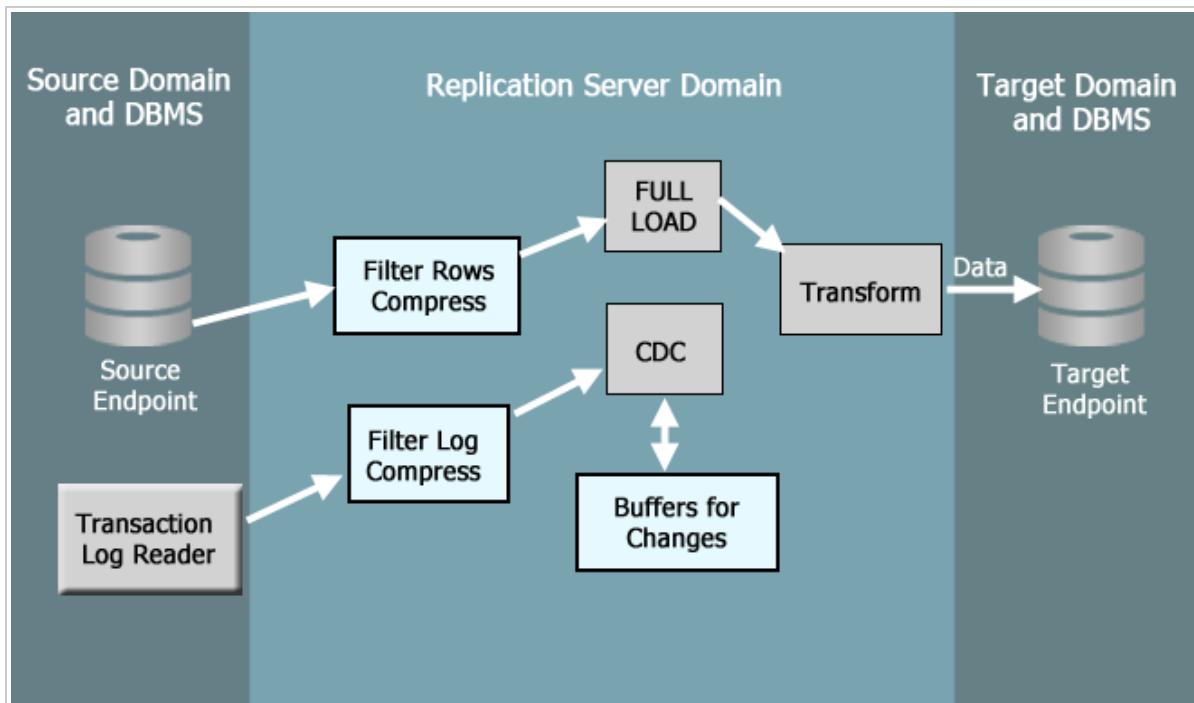
- » Replicate does not support replication of Primary Keys that are LOB data types.
- » When the [Limit LOB size to](#) option is enabled, replication of structured data LOBs (e.g. XML, JSON, IMAGE, etc.) may truncate (and thereby invalidate) the structured data in the target LOB.
- » In Batch Optimized Apply mode, if the target table has more columns than the source table, any values in the extra columns will be replaced with NULL.  
The workaround is to create two tasks. One task for the target table(s) with extra columns and the other task for the source table(s) which have the same number of columns as the target tables. Then, run the task for the target table(s) with extra columns in [Transactional Apply](#) mode and run the other task (where the target tables do not have extra columns) in [Batch Optimized Apply](#) mode. Note, however, that updating large tables in Transactional Apply mode may impact performance.
- » When Replicate creates a new table in the target endpoint, it defines only *one* index on the table. The index will either be the Primary Key or the first Unique Key (according to alphabetical order) of the table. No other indexes will be defined in the target. If additional indexes are required, these will need to be defined manually. It should be noted however that As Replicate does not support tables that have both a Primary Key and a Unique Key, only one of them should be defined.
- » LOB columns are always created as nullable on the target database. If you create the target table(s) manually, then you must set all LOB columns to nullable.
- » If you stop a task after Full Load completes, perform some changes on the source tables, and later resume the task from timestamp (by selecting the **Start processing changes from** run option), some changes may not be replicated to the target. This usually only happens if the transaction logs in the source database have been deleted due to a log purge policy. In this case, Replicate will resume the task from the last change in the current transaction log.
- » When replicating tables without a Primary Key, there is no way to verify whether a record already exists on the target.
- » Replication of calculated values is not supported during Change Processing.

- » If a task fails with a recoverable error on the target while it is starting, it will not read changes from the source.

## System Architecture

The following diagram shows the basic architecture of Attunity Replicate.

Figure 1.1 | Attunity Replicate System Architecture



In this diagram, the source data and metadata are part of the source server. The transaction log reader can be on the source server (for efficiency) or on the Attunity Replicate server (for zero footprint on the source). Filtering and compression of the source rows/logs can occur on the source or Attunity Replicate servers.

In the initial load process, Attunity Replicate reads a filtered stream of rows (with relevant columns only) and passes them to the transformation process for further filtering and subsequent writing to the target endpoint (in the expected output format).

The CDC process obtains a stream of filtered events or changes in data or metadata from the transaction log file. It then buffers all changes for a given transaction into a single unit before forwarding them to the target when the transaction commits. During the initial load process, CDC also buffers all changes that occur within a transaction until all affected tables have been loaded.

The Designer/Console server, which is part of the Replication server, is a Web-based application that serves as the user interface for dealing with designing or modifying the replication system and displaying and controlling its operation.

## Replication Tasks

Each instance of a table synchronization activity comprises a task in Attunity Replicate. You define a task using the browser-based Attunity Replicate Console. When defining a task, you specify:

- » The source and target endpoints
- » The source and target tables to be kept in sync
- » The relevant source table columns
- » The filtering conditions (if any) for each source table as Boolean predicates (in SQLite syntax) on the values of one or more source columns
- » The target table columns (optionally), including their data types and values (as expressions or functions over the values of one or more source or target columns, using SQL syntax). If not specified, Replicate uses the same column names and values as the source tables, with default mapping of the source DBMS data types onto the target DBMS data types. Replicate automatically takes care of the required filtering, transformations, and computations during the Load or CDC execution.

When a task is defined, you can activate it immediately. Replicate automatically creates and loads the target tables with the necessary metadata definitions and activates the CDC. Using the Attunity Replicate Console, you can then monitor, stop, or restart the replication process.

## Using Multiple Tasks

You can define and activate several replication tasks at once. This is best if the tasks:

- » Have different source tables
- » Share some source tables but have different filtering conditions on the source rows
- » Update different target tables

Updating the same target table and row by two different replication tasks would not be good practice and may cause unpredictable results.

The different replication tasks work independently and run concurrently. Each has its own Initial Load, CDC, and Log Reader processes.

## Full Load and CDC Processes

The full load process creates files or tables at the target endpoint, automatically defines the metadata that is required at the target, and populates the tables with data from the source. Unlike the CDC process, the full load process loads the data one entire table or file at a time, for maximum efficiency.

The source tables may be subject to update activity during the Load process. *However, there is no need to stop processing in the source.* Replicate automatically starts the CDC process as soon as the load process starts. It does not apply the changes to the target until

after the load of a table completes because the data on the target might not be consistent while the load process is active. At the conclusion of the load process, however, Replicate guarantees consistency and integrity of the target data.

If the load process is interrupted, it continues from wherever it stopped when restarted.

You can add new tables to an existing target without reloading the existing tables.

Similarly, you can add or drop columns in previously populated target tables without reloading.

The CDC process captures changes in the source data or metadata as they occur and applies them to the target endpoint as soon as possible in near real time. It captures and applies the changes as units of single committed transactions and can update several different target tables as the result of a single source commit. This guarantees transactional integrity in the target endpoint. The CDC process for any file or table starts as soon as the data load process for the file or table begins.

CDC operates by reading the recovery log file of the source endpoint management system and grouping together the entries for each transaction. The process employs techniques that ensure efficiency without seriously impacting the latency of the target data. If the CDC process cannot apply the changes to the target within a reasonable amount of time (for example when the target is not accessible), it buffers the changes on the Replication server for as long as necessary. There is no need to re-read the source DBMS logs, which may take a long time.

## Replication Topologies

Attunity Replicate supports the following topologies for replication tasks:

- » [One to One](#)
- » [Logical Independence](#)
- » [Hub and Spoke](#)

### One to One

In a one-one topology, there is one source and one target endpoint. When the source and target endpoints are distinct, Attunity Replicate guarantees transactional integrity and consistency. If you use two different replication tasks, the endpoints may switch roles, allowing two-way synchronization.

**Caution:** If the same row in a table is updated by two different replication tasks, the result of two-way synchronization may be unpredictable. A problem can occur even if two different rows are referentially related, that is if some application updates a row based on reading a value in a different row. If the rows are updated concurrently on the

source and the target, the result may be unpredictable<sup>1</sup>. Such occurrences are rare, but they can occur.

## Logical Independence

Two-way replication works best when updates of a row on a source and on a target are entirely autonomous and do not affect each other. There is an assumption that any table or a horizontal or vertical segment of a partitioned table can only be updated in one source. Attunity Replicate allows updating the same row in several places, but in this case, the columns being updated must be distinct. Another assumption is that if a data value in one row depends on or is derived from a value in another row, the values can be changed only on the same server but nowhere else (except by the Replicator). This is called logical independence. With logical independence, concurrent update conflicts cannot occur during replication.

## Hub and Spoke

Many-to-one and one-to-many relationships can be combined into a hub-and-spoke topology, which allows the merging of data into multiple targets and then distributing to other targets. It does not allow cycles or multiple paths for propagating changes. The hub-and-spoke topology is that of an acyclic directed graph.

---

<sup>1</sup>CDC has no way of knowing exactly when a row was read by an application on one system relative to its having been changed on another system. Read operations are typically not logged.

# 2 | Installing Attunity Replicate

This section describes how to prepare your system for Attunity Replicate, how to install Attunity Replicate, and how to access the Attunity Replicate Console.

**Important:** To work, Attunity Replicate needs to be set up with the proper security configuration. It is therefore strongly recommended to review [Security Considerations](#) before using the product for the first time.

## In this chapter:

[Installation Prerequisites](#)

[Attunity Replicate on Windows: Installing, Upgrading and Uninstalling](#)

[Installing Attunity Replicate on Linux](#)

## Installation Prerequisites

This section describes how to prepare your system to use Attunity Replicate. The requirements differ according to the platform on which you want to install Attunity Replicate and according to the desired Attunity Replicate UI Server configuration. For more information on the available UI Server configurations, see [Attunity Replicate UI Server Configurations](#).

- » [Software Requirements](#)
- » [Supported Endpoints](#)

## Software Requirements

This section describes what software is required to work with Attunity Replicate.

- » [Windows Software Requirements](#)
- » [Linux Software Requirements](#)

### Windows Software Requirements

To install the Attunity Replicate Server and Console on a Windows computer, you must have the following installed on your system:

- » .NET Framework 4.5.2 or above
- » Visual C++ Redistributable for Visual Studio 2015. If it is not installed or if an older version is installed, it will be installed automatically during installation.
- » TLS v1.2 needs to be fully installed and configured prior to installing Replicate on a

Windows 2016 Server.

- » For a list of supported browsers, see [Supported Browsers](#).

For a list of supported operating systems, see [Supported Platforms](#).

## Linux Software Requirements

For a list of supported Linux operating systems, see [Supported Linux Platforms](#).

## Windows Permissions

Attunity Replicate needs to be installed as an Administrator.

The following privileges are required to start the Attunity Replicate **UI Server** service (which is run as a local system service), but are dropped as soon as the service is started:

- » SE\_CREATE\_GLOBAL\_NAME
- » SE\_CREATE\_PAGEFILE\_NAME
- » SE\_CREATE\_PERMANENT\_NAME
- » SE\_CREATE\_SYMBOLIC\_LINK\_NAME
- » SE\_CREATE\_TOKEN\_NAME
- » SE\_DEBUG\_NAME
- » SE\_ENABLE\_DELEGATION\_NAME
- » SE\_IMPERSONATE\_NAME
- » SE\_INC\_BASE\_PRIORITY\_NAME
- » SE\_INCREASE\_QUOTA\_NAME
- » SE\_INC\_WORKING\_SET\_NAME
- » SE\_LOAD\_DRIVER\_NAME
- » SE\_LOCK\_MEMORY\_NAME
- » SE\_MACHINE\_ACCOUNT\_NAME
- » SE\_MANAGE\_VOLUME\_NAME
- » SE\_PROF\_SINGLE\_PROCESS\_NAME
- » SE\_RELABEL\_NAME
- » SE\_REMOTE\_SHUTDOWN\_NAME
- » SE\_RESTORE\_NAME
- » SE\_SECURITY\_NAME
- » SE\_SHUTDOWN\_NAME
- » SE\_SYNC\_AGENT\_NAME
- » SE\_SYSTEM\_ENVIRONMENT\_NAME
- » SE\_SYSTEM\_PROFILE\_NAME
- » SE\_SYSTEMTIME\_NAME
- » SE\_TAKE\_OWNERSHIP\_NAME
- » SE\_TCB\_NAME

- » SE\_TIME\_ZONE\_NAME
- » SE\_TRUSTED\_CREDMAN\_ACCESS\_NAME
- » SE\_UNDOCK\_NAME

In addition, the account that runs Replicate needs to be granted access to the **Data** directory (~\Attunity\Replicate\Data) as well as any directory containing files (such as CSV files) that need to be used in a replication task.

## Recommended Hardware Configuration

This section describes the recommended hardware configurations for using Attunity Replicate. For information on the software requirements for using Attunity Replicate, see [Software Requirements](#).

The following table describes the recommended hardware configuration for installing Attunity Replicate on Windows and Linux operating systems. Note that the recommendations apply to mid-scale systems (i.e. hundreds of tasks) rather than large-scale systems (i.e. thousands of tasks).

**Table 2.1 | Recommended Hardware Configuration**

	<b>Basic System</b>	<b>Large System</b>	<b>Extra-Large System</b>	<b>Notes:</b>
Processor	Quad core	Quad core base	8-core base	Additional cores are useful in any of the following situations: <ul style="list-style-type: none"> <li>» Many tasks running in parallel</li> <li>» Full-load performance priority</li> <li>» Multiple full-load processes running in parallel</li> </ul>
Memory	8 GB	32 GB	64 GB	More memory is useful in any of the following situations: <ul style="list-style-type: none"> <li>» Many tasks running in parallel</li> <li>» Long-running transactions on the source endpoint (for example, monthly batch processing)</li> <li>» Many active users on the source system</li> </ul>
Disk requirements	320 GB 7200 RPM	500 GB 10,000 RPM	500 GB 15,000 RPM	A faster disk is useful in any of the following situations: <ul style="list-style-type: none"> <li>» Using a file-based target, such as Greenplum or Actian Vector</li> <li>» Long-running source transactions that</li> </ul>

**Table 2.1 | Recommended Hardware Configuration (Cont.)**

Basic System	Large System	Extra-Large System	Notes:
			<p>may not fit into memory</p> <ul style="list-style-type: none"> <li>» Using tasks that are set up to continue processing during target outage</li> </ul> <p>A larger disk is required in any of the following situations:</p> <ul style="list-style-type: none"> <li>» Using tasks that are set up to continue processing during target outage</li> <li>» Very large source transactions that do not fit into memory</li> </ul> <p>RAID is recommended for system recoverability in case of disk failure for all configurations.</p>
Network	1 Gb	10 Gb	Two 10 Gb

## Supported Endpoints

To replicate data using Attunity Replicate, you must be sure to have a supported version of the endpoint you are working with available. For information about the endpoints you can use with Attunity Replicate, see [Supported Platforms and Endpoints](#).

## Attunity Replicate on Windows: Installing, Upgrading and Uninstalling

Install Attunity Replicate using the AttunityReplicate\_<version-build>\_X64.exe installation kit. This kit runs on Windows 64-bit (x64) environments. For a list of the Windows versions supported by Attunity Replicate, see [Windows Software Requirements](#).

Follow the instructions in the Setup wizard to install Attunity Replicate. Before upgrading, it is strongly recommended to back up the Replicate "Data" folder.

Later, if you need to start or stop the Attunity Replicate Server, see the following section: [Starting and Stopping the Attunity Replicate Server on Windows](#)

**Note** In the setup wizard's **Replication Server Location** screen, one of the options is **Connect to a remote Linux Attunity Replicate Server**. You should only select this option if you have already installed Attunity Replicate Server on a Linux machine. If you select this option, you will be prompted for the IP address and port number of the Linux machine in the following screen.

For more information on installing Attunity Replicate Server on Linux, see [Installing Attunity Replicate on Linux](#).

For information on the possible deployment configurations, see [Attunity Replicate UI Server Configurations](#).

All of the data that is created when you use Attunity Replicate is stored in a directory called **data**. By default, this directory is located in the installation directory where you install Attunity Replicate. If you want to create the data directory in a different location, select this option in the installation wizard.

If you elect to create the data directory in a different location, all command line actions must be prefixed with `repctl -d <path to the data directory>`

## Starting and Stopping the Attunity Replicate Server on Windows

In some cases you may need to stop and start the Attunity Replicate Server. You must do this from the Windows computer where Attunity Replicate is installed.

### To stop and start the Attunity Replicate Server on Windows

- » From the **Start** menu on the Windows computer where Attunity Replicate is installed, find **Attunity Replicate**; then select either **Stop Attunity Replicate Server** or **Start Attunity Replicate Server**.

## Silently Installing Attunity Replicate

Attunity Replicate can be installed silently (i.e. without requiring user interaction). This option is useful, for example, if you need to install Attunity Replicate on several machines throughout your organization.

**Note** Before commencing the installation, make sure that the [prerequisites have been met](#).

The installation process consists of two stages:

1. [Creating a Response File](#)
2. [Running the Silent Install](#)

## Creating a Response File

Before starting the installation, you need to create a response file.

### To create the response file

1. From the directory containing the Attunity Replicate setup file, run the following command (note that this will also install Attunity Replicate):

```
AttunityReplicate_<version-build>_X64.exe /r /f1<my_response_file>
```

where:

<my\_response\_file> is the full path to the generated response file.

#### Example:

```
AttunityReplicate_<version-build>_X64.exe /r /f1C:\Replicate_install.iss
```

2. To change the default installation directory, open the response file in a text editor and edit the *first szDir* value as necessary.
3. To change the default data directory, edit the *third szDir* value as necessary.
4. Save the file as <name>.iss, e.g. **silent\_inst\_64.iss**.

## Running the Silent Install

To silently install Attunity Replicate, open a command prompt and change the working directory to the directory containing the Attunity Replicate setup file. Then issue the following command (where <response file> is the path to the response file you created earlier):

#### Syntax:

```
<Replicate_setup_file> /s /f1<my_response_file> [/f2<LOG_FILE>]
```

#### Example:

```
C:\>AttunityReplicate_<version-build>_X64.exe /s /f1C:\temp\1\Replicate_install.iss /f2C:\temp\1\silent_x64_install.log
```

If the installation was successful, the log file should contain the following rows:

```
[ResponseResult]  
resultCode=0
```

## Silently Upgrading Attunity Replicate

Silently upgrading Attunity Replicate consists of two stages:

1. [Creating a Response File](#)
2. [Running a Silent Upgrade](#)

## Creating a Response File

Before starting the upgrade, you need to create a response file.

For instructions, see Step 1 of [Creating a Response File](#).

## Running a Silent Upgrade

Before upgrading it is strongly recommended to back up the Replicate "Data" folder. To silently upgrade Attunity Replicate, open a command prompt and change the working directory to the directory containing the Attunity Replicate setup file.

Then issue the following command (where <my\_response\_file> is the path to the response file you created earlier):

### Syntax:

```
<REPLICATE_KIT> /s /f1<my_response_file> [/f2<LOG_FILE>]
```

### Example:

```
C:\>AttunityReplicate_<version-build>_X64.exe /s /f1C:\temp\1\Replicate_
upgrade.iss /f2C:\temp\1\silent_x64_up.log
```

If the upgrade was successful, the log file should contain the following rows:

```
[ResponseResult]
resultCode=0
```

## Silently Uninstalling Attunity Replicate

Silently uninstalling Attunity Replicate consists of two stages:

1. [Creating a Response File](#)
2. [Running a Silent Uninstall](#)

### Creating a Response File

Before starting the uninstall, you need to create a response file.

#### To create the response file

1. Copy the response file text below into a text editor.

#### Response file text:

```
[{9C614355-28A0-4C2A-98DF-DB9FD674826F}-DlgOrder]
Dlg0={9C614355-28A0-4C2A-98DF-DB9FD674826F}-SdWelcomeMaint-0
Count=3
Dlg1={9C614355-28A0-4C2A-98DF-DB9FD674826F}-MessageBox-0
Dlg2={9C614355-28A0-4C2A-98DF-DB9FD674826F}-SdFinish-0
[{9C614355-28A0-4C2A-98DF-DB9FD674826F}-SdWelcomeMaint-0]
Result=303
[{9C614355-28A0-4C2A-98DF-DB9FD674826F}-MessageBox-0]
Result=6
[{9C614355-28A0-4C2A-98DF-DB9FD674826F}-SdFinish-0]
Result=1
bOpt1=0
```

bOpt2=0

2. Save the file as <name>.iss, e.g. **silent\_uninst\_64.iss**.

## Running a Silent Uninstall

To silently uninstall Attunity Replicate, open a command prompt and issue the following command (where *RESPONSE\_FILE* is the path to the response file you [created earlier](#) and *LOG\_FILE* is the path to the uninstall log file):

### Syntax:

```
"C:\Program Files (x86)\InstallShield Installation Information\<directoryContaining_setup_file>\setup.exe" /s /f1RESPONSE_FILE /f2LOG_FILE
```

**Note** The directory containing the Replicate setup file always ends with the following string: DB9FD674826F

### Example:

```
C:>"C:\Program Files (x86)\InstallShield Installation Information\{9C614355-28A0-4C2A-98DF-DB9FD674826F}\setup.exe" /s  
/f1C:\temp\response.iss /f2C:\temp\1\silent_uninstall.log
```

If the uninstall was successful, the log file should contain the following rows:

```
[ResponseResult]  
resultCode=0
```

## Changing the Data Directory Location on Windows

This section explains how to change the location of the Attunity Replicate Data Directory. Such a procedure may need to be performed if the drive on which the current directory resides has insufficient space or if you are moving from a temporary POC setup to production, for example.

### To change the location of the data directory

1. Stop the Attunity Replicate **UI Server** and Attunity Replicate **Server** services.
2. Move the data directory to a new location. For example:

C:\Program Files\Attunity\Replicate\\*\*Data2\*\*

3. Open the Registry and perform the following procedure:
  - a. Browse to:  
HKEY\_LOCAL\_MACHINE\SYSTEM\CurrentControlSet\services\AttunityReplicateConsole
  - b. Modify the **ImagePath** string as follows:

- "C:\Program Files\Attunity\Replicate\bin\RepUiCtl.exe" -d "C:\Program Files\Attunity\Replicate\\*\*Data2\*\*" service run
- c. Browse to:  
HKEY\_LOCAL\_MACHINE\SYSTEM\CurrentControlSet\services\AttunityReplicateServer
  - d. Open the **ImagePath** string and add **-d <path\_for\_new\_data\_directory>** after the repctl.exe path. For example:  
"C:\Program Files\Attunity\Replicate\bin\repctl.exe" -d "C:\Program Files\Attunity\Replicate\\*\*Data2\*\*" service start name=Server address=127.0.0.1 port=3552
4. Start the Attunity Replicate services.

# Installing Attunity Replicate on Linux

This section describes how to install Attunity Replicate on Linux.

For information on supported Linux platforms, see [Supported Linux Platforms](#).

**Note** For all command line operations involving files such as `arep_login.sh`, only the bash shell is supported.

This section contains the following topics:

- » [Linux Replicate Instances and Services](#)
- » [Installation Procedures](#)
- » [Attunity Replicate Server Procedures](#)
- » [Upgrading Attunity Replicate](#)
- » [Uninstalling Attunity Replicate](#)
- » [Working with Additional Replicate Instances](#)
- » [Changing the Data Directory Location on Linux](#)

**Note** The commands for installing, upgrading and uninstalling Attunity Replicate must be run as root or using the sudo command.

All of the commands and examples in this section assume that Attunity Replicate is being installed/upgraded/uninstalled as root.

## Linux Replicate Instances and Services

Replicate supports running multiple instances concurrently on the same Linux server with a single installation. This may be useful, for instance, if you need to run several tasks or groups of tasks, but with different Replicate server settings for each group or task.

Instances can be installed as Linux services, which means that the instance will be stopped in an orderly fashion when a server is shut down and restarted when a server is rebooted. Installing Replicate creates an initial instance, named areplicate, which is installed as a service.

Additional instances can be created after Replicate is installed. An additional instance will *not* be installed as a service if installed by a non-root user. A new instance will not be run when it is created, allowing for configuration first.

Replicate instances get their environment from several files:

<code>arep_login.sh</code>	Sets shell variables, e.g. <code>LD_LIBRARY_PATH</code> for all instances. This file should not be modified manually.
<code>site_arep_login.sh</code>	Created functionally null; can be modified manually to contain shell settings for all instances.
<code>instancename_arep_login.sh</code>	Created functionally null in the instance's data directory, for an instance-specific shell configuration.

Each instance has a unique name, uses its own ports, and has its own **data** directory. This means that when running commands such as `repctl`, you need to specify the instance-specific **data** directory in the command line so that the correct instance is affected.

### Notes

- » When starting and stopping an instance, it is strongly suggested to use the instance script rather than run `repctl` directly.
- » All instances are run as the same user. Instances are listed in a file named **services\_list.txt** in the Replicate root directory. This file should not be modified manually.
- » When upgrading Replicate, all instances will be reinstalled and started, even if they were not running prior to the upgrade.

## Installation Procedures

Before performing the following procedures, run the following command to untar the Attunity Replicate RPM:

```
tar xf AttunityReplicate_version_buildnum_Linux_X64.tar.gz
```

Then, copy the Attunity Replicate RPM file to any location on the Linux computer.

The default installation directory for Attunity Replicate is: **/opt/attunity/replicate**

You can choose to install to a different directory as described below.

**Note** When installing or upgrading Replicate on SUSE Linux, the `--nodeps` parameter must be added to the command, as in the following example:

```
rpm -ivh --nodeps ...
```

### To install Attunity Replicate:

Run the following command:

```
[user=user] [group=group] [verbose=true|debug=true] [nocredentials=true]  
[data=replicate_data_directory] rpm -i[vh] [--prefix dirname] areplicate-  
<version-build>.x86_64.rpm [--nodeps]
```

### Example:

```
user=mike group=sales verbose=true rpm -i[vh] --prefix /opt/mydir/  
areplicate-6.2.0-102.x86_64.rpm
```

For description of the optional parameters, see the [Optional Command Parameters](#) table below.

**Table 2.2 | Optional Command Parameters**

Parameter	Description
[user= <i>user</i> ]	The default user under which Attunity Replicate is installed is <b>attunity</b> . You can choose to install the product under a different user by adding the prefix <i>user=user</i> to the command.  See also the [nocredentials=true] parameter below.
[pass= <i>password</i> ]	Sets the server password.  Users will be prompted for this password when connecting to the Replicate server through the Replicate Web Console.  You can either set this password when installing Replicate (recommended) or you can set it later as described in <a href="#">Changing the Server Password</a> .
[group= <i>group</i> ]	The default group under which Attunity Replicate is installed is attunity. You can choose to install the product under a different group by adding the prefix <i>group=group</i> to the command.  See also the [nocredentials=true] parameter below.
[nocredentials=true]	If the specified user or group is not defined locally (namely, in Active Directory), you must include this parameter in the command. Otherwise, the installation will fail.
[data= <i>replicate_data_directory</i> ]	The default Attunity Replicate "data" directory is: <product_dir>/data.  Use this parameter for installing the Replicate <b>data</b> directory in a non-default location.
[--prefix <i>dirname</i> ]	Prefixes the <b>attunity/replicate</b> application directory with the path specified by <i>dirname</i> . So, for example, if --prefix /opt/mydir, then Replicate will be installed to:  <b>/opt/mydir/attunity/replicate</b>  This is only required when installing Attunity Replicate to a non-default path.
[verbose=true debug=true]	Specify verbose=true for additional information during the installation, or debug=true for detailed debug messages during the installation.
[--nodeps]	This parameter is only required when installing Replicate on SUSE Linux.

The installation procedure will perform the following actions:

1. Create a new user and group named **attunity** (unless you chose to use a different user and a group and/or a user named **attunity** already exists).
2. Change the Attunity Replicate installation directory owner to the **attunity** user and group, or to your preferred user and group.
3. Install the application files.
4. Start the service (areplicate).

**Note** The Attunity Replicate/lib directory *must* precede the /usr/lib64 directory in the LD\_LIBRARY\_PATH environment variable.

The environment variable is set in the <product\_dir>/bin/arep\_login.sh file.

**Example:**

```
export LD_LIBRARY_PATH=/opt/attunity/replicate/lib:/usr/lib64
```

Additional changes to *LD\_LIBRARY\_PATH* in the files **site\_arep\_login.sh** and/or **instancename\_arep\_login.sh** should be made with caution.

## Attunity Replicate Server Procedures

This section describes how to start and stop an Attunity Replicate instance, and how to determine whether an instance is running.

### Verifying that an Attunity Replicate Instance is Running

To verify that an Attunity Replicate instance is running, run the following command:

```
/opt/attunity/replicate/bin/instancename status
```

**Example:**

```
/opt/attunity/replicate/bin/areplicate status
```

The output will be similar to the following:

```
running: /opt/attunity/replicate/bin/repctl -d /opt/attunity/replicate/data
service start port=3550 rest_port=3552
```

### Starting and Stopping an Attunity Replicate Instance

#### To start an Attunity Replicate instance:

Run the following command (shown using the default installation path):

```
/opt/attunity/replicate/bin/instancename start
```

**Example:**

```
/opt/attunity/replicate/bin/areplicate start
```

### To stop an Attunity Replicate instance:

Run the following command (shown using the default installation path):

```
/opt/attunity/replicate/bin/instancename stop
```

#### Example:

```
/opt/attunity/replicate/bin/areplicate stop
```

## Upgrading Attunity Replicate

This section explains how to upgrade an installation of Attunity Replicate. Before upgrading it is strongly recommended to back up the Replicate **data** directory or directories (when multiple instances are installed).

**Note** If the new configuration file **repctl.cfg** is different than the existing configuration file, and the existing configuration file has been modified, the following warning will be displayed during the upgrade:

```
/opt/attunity/replicate/bin/repctl.cfg will be created as  
/opt/attunity/replicate/bin/repctl.cfg.rpmnew
```

For additional information and instructions on merging the two files, see [Resolving Configuration File Conflicts](#).

**Note** Upgrading Replicate on SUSE Linux requires adding the **--nodeps** parameter to the command, as in the following example:

```
rpm -Uvh --nodeps areplicate-6.2.0-102.x86_64.rpm
```

### To upgrade Attunity Replicate

» Run the following command:

```
[user=username] [group=groupname] [nocredentials=true]  
[verbose=true|debug=true] rpm -Uvh [--prefix dirname] areplicate-  
<version-build>.x86_64.rpm
```

where **[--prefix dirname]** is only required when Attunity Replicate is installed in a non-default directory.

For additional information on the available command parameters see the table [Optional Command Parameters](#).

**Note** When upgrading from a version prior to Replicate 6.1 where the **data** directory is in a non-default location, you need to add the following parameter to the upgrade command:

*data=existing-data-directory*

**Example (when Replicate is installed in the default installation directory):**

```
data=/opt/mydatadir/ rpm -Uvh arePLICATE-6.2.0-102.x86_64.rpm
```

**Note** As in the initial installation, if the new or existing user and/or group is not defined locally (namely, in Active Directory), you must include the `nocredentials=true` parameter in the command. Otherwise, the upgrade will fail.

**Note** When upgrading Replicate, all instances will be reinstalled and started, even if they were not running prior to the upgrade.

## Resolving Configuration File Conflicts

During an upgrade, if the new version's **repctl.cfg** file contains different parameters than the existing file, and the existing file has been modified, you need to manually merge the new configuration file with the existing one.

In such a scenario the upgrade process will:

- » Rename the file from the new version.

The file will be renamed **repctl.cfg.rpmnew** and installed in **<product\_dir>/replicate/bin/** (the same directory as the **repctl.cfg** file).

- » Issue the following warning (assumes the default installation path):

```
[root@bldlinux-rh62 tmp]# rpm -Uvh arePLICATE-version-build.x86_64.rpm
```

```
Preparing... ##### [100%]
1:arePLICATE warning:
/opt/attunity/replicate/bin/repctl.cfg created as
/opt/attunity/replicate/bin/repctl.cfg.rpmnew
##### [100%]
```

**Note** When the configuration files need to be merged, you need to restart each instance manually after merging the files.

## To complete the upgrade

1. Manually (and cautiously) merge the new parameters in the **repctl.cfg.rpmnew** file with the existing parameters in the **repctl.cfg** file. Save the **repctl.cfg** file.
2. Delete the **repctl.cfg.rpmnew** file by issuing the following command:

- ```
rm -f <product_dir>/bin/repctl.cfg.rpmnew
```
3. Restart each instance by running the following commands in the **<product\_dir>/replicate/bin** directory:
- ```
./instancename start
```

**Example:**

```
./areplicate start
```

## Uninstalling Attunity Replicate

To uninstall Attunity Replicate, run the following command:

```
[verbose=true|debug=true] rpm -e areplicate
```

To ensure that Attunity Replicate was removed from the computer, run the following command:

```
rpm -q areplicate
```

The output should be:

```
Package areplicate is not installed.
```

**Note** Uninstalling Replicate will not delete a Replicate instance's **data** directory, the **services\_list.txt** file, or any other modified files.

## Working with Additional Replicate Instances

Replicate supports running multiple instances concurrently on the same Linux server with a single installation.

For an overview of multiple instance support, see [Linux Replicate Instances and Services](#)

**In this section:**

- » [Installing an Instance of Replicate as a Service](#)
- » [Uninstalling an Instance of a Replicate Service](#)

## Installing an Instance of Replicate as a Service

To install a new instance, run the following command in the Replicate bin directory.

```
[pass=server_password] [iport=i_port_number] [rport=rest_port_number]  
data=data-directory ./arep.sh install instancename
```

Running the script will:

- » Verify that the specified service name, port numbers, and data directory are not already in use

**Note** Reinstalling an instance immediately after it was stopped and uninstalled may require you to wait a few minutes until TCP releases the port(s).

- » Create a configured copy of itself, named *instancename*
- » Add an *instancename* record to the list of services in the file `services_list.txt`
- » Create a functionally empty instance-specific *instancename\_arep\_login.sh* file in the data directory, for instance-specific settings
- » If run as root, running the script will:
  - » Create start/stop links for run levels as specified in the script (`chkconfig`)
  - » Create a symbolic link to **/etc/init.d/instancename** in the Replicate bin directory (same name)
- » If a server password is specified, the script will run **repctl** to set the admin UI server password

## Uninstalling an Instance of a Replicate Service

To uninstall an instance of Replicate, run the following command in the Replicate bin directory:

```
./instancename uninstall
```

### Notes

- » Uninstalling an instance will stop the instance's processes, but leave the instance's **data** directory in place.
- » The script will not allow a non-root user to uninstall a service that was installed by root.

## Changing the Data Directory Location on Linux

This section explains how to change the location of an Attunity Replicate instance's Data Directory. Such a procedure may need to be performed if the drive on which the current

directory resides has insufficient space or if you are moving from a temporary POC setup to production, for example.

### To change the Data Directory Location

1. Uninstall the areplicate service by running the following command:

```
<product_dir>/bin/instancename uninstall
```

#### Example:

```
<product_dir>/bin/areplicate uninstall
```

2. Confirm that the instance is *not* running by running the following command:

```
ps -ef | grep repctl
```

3. Move the data directory from its current location (e.g. <product\_dir>/data) to your requested location.

4. Reinstall the service, specifying the new location for the data directory:

```
data=data_dir iport=portnum rport=portnum <product_dir>/bin/arep.sh  
install instancename
```

5. Start the instance by running the following command:

```
<product_dir>/bin/instancename start
```

#### Example:

```
<product_dir>/bin/areplicate start
```

6. Confirm that the service is running by running the following command:

```
<product_dir>/bin/instancename status
```

# 3 | Security Considerations

Attunity Replicate is tasked with replicating data within an organization, a task which involves reading from source endpoints (such as databases) and writing to target endpoints (including databases, files, and queuing systems).

This section provides important information for protecting the data that Attunity Replicate stores and replicates.

## In this chapter:

- [Securing Access to the Attunity Replicate Web UI](#)
- [Setting Up Replicate Console HTTPS Support](#)
- [Setting Up Attunity Replicate Server HTTPS Support](#)
- [Changing the Server Password](#)
- [Protecting Replicate Passwords](#)
- [Encrypting the User Permissions File](#)
- [Securing Connections to Endpoints](#)
- [Application Security](#)

## Securing Access to the Attunity Replicate Web UI

Attunity Replicate offers the following Web UI configurations:

- » A Windows-based Attunity Replicate UI Server service which offers granular user authorization based on a user's Active Directory identity and group membership. This service provides user interface functionality and communicates with the backend Attunity Replicate Server (on Windows or Linux).  
Connecting to this server is done using HTTPS with Windows Authentication.
- » The Attunity Replicate Server on Windows or Linux can also serve the Web UI directly, but supports just a single user with a fixed role of administrator ('admin').  
Connecting to this server is done using HTTPS with Basic Authentication.

See also [Configuration 3: Replicate UI Console and Replicate Server Running on Linux](#).

In line with current industry security standards, the Attunity Replicate web user interface enforces the use of HTTPS to protect against eavesdropping and data leakage. Using HTTPS requires a valid server certificate to be installed on the Attunity Replicate server machine.

## Setting Up Replicate Console HTTPS Support

Industry-standard security practices dictate that web user interface for enterprise products must use secure HTTP (HTTPS). Attunity Replicate enforces the use of HTTPS and will not work if HTTPS is configured incorrectly.

As Attunity Replicate uses the built-in HTTPS support in Windows, it relies on the proper setup of the Windows machine it runs on to offer HTTPS access. In most organizations, the IT security group is responsible for generating and installing the SSL server certificates required to offer HTTPS. It is strongly recommended that the machine on which Replicate is installed already has a valid SSL server certificate installed and bound to the default HTTPS port (443).

## Checking if an SSL Certificate is Installed

To check whether an SSL certificate is installed, you can use the following command:

```
netsh http show sslcert | findstr /c:"443 "
```

If an SSL certificate is installed, the output should look like this:

```
netsh http show sslcert | findstr /c:"443 "
IP:port : 192.168.1.13:443
IP:port : 192.168.1.11:443
IP:port : [fe80::285d:599c:4a55:1092%11]:443
IP:port : [fe80::3d0e:fb1c:f6c3:bc52%23]:443
```

With a valid SSL certificate installed, the Attunity Replicate web user interface will automatically be available for secure access from a web browser using the following URL:

<https://<machine-name>/attunityreplicate>

## Using the Self-Signed Certificate

Due to the way the HTTPS protocol works, there is no way for Attunity Replicate to automatically provide and install a valid SSL server certificate. Still, in the event that no SSL server certificate is installed, Attunity Replicate automatically generates and installs a self-signed SSL server certificate (as a temporary measure). This certificate is generated on the Replicate machine and cannot be exported or used elsewhere.

It should be noted that browsers do not consider the certificate to be valid because it was not signed by a trusted certificate authority (CA).

When connecting with a browser to a server that uses a self-signed certificate, a warning page is shown informing you that the connection is not secure or similar (depending on the browser).

The warning page informs you that the certificate was signed by an unknown certificate authority. All browsers display a similar page when presented with a self-signed certificate. If you know that the self-signed certificate is from a trusted organization, then you can instruct the browser to trust the certificate and allow the connection. Instructions

on how to trust the certificate vary between browsers and even between different versions of the same browser. If necessary, refer to the help for your specific browser.

**Note** Some corporate security policies prohibit the use of self-signed certificates. In such cases, it is incumbent upon the IT Security department to provide and install the appropriate SSL server certificate (as is the practice with other Windows products such as IIS and SharePoint). If a self-signed certificate was installed and needs to be removed, then the following command can be used:

```
$ netsh http delete sslcert ipport=192.168.1.13:443
```

where `ipport` should be replaced with the `ip:port` combination generated by the `netsh` command shown in [Checking if an SSL Certificate is Installed](#).

## Setting Up Attunity Replicate Server HTTPS Support

The Attunity Replicate Server which runs on both Windows and Linux uses the OpenSSL HTTPS implementation. The Attunity Replicate Server automatically generates a self-signed certificate server but it allows you to replace it with a server certificate signed by a trusted certificate authority.

### Replacing the Self-Signed SSL Certificates on Linux

When Attunity Replicate Server starts for the first time, it checks the `<product-dir>/ssl/data` directory for the presence of certificates. If the `ssl` folder is not found, it will then check the `<product-dir>/<data-directory>/ssl/data` directory (or directories when [running multiple Linux instances](#)) for the certificates.

If there are no certificates, it will create the following self-signed certificates:

- » **agent-ca.pem** - The CA certificate
- » **agent-certificate.pem** - The public certificate
- » **agent-private-key.pem** - The private key data
- » **agent-private-key-passphrase.dat** - The private key passphrase

**Note** When working with multiple instances, instead of creating a separate set of certificates for each instance in `<product-dir>/<data-directory>/ssl/data`, you can create a single set of certificates in `<product-dir>/ssl/data`. This way, instead of managing multiple sets of certificates for each instance, you only need to create/manage a single set of certificates.

You can replace the default self-signed certificates with your own, as follows:

1. Stop the Attunity Replicate Server service.
2. Create the required certificates using names that are identical to the certificates listed above.
3. Copy the certificates to the **ssl/data** directory (**<product-dir>/<data-directory>/ssl/data** by default).
4. Edit the **agent-private-key-passphrase.dat** file as follows:

```
/clear:PRIVATE_KEY_PASSWORD
```

**Example:**

```
/clear:12345
```

When Attunity Replicate Server starts it will scramble the private key passphrase as shown in [Examples of the Scrambled Private Key Password](#).

5. Start the Attunity Replicate Server service.

For information on stopping and starting Attunity Replicate Server, see [Attunity Replicate on Windows: Installing, Upgrading and Uninstalling](#) and [Installing Attunity Replicate on Linux](#).

## Examples of the Scrambled Private Key Password

The scrambled private key passphrase stored in the **agent-private-key-passphrase.dat** file will look similar to this:

```
{S:DEA326D0DF190430975DE44CFBD6FDFD21883C10E7651081B3B5A0A7404BB97DB520876F  
60390B51300C831C82DE871CF8BA22393D8DD9B359DD5A93C5956710AD2546E188155482452  
235C5D91B430D151E3DDA7381CA3E}
```

## Replacing the Self-Signed Certificate on Windows

The instructions below are intended for organizations who wish to replace the self-signed certificate generated by the Replicate UI Server on Windows with their own certificate. This is achieved by removing the self-signed certificate and then importing the new certificate.

See also [Setting Up Replicate Console HTTPS Support](#).

Before starting, make sure that the following prerequisites have been met:

- » The replacement certificate must be a correctly configured SSL PFX file containing both the private key and the certificate.
- » The common name field in the certificate must match the name browsers will use to access the machine.

### To remove the self-signed certificate created by Attunity Replicate:

1. Stop the Attunity Replicate Server and Attunity Replicate UI Server services.
2. Open a command prompt (using the "Run as administrator" option) and change the path to the Replicate **bin** directory. The default path is:  
`C:\Program Files\Attunity\Replicate\bin.`

3. Run the following command:

```
RepUiCtl.exe certificate clean
```

**To import your own certificate:**

1. Run mmc.exe to open the Microsoft Management Console.
2. From the **File** menu, select **Add/Remove Snap-in**.  
The **Add or Remove Snap-ins** dialog box opens.
3. In the left pane, double-click **Certificates**.  
The **Certificates snap-in** wizard opens.
4. Select **Computer account** and then click **Next**.
5. In the **Select Computer** screen, make sure that **Local computer** is selected and then click **Finish**.
6. Click **OK** to close the **Add or Remove Snap-ins** dialog box.
7. In the left pane, expand the **Certificates** folder. Then, right-click the **Personal** folder and select **All Tasks>Import**.
8. In the **File to Import** screen, select your PFX certificate file. Note that by default the **Open** dialog box displays CER files. In order to see your PFX files, you need to select **Personal Information Exchange** from the drop-down list in the bottom right of the dialog box.
9. Click **Next** and enter the private key password.
10. Continue clicking **Next** until you reach the **Completing the Certificate Import Wizard** screen. Then click **Finish** to exit the wizard.
11. In the **Personal> Certificates** folder, double-click the newly imported certificate.  
The **Certificate** dialog box opens.
12. Scroll down the **Details** tab until you see the **Thumbprint** details and copy them to the clipboard.
13. Open a command prompt and run the following commands:

**Syntax:**

```
$ netsh http add sslcert ipport=0.0.0.0:443 certhash=[YOUR_CERTIFICATE_THUMBPRINT_WITHOUT_SPACES] appid={4dc3e181-e14b-4a21-b022-59fc669b0914}
```

**Example:**

```
netsh http add sslcert ipport=0.0.0.0:443
certhash=5f6eccba751a75120cd0117389248ef3ca716e61 appid={4dc3e181-e14b-4a21-b022-59fc669b0914}
```

**Syntax:**

```
$ netsh http add sslcert ipport=[::]:443 certhash=[YOUR_CERTIFICATE_THUMBPRINT_WITHOUT_SPACES] appid={4dc3e181-e14b-4a21-b022-59fc669b0914}
```

**Example:**

```
netsh http add sslcert ipport=[::]:443
certhash=5f6eccba751a75120cd0117389248ef3ca716e61 appid={4dc3e181-e14b-4a21-b022-59fc669b0914}
```

14. Close the command prompt and Microsoft Management Console.
15. Start the Attunity Replicate Server and Attunity Replicate UI Server services.

## Changing the Server Password

The Attunity Replicate Server has a fixed 'admin' user with an automatically generated random password that is stored in the mk.dat file. Although the password is unknown, it is unique and safe. The Attunity Replicate UI Server service always connects to the Attunity Replicate Server service using the 'admin' user. When both services run on the same machine the admin password is accessible to both servers, so there is no need to specify this password explicitly.

When Attunity Replicate Server runs on a different machine or when a remote Attunity Replicate client needs to communicate with a remote Attunity Replicate Server, the server password must be known to both sides.

The following sections explain how to change the replication server password so that it can be provided remotely.

**Note** When running multiple Replicate Linux instances, this procedure needs to be repeated for each instance (as each instance has its own **data** directory).

For information on installing multiple Replicate Linux instances, see [Linux Replicate Instances and Services](#).

### To change the server password:

1. To set the password by using a script, use the following command:

```
repctl [-d data-directory] SETSERVERPASSWORD new_password
```

where *data-directory* is the name of the Replicate data directory (by default: **data**).

**Note** You only need to include `-d data-directory` in the command if you changed the default name of the data directory (or when installing multiple Replicate Linux instances).

2. To set the password interactively:

- a. Run the following command:

```
repctl [-d data-directory]
```

- b. Press [Enter] and then type the following:

```
SETSERVERPASSWORD new_password
```

- c. Press [Enter] again to set the password.

3. Restart the Attunity Replicate services (Windows) or the Attunity Replicate instance (Linux).

**Note** When the Attunity Replicate .NET UI Server is running on one machine and the Attunity Replicate Server is running on another, the Attunity Replicate Server password must be the same on both machines. The password is used during the SSL handshake to establish a secure connection between the participating machines.

## Protecting Replicate Passwords

Replicate stores secrets (e.g. passwords and keys) in its internal repository, enabling it to perform secure operations during runtime, such as connecting to an endpoint, connecting to a web server, connecting to an email server, connecting to a remote file transfer server, and so on.

As a rule, all UI values displayed as asterisks are stored encrypted and never transmitted or exposed by the API. For instance, when exporting task definitions, all passwords are encrypted and can only be decrypted if the source machine's **mk.dat** file - and possibly also the account or machine identity (on Windows) - is copied to the target machine. See also [Master Key Considerations when Exporting and Importing Tasks](#).

Secrets that appear in Replicate settings are stored in an encrypted form with the following properties:

- » The secret is encrypted using the AES-256 encryption algorithm.
- » The encryption key, also known as the 'master key', is a 256-bit key that is stored (and protected as described later) in the master key file (**mk.dat**).
- » The encryption process uses a salt that depends on the name and type (or 'context') of the protected entity. This prevents reuse attacks.
- » The encryption process uses a nonce so that the same secret is always encrypted differently. This prevents dictionary attacks.

When exported to a JSON file, secrets appear in the following format:

```
"{Zxxxxxxxxxxxxxxxxxxxxxx}"
```

Where:

- » 'Z' is a fixed character
- » 'x' a protection method indicator
- » 'hhhhhh...' is a hexadecimal representation of the encrypted secret

Upon import, if a secret is provided in clear text (i.e. not in the format shown above), it is automatically encrypted and stored in the protected format.

The master key used in encrypting secrets is stored in the master key file (**mk.dat**) described below.

## The Master Key File

The master key file is a binary file that stores the root secrets of Replicate. These root secrets currently include:

- » The AES 256-bit master key, which is used for encrypting passwords and other secrets in Replicate settings.
- » The server admin password, which is used (by the UI server) to access the replication server remotely.

**Note** When running multiple Replicate Linux instances, you need to enter the server admin password for each instance. For details, see [Installing an Instance of Replicate as a Service](#).

- » The default location for the master key file is the product data folder - by default **<product-dir>/data** - or data directories when [multiple instances of Replicate](#) are installed on Linux. If the server admin password does not exist, it is automatically created with randomly generated passwords that are safe but unknown. The user can change the server admin password as well as the master key to known values, if needed (e.g to connect to the replication server remotely).

For more information, see [Changing the Server Password](#).

When Replicate is set to run on a cluster using the same settings and storage, the **mk.dat** file should also be the same (or shared). Similarly, if the Replicate settings are exported in order to be moved to a different machine, the **mk.dat** file should also be moved in order to avoid the need to reenter all secrets.

The procedure for changing the master key as well as measures that can be taken to protect the file containing the master key are described below in [Changing and Protecting the Master Key](#).

## Changing and Protecting the Master Key

This section describes how to change the master key as well as how to prevent unauthorized access to the master key file.

### Changing the Master Key Replacement

The master key is originally a randomly generated 256-bit key. It can be changed as described below immediately after installation with no consequences. However, if you change the master key *after* endpoints or tasks are already configured, all stored secrets will no longer be valid (as they were encrypted using the old key). Therefore, after changing the master key, you need to reenter the passwords in all the relevant places.

**Note** When running multiple Replicate Linux instances, this procedure needs to be repeated for each instance (as each instance has its own **data** directory).

For information on multiple Replicate Linux instances, see [Linux Replicate Instances and Services](#).

### To change the Master Key

1. Stop any running tasks.
2. Stop the Replicate services or **instance(s)** on Linux.
3. Open a command prompt as an administrator/root.
4. Change the working directory to the product "bin" directory and then run the following command (on Linux run `./repctl ...`):  
`repctl [-d data-directory] setmasterkey your_new_master_key [master_key_scope=scope]`  
where `data-directory` is the name of the Replicate data directory (by default: **data**).

**Note** You only need to include `-d data-directory` in the command if you changed the default name of the data directory (or when installing multiple Replicate Linux instances).

**Note** In order not to have the key appear in the shell history, you can use the command interface (on Linux run `./repctl`):

```
repctl {enter}  
setmasterkey your_new_master_key [master_key_scope=scope] {enter}  
quit {enter}
```

See [Protecting the Master Key File from Misuse](#) for the `master_key_scope` options.

**Example:**

```
repctl -d opt/mydatadir setmasterkey 78543043vuiyfyrf64454555jy65  
master_key_scope=1
```

5. Start the Attunity Replicate Server or **instance(s)** on Linux.
6. Reenter the access passwords in all endpoints.
7. Start the tasks.

### Protecting the Master Key File from Misuse

Access to the **mk.dat** file is restricted to administrators (Windows) or to the users in the group under which the product was installed (Linux). Care should be taken to maintain this file protection.

The **mk.dat** file is always encrypted by some built-in, fixed key. On Windows, there are two additional options for preventing unauthorized access and use of the **mk.dat** file. These are as follows:

- » Tying the **mk.dat** to the Machine Profile - With this option, the **mk.dat** file can only be used on the Windows machine where it was created. Using the file from a different machine will generate an error. This option is not appropriate for clusters that share the **mk.dat** file as only one machine will be able to read it.
- » Tying the **mk.dat** to a User Profile - With this option, the **mk.dat** file can only be used under the identity that was used while creating it (typically the user that installed the product). For this option to work, the Replicate services must be modified to run under the same user. If the user has a roaming profile, then the **mk.dat** file can be used on multiple machines (e.g. in a cluster).

These options are specified in the `master_key_scope` option of the `setmasterkey` command. They should be set at the same time that the master key is set since any such change invalidates the stored passwords.

The master key scopes are:

- » 1 (Constant) - The default. The **mk.dat** file can be used wherever it is copied to.
- » 2 (User) - The **mk.dat** file can only be used under the same account as the one that was used when creating it.
- » 3 (Machine) - The **mk.dat** file can only be used on the same machine where it was created.

## Master Key Considerations when Exporting and Importing Tasks

To be able to export tasks from one machine and then import them to another, the same master key must exist on both machines. Meaning that if you change the master key on one machine, you must also change it on the other machine (using the procedure described above).

**Note** Replicate enforces strict access restrictions to the **mk.dat** file. Consequently, in order to export a task, you will also need to open the command prompt as an administrator (on Windows) or the product account (Linux).

For more information on importing and exporting Replicate tasks, see [Exporting Tasks](#).

## Encrypting the User Permissions File

User permissions are stored in the following repository file:

`<product_dir>\Data\GlobalRepo.sqlite`

To prevent unauthorized access of this file, you can encrypt it using the procedure described below. After you perform the procedure, the repository file will be encrypted with the AES-256 bit cipher.

**Note** The length of any passwords specified during the procedure must be at least 32 characters.

### To encrypt the repository file:

1. Open a command prompt as administrator and change the working directory to:

```
<product_dir>\bin
```

2. Run the following command to set the master user key:

```
repuictl.exe masterukey set --password your_MasterUserPassword
```

Example:

```
repuictl.exe masterukey set --password ANqaGYERP3UKmGLK6UNuMqrkAGxwH8FM
```

3. Restart the Attunity Replicate Server service.

4. Run the following command to set the repository password:

```
repuictl repository setpassword --master-user-password your_MasterUserPassword --repository-password your_RepositoryPassword
```

Example:

```
repuictl repository setpassword --master-user-password ANqaGYERP3UKmGLK6UNuMqrkAGxwH8FM --repository-password 12345678901234567890123456789000
```

**Note** Steps 1-4 only need to be performed the first time you want to encrypt the repository file. If you subsequently need to decrypt the repository file and then re-encrypt it, they are not required.

5. Run the following command to encrypt the repository:

```
repuictl.exe repository secure --on --master-user-password your_MasterUserPassword
```

Example:

```
repuictl.exe repository secure --on --master-user-password ANqaGYERP3UKmGLK6UNuMqrkAGxwH8FM
```

6. Restart the Attunity Replicate Server service.

### To disable encryption for the repository:

- » Run the following command:

```
repuictl repository secure --off --master-user-password your_MasterUserPassword
```

For information on setting user permission, see [User Permissions](#).

## Securing Connections to Endpoints

Attunity Replicate communicates with the source and target endpoints (typically databases) using either the vendor provided client package or via a standard ODBC driver.

Attunity does not implement the network protocol (see important exceptions below) and for this reason, Attunity Replicate generally relies on the vendor of the source or target endpoint to offer encryption. When setting up endpoint connections, the user is able to specify any connection properties required for the use of encryption; these properties are, invariably, vendor-specific properties. In some cases, use of encryption requires system-level settings (such as adding a certificate to the machine trust store) which are outside of the scope of Attunity Replicate. Users are referred to the operation manual of the source or target endpoint for details on how to set up encrypted client communication with the server.

One exception to the previous paragraph is for endpoints based on the Attunity Connect product (endpoints on zOS, iSeries, HP NonStop and HP OpenVMS). In this case, the network encryption is implemented by the Attunity Connect product and is based on the AES encryption algorithm with a 256-bit key.

Another exception is for endpoints that work over HTTP. In these cases, the user is advised to ensure that the endpoint server is configured to offer HTTPS and then use the appropriate https:// based URL when setting up the connection.

## Application Security

As a leading provider of enterprise-class big data management solutions, Attunity understands that application security is of paramount importance. With the integration of Static Code Analysis into the development lifecycle, the code is rigorously tested for vulnerabilities before each product release.

# 4 | Overview of Attunity Replicate Endpoints

Attunity Replicate lets you work with databases that already exist in your environment. There is no need to install any additional software other than Replicate. You can also use CDC Agents in Attunity Replicate Connect (ARC) as source data for replication tasks.

For a list of supported endpoint versions, see [Supported Platforms and Endpoints](#).

## In this chapter:

[Supported Replicate Endpoints](#)

[Using ARC CDC Agents as Endpoints](#)

[Replicate Data Types](#)

[Supported DDL Statements](#)

[Configuring Replicate to Automatically Replace the User-Entered Password](#)

## Supported Replicate Endpoints

Attunity Replicate can replicate data from the types of endpoints listed in [Supported Platforms and Endpoints](#). A Replicate endpoint can be either a source or a target. A source endpoint contains the original data (the data you want to copy). A target endpoint is where the replicated data is stored. Source and target can be completely different endpoints.

For a list of supported source and target endpoints, see [Supported Platforms and Endpoints](#).

You can also use CDC Agents in the Attunity Integration Suite as a source endpoint. For a list of supported ARC CDC Agents and information on how to use them with Replicate, see [Using ARC CDC Agents as Endpoints](#).

## Using ARC CDC Agents as Endpoints

In a replication project, you can use both relational and non-relational endpoints supported by Attunity Replicate Connect (ARC).

**Note** ARC CDC Agents can be used for capturing changes (CDC) only.

**Table 4.1 | Endpoints Supported by ARC**

Relational Endpoints	Non-Relational Endpoints
SQL/MP	HP NonStop Enscribe RMS VSAM IBM IMS

For information on how to work with ARC, see [Using ARC CDC Solutions in Attunity Replicate](#).

## Replicate Data Types

Attunity Replicate converts source data to its own data type. For data that Replicate cannot convert, it returns an error.

To see how a data type is mapped from source to target:

- » See the chapter for the source target endpoint you use. In the section on data types, see the mapping table to see the Attunity Replicate data type.
- » See the chapter for the target endpoint you are use. In the section on data types, see the mapping table to see how the Replicate data type maps to the target.

For example, when replicating data from an Oracle source endpoint to a Microsoft SQL Server target end point, Replicate first converts the Oracle data type BINARY to the Replicate data type BYTES. BYTES maps to the Microsoft SQL Server data type VARBINARY (Length). For more information on how Replicate maps data types, see the chapters on the individual endpoints.

The following table describes the Attunity Replicate data types. Some data types have precision and scale information that applies to them.

**Table 4.2 | Replicate Data Types**

Replicate Data Types	Description
STRING	A character string
WSTRING	A double-byte character string
BOOLEAN	A Boolean value
BYTES	A binary data value
DATE	A date value: Year, Month, Day
TIME	A time value: Hour, Minutes, Seconds
	Only the following format is supported:

**Table 4.2 | Replicate Data Types (Cont.)**

<b>Replicate Data Types</b>	<b>Description</b>
	HH:MM:SS
DATETIME	A timestamp value: Year, Month, Day, Hour, Minute, Second, Fractional Seconds The fractional seconds have a maximum scale of 9 digits. Only the following format is supported: YYYY:MM:DD HH:MM:SS.F(9)
INT1	A one-byte, signed integer
INT2	A two-byte, signed integer
INT4	A four-byte, signed integer
INT8	An eight-byte, signed integer
NUMERIC	An exact numeric value with a fixed precision and scale
REAL4	A single-precision floating-point value
REAL8	A double-precision floating-point value
UINT1	A one-byte, unsigned integer
UINT2	A two-byte, unsigned integer
UINT4	A four-byte, unsigned integer
UINT8	An eight-byte, unsigned integer
BLOB	Binary Large Object
CLOB	Character Large Object
NCLOB	Native Character Large Object

For more information, see **LOB support** in **Task Settings/Metadata**.

## Supported DDL Statements

Attunity Replicate automatically changes the metadata of the target table to reflect DDL statements performed on the source endpoint.

Supported DDL statements include:

- » Create table
- » Drop table
- » Rename table
- » Add column
- » Drop column

- » Rename column
- » Change column data type

For information about supported DDL statements for a specific endpoint, see the chapter describing that endpoint. For more information about DDL settings, see [Apply Changes Settings](#).

## How Replicate Handles DDL Changes

When DDL changes occur, Replicate:

1. Captures ALTER TABLE DDLs from the transaction log without identifying the DDL type (ADD/DROP/MODIFY COLUMN).
2. Reads the new table metadata from the source backend.
3. Compares the previous table metadata with the new table metadata in order to determine the change. Note that a single change may include multiple DDL operations performed on the backend.
4. Uses the new table metadata to parse the subsequent DML events.

## Limitations when Capturing DDL Changes

When capturing DDL changes, the following limitations apply:

- » When a rapid sequence of DDL-DMLs-DDL occurs, Replicate may read the table metadata *after* the second DDL which may (on rare occasions) result in missing data due to incorrect parsing of DML events from the log.
- » If you change the name of a table used in a task and then stop the task, Replicate will not capture any changes made to that table after the task is resumed.
- » Reallocation of a table's Primary Key columns is not supported (and will therefore not be written to the [DDL History Control Table](#)).
- » When a column's data type is changed and the (same) column is then renamed *while* the task is stopped, the DDL change will appear in the [DDL History Control Table](#) as "Drop Column" and then "Add Column" when the task is resumed. Note that the same behavior can also occur as a result of prolonged latency.
- » If a table is created *while* the task is stopped and the new table matches the existing table selection pattern, the new table will be captured when the task is resumed but the DDL change will not be written to the [DDL History Control Table](#).

## Configuring Replicate to Automatically Replace the User-Entered Password

To prevent illicit database activity by unauthorized third-parties, Replicate can be configured to automatically replace the user-entered password with a strong random password.

This feature is currently supported with the following endpoint types:

- » Microsoft SQL Server
- » Microsoft Azure SQL Database
- » Oracle

**Note** This feature cannot be used when the user name is "sa".

**Note** Clicking the "Test Connection" button will verify the connection using the original password. The password will be automatically changed the first time the task runs.

To utilize this feature, the password must be defined both in the Replicate endpoint settings *and* on the actual database, in the following format:

*replace:your\_password*

**Example:**

*replace:k\$RJdg7!S&ib*

## Defining Multiple Endpoints to use the same Automatically Changed Password

In Attunity Replicate, more than one endpoint may be configured to connect to the same database server.

To allow multiple endpoints to use the same (automatically changed) credentials, the password in one of the endpoints needs to be defined. Then, each of the other endpoint connections needs to be configured to reference that endpoint.

**Note** The following rules apply:

- » A source endpoint cannot reference a target endpoint, only another source endpoint.
- » A target endpoint cannot reference a source endpoint, only another target endpoint.
- » An endpoint cannot reference another endpoint that uses a different database server.

To configure an endpoint to use the automatically changed credentials of another endpoint:

1. In the **User name** field, enter the user name in the following format:

`ref:endpoint_name`

Where `endpoint_name` is the name of the endpoint connection whose password was automatically changed.

2. In the **Password** field, specify the password *before* it was automatically changed and without the "replace" prefix.

**Example:**

If the original password is:

`replace:54lakrfgnier3!`

Specify:

`54lakrfgnier3!`

# 5 | Using the Attunity Replicate Console

The Attunity Replicate Console is a Web-based application that runs in most browsers (for information on supported browsers, see [Supported Browsers](#)). You can connect from any computer to the Replicate Server.

This section describes the elements of the Replicate Console.

## In this chapter:

[Accessing the Attunity Replicate Console](#)

[Tasks View](#)

[Server View](#)

[List Actions](#)

## Accessing the Attunity Replicate Console

You browse to the Attunity Replicate Console using a supported Web browser from a computer in the same network as the computer with the Attunity Replicate Server. For information on supported browsers, see [Supported Browsers](#).

You can access the Console from the **Start** menu of the computer where you installed Attunity Replicate.

To enable and control access to Attunity Replicate, you can create user roles as described in [User Permissions](#).

### To access Attunity Replicate

- » Click Start and from the **All Programs** section point to Attunity Replicate and select **Attunity Replicate Console**.

**Note** When you connect to the Attunity Replicate Console, your browser will prompt you for a username and password. The username and password that you need to specify depends whether Replicate Server is installed on Windows or Linux.

- » **Attunity Replicate Server on Windows:** Your domain username and password.
- » **Attunity Replicate Server on Linux:** Either specify your PAM credentials or, if PAM is not set up in your environment, specify `admin` as your username and the Replicate Server password as your password.

For information on setting the Replicate Server password, see [Security Considerations](#).

For information on PAM prerequisites, see [Configuration 3: Replicate UI Console and Replicate Server Running on Linux](#).

## Accessing Attunity Replicate from a Remote Computer

You can access Attunity Replicate from any computer in your network. The default URL is defined in a file called **ServiceConfiguration.xml**, which is located in the following directory:

```
<product_dir>\data
```

**Note** When the Attunity Replicate machine is located in a subdomain, the URL in the **ServiceConfiguration.xml** file will contain `localhost` instead of the machine name. In order to connect remotely, to the Attunity Replicate machine, you need to replace `localhost` with the actual machine name or IP address.

To access the Attunity Replicate Console from a remote computer, type the following address in the address bar of your Web browser:

### Attunity Replicate Server on Windows:

```
https://<computer name>/attunityreplicate
```

### Attunity Replicate Server on Linux:

```
https://<computer name>:<port>/attunityreplicate
```

Where `<computer name>` is the name or IP address of the computer where the Attunity Replicate Server is installed and `<port>` is the C UI Server port (3552 by default). For more information on the C UI Server component, see [Attunity Replicate UI Server Configurations](#).

**Note** The person logged in to the computer where you are accessing the Console must be an authorized Attunity Replicate user. For more information, see [User Permissions](#).

## Attunity Replicate UI Server Configurations

You can either install Attunity Replicate on a single machine or on two separate machines. The possible configurations for installing Attunity Replicate on two separate machines are described below.

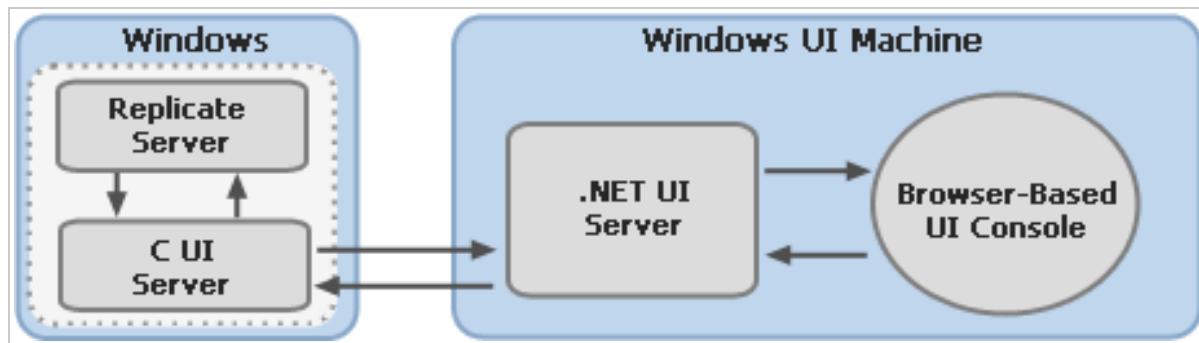
- » [Configuration 1: Replicate Server Running on Windows](#)
- » [Configuration 2: Replicate Server Running on Linux](#)
- » [Configuration 3: Replicate UI Console and Replicate Server Running on Linux](#)

**Note** When the Attunity Replicate .NET UI Server is running on one machine and the Attunity Replicate Server is running on another, the Attunity Replicate Server password must be the same on both machines. The password is used during the SSL handshake to establish a secure connection between the participating machines.

For information on setting the password, see [Changing the Server Password](#).

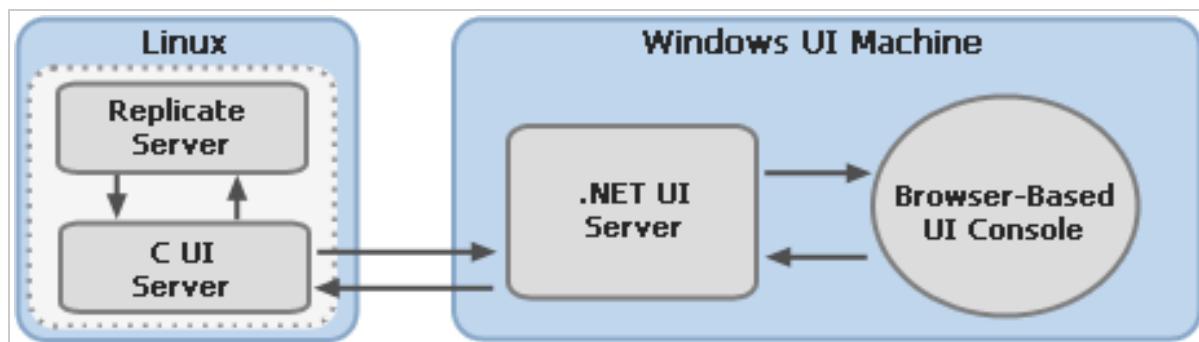
## Configuration 1: Replicate Server Running on Windows

In this configuration, the Replicate Console component and the Replicate Server components are running on two separate Windows machines.



## Configuration 2: Replicate Server Running on Linux

In this configuration, the Replicate Console component and the Replicate Server components are running on two separate machines - the former on Windows and the latter on Linux.



## Configuration 3: Replicate UI Console and Replicate Server Running on Linux

In this configuration, the UI Console and the Web server (Attunity Replicate Server) are hosted on two separate Linux machines, though it is also possible to install them on a single machine.

Note that in such a configuration, the ability to assign different roles (as described in [User Permissions](#)) is not supported. In other words, all users will have the admin role.

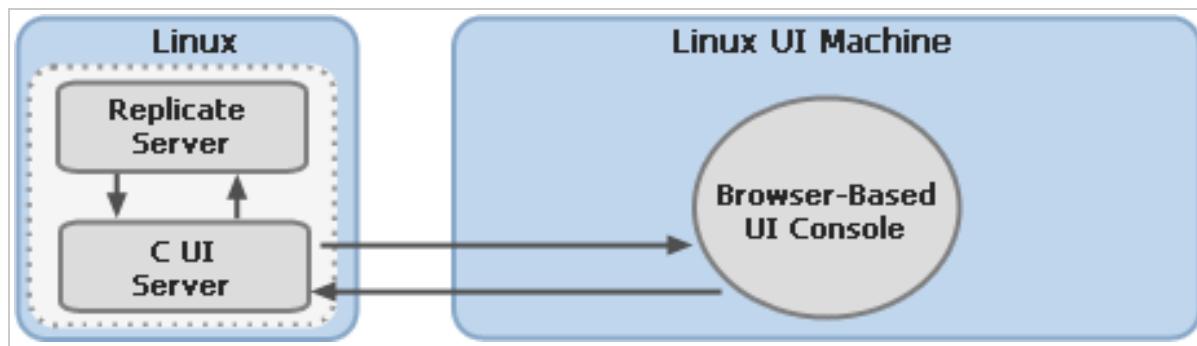
## PAM Prerequisites

To establish a secure connection using PAM, make sure that the following prerequisites have been met:

- » The Attunity user or group (or the user/group set during the installation) must be granted permission to read the file: `etc/shadow`. Note that this prerequisite is only required when Attunity Replicate is installed on two machines.
- » Edit the `repctl.cfg` file and modify the path to the fully qualified name of the `libpam.so.0` library if required.

**Example:**

```
"login_pam_libpam_full_path":"/lib64/libpam.so.0",
"login_pam_service_name": "system-auth"
}
```



## Multiple Users Connecting to a Single Console

Multiple users can connect to a single Attunity Replicate Console using a Web browser, as follows:

1. Install Attunity Replicate on the computer that will serve as the Attunity Replicate Console.
2. If Attunity Replicate Server is installed on another computer (Linux for example), on the console machine, edit the Attunity Replicate URL (and port if required) in the `ServiceConfiguration.xml` file to point to that machine.

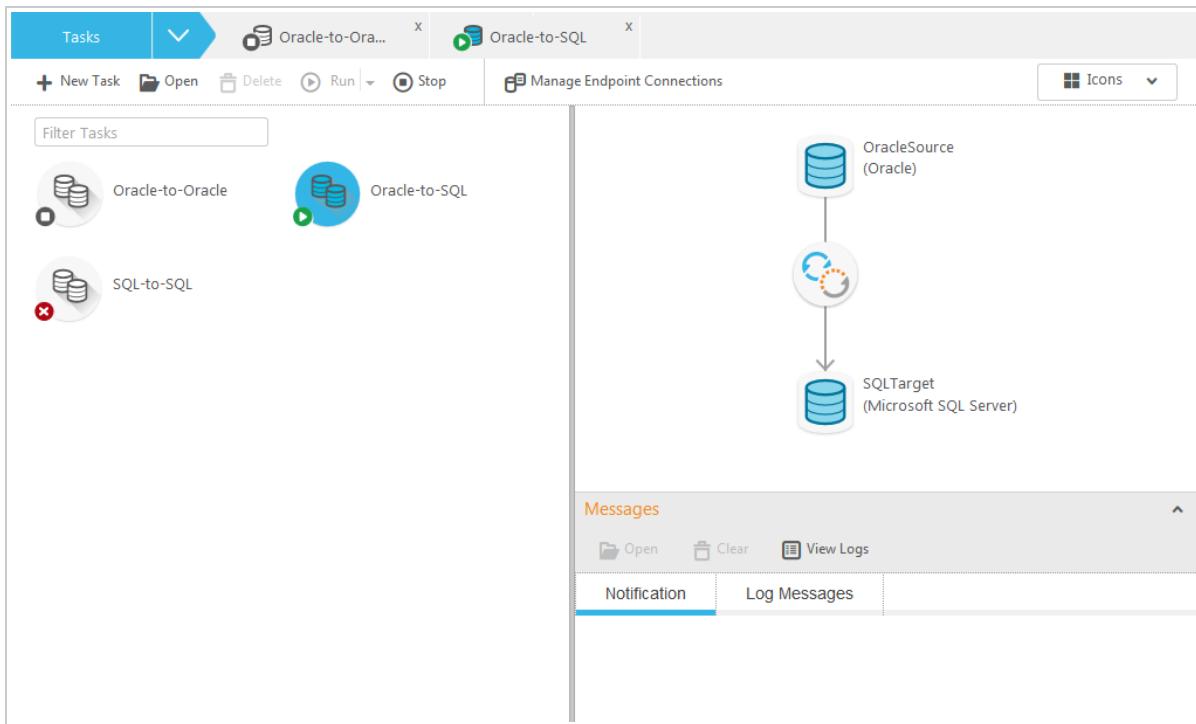
By default, the file is located in the following directory:

`C:\Program Files\Attunity\Replicate\data`

3. Open the Windows Services console and restart the **Attunity Replicate Console** service.
4. Connect as described in [Accessing the Attunity Replicate Console](#) above.

## Tasks View

The **Tasks** view is the default view that opens when you launch Attunity Replicate for the first time, as shown in the following figure:



It lists all replication tasks you have defined. You use this view to view, edit, run, and delete tasks, or to create new tasks.

This view includes the following elements:

- » **Toolbar** running along the top. It includes buttons that let you create a new task, open, delete, run, or stop an existing task, configure advanced run options, and manage endpoint connections. See also [Adding Tasks](#).
- » **Tasks** already defined in the system, listed in the left pane.

You can view tasks in:

- » **Icons** view, where each icon indicates the current state of the tasks.  
See the [Task Icons](#) table for more information.
- » **Details** view, which displays a table with additional information about each task including their current state. Note that the state icons are the same as described in the [Task Icons](#) table, but without the  part of the icon.

To toggle between these views, you can select **Icons** or **Details** from the drop-down list in the top right of the Console.

For information about creating a task, see [Designing Tasks](#).

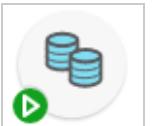
The Console displays each open task on its own tab along the top. For more information, see [Viewing Specific Tasks](#).

- » **Endpoints map** in the right pane, which illustrates the endpoints for the task selected in the left pane. Any notifications (if defined) and log messages will be shown in the **Messages** pane below the map.
- » **Messages pane** below the endpoints diagram on the right. This pane includes a **Notifications** tab for progress messages and a **Log Messages** tab for warnings and error messages issued when Replicate encounters a problem. For more information, see [Reading Messages about a Task](#) and [Define the Notification Message](#).

### To access the Tasks view

- » Select **Tasks** from the drop-down list in the top left, below the Attunity Replicate logo.
- The following table shows examples of task icons.

**Table 5.1 | Task Icons**

Task Icon	Description
	Indicates that the task has not been run yet.
	Can be one of the following: <ul style="list-style-type: none"> <li>» Manually stopped by the user</li> <li>» Stopped due to the task definition (Full Load settings)</li> <li>» Stopped by the Scheduler</li> </ul>
	Indicates that the task has stopped due to an error. When you select the task, Replicate displays a list of errors on the <b>Log Messages</b> tab at the bottom right of the console.
	Indicates that the task has stopped due to a recoverable error. When you select the task, Replicate displays a list of errors on the <b>Log Messages</b> tab at the bottom right of the console.
	Indicates that the task is running.

## Viewing Specific Tasks

From the **Tasks** view, you can drill down to an individual task, provided you have already created at least one task (see [Designing Tasks](#) for more information). Two modes display different sets of information for each task:

- » **Designer Mode:** Default mode when you open a task. Here you define endpoints, select tables, modify table settings (including filters and transformations), and create global transformation rules.
- » **Monitor Mode:** Here you view replication task activities in real time, along with log messages and notifications.

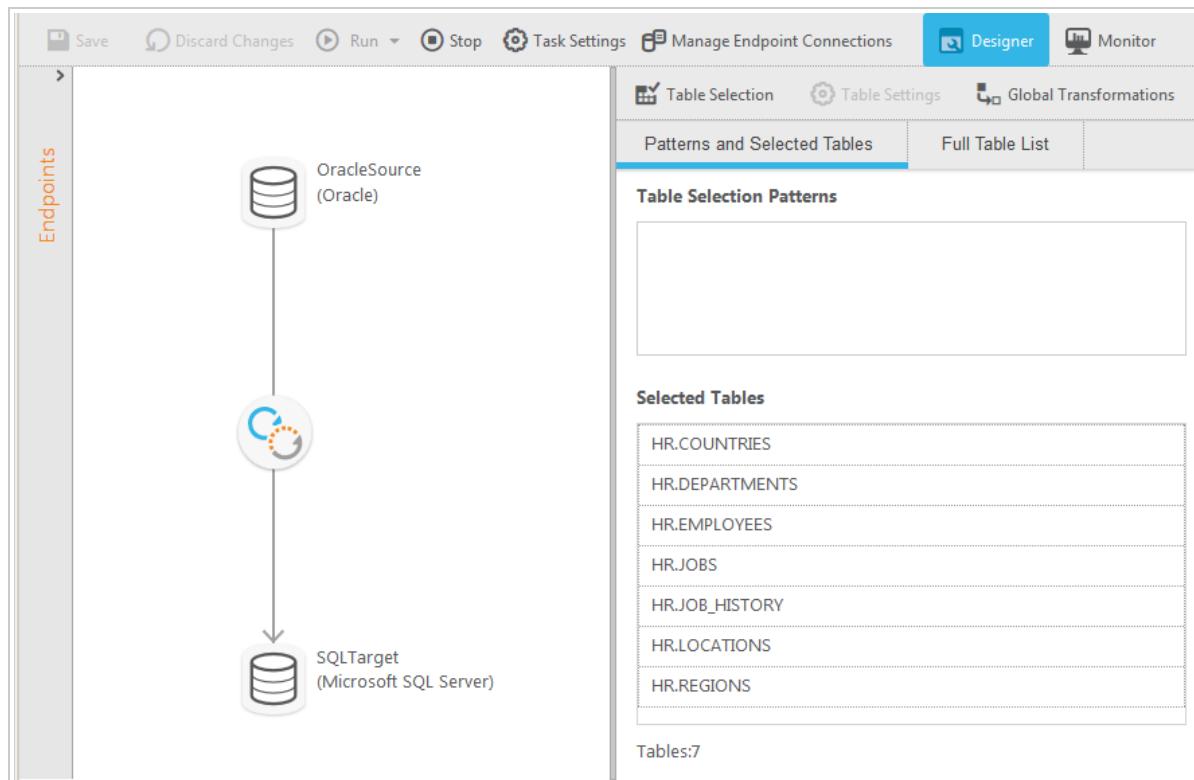
### To view a specific task:

1. In the **Tasks** view, select the task you want to work with.  
The right pane displays the task diagram on the right side of the page.
2. On the **Tasks** view toolbar, click **Open**.

### Designer Mode

In **Designer** mode, you define endpoints, select tables to be replicated, modify table settings (including filters and transformations), and create global transformation rules. This is the default mode when you open a task.

**Figure 5.1 | Viewing a Task in Designer Mode**



The **Designer** mode includes the following elements:

- » **Endpoints list:** Lists the source and target endpoint connections that you added to Attunity Replicate. For more information, see [Working with Endpoints](#). The figure shows the Endpoints List in a collapsed state, hiding the endpoints. To expand the list, click the right arrow at the top or anywhere below it. To close the panel, click the left arrow.
- » **Endpoints map:** Illustrates the connection between the source and target endpoints for the task. The round icon between the endpoints represents the task type, which can indicate Full Load only, Full Load and Apply Changes, or Apply Changes only.
- » When you create a task, you can drag the endpoints to the source and target drop spots as required. For more information, see [Adding a Source and Target Endpoint to a Task](#).
- » **Monitor and Designer buttons:** Lets you switch between **Monitor** mode and **Designer** mode. See also [Monitor Mode](#) and [Monitoring and Controlling Replication Tasks](#).
- » **Run button:** Lets you run the task at hand.
- » **Task Settings button:** Opens the **Task Settings** dialog box. For more information, see [Task Settings](#).
- » **Manage Endpoint Connections button:** Lets you view the endpoints defined, edit them, or add new endpoints. For more information, see [Working with Endpoints](#).
- » **Select and Define Tables:** Lets you select the tables you want to include in your replication task. In addition, you can use transformation and filter operations to create new tables or to replicate parts of tables. For more information, [Adding Tables and/or Views to a Task](#), [Using Filters](#), and [Defining Transformations for a Single Table/View](#).
- » **Global Transformations option:** Lets you create transformations for all tables in a task. For more information, see [Defining Global Transformations](#).

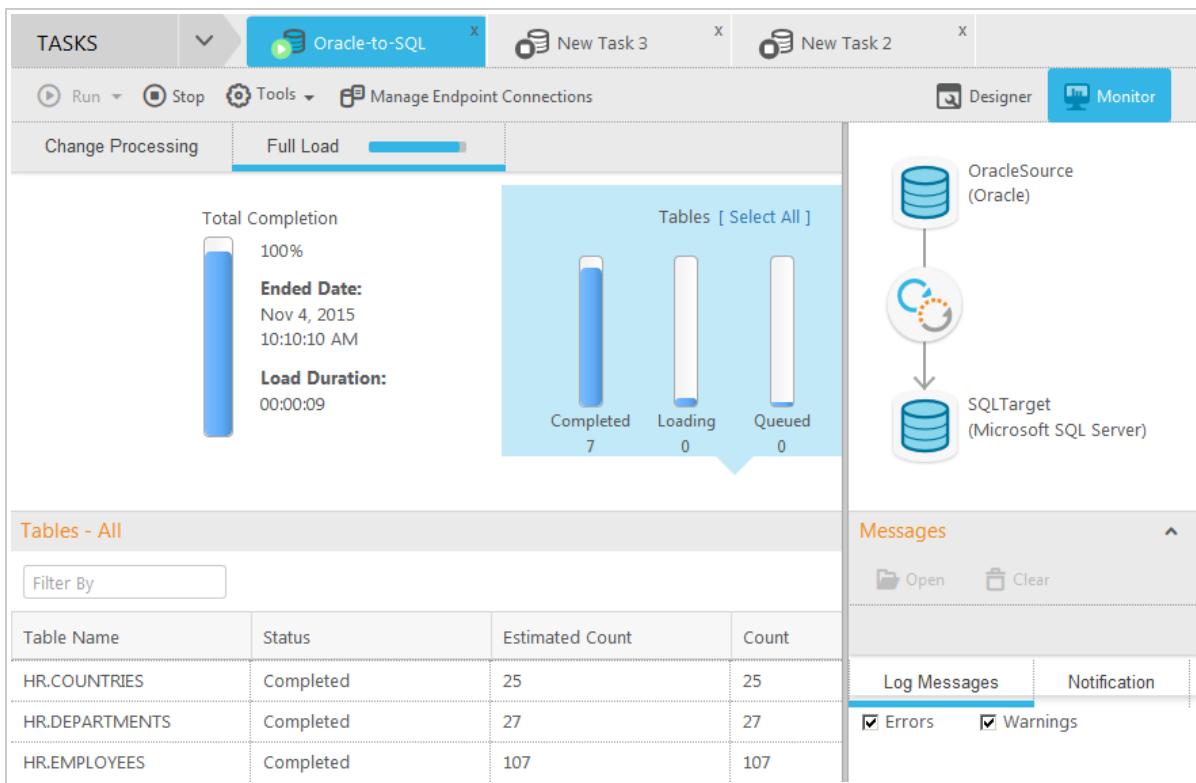
#### To display a task in Designer mode:

- » On the right side of the toolbar, click **Designer**.

## Monitor Mode

In **Monitor** mode, you view the replication task activities in real time.

Figure 5.2 | Viewing a Task in Monitor Mode



The **Monitor** mode includes the following elements:

- » **Run button:** Lets you run the task at hand.
- » **Manage Endpoint Connections button:** Lets you view the endpoints defined, edit them, or add new endpoints. For more information, see [Working with Endpoints](#).
- » **Monitor and Designer buttons:** Switch between **Monitor** mode and **Designer** mode. See also [Monitoring and Controlling Replication Tasks](#), [Designer Mode](#), [Designing Tasks](#).
- » **Tools list:** Provides access to history, log management, and status information.
- » **Change Processing/Full Load tabs:** Lets you select the information you want to focus on. By default, Replicate displays the **Full Load** view (also shown in the figure).
- » **Task Map:** Illustrates the connection between the source and target endpoints for the task. The round icon between the endpoints represents the task type, which can indicate Full Load only, Full Load and Apply Changes, or Apply Changes only.
- » **Messages pane:** Displays notifications and logging messages. For more information, see [Reading Messages about a Task](#).

#### To display a task in Monitor mode:

- » On the right side of the toolbar, click **Monitor**.

## Server View

**SERVER** view lets you view and configure the Attunity Replicate Server settings.

### To switch to SERVER view:

- » From the drop-down list in the top left corner of the console (below the product logo) select **Server**.

For information on configuring server settings, see [Attunity Replicate Server Settings](#).

## List Actions

The following table describes the various list actions you can perform. Note that, depending on the list type, some of the actions may not be available.

**Table 5.2 | List Actions**

To	Do This
Sort ascending or sort descending	Right click the desired column and select one of the sorting options as required.
Restore the default sorting order	Right click any of the column headings and select <b>Default Sorting</b> .
Export the list to a TSV file	The following lists can be exported: tasks, messages, selected tables, and processed tables (in Monitor view). Either click the <b>Export to TSV</b> button above the list or right-click any of the column headings and select <b>Export to TSV</b> . Choose where to save the file and then click <b>Save</b> .
Add or remove columns	Right click any of the column headings and select <b>Column Settings</b> . Then add or remove columns as required.
Hide a column	Right click the desired column and select <b>Hide Column</b> .

# 6 | Getting Started: An Attunity Replicate Tutorial

This section guides you through setting up a basic replication task for data from an Oracle source to a Microsoft SQL Server target.

## In this chapter:

- [What You Need](#)
- [Open the Attunity Replicate Console](#)
- [Add an Oracle Endpoint as a Source](#)
- [Add a Microsoft SQL Server database as a Target](#)
- [Add a Replication Task](#)
- [Run and Monitor the Replication Task](#)
- [View the Replicated Tables in Microsoft SQL Server](#)

## What You Need

For this tutorial, you need the following:

- » Attunity Replicate installed on a computer in your network
- » For the Oracle source:
  - » Access to the HR schema tables that are part of the Oracle database installation

**Note** If these tables are not available, contact your Oracle database administrator.

- » system/<password> for an admin user
- » For the target: A Microsoft SQL Server database with the default tempdb system database (used to store the target tables)  
This can be installed on your local computer.
- » For the Attunity Replicate Console, one of the following Internet browsers:
  - » Microsoft Internet Explorer version 11 and above
  - » Mozilla Firefox
  - » Google Chrome

For additional installation information, see the [Installation Prerequisites](#).

## Open the Attunity Replicate Console

From the Windows Start menu, select **All Programs > Attunity Replicate > Attunity Replicate Console.**

**Note** You can access Attunity Replicate from any computer in your system.

To access the Console from a remote computer, type the following address in the address bar of your Web browser:

`http://<computer name>/attunityreplicate`

where *<computer name>* is the name or IP address of the computer (including the Windows domain name) on which the Attunity Replicate Server is installed.

**Note** The person logged in to the computer hosting the Console must be an authorized Attunity Replicate user. For more information, see [User Permissions](#).

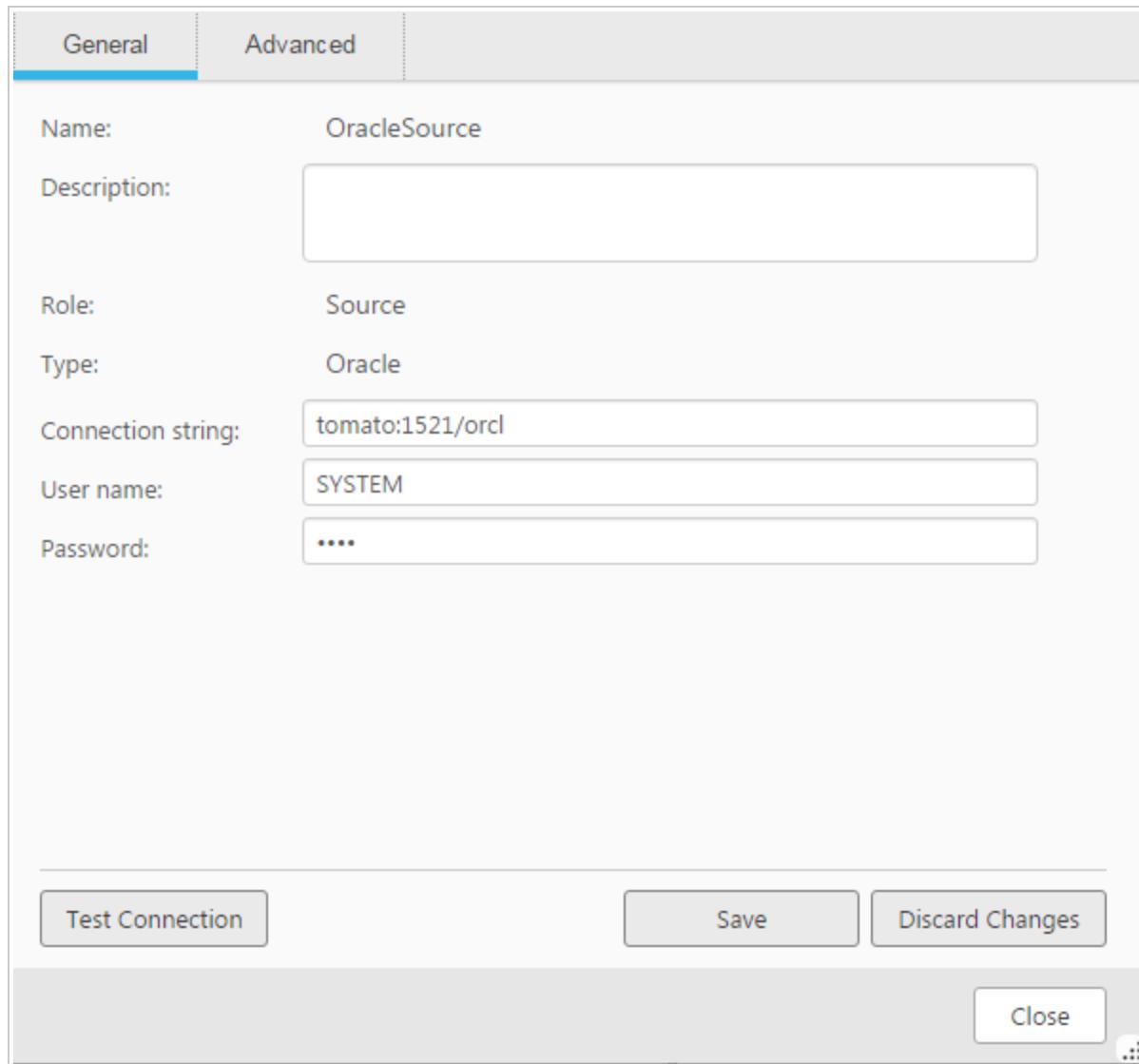
## Add an Oracle Endpoint as a Source

This task guides you through adding and configuring an Oracle endpoint as the source database. This is the database from where you want to replicate data.

### To add an Oracle source database:

1. In Task view, click **Manage Endpoint Connections**.  
The **Manage Endpoint Connections** dialog box opens.
2. Click **New Endpoint Connection**.
3. Provide the following information:
  - » **Name:** Type **OracleSource**.
  - » **Description:** Optionally, enter a description or leave blank.
  - » **Role:** Select **Source**.
  - » **Type:** Select **Oracle**.
  - » **Connection string:** Enter the connect string to the Oracle database you work with, in any Oracle format.  
For example, if you connect to an Oracle database on a computer called **tomato** using the default Oracle port and service name, the connect string looks like this:  
`tomato:1521/orcl`
  - » **User Name:** Enter the user name for the Oracle database you work with.  
The default user name is **SYSTEM**.
  - » **Password:** Enter the password for the Oracle database you work with.  
The default password is **manager**.

The figure below shows the data that you need to enter on the General tab of the Oracle database.



The screenshot shows the 'General' tab selected in a configuration dialog. The form contains the following fields:

Name:	OracleSource
Description:	(empty text area)
Role:	Source
Type:	Oracle
Connection string:	tomato:1521/orcl
User name:	SYSTEM
Password:	****

At the bottom of the dialog are four buttons: 'Test Connection', 'Save', 'Discard Changes', and 'Close'. A small 'More' button is located to the right of the 'Close' button.

4. Click **Test Connection** to verify the information you entered and the availability of the database.
5. Click **Save** to add the database.

You can also set advanced settings for the Oracle database, but this beyond the scope of this tutorial. For more information, see [Setting Advanced Connection Properties Using Oracle LogMiner](#).

For information on adding other types of databases, see the chapter for the required database. For a list of supported databases, see [Supported Platforms and Endpoints](#).

## Add a Microsoft SQL Server database as a Target

This task guides you through adding and configuring a Microsoft SQL Server endpoint as the target database connection. This is the database to where you want to replicate data.

### To add a Microsoft SQL Server target endpoint:

1. In Tasks view, click **Manage Endpoint Connections**.

The Manage Endpoint Connections dialog box opens.

2. Click **New Endpoint Connection**.

3. Provide the following information:

- » **Name:** Type sqlserver\_target.
- » **Description:** Optionally, enter a description or leave blank.
- » **Role:** Select **Target**.
- » **Server name:** Enter the name of the computer where your Microsoft SQL Server database is installed.

For example, if you connect to a Microsoft SQL Server database on a computer called **bee**, enter **bee**.

- » Select one of the following:

**Windows authentication** if your Microsoft SQL Server database is configured to accept Windows authentication.

Microsoft SQL Server authentication if your Microsoft SQL Server database is not configured to accept Windows authentication. In this case, you also need to provide a valid user name and password.

- » **Database name:** Enter **tempdb**, which is the name of the database to where you are going to replicate data. If you created a new database for this purpose, enter the name of that database.

General
Advanced

---

Name:

Description:

Role:  Source  Target

Type:

Server name:

Windows authentication  
 SQL Server authentication

User name:

Password:

Database name:

---



4. Click **Test Connection** to verify the information you entered and the availability of the database.
5. Click **Save** to add the database.

You can also set advanced settings for the Microsoft SQL Server database, but this is beyond the scope of this tutorial. For more information, see [Setting Advanced Connection Properties](#).

For information on adding other types of databases, see the chapter for the required database. For a list of supported databases, see [Supported Platforms and Endpoints](#).

## Add a Replication Task

This task guides you through defining a replication task that copies the data from the HR.EMPLOYEES and HR.JOBs tables. It is not mandatory to add a source and a target database prior to this step; you can also do this as part of setting up the replication task.

By default the Oracle database includes the HR schema. You will make a copy of the same tables in your Microsoft SQL Server tempdb. The EMPLOYEES and JOBS tables created in Microsoft SQL Server will be identical to the Oracle tables.

For information on how to use Transformations and Filters when creating a replication task, see [Defining Transformations for a Single Table/View](#) and [Using Filters](#).

Adding a replication task includes the following subtasks:

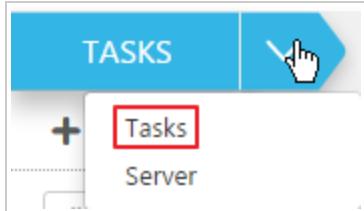
- » [Add a Replication Task to the Attunity Replicate Console](#)
- » [Add the Source and Target Endpoints to the Task](#)
- » [Select Tables for the Replication Task](#)

## Add a Replication Task to the Attunity Replicate Console

This task guides you through adding a replication task to the Attunity Replicate Console.

### To add a replication task:

1. Make sure **Tasks** is selected in the upper left corner of the Attunity Replicate Console.



2. Click **New Task** to open the New Task dialog box.
3. In the New Task dialog box, in the **Name** field, type **My\_Task** and click **OK**.

## New Task

Name i

Description

---

**Replicate Profile**  
Select the profile that best describes your replication use case

Unidirectional  
 Bidirectional

---

**Task Options**  
Select the replication options for this task

 Full Load     Apply Changes     Store Changes

Perform a full load of target tables, then keep them up-to-date by applying changes.

Save Cancel

The Attunity Replicate Console displays the task on a new tab. By default, because the task has not been set up yet, the tab opens in Designer view. The diagram on the left serves as a drop-off point for the source and target databases you defined previously. The right pane lets you select the tables you want to work with and carry out transformations and filtering operations. For more information, see [Tasks View](#), [Viewing Specific Tasks](#), and [Designing Tasks](#).

If needed, you can also change the default task settings. For more information, see [Task Settings](#).

## Add the Source and Target Endpoints to the Task

This section guides you through adding the source and target endpoints to the replication task, which is a simple drag-and-drop operation. In the **Endpoints** tab, the following icons help you distinguish between source and target endpoints:



Source endpoint, which is represented by a database, file, or NoSQL icon, depending on the endpoint type, with an orange arrow pointing away from the source (a database in this example).



Target endpoint, which is represented by a database, file or NoSQL icon, depending on the endpoint type, with a blue arrow pointing toward the target (a database in this example).

The **Endpoints** pane consists of **All**, **Source**, and **Target** tabs. Because each database is named in a way that reflects whether it is a source or a target, click the **All** tab.

### To add the source or target endpoints to the task:

1. In the **Endpoints** pane, click the **All** tab.
2. Drag the `OracleSource` database to the **Drop source endpoint here** area in the endpoints diagram.



3. Drag the `sqlserver_target` database to the **Drop target endpoint here** area.

Next, you can select the tables from the source database to use in the replication task. For more information, see [Designing Tasks](#).

## Select Tables for the Replication Task

After adding the source and target databases, you now need to select which Oracle source tables you want to replicate to the Microsoft SQL Server target.

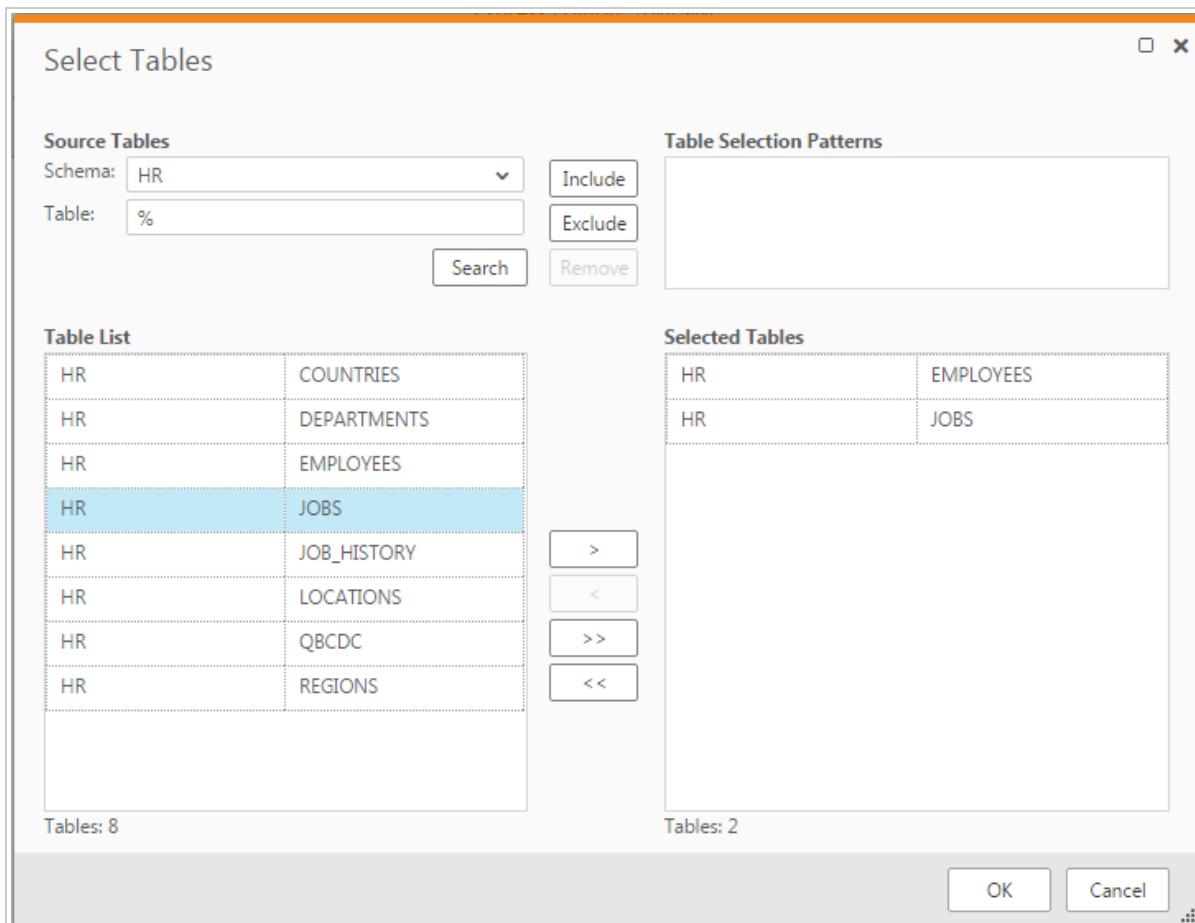
This task guides you through selecting specific tables (HR.EMPLOYEES and HR.JOBS) from the Oracle source. Replicate takes all of the data from these tables "as is" and copies it to the Microsoft SQL Server target.

**Note** If you need to copy only some of the data to the target database, you need to use a filter. For information, see [Using Filters](#).

If you need to copy the data into the target using different rows or columns than those in the source, you need to use transforms. For more information, see [Defining Transformations for a Single Table/View](#).

### To add tables to the replication task:

1. In the right pane of the Attunity Replicate Console, click **Table Selection**. The Select Tables dialog box opens.
2. In the Select Tables dialog box, do the following:
  - » From the **Schema** list, select **HR**, and then click **Search**.
  - » From the **Table List**, select **EMPLOYEES**, and then click the right arrow to select that table.
  - » Repeat these steps for the **JOB**s table.
  - » Click **OK**.



3. On the task tab, click **Save**. The task is now ready to run.

## Run and Monitor the Replication Task

You can now run the replication task and see the results of the replication in real time. This task guides you through running the replication task as a full load and viewing the progress in the Monitor. Additional run options are also available. For more information, see [Using the Run Button Options](#).

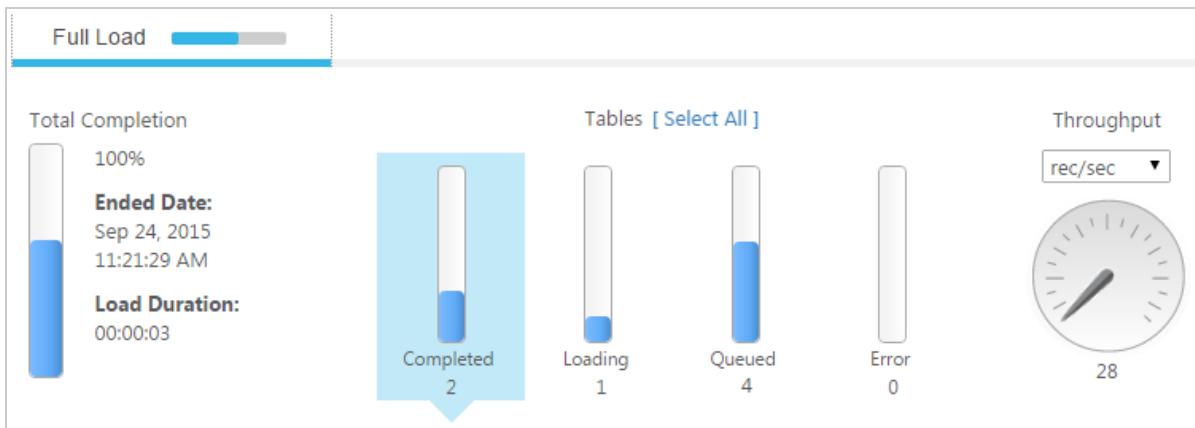
### To run and monitor the replication task:

1. On the task tab, click **Run**.

The **Starting task** message displays, and the console switches to Monitor view, which includes gauges and graphs on two tabs:

- » **Full Load** tab: Indicates the status progress during the full load process.
- » **Change Processing** tab: Monitors changes that occur after the full load completes.

For information on reading the data presented in these sections, see [Viewing Information in the Monitor](#).



2. Click the **Select All** link above the Tables graphs. Replicate displays a table below the graphs with information about each of the tables being processed in the task.

Tables - All					
<input type="button" value="Filter By"/> <span style="float: right;">Resume</span> <span style="float: right;">Reload</span>					
Table Name	Status	Estimated Count	Count	Elapsed Time	Progress
HR.EMPLOYEES	Completed	107	107	00:00:02	<div style="width: 100%;">100%</div>
HRJOBS	Completed	19	19	00:00:02	<div style="width: 100%;">100%</div>

3. Click the individual bar graphs, such as the Completed graph and the Loading graph, to view additional information.

For information about the data supplied in these tables, see [Monitoring Full-Load Operations](#).

## View the Replicated Tables in Microsoft SQL Server

This task guides you through viewing the `tempdb` database in Microsoft SQL Server. You will see that this database now includes two new tables: `HR.EMPLOYEES` and `HR.JOBS`.

### To view the replicated tables in Microsoft SQL Server:

1. From the Windows **Start** menu, go to **All Programs > Microsoft SQL Server > Microsoft SQL Server Management Studio**.
2. In the Object Explorer, find the Microsoft SQL Server target computer you are working with.
3. Expand the **databases** folder for that computer, then expand the **System databases** folder, then expand the **tempdb** database. The `EMPLOYEES` and `JOBS` tables should now appear in the list.
4. Right-click the `EMPLOYEES` table and select **Select Top 1000 Rows**. Check that there is data in the table.
5. Right-click the `JOBS` table and select **Select Top 1000 Rows**. Check that there is data in the table.

# 7 | Designing Tasks

This section describes how to design a replication task. To design a replication task, you must first be sure that you have configured at least one source endpoint and one target endpoint to work with Attunity Replicate.

It is also possible to customize a task by creating new tables or columns for the target endpoint or by selecting only some of the data from each column to be replicated. This is done using transformations and filters.

**Note** A number of variables affect the amount of tasks that can be run on a single Replicate Server, including the task configuration (e.g. how many tables are being replicated), the size of the source tables and the hardware configuration of the Replicate Server machine. Bearing this in mind, the number of tasks that can be run on a single Replicate Server should not exceed 100 (and may need to be significantly less depending on the aforementioned variables). Best practice is to perform load testing in a Test environment before moving to Production.

For more information, see:

- » [Customizing Tasks](#)
- » [Replication Tasks](#)

## In this chapter:

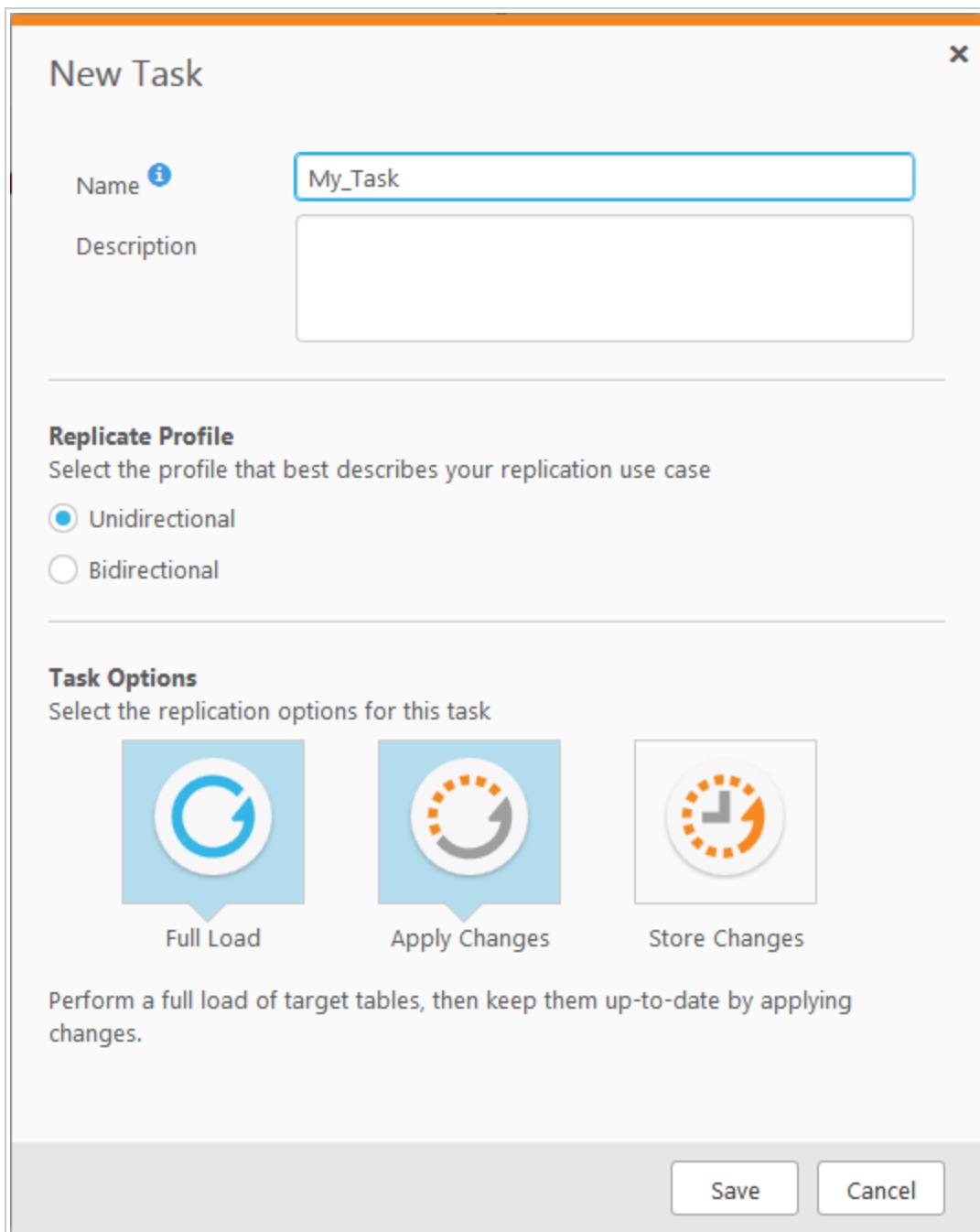
- [Adding Tasks](#)
- [Working with Endpoints](#)
- [Adding a Source and Target Endpoint to a Task](#)
- [Adding Tables and/or Views to a Task](#)
- [Providing a Task Description](#)
- [Editing a Replication Task](#)
- [Searching for Tasks](#)
- [Deleting a Replication Task](#)
- [Exporting and Importing Tasks](#)

## Adding Tasks

Before you get started with designing the features that you need for a task, you must define the task's default behavior.

**To get started setting up a task:**

1. In Tasks view, click **New Task**. The **New Task** dialog box opens.



2. Enter a name for the task. The name should be descriptive to indicate the purpose of the task. The name cannot exceed 32 characters, contain non-Latin characters, or contain any of the following characters: | \ / : \* ? " < >
3. Optionally, enter a description for the task.

4. Choose one of the following replication profiles:
  - » **Unidirectional** - Choose to replicate between endpoints for the purpose of Unidirectional.
  - » **Bidirectional** - Choose to synchronize records between two endpoints.  
For more information, see the instructions on setting up [Bidirectional Replication](#).
5. Select task options:
  - » **Full Load:** Click to enable or disable Full Load options for this task.  
When full load is enabled, Attunity Replicate loads the initial source data to the target endpoint. By default a full load is carried out for this task. If you want to change this setting after you begin working with this task, you make the change in the Task Settings, [Full Load](#) tab.
  - » **Apply Changes:** Click to enable or disable Apply Changes (Change Processing).  
When this option is enabled, Attunity Replicate processes the changes. By default, change processing is carried out for this task. You can view the change processing in the Monitor view.  
For more information, see [Monitoring Change Processing Operations](#). If you want to change this setting after you begin working with this task, you make the change in the Task Settings > [Change Processing](#) tab.

**Note** When the **Bidirectional** replication option is selected, the **Apply Changes** option cannot be disabled.

- » **Store Changes:** Click this button to enable or disable **Store Changes**.  
If this option is enabled, changes are stored in change tables or in an audit table. By default, changes are not stored.  
For information about storing and applying changes, see [Working with Change Tables](#) and [Using an Audit Table](#).

**Note** When the **Bidirectional** replication option is selected, the **Store Changes** button will be unavailable.

6. Click **OK** to close the **New Task** dialog box and save your settings.

## Bidirectional Replication

Bidirectional replication enables organizations to synchronize data between two endpoints (henceforth referred to as Endpoint A and Endpoint B), ensuring that both endpoints contain identical records. The endpoints can either be the same type (e.g. Oracle-to-Oracle) or different types (e.g. Microsoft SQL Server-to-Oracle). To implement bidirectional replication, two **Bidirectional Replication** tasks need to be defined: one that captures changes made to Endpoint A and replicates them to Endpoint B (Task 1) and another that

captures changes made to Endpoint B and replicates them to Endpoint A (Task 2). An explanation of how to set up these tasks is provided below.

## Limitations

The following limitations apply to Bidirectional replication tasks:

- » Bidirectional replication does not currently support conflict resolution. To prevent conflicts, organizations should ensure that the application that updates the endpoints participating in a bidirectional replication task, does not simultaneously update the same record in both endpoints.

In other words, if a record in Endpoint A was updated, the equivalent record in Endpoint B should only be updated after the update from Endpoint A is replicated to Endpoint B.

- » Bidirectional replication tasks currently only support DDL statements from one source only.

**Note** The `CREATE TABLE` DDL is not supported.

- » To ensure that the source and target endpoints are identical, transformations and filters should not be used in bidirectional replication tasks.
- » The **Use direct path full load** option in the Oracle target endpoint settings is not supported.
- » The **Stopping the Task after Full Load** options in the task settings' [Full Load Settings](#) tab is not supported.
- » The task's **Change Processing Mode** must be set to [Transactional apply](#).

## Supported Endpoints

Bidirectional tasks support the following endpoints:

### Source Endpoints:

- » Oracle
- » Microsoft SQL Server
- » MySQL
- » PostgreSQL
- » All AIS sources
- » File Channel
- » SAP Sybase ASE
- » IBM DB2 for iSeries

### Target Endpoints:

- » Oracle
- » Microsoft SQL Server
- » MySQL

- » PostgreSQL
- » ODBC
- » File Channel
- » SAP Sybase ASE

## Setting up Bidirectional Replication

This section describes how to set up a Bidirectional replication task in Attunity Replicate . Note that if Endpoint B contains tables that do not exist in Endpoint A, you must first set up and run a Unidirectional task that replicates data from Endpoint B to Endpoint A.

### To replicate data from Endpoint B to Endpoint A:

1. Define and run a **Unidirectional** task that replicates data from Endpoint B to Endpoint A with Full Load enabled only (make sure to disable the Apply Changes option).
2. When the task completes, first verify that all the required tables exist in Endpoint A.
3. Continue with setting up Bidirectional Task 1, as described in the following procedure.

### To set up Bidirectional Task 1:

1. Define a **Bidirectional Replication** task that replicates data from Endpoint A to Endpoint B.

**Note** In a bidirectional replication task, **Full Load** replication is not enabled by default since it is assumed that both endpoints contain identical tables. If this is not the case (for instance, if Endpoint A contains tables that do not exist in Endpoint B), enable **Full Load** replication as well.

2. Specify a source and target **Loopback prevention table schema** in the task settings' **Loopback Prevention** tab. For more information about loopback prevention settings, see [Bidirectional](#).
3. Run the task.

### To set up Bidirectional Task 2:

1. Define another **Bidirectional Replication** task that replicates data from Endpoint B to Endpoint A.
2. Specify a source and target **Loopback prevention table schema** in the task settings' **Loopback Prevention** tab. For more information about loopback prevention settings, see [Bidirectional](#).
3. Run the task. If Full Load was enabled when replicating data from Endpoint A to Endpoint B, you must first wait for the Full Load replication to complete before running the task.

## Using Bidirectional Replication with the File Channel Endpoint

You can use bidirectional replication together with the File Channel endpoint. This is useful if you need to synchronize two endpoints that are either not able to communicate with each other (i.e. are not physically connected) or are located in the WAN. The process involves setting up six separate tasks: Two *Full Load-only* Unidirectional tasks and four *Apply Changes-only* Bidirectional tasks.

For information on setting up the File Channel endpoint, see [Using the Attunity Replicate File Channel](#).

### To set up bidirectional replication with File Channel Endpoints

1. Set up and run two Full Load only Unidirectional tasks.

#### **Example (FC = File Channel):**

**Task 1:** MySQL --> FC Target **Task 2:** FC Source --> Oracle

2. Wait for the *Full Load-only* tasks to finish.
3. Set up and run four *Apply Changes-only* Bidirectional tasks.

#### **Example (FC = File Channel):**

**Task 1:** MySQL Source --> FC Target **Task 2:** FC Source 1 --> Oracle Target

**Task 3:** Oracle Source --> FC Target 2 **Task 4:** FC Source 2 --> MySQL Target

## Working with Endpoints

Attunity Replicate requires information to connect to the source and target endpoints that you want to use in a task. For a list of endpoints you can work with in Attunity Replicate, see [Supported Platforms and Endpoints](#) .

You use the **Manage Endpoint Connections** window to add endpoints and edit and view the endpoint connection information.

**Note** The name cannot exceed 32 characters, contain non-Latin characters, or contain any of the following characters: | \ / : \* ? " < >

- » [Adding an Endpoint](#)
- » [Editing Endpoint Configuration Information](#)
- » [Viewing Endpoint Configuration Information](#)

## Adding an Endpoint

Before you can begin to design a task, you must add endpoints to the Replicate server. To use an endpoint, you must have access to it somewhere in your system. When you add the endpoint to the Replicate server, you must provide connection information and proper user credentials.

Once you add endpoints to the Replicate server, you can begin to use them to build a replication task. For information on how to add an endpoint to a replication task, see [Adding a Source and Target Endpoint to a Task](#).

#### To add an endpoint:

1. In the Tasks view, click **Manage Endpoints**.  
The **Manage Endpoint Connections** window opens.
2. In the **Manage Endpoint Connections** window, click **New Endpoint**.
3. Select the **Type** of endpoint you are using. The information that you must enter depends on which endpoint you select.  
For more information, see the chapter that describes the endpoint you are using. For a list of supported databases, see [Supported Platforms and Endpoints](#) .

## Editing Endpoint Configuration Information

After you add the endpoint to the Replicate server and provide the connection information, you can make changes to some of the information.

**Note** You *cannot* change the following information in the endpoint window:

- » The name you provided for the endpoint.
- » The endpoint **Type**, for example Oracle or Microsoft SQL Server.
- » The endpoint **role**, either SOURCE or TARGET.

#### To edit endpoint configuration information:

1. In the **Manage Endpoint Connections** window, select the endpoint you want to edit.  
or  
In the **Endpoints** list on the left of the Designer view, double-click the endpoint you want to edit. Note that this option is only available when editing a specific task.  
The **Manage Endpoint Connections** window opens with the selected endpoint settings.
2. Make changes to the information in any of the tabs in the window.  
For more information, see the chapter for the specific Attunity Replicate endpoint you are using. For information which endpoints are supported by Attunity Replicate, see [Supported Platforms and Endpoints](#) .

## Viewing Endpoint Configuration Information

After you add the endpoint to the Replicate server and provide the connection information, you can view the information in the **Manage Endpoint Connections** window.

### To view endpoint configuration information:

- » Select an endpoint from the **Endpoints** list in the left pane; then click the tabs to view the information.

## Testing an Endpoint Connection

You can try to contact the endpoint to make sure that you are connected to the endpoint you want to work with.

### To test the endpoint connection:

1. In the **Manage Endpoint Connections** window, select the endpoint you want to work with.
2. At the bottom of the endpoint's **General** tab, click **Test Connection**.  
If the connection is successful, a success message is displayed and a green check mark icon appears next to the **Test Connection** button.  
If the connection fails, an error message is displayed at the bottom of the dialog box and the **View Log** button becomes available.
3. If the connection is successful, click **Close**.  
If the connection fails, click **View Log** to view the server log entry with information for the connection failure.

## Duplicating Endpoints

You can duplicate an endpoint if you need to define a new endpoint with similar settings. Except for the name, all endpoint settings are duplicated to the new endpoint.

### To duplicate an endpoint:

1. In the left panel of the **Manage Endpoint Connections** window, click the endpoint you want to duplicate.
2. Click **Duplicate**.
3. On the General tab, edit the name for the endpoint.
4. Make any other necessary changes.
5. Click **Save**; then click **Close**.

## Searching for Endpoints

You can search for endpoints by typing a sequence of letters in the **Filter by** box above the endpoints list. For example, to search for all endpoints whose names contain the string "Oracle", type "or". Only endpoints that match the search string are displayed.

## Deleting Endpoints

You can delete endpoints that you no longer require. Note that to delete an endpoint that is defined as a source or target in a task, you first need to remove the endpoint from the task.

### To delete an endpoint:

- » In the left panel of the **Manage Endpoint Connections** window, Select the endpoint and click **Delete**.

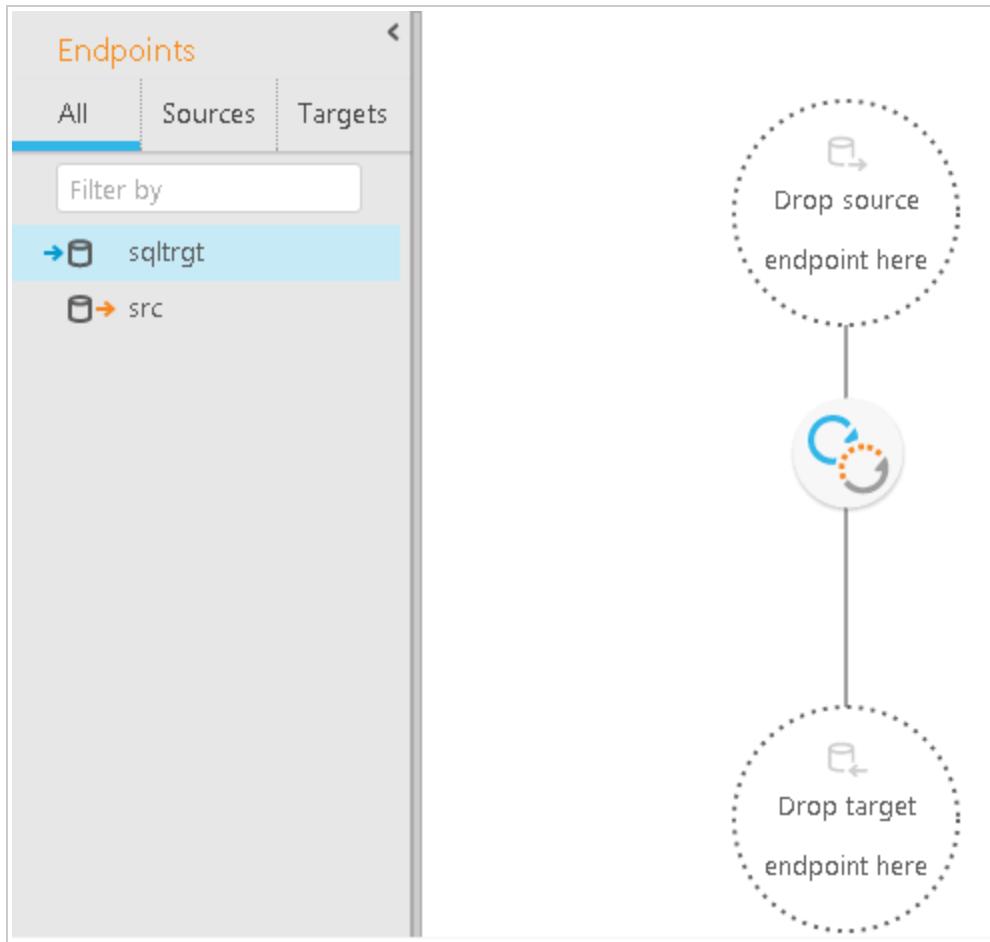
## Adding a Source and Target Endpoint to a Task

Once you have added the endpoints, you can design the replication task. The first step in this process is to define the source endpoint where your data is currently stored and the target endpoints where you want to replicate the data. To do this, you just drag one of the endpoints you added into the task map (in Designer mode).

Once you select the endpoint for your task, you must select the tables from the source endpoint to be replicated. The next step in creating a replication task is [Adding Tables and/or Views to a Task](#).

### To add source and target endpoints to a task:

1. Do one of the following:
  - » Create a new task. When you click **OK** in the **Create New Task** dialog box, the task opens on a dedicated tab. For more information, see [Adding Tasks](#).
  - » In the Tasks view, select the task to which you want to add endpoints and click **Open**. The task opens on a dedicated tab.
2. The Task map is displayed, with the available endpoints listed in the pane on the left, as shown in the following figure.



3. Drag a source endpoint to the top circle in the task map (that contains the text **Drop source endpoint here**). If dragging is not possible, make sure that the endpoint you are using is defined as a source endpoint.
4. Drag a target endpoint to the bottom circle in the task map (that contains the text **Drop target endpoint here**). If dragging is not possible, make sure that the endpoint you are using is defined as a target endpoint.
5. Click **Save**.

## Adding Tables and/or Views to a Task

This procedure describes how to select the source tables or views that you want to replicate. Note that tables can be selected from any supported endpoint, but views can only be selected from the following endpoints:

- » Teradata
- » IBM Netezza
- » Amazon Redshift
- » PostgreSQL

- » MySQL
- » SAP Sybase ASE
- » IBM DB2 for LUW
- » Oracle
- » Microsoft SQL Server
- » ODBC with CDC
- » ODBC

### Notes

- » Replication of views is supported in Full Load Only tasks only, except when replicating from the following sources:
  - » Amazon Redshift
  - » IBM Netezza
  - » Teradata
  - » ODBC with CDC
- » Views are replicated to the target endpoint as tables
- » When replicating views, the corresponding tables are created without a primary key. This presents an issue for Apply Changes tasks, which require the target tables to have a primary key. Therefore, if you are also running Apply Changes tasks (using one of the CDC-capable endpoints mentioned above), you need to define one or more primary keys for each of the target tables using a transformation. For an explanation of how to accomplish this, see [Using the Transform Tab in Defining Transformations for a Single Table/View](#).

**Note** When working with ODBC with CDC and Teradata source endpoints, any views and tables that you want to replicate must have the same context field(s). If you only want to replicate views, then all of the views must have the same context field(s).

For information on setting up context fields, see [Configuring Change Processing Settings](#).

Once you have selected tables/views to replicate, you can run the replication task. However, if you need to make any changes to the structure of the tables in the target endpoint or only select specific columns, you will need to carry out one or both of the following procedures:

- » [Defining Transformations for a Single Table/View](#)
- » [Using Filters](#)

### To select tables/views:

1. Open the task you are working with if it is not already displayed in a dedicated tab.  
For information on opening a task, see [Editing a Replication Task](#).

2. In Designer mode, on the right side, click **Table Selection**.

If the source endpoint does not support view selection, the **Select Tables** dialog box opens. If the [source endpoint supports view selection](#), the **Select Tables/Views** dialog box opens.

See the following for information on how to work with the **Select Tables/Select Tables/Views** dialog box:

- » [Searching for Tables/Views to use in a Replication Task](#)
- » [Selecting Specific Tables/Views for Replication](#)
- » [Creating Table/View Selection Patterns](#)
- » [Setting Load Order](#)

## Searching for Tables/Views to use in a Replication Task

This topic walks you through searching for specific tables/views in preparation for including them in a replication task. You first search for tables that match specific criteria. Then you select the required tables/views from the search results to include them in the task. You can also carry out another search with new criteria and then add additional tables/views to the replication task.

After you finish searching, you can select tables/views for replication. Continue with [Selecting Specific Tables/Views for Replication](#).

### To search for tables/views to use in a replication task:

1. In **Designer** mode, click **Table Selection**.
2. In the **Select Tables** dialog box, if the source endpoint supports view selection, select one of the following:
  - » **All** to search for tables and views
  - » **Tables** to search for tables only
  - » **Views** to search for views onlyOtherwise, skip to the next step.
3. From the **Schema** drop-down list, select a table/view schema.

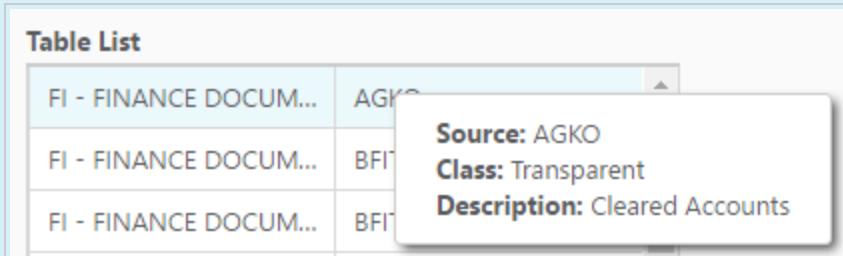
**Note** When selecting tables from the SAP Application endpoint, "Business Groups" will appear instead of "Schema".

4. In the **Table/View** field, type the name or partial name of a table/view.

**Note** You can also include special characters in your search string. For more information, see the Note in [Creating a Record Selection Condition for One or More Columns](#).

5. Click **Search** to display a list of tables/views.

**Note** When selecting tables from the SAP Application endpoint, the **Table List** will display all of the tables in the selected Business Group. Hovering your mouse cursor over a table will display a tooltip as shown below.



The **Table List** field displays any table/view that matches the specified.

If the source endpoint supports view selection, an additional **Type** column indicates whether the database object is a table or a view.

6. Click **OK**.

## Selecting Specific Tables/Views for Replication

This topic walks you through selecting tables/views to replicate in full. It assumes that you have already searched for the tables/views to use in the replication task. If you have not, start here: [Searching for Tables/Views to use in a Replication Task](#)

When you explicitly select tables/views, all selected tables/views are replicated in full unless you define transformations or filters for the table/view. If you need to make changes to the table/view structures in the target endpoint or if you only want to select specific columns, then you need to perform the procedures described in [Defining Transformations for a Single Table/View](#) and [Using Filters](#) respectively.

### To explicitly select tables/views for replication:

1. In the **Select Tables** dialog box, from the **Table List** field, select one or more tables that you want to include in the replication task.
2. To select a table, click the button with a single right-facing arrowhead (**Add**).  
To select all tables in the **Table List**, click the button with two right-facing arrowheads (**Add All**).  
The selected tables are added to the **Selected Tables** list.
3. Click **OK** to close the **Select Tables** or **Select Tables/Views** dialog box.
4. Click **Save** to make sure that Attunity Replicate saves the table information for this task.

**Note** If you rename a table in the database, the **Designer** tab will still show the original table name. The **Monitor** tab, on the other hand, will show the new table name.

## Removing Specific Tables/Views from a Replication Task

This topic walks you through removing specific tables/views from the replication task.

### To remove tables from the Selected Tables list:

1. From the **Selected Tables** list, select a table that you want to remove from the replication task and then click the button with a single left-facing arrowhead (**Remove**).
2. To remove all of the tables/views from the **Selected Tables** or **Selected Tables/Views** list, click the button with two left-facing arrowheads (**Remove All**).
3. Click **OK** to close the **Select Tables** or **Select Tables/Views** dialog box.
4. Click **Save** to make sure that Attunity Replicate saves the table information for this task.

## Creating Table/View Selection Patterns

This topic walks you through selecting tables/views using patterns. For example, you can include all tables/views that belong to the HR schema except for one or two tables/views that you exclude. You can also only exclude one or more table/view schemas or tables/views. This replicates the entire endpoint, except for those tables/views that you excluded.

The following example shows a pattern that replicates all tables that are members of the HR schema except for the HR.EMPLOYEES table.

```
Include HR.%  
Exclude HR.EMPLOYEES%
```

You can also use the "\_" wildcard character to match a single character. For example, specifying `Exclude m_d%` will exclude all tables that begin with `m` and end with `d%`, such as `model` or `msdb`.

When you explicitly select tables/views, all selected tables/views are replicated in full unless you define transformations or filters for the table/view. If you need to make changes to the table/view structures in the target endpoint or if you only want to select specific columns, then you need to perform the procedures described in [Defining Transformations for a Single Table/View](#) and [Using Filters](#) respectively.

**Note** To view all of the tables/views included when you use a table selection pattern, click the **Full Table List** tab in Designer view. The **Full Table List** lists all of the tables/views included in any table pattern you defined as well as all explicitly selected tables/views. To view only patterns and explicitly selected tables/views, click the **Patterns and Selected Tables** tab in Designer view.

### To create table/view selection patterns:

1. In the Designer view, in the **Select Tables/Views** dialog box, do any of the following:
  - » Select a schema from the **Schema** drop-down list. All tables/views that belong to that schema are included in the table/view selection pattern.
  - » Type the name or partial name of a table/view in the **Table/View** field. Any string that you enter here is included in the table/view selection pattern.
  - » If the table/view that you type here is a member of the schema you selected in the **Schema** drop-down list, then you only have to type the name of the table/view.
  - » If you did not select a schema or the table/view belongs to another schema, include the schema with the table name in the following format: `HR.Employees`, where `HR` is the schema.
2. Click **Include** to include all of the tables/views that match the selection criteria.
3. Click **Exclude** to exclude any tables that match the selection criteria.
4. Click **OK** to close the **Select Tables/Views** dialog box.
5. Click **Save** to make sure that Attunity Replicate saves the table/view information for this task.

## Setting Load Order

You can set the load order for each of the selected tables. This may be useful, for example, if your selected tables list contains tables of different sizes and you want the smaller tables to be loaded before the larger tables. When a group of tables are set with the same load order, Replicate will load the tables according to the table ID.

Load order can be set and modified (see [note](#) below) in the following places:

- » The **Select Tables** window (opened in Designer view by clicking the **Table Selection** button in the right of the console).
- » The **Patterns and Selected Tables** list in the right of the console (in Designer view).

### Notes

- » Load order cannot be changed during a task. If you want to change the load order, first stop the task, then change the load order as desired, and finally reload the target.
- » Load order cannot be set for table patterns.

### To set the load order for a specific table

1. Select the desired table in the **Selected Tables** list.
2. From the **Load Order** drop-down list, select one of the available priority levels (Lowest Priority, Low Priority, Normal Priority, High Priority, and Highest Priority).

3. This step is only relevant if you are setting load order in the **Select Tables** window.  
Click **OK** to save your settings and close the **Select Tables** window.

#### To set the same load order for multiple tables

1. Select the desired tables in the **Selected Tables** list.
2. From any of the selected items' **Load Order** drop-down list, select one of the available priority levels.
3. This step is only relevant if you are setting load order in the **Select Tables** window.  
Click **OK** to save your settings and close the **Select Tables** window.

## Providing a Task Description

You can provide a description for specific tasks and then easily view or edit that description as required.

#### To provide, view or edit a task description:

1. Open the desired task.
2. In Designer or Monitor view, click the **Description** toolbar button.
3. Enter a description.  
-OR-  
Edit or view an existing description.
4. Click **OK**.

## Editing a Replication Task

You can make changes to tasks that you previously created. Just open the task and make the changes in the same way that you did when you created the task.

#### To edit a task:

1. In **Tasks** view, select the task and click **Open**.  
The task opens, displaying the source and target endpoints and which tables have been selected for replication.
2. Continue with any of the following procedures:
  - » [Adding a Source and Target Endpoint to a Task](#)
  - » [Adding Tables and/or Views to a Task](#)
  - » [Defining Transformations for a Single Table/View](#)

- » [Using Filters](#)
- » [Task Settings](#)

## Searching for Tasks

In **Tasks** view, you can search for tasks by typing a sequence of letters in the **Filter Tasks** box above the tasks. For example, to search for all tasks with names that begin with "Oracle-to", type "or". Only tasks that match the search string are displayed.

## Deleting a Replication Task

You can delete tasks that you created. To prevent complications, it is recommended that you not use the name of a deleted task for a new task you create. Such a task would be created with the same settings as the deleted task.

**Note** If you use a Microsoft SQL Server endpoint, a Microsoft SQL Server system administrator must delete the Microsoft SQL Server Replication Publisher definitions for the endpoint that was used in the task from SQL Server.

For more information, see the [Limitations](#) in the Microsoft SQL Server chapter.

### To delete a task:

1. Stop the task that you want to delete.
2. In **Tasks** view, click **Delete**.

The task is deleted.

## Exporting and Importing Tasks

You can export replication tasks to a file. When exporting a task using the command line, all exported tasks are saved to the **imports** folder under <product\_dir>/Attunity/Replicate/Data. When exporting a task using the Attunity Replicate Console, one of the following occurs (according to your browser settings):

- » The task JSON file will be automatically downloaded to the default download location
- » You will be prompted for a download location

You can import an export file (\*.json) to another instance of the Attunity Replicate Server. This lets you use a task that you created in Attunity Replicate in a different environment. For example, if you created tasks in a development environment and now want to use the task in a production environment.

Importing and exporting a task can be done using either the command line or the Attunity Replicate Console. When exporting or importing a task using the command line, you must perform this task on the computer where Attunity Replicate is installed.

**Note** If you need to access the computer with Attunity Replicate from a remote computer, you can use a telnet connection.

When you export a task to a different environment, you may need to edit the task information. For example, you may need to change the connection string for an endpoint.

- » [Exporting Tasks](#)
- » [Editing an Exported \(json\) File](#)

## Exporting Tasks

The following section explains how to export a task using either the Attunity Replicate Console or the command line.

### To export a task using the Attunity Replicate Console:

1. Switch to **Tasks** view (make sure you're in **Designer** mode).
2. Do one of the following:
  - » In **TASKS** tab, select the task you want to export and then either click the **Export** toolbar button or right-click the task and select **Export**.  
-OR-
  - » In the **TASK\_NAME** tab (opened when a task is being edited), click the **Export Task** toolbar button.

Depending on your browser settings, one of the following will occur:

- » The task JSON file will be automatically downloaded to the default download location
- » You will be prompted for a download location. In this case, save the JSON file to your preferred location.

### To export a task using the command line:

1. From the Attunity Replicate computer where you defined the task you want to import, open the Attunity Replicate command line console by doing the following:

**On Windows:** Go to **All Programs** in the **Start** menu and point to **Attunity Replicate**, then to **Utilities** and then select **Attunity Replicate Command Line**.

A command-line console is displayed with the correct prompt for Attunity Replicate.

**Note:** You can also open the Windows command-line console and change the directory to the following:

<Full path to the Attunity Replicate root folder>\bin

For example, to use the path to the folder or directory where Attunity Replicate is installed by default, type: C:\Program Files\Attunity\Replicate\bin.

**On Linux:** Run the following command in the Replicate **bin** directory:

```
source ./arep_login.sh
```

2. At the prompt in the command-line console, type the following:

```
repctl -d data-directory exportrepository task=task_name [folder_name=path]
```

By default, a file called <task\_name>.json containing the exported task settings is created in the <product\_dir>\data\imports folder. If you want the file to be created in a different folder, include the `folder_name=path` parameter in the command.

After the file has been created, you can import it into another Attunity Replicate instance as described in [Importing Tasks](#).

**Note** If the <product\_dir>\data folder was installed in a non-default location during the installation - OR - if it was later moved to a non-default location, you need to tell Replicate where the folder is located.

This is done by including the `-d <data_folder>` parameter in the command.

Example:

```
repctl -d D:\Data exportrepository task=mytask
```

## Importing Tasks

The following section explains how to import a task using either the Attunity Replicate Console or the command line.

### To import a task using the Attunity Replicate Console:

1. Switch to **Tasks** view (make sure you're in **Designer** mode).
2. Click the **Import Task** toolbar button.  
The **Import Task** dialog box opens.
3. Browse to the task JSON file you want to import and then click **Import Task**.  
The task is imported.

### To import a task using the command line:

1. From the Attunity Replicate computer where you want to export the task, open the Attunity Replicate command line console by doing the following:  
Go to **All Programs** in the **Start** menu and point to **Attunity Replicate**, then to **Utilities** and then select **Attunity ReplicateCommand Line**.  
A command-line console is displayed with the correct prompt for Attunity Replicate.

**Note** You can also open the Windows command-line console and change the directory to the following:

```
<product_dir>\Attunity Replicate>\bin
```

For example to use the path to the directory where Attunity Replicate is installed by default, type: C:\Program Files\Attunity\Replicate\bin.

2. At the prompt in the command-line console, type the following:

```
repctl -d data-directory importrepository json_file=<Full path to the  
exported *.json file>
```

**Example:**

```
repctl -d data-directory importrepository json_file=C:\Temp\many_tables
```

**Important:** The name of the JSON file must be specified *without* the .JSON extension.

The export utility automatically appends the extension .JSON to exported files, thus eliminating the need to add the extension manually.

The exported \*.json file will be located in the <data-directory>\imports folder or directory on the original computer where the task was exported or in the folder specified by the folder\_name parameter in the export command.

**Example:**

```
<product_dir>\data\imports\many_tables.json
```

**Note** If the <product\_dir>\data folder was installed in a non-default location during the installation - OR - if it was later moved to a non-default location, you need to tell Replicate where the folder is located.

This is done by including the -d <data\_folder> parameter in the command.

**Example:**

```
repctl -d D:\MyData importrepository json_file=C:\mytask.json
```

If you are importing this task into a different environment, you should copy the file to a location on the second Attunity Replicate computer and then import the file from there.

In many cases, when you import the task into a different environment, you will need to make changes to the task. For example, you may need to change the connect strings for the endpoints in the task or change the user password. In that case, you will need to edit the \*.json file.

See [Editing an Exported \(json\) File](#) for more information.

## Editing an Exported (json) File

You can open the \*.json file in any plain text editor. It is possible to make changes to any of the sections in the file; however, be sure that you only change the data and not the field names. For example, the entry "name": "DB\_Name" displays the name field for a source table in a defined endpoint. In this case, you can change the data "DB\_Name" but not the included metadata ("name").

**Important:** Make any changes to the \*.json file *before* you carry out the import operation.

**Note** Information about the endpoints, tables, tasks, task settings, and logger settings should be changed using the Attunity Replicate Console after the file is imported.

To be able to use the new task, you will need to make changes to the endpoint password and connection strings by editing the \*.json file. See [Making Changes to the Endpoint Connection Information](#) for more information.

## Making Changes to the Endpoint Connection Information

In the "endpoints" section, you can make changes to the connection string and the password. The following is an example of the "endpoints" section of the \*.json file.

```
"endpoints": [ {  
    "name": "Oracle_Source",  
    "type": "Oracle",  
    "connection_string": "server= bee01-xp:1521/xe;username=SYSTEM",  
    "authenticator": "  
{01000000D08C9DDF0115D1118C7A00C04FC297EB010000003EA495B32CAAE14CB9777B96B3  
CC00B300000000002000000000003660000A800000100000002765A3287AB56447DA31508F7  
1CE62700000000004800000A000000100000088D5C1BBD615BEEEAF5FAC1B9B0E20800800  
00075D89177A9C6F11B1400000047B3110B80920DD9EB0A5FABA05679979B78DD0}",  
    "role": "SOURCE"  
}, {  
    "name": "SQLSERVER_Target",  
    "type": "SQLServer",  
    "connection_string": "server=bee01-  
xp;endpoint=tempdb;WindowsAuthentication=Y;CDCBCP=Y;FullloadBCP=Y;BCPPacket  
Size=16384",  
    "role": "TARGET"
```

### To change the connect string:

1. In the \*.json file, under "endpoints", find "connection string".

For example, "connection\_string": "server=bee01:1521/xe;username=SYSTEM".

2. Change the information after the equal signs (=) as necessary.

For example, if the endpoint in the new environment is on a computer called B2, change server=bee01 to server=B2.

**Important:** Make sure that the connect string remains between the quotation marks (").

### To change an endpoint password:

1. In the \*.json file, under "endpoints", find "authenticator".

For example, "authenticator": "  
{01000000D08C9DDF0115D1118C7A00C04FC297EB010000003EA495B32CAAE14CB9777B  
96B3CC00B3000000000200000000003660000A8000000100000002765A3287AB56447D  
A31508F71CE62700000000004800000A0000001000000088D5C1BBD615BEEEA5FAC1B  
9B0E2080080000075D89177A9C6F11B140000047B3110B80920DD9EB0A5FABA056799  
79B78DD0}".

**Note** The password is presented as an encrypted string.

2. Change the password string to the relevant password for the endpoint in the new environment. Type the new password using plain text exactly as it is configured in the endpoint. For example, 8yTkLMt.

When you save the file and then import it to the new environment, the password is encrypted automatically.

# 8 | Adding and Managing Source Endpoints

This chapter describes how to configure source endpoint settings.

## In this chapter:

- [Using Oracle as a Source](#)
- [Using Microsoft SQL Server as a Source](#)
- [Using SAP Sybase ASE as a Source](#)
- [Using a MySQL-Based Database as a Source](#)
- [Using Hadoop as a Source](#)
- [Using Teradata Database as a Source](#)
- [Using PostgreSQL as a Source](#)
- [Using a File as a Source](#)
- [Using ODBC with CDC as a Source](#)
- [Using IBM Informix as a Source](#)
- [Using IBM DB2 for LUW as a Source](#)
- [Using IBM DB2 for iSeries as a Source](#)
- [Using IBM DB2 for z/OS as a Source](#)
- [Using IBM Netezza as a Source](#)
- [Using SAP Application as a Source](#)
- [Using SAP HANA as a Source](#)
- [Using ODBC to Connect to a Source](#)
- [Using ARC CDC Solutions in Attunity Replicate](#)

# Using Oracle as a Source

This section describes how to set up and use an Oracle database as a source in a replication task.

## In this section:

- [Supported Oracle Database Editions](#)
- [Prerequisites](#)
- [Limitations](#)
- [Required Permissions](#)
- [Supported Encryption Methods](#)
- [Supported Compression Methods](#)
- [Redo Log Files - Access Method Guidelines](#)
- [Handling Shrink Space Operations](#)
- [Replicating Nested Tables](#)
- [Oracle Source Data Types](#)
- [Non-Supported Data Types](#)
- [Homogeneous Replication](#)
- [Preparing the Oracle Database for Replication](#)
- [Setting General Connection Properties](#)
- [Setting Advanced Connection Properties](#)
- [Finding the Wallet Entries used for TDE Encryption](#)

## Supported Oracle Database Editions

Before you begin to work with an Oracle database as a source or target in Attunity Replicate, make sure that the Oracle database with the tables that are necessary for replication is available in your system. Attunity Replicate supports the following Oracle database editions:

- » Oracle Enterprise Edition
- » Oracle Standard Edition
- » Oracle Express Edition
- » Oracle Personal Edition

## Prerequisites

Before you can work with an Oracle endpoint, make sure the prerequisites listed in this section have been met.

- » On Windows systems, install Oracle Instant Client for Microsoft Windows (x64) Version 11.2.0.3.0 and above.

**Note** Support for the XMLTYPE data type requires the full Oracle Client.

- » On Linux systems, install Oracle Instant Client for Linux (x86-64) Version 11.2.0.3.0 and above.

**Note** Support for the XMLTYPE data type requires the full Oracle Client.

In addition, if not already included in your system, you need to create a symbolic link in the \$Oracle\_Home\lib directory. This link should be called libclntsh.so, and should point to a specific version of this file.

For example, on an Oracle 12c client:

```
lrwxrwxrwx 1 oracle oracle 63 Oct 2 14:16 libclntsh.so ->
/u01/app/oracle/home/lib/libclntsh.so.12.1
```

Additionally, append the LD\_LIBRARY\_PATH environment variable to the Oracle lib directory by copying the driver location to the site\_arep\_login.sh file as follows:

```
echo "export LD_LIBRARY_PATH=$LD_LIBRARY_
PATH:/u01/app/oracle/home/lib/" > site_arep_login.sh
```

## Limitations

The following limitations apply:

- » Long object names (over 30 bytes) are not supported.
- » Function-based indexes are not supported.
- » If you are managing supplemental logging and you carry out transformations on any of the columns, you must be sure that supplemental logging is activated for all fields and columns.
- » The AR\_H\_USER header column is supported only for Oracle database version 11.2.0.3 and higher. In Oracle database version 10, the value for this column may not be correct. For information on using header columns, see [Headers](#).
- » Connecting to a CDB is not supported.
- » The rename table <table name> to <new table name> syntax is supported by Attunity Replicate when using Oracle version 11 and higher.
- » Data changes resulting from partition/sub-partition operations (ADD, DROP, EXCHANGE and TRUNCATE) will not be replicated and may cause the following errors:
  - » For ADD operations, updates and deletes on the added data may return a "0 rows affected" warning.
  - » For DROP and TRUNCATE operations, new inserts may result in "duplicates" errors.

- » For EXCHANGE operations, both a "0 rows affected" warning and "duplicates" errors may be encountered.

To replicate changes resulting from partition/sub-partition operations, you need to reload the tables in question. When adding a new *empty* partition, operations on the newly added partition will be replicated to the target as normal.

- » Data changes resulting from the "CREATE TABLE AS..." statement is not supported. However, the new table *will* be created on the target.
- » When Limited-size LOB mode is enabled, empty LOBs on the Oracle source are replicated as NULL values. For more information on Limited-size LOB mode, see Task Settings|[Metadata](#).
- » Changes made by the Oracle DBMS\_REDEFINITION package - e.g. table metadata and the OBJECT\_ID) - will not be captured by Attunity Replicate.
- » To enable change processing from an Oracle standby database, the database must be a physical standby database with Active Data Guard enabled (available from Oracle 11g and above).
- » Empty BLOB/CLOB columns are mapped to NULL on the target.
- » During Change Processing, columns without supplemental logging that are not updated will be inserted as NULL in the Change Table.
- » During Change Processing, batch updates to numeric columns defined as a Primary Key are not supported.

Example of an unsupported UPDATE command:

```
UPDATE tableX set ID=ID+1;
```

Where `tableX` is the table name and `ID` is a numeric column defined as a Primary Key.

- » Data in LONG and LONG RAW column cannot exceed 64k. Any data that is larger than 64k will be truncated.
- » Tables whose names contain apostrophes cannot be replicated.
- » Change Data Capture (CDC) is not supported from dynamic views.
- » When running a Full Load and Apply Changes task on a physical standby Oracle database, Replicate may not be able to properly synchronize the Full Load and Appy Changes processes, which could result in missing operations.
- » Index-organized tables with an overflow segment are not supported in Change Processing (CDC) tasks.
- » Replicating from a Hot Standby database is not supported.
- » When using Oracle LogMiner to access the redo logs, the following limitations apply:
  - » In Oracle 12 only, *any* changes to LOB columns are not supported (i.e. replicated).
  - » UPDATEs to XMLTYPE and LOB columns are not supported (i.e. replicated).
  - » The DDL statement `ALTER TABLE ADD <column> <data_type> DEFAULT <>` does not replicate the default value to the target and the new column is set to NULL. Note that this may happen even if the DDL that added the column was executed in the past. If the new column is nullable, Oracle updates all the table rows before logging the DDL itself. As a result, Attunity Replicate captures the changes but

does not update the target. As the new column is set to NULL, if the target table has no Primary Key/Unique Index, subsequent updates will generate a "zero rows affected" message.

- » SHRINK SPACE operations are not supported
- » Connecting to a PDB using Oracle LogMiner is not supported. Therefore, if you want to connect to a PDB, make sure that the **Access redo logs via Attunity Log Reader** option is selected in the **Advanced** tab.
- » When using Attunity Log Reader to access the redo logs, the following limitations apply:
  - » Table clusters are not supported.
  - » Only table-level SHRINK SPACE operations are supported. These include the full table, partitions, and sub-partitions.
  - » Implementing online redo logs on raw devices is not supported.
  - » Changes to Index-organized tables with key compression are not supported.

## Required Permissions

In this section:

- » [General Permissions](#)
- » [Access Privileges when using Oracle LogMiner to Access the Redo Logs](#)
- » [Access Privileges when using Attunity Log Reader to Access the Redo Logs](#)
- » [Required ASM Privileges](#)

### General Permissions

To use an Oracle source in an Attunity Replicate task, the user specified in the Attunity Replicate Oracle endpoint connection settings must be granted the following privileges in the Oracle database:

**Note** If any of the required privileges cannot be granted to a V\$xxx, then grant them to the V\_\$.xxx.

- » SELECT ANY TRANSACTION
- » SELECT on V\_\$ARCHIVED\_LOG
- » SELECT on V\_\$LOG
- » SELECT on V\_\$LOGFILE
- » SELECT on V\_\$DATABASE
- » SELECT on V\_\$THREAD
- » SELECT on V\_\$PARAMETER
- » SELECT on V\_\$NLS\_PARAMETERS
- » SELECT on V\_\$TIMEZONE\_NAMES

- » SELECT on V\_\$TRANSACTION
- » SELECT on ALL\_INDEXES
- » SELECT on ALL\_OBJECTS
- » SELECT on DBA\_OBJECTS - Required if the Oracle version is earlier than 11.2.0.3.
- » SELECT on ALL\_TABLES
- » SELECT on ALL\_USERS
- » SELECT on ALL\_CATALOG
- » SELECT on ALL\_CONSTRAINTS
- » SELECT on ALL\_CONS\_COLUMNS
- » SELECT on ALL\_TAB\_COLS
- » SELECT on ALL\_IND\_COLUMNS
- » SELECT on ALL\_LOG\_GROUPS
- » SELECT on SYS.DBA\_REGISTRY
- » SELECT on SYS.OBJ\$
- » SELECT on SYS.ENC\$
- » SELECT on DBA\_TABLESPACES
- » SELECT on ALL\_TAB\_PARTITIONS
- » SELECT on ALL\_ENCRYPTED\_COLUMNS
- » If views are exposed: SELECT on ALL\_VIEWS

Grant the following additional privilege (for each replicated table) when you are using a specific table list:

- » SELECT on <any-replicated-table>;

Grant the following additional privilege when using a pattern for the table list:

- » SELECT ANY TABLE;

Grant the following additional privilege (for each replicated table) when Attunity Replicate adds supplemental logging automatically (the default behavior) and you are using a specific table list. For information on how to turn off supplemental logging, see [Setting Advanced Connection Properties Using Oracle LogMiner](#)[Setting Advanced Connection Properties Using Oracle LogMiner](#).

- » ALTER on <any-replicated-table>;

Grant the following additional privilege when Attunity Replicate adds supplemental logging automatically (the default behavior). For information on how to turn off supplemental logging, see [Setting Advanced Connection Properties Using Oracle LogMiner](#)[Setting Advanced Connection Properties Using Oracle LogMiner](#).

- » ALTER ANY TABLE;

## Access Privileges when using Oracle LogMiner to Access the Redo Logs

If you are using Oracle LogMiner to access the Redo logs, grant the following privileges.

- » CREATE SESSION
- » EXECUTE on DBMS\_LOGMNR
- » SELECT on V\_\$LOGMNR\_LOGS
- » SELECT on V\_\$LOGMNR\_CONTENTS
- » LOGMINING

**Note** This privilege is only required for Oracle 12c and above.

## Access Privileges when using Attunity Log Reader to Access the Redo Logs

The following privileges should be granted when using Attunity Log Reader to access the Redo logs:

- » CREATE SESSION
- » SELECT on v\_\$transportable\_platform

Grant the SELECT on v\_\$transportable\_platform privilege if the Redo logs are stored in ASM and accessed by Replicate from ASM.

- » CREATE ANY DIRECTORY

Attunity Replicate uses following Oracle file access features:

- » BFILE read - Used when Replicate does not have file-level access to the Redo logs, and the Redo logs are not accessed from ASM.
- » DBMS\_FILE\_TRANSFER package - Used to copy the Redo log files to a temporary folder (in which case the EXECUTE ON DBMS\_FILE\_TRANSFER privilege needs to be granted as well)
- » DBMS\_FILE\_GROUP package - Used to delete the Redo log files from a temporary/alternate folder (in which case the EXECUTE ON DBMS\_FILE\_GROUP privilege needs to be granted as well).

Oracle file features work together with Oracle directories. Each Oracle directory object includes the name of the folder containing the files which need to be processed.

If you want Replicate to create and manage the Oracle directories, you need to grant the CREATE ANY DIRECTORY privilege specified above. Note that the directory names will be prefixed with attu\_. If you do not grant this privilege, you need to create the corresponding directories manually. If you create the directories manually and the Oracle user specified in the Oracle Source endpoint is not the user that created the Oracle Directories, grant the READ on DIRECTORY privilege as well.

If the Oracle source endpoint is configured to copy the Redo log files to a temporary folder, and the Oracle user specified in the Oracle source endpoint is not the user that created the Oracle directories, the following additional privileges are required:

- » READ on the Oracle directory object specified as the source directory
- » WRITE on the directory object specified as the destination directory in the copy process

See also: [Setting Advanced Connection Properties](#).

## Required ASM Privileges

The following section describes the additional permissions that are required when the redo logs are stored in ASM.

Grant the following read privilege:

```
SELECT ON v$transportable_platform
```

From Oracle 11g Release 2 (11.2.0.2), Attunity Replicate must be granted the SYSASM privilege in order to access the ASM account. For older supported versions, granting Attunity Replicate the SYSDBA privilege should be sufficient.

**Note** When connecting to ASM, Attunity Replicate will first try to log in as SYSDBA and, if unsuccessful, will try to log in as SYSASM.

You can validate ASM account access by opening a command prompt and issuing the following statements:

```
sqlplus asmuser/asmpassword@+asmserver as sysdba
```

-OR-

```
sqlplus asmuser/asmpassword@+asmserver as sysasm
```

## Supported Encryption Methods

The table below lists which encryption methods Attunity Replicate supports when working with an Oracle source database.

**Table 8.1 | Supported Oracle Encryption Methods**

Redo Logs Access Method	TDE Tablespace	TDE Column
Attunity Log Reader	Yes	Yes
Oracle LogMiner	Yes	Yes

## Supported Compression Methods

The table below lists which compression methods Attunity Replicate supports when working with an Oracle source database. As the table shows, compression support depends both on your Oracle database version and whether or not Attunity Replicate is configured to use Oracle LogMiner to access the redo logs.

**Table 8.2 | Supported Oracle Compression Methods**

Version	Basic	OLTP	HCC (from Oracle 11g R2)	Others
Oracle 10	No	n/a		No
Oracle 11 and above - Attunity Log Reader	Yes	Yes	Yes See <a href="#">Note</a> below.	No
Oracle 11 and above - Oracle LogMiner	Yes	Yes	Yes	*Yes

\*Any compression method supported by Oracle LogMiner

**Note** When the Oracle source endpoint is configured to use Attunity Log Reader, the Query Low level of the HCC compression method is only supported in the **Full Load** task mode.

## Redo Log Files - Access Method Guidelines

The Replicate Oracle source endpoint can be configured to access online and archived Oracle redo log files using either Oracle LogMiner (Oracle's built-in method) or Attunity Log Reader (Replicate's high-speed redo log reader).

Generally, it is recommended to use Attunity Log Reader as it is more efficient, faster, and uses less resources.

Attunity Log Reader is especially recommended in the following situations:

- » The volume of changes in the redo log is more than 30GB/hour
- » The volume of changes is between 10GB/hour and 30GB/hour and the changes need to be processed (i.e. replicated to the target) as fast as possible.
- » There are multiple tasks replicating from the same source. Using Oracle LogMiner is less efficient in this case, as it accesses the redo logs via the database, thereby consuming additional database resources.

Both Attunity Log Reader and Oracle LogMiner are subject to certain [limitations](#), support different [compression methods](#), and require different [access permissions](#). It is therefore strongly recommended to review the relevant sections before configuring the endpoint settings. In the end, your decision whether to use Attunity Log Reader or Oracle LogMiner may be based on a limitation that exists in one but not the other, the way your data is compressed, or the permissions that you are willing to grant the Replicate user.

## Handling Shrink Space Operations

When a SHRINK SPACE operation occurs, Replicate will capture all of the changes logged to the redo log as a result of the operation and ignore them.

The following message will appear in the task's log file:

Operations generated by the SHRINK SPACE process were ignored.

### Monitoring Considerations:

When Replicate captures changes resulting from a SHRINK SPACE operation, the task's Incoming Changes bar will indicate an unusually large number of changes. However, these changes will not be reflected in the Applied Changes pie chart or the Applied Changes Details table.

See also the [Limitations](#) section for the limitations related to SHRINK SPACE operations in Attunity Log Reader and LogMiner mode.

## Replicating Nested Tables

Replicate supports the replication of Oracle tables containing columns that are nested tables or defined types. To enable this functionality, select the **Support nested tables** option in the **Advanced** tab.

Replicate creates the target tables of Oracle nested tables as regular tables without a unique constraint. As you will most likely need join the parent and child tables for meaningful data, it is important to manually create a non-unique index on the **NESTED\_TABLE\_ID** column in the target child table. The **NESTED\_TABLE\_ID** column can then be used in the JOIN ON clause, together with the parent column corresponding to the child table name. Additionally, creating such an index will improve performance when the target child table data is updated/deleted by Replicate.

It is recommended to [configure the task to stop after Full Load completes](#). After Full Load completes, manually create non-unique indexes for all the replicated child tables on the target, and then resume the task.

If a captured nested table is added to an existing parent table (captured or not captured), Replicate will handle it correctly, but the non-unique index for the corresponding target table will not be created. Note that in this case, if the target child table becomes extremely large, performance may be impacted. In such a case, it is recommended to stop the task, create the index, and then resume the task.

After the nested tables are replicated to the target, the DBA will need to [run a JOIN statement](#) on the parent and corresponding child tables in order to flatten the data.

## Prerequisites

Make sure that you replicate parent tables for all the replicated nested tables. Both the parent tables (the tables containing the nested table column) and the child (i.e. nested) tables will be available for selection in Replicate.

## Supported Nested Table Types

The following nested table types are supported:

- » Data type
- » User defined Object

## Limitations

- » Only one level of nesting is supported.
- » Replicate does not verify that both the parent and child table(s) are selected for replication. In other words, it's possible to select a parent table without a child and vice versa.

## How Nested Tables are Replicated

The parent and nested tables are replicated to the target as follows:

- » The parent table is created identical to the source. The nested column will be defined as RAW(16) and contain a reference to its nested tables in the **NESTED\_TABLE\_ID** column.
- » The child table is created identical to the source, but with an additional column named **NESTED\_TABLE\_ID** with the same type as the parent nested column and with the same meaning.

## JOIN Statement Example

To flatten the parent table, the DBA should run a JOIN statement between the parent and child tables, as shown in the following example:

### **Creating the Type table:**

```
CREATE OR REPLACE TYPE my_tab_t AS TABLE OF VARCHAR2(30);
```

**Creating the parent table with a column of type my\_tab\_t that was defined above:**

```
CREATE TABLE my_parent_table (id NUMBER PRIMARY KEY, col1 my_tab_t) NESTED
TABLE col1 STORE AS col1_tab;
```

**Flattening the my\_parent\_table:**

```
Select ... from my_parent_table parent, col1_tab child where child.nested_
table_id = parent.col1
```

## Oracle Source Data Types

The Oracle database for Attunity Replicate supports most Oracle data types. The following table shows the Oracle source data types that are supported when using Attunity Replicate and the default mapping to Attunity Replicate data types.

For information on how to view the data type that is mapped in the target, see the section for the target database you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 8.3 | Supported Oracle Data Types with Mapping to Attunity Replicate Data Types**

Oracle Data Types	Attunity Replicate Data Types
BINARY_FLOAT	<b>REAL4</b>
BINARY_DOUBLE	<b>REAL8</b>
BINARY	<b>BYTES</b>
FLOAT (P)	<b>REAL8</b>
NUMBER (P,S)	When scale is < 0: <b>REAL8</b>
NUMBER according to the "Expose number as" property in the Attunity Replicate Oracle source database settings.	When scale is 0 and: Precision = 0: <b>REAL8</b> Precision < or = 2: <b>INT1</b> Precision >2 and <or = 4: <b>INT2</b> Precision >4 and <or = 9: <b>INT4</b> Precision > 9: <b>NUMERIC</b> If precision > or = scale: <b>NUMERIC</b> In all other cases: <b>REAL8</b>
DATE	<b>DATETIME</b>
INTERVAL_YEAR TO MONTH	<b>STRING (with interval year_ to_month indication)</b>
INTERVAL_DAY TO SECOND	<b>STRING (with interval day_to_</b>

**Table 8.3 | Supported Oracle Data Types with Mapping to Attunity Replicate Data Types (Cont.)**

Oracle Data Types	Attunity Replicate Data Types
TIMESTAMP	<b>second indication)</b>
TIMESTAMP WITH TIME ZONE	<b>DATETIME</b>
TIMESTAMP WITH LOCAL TIME ZONE	<b>STRING (with timestamp_with_timezone indication)</b>
CHAR	<b>STRING</b>
VARCHAR2	<b>STRING</b>
NCHAR	<b>WSTRING</b>
NVARCHAR2	<b>WSTRING</b>
RAW	<b>BYTES</b>
REAL	<b>REAL8</b>
BLOB	<b>BLOB</b>
To use this data type with Attunity Replicate, you must enable the use of BLOBS for a specific task.	
BLOB data types are supported only in tables that include a primary key.	
For more information, see <b>LOB support in Task Settings/Metadata</b> .	
CLOB	<b>CLOB</b>
To use this data type with Attunity Replicate, you must enable the use of CLOBs for a specific task.	
During CDC, CLOB data types are supported only in tables that include a primary key.	
For more information, see <b>LOB support in Task Settings/Metadata</b> .	
NCLOB	<b>NCLOB</b>
To use this data type with Attunity Replicate, you must enable the use of NCLOBs for a specific task.	
During CDC, NCLOB data types are supported only in tables that include a primary key.	
For more information, see <b>LOB support in Task Settings/Metadata</b> .	

**Table 8.3 | Supported Oracle Data Types with Mapping to Attunity Replicate Data Types (Cont.)**

Oracle Data Types	Attunity Replicate Data Types
LONG	<b>CLOB</b>
<p>The LONG data type is not supported in <a href="#">Batch Optimized Apply</a> mode.</p> <p>To use this data type with Attunity Replicate, you must enable the use of LOBs for a specific task.</p> <p>During CDC, LOB data types are supported only in tables that have a primary key.</p> <p>For more information, see <a href="#">LOB support in Task Settings/Metadata</a>.</p>	
<p>LONG RAW</p> <p>The LONG RAW data type is not supported in <a href="#">Batch Optimized Apply</a> mode.</p> <p>To use this data type with Attunity Replicate, you must enable the use of LOBs for a specific task.</p> <p>During CDC, LOB data types are supported only in tables that have a primary key.</p> <p>For more information, see <a href="#">LOB support in Task Settings/Metadata</a>.</p>	<b>BLOB</b>
XMLTYPE	<b>CLOB</b>

#### Notes

- » When replicating XML columns, performance can be improved by *not* using the Oracle 12 client.
- » Support for the XMLTYPE data type requires the full Oracle Client (as opposed to the Oracle Instant Client).

When the target column is a CLOB, both full LOB mode and limited LOB mode are supported (depending on the target).

For more information, see [LOB support in Task Settings/Metadata](#).

## Non-Supported Data Types

Columns with the following data types are not supported and will not be replicated:

- » BFILE
- » ROWID
- » REF
- » UROWID
- » ANYDATA
- » SDO\_Geometry
- » Nested Table
- » User-defined data types

### Note

- » Virtual columns are not supported.
- » As the ROWID data type is not supported, materialized views based on a ROWID column are also not supported.

## Homogeneous Replication

With the exception of the LONG and LONG RAW data types, when replicating from an Oracle source to an Oracle target, all of the source and target data types will be identical. The LONG data type will be mapped to CLOB and the LONG RAW data type will be mapped to BLOB. It should be noted that, as of Oracle 9.0, the LONG and LONG RAW data types are no longer supported by Oracle.

Additionally, Primary/Unique Index names are preserved during homogeneous replication.

**Note** In homogeneous replication, the source data first passes through the Attunity Replicate data type and is therefore subject to any limitations of that type.

For information on Replicate data types and their limitations (where relevant), see [Replicate Data Types](#).

For information on which Replicate data types the source data passes through when replicating from Oracle, see the Oracle to Attunity Replicate data types mapping table described earlier.

## Preparing the Oracle Database for Replication

The following topics describe the configuration requirements for using an Oracle database with Attunity Replicate as a source. An Oracle DBA should know how to carry out these tasks.

- » [Provide Oracle Account Access](#)
- » [Ensure that ARCHIVELOG Mode is On](#)
- » [Setting up Supplemental Logging](#)

### Provide Oracle Account Access

You must provide Oracle account access to the Attunity Replicate user. This user must have read/write privileges on the Oracle database. For information on setting up access to the Oracle account, see [Required Permissions](#).

### Ensure that ARCHIVELOG Mode is On

Oracle can be run in two different modes: the ARCHIVELOG mode and the NOARCHIVELOG mode. To use the Oracle logs with Attunity Replicate, run the database in ARCHIVELOG mode. If the log is not set to ARCHIVELOG mode, then execute the following query:

```
ALTER database ARCHIVELOG
```

Note that if your Oracle database instance is on Amazon RDS, a different command needs to be executed. For more information, see [Working with Oracle on Amazon RDS](#) and [Working with Oracle on Amazon RDS](#) in [Working with Oracle on Amazon RDS](#).

### Setting up Supplemental Logging

Supplemental logging must be enabled for the Oracle database.

**Note** You can automatically set up supplemental logging in the **Advanced** tab of the Oracle database dialog box. If you select this option, you do not have to carry out the following procedure. For more information, see [Setting Advanced Connection Properties Using Oracle LogMiner](#).

Set up supplemental logging as described in the steps below.

#### Step 1: Check that supplemental logging is enabled for the database

1. Run the following query:

```
SELECT name, value, description FROM v$parameter WHERE name =  
'compatible';
```

The returned result should be from GE to n.n.n where n.n.n is the Oracle database version (e.g. 10.0.0).

**Note** For Replicate to work, the parameter value must match the real version of the database.

2. Run the following query:

```
SELECT supplemental_log_data_min FROM v$database;
```

The returned result should be YES or IMPLICIT.

Enable supplemental logging by executing the following query:

```
ALTER DATABASE ADD SUPPLEMENTAL LOG DATA
```

**Note** If your Oracle database instance is on Amazon RDS, a different command needs to be executed. For more information, see [Working with Oracle on Amazon RDS](#).

## Step 2: Make sure that the required supplemental logging is added for each table

1. If a Primary Key exists, supplemental logging must be added for the Primary Key either by using the format to add supplemental logging on the Primary Key, or by adding supplemental logging on the Primary Key columns.
2. If no Primary Key exists and the table has a single Unique Index, then all of the Unique Index's columns must be added to the supplemental log. Using SUPPLEMENTAL LOG DATA (UNIQUE INDEX) COLUMNS does not add the Unique Index columns to the log.
3. If no Primary Key exists and the table has multiple Unique Indexes, Attunity Replicate will select the first Unique Index. Attunity Replicate will use the first index in an alphabetically ordered ascending list. Supplemental logging must be added on the selected index's columns. Using SUPPLEMENTAL LOG DATA (UNIQUE INDEX) COLUMNS does not add the Unique Index columns to the log.
4. If there is no Primary Key and no Unique Index, supplemental logging must be added on all columns.

**Note** When the target table Primary Key/Unique Index is different than the source table Primary Key/Unique Index, the user needs to add supplemental logging manually on the source table columns that comprise the target table Primary Key/Unique Index.

5. If you change the target table primary key, the supplemental logging must be added on the selected index's columns instead of the columns of the original primary key/unique index.

### Step 3: If a filter or transformation is defined for the table, additional logging might be necessary

**Note** If ALL COLUMNS supplemental logging has been added to the table, there is no need to add any additional logging.

If the table has a Unique Index or a Primary Key, you also need to add supplemental logging on each column that is involved in a filter or transformation (if those columns are different than the Primary Key or Unique Index columns).

**Note** If a transformation uses only one column, this column may not be added to a supplemental logging group. For example, "A+B" needs both columns to be added, whereas substring(A, 10) does not need "A" to be added.

One method of setting up both Primary Key/Unique Index supplemental logging and supplemental logging on specific columns is to add `USER_LOG_GROUP` supplemental logging only on the Primary Key/Unique Index columns and on the columns that are filtered or transformed.

For example, to replicate a table named `EXAMPLE.TABLE` with Primary Key ID and filter by column `NAME`, you can run a command similar to the one below to create the log group supplemental logging:

```
ALTER TABLE EXAMPLE.TABLE ADD SUPPLEMENTAL LOG GROUP example_log_group  
(ID,NAME) ALWAYS;
```

### Step 4: When the [Insert the missing target record Apply Conflicts option is selected](#), supplemental logging must be enabled for ALL the source table columns.

## Working with Oracle on Amazon RDS

Attunity Replicate supports Oracle 11.2.0.2.v7 and above on Amazon RDS as a source database and in Oracle LogMiner mode only. This section details the requirements for working with Oracle on Amazon RDS.

## Setting Up Supplemental Logging

Attunity Replicate requires database-level supplemental logging to be enabled. To enable database-level supplemental logging, execute the following command:

```
exec rdsadmin.rdsadmin_util.alter_supplemental_logging('ADD');
```

Although not required, examples of additional commands that you can execute to change the supplemental logging attributes include:

```
exec rdsadmin.rdsadmin_util.alter_supplemental_logging('ADD', 'ALL');
```

```
exec rdsadmin.rdsadmin_util.alter_supplemental_logging('DROP','PRIMARY  
KEY');
```

## Enabling Automatic Backups

In **Step 5: Management Options** of setting up your Oracle database instance, set the **Enabled Automatic Backups** option to **Yes**.

## Setting Up Archiving

To retain archived redo logs of your Oracle database instance (which will allow Attunity Replicate to retrieve the log information using Oracle LogMiner), execute the following command (example 24 hours):

```
exec rdsadmin.rdsadmin_util.set_configuration('archivelog retention  
hours',24);
```

Make sure that your storage has sufficient space for the archived redo logs during the specified period.

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

### Note

- » Oracle can also be used as a target database. For information on using Oracle as a target, see [Setting General Connection Properties](#).
- » You can also use Oracle files as a source or target. For more information, see [Using a File as a Source](#).

### To add an Oracle source endpoint to Attunity Replicate

1. In **Tasks** view, click **Manage Endpoint Connections** to open the **Manage Endpoints Connections** dialog box. Then click the **New Endpoint Connection** button.
2. In the **Name** field, type a name for your database. This can be any name that will help to identify the database being used.
3. In the **Description** field, type a description that helps to identify the Oracle database. This is optional.
4. Select **SOURCE** as the database **role**.
5. Select **Oracle** as the database **Type**.
6. Type the Oracle **Connection String** for the Oracle database you want to work with.

You can type the connect string in any Oracle format, for example:

```
//host:port/service name
```

Where:

- » **host:** This is the name or IP address for the computer with the Oracle database that you are using. For example, `johnboy_W7` or `255.255.255.0`.
- » **port:** (optional) This is the TNS Listener Port number for the computer with the Oracle database that you are using. If you do not enter a port number the default Oracle TNS Listener port is used.
- » **service name:** (optional) This is the service name for the computer with the Oracle database you are using. If you do not enter a service name the default service name is used.

You can also enter an Oracle Net keyword-value pair. For example:

```
"(DESCRIPTION=(ADDRESS=(PROTOCOL=tcp) (HOST=dlsun242) (PORT=5521))
(CONNECT_DATA=(SERVICE_NAME=bjava21)))"
```

**Note** When working with a Multitenant environment, the connection string should specify a specific PDB.

Limitations:

- » Connecting to the CDB is not supported.
- » Oracle does not support using PDB with Oracle LogMiner. Therefore, if you want to connect to a PDB, make sure that the **Use Oracle LogMiner to access redo logs** option is disabled in the **Advanced** tab.

## Specifying Separate Connection Strings for Different RAC Instances

If the Oracle endpoint is configured to use [Attunity Log Reader](#) and the node to which Replicate is connected cannot access the logs created by the other cluster nodes, you need to specify a separate connection string for each RAC instance.

When the redo logs are stored in ASM, the connection string syntax is as follows:

```
[<common ASM connection string>,] <thread id> <thread ASM connection string>, <thread id> <thread ASM connection string>...
```

**Note** If no <common ASM connection string> is specified, all the RAC instances should be defined in the ASM connection.

When using Attunity Log Reader to access the redo logs, the connection string syntax is as follows:

```
<Oracle connection string>[, <thread id> <thread BFILE connection string>, <thread id> <thread BFILE connection string> ...]
```

<Oracle connection string> is mandatory. If specified, the <thread BFILE connection string> will be used instead of the <Oracle connection string>.

7. Type the Oracle authentication information (User Name, Password) for the authorized

user for this Oracle database. If you do not know this information, see your Oracle database Administrator (DBA).

**Note** This information is case sensitive.

**Important:** Make sure that the Oracle user entered in the Oracle Authentication section has the correct access privileges. For information on how to provide the required privileges, see [Required Permissions](#).

To prevent illicit database activity by unauthorized third-parties, Replicate can be configured to automatically replace the user-entered password with a strong random password. For more information, see [Configuring Replicate to Automatically Replace the User-Entered Password](#).

## Setting Advanced Connection Properties

You can configure the Oracle endpoint to access the redo logs using either Oracle LogMiner or Attunity Log Reader, Replicate's high-speed redo log reader.

The following sections describe how to do this:

- » [Setting Advanced Connection Properties Using Oracle LogMiner](#)
- » [Setting Advanced Connection Properties Using Attunity Log Reader](#)

**Note** For guidelines on choosing which redo logs access method to use, see [Redo Log Files - Access Method Guidelines](#).

### Setting Advanced Connection Properties Using Oracle LogMiner

This section describes which properties are available in the **Advanced** tab when using Oracle LogMiner to access the redo logs. For information on which properties are available in the **Advanced** tab when using Attunity Log Reader to access the redo logs, see [Setting Advanced Connection Properties Using Attunity Log Reader](#).

**Note** If your Oracle database version precedes 10.2.0.4 (i.e. version 10.1.x to 10.2.0.3), you must [use Oracle LogMiner](#) to access the redo logs.

- » **Automatically add supplemental logging:** Select this (the default) to automatically set up supplemental logging for the Oracle database.  
For more information on supplemental logging, see [Setting up Supplemental Logging](#).
- » Under the **Access redo logs via** label, choose **Oracle LogMiner**. Changes will be captured using the Oracle LogMiner utility.
- » **Secret Store encryption entries:** When some of the columns in the tables that you

intend to replicate are encrypted you need to specify the Oracle Wallet encryption keys and their values.

See also: [Finding the Wallet Entry used for TDE Column Encryption in a Specific Table](#) and [Finding the Wallet Entries used for TDE Encryption](#).

- » **Retry interval:** Use the counter or type the number of seconds that the system waits before resending a query.
- » **Archived redo logs destination identifier:** The destination of the archived redo logs. The value should be the same as the `DEST_ID` number in the `V$archived_log` table.

**Note** When working with multiple log destinations (`DEST_ID`), you should specify an **Archived redo logs location identifier** that represents archived logs that can be accessed by Replicate. If the **Archived redo logs location identifier** is not specified, Replicate will use the minimal existing `DEST_ID`.

- » **Expose NUMBER as:** Select a precision-scale combination, FLOAT or VARCHAR. Attunity Replicate supports any precision-scale combination supported by Oracle. By default, the NUMBER data type is converted to precision 38, scale 10.

**Note** If precision is 39 or above, select VARCHAR.

**Note** The "Expose NUMBER" definition in the Oracle database is used for the NUMBER data type only (without the explicit precision and scale definition).

- » **Use archived redo logs only:** When this option is selected, Attunity Replicate will only access the archived redo logs. If the archived redo logs are stored on ASM only, the Attunity Replicate user needs to be granted the ASM privileges described in [Required ASM Privileges](#).
- » **Support nested tables:** Select this option if you need to replicate Oracle tables containing columns that are nested tables or defined types.

For more information on this feature and its prerequisites, see [Replicating Nested Tables](#).

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.

2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

## Finding the Wallet Entry used for TDE Column Encryption in a Specific Table

This section describes how to find the correct encryption key used for TDE column encryption in a specific table.

### To find the Oracle Wallet entry:

1. On the Oracle database, run the following query to return the `object_id` (e.g. the table ID) according to a given owner and table name:  
`Select object_id from all_objects where owner='<table owner>' and object_name='<table name>' and object_type='TABLE';`
2. Use the retrieved `object_id` in the following query to return the relevant master key:  
`select mkeyid from sys.enc$ where obj#=OBJECT_ID;`
3. Select the key value from the Oracle Wallet as follows:  
`mkstore -wrl <full_wallet_name> -viewEntry <entry_name>`

**Note** For more information, see [Step 5 in Finding the Wallet Entries used for TDE Encryption](#).

4. Copy the master key entry and its value into the **Names** and **Values** fields respectively.

## Setting Advanced Connection Properties Using Attunity Log Reader

This section describes which properties are available in the **Advanced** tab when using Attunity Log Reader to access the redo logs. For information on which properties are available in the **Advanced** tab when using LogMiner to access the redo logs, see [Setting Advanced Connection Properties Using Oracle LogMiner](#).

**Note** If your Oracle database version precedes 10.2.0.4 (i.e. version 10.1.x to 10.2.0.3), you must [use Oracle LogMiner](#) to access the redo logs.

- » **Automatically add supplemental logging:** Select this to automatically set up supplemental logging for the Oracle database. This option is also available when LogMiner is selected as the redo logs access method.  
For more information on supplemental logging, see [Setting up Supplemental Logging](#).
- » Under the **Access redo logs via** label, choose **Attunity Log Reader** (the default). Replicate will access the redo logs as a binary file.
- » **Secret Store encryption entries:** When the source tables are encrypted or contain encrypted columns, you need to specify the Oracle Wallet encryption keys and their values.  
For information on locating the required keys, see [Finding the Wallet Entries used for TDE Encryption](#).
- » **ASM Parameters (if redo logs are stored in ASM)** - If the Oracle redo logs you are using are stored using Automated Storage Management (ASM), enter the required access information in the designated fields.

**Note** To access the redo logs in ASM, you also need to grant the additional privileges described in [Required ASM Privileges](#)

See also: [Best Practices when Working with Oracle ASM](#).

- » **ASM Connection String:** The connection string to the ASM instance if your Oracle database is using ASM.
- » **ASM user name:** The user name for the ASM user.
- » **ASM password:** The password for the ASM user.
- » To access a redo log as a binary file (i.e. *not* using LogMiner), select one of the following options:
  - » **Use path as it appears in the database:** Select this to access the redo logs using the path as it appears in the database. Continue from [Using the Path as it Appears in the Database](#).  
-OR-
  - » **Replace path prefix:** You can determine whether to read the redo logs from a different root location while leaving the relative path unchanged. Continue from [Replacing the Path with a Prefix](#).

## Using the Path as it Appears in the Database

- » **Replicate has file-level access to the redo log files:** Select this to access and read the redo logs directly from the file system of the local computer where Attunity Replicate is installed.

- » **Copy redo logs to a temporary folder:** Select this to copy the redo logs to a temporary folder and then specify the path of the redo logs on the Oracle machine.

**Note** When configuring multiple tasks that use the same temporary folder (configured in the Oracle source endpoint), do not select the **Delete processed archived redo log files** option. This is because Replicate uses the *original* archived log names.

**Note** When working in a RAC environment, it is strongly recommended to set up a shared folder that is accessible by all the RAC instances. If this is not possible, you need to define a temporary folder with the same name on each of the RAC instances. In addition, you need to define separate Oracle and ASM connection strings for each RAC instance.

For more information on defining RAC connection strings, see [Setting General Connection Properties](#).

- » **Replicate has file-level access to temporary folder:** Select this to access the archived redo logs directly from the file system of the local computer where Attunity Replicate is installed.
  - » **Access archived redo logs in folder:** To enable Attunity Replicate to access the temporary folder (when it has file level access), you need to specify the path to the shared temporary folder on the Oracle machine, e.g. \\my.oracle.box\tempshare.

**Note** When a stopped task is resumed, Replicate will try to re-copy the currently processed Redo logs. If there are no Redo logs in the specified directory, the task will wait for them to be copied there.

- » **Look for missing archived redo logs in folder:** Type the full path to a location from where you want Attunity Replicate to read the archived redo logs if they are not found in the default location. The folder can be located anywhere in the network where Attunity Replicate is located, but be sure that the location is accessible to the Attunity Replicate user.
  - » **Replicate has file-level access to the specified folder:** Select this to access and read the archived redo logs directly from the file system of the local computer where Attunity Replicate is installed.
- » **Delete processed archived redo log files:** Select this to delete the copied archived redo log files after they have been read. This option requires the following additional permissions for the Replicate user:
  - » GRANT SELECT ON DBA\_FILE\_GROUPS

**Example:**

```
GRANT SELECT ON DBA_FILE_GROUPS to nonpriv_user;
```

- » GRANT EXECUTE on SYS.DBMS\_FILE\_GROUP

**Example:**

```
GRANT EXECUTE ON SYS.DBMS_FILE_GROUP TO nonpriv_user;
```

- » EXECUTE DBMS\_FILE\_GROUP.GRANT\_SYSTEM\_PRIVILEGE with the system privilege 'MANAGE\_FILE\_GROUP' for the Replicate user.

**Example:**

```
EXECUTE DBMS_FILE_GROUP.GRANT_SYSTEM_PRIVILEGE (DBMS_FILE_
GROUP.MANAGE_FILE_GROUP, 'nonpriv_user', FALSE)
```

**Note** Verify that another file group is not using the configured temp directory under a different Oracle user.

- » **Retry interval:** Use the counter or type the number of seconds that the system waits before resending a query.
- » **Archived redo logs destination identifier:** The destination of the archived redo logs. The value should be the same as the DEST\_ID number in the V\$archived\_log table.

**Note** When working with multiple log destinations (DEST\_ID), you should specify an **Archived redo logs location identifier** that represents archived logs that can be accessed by Replicate. If the **Archived redo logs location identifier** is not specified, Replicate will use the minimal existing DEST\_ID.

- » **Expose NUMBER as:** Select a precision-scale combination, FLOAT or VARCHAR. Attunity Replicate supports any precision-scale combination supported by Oracle. By default, the NUMBER data type is converted to precision 38, scale 10.

**Note** If precision is 39 or above, select VARCHAR.

**Note** The "Expose NUMBER" definition in the Oracle database is used for the NUMBER data type only (without the explicit precision and scale definition).

- » **Use archived redo logs only:** When this option is selected, Attunity Replicate will only access the archived redo logs. If the archived redo logs are stored on ASM only, the Attunity Replicate user needs to be granted the ASM privileges described in [Required ASM Privileges](#).
- » **Support nested tables:** Select this option if you need to replicate Oracle tables containing columns that are nested tables or defined types.  
For more information on this feature and its prerequisites, see [Replicating Nested Tables](#).

## Replacing the Path with a Prefix

- » **Replace path prefix:** You can determine whether to read the redo logs from a different root location while leaving the relative path unchanged.

Type the first part of the path to the current location of the redo logs. For example, C:\OldFolder.

You can include one folder or directory level or multiple folders or directories in this field.

**With:** Type the name of the folder or prefix to replace the existing prefix that you added in the field above. For example, C:\NewFolder.

**Note** The examples illustrate how to change the prefix:

If the redo logs are located in C:\OldFolder\archive\logs and you specify C:\NewFolder in the **With** field, the redo logs will be read from:

C:\NewFolder\archive\logs

If the redo logs are located in C:\replicate\oracle\logs\archive\RedoLogs and you specify C:\replicate\oracle\logs in the **Replace path prefix** field, and C:\companyName in the **With** field, then the redo logs will be read from:

C:\companyName\archive\RedoLogs

In this case, the new folder or directory called companyName replaces all of the first three level folders that you included in the **Replace path prefix** field.

- » **Apply prefix replacement to online and archived redo logs:** Select this to apply the prefix replacement to the online and archived redo logs.
  - » **Replicate has file-level access to the new location:** Select this to access and read the online and archived redo log files directly from the file system of the local computer where Attunity Replicate is installed.
- » **Apply prefix replacement to archived redo logs only:** Select this to apply the prefix replacement to the archived redo logs only (and not to the online redo logs).
  - » **Replicate has file-level access to the original online location:** Select this to access and read the original online redo log files directly from the file system of the local computer where Attunity Replicate is installed.
  - » **Replicate has file-level access to the new archive location:** Select this to access and read the archived redo log files directly from the file system of the local computer where Attunity Replicate is installed.
- » **Delete processed archived redo log files:** Select this to delete the copied archived redo log files after they have been read. This option requires the following additional permissions for the Replicate user:
  - » GRANT SELECT ON DBA\_FILE\_GROUPS

**Example:**

```
GRANT SELECT ON DBA_FILE_GROUPS to nonpriv_user;
```

- » GRANT EXECUTE on SYS.DBMS\_FILE\_GROUP

**Example:**

```
GRANT EXECUTE ON SYS.DBMS_FILE_GROUP to nonpriv_user;
```

- » EXECUTE DBMS\_FILE\_GROUP.GRANT\_SYSTEM\_PRIVILEGE with the system privilege 'MANAGE\_FILE\_GROUP' for the Replicate user.

**Example:**

```
execute DBMS_FILE_GROUP.GRANT_SYSTEM_PRIVILEGE (DBMS_FILE_
GROUP.MANAGE_FILE_GROUP, 'nonpriv_user', FALSE)
```

**Note** Verify that another file group is not using the configured temp directory under a different Oracle user.

- » **Retry interval:** Use the counter or type the number of seconds that the system waits before resending a query.
- » **Archived redo logs destination identifier:** The destination of the archived redo logs. The value should be the same as the DEST\_ID number in the V\$archived\_log table.

**Note** When working with multiple log destinations (DEST\_ID), you should specify an **Archived redo logs location identifier** that represents archived logs that can be accessed by Replicate. If the **Archived redo logs location identifier** is not specified, Replicate will use the minimal existing DEST\_ID.

- » **Expose NUMBER as:** Select a precision-scale combination, FLOAT or VARCHAR. Attunity Replicate supports any precision-scale combination supported by Oracle. By default, the NUMBER data type is converted to precision 38, scale 10.

**Note** If precision is 39 or above, select VARCHAR.

**Note** The "Expose NUMBER" definition in the Oracle database is used for the NUMBER data type only (without the explicit precision and scale definition).

- » **Use archived redo logs only:** When this option is selected, Attunity Replicate will only access the archived redo logs. If the archived redo logs are stored on ASM only, the Attunity Replicate user needs to be granted the ASM privileges described in [Required ASM Privileges](#).
- » **Support nested tables:** Select this option if you need to replicate Oracle tables containing columns that are nested tables or defined types.  
For more information on this feature and its prerequisites, see [Replicating Nested Tables](#).

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

## Finding the Wallet Entries used for TDE Encryption

In order to specify the correct encryption key(s) used for TDE tablespace encryption or TDE column encryption, you first need to find the relevant entry (or entries in the case of multiple keys) in the Oracle Wallet containing the encryption key(s). After you find the relevant entry or entries, copy the entry and its value (or entries and values if more than one) into the **Names** and **Values** fields respectively.

**Note** To enter multiple values, first copy each entry into a text editor such as Notepad making sure to separate the values with a comma. Then, copy the string containing the values and commas from the text editor and paste it into the **Values** field. There is no need to do this for entries. You can paste the entries directly into the **Entries** field, remembering to separate each entry with a comma.

### To find the Oracle Wallet entries:

1. If the ENCRYPTION\_WALLET\_LOCATION parameter is defined in the sqlnet.ora file, use the wallet from the directory defined by this parameter.
2. If the WALLET\_LOCATION parameter is defined in the sqlnet.ora file, use the wallet from the directory defined by this parameter.
3. In other cases, use the wallet in the default database location.

**Note** The name of the wallet should be **ewallet.p12**

4. Use the "list" option in the Oracle mkstore utility to determine the ORACLE.SECURITY.DB/TS.ENCRYPTION.<SUFFIX> entry name(s), as follows:  
`mkstore -wrl <full wallet name> -list`
5. If you know which entry/entries is/are used to encrypt the Redo logs, select the entry name(s) and use the "viewEntry" option in the Oracle mkstore utility to determine the entry value, as follows:  
`mkstore -wrl <full wallet name> -viewEntry <entry name>`

**Note** If you do not know which entry is used to encrypt the Redo logs, you can select multiple DB or TS entries and determine their values as described above (and then copy and paste the entry names and values into the **Names** and **Values** fields as described in the [Finding the Wallet Entries used for TDE Encryption](#)). If the specified entries are not correct, the task will fail and the error message will contain the correct entry name.

**Note** If the DBA changes the entry while the task is running, the task will fail and the error message will contain the new entry name. Add the new entry (name and value) to the already specified entries and then resume the task.

## Using Microsoft SQL Server as a Source

This section describes how to set up and use a Microsoft SQL Server database as the source database in a replication task.

### In this section:

[Supported Editions](#)

[Prerequisites](#)

[Limitations](#)

[Working with Microsoft SQL Server AlwaysOn Availability Groups](#)

[Required Permissions](#)

[Supported Compression Methods](#)

[Microsoft SQL Server Source Data Types](#)

[Homogeneous Replication](#)

[Preparing the Microsoft SQL Server Database for Replication](#)

[Setting General Connection Properties](#)

[Setting Advanced Connection Properties](#)

## Supported Editions

Attunity Replicate supports the following Microsoft SQL Server editions:

- » Enterprise Edition
- » Standard Edition
- » Workgroup Edition
- » Developer Edition

## Prerequisites

Make sure that the following prerequisites have been met:

- » Client prerequisites (for source and target endpoints):

### Attunity Replicate for Windows:

For all versions of Microsoft SQL Server, Microsoft SQL Server Native Client 11.0 must be installed on the Attunity Replicate Server machine.

### Attunity Replicate for Linux:

You can either work with the Microsoft ODBC Driver or the Simba Microsoft SQL Server ODBC Driver. Instructions for both are provided below.

First, install Microsoft ODBC Driver 13.1.1.0 for Linux on the Attunity Replicate Server machine.

Then, on the Attunity Replicate Server machine, open a Unix shell and perform the following steps:

**Note** The procedure below assumes that you have installed a single default instance of Replicate on Linux (areplicate). If you have [installed multiple instances](#), replace areplicate with the name of the instance running the task with a Microsoft SQL Server source. If several instances are running such as task, the procedure needs to be repeated for each instance.

1. Change the working directory to:

```
cd <product_dir>/bin
```

2. Stop the Replicate service:

```
./areplicate stop
```

3. Optionally, confirm that the service has stopped:

```
./areplicate status
```

4. Copy the driver location to the site\_arep\_login.sh file:

```
echo "export LD_LIBRARY_PATH=$LD_LIBRARY_
PATH:/opt/microsoft/msodbcsql/lib64/" >> site_arep_login.sh
```

5. Optionally, confirm that the driver location was copied:

```
cat site_arep_login.sh
```

6. Start the Replicate instance:

```
./areplicate start
```

7. Optionally confirm that the instance has started:

```
./areplicate status
```

**Note** Replicate requires the following ODBC library:

```
libmsodbcsql-13.1.so.0.0
```

If the existing library has a different version number (e.g. libmsodbcsql-13.1.so.0.2), you need to create a symbolic link between the existing library and the required library.

### To check which library version is currently installed

Issue the following command:

```
cd /opt/microsoft/msodbcsql/lib64/
```

### To create a symbolic link

Issue the following command:

```
ln -s <existing_library_name> libmsodbcsql-13.1.so.0.0
```

where <existing\_library\_name> is the name of the currently installed library (e.g. libmsodbcsql-13.1.so.0.2).

- » A Microsoft SQL Server account with the specific access privileges is required. See [Source Permissions](#) for more information.
- » Microsoft SQL Server as a source must be configured for a full backup to work with Attunity Replicate. For more information, see [Preparing Microsoft SQL Server Backup and Recovery](#).

## Limitations

When using a Microsoft SQL Server source endpoint in a Replicate task, the following limitations apply:

- » A Secondary SQL Server database is not supported as a source database.
- » If you are using a Microsoft SQL Server source database in a replication task, the Microsoft SQL Server Replication Publisher definitions for the database that was used in the task are not removed when you remove a task. A Microsoft SQL Server system administrator must delete these definitions from Microsoft SQL Server.
- » Sparse tables are not supported.
- » Replicating data from indexed views is not supported.
- » Renaming tables using `sp_rename` is not supported (e.g. `sp_rename 'Sales.SalesRegion', 'SalesReg;`)
- » Renaming columns using `sp_rename` is not supported (e.g. `sp_rename 'Sales.Sales.Region', 'RegID', 'COLUMN';`)
- » TRUNCATE events will not be captured.
- » Changes to computed fields in a Microsoft SQL Server source will not be replicated.
- » Microsoft SQL Server partition switching is not supported.
- » When using the `WRITETEXT` and `UPDATETEXT` utilities, Attunity Replicate does not capture events applied on the source database.
- » The following DML pattern is not supported:  
`select <*> into <new_table> from <existing_table>`
- » Column-level encryption is not supported.
- » Due to a known issue with Microsoft SQL Server 2008/2008 R2, Attunity Replicate does not support server level audits on Microsoft SQL Server 2008/2008 R2 as a source database.

For example, running the following command:

```
USE [master]
```

```
GO  
ALTER SERVER AUDIT [my_audit_test-20140710] WITH (STATE=on)  
GO
```

Will cause Attunity Replicate to fail.

**Note** This issue was resolved in Microsoft SQL Server 2012.

- » The following limitations apply when accessing the backup transaction logs:
  - » Encrypted backups are not supported.
  - » Backups stored at a URL or on Windows Azure are not supported.
- » The following limitations apply when accessing the backup transaction logs *at file level*:
  - » The backup transaction logs must reside in a shared folder with the appropriate permissions and access rights.
  - » Active transaction logs are accessed through the Microsoft SQL Server API (and not at file-level).
  - » The Attunity Replicate and Microsoft SQL Server machines must reside in the same domain.
  - » Compressed backup transaction logs are not supported.
  - » Transparent Data Encryption (TDE) is not supported. Note that when accessing the backup transaction logs using SQL Server's native functionality (i.e. not using file-level access), TDE encryption *is* supported.
  - » Unix platforms are not supported.
  - » Reading the backup logs from multiple stripes is not supported.

For more information on configuring Attunity Replicate to access the backup transaction logs at file-level access, see [Setting Advanced Connection Properties](#).

- » Microsoft SQL Server backup to multiple disks is not supported.
- » When inserting a value into SQL Server spatial data types (GEOGRAPHY and GEOMETRY), one can either ignore the SRID (Spatial Reference System Identifier) property - in which case the default SRID will be used (0 for GEOMETRY and 4326 for GEOGRAPHY) - or specify a different number. When replicating tables with spatial data types, Attunity Replicate replaces the SRID that was inserted by user with the default SRID.
- » If your database is not set up for MS-REPLICATION or MS-CDC, you can still capture tables that do not have a Primary Key, but bear in mind that in such a setup only INSERT/DELETE DML events will be captured. UPDATE and TRUNCATE TABLE events will be ignored.
- » Columnstore indexes are not supported.
- » Memory-optimized tables (using In-Memory OLTP) are not supported.
- » When replicating a table with a Primary Key that consists of multiple columns, updating the Primary Key columns during Full Load is not supported.

- » Temporal databases are not supported
- » Delayed durability is not supported
- » Table change tracking is not supported
- » Due to an ODBC limitation, no more than 16 columns can be part of a Primary Key.

## Non-Supported Microsoft SQL Server Security Features

Tables that use the following Microsoft SQL Server security features are not supported:

- » Always Encrypted
- » Dynamic Data Masking
- » Row-Level Security

## Working with Microsoft SQL Server AlwaysOn Availability Groups

The Microsoft SQL Server AlwaysOn Availability Groups feature is a high-availability, disaster-recovery solution that provides an enterprise-level alternative to database mirroring.

**Note** Support for AlwaysOn Availability Groups is not available when Replicate is installed on Linux.

### Accessing Backup Logs in AlwaysOn Availability Groups

As opposed to active transaction logs which are synchronized across the AlwaysOn Availability Group, backup transaction logs are local to each individual replica.

Each of the replicas (primary or secondary) in an AlwaysOn Availability Group can create local backup logs. However, since Replicate should be configured to connect to the Availability Group Listener (see below) which routes the connection to a *primary* replica, it has no way of determining whether the secondary replica's backup logs are present and/or accessible. This can result in Replicate missing events that are only present in the backup logs on the secondary replica.

To prevent this from happening, you need define the backup maintenance plan for the AlwaysOn configuration so that only *one of the replicas maintains the backup logs*. This is the replica that should be specified in the **AlwaysOn backup replica** field described below.

For a detailed explanation of how to set up a maintenance plan, see <https://msdn.microsoft.com/en-us/library/ms191002.aspx>

**Important:** The maintenance plan must be performed *directly* on the designated backup replica.

In the event that Replicate is connected to a primary replica that is not the AlwaysOn backup replica and needs to access the backup transaction logs, it will be unable to do so. In such a situation, the task will stop with a fatal error.

The scenarios where Replicate needs to access the backup transaction logs are as follows:

- » Working in backup only mode.  
For more information on this mode, see [Read changes from backup only](#).
- » Starting a task from a specific timestamp.  
For more information on this option, see the [Tables are already loaded](#) in [Using Advanced Run Options](#).
- » Due to latency i.e. if there is a high rate of events (changes) that Replicate is unable to process using the active log only.

**Note** Replicate relies on backup maintenance plan being implemented as described above. Deviating from this plan may result in lost events if Replicate needs to access the backup logs.

### To use AlwaysOn Availability Groups in Attunity Replicate:

1. Enable Distribution on all Microsoft SQL Server instances in your Availability Replicas.

**Note** This is required regardless of whether you are working in MS-REPLICATION or MS-CDC mode. For more information on working in MS-CDC mode, see [Replicating Tables that do not have a Primary Key](#).

2. In Replicate:
  - a. Open the Microsoft SQL Server endpoint (source or target) settings.
  - b. In the **Server Name** field, specify the DSN name or IP address that was configured for the Availability Group Listener.
  - c. Specify the name of the replica server where Replicate expects to find the backup logs in the **AlwaysOn backup replica** field in the **Advanced** tab of the Microsoft SQL Server source endpoint. The name must be specified without the domain suffix, even if it is the correct domain. For example, instead of `myreplica.qa.int`, specify `myreplica`.

**Note**

- » When you start a Replicate task for the first time, it may take longer than usual to start as the creation of the table articles is being duplicated by the Availability Groups Server.
- » In the event of failover, you will see recoverable errors in the log and the task will

restart. This is normal as the connection is being forcibly closed by the failover. As soon as the new primary server is available, processing will resume.

## Required Permissions

To use a Microsoft SQL Server source in an Attunity Replicate task, the user specified in the Microsoft SQL Server [endpoint connection settings](#) must be a member of both the `db_owner` database role and the `sysAdmin` fixed server role.

## Supported Compression Methods

The table below lists which compression methods Attunity Replicate supports for each Microsoft SQL Server version.

**Table 8.4 | Supported Microsoft SQL Server Compression Methods**

Microsoft SQL Server Version	Row/Page Compression (at Partition Level)	Vardecimal Storage Format	Vardecimal Storage Format	Vardecimal Storage Format
		Sparse Columns	Sparse Columns	Columnar Structure Compression
2005	No	No	No	No
2008-2016	Yes	No	No	No

## Microsoft SQL Server Source Data Types

The Microsoft SQL Server source for Attunity Replicate supports most Microsoft SQL Server data types. The following table shows the Microsoft SQL Server source data types that are supported when using Attunity Replicate and the default mapping to Attunity Replicate data types. Note that Microsoft SQL Server data types are only mapped to Attunity Replicate data types when the target endpoint is *not* Microsoft SQL Server. For information on data type mapping and collation support when the target endpoint *is* Microsoft SQL Server, see [Homogeneous Replication](#) below.

For information on how to view the data type that is mapped in the target, see the section for the target endpoint you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Note** Collatable data types are indicated by an asterisk (\*).

**Table 8.5 | Microsoft SQL Server Source Data Types with Mapping to Attunity Replicate Data Types when the Target is not Microsoft SQL Server**

Microsoft SQL Server Data Types	Attunity Replicate Data Types
BIGINT	INT8
BIT	BOOLEAN
DECIMAL	NUMERIC
INT	INT4
MONEY	NUMERIC (19,4)
NUMERIC (p,s)	NUMERIC
SMALLINT	INT2
SMALLMONEY	NUMERIC (10,4)
TINYINT	UINT1
REAL	REAL4
FLOAT	REAL8
DOUBLE	REAL8
DATETIME	DATETIME
DATETIME2 (Microsoft SQL Server 2008 and later)	DATETIME
SMALLDATETIME	DATETIME
DATE	DATE
TIME	STRING (16)
DATETIMEOFFSET	STRING
*CHAR	STRING
*VARCHAR	STRING
*VARCHAR (max)	CLOB
*TEXT	

To use this data type with Attunity Replicate, you must enable the use of CLOBs for a specific task.

LOB columns for Microsoft SQL Server tables are updated in the target even for UPDATE statements that did not change the value of the LOB column in Microsoft SQL Server.

During CDC, CLOB data types are supported only in tables that

**Table 8.5 | Microsoft SQL Server Source Data Types with Mapping to Attunity Replicate Data Types when the Target is not Microsoft SQL Server (Cont.)**

Microsoft SQL Server Data Types	Attunity Replicate Data Types
include a primary key.  For more information, see <b>LOB support</b> in <b>Task Settings/Metadata</b> .	
*NCHAR	<b>WSTRING</b>
*NVARCHAR (length)	<b>WSTRING</b>
*NVARCHAR (max)	<b>NCLOB</b>
*NTEXT	
To use this data type with Attunity Replicate, you must enable the use of NCLOBs for a specific task.  LOB columns for Microsoft SQL Server tables are updated in the target even for UPDATE statements that did not change the value of the LOB column in Microsoft SQL Server.	
During CDC, NCLOB data types are supported only in tables that include a primary key.  For more information, see <b>LOB support</b> in <b>Task Settings/Metadata</b> .	
BINARY	<b>BYTES</b>
VARBINARY	<b>BYTES</b>
VARBINARY (max)	<b>BLOB</b>
IMAGE	
LOB columns for Microsoft SQL Server tables are updated in the target even for UPDATE statements that did not change the value of the LOB column in Microsoft SQL Server.	
To use this data type with Attunity Replicate, you must enable the use of BLOBS for a specific task.  BLOB data types are supported only in tables that include a primary key.  For more information, see <b>LOB support</b> in <b>Task Settings/Metadata</b> .	
TIMESTAMP	<b>BYTES</b>
UNIQUEIDENTIFIER	<b>STRING</b>
HIERARCHYID	<b>HIERARCHYID -</b> When replicating to

**Table 8.5 | Microsoft SQL Server Source Data Types with Mapping to Attunity Replicate Data Types when the Target is not Microsoft SQL Server (Cont.)**

Microsoft SQL Server Data Types	Attunity Replicate Data Types
XML	Microsoft SQL Server. <b>STRING (250)</b> - When replicating to all other endpoints.
LOB columns for Microsoft SQL Server tables are updated in the target even for UPDATE statements that did not change the value of the LOB column in Microsoft SQL Server. To use this data type with Attunity Replicate, you must enable the use of NCLOBs for a specific task. During CDC, NCLOB data types are supported only in tables that include a primary key. For more information, see <b>LOB support in Task Settings/Metadata</b> .	<b>CLOB</b>
GEOMETRY	<b>CLOB</b>
GEOGRAPHY	<b>CLOB</b>

## Non-Supported Data Types

Tables that include fields with the following data types are not supported by Attunity Replicate.

- » CURSOR
- » SQL\_VARIANT
- » TABLE

**Note** User-defined data types are supported according to their base-type. For example a user-defined data type based on DATETIME is handled as a DATETIME data type.

## Homogeneous Replication

When replicating from a Microsoft SQL Server source to a Microsoft SQL Server target, most of the source and target data types will be identical. The exceptions are listed in the table below.

**Note** In homogeneous replication, the source data first passes through the Attunity Replicate data type and is therefore subject to any limitations of that type.

For information on Replicate data types and their limitations (where relevant), see [Replicate Data Types](#).

For information on which Replicate data types the source data passes through when replicating from Microsoft SQL Server, see the Microsoft SQL Server to Attunity Replicate data types mapping table described earlier.

**Note** To prevent data truncation when replicating **XML**, **Geometry** and **Geography** data types, it is strongly recommended to enable the [Allow unlimited LOB size](#) option in the task settings.

Additionally, in homogeneous replication, source column and table collations will be replicated to the target as described in [Column and Table Collation](#).

## Data Type Exceptions

When replicating from one Microsoft SQL Server database to another, source and target data types are identical for all supported Microsoft SQL Server versions, with the following exceptions:

**Table 8.6 | Data Type Exceptions in Homogeneous Replication**

Microsoft SQL Server Source	Microsoft SQL Server 2005 Target	Microsoft SQL Server 2005-2016 Target
DATETIME2 (Microsoft SQL Server 2008 and later)	DATETIME (when prec<=3) else VARCHAR (37)	
DATE	VARCHAR (11)	
TIME	VARCHAR (27)	
DATETIMEOFFSET	VARCHAR (34)	
VARCHAR		VARCHAR (x) (when x=0 or x>8000) else VARCHAR (max)
NVARCHAR (length)		NVARCHAR (x) (when x=0 or x>8000) else NVARCHAR (max)
VARBINARY		VARBINARY (x)

**Table 8.6 | Data Type Exceptions in Homogeneous Replication (Cont.)**

Microsoft SQL Server Source	Microsoft SQL Server 2005 Target	Microsoft SQL Server 2005-2016 Target
		(when $x=0$ or $x>8000$ ) else VARBINARY (max)
HIERARCHYID		VARCHAR (x)
GEOMETRY	VARCHAR (MAX)	
GEOGRAPHY	VARCHAR (MAX)	
TIMESTAMP		VARBINARY

## Column and Table Collation

When replicating from one Microsoft SQL Server database to another, column and table collations will be replicated to the target.

**Note** To support collation replication, the DBA must ensure that the collations defined for the source Microsoft SQL Server database are the same as those defined for the target Microsoft SQL Server database.

## Non-Nullable Columns and Primary/Unique Index Names

Primary/Unique Index names are preserved during homogeneous replication. Non-nullable columns are also preserved during homogeneous replication, with the exception of the following data types:

- » text
- » ntext1
- » varchar(max)
- » nvarchar(max)
- » varbinary(max)
- » image
- » xml

## Preparing the Microsoft SQL Server Database for Replication

This topics describes the configuration requirements for using a Microsoft SQL Server database. A Microsoft SQL Server system administrator should carry out these tasks.

- » [Preparing Microsoft SQL Server Backup and Recovery](#)
- » [Setting up Microsoft SQL Server for Replication](#)

- » [Replicating Tables that do not have a Primary Key](#)
- » [Defining Microsoft SQL Server Database Settings](#)

## Preparing Microsoft SQL Server Backup and Recovery

Attunity Replicate consumes changes captured from the database transaction log (TLOG). The TLOG is maintained by Microsoft SQL Server for recovery purposes. All changes made to a database are written to the TLOG. The following happens when recovery is required:

- » A backup copy of the database is made.
- » Logged events are taken and used in a rolling-forward process where the recorded changes are replayed against that copy.

To prepare for backup and recovery you must make sure that the Microsoft SQL Server Recovery Model is set up. You select the Recovery Model in the Microsoft SQL Server Management Studio. This should be carried out by a Microsoft SQL Server system administrator.

The TLOG data is truncated as soon as it is no longer needed therefore the TLOG is not persistent. However, Attunity Replicate guaranteed delivery requires persistency in the changed data. To ensure persistency:

- » A full database backup must be carried out before beginning to replicate data.
- » The Recovery Model must be set to **Bulk logged** or **Full**.

### To set the recovery model:

In the database properties **Options** tab, set the Recovery Model to **Bulk logged** or **Full**. In these modes, the transaction Log is more durable.

**Note** After setting the Recovery Model, it is strongly recommended *not* to change it; doing so may result in loss of data.

## Setting up Microsoft SQL Server for Replication

If you are using Microsoft SQL Server as the source in an Attunity Replicate task, you need to enable your Microsoft SQL Server database for MS-REPLICATION.

In the Microsoft SQL Server's Management Studio, follow the instructions provided by the Configure Distribution wizard to set up replication or see the Microsoft SQL Server documentation.

### To open the wizard from Microsoft SQL Server:

1. In the Microsoft SQL Server Management Studio, right-click the Replication folder and select **Configure Distribution**.  
The Configure Distribution wizard opens.
2. Make the following selections:

In the Distributor step, select **<Microsoft SQL Server Name> will act as its own distributor; Microsoft SQL Server will create a distribution database and log.**

## Replicating Tables that do not have a Primary Key

**Note** This functionality is supported only for Microsoft SQL Server Enterprise edition and *not* on Microsoft SQL Server 2005.

By default, Attunity Replicate automatically sets up MS-REPLICATION for each of the source tables in a replication task. However, MS-REPLICATION requires each of the source tables to have a primary key, which may not always be the case. Therefore, if you need to replicate tables that do not have a primary key, the following options are available:

- » [Use MS-CDC](#)
- » [Do not Use MS-Replication or MS-CDC](#)

### Use MS-CDC

To set up MS-CDC, you first need to enable MS-CDC for the database by running the following command:

```
use [Dbname]
EXEC sys.sp_cdc_enable_db
```

Then you need to enable MS-CDC for each of the source tables by running the following command:

```
EXECUTE sys.sp_cdc_enable_table @source_schema = N'MySchema', @source_name
= N'MyTable', @role_name = NULL;
```

**Note** Replicating tables that do not have a Primary Key or a Unique Index may adversely affect performance (since additional database resources are required to capture the changes). However, you can prevent performance issues related to the absence of Primary Keys or a Unique Index by manually adding indexes to the target tables.

For more information on setting up MS-CDC for specific tables, please refer to the Microsoft website.

### Do not Use MS-Replication or MS-CDC

If your database is not set up for MS-REPLICATION or MS-CDC, you can still capture tables that do not have a Primary Key, but bear in mind that in such a setup only INSERT/DELETE DML events will be captured. UPDATE and TRUNCATE TABLE events will be ignored.

It is also important to note that a DELETE statement executed on an UPDATED source record, will *not* be applied on the target.

## Defining Microsoft SQL Server Database Settings

Set the following for the Microsoft SQL Server database(s) that you are using as a source:

- » From the Object Explorer in the Microsoft SQL Server Management Studio, right click the database and select **Properties**. In the **Options** tab, set the **Recovery model** to **Bulk logged** or **Full**. In this mode, the transaction Log is more durable and truncation occurs less frequently.
- » Ensure that there is a full database backup for each Microsoft SQL Server database that you are using as a source.
- » When creating a connection string, it is possible to use any parameter supported by Microsoft SQL Server. The Microsoft SQL Server system administrator must ensure that the Microsoft SQL Server instance is configured correctly so that the proper authentication credentials are accepted.
- » To be able to work with MS-REPLICATION, each of the source tables must have a primary key.

## Working with Windows Authentication

You can configure the Attunity Replicate Microsoft SQL Server endpoint to log in to Microsoft SQL Server (on Windows) using Windows authentication.

If you choose this option, you also need to make sure that:

- » The Microsoft SQL Server instance is set up to allow Windows log on.
- » The Attunity Replicate user is specified as the "Log on as" user for the "Attunity Replicate Server" service account.

-OR-

Microsoft SQL Server is configured to allow login for the Attunity Replicate Server service account.

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

### To add a Microsoft SQL Server source endpoint to Attunity Replicate:

1. In the Attunity Replicate Console, click Manage Endpoint Connections to open the **Manage Endpoints Connections** dialog box. Then click the **New Endpoint Connection** button. For more information on adding an endpoint to Attunity Replicate, see [Working with Endpoints](#).
2. In the **Name** field, type a name for your database. This can be any name that will help to identify the database being used.

3. In the **Description** field, type a description that helps to identify the Microsoft SQL Server database. This is optional.
4. Select **SOURCE** as the database **role**.
5. Select **Microsoft SQL Server** as the database **Type**.
6. Specify the **Server name**. This is the host name or IP address of the computer with the Microsoft SQL Server instance containing the source database.

**Note:** To override the default port, add the port to the server name, separated by a comma. For example, if the server name is `myserver.company.local` and the port is `3333`, then the server name should be entered like this:

`myserver.company.local,3333`

7. Select **Windows authentication** (only relevant when Replicate is installed on Windows) or **SQL Server authentication**.

If you select **Windows authentication**, the user credentials for the Windows domain will be used. This privilege must be configured in the Microsoft SQL Server database by the system administrator. Note that this option is not relevant when Microsoft SQL Server is running on Linux.

**Note** When using **Windows authentication**, make sure that the user account that is associated with the **Attunity Replicate Server** service has Network read and write permissions. This must be configured by a Windows system administrator.

See also [Working with Windows Authentication](#).

If you select **SQL Server authentication**, type the Microsoft SQL Server authentication information (User name, Password) for the authorized user for this Microsoft SQL Server database. If you do not know this information, see your Microsoft SQL Server System Administrator.

To prevent illicit database activity by unauthorized third-parties, Replicate can be configured to automatically replace the user-entered password with a strong random password. For more information, see [Configuring Replicate to Automatically Replace the User-Entered Password](#).

#### Notes

- » This information is case sensitive.
- » To determine if you are connected to the database you want to use or if the connection information you entered is correct, click **Test Connection**.  
If the connection is successful a message in green is displayed. If the connection fails, an error message is displayed at the bottom of the dialog box.

To view the log entry if the connection fails, click **View Log**. The server log is displayed with the information for the connection failure. Note that this button is not available unless the test connection fails.

**Important:** Make sure that the Microsoft SQL Server user has the correct access privileges. For information on how to provide the required privileges, see [Required Permissions](#).

8. Type the **Database name** or click **Browse** and select one from the list of available databases. This is the name of the database from where you are replicating the data.

## Setting Advanced Connection Properties

In the **Advanced** tab, you can set the following properties:

- » **Prevent truncation of unread changes from TLOG:** For optimal performance, Attunity Replicate will try to capture all unread changes from the active transaction log (TLOG). However, sometimes due to truncation, the active TLOG may not contain all of the unread changes. When this occurs, Attunity Replicate accesses the backup log to capture the missing changes. To minimize the need to access the backup log, Attunity Replicate prevents truncation using one of the following methods:
  - » **Start transactions in the database:** This is the default method. When this method is used, Attunity Replicate prevents TLOG truncation by mimicking a transaction in the database. As long as such a transaction is open, changes that appear after the transaction started will not be truncated. If you need Microsoft Replication to be enabled in your database, then you must choose this method.

**Note** This method also requires the Log Reader Agent to be running to enable truncation of the Microsoft SQL Server active transaction log. Note that if the Log Reader Agent is *not* running, the active log may become full, causing the source database to be essentially "read-only" until the issue is resolved.

**Note** When this option is selected, Replicate creates a table named `attrep_truncation_safeguard` in the source database. This is a very small but important table whose purpose is to prevent truncation of the transaction log by mimicking a transaction in the database. The table can be safely deleted if there are no tasks configured with the **Start transactions in the database** option.

- » **Exclusively use `sp_repldone` within a single task:** When this method is used, Attunity Replicate reads the changes and then uses `sp_repldone` to mark the TLOG transactions as ready for truncation. Although this method does not

involve any transactional activities, it can only be used when Microsoft Replication is not running. Also, using this method, only one Attunity Replicate task can access the database at any given time. Therefore, if you need to run parallel Attunity Replicate tasks against the same database, use the default method.

**Note** This method requires the Log Reader Agent to be stopped in the database. If the Log Reader Agent is running when the task starts, Attunity Replicate will forcibly stop it. Alternatively, you can stop the Log Reader Agent manually, before starting the Attunity Replicate task. For instructions on how to do this, refer to the Microsoft SQL Server Management Studio help.

**Note** This option is not available when the Microsoft SQL Server Replication job resides on a remote Distributor machine as Replicate does not have access to the remote machine.

- » **Apply TLOG truncation prevention policy every (seconds):** Specify how often to prevent TLOG truncation using one of the methods described above. Factors that you should consider when determining the policy frequency include storage availability, backup and log routines, and the rate at which Attunity Replicate processes events.
- » **Alternate backup folder:** The location of the backup logs when using a third-party utility to back up the transaction logs (i.e. instead of Microsoft SQL Server's own backup mechanism). You can run the backup utility yourself or you can configure Attunity Replicate to run it as described in [Backup file preprocessing command](#) below. Note that the backup files must be exported to the specified location in standard Microsoft SQL Server format.
- » **Change processing mode:** Choose one of the following change processing modes:
  - » **Prioritize Online Logs** - This is the default. Attunity Replicate will first look for the changes in the online transaction logs. In the event that Replicate cannot find the changes in the online transaction logs, it will look for them in the backup transaction logs instead.
  - » **Prioritize Backup Logs** - When this option is enabled, Attunity Replicate will first look for the changes in the backup transaction logs. This can improve performance when reading from the online transaction log is slow (e.g due to lock contention) or when using file-level access to access the backup transaction logs. In the event that Replicate cannot find the changes in the backup transaction logs, it will look for them in the online transaction logs instead.
  - » **Backup Logs Only** - When this option is selected, Attunity Replicate will try and find the changes in the backup transaction logs only. Selecting this method results in increased latency due to the interval between backups. The actual latency time will remain constant, but will vary according to the backup schedule.

- » **Replicate has file-level access to the backup log files:** Select this option if Attunity Replicate has been granted file-level access to the backup log files in the **Alternate backup folder**.

**Note** When Attunity Replicate has file-level access to the backup transaction logs, the following rules apply:

- » The **Alternate backup folder** must be a common shared network folder, for example: \\temp\\backup.
- » The Attunity Replicate **Server** service must be configured to log on using the user name and password specified in the **Backup folder user name** and **Backup folder password** fields.

**To do this:**

In the Windows **Services** console, double-click the Attunity Replicate **Server** service.

In the **Log On** tab, select **This account** and then enter the user name and password.

- » The specified user must be granted Read permission to the alternate backup folder (i.e. the shared network folder).

For a complete list of the limitations affecting file-level access, see [Limitations](#).

- » **Backup folder user name:** The user name required to access the backup folder when Attunity Replicate has file-level access.
- » **Backup folder password:** The password required to access the backup folder when Attunity Replicate has file-level access.
- » **Backup file preprocessing command:** You can use a third-party utility to convert the transaction logs to standard Microsoft SQL Server format (if they are in a different format) and back them up to an alternate backup folder. This option should be used in conjunction with the [Alternate backup folder](#) option described above.

**Prerequisites and Notes:**

The command is invoked via the XP\_CMDSHELL extended procedure.

- » The backup utility is responsible for setting the system return code (0 for success, 1 for failure), assuming that this code is delegated as the XP\_CMDSHELL return value.
- » The backup utility invoked by XP\_CMDSHELL must have the same security rights as the Microsoft SQL Server service account.
- » XP\_CMDSHELL is normally disabled. It can be enabled and disabled by using the Policy-Based Management or by executing SP\_CONFIGURE.
- » Using this extended procedure requires CONTROL SERVER permission (at least).

**Command Usage:**

The backup utility should provide Attunity Replicate with the following parameters:

- » {BACKUP\_INFILE} - The full path to the original backed up transaction log.
- » {ALTDIR\_OUTFILE} - The specifications of the target file to transfer to the alternate backup folder.
- » {BACKUP\_SET} - The backup set to be processed within the backup log.

**Example command:**

```
C:\Temp\YourBackupUtility.exe -B{BACKUP_INFILE} -A{ALTDIR_OUTFILE}"
```

**Important:** Directory names in the command path or file names in the actual command that contain spaces must be enclosed in double-quotes:

**Example:**

```
C:\temp\test\"my program"\\"new version"\converter.exe -A>{"input file"} -B  
{outfile}
```

- » **Delete processed backup logs:** Select this option to delete the backup logs after they have been read.
- » **Select virtual backup device types:** When this option is selected, Attunity Replicate will read changes from the specified virtual device(s). Usually, this option only needs to be enabled when using a third-party backup utility (which will be recorded as a virtual device).
- » **AlwaysOn backup replica:** See [Working with Microsoft SQL Server AlwaysOn Availability Groups](#).

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

**To add internal Attunity Replicate parameters:**

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.



# Using SAP Sybase ASE as a Source

This section describes how to set up and use a SAP Sybase ASE database as the source endpoint in a replication task.

## In this section:

[Prerequisites](#)

[Limitations](#)

[Required Permissions](#)

[SAP Sybase ASE database Source Data Types](#)

[Setting General Connection Properties](#)

[Setting Advanced Connection Properties](#)

[Removing the Truncation Point](#)

## Prerequisites

Make sure the following prerequisites have been met:

- » SAP Sybase ASE ODBC 64-bit client installed on the computer where Attunity Replicate is located.
- » SAP Sybase ASE replication enabled for tables using the `sp_setreptable` command or privileges to enable it automatically.
- » RepAgent must be disabled on the SAP Sybase ASE database.
- » When replicating to SAP Sybase ASE 15.7 installed on a Windows machine configured with a non-Latin language (e.g. Chinese), Attunity Replicate requires Sybase 15.7 SP121 to be installed on the SAP Sybase ASE machine.

## Limitations

The following limitations apply:

- » Sybase ASE primary/standby configuration is supported with the publish-and-subscribe model only (i.e. Warm standby/MSA is not supported).
- » Only one Attunity Replicate task can be run per SAP Sybase ASE database.
- » Attunity Replicate tasks cannot run concurrently with SAP Sybase ASE Replication Server against the same SAP Sybase ASE database.
- » Rename table is not supported (e.g. `sp_rename 'Sales.SalesRegion', 'SalesReg;'`)
- » Rename column is not supported (e.g. `sp_rename 'Sales.Sales.Region', 'RegID', 'COLUMN';`)
- » Zero values located at the end of binary data type strings are truncated when replicated to the target database. For example,

0x00000000000000000000000000000000100000100000000 in the source table will become 0x000000000000000000000000000000001000001 in the target table.

- » The `reorg rebuild index` command is not supported.
- » Clusters are not supported.
- » Materialized views are not supported.

## Required Permissions

To use SAP Sybase ASE database as a source in a Replicate task, the following permissions are required:

- » `sa_role`
- » `replication_role`
- » `sybase_ts_role`

If the **Automatically enable Sybase replication** option is enabled (in the **Advanced** tab), Replicate also needs permission to run the stored procedure `sp_setreptable`.

For information on the **Automatically enable SAP Sybase ASE replication** option, see [Setting Advanced Connection Properties](#).

## SAP Sybase ASE database Source Data Types

The following table shows the SAP Sybase ASE database source data types that are supported when using Attunity Replicate and the default mapping from Attunity Replicate data types.

For information on how to view the data type that is mapped in the target, see the section for the target database you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 8.7 | SAP Sybase ASE database Source Data Types with Mapping to Attunity Replicate Data Types**

SAP Sybase ASE Source Data Types	Attunity Replicate Data Types
BIGINT	INT8
UNSIGNED BIGINT	UINT8
INT	INT4
UNSIGNED INT	UINT4
SMALLINT	INT2
UNSIGNED SMALLINT	UINT2
TINYINT	UINT1

**Table 8.7 | SAP Sybase ASE database Source Data Types with Mapping to Attunity Replicate Data Types (Cont.)**

SAP Sybase ASE Source Data Types	Attunity Replicate Data Types
DECIMAL	NUMERIC
NUMERIC	NUMERIC
FLOAT	REAL8
DOUBLE	REAL8
REAL	REAL4
MONEY	NUMERIC
SMALLMONEY	NUMERIC
DATETIME	DATETIME
BIGDATETIME	DATETIME (6)
SMALLDATETIME	DATETIME
DATE	DATE
TIME	TIME
BIGTIME	TIME
CHAR	STRING
UNICHAR	WSTRING
NCHAR	WSTRING
VARCHAR	STRING
UNIVARCHAR	WSTRING
NVARCHAR	WSTRING
BINARY	BYTES
VARBINARY	BYTES
BIT	BOOLEAN
TEXT	CLOB
UNITEXT	NCLOB
IMAGE	BLOB

## Non-Supported Data Types

Source SAP Sybase ASE tables with columns of the following SAP Sybase ASE data types cannot be replicated. Replicated columns with these data types will show as null.

» UDT

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see [Setting Advanced Connection Properties](#) below.

**Note** You can also use SAP Sybase ASE files as a source. For more information, see [Using the Attunity Replicate File Channel](#).

### To add a SAP Sybase ASE source endpoint to Attunity Replicate:

1. In the Attunity Replicate Console, click **Manage Endpoint Connections** to open the **Manage Endpoints Connections** dialog box. Then click the **New Endpoint Connection** button. For more information on adding an endpoint to Attunity Replicate, see [Working with Endpoints](#).
2. In the **Name** field, type a name for your database. This can be any name that will help to identify the database being used.
3. In the **Description** field, type a description that helps to identify the SAP Sybase ASE database. This is optional.
4. Select **SOURCE** as the endpoint **role**.
5. Select **SAP Sybase ASE** as the database **Type**.
6. In the **Server Name** field, enter the host name or IP address of the computer on which the SAP Sybase ASE database is installed.

**Note** Consider the following:

- » This information is case sensitive.
- » You can use the **Advanced** tab to add specific properties and create a custom connect string. In this case, you do not need to enter information in this tab. For more information on using the **Advanced** tab, see [Setting Advanced Connection Properties](#).
- » To determine if you are connected to the database you want to use or if the connection information you entered is correct, click **Test Connection**. If the connection is successful a message in green is displayed. If the connection fails, an error message is displayed at the bottom of the dialog box.  
To view the log entry if the connection fails, click **View Log**. The server log is displayed with the information for the connection failure. Note that this button is not available unless the test connection fails.

7. Optionally, change the default port (5000).
8. Type the SAP Sybase ASE authentication information (**User Name**, **Password**) for the authorized user for this SAP Sybase ASE database. If you do not know this

information, see your SAP Sybase ASE database Administrator (DBA).

**Note** Consider the following:

- » This information is case sensitive.
- » This information is required. If you are using the **Advanced** tab to create a custom string, make sure to include the **User Name** and **Password** properties. See [Setting Advanced Connection Properties](#) for more information.
- » If you want to set custom properties for this database, see [Setting Advanced Connection Properties](#).

**Important:** Make sure that the SAP Sybase ASE user entered in the SAP Sybase ASE Authentication section has the correct access privileges. For information on how to provide the required privileges, see [Required Permissions](#).

9. In the **Database name** field, enter the SAP Sybase ASE database name.

## Setting Advanced Connection Properties

In the **Advanced** tab, you can set the following parameters:

- » **Automatically enable SAP Sybase ASE replication:** Select this to automatically enable SAP Sybase ASE replication. This is only required if SAP Sybase ASE replication has not been enabled already. For more information, see [Prerequisites](#).
- » **Additional ODBC connection properties:** Specify any additional ODBC connection parameters that you want to use.

**Note** If the user name or password specified in the **General** tab contains non-Latin characters (e.g. Chinese), the following property is required:

```
charset=gb18030
```

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.

5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

## Removing the Truncation Point

When a task starts, Replicate establishes a \$replication\_truncation\_point entry in the syslogshold system view, indicating that a replication process is in progress. While Attunity Replicate is working, it advances the replication truncation point at regular intervals, according to the amount of data that has already been copied to the target.

Once the \$replication\_truncation\_point entry has been established, the Replicate task must be kept running at all times to prevent the database log from becoming excessively large. If you want to stop the Replicate task permanently, the replication truncation point must be removed by issuing the following command:

```
dbcc settrunc('ltm','ignore')
```

After the truncation point has been removed, the Replicate task cannot be resumed. The log will continue to be truncated automatically at the checkpoints (if automatic truncation is set).

# Using a MySQL-Based Database as a Source

This section describes how to set up and use a MySQL-based database as a source in a replication task.

You need to configure the Replicate MySQL endpoint when replicating from any of the following databases:

- » MySQL
- » Percona
- » MariaDB
- » Amazon Aurora
- » Amazon RDS for MySQL

**Note** The procedures for configuring connectivity to these endpoints are identical to those described in this section, for MySQL. However, when using Percona as a source, there is no need to perform the procedures described in [Cluster Prerequisites](#).

## In this section:

- [Prerequisites](#)
- [Limitations](#)
- [Security Requirements](#)
- [Setting up Amazon RDS MySQL for CDC \(Change Data Capture\)](#)
- [MySQL Database Source Data Types](#)
- [Setting General Connection Properties](#)
- [Selecting a Schema](#)
- [Setting Advanced Connection Properties](#)

## Prerequisites

Make sure that the prerequisites described in this section have been met.

In this section:

- [General Prerequisites](#)
- [Attunity Replicate Server for Windows](#)
- [Attunity Replicate Server for Linux](#)
- [MySQL Replication](#)
- [Enable Binary Logging](#)
- [Cluster Prerequisites](#)
- [Replicating 4-byte UTF8 Emojis](#)

## General Prerequisites

The following is required:

- » A MySQL account with the required [Security Requirements](#).
- » A MySQL database with the tables that you want to replicate should be accessible in your network.

The following MySQL editions are supported:

- » MySQL Community Edition
- » MySQL Standard Edition
- » MySQL Enterprise Edition
- » MySQL Cluster Carrier Grade Edition

## Attunity Replicate Server for Windows

To be able to work with Attunity Replicate for Windows and MySQL as a source endpoint in a Attunity Replicate task, you need to install MySQL ODBC 64-bit client version 5.2.6 or later on the same computer as Attunity Replicate.

## Attunity Replicate Server for Linux

To be able to work with Attunity Replicate for Linux and MySQL as a source endpoint in a Replicate task, you need to:

- » Install MySQL Connector/ODBC for Linux, version 5.2.6 or later, on the Attunity Replicate machine.
- » Make sure that the `/etc/odbcinst.ini` file contains an entry for MySQL, as in the following example:

```
[MySQL ODBC 5.2.6 Unicode Driver]
Driver = /usr/lib64/libmyodbc5w.so
UsageCount = 1
```

## MySQL Replication

Replication enables data from one MySQL database server (the master) to be copied to one or more MySQL database servers (the slaves).

The Replicate MySQL source endpoint can be configured to replicate data from either a master or a slave.

To replicate changes from a slave (CDC), the [binary logging](#) parameter `log_slave_updates` needs to be set to `true` (1).

## Enable Binary Logging

To enable binary logging, the following parameters must be configured in MySQL's `my.ini` (Windows) or `my.cnf` (UNIX) files.

**Table 8.8 | Required my.ini/my.cnf Parameters for Binary Logging**

Parameter	Value
server_id	Any value from 1. Example: <code>server_id=1</code>
log-bin=<path>	Path to the binary log file (without an extension). Example: <code>log-bin=E:\ MySql_Logs\BinLog</code>
binlog_format	Must be: <code>binlog_format=row</code>
expire_logs_days	To prevent disk space issues, it is strongly recommended not to use the default value (0). Example: <code>expire_logs_days=5</code>
binlog_row_image	Must be: <code>binlog_row_image=full</code>
binlog_checksum	NONE or CRC32 When enabled, this parameter causes the master to write a checksum for each event in the binary log. The default from MySQL 5.6.6 is CRC32. Before that, the default is NONE.
log_slave_updates	When replicating from a MySQL slave database server, this value should be set to true (1). If set to 0 (the default) updates on a slave received from a master during replication are not logged to the slave's binary log. The slave's binary log needs to be enabled for this to have an effect.

## Cluster Prerequisites

To be able to replicate clustered (NDB) tables (i.e. by connecting Attunity Replicate to any of the cluster nodes), the following parameters must be configured in MySQL's my.ini (Windows) or my.cnf (UNIX) files.

**Note** When using Percona as a source, there is no need to perform the procedures described in this section.

**Table 8.9 | Required my.ini/my.cnf Parameters for Cluster Replication**

Parameter	Value
ndb_log_bin	Must be: ndb_log_bin=on  This ensures that changes in clustered tables will be logged to the binary log.
ndb_log_update_as_write	Must be: ndb_log_update_as_write=OFF  This prevents writing UPDATEs as INSERTs in the binary log.
ndb_log_updated_only	Must be: ndb_log_updated_only=OFF  Ensures that the binary log will contain the entire row and not just the changed columns.

## Replicating 4-byte UTF8 Emojis

Replication of 4-byte UTF8 emojis to certain targets requires the following preparation:

- » **Microsoft SQL Server Target:** Transform the emojis from WSTRING (n) to WSTRING (n\*2).
- » **Amazon Redshift Target:** Transform the emojis from WSTRING (n) to WSTRING (n\*2).
- » **MySQL Target:** The target schema character set must be set to utf8mb4.

For information on defining transformations, see [Using the Transform Tab](#).

## Limitations

The following limitations apply:

- » The following DDLs are not supported:
  - » All partition DDLs
  - » Drop Table
  - » Rename Table
- » Using the `alter table <table_name> add column <column_name>` statement to add columns to the beginning or to the middle of a table is not supported.
- » Using the `alter table <table_name> add column <column_name>` statement to add a column to the middle of a table, will add the column to the end of the table instead.
- » When MySQL is installed on Windows, changes are not captured from tables whose names contain both upper and lower case characters.
- » The **AR\_H\_USER** header column is currently not supported. For information on using header columns, see [Headers](#).

- » If a MySQL table contains LOBs and the task's **Replicate Lob columns** option is disabled, the table will be replicated without the LOB columns. Note that this only applies to MEDIUMBLOB, LONGBLOB, MEDIUMTEXT and LONGTEXT columns. This limitation does not apply to BLOB, TINYBLOB, TEXT and TINYTEXT columns.
- » If the MySQL database is stopped during Full Load, the Full Load will end successfully, but the tables on the target may have less rows than the source tables. If this should happen, either restart the task or reload the tables with the missing rows.
- » Indexes created on only part of the column data are not supported.

The following is an example of a statement that creates an index using only part of the column data:

```
CREATE INDEX partial_name ON customer (name(10));
```

## Security Requirements

The Attunity Replicate user must have the ReplicationAdmin role with the following privileges (according to task type):

- » REPLICATION CLIENT - Required for Change Processing tasks only. In other words, Full Load only tasks do not require this privilege.
- » REPLICATION SLAVE - Required for Change Processing tasks only. In other words, Full Load only tasks do not require this privilege.
- » SUPER - Only required in versions *prior* to MySQL 5.6.6.

The Attunity Replicate user must also have SELECT privileges for the source tables designated for replication.

## Setting up Amazon RDS MySQL for CDC (Change Data Capture)

To enable CDC with Amazon RDS MySQL, you need to use Amazon RDS MySQL version 5.6 or 5.7.

### To set up Amazon RDS MySQL for CDC:

1. Follow the instructions provided by AWS to create a new Parameter Group (see the Binary Logging Format section):  
[http://docs.aws.amazon.com/AmazonRDS/latest/UserGuide/USER\\_LogAccess.Concepts.MySQL.html](http://docs.aws.amazon.com/AmazonRDS/latest/UserGuide/USER_LogAccess.Concepts.MySQL.html)
2. When creating the new Parameter Group, set the following values:
  - » binlog\_format=row
3. Save the new Parameter Group.
4. If you have an existing instance of Amazon RDS MySQL, edit the instance to use the parameters specified in **Step 2** above. Or, if you are provisioning a new instance of Amazon RDS MySQL, reference the new Parameter Group created in **Step 1** above.

## MySQL Database Source Data Types

The following table shows the MySQL database source data types that are supported when using Attunity Replicate and the default mapping to Attunity Replicate data types. When replicating to a MySQL target, the source and target data types are the same, apart from the exceptions described in [Homogeneous Replication](#).

For information on how to view the data type that is mapped in the target, see the section for the target database you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 8.10 | MySQL Database Source Data Types with Mapping to Attunity Replicate Data Types when the Target is not MySQL**

MySQL Source Data Types	Attunity Replicate Data Types
INT	INT4
BIGINT	INT8
MEDIUMINT	INT4
TINYINT	INT1
DECIMAL (10)	NUMERIC (10,0)
BINARY	BYTES (1)
BIT	BOOLEAN
BIT (64)	BYTES (8)
BLOB	BYTES (66535)
LONGBLOB	BLOB
MEDIUMBLOB	BLOB
TINYBLOB	BYTES (255)
DATE	DATE
DATETIME	DATETIME

**Note** DATETIME without a parenthetical value is replicated without milliseconds, whereas DATETIME with a value of 1-5 - e.g. DATETIME(5) - is replicated with milliseconds.

**Note** When replicating a DATETIME column, the time remains the same on the target (i.e. it is not converted

**Table 8.10 | MySQL Database Source Data Types with Mapping to Attunity Replicate Data Types when the Target is not MySQL (Cont.)**

MySQL Source Data Types	Attunity Replicate Data Types
to UTC).	
TIME	STRING
TIMESTAMP	DATETIME
<b>Note</b> When replicating a TIMESTAMP column, the time is converted to UTC on the target.	
YEAR	INT2
DOUBLE	REAL8
FLOAT	REAL (DOUBLE)
If the FLOAT values are not in the range specified below, use a transformation to map FLOAT to STRING. For an explanation of how to do this, see <a href="#">Using the Transform Tab</a> .	
Supported FLOAT range: - 1.79E+308 to -2.23E-308, 0 and 2.23E-308 to 1.79E+308	
*VARCHAR (45)	WSTRING (45)
*VARCHAR (2000)	WSTRING (2000)
*VARCHAR (4000)	WSTRING (4000)
VARBINARY (4000)	BYTES (4000)
VARBINARY (2000)	BYTES (2000)
*CHAR	WSTRING
*TEXT	WSTRING (65535)
*LONGTEXT	NCLOB
*MEDIUMTEXT	NCLOB
*TINYTEXT	WSTRING (255)
GEOMETRY	BLOB
POINT	BLOB

**Table 8.10 | MySQL Database Source Data Types with Mapping to Attunity Replicate Data Types when the Target is not MySQL (Cont.)**

MySQL Source Data Types	Attunity Replicate Data Types
LINESTRING	BLOB
POLYGON	BLOB
MULTIPOINT	BLOB
MULTILINESTRING	BLOB
MULTIPOLYGON	BLOB
GEOMETRYCOLLECTION	BLOB
ENUM	WSTRING (Length) Where "Length" is the longest value in the ENUM.
SET	WSTRING (Length) Where "Length" is the total of all values in the SET, including commas.

**Note** If the DATETIME and TIMESTAMP data types are specified with a "zero" value (i.e. 0000-00-00), you need to make sure that the target database in the replication task supports "zero" values for the DATETIME and TIMESTAMP data types. If they are not supported, you can use a transformation to specify a supported value (e.g. 1970.) Otherwise, they will be recorded as null on the target.

**Note** The JSON data type introduced in MySQL 5.7 is not supported. Consequently, JSON columns in the source tables will be ignored.

## Homogeneous Replication

The following section describes how Replicate handles replication between a MySQL source and a MySQL target (i.e. homogeneous replication).

**Note** In homogeneous replication, the source data first passes through the Attunity Replicate data type and is therefore subject to any limitations of that type.

For information on Replicate data types and their limitations (where relevant), see [Replicate Data Types](#).

For information on which Replicate data types the source data passes through when replicating from MySQL, see the MySQL to Attunity Replicate data types mapping table described earlier.

## Data Types

When replicating to a MySQL target endpoint, the data types will be identical with the following exceptions:

MySQL Source Data Types	MySQL Target Data Types
NUMERIC	DECIMAL
LONG VARBINARY	MEDIUMBLOB

## Collation

When replicating from one MySQL endpoint to another, table and column collations will be replicated to the target. Collatable data types are indicated by an asterisk (\*) in Table 11-3 above.

To support collation replication, the DBA must ensure that the collations defined for the source MySQL database are the same as those defined for the target MySQL database.

## Non-Nullable Columns and Primary/Unique Index Names

Non-nullable columns and Primary/Unique Index names are preserved during homogeneous replication.

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

**Note** You can also use MySQL files as a source. For more information, see [Using the Attunity Replicate File Channel](#).

### To add a MySQL source endpoint to Attunity Replicate:

1. In the Attunity Replicate Console, click **Manage Endpoint Connections** to open the **Manage Endpoints Connections** dialog box. Then click the **New Endpoint Connection** button. For more information on adding an endpoint to Attunity Replicate, see [Working with Endpoints](#).

2. In the **Name** field, type a name for your endpoint. This can be any name that will help to identify the database being used.
3. In the **Description** field, type a description that helps to identify the MySQL database. This is optional.
4. Select **SOURCE** as the endpoint **role**.
5. From the **Type** drop-down list, select **MySQL**.
6. In the **Server Name** field, enter the host name or IP address of the computer on which the MySQL database is installed.
7. Optionally, change the default port (3306).
8. Type the MySQL authentication information (**User Name**, **Password**) for the authorized user for this MySQL database. If you do not know this information, see your MySQL database Administrator (DBA).

**Note** Consider the following:

- » This information is required. If you are using the **Advanced** tab to create a custom string, make sure to include the **User Name** and **Password** properties. See [Setting Advanced Connection Properties](#) for more information.
- » This information is case sensitive.
- » If you want to set custom properties for this database, see [Setting Advanced Connection Properties](#).

**Important:** Make sure that the MySQL user entered in the MySQL Authentication section has the correct access privileges. For information on how to provide the required privileges, see [Security Requirements](#).

## Selecting a Schema

You can choose which MySQL database to access. After configuring the MySQL source database connection settings, open the **Select Tables** dialog box (by clicking the **Table Selection** button on the right of the console) and select which schema to use from the **Schema** drop down list.

See also [Designing Tasks](#).

## Setting Advanced Connection Properties

In the **Advanced** tab, you can set the following parameters:

- » **Check binary log for new events every:** Specify how often to check the binary log for changes when the endpoints is idle.
- » **Additional ODBC connection properties:** Specify any additional ODBC connection parameters that may be required.

**Note** Attunity Replicate assumes that MySQL Client 5.2.6 to 5.3.x for Linux or MySQL ODBC Client 5.2.6 to 5.3.x 64-bit for Windows is installed on the Attunity Replicate Server machine. If a version later than 5.3.x is installed, you need to specify the version number as an internal parameter where provider is the **Parameter** and MySQL ODBC <version> Unicode Driver is the **Value** (where <version> is the client version e.g. 5.4).

For instructions on setting internal parameters, see [Internal Parameters](#).

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

# Using Hadoop as a Source

This section describes how to set up and use Hadoop as the source endpoint in a replication task.

## In this section:

[Prerequisites](#)

[Limitations](#)

[Required Permissions](#)

[Hadoop Endpoint Source Data Types](#)

[Setting General Connection Properties](#)

[Setting Advanced Connection Properties](#)

## Prerequisites

Before you begin to work with a Hadoop cluster as a data source in Attunity Replicate, make sure that the following prerequisites have been met:

» **General:**

- » The Hadoop WebHDFS must be accessible from the Attunity Replicate machine.
- » The Hadoop Data Nodes must be accessible from the Attunity Replicate machine.
- » The Hadoop WebHDFS service must be running.
- » To access Hive using WebHCat, the Hadoop WebHCat service must be running.  
Other methods for accessing Hive are described later in this chapter.
- » The user specified in the Attunity Replicate Hadoop target settings must have access to HCatalog.

» **SSL:** Before you can use SSL, you first need to perform the following tasks:

- » Configure each NameNode and each DataNode with an SSL certificate (issued by the same CA).
- » Place the CA certificate on the Replicate Server machine. The certificate should be a base64-encoded PEM (OpenSSL) file.

» **Permissions:** The user specified in the Hadoop source settings must have read permission for the HDFS directories that contain the data files.

## Limitations

The following limitations apply:

- » Change data capture is not supported. The Hadoop endpoint will not be available for selection if either **Apply Changes** or **Store Changes** is enabled in the task settings.
- » Replicating data compressed using a method other than gzip is currently not supported.

- » Replicating data that is not in Text format is currently not supported.
- » Replicating from tables with skews, buckets or partitions is currently not supported.
- » Limited LOB support only.
- » Due to a Hive limitation, in Hive version 0.12 and earlier versions, only alphanumeric and underscore characters are allowed in table and column names. From Hive 0.13, column names can contain any Unicode character.

## Required Permissions

The Hadoop NameNode must be accessible from the Attunity Replicate machine.

## Hadoop Endpoint Source Data Types

The following table shows the Hadoop data types that are supported when using Attunity Replicate and the default mapping to Attunity Replicate data types.

For information on how to view the data type that is mapped in the target, see the section for the target endpoint you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 8.11 | Supported Hadoop Data Types Mapped to Attunity Replicate Data Types**

Hadoop Data Types	Attunity Replicate Data Types
BOOLEAN	BOOL
BINARY	BLOB
DATE	DATE
TIMESTAMP	DATETIME
TINYINT	INT1
SMALLINT	INT2
INT	INT4
BIGINT	INT8
FLOAT	REAL4
DOUBLE	REAL8
VARCHAR	STRING
CHAR	STRING
STRING	CLOB
DECIMAL	NUMERIC

## Unsupported Data Types

The Complex Types listed below are not supported:

- » ARRAYS
- » MAPS
- » STRUCTS
- » UNION

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

### To add a Hadoop source endpoint to Attunity Replicate:

1. In the Attunity Replicate console, click the Manage Endpoint Connections toolbar button to open the Manage Endpoints Connections dialog box. Then click the **New Endpoint Connection** button. For more information on adding an endpoint to Attunity Replicate, see [Working with Endpoints](#).
2. In the **Name** field, type a name for your endpoint. This can be any name that will help to identify the endpoint being used.
3. In the **Description** field, type a description that helps to identify the Hadoop endpoint. This is optional.
4. Select **SOURCE** as the endpoint **Role**.
5. Select **Hadoop** as the endpoint **Type**.
6. In the **Hadoop NameNode** field, enter the host name or IP address of the Hadoop NameNode machine.

**Note** Consider the following:

- » This information is case sensitive.
  - » To determine if you are connected to the endpoint you want to use or if the connection information you entered is correct, click **Test Connection**. If the connection is successful, a green confirmation message is displayed. If the connection fails, an error message is displayed at the bottom of the dialog box.
- To view the log entry if the connection fails, click **View Log**. The server log is displayed with the information for the connection failure. Note that this button is not available unless the test connection fails.

7. In the **Security section**, do the following:
  - a. To encrypt the data between the Replicate machine and HDFS, select **Use SSL**. In order to use SSL, first make sure that the [SSL](#) prerequisites described in

[Prerequisites](#) has been met.

In the **CA path** field, either specify the directory containing the CA certificate.

-OR-

Specify the full path to a specific CA certificate.

b. Select one of the following authentication types:

- » **User name** - Select to connect to the Hadoop cluster with only a user name. Then, in the **User name** field, specify the name of a user authorized to access the Hadoop cluster.
- » **Kerberos** - Select to authenticate against the Hadoop cluster using Kerberos. Replicate automatically detects whether Attunity Replicate Server is running on Linux or on Windows and displays the appropriate settings.

#### **Attunity Replicate Server on Linux:**

When Attunity Replicate Server is running on Linux, select either **Ticket** or **Keytab** from the **Kerberos options** drop-down list.

If you selected **Ticket**, select one of the following options:

- » **Use global Kerberos ticket file** - Select this option if you want to use the same ticket for several Hadoop endpoints (source or target). In this case, you must make sure to select this option for each Hadoop endpoint instance that you define.
- » **Use specific Kerberos ticket file** - Select this option if you want to use a different ticket file for each Hadoop endpoint (source or target). Then specify the ticket file name in the designated field.

This option is especially useful if you need to perform a task-level audit of Replicate activity (using a third-party tool) on the Hadoop NameNode. To set this up, define several instances of the same Hadoop endpoint and specify a unique Kerberos ticket file for each instance. Then, for each task, simply select a different Hadoop endpoint instance.

**Note** You need to define a global Kerberos ticket file even if you select the **Use specific Kerberos ticket file** option. The global Kerberos ticket file is used for authentication when selecting a Hive endpoint, when testing the connection (using the **Test Connection** button), and when selecting which tables to replicate.

**Note** When replicating from a Hadoop source endpoint to a Hadoop target endpoint, both endpoints must be configured to use the same ticket file.

For additional steps required to complete setup for Kerberos ticket-based authentication, see [Using Kerberos Authentication](#).

If you selected **Keytab**, provide the following information:

- » **Realm:** The name of the realm in which your Hadoop cluster resides.  
For example, if the full principal name is `john.doe@EXAMPLE.COM`, then `EXAMPLE.COM` is the realm.
- » **Principal:** The user name to use for authentication. The principal must be a member of the realm entered above.  
For example, if the full principal name is `john.doe@EXAMPLE.COM`, then `john.doe` is the principal.
- » **Keytab file:** The full path of the Keytab file. The Keytab file should contain the key of the **Principal** specified above.

#### Attunity Replicate Server on Windows:

When Attunity Replicate Server is running on Windows, select one of the following:

- » **Use the following KDC:** Select **Active Directory** (default) if your KDC is Microsoft Active Directory or select **MIT** if your KDC is MIT KDC running on Linux/UNIX.

**Note** When the Replicate KDC and the Hadoop KDC are in different domains, a relationship of trust must exist between the two domains.

- » **Realm:** The name of the realm/domain in which your Hadoop cluster resides (where *realm* is the MIT term while *domain* is the Active Directory term).
- » **Principal:** The username to use for authentication. The principal must be a member of the realm/domain entered above.
- » When **Active Directory** is selected - **Password:** The password for the principal entered above.
- » When **MIT** is selected - **Keytab file:** The keytab file containing the principal entered above.

**Note** When replicating from a Hadoop source endpoint to a Hadoop target endpoint, both endpoints must be configured to use the same parameters (KDC, realm, principal, and password).

If you are unsure about any of the above, consult your IT/security administrator.

For additional steps required to complete setup for Kerberos authentication, see [Using Kerberos Authentication](#).

- » **User name and password** - Select to connect to the Hadoop NameNode or

to the Knox Gateway (when enabled - see below) with a user name and password. Then, in the **User name** and **Password** fields, specify the required user name and password.

**Note** Consider the following:

- » A user name and password is required to access the MapR Control System.
- » This information is case sensitive.

**Important:** Make sure that the specified user has the required Hadoop access privileges. For information on how to provide the required privileges, see [Required Permissions](#).

8. If you need to access the Hortonworks Hadoop distribution through a Knox Gateway, select **Use Knox Gateway**.

**Note** To be able to select this option, first select **Use SSL** and then select **Password** from the **Authentication type** drop-down list.

9. Provide values for the following fields:

- » **Knox Gateway host** - The FQDN (Fully Qualified Domain Name) of the Knox Gateway host.
- » **Knox port** - The port number to use to access the host. The default is "8443".
- » **Knox Gateway path** - The context path for the gateway. The default is "gateway".

**Note** The port and path values are set in the **gateway-site.xml** file. If you are unsure whether the default values have been changed, contact your IT department.

- » **Cluster name** - The cluster name as configured in Knox. The default is "Default".

10. In the **HDFS section**, select either **WebHDFS** or **HttpFS** as the HDFS access method. If you are accessing MapR, it is recommended to use HttpFS.

**Note** When the **Use Knox Gateway** option is selected, the **NameNode**, **HttpFS Host**, and **Port** fields described below are not relevant (and are therefore hidden).

11. Do one of the following, depending on whether you selected **WebHDFS** or **HttpFS**:  
If you selected **WebHDFS**:

- a. In the **NameNode** field, specify the IP address of the NameNode.

**Note** This is the Active node when High Availability is enabled (see below).

- b. Replicate supports replication from an HDFS High Availability cluster. In such a configuration, Replicate communicates with the Active node, but switches to the Standby node in the event of failover. To enable this feature, select the **High Availability** check box. Then, specify the FQDN (Fully Qualified Domain Name) of the Standby NameNode in the **Standby NameNode** field.

- c. In the **Port** field, optionally change the default port (50070).

If you selected **HttpFS**:

- a. In the **HttpFS Host** field, specify the IP address of the HttpFS host.
- b. In the **Port** field, optionally change the default port (14000).

12. In the **Hive Access section**, do the following:

**Note** When the **Use Knox Gateway** option is selected, the **Host** and **Port** fields described below are not relevant (and are therefore hidden).

- » **Access Hive using** field (WebHCat): This value cannot be changed.
- » **Host** field: Specify the IP address of the Hive machine.
- » **Port** field: Optionally change the default port.
- » **Database** field: Specify the name of the Hive target database.

## Setting Advanced Connection Properties

In the **Advanced** tab, you can specify source file delimiters and other properties. Note that the source file delimiters only need to be specified if one of the following is true:

- » The Hive version is earlier than 0.13
- » The SerDe property names used to create the source data files are different from the Hadoop defaults

The default Hadoop property names are as follows:

- » `field.delim` (**Field delimiter** in the UI)
- » `serialization.null.format` (**Null value** in the UI)
- » `escape.delim` (**Escape character** in the UI)
- » `line.delim` (**Record delimiter** in the UI)
- » `quote.delim` (**Quote character** in the UI)

In the **Advanced** tab, you can set the parameters described in the following table.

**Table 8.12 | Hadoop Source Endpoint - Advanced Tab Options**

Option	Description
Field delimiter	The delimiter used to separate fields in the source files.
Null value	The value used to indicate a null value in the source files. <b>Example (where @@ is the null value):</b> mike,male,295678 sara,female,@@
Escape character	This can either be the character used to escape the field delimiter character - if the source files were created using a SerDe that does not support quote characters (see Example 1) or the character used to escape the quote character - if the source files were created using a SerDe that supports quote characters (see Example 2). <b>Example 1 (where \ is the escape character and a comma is the field delimiter):</b> sunroof\,power-steering
	<b>Example 2 (where \ is the escape character and double quotes is the quote character):</b> "\"sunroof, power-steering\""
Record delimiter	The delimiter used to separate records (rows) in the source files. If the LazySimpleSerde SerDe was used, the record delimiter must be \n.
Quote character	The character used to escape the field delimiter character in the source files. When a field delimiter is escaped, it is interpreted as actual data, and not as a field delimiter. <b>Example (where double-quotes is the quote character):</b> "sunroof,power-steering"

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.

5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

# Using Teradata Database as a Source

This section describes how to set up and use Teradata Database as a source in a replication task.

## In this section:

[Prerequisites](#)

[Required Permissions](#)

[Teradata Source Data Types](#)

[Setting General Connection Properties](#)

[Setting Change Processing Parameters](#)

## Prerequisites

The following section describes the prerequisites for working with Attunity Replicate and a Teradata Database Source.

### Replicate Server for Windows

Teradata Database ODBC Driver for Windows version 15.00 or above must be installed on the Attunity Replicate Server machine.

### Replicate Server for Linux

The following section describes the steps you need to perform to work with Attunity Replicate for Linux and Teradata Database as a source database in a Replicate task.

Teradata Database Client requires the DataDirect ODBC driver manager (provided with Teradata Database Client).

1. Install Replicate on the Linux machine as described in [Installing Attunity Replicate on Linux](#).
2. Install Teradata Database Client 14.10 or above for Linux.

**Note** These instructions assume that the Teradata Database Client is installed in the following location:

/opt/teradata/client/14.10

3. Run the following command:

```
export AREP_ODBC_DRIVER_MANAGER=/opt/teradata/client/14.10/odbc_
64/lib/libodbc.so
```

4. Run the following command:

```
export LD_LIBRARY_PATH=$LD_LIBRARY_PATH:/opt/attunity/replicate/lib:/opt/teradata/client/14.10/tbuild/lib64:$LD_LIBRARY_PATH:/usr/lib64
```

5. To make sure that the path is updated, run the following command:  
`echo $LD_LIBRARY_PATH`
6. Run the following command:  
`export ODBCINI=/opt/teradata/client/14.10/odbc_64/odbc.ini`
7. Add the export commands to the **[site\\_arep\\_login.sh file](#)**.
8. Add the Teradata Database name to the hosts file as described in [Editing the Hosts File](#).

**Important:** A Replicate task cannot be defined with endpoints that use different ODBC Driver Managers. Teradata Database source is accessed using the DataDirect ODBC Driver Manager. With the exception of Oracle, Hadoop, File and Replicate Connect sources (which are not subject to the above limitation), all other source endpoints are accessed using the unixODBC Driver Manager.

To configure a task with a DataDirect source and a unixODBC target, you need to use the Replicate File Channel. For more information about setting up a task using the File Channel, see [Using the Attunity Replicate File Channel](#).

## Required Permissions

The user that is specified in the **General** tab when [Setting General Connection Properties](#) must be registered as a user in the Teradata Database.

## Teradata Source Data Types

The following table shows the Teradata target data types that are supported when using Attunity Replicate and the default mapping to the Attunity Replicate data types.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 8.13 | Supported Teradata Source Data Types with Mapping to Attunity Replicate Data Types**

Teradata Data Types	Attunity Replicate Data Types
BLOB	BLOB
BYTE	BYTES
BYTEINT	INT1
BIGINT	INT8

**Table 8.13 | Supported Teradata Source Data Types with Mapping to Attunity Replicate Data Types (Cont.)**

Teradata Data Types	Attunity Replicate Data Types
DATE	DATE
DECIMAL	REAL8
DOUBLE PRECISION	REAL8
FLOAT	REAL8
INTEGER	INT4
INTERVAL DAY	STRING (Support a maximum of 9,999 days)
INTERVAL DAY TO HOUR	STRING
INTERVAL DAY TO MINUTE	STRING
INTERVAL DAY TO SECOND	STRING
INTERVAL HOUR	STRING
INTERVAL HOUR TO MINUTE	STRING
INTERVAL HOUR TO SECOND	STRING
INTERVAL MINUTE	STRING
INTERVAL MINUTE TO SECOND	STRING
INTERVAL SECOND	STRING (Supports up to six fractional seconds)
CHAR	STRING
CLOB	CLOB
GRAPHIC	STRING
INTERVAL MONTH	STRING
INTERVAL YEAR	STRING
INTERVAL YEAR TO MONTH	STRING
REAL	REAL8
SMALLINT	INT2
TIME	TIME
TIMESTAMP	DATETIME
TIMESTAMP WITH TIME ZONE	DATETIME
TIME WITH TIME ZONE	TIME
VARBYTE	BYTES
VARCHAR	STRING (10)

**Table 8.13 | Supported Teradata Source Data Types with Mapping to Attunity Replicate Data Types (Cont.)**

Teradata Data Types	Attunity Replicate Data Types
VARGRAPHIC	STRING (10)
NUMERIC	NUMERIC
CHAR VARYING	STRING
LONG VARCHAR	STRING

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure change processing parameters, see [Configuring Change Processing](#) below.

### To add a Teradata Database source endpoint to Attunity Replicate:

1. In the Attunity Replicate console, click **Add Database** to open the Add Endpoints dialog box. For more information on adding an endpoint to Attunity Replicate, see [Working with Endpoints](#).
2. In the **Name** field, type a name for your Teradata database. This can be any name that will help to identify the database being used.
3. In the **Description** field, type a description that helps to identify the Teradata database. This is optional.
4. Select **SOURCE** as the database **role**.
5. Select **Teradata Database** as the database **Type**.
6. Type the **Server** name. This is the name of the computer with the Teradata Database instance you want to work with.
7. Type the Teradata Database authentication information (**Username**, **Password**) for the authorized user for this Teradata Database. If you do not know this information, see your Teradata Database system manager.

**Note** Consider the following:

- » This information is case sensitive.
- » To determine if you are connected to the database you want to use or if the connection information you entered is correct, click **Test Connection**.

If the connection is successful a message in green is displayed. If the connection fails, an error message is displayed at the bottom of the dialog box.

To view the log entry if the connection fails, click **View Log**. The server log is displayed with the information for the connection failure. Note that this button is not available unless the test connection fails.

**Important:** Make sure that the Teradata Database user entered in the Teradata Database Authentication section has the correct access privileges. For information on how to provide the required privileges, see [Required Permissions](#).

8. Type the **Default database** name or select one from the list of available endpoints. This is the name of the Teradata Database where you are replicating the data to.

## Setting Change Processing Parameters

The **Change Processing** tab lets you define change processing settings for the Teradata Database source. Normally, Replicate scans a database's transaction logs for changes and then applies those changes to the target database. However, this method of change processing is not possible with Data Warehouse endpoints such as Teradata Database since these endpoints do not generate transaction logs.

The good news is that you can still use Replicate to capture changes from Teradata Database - it just requires a little bit of preparation.

### Prerequisites

Before you can define the settings in the **Change Processing** tab, you need to ensure that at least one special "Context" column exists in your source database tables. Context column(s) are basically columns in a table that enable Replicate to determine whether the data has changed. You can add Context columns specifically for the purpose of change processing (either using a script or manually) or you can use existing columns that contain suitable "Context" data.

**Note** You can create and reference any number of Context columns in a table as long as the Context column names are the same for all source tables. Additionally, each value in the Context column(s) must be unique.

In the example below, the Context column **cf** has been added to the table. The **cf** column contains TIMESTAMPs that enable Replicate to determine whether a change occurred (by comparing the current TIMESTAMP with the TIMESTAMP stored in its repository).

By default, all changes are assumed to be INSERTs. If UPDATE and DELETE operations are also performed on the source tables, you can write an UPDATE and/or DELETE expression (described below) that will enable Replicate to identify the operation type.

Figure 8.1 | Example of a Table with a Context Column

a	first_name	cf	oper
1	may1	2014-12-29 14:52:2...	D
2	may2	2014-12-29 14:52:2...	D
6	omri6	2014-12-29 14:53:5...	D
8	omri8	2014-12-29 14:53:5...	D
9	omri9	2014-12-29 14:53:5...	U
10	omri10	2014-12-29 14:53:5...	U
11	omri11	2014-12-29 14:53:5...	U
3	pitz	2014-12-30 11:04:0...	U
7	gal	2014-12-30 13:27:1...	U
5	gal	2014-12-30 13:29:2...	U
12	gal	2014-12-30 13:41:5...	U

## Limitations

The following limitations apply when Change Processing is enabled for the Teradata Database source:

- » The "Start from timestamp" run option is not supported. For more information, see [Using Advanced Run Options](#).
- » If one of the Context columns is part of the Primary Key or Unique Index, then UPDATE and DELETE operations are not supported.
- » Context columns cannot be LOB columns
- » DDLs are not supported
- » When inserting a record and then updating the same record, the task error handling settings should be set as follows:
  - » Open the **<Task Name> Settings** dialog box.
  - » Select the **Error Handling|Apply Conflicts** tab.
  - » Set a task-specific Apply Conflicts policy as described in [Error Handling Settings](#).
  - » From the **No record found for applying an update** drop-down list, select **INSERT the missing target record**.

For more information on error handling, see [Error Handling](#).

## Configuring Change Processing Settings

Perform the following steps to configure change processing settings.

### To configure change processing settings:

1. Select the **Change Processing** tab in the Teradata Database source.
2. In the **Columns** field, specify the names of the Context columns. The column names are case-sensitive and must be separated by commas.  
Example:  
context1,context2
3. Choose the sorting order of the Context columns as appropriate (**Ascending** or **Descending**). Note that if the order you select is not the same as the actual sorting order, an error will occur.
4. In the **Check for changes every** field, specify how often to check for changes.
5. Enter expressions that Replicate will use to identify UPDATE and DELETE operations. If you do not enter any expressions or if no match is found for an expression, any row whose context is higher (if the sorting order is **Ascending**) or lower (if the sorting order is **Descending**) than the previous context value will be considered an INSERT.

**Note** Expressions must be written in the native syntax of the Teradata Database source. All examples in this section are written using PostgresSQL syntax.

» **Update expression** - Enter an expression for identifying UPDATE operations.

**Example (based on Figure "Example of a Table with a Context Column"):**

```
case when oper='U' then 1 else 0 end
```

**Tip:** [Selecting the **UPDATE the existing target record** option in the **Apply Conflicts** tab, eliminates the need to provide an UPDATE expression.

» **Delete expression** - Enter an expression for identifying DELETE operations.

**Example (based on Figure "Example of a Table with a Context Column"):**

```
case when oper='D' then 1 else 0 end
```

**Important:** In addition to the DELETE expression, DELETE operations should be carried out as "Soft" deletes. This means that the row is not actually deleted from the table, but rather, marked as "deleted".

6. Select **Override connection string parameters** to append the connection string with parameters that are not exposed in the UI. As such parameters are normally not required, they should only be used after consulting with Attunity Support.

# Using PostgreSQL as a Source

This section describes how to set up and use a PostgreSQL database as a source in a replication task.

## In this section:

- [Source Prerequisites](#)
- [Required Permissions](#)
- [Source Limitations](#)
- [PostgreSQL Source Data Types](#)
- [Homogeneous Replication](#)
- [Setting General Connection Properties](#)
- [Setting Advanced Connection Properties](#)
- [Removing Replicate Artifacts from the PostgreSQL Database](#)

## Source Prerequisites

The following section lists the prerequisites for working with Attunity Replicate and a PostgreSQL database source.

### Client Side

#### » Attunity Replicate Server for Windows:

- » The PostgreSQL ODBC Driver `psqlodbc_09_03_0300-x64-1` must be installed on the Attunity Replicate machine.

**Note** Make sure that the PostgreSQL ODBC installation folder "bin" (e.g. "C:\Program Files\psqlODBC\0905\bin") is added to the system PATH.

#### » Attunity Replicate Server for Linux:

On the Attunity Replicate machine:

- » Install `postgresql94-9.4.4-1PGDG.<OS Version>.x86_64.rpm`. This is the package that contains the `psql` executable.  
For example, `postgresql94-9.4.4-1PGDG.rhel7.x86_64.rpm` is the package required for Red Hat 7.
- » Install the ODBC driver `postgresql94-odbc-09.03.0400-1PGDG.<OS version>.x86_64` or above for Linux, where `<OS version>` is the OS of the Attunity Replicate Server machine.  
For example, `postgresql94-odbc-09.03.0400-1PGDG.rhel7.x86_64` is the client required for Red Hat 7.

- » Make sure that the `/etc/odbcinst.ini` file contains an entry for PostgreSQL, as in the following example:

```
[PostgreSQL]
Description = PostgreSQL ODBC driver
Driver = /usr/pgsql-9.4/lib/pgsqlodbc.so
Setup = /usr/pgsql-9.4/lib/pgsqlodbcw.so
Debug = 0
CommLog = 1
UsageCount = 2
```

- » When the **Apply Changes** task option is enabled, the user specified in the PostgreSQL source database's **General** tab must be granted super-user permissions.

## Server Side

- » The IP address of the Attunity Replicate machine must be added to the `pg_hba.conf` configuration file with the "replication" keyword in the database field.

Example:

```
host replication all 176.123.1.212/32 trust
```

- » Make sure that the **test\_decoding** output plugin (found in the **postgresql94-contrib** package) is installed.

- » The following parameters and values must be set in the `postgresql.conf` configuration file.

```
wal_level = logical
```

```
max_replication_slots >=1
```

The `max_replication_slots` value should be set according to the number of tasks that you want to run. For example, to run 5 tasks you need to set a minimum of 5 slots. Slots open automatically as soon as a task starts and remain open, even when task is no longer running. Note that open slots need to be manually deleted.

```
max_wal_senders >=1
```

The `max_wal_senders` parameter sets the number of concurrent tasks that can run.

- » The `wal_sender_timeout` parameter terminates replication connections that are inactive longer than the specified number of milliseconds. The default timeout is 60 seconds. To disable the timeout mechanism (optional), set this parameter to zero.

**Note** By default, the value of the `wal_sender_timeout` parameter is interpreted by the server as milliseconds. To explicitly specify seconds, append an "s" to the value as in the following example:

```
wal_sender_timeout=60s
```

For more information on the configuration parameters, see:

<http://www.postgresql.org/docs/9.4/static/runtime-config-replication.html>

## Required Permissions

The user specified in the **General** tab when [Setting General Connection Properties](#) must be granted the following permissions in the PostgreSQL database:

- » **For Full Load replication:** Standard SELECT on the source database
- » **For Apply Changes replication:** SUPERUSER

## Source Limitations

The following limitations apply when using PostgreSQL as a source:

- » The database name cannot include a semi-colon (;).
- » Both the source table and the corresponding target table must have an identical Primary Key. In the event that one of the tables does not have a Primary Key, the result of DELETE and UPDATE record operations will be unpredictable.
- » The "Start Process Changes from Timestamp" run option is not supported.
- » Replication of the Before Image is not supported.
- » Change processing is not supported on Amazon RDS for PostgreSQL.
- » Replication of multiple tables with the same name but a different case (e.g. `table1`, `TABLE1` and `Table1`) may cause unpredictable behavior and is therefore not supported.
- » Change processing of [CREATE | ALTER | DROP] table DDLs are supported unless they are held in an inner function/procedure body block or in other nested constructs.

For example, the following change will not be captured:

```
CREATE OR REPLACE FUNCTION attu.create_distributors1() RETURNS void
LANGUAGE plpgsql
AS $$

BEGIN
    create table attu.distributors1(did serial PRIMARY KEY, name varchar
(40) NOT NULL);
END;
$$;
```

- » Change processing of TRUNCATE operations is not supported.
- » The DDL statement `ALTER TABLE ADD <column> <data_type> DEFAULT <>` will not replicate the default value to the target.
- » **Partitioned tables:** When performing a Full Load replication of partitioned tables, the parent table will be created and separate tables will be created for each partition. A DML on the parent partitioned table will be applied on the physical partition of the corresponding target table only.

Primary keys are not supported on partitioned tables, which may impact UPDATE operations.

**Note** In order to replicate partitioned tables from a PostgreSQL source to a PostgreSQL target, you first need to manually create the parent and child tables on the target. Then define a separate task to replicate to those tables. In such a case, the task settings should be configured to “Truncate before loading”. For more information on the “Truncate before loading” option, see [Full Load Settings](#).

## PostgreSQL Source Data Types

The following table shows the PostgreSQL target data types that are supported when using Attunity Replicate and the default mapping to the Attunity Replicate data types.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 8.14 | Supported PostgreSQL Source Data Types with Mapping to Attunity Replicate Data Types**

PostgreSQL Data Types	Attunity Replicate Data Types
INTEGER	INT4
SMALLINT	INT2
BIGINT	INT8
NUMERIC(p,s)	If precision is => 0 and =< 38, then: NUMERIC If precision is => 39, then: STRING
DECIMAL(p,s)	If precision is => 0 and =< 38, then: NUMERIC If precision is => 39, then: STRING
REAL	REAL4
DOUBLE	REAL8
SMALLSERIAL	INT2
SERIAL	INT4
BIGSERIAL	INT8
MONEY	NUMERIC(38,4)

**Table 8.14 | Supported PostgreSQL Source Data Types with Mapping to Attunity Replicate Data Types (Cont.)**

PostgreSQL Data Types	Attunity Replicate Data Types
CHAR	WSTRING (1)
CHAR(n)	WSTRING (n)
VARCHAR(n)	WSTRING (n)
<p><b>Note</b> VARCHAR without a length (n) is not recognized as a valid data type by target endpoints. Consequently, if a source column data type is set to VARCHAR without an explicit length, Replicate will set a default length of 8000 bytes.</p> <p>You can change the default by setting the following internal parameter to the required length:</p> <pre>unboundedVarcharMaxSize</pre> <p>See also <a href="#">Internal Parameters</a>.</p>	
TEXT	NCLOB
BYTEA	BLOB
TIMESTAMP	DATETIME
TIMESTAMP (z)	DATETIME
<p><b>Note</b> Replicate only supports ISO formatted textual DATE formats (the default). If other formats are used, an error will be generated. You can change the date format in the <code>postgresql.conf</code> file or using the <code>PGDATESTYLE</code> environment variable. You can also change the date format at database level.</p>	
DATE	DATE
TIME	TIME
TIME (z)	TIME
INTERVAL	STRING (128) - 1 YEAR, 2 MONTHS, 3 DAYS, 4 HOURS, 5 MINUTES, 6 SECONDS

**Table 8.14 | Supported PostgreSQL Source Data Types with Mapping to Attunity Replicate Data Types (Cont.)**

PostgreSQL Data Types	Attunity Replicate Data Types
BOOLEAN	STRING (5) TRUE FALSE
ENUM	STRING (64)
CIDR	STRING (50)
INET	STRING (50)
MACADDR	STRING (18)
BIT (n)	STRING (n)
BIT VARYING (n)	STRING (n)
UUID	STRING
TSVECTOR	CLOB
TSQUERY	CLOB
XML	CLOB
POINT	STRING (255) "(x,y)"
LINE	STRING (255) "(x,y,z)"
LSEG	STRING (255) "((x1,y1),(x2,y2))"
BOX	STRING (255) "((x1,y1),(x2,y2))"
PATH	CLOB "((x1,y1),(xn,yn))"
POLYGON	CLOB "((x1,y1),(xn,yn))"
CIRCLE	STRING (255) "(x,y),r"
JSON	NCLOB
ARRAY	NCLOB
COMPOSITE	NCLOB
INT4RANGE	STRING (255)
INT8RANGE	STRING (255)
NUMRANGE	STRING (255)
STRRANGE	STRING (255)
CHARACTER VARYING	If length is specified: WSTRING (LENGTH) If no length is specified: WSTRING (8000)
TINTERVAL	WSTRING(255)

## Homogeneous Replication

When replicating from a PostgreSQL source to a PostgreSQL target, most of the source and target data types will be identical. The exceptions are listed in the table below.

Additionally, in homogeneous replication, source column and table collations will be replicated to the target as described in [Column and Table Collation](#).

**Note** In homogeneous replication, the source data first passes through the Attunity Replicate data type and is therefore subject to any limitations of that type.

For information on Replicate data types and their limitations (where relevant), see [Replicate Data Types](#).

For information on which Replicate data types the source data passes through when replicating from PostgreSQL, see the PostgreSQL to Attunity Replicate data types mapping table described earlier.

## Data Type Exceptions

When replicating from one PostgreSQL database to another, source and target data types are identical for all supported PostgreSQL versions, with the following exceptions:

**Table 8.15 | Data Type Exceptions in Homogeneous Replication**

PostgreSQL Source	PostgreSQL Target
ENUM	STRING
COMPOSITE	STRING
NUMERIC	NUMERIC (28,6)

## Column and Table Collation

When replicating from one PostgreSQL database to another, column and table collations will be replicated to the target.

**Note** To support collation replication, the DBA must ensure that the collations defined for the source PostgreSQL database are the same as those defined for the target PostgreSQL database.

## Non-Nullable Columns and Primary/Unique Index Names

Non-nullable columns and Primary/Unique Index names are preserved during homogeneous replication.

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

### To add a PostgreSQL endpoint source database to Attunity Replicate:

1. In the Attunity Replicate console, click **Add database** to open the **Add Endpoints** dialog box. For more information on adding an endpoint to Attunity Replicate, see [Working with Endpoints](#).
2. In the **Name** field, type a name for your PostgreSQL database. This can be any name that will help to identify the database being used.
3. In the **Description** field, type a description that helps to identify the PostgreSQL database. This is optional.
4. Select **SOURCE** as the database **role**.
5. Select **PostgreSQL** as the database **Type**.
6. Type the **Server** name. This is the name or IP address of the computer with the PostgreSQL database that you want to access.
7. Optionally, change the default port (5432).
8. Enter the PostgreSQL database authentication information (**User name**, **Password**) of an authorized PostgreSQL user. If you do not know this information, see your PostgreSQL database system manager.

**Note** Consider the following:

- » This information is case sensitive.
- » To determine if you are connected to the database you want to use or if the connection information you entered is correct, click **Test Connection**.  
If the connection is successful a message in green is displayed. If the connection fails, an error message is displayed at the bottom of the dialog box.  
To view the log entry if the connection fails, click **View Log**. The server log is displayed with the information for the connection failure. Note that this button is not available unless the test connection fails.

**Important:** Make sure that the PostgreSQL database user entered in the PostgreSQL database Authentication section has the correct access privileges.

9. Type the **database name** or select one from the list of available endpoints. This is the name of the PostgreSQL database from which you are replicating data.
10. Click **OK** to save your settings and close the dialog box.

## Setting Advanced Connection Properties

In the **Advanced** tab, you can set the following properties:

- » **Capture DDLs:** When this option is selected, the following actions occur:
  - » Operational artifacts are created (by Replicate) in the database when the task starts. In order to capture DDL events, Attunity Replicate creates various artifacts in the PostgreSQL database when the task starts. You can later remove these artifacts as described in [Removing Replicate Artifacts from the PostgreSQL Database](#).
  - » Streamed DDL events are captured.
- » **Create DDL artifacts in schema:** The schema in which the operational DDL database artifacts will be created. The default value is "Public".
- » **WAL heartbeat** - An Apply Changes task that is running but not capturing changes (due to source table inactivity) will continue to occupy the LSN position in its replication slot, thereby preventing truncation of the WAL. Since the WAL is a server-wide resource used by all PostgreSQL processes, it may grow extremely large if no changes are captured for an extended period.

To prevent this from happening, enable the "WAL heartbeat" option. When this option is enabled, the PostgreSQL source endpoint mimics task activity by periodically committing pseudo transactions (i.e. "Heartbeats") to the heartbeat table, thereby advancing the task slot's LSN position.

- » **Create WAL heartbeat table in schema:** The schema in which the WAL heartbeat table (attrep\_wal\_heartbeat) will be created. The default value is "public".
- » **Heartbeat frequency (minutes):** The frequency with which to commit transactions to the heartbeat table.

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

## Removing Replicate Artifacts from the PostgreSQL Database

In order to capture DDLs, Attunity Replicate creates various artifacts in the PostgreSQL database when the task starts. When the task completes, you may wish to remove these artifacts.

To remove the artifacts, issue the following statements (in the order they appear below), where `public` is the default schema in which the artifacts were created:

```
drop event trigger attrep_intercept_ddl;
```

Note that the event trigger does not belong to a specific schema.

```
drop function public.attrep_intercept_ddl()
```

```
drop table public.attrep_ddl_audit
```

```
drop schema public
```

**Important:** Dropping a schema should be done with extreme caution, if at all. Never drop an operational schema, especially not `public`.

# Using a File as a Source

This section describes how to set up and use delimited text files as a source in a replication task. You can use the File target endpoint to export database tables to files, which can then be used as a source in a Replicate task with a File source endpoint.

## In this section:

- [General Overview](#)
- [File Source Overview](#)
- [Prerequisites](#)
- [Limitations](#)
- [Setting General Connection Properties](#)
- [Setting Advanced Options](#)

## General Overview

The Replicate File endpoint can be used either as a source or as a target. When used as a source, the File endpoint requires the source files to be in delimited text file format. When used as a target, the File endpoint generates the data files either in delimited text file format (CSV) or in JSON format (according to the format selected in the endpoint settings).

Delimited text files are used to store data in tabular format. Examples of delimited text file formats include the CSV (Comma Separated Values) and TSV (Tab Separated Values) formats. Some organizations may implement procedures that export data from a database to a delimited text file while others may simply prefer this format as a convenient way of storing tabular data.

In a delimited text file, each record in the table occupies a separate row. Delimiters are used to mark the beginning of a new row or the beginning of a new column. Virtually any character can be used as a delimiter, although a newline (\n) is often used to separate rows, and commas are commonly used to separate columns.

In JSON files, each record is represented by a single line.

So, for example, the following table:

book_id	title	price	is_hardcover
123	Angels	6.99	false
456	The Fallen	6.49	true
789	Rise Up	7.23	true

Will be represented as:

```
{ "book_id": 123, "title": "Angels", "price": 6.99, "is_hardcover": false }
```

```
{ "book_id": 456, "title": "Fallen", "price": 6.49, "is_hardcover": true }
{ "book_id": 789, "title": "Rise Up", "price": 7.23, "is_hardcover": true }
```

See also [File Source Overview](#) and [File Target Overview](#).

## File Source Overview

When you configure the File Source endpoint in Replicate, you need to specify which row and column delimiters are used in your CSV source files as well as which characters are used to enclose columns containing delimiters. You may also need to specify which character is used to escape columns enclosed in double-quotes (should such columns exist in your source files). If you have previously used Replicate to transfer endpoint tables to files and you now wish to use those files as a source in another task, then you should specify the same delimiters (i.e. that were used to generate target files).

For more information, see [Setting General Connection Properties](#).

Three types of delimited files are used in the Replicate Source File endpoint:

- » [Full Load Files](#)
- » [Change Files](#)
- » [Reference Files](#)

### Reference Files

Change Files can either reside in a single location or in multiple locations. To access Change Files that reside in different locations and/or that do not include the target table names, you need to use a Reference File. If the rows in the Change File(s) contain the names of the tables to which to apply the changes, then the Reference File only needs to contain the paths to the Change Files. If each Change File contains changes for a single table, then each of the Change File paths in the Reference File needs to be preceded by the name of its corresponding target table.

For more information on Reference File and Reference File formats, see [Change Processing](#).

Each row in the Reference File should be formatted as follows:

```
[<table_name>],<full path to Change File>
```

Where [<table\_name>] is required only if the referenced Change File contains changes for a single table.

**Note** Reference File names cannot exceed 70 characters (no such limitation exists for the path length). Reference File names that exceed 70 characters will be ignored and appropriate warning will be written to the log.

## Example 8.1 | Reference File: Each Change File contains changes for a single table:

```
table1,c:\temp\cdc1.csv  
table2,c:\temp\cdc2.csv  
table3,c:\temp\cdc3.csv
```

## Example 8.2 | Reference File: Each Change File contains changes for multiple tables:

```
c:\temp\cdc1.csv  
c:\temp\cdc2.csv  
c:\temp\cdc3.csv
```

## Full Load Files

Full Load Files are used to populate the empty source tables with data. Full Load Files should only contain the table data. The source tables themselves are created using the External Table Editor provided in the File source endpoint configuration. Both the tables and their data are replicated to the target endpoint during the Full Load stage of the Replicate task.

### Example of a Full Load Data File

```
22,January,2014,male,5463565  
12,May,2011,female,3236776  
9,March,2009,male,9648675
```

For more information on Full Load data files and creating tables, see [Defining Tables and Full Load Data](#).

## Change Files

A Change File is a delimited text file that contains a record of DML changes - represented as rows - to apply to the specified target tables. Replicate reads the Change File(s) and applies the changes to the relevant target tables, which can either be specified in the Change File itself or in a Reference File (see [Reference Files](#) below for details). Change Files are picked up from the source directory according to their modification date, thereby ensuring that the changes will be processed in the proper sequence.

**Note** The Change File modification date *must* be both newer than the task start timestamp and newer than the last processed Change File.

Each row in a Change File consists of the following delimited columns:

- » (Optional) The change operation e.g. DELETE. If the operation field is absent, INSERT is assumed.

- » The name of the target table to which to apply the change (only required if the Change File contains changes for multiple tables)
- » (Optional) The timestamp of the change i.e. when the change occurred
- » (Optional) The user who applied the change
- » The data to change (one or more columns)

Change Files can either contain changes for multiple tables or for a single table, as shown in the examples below.

**Note** To access Change Files that reside in different locations and/or that do not include the target table names, you need to use a Reference File. For more information on Reference Files, see [Reference Files](#).

**Note** Change File names cannot exceed 70 characters (no such limitation exists for the path length). Change File names that exceed 70 characters will be ignored and appropriate warning will be written to the log.

### Example 8.3 | Change File that contains changes for multiple tables

```
INSERT,table1,ts1,user,dog,cat,bird  
INSERT,table2,ts1,user,dog,cat,bird  
DELETE,table3,ts1,user,dog,cat,bird
```

### Example 8.4 | Change File that contains changes for a single table

```
INSERT,,ts1,user,dog,cat,bird  
INSERT,,ts1,user,dog,cat,bird  
DELETE,,ts1,user,dog,cat,bird
```

## Prerequisites

Before you begin to work with a File as a source in Attunity Replicate, make sure that the following prerequisites have been met:

- » Attunity Replicate installed in your network
- » Change Files, Full Load files and Reference Files should be in delimited text file format
- » Source files (including the Reference File) should be accessible from the Attunity Replicate machine.

## Limitations

The following limitations apply to the File source:

- » Change Files that are currently being used in a Replicate task cannot be modified while the task is in progress.
- » Stopping a Full Load task and then starting it again will start the task from the beginning (and not from the point at which it was stopped).

## Setting General Connection Properties

You can add a File endpoint to Attunity Replicate to use as a source. For information on how to add endpoints, see [Working with Endpoints](#).

### To add a File source endpoint to Attunity Replicate:

1. In **Tasks** view, click **Manage Endpoint Connections** to open the **Manage Endpoints Connections** dialog box. Then click the **New Endpoint Connection** button.
2. In the **Name** field, type a name for your endpoint. This can be any name that will help to identify the endpoint being used.
3. In the **Description** field, type a description that helps to identify the File endpoint. This is optional.
4. Select **SOURCE** as the endpoint **role**.
5. Select **File** as the endpoint **Type**.
6. Configure the settings in the **General** tab as described in the table below.

**Table 8.16 | File Source Endpoint - General Tab Options**

Option	Description
<b>File Format</b>	
Field Delimiter	The delimiter used to separate columns in the source files. The default is a comma.  <b>Example:</b> mike,male
Record delimiter	The delimiter used to separate records (rows) in the source files. The default is a carriage return (\n).  <b>Example (Using an asterisk as the row delimiter)</b> mike,male*sara,female
Null value	The character used to indicate a null value in the source files.  <b>Example (where * is the row delimiter and @ is the null value):</b> mike,male,295678*sara,female,@
Quote character	The character used at the beginning and end of a column that

**Table 8.16 | File Source Endpoint - General Tab Options (Cont.)**

Option	Description
	<p>contains the column delimiter character. The default is the double-quote character ("). When a column that contains column delimiters is enclosed in double-quotes, the column delimiter characters are interpreted as actual data, and not as column delimiters.</p> <p><b>Example (where a comma is the column delimiter):</b> "sunroof, power-steering"</p>
Escape character	<p>The character used to escape a string when both the string and the column containing the string are enclosed in quotation marks. Note that the string's quotation marks will be removed unless they are escaped.</p> <p><b>Example (where " is the quote character and \ is the escape character):</b> 1955,"old, \"rare\", Chevrolet",\$1000</p>
Code page	<p>Specify the code page of your source files if it is different from the default (65001).</p> <p><b>Note</b> Windows and Linux systems use different code page conventions. The specified code page must comply with the code page convention of the source file system.</p>
Ignore records	<p>Optionally, specify which header and footer rows in the source files to ignore. Make sure that the header and footer rows to ignore do not contain actual data.</p>

### Change Processing

**Important:** Changes cannot be captured from Change Files that are present *during* the Full Load operation. Consequently, the Change Files should be placed in their source location(s) only *after* Full Load completes.

Folder	<p>Select this option if your Change Files contain the target table names and reside in a single folder. Then specify the folder location in the designated field. You can optionally use wildcard characters to only process files that match the specified pattern.</p> <p><b>Example:</b> c:\temp\*changes.csv</p> <p>See also: <a href="#">Change Files</a>.</p>
--------	--

**Table 8.16 | File Source Endpoint - General Tab Options (Cont.)**

Option	Description
Use Reference Files	<p>Select this option if you are using Reference Files to point to the location of the Change Files. Then specify one of the following:</p> <ul style="list-style-type: none"> <li>» The path to the Reference Files</li> <li>» The path to a specific Reference File</li> <li>» A path with a wildcard pattern that matches the Reference File names (e.g. C:\Reference Files\*.csv)</li> </ul> <p>The folder can either contain a single reference file (which is continually appended with the Change File locations) or multiple reference files.</p> <p>For information on when Reference Files should be used, see <a href="#">Reference Files</a>.</p>
Change File path is preceded by table name	<p>Select this option if each of the Change File paths in the reference files is preceded by a table name.</p> <p><b>Note</b> Selecting this option will disable the <b>Table name</b> check box in the <b>Header columns ordinal position</b> section.</p>
Header column order	<p>Specify the position of each header column in your Change Files. Apart from the data columns which must be positioned after the header columns, the columns can be positioned in any order.</p> <p>So, for example, if your Change Files looked liked this:</p> <pre>DELETE,table1,timestamp,user1,dog,cat,bird</pre> <p>Then, the column positions would be set as follows:</p> <p><b>Operations are in column: 1</b></p> <p><b>Table names are in column: 2</b></p> <p><b>Timestamps are in column: 3</b></p> <p><b>User names are in column: 4</b></p> <p><b>Start data from column: 5</b></p> <p>For more information on the columns, see <a href="#">Change Files</a>.</p> <p><b>Note</b> To change the ordinal positions of the "User name" and "Timestamp" columns, you first need to define two transformations (one for each column) that add the \$AR_H_TIMESTAMP and \$AR_H_USER header columns to the Change Files.</p>

**Table 8.16 | File Source Endpoint - General Tab Options (Cont.)**

Option	Description
	<p><b>To add the columns to a single table (i.e. Change File):</b></p> <ol style="list-style-type: none"> <li>1. Open the <b>Table Settings</b> window as described in <a href="#">Defining Transformations for a Single Table/View</a>.</li> <li>2. Select the <b>Transform</b> tab and then click <b>Add Column</b>. A new row will be added to the <b>Output</b> table.</li> <li>3. Click the  button at the end of the row (in the <b>Expression</b> column). This will open the <b>Expression Builder</b> Window.</li> <li>4. Select the column from the <b>Header Columns</b> tab and then click <b>OK</b>.</li> <li>5. Specify a name for the column. For example, if you selected the \$AR_H_TIMESTAMP header column, specify "Timestamp".</li> <li>6. Repeat Steps 1-5 to add the other header column.</li> <li>7. Click <b>OK</b> to close the <b>Table Settings</b> window.</li> </ol> <p><b>To add the header column to all tables (i.e. Change Files):</b></p> <ol style="list-style-type: none"> <li>1. Open the <b>Global Transformation Rules</b> window as described in <a href="#">Starting the New Transformation Rule Wizard</a>.</li> <li>2. Click <b>Next</b> twice until you get to the <b>How to transform</b> screen.</li> <li>3. Click the Browse button next to the <b>Computation expression</b> field. This will open the <b>Expression Builder</b> Window.</li> <li>4. Select the column from the <b>Header Columns</b> tab and then click <b>OK</b>.</li> <li>5. Specify a name for the column. For example, if you selected the \$AR_H_TIMESTAMP header column, specify "Timestamp".</li> <li>6. Click <b>Finish</b>.</li> <li>7. Repeat steps 1-6 to add the other header column.</li> </ol>
Start data from column:	Specify which column to start the actual data from. Note that data columns must be positioned after header columns. See the example in the description of the <b>Header column order</b> field above.

**Note** To determine if you are connected to the endpoint you want to use or if the connection information you entered is correct, click **Test Connection**.

If the connection is successful a message in green is displayed. If the connection fails, an error message is displayed at the bottom of the dialog box.

To view the log entry if the connection fails, click **View Log**. The server log is displayed with the information for the connection failure. Note that this button is not available unless the test connection fails.

## Defining Tables and Full Load Data

In the **Tables** tab, you specify the location of your Full Load data files and define how the source tables will be created. During Full Load, Replicate will copy the source tables to the target endpoint.

### To define a table:

1. In the **Tables** tab, click **New Table**.  
The **New Source Table** window opens.
2. In the **Table name** field, specify the name of the table.
3. In the **Location of full load data file(s)** field, specify location of the delimited text files that contain your full load data. Wildcard characters are supported.
4. To add a field, click **Add Field**. Then, click the default column name to edit it.
5. To specify a data type, select the row and then select a type from the drop-down list in the **Type** column.
6. (Optional) Click in the **Key** column to add or remove a Primary Key to/from a column.
7. To create the table, click **OK**.

The table will be added to the list of tables in the **Tables** tab.

See also the example for [Creating a Table](#).

### To edit a field:

- » Double-click the column in the **New/Edit Source Table** dialog box and then edit the values as described above.

### To delete a field:

- » Select the column in the **New/Edit Source Table** dialog box and then click the **Delete Field** button.

### To change the position of a field:

- » Select the field and then click the **Up/Down** and **Move to Top/Move to Bottom** buttons as required.

**To edit a table:**

- » In the **Tables** tab, either double-click the table or select the table and then click the **Edit** button. Edit the table as described above.

**To delete a table:**

- » In the **Tables** tab, select the table and then click the **Delete** button.

## Example 8.5 | Creating a Table

The source table definition must match the column data values in the Full Load file(s). So, for example, if the Full Load data file contains the following delimited columns:

22,January,2014,male,5463565  
12,May,2011,female,3236776  
9,March,2009,male,9648675  
30,June,2002,female,3458795

**Note** Boolean values must be expressed as the digits 1 (TRUE) or 0 (FALSE) and not TRUE or FALSE.

Then the table definitions would look something like this:

Edit Source Table

Table name:	MyTable		
Location of full load data file(s):	C:\Full Load		
<input type="button" value="Add Field"/> <input type="button" value="Delete Field"/> <span style="margin-left: 20px;"><input type="button" value=""/></span>		<input type="text" value="Search"/> <input type="button" value="Search"/>	
Key	Name	Type	
	Day	NUMERIC(18,0)	
	Month	STRING(50)	
	Year	NUMERIC(18,0)	
	Gender	STRING(50)	
<input checked="" type="checkbox"/>	ID	NUMERIC(18,0) <input type="button" value=""/>	
5 Field(s)			
<input type="button" value="OK"/> <input type="button" value="Cancel"/>			

## Setting Advanced Options

In the **Advanced** tab, the following options are available.

**Table 8.17 | File Source Endpoint - Advanced Tab Options**

Option	Description
File preprocessing	If your source files (Full Load and/or Change Files) are not in delimited text format, you can convert them to the required format using a command. The command should be specified as in the following example: c:\temp\files\convertfile.exe

**Table 8.17 | File Source Endpoint - Advanced Tab Options (Cont.)**

Option	Description
	<p><b>Note</b> The path is only necessary if the conversion program's location is not defined in the "Path" system variable.</p> <p>The conversion program should accept the following parameters:</p> <ul style="list-style-type: none"> <li>» The location of the input file(s) (as specified in the <b>Change Processing</b> settings)</li> <li>» The output file</li> </ul> <p>The output file will be written to the following location:</p> <pre>PRODUCT_INSTALLATION\prod\data\tasks\TASK_NAME\trans_files\</pre>
Check for changes every	Specify how often to check the Change Files for updates.
Change Processing Cleanup	<p>Select one of the following cleanup options to determine what Replicate should do with the processed Change Files/Reference Files:</p> <ul style="list-style-type: none"> <li>» <b>Do nothing</b> - to leave the file(s) in the original location.</li> <li>» <b>Delete files</b> - to delete the file(s) from the disk.</li> <li>» <b>Archive files to folder</b> - to archive the file(s) to the specified location.</li> </ul> <p><b>Note</b> In the case of Reference Files, the <b>Delete files</b> and <b>Archive files to folder</b> operations will only be performed if there are multiple reference files.</p>

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

# Using ODBC with CDC as a Source

This section describes how to use ODBC connectivity to connect to a source endpoint in a Full Load and/or CDC task.

## In this section:

[Prerequisites](#)

[Limitations](#)

[ODBC with CDC Source Data Types](#)

[Setting General Connection Properties](#)

[Setting Change Processing Parameters](#)

## Prerequisites

The following section describes the prerequisites for working with Attunity Replicate and an ODBC source with CDC.

### Replicate Server for Windows

You can connect an endpoint to Attunity Replicate using ODBC by indicating the DSN (Data Source Name). In this case you must be sure that a DSN is defined for the ODBC endpoint on the computer where Attunity Replicate is installed.

1. Install an endpoint client on the computer where Attunity Replicate is installed. The client you install depends on the ODBC provider you are using. For example, if you are using an IBM DB2 endpoint, install an IBM DB2 client.

**Note** You must use a 64-bit ODBC provider client to work with Attunity Replicate

2. Use the ODBC Data Source Administrator to create a System DSN. The Data Source is located in the Windows control panel.

### Replicate Server for Linux

The following section describes the steps for working with Attunity Replicate for Linux and ODBC with CDC as a source endpoint in a Replicate task.

1. On the Attunity Replicate Server machine, install the ODBC client that you want to use (e.g. PostgreSQL).
2. Makes sure that the `/etc/odbcinst.ini` file contains the correct entry for the driver you installed, as in the following example: [PostgreSQL]

```
Description = ODBC for PostgreSQL
Driver = /usr/lib/pgsqlodbc.so
Setup = /usr/lib/libodbcpgsqlS.so
```

```
Driver64 = /usr/lib64/psqlodbc.so
Setup64 = /usr/lib64/libodbcsqlS.so
FileUsage = 1
```

3. Define a DSN for the installed driver by editing the `/etc/odbc.ini` file, as in the following example:

```
[Postgre_DSN]
Description = Test
Driver = /usr/lib64/psqlodbc.so
Endpoint = MyDatabase
Servername = 12.3.45.678
Port = 5432
```

## Limitations

The following limitations apply:

- » `UPDATES` to primary key fields are not supported. To update the field, define it as a unique index instead.
- » For providers that do not support batch operations, you must manually add the `RowByRow=true` internal parameter according to the instruction provided in [Setting Change Processing Parameters](#).
- » The "Resume from timestamp" run option is not supported.

## ODBC with CDC Source Data Types

The following table shows the ODBC target data types that are supported when using Attunity Replicate and the default mapping from Attunity Replicate data types.

For information on how to view the data type that is mapped in the target, see the section for the target endpoint you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 8.18 | Supported ODBC with CDC Source Data Types with Mapping to Attunity Replicate Data Types**

ODBC Data Types	Attunity Replicate Data Types
<code>SQL_BIT</code>	<code>BOOLEAN</code>
<code>SQL_TINYINT</code>	<code>INT1</code> <code>UINT1</code>

**Note** SQL data types are mapped to unsigned data types when the `UNSIGNED_ATTRIBUTE` is set

**Table 8.18 | Supported ODBC with CDC Source Data Types with Mapping to Attunity Replicate Data Types (Cont.)**

ODBC Data Types	Attunity Replicate Data Types
SQL_SMALLINT	<b>INT2</b> <b>UINT2</b>
	<p><b>Note</b> SQL data types are mapped to unsigned data types when the <code>UNSIGNED_ATTRIBUTE</code> is set to <code>SQL_TRUE</code> for the data type being mapped.</p>
SQL_INTEGER	<b>INT4</b> <b>UINT4</b>
	<p><b>Note</b> SQL data types are mapped to unsigned data types when the <code>UNSIGNED_ATTRIBUTE</code> is set to <code>SQL_TRUE</code> for the data type being mapped.</p>
SQL_BIGINT	<b>INT8</b> <b>UINT8</b>
	<p><b>Note</b> SQL data types are mapped to unsigned data types when the <code>UNSIGNED_ATTRIBUTE</code> is set to <code>SQL_TRUE</code> for the data type being mapped.</p>
SQL_DOUBLE	<b>REAL8</b>
SQL_FLOAT	<b>REAL8</b>
SQL_REAL	<b>REAL8</b>
SQL_NUMERIC (P,S)	<b>NUMERIC (P,S)</b> <b>REAL8</b>
	<p>The SQL_NUMERIC data type is mapped to REAL8 when <i>at least one</i> of the following is true:</p> <ul style="list-style-type: none"> <li>» Precision &gt; 38</li> <li>» Scale &lt; 0</li> <li>» Scale &gt; 38</li> <li>» Scale &gt; Precision</li> </ul>
SQL_DECIMAL (P,S)	<b>NUMERIC (P,S)</b>

**Table 8.18 | Supported ODBC with CDC Source Data Types with Mapping to Attunity Replicate Data Types (Cont.)**

ODBC Data Types	Attunity Replicate Data Types
	<b>REAL 8</b>
	The SQL_NUMERIC data type is mapped to REAL8 when <i>at least one</i> of the following is true:
	<ul style="list-style-type: none"> <li>» Precision &gt; 38</li> <li>» Scale &lt; 0</li> <li>» Scale &gt; 38</li> <li>» Scale &gt; Precision</li> </ul>
SQL_DATE	<b>DATE</b>
SQL_TYPE_DATE	
SQL_TIME	<b>TIME</b>
SQL_TYPE_TIME	
SQL_TIMESTAMP	<b>DATETIME</b>
SQL_TYPE_TIMESTAMP	
SQL_CHAR	<b>STRING</b>
SQL_VARCHAR	
SQL_WCHAR	<b>WSTRING</b>
SQL_WVARCHAR	
SQL_LONGVARCHAR	<b>CLOB</b>
To use this data type with Attunity Replicate, you must enable the use of CLOBs for a specific task.	
During CDC, CLOB data types are supported only in tables that include a primary key.	
For more information, see <a href="#">LOB support in Task Settings/Metadata</a> .	
SQL_WLONGVARCHAR	<b>NCLOB</b>
To use this data type with Attunity Replicate, you must enable the use of NCLOBs for a specific task.	
During CDC, NCLOB data types are supported only in tables that include a primary key.	

**Table 8.18 | Supported ODBC with CDC Source Data Types with Mapping to Attunity Replicate Data Types (Cont.)**

ODBC Data Types	Attunity Replicate Data Types
For more information, see <b>LOB support in Task Settings/Metadata.</b>	
SQL_BINARY	<b>BYTES</b>
SQL_LONGVARBINARY	<b>BLOB</b>
To use this data type with Attunity Replicate, you must enable the use of BLOBS for a specific task.	
BLOB data types are supported only in tables that include a primary key.	
For more information, see <b>LOB support in Task Settings/Metadata.</b>	
SQL_GUID	<b>STRING</b>
SQL_INTERVAL_YEAR	<b>STRING</b>
SQL_INTERVAL_MONTH	
SQL_INTERVAL_DAY	
SQL_INTERVAL_MINUTE	
SQL_INTERVAL_HOUR	
SQL_INTERVAL_SECOND	
SQL_INTERVAL_YEAR_TO_MONTH	
SQL_INTERVAL_DAY_TO_HOUR	
SQL_INTERVAL_DAY_TO_MINUTE	
SQL_INTERVAL_DAY_TO_SECOND	
SQL_INTERVAL_HOUR_TO_MINUTE	
SQL_INTERVAL_HOUR_TO_SECOND	
SQL_INTERVAL_MINUTE_TO_SECOND	
Provider specific data types	If column length is < or = 4000:
If column length is 0 or > 4000 then:	<b>BYTES</b>
To use this data type with Attunity Replicate, you must enable the use of BLOBS for a specific task.	If column length is 0 or > 4000: <b>BLOB</b>

**Table 8.18 | Supported ODBC with CDC Source Data Types with Mapping to Attunity Replicate Data Types (Cont.)**

ODBC Data Types	Attunity Replicate Data Types
BLOB data types are supported only in tables that include a primary key.  For more information, see <b>LOB support in Task Settings/Metadata</b> .	

## Setting General Connection Properties

This section describes how to configure general connection properties.

### To add an ODBC with CDC source endpoint to Attunity Replicate:

1. In the Attunity Replicate console, click the Manage Endpoint Connections toolbar button to open the Manage Endpoints Connections dialog box. Then click the **New Endpoint Connection** button. For more information on adding an endpoint to Attunity Replicate, see [Working with Endpoints](#).
2. In the **Name** field, type a name for your ODBC endpoint. This can be any name that will help to identify the endpoint being used.
3. In the **Description** field, type a description that helps to identify the ODBC endpoint. This is optional.
4. Select **SOURCE** as the endpoint **role**.
5. Select **ODBC with CDC** as the endpoint **Type**.
6. Select *one* of the following:
  - » **DSN:** Select this to connect to an ODBC-supported endpoint using a DSN. When you select DSN you must select the DSN you are using from the list.  
  
If the DSN you want to use is not included in the list, make sure that the endpoint client is installed on the computer with Attunity Replicate and that the DSN is defined. Note that the ODBC provider client must be 64-bit. For more information, see [Prerequisites](#).

**Note** If you are using a Replicate Connect CDC Agent as the source in a Replicate task, you cannot select the DSN for the Attunity ODBC driver as the target. In this case, to use Attunity ODBC as a source, you must enter the connection string manually by selecting **Connection String** and following the directions for that option in this procedure.

- » **Connection String:** Select this to connect to an ODBC-supported endpoint using a connection string then type a valid connection string in the field below. For information on how to create a connection string, see the documentation for the

ODBC endpoint provider you are using.

Note that if you specify a password in your connection string, it will be revealed as plain text in the task log files. It is therefore recommended to specify the password in the GUI **Password** field.

**Note** To determine if you are connected to the endpoint you want to use or if the connection information you entered is correct, click **Test Connection**.

If the connection is successful a message in green is displayed. If the connection fails, an error message is displayed at the bottom of the dialog box.

To view the log entry if the connection fails, click **View Log** (this button is not available unless the test connection fails). The server log is displayed with the information for the connection failure.

7. Type the authentication information (**User Name, Password**) for the authorized user for the ODBC endpoint being used. For example, the IBM DB2 system administrator if you are using a IBM DB2 provider. If you do not know this information, see your ODBC Endpoint System Administrator.

**Note** Consider the following:

- » If you select **Connection String**, be sure to include **User name/password** information in the connection string that you type in the box.
- » This information is case sensitive.

**Important:** Make sure that the ODBC endpoint user has the correct access privileges for the ODBC provider being used.

## Setting Change Processing Parameters

The **Change Processing** tab lets you define change processing settings for the source database. Normally, Replicate scans a database's transaction logs for changes and then applies those changes to the target database. However, this method of change processing is not possible with Data Warehouse endpoint types since these endpoints do not generate transaction logs.

The good news is that you can still use Replicate to capture changes from the database - it just requires a little bit of preparation.

### Prerequisites

Before you can define the settings in the **Change Processing** tab, you need to ensure that at least one special "Context" column exists in your source database tables. Context column(s) are basically columns in a table that enable Replicate to determine whether the

data has changed. You can add Context columns specifically for the purpose of change processing (either using a script or manually) or you can use existing columns that contain suitable "Context" data.

**Note** You can create and reference any number of Context columns in a table as long as the Context column names are the same for all source tables. Additionally, each value in the Context column(s) must be unique.

In the example below, the Context column **cf** has been added to the table. The **cf** column contains TIMESTAMPs that enable Replicate to determine whether a change occurred (by comparing the current TIMESTAMP with the TIMESTAMP stored in its repository).

By default, all changes are assumed to be INSERTs. If UPDATE and DELETE operations are also performed on the source tables, you can write an UPDATE and/or DELETE expression (described below) that will enable Replicate to identify the operation type.

**Figure 8.2 | Example of a Table with a Context Column**

a	first_name	cf ▾	oper
1	may1	2014-12-29 14:52:2...	D
2	may2	2014-12-29 14:52:2...	D
6	omri6	2014-12-29 14:53:5...	D
8	omri8	2014-12-29 14:53:5...	D
9	omri9	2014-12-29 14:53:5...	U
10	omri10	2014-12-29 14:53:5...	U
11	omri11	2014-12-29 14:53:5...	U
3	pitz	2014-12-30 11:04:0...	U
7	gal	2014-12-30 13:27:1...	U
5	gal	2014-12-30 13:29:2...	U
12	gal	2014-12-30 13:41:5...	U

## Limitations

The following limitations apply when Change Processing is enabled:

- » The "Start from timestamp" run option is not supported. For more information, see [Using Advanced Run Options](#).
- » If one of the Context columns is part of the Primary Key or Unique Index, then UPDATE and DELETE operations are not supported.
- » Context columns cannot be LOB columns
- » DDLs are not supported
- » When inserting a record and then updating the same record, the task error handling

settings should be set as follows:

- » Open the **<Task Name> Settings** dialog box.
- » Select the **Error Handling|Apply Conflicts** tab.
- » Set a task-specific Apply Conflicts policy as described in [Error Handling Settings](#).
- » From the **No record found for applying an update** drop-down list, select **INSERT the missing target record**.

For more information on error handling, see [Error Handling](#).

## Configuring Change Processing Settings

Perform the following steps to configure change processing settings.

### To configure change processing settings:

1. Select the endpoint's **Change Processing** tab.
2. In the **Columns** field, specify the names of the Context columns. The column names are case-sensitive and must be separated by commas.  
Example:  
context1,context2
3. Choose the sorting order of the Context columns as appropriate (**Ascending** or **Descending**). Note that if the order you select is not the same as the actual sorting order, an error will occur.
4. In the **Check for changes every** field, specify how often to check for changes.
5. Enter expressions that Replicate will use to identify UPDATE and DELETE operations. If you do not enter any expressions or if no match is found for an expression, any row whose context is higher (if the sorting order is **Ascending**) or lower (if the sorting order is **Descending**) than the previous context value will be considered an INSERT.

**Note** Expressions must be written in the native syntax of the source database. All examples in this section are written using PostgreSQL syntax.

- » **Update expression** - Enter an expression for identifying UPDATE operations.

**Example (based on Figure "Example of a Table with a Context Column"):**

```
case when oper='U' then 1 else 0 end
```

**Tip:** Selecting the **UPDATE the existing target record** option in the **Apply Conflicts** tab, eliminates the need to provide an UPDATE expression.

- » **Delete expression** - Enter an expression for identifying DELETE operations.

**Example (based on Figure "Example of a Table with a Context Column"):**

```
case when oper='D' then 1 else 0 end
```

**Important:** In addition to the DELETE expression, DELETE operations should be carried out as "Soft" deletes. This means that the row is not actually deleted from the table, but rather, marked as "deleted".

6. Select **Override connection string parameters** to append the connection string with parameters that are not exposed in the UI. As such parameters are normally not required, they should only be used after consulting with Attunity Support.

# Using IBM Informix as a Source

This section describes how to set up and use an IBM Informix database as the source database in a replication task.

## In this section:

[Prerequisites](#)

[Limitations](#)

[Required Permissions](#)

[IBM Informix Database Source Data Types](#)

[Setting General Connection Properties](#)

[Setting Advanced Connection Properties](#)

## Prerequisites

Before you begin to work with an IBM Informix database as a source in Attunity Replicate, make sure that the following prerequisites have been met:

» **Attunity Replicate machine:**

- » Attunity Replicate installed in your network.
- » IBM Informix ODBC Driver (64-bit) version 3.70 or above must be installed on the computer where Attunity Replicate is located.
- » The `DB_LOCALE=<Informix_db_locale_value>` environment variable must be set to be the name of the IBM Informix database locale from which you want to capture data.
- » The `INFORMIXSQLHOSTS` environment variable must be set to include the names of the IBM Informix servers that are available for use as Replicate source endpoints.

» **IBM Informix Server:**

- » An IBM Informix account with the required [Required Permissions](#).
- » CDC enabled. To enable CDC, run the script `$INFORMIXDIR/etc/syscdcv1.sql` on the IBM Informix server.

**Note** This requires DBA privileges (User 'IBM Informix' or another DBA user).

- » Make sure that the database to be replicated was created with either the `WITH LOG` or the `WITH BUFFERED LOG` property.

## Limitations

When using IBM Informix as a database in a Replicate task, the following limitations currently apply:

- » CDC does not capture DDL changes. Due to an IBM Informix limitation, IBM Informix does not allow DDLs to be executed on tables with Full Row Logging enabled.  
To learn how to capture DDL changes during CDC, see [Automatically enable full row logging](#).
  - » Due to an IBM Informix limitation, columns that follow columns of data types SET, MULTISET or LIST will not be replicated during CDC.
- For example, in the table below, changes to Col3 will not be captured during CDC.

**Table 8.19 | Example**

Name	Data Type
Col1	INTEGER
Col2	SET
Col3	INTEGER

- » User-defined data types are not supported.
- » Resume task by timestamp is not currently supported.

**Important:** Choosing this option will resume the task from the current time.

- » If a task with an IBM Informix source is stopped before any changes have been made and then resumed, any changes that were made between the time that the task was stopped and the time that it was resumed will be lost.
- » Due to a known issue with the IBM Informix CDC API, Replicate does not support replication of tables whose names contain spaces or non-English letters.
- » Due to a known issue with the IBM Informix transaction consistency mechanism, cached changes during Full Load are not supported.

## Required Permissions

In order to access the specified database, the user specified in the **General** tab must be a member of the "IBM Informix" group (which has DBA privileges) on the database server.

## IBM Informix Database Source Data Types

The following table shows the IBM Informix database source data types that are supported when using Attunity Replicate and the default mapping from Attunity Replicate data types.

For information on how to view the data type that is mapped in the target, see the section for the target database you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 8.20 | IBM Informix database Source Data Types with Mapping to Attunity Replicate Data Types**

IBM Informix Source Data Types	Attunity Replicate Data Types
INTEGER	INT4
SMALLINT	INT2
INT8	INT8
SERIAL	INT4
SERIAL8	INT8
NUMERIC (p,s)	NUMERIC (p,s)
DECIMAL (p,s)	NUMERIC (p,s)
MONEY (p,s)	NUMERIC (p,s)
FLOAT	REAL8
DOUBLE	REAL8
REAL	REAL4
SMALLFLOAT	REAL4
BIGINT	STRING (20)
DATE	DATE
DATETIME (fraction)	DATETIME (fraction)
INTERVAL	STRING
CHAR	STRING (n)
VARCHAR (n)	STRING (n)
LVARCHAR (n)	STRING (n)
NCHAR (n)	STRING (n)
NVARCHAR (n)	STRING (n)
BLOB	BLOB
BYTE	BLOB
CLOB	CLOB
LIST	CLOB
See also <a href="#">Limitations</a> .	
MULTISSET	CLOB

**Table 8.20 | IBM Informix database Source Data Types with Mapping to Attunity Replicate Data Types (Cont.)**

IBM Informix Source Data Types	Attunity Replicate Data Types
See also <a href="#">Limitations</a> .	
SET	CLOB
See also <a href="#">Limitations</a> .	
TEXT	CLOB
BOOLEAN	BOOLEAN

## Unsupported Data Types

The following IBM Informix data types are not supported:

- » Any user-defined data type

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

**Note** You can also use IBM Informix files as a source. For more information, see [Using the Attunity Replicate File Channel](#).

### To add an IBM Informix source endpoint to Attunity Replicate:

1. In **Tasks** view, click **Manage Endpoint Connections** to open the **Manage Endpoints Connections** dialog box. Then click the **New Endpoint Connection** button.
2. In the **Name** field, type a name for your database. This can be any name that will help to identify the database being used.
3. In the **Description** field, type a description that helps to identify the IBM Informix database. This is optional.
4. Select **SOURCE** as the database **role**.
5. Select **IBM Informix** as the database **Type**.
6. In the **Server** field, enter the name of the IBM Informix server. On Windows, this must correspond to one of the hosts defined using the setnet32.exe tool. On Linux, this must correspond to a valid `dbservername` entry in the `$INFORMIXDIR/etc/sqlhosts` file on the computer running the application.

**Note** Consider the following:

- » This information is case sensitive.
- » You can use the **Advanced** tab to add specific properties and create a custom connect string. In this case, you do not need to enter information in this tab. For more information on using the **Advanced** tab, see [Setting Advanced Connection Properties](#).
- » To determine if you are connected to the database you want to use or if the connection information you entered is correct, click **Test Connection**. If the connection is successful a message in green is displayed. If the connection fails, an error message is displayed at the bottom of the dialog box.  
To view the log entry if the connection fails, click **View Log**. The server log is displayed with the information for the connection failure. Note that this button is not available unless the test connection fails.

7. Enter the IBM Informix authentication information (**User Name**, **Password**) for the authorized user for this IBM Informix database. If you do not know this information, see your IBM Informix database administrator (DBA).

**Note** Consider the following:

- » This information is required. If you are using the **Advanced** tab to create a custom string, make sure to include the **User Name** and **Password** properties. See [Setting Advanced Connection Properties](#) for more information.
- » This information is case sensitive.
- » If you want to set custom properties for this database, see [Setting Advanced Connection Properties](#).

**Important:** Make sure that the IBM Informix user entered in the IBM Informix Authentication section has the correct access privileges. For information on how to provide the required privileges, see [Required Permissions](#).

8. In the **Database name** field, enter the IBM Informix database name.

## Setting Advanced Connection Properties

In the **Advanced** tab, you can set the following parameters:

- » **Automatically enable full row logging:** Full Row Logging is required for CDC. Select this option to automatically enable Full Row Logging for the tables to be replicated. To automatically enable Full Row Logging, the user specified in the **General** tab must have administrative privileges on the IBM Informix database.

**Note** DDL events are not captured during CDC. To perform DDL operations on source tables in a Replicate CDC task:

- » Stop the Replicate task.
- » Disable Full Row Logging for the relevant tables as in the following example:

```
execute function syscdcv1:IBM Informix.cdc_set_fullrowlogging('sysuser:IBM Informix.employees_table', 0)
```
- » Perform the DDL operation(s).
- » If the **Automatically enable full row logging** option is not selected, manually enable Full Row Logging for the relevant tables.
- » Start the Replicate task.
- » Reload the relevant tables or perform a Full Load.

- » **Max bytes per read:** Specify the maximum number of bytes to read each time the log is accessed. If you encounter performance issues, adjusting this number may help.

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

# Using IBM DB2 for LUW as a Source

This section describes how to set up and use an IBM DB2 for LUW database as the source database in a replication task.

## In this section:

- [Prerequisites](#)
- [Replicating 4-byte UTF8 Emojis](#)
- [Limitations](#)
- [IBM DB2 for LUW Database Source Data Types](#)
- [Setting General Connection Properties](#)
- [Setting Advanced Connection Properties](#)

## Prerequisites

Before you begin to work with an IBM DB2 for LUW database as a source in Attunity Replicate, make sure that the prerequisites described in this section have been met.

In this section:

- » [Client Prerequisites](#)
- » [IBM DB2 for LUW Server Prerequisites](#)

### Client Prerequisites

The IBM DB2 for LUW client prerequisites are determined by the platform on which Attunity Replicate Server is installed (Windows or Linux).

#### Attunity Replicate Server On Windows

The IBM Data Server Client version 10.5 must be installed on the Attunity Replicate Server machine.

#### Attunity Replicate Server On Linux

The following steps need to be performed on the Attunity Replicate Server machine:

1. Install **v10.5fp9\_linuxx64\_server\_t.tar.gz**; choose to install "CLIENT".
2. If the Attunity Replicate Server machine does not have a DB2 instance, create a DB2 instance by running the following commands:  

```
adduser <db2_instance_name>
/opt/ibm/db2/v10.5/instance/db2icrt <db2_instance_name>
```
3. Add the DB2 driver location to the Linux library path. To do this, add the following line

to the **site\_ arep\_login.sh** file:

```
export LD_LIBRARY_PATH=$LD_LIBRARY_PATH:path/lib64
```

where path is the path to the driver.

**Example:**

```
export LD_LIBRARY_PATH=$LD_LIBRARY_PATH:/opt/ibm/db2/v10.5/lib64
```

4. Create a new file named **odbcinst.ini** under **/etc** and add the following entry:

```
[IBM DB2 ODBC DRIVER]
```

```
Driver = /opt/ibm/db2/v10.5/lib64/libdb2o.so
```

```
fileusage=1
```

```
dontdlclose=1
```

5. Restart Attunity Replicate Server.

6. Add the IBM DB2 for LUW endpoint as described in [Setting General Connection Properties](#) and click **Test Connection**.

If you get the following error:

Cannot connect to DB2 LUW Server ODBC unknown error.

```
RetCode: SQL_ERROR SqlState: NativeError: -1390 Message: [unixODBC]
[IBM] [CLI Driver] SQL10007N Message "0" could not be retrieved. Reason
code: "3". ODBC general error.
```

- a. Run the following command:

```
/opt/ibm/db2/V10.5/bin /db2cli writecfg add -database <db_name_
from_endpoint_connection_settings> -host <server_name_from_
endpoint_connection_settings> -port <port_from_endpoint_connection_
settings>
```

- b. Restart Attunity Replicate Server.

## IBM DB2 for LUW Server Prerequisites

To enable CDC (Change Data Capture):

- » **Set the database to be recoverable** - To capture changes, Replicate requires that the database is configured to be recoverable. A database is recoverable if either or both of the database configuration parameters `LOGARCHMETH1` and `LOGARCHMETH2` are *not* set to OFF.
- » **Permissions** - The Attunity user must be granted the following permissions:
  - » SYSADM or DBADM
  - » DATAACCESS

## Replicating 4-byte UTF8 Emojis

In order to replicate 4-byte UTF8 emojis, you must transform the emojis from `STRING(n)` to `WSTRING(n)`.

For information on defining transformations, see [Using the Transform Tab](#).

## Limitations

When using IBM DB2 for LUW as a database in a Replicate task, the following limitations currently apply:

- » Clustered database is not supported

**Note** Users can define a separate IBM DB2 for LUW database for each of the endpoints in the cluster.

### » Change processing limitations:

- » When truncating a table with multiple partitions, the number of DDL events displayed in the Replicate console will be equal to the number of partitions. This is because IBM DB2 for LUW records a separate DDL for each partition.
- » The following DDLs on partitioned tables are not supported:
  - » ALTER TABLE ADD PARTITION
  - » ALTER TABLE DETACH PARTITION
  - » ALTER TABLE ATTACH PARTITION
- » Change processing does not support the DECFLOAT data type. Consequently, changes to DECFLOAT columns will be ignored during CDC.
- » The RENAME COLUMN statement is not captured.
- » When performing updates on MDC (Multi-Dimensional Clustering) tables, each update is shown in the Replicate console as INSERT + DELETE.
- » When the task setting “Include LOB columns in replication” is disabled, any table that has LOB columns will be suspended during change processing.
- » When the **Audit table** option is enabled in the **Store Changes Settings** tab, the first timestamp record in the audit table will be NULL.
- » When the **Change table** option is enabled in the **Store Changes Settings** tab, the first timestamp record in the table will be Zero (i.e. 1970-01-01 00:00:00.000000).
- » **DB2 10.5 and above:** Variable-length string columns with data that is stored out-of-row will be ignored. Note that this limitation is only applicable to tables created with extended row size.

## IBM DB2 for LUW Database Source Data Types

The following table shows the IBM DB2 for LUW database source data types that are supported when using Attunity Replicate and the default mapping from Attunity Replicate data types.

For information on how to view the data type that is mapped in the target, see the section for the target database you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 8.21 | IBM DB2 for LUW database Source Data Types with Mapping to Attunity Replicate Data Types**

IBM DB2 for LUW Source Data Types	Attunity Replicate Data Types
INTEGER	INT4
SMALLINT	INT2
BIGINT	INT8
DECIMAL (p,s)	NUMERIC (p,s)
FLOAT	REAL8
DOUBLE	REAL8
REAL	REAL4
DECFLOAT (p)	If precision = 16, then: REAL8 If precision is = 34, then: STRING
GRAPHIC	WSTRING n<=127
VARGRAPHIC	WSTRING n<=16k double byte chars
LONG VARGRAPHIC	CLOB
CHAR (n)	STRING n<=255
VARCHAR (n)	STRING n<=32k
LONG VARCHAR (n)	CLOB n<=32k
CHAR (n) FOR BIT DATA	BYTES
VARCHAR (n) FOR BIT DATA	BYTES
LONG VARCHAR FOR BIT DATA	BYTES
DATE	DATE
TIME	TIME
TIMESTAMP	DATETIME
BLOB	BLOB
CLOB	CLOB

**Table 8.21 | IBM DB2 for LUW database Source Data Types with Mapping to Attunity Replicate Data Types (Cont.)**

IBM DB2 for LUW Source Data Types	Attunity Replicate Data Types
DBCLOB	Maximum size: 2 GB CLOB
XML	Maximum size: 1 G double byte chars CLOB

## Setting General Connection Properties

You can add an IBM DB2 for LUW database to Attunity Replicate to use as a source. For information on how to add endpoints, see [Working with Endpoints](#).

**Note** You can also use IBM DB2 for LUW File Channel files as a source. For more information, see [Using the Attunity Replicate File Channel](#).

### To add an IBM DB2 for LUW source endpoint to Attunity Replicate:

1. In the Attunity Replicate console, click **Add database** to open the Add Endpoints dialog box.
2. In the **Name** field, type a name for your database. This can be any name that will help to identify the database being used.
3. In the **Description** field, type a description that helps to identify the IBM DB2 for LUW database. This is optional.
4. Select **SOURCE** as the database **role**.
5. Select **IBM DB2 for LUW** as the database **Type**.
6. Choose one of the following:
  - » **Use database alias** - If you choose this option, specify the IBM DB2 for LUW database alias.
  - » **Use these connection properties** - If you choose this option, enter the IBM DB2 for LUW **Server** (hostname or IP address), **Port** and **Database name** in the designated fields.
7. Enter the IBM DB2 for LUW authentication information (**User Name**, **Password**) for the authorized user for this IBM DB2 for LUW database. If you do not know this information, see your IBM DB2 for LUW database administrator (DBA).

**Note** This information is case sensitive.

**Important:** Make sure that the specified user has the required access privileges.

## Setting Advanced Connection Properties

In the **Advanced** tab, you can set the following properties:

- » **Maximum Buffer Size for Read (KB):** Specify the maximum number of bytes to read each time the log is accessed during Change Processing. If you encounter performance issues, adjusting this number may help.
- » **Change Data Capture:** To enable data capture from IBM DB2 for LUW, the source tables need to be set up as follows:

```
CREATE / ALTER TABLE table-name .... DATA CAPTURE CHANGES [INCLUDE LONGVAR COLUMNS];
```

You can either configure Replicate to perform this operation by selecting the **Automatically alter tables to enable data capture** or you can do this manually by selecting **Let DBA set up data capture**.

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

## Required Internal Parameter for Version 9.7

When replicating data from IBM DB2 for LUW version 9.7, Replicate needs to know the current LSN (Log Sequence Number). You can either specify the current LSN or instruct Replicate to scan the log for the current LSN. This only applies to tasks with Full Load replication (i.e. Full Load or Full Load + CDC).

### Specifying the Current LSN

In order to specify the current LSN, you first need to retrieve it by issuing the following command on the IBM DB2 for LUW server:

```
db2pd -logs -db <your_database>
```

You can find the current LSN in the output header.

**For example:**

```
database Partition 0 - database TEST - Active - Up 3 days 00:00:30
```

Logs:

Current Log Number 0

Pages Written 612

Cur Commit Disk Log Reads 0

Cur Commit Total Log Reads 0

Method 1 Archive Status n/a

Method 1 Next Log to Archive n/a

Method 1 First Failure n/a

Method 2 Archive Status n/a

Method 2 Next Log to Archive n/a

Method 2 First Failure n/a

Log Chain ID 0

**Current LSN 0x000000000452CABB**

From this header, you can see that the current LSN is **0x000000000452CABB**.

After retrieving the current LSN, specify it as described in [Internal Parameters](#).

**Unable to retrieve the current LSN?**

If you are unable to retrieve the current LSN, you can instruct Replicate to scan the log by specifying `CurrentLSN=scan` (as described in [Internal Parameters](#)) instead of the current LSN.

**Note** When `CurrentLSN=scan`, Replicate will search the log from the start until it finds the current LSN. This may take some time depending on the size of the log.

# Using IBM DB2 for iSeries as a Source

This section describes how to set up and use an IBM DB2 for iSeries database as the source database in a replication task.

## In this section:

[Prerequisites](#)

[Required Permissions](#)

[Limitations](#)

[IBM DB2 for iSeries Database Source Data Types](#)

[Setting General Connection Properties](#)

[Setting Advanced Connection Properties](#)

## Prerequisites

The following topic lists the prerequisites for using an IBM DB2 for iSeries endpoint in a Replicate task.

### Client

- » **Windows:** To work with an IBM DB2 for iSeries database as a source in Attunity Replicate, the iSeries ODBC driver (5770-XE1 IBM i Access for Windows) must be installed on the Replicate Server machine.

The minimum supported version is 12.64.

The driver is part of IBM i Access Client Solutions, which can be downloaded from the IBM web site by authorized IBM customers. Note that it is not necessary to install all of the IBM i Access Client Solutions components, only the ODBC driver (which is installed regardless of which components you choose to install).

- » **Linux:** To work with an IBM DB2 for iSeries database as a source in Attunity Replicate, the iSeries ODBC driver (5770-XL1 IBM i Access for Linux) must be installed on the Replicate Server machine.

The minimum supported version is 12.64.

The driver is part of IBM i Access Client Solutions, which can be downloaded from the IBM web site by authorized IBM customers. Note that it is not necessary to install all of the IBM i Access Client Solutions components, only the ODBC driver (which is installed regardless of which components you choose to install).

After installing the Linux Driver, edit the file `/etc/odbcinst.ini` and add the following section:

```
[IBM i Access ODBC Driver 64-bit]
Description = IBM i Access for Linux 64-bit
ODBC Driver Driver = /opt/ibm/iaccess/lib64/libcwbodbc.so
```

```
Setup = /opt/ibm/iaccess/lib64/libcwbodbc.so
Threading = 0
DontDLClose = 1
UsageCount = 1
```

## Change Processing

- » For DB2 iSeries version 7.1, the following IBM patch needs to be installed:  
DB2 for IBM i Group PTF  
SF99701: 710 DB2 for IBM i - Level 3 (released August 2010) or PTF '5770SS1 V7R1M0 SI39820' , PTF '5770SS1 V7R1M0 SI39821'.
- » All of the source tables for a given Replicate task need to be journaled to *the same journal*. The name of the journal and the library in which it is located must be specified [in the endpoint settings](#). During the task, Replicate polls this journal for changes to the source tables.

When you start journaling the source tables, the `Record images` parameter can be set to `*BOTH` (for capturing before and after images) or `*AFTER`.

**Note** If you need to run several Replicate tasks (that replicate data from IBM DB2 for iSeries), it is more efficient (though not essential) to create a separate journal for each task. As only one journal can be specified per endpoint, you would also need to define a separate endpoint for each task.

## Required Permissions

The following permissions must be granted to the user specified in the **General** tab of the [IBM DB2 for iSeries endpoint settings](#):

- » `USER CLASS = *USER` (default value)
- » `Special authority = *NONE`
- » Full Load: Read permissions for the source tables.
- » CDC: Read permissions for the journal defined for the IBM DB2 for iSeries endpoint and for the task's source tables.

You must also set the following **Authorities and Locks** for the IBM DB2 for iSeries database:

- » **Journal Authority:** `*USE`
- » **Journal Library Authority:** `*EXECUTE`
- » **Journal Receivers Authority:** `*USE`
- » **Journal Receivers Library's Authority:** `*EXECUTE`

- » **File Authority (if specified):** \*USE
- » **File Library Authority:** \*EXECUTE
- » **Journal Lock:** \*SHRRD
- » **Journal Receiver Lock:** \*SHRRD
- » **File Lock (if specified):** \*SHRRD

\*OBJEXIST is also required for the journal authority if any of the following are true:

- » \*ALLFILE has been specified for the file key.
- » Specified object does not exist on the system.
- » \*IGNFILSLT or \*IGNOBJSLT is specified for the journal code selection value for any selected journal codes.
- » The journal is a remote journal.

## Limitations

The following limitations apply when using the IBM for DB2 iSeries endpoint as a source in a Replicate task:

- » The IBM for DB2 iSeries endpoint is not supported when Replicate is installed on Windows Server 2016.
- » Multi-member tables are not supported
- » Field level encryption is not supported
- » Journal receivers must be System Managed rather than User Managed.
- » All tables must be in the same journal
- » The DROP TABLE DDL is not supported
- » The RENAME TABLE DDL is not supported
- » Limited LOB support is actually full LOB support
- » Replicating BLOBs will significantly affect performance
- » The XML data type is not supported
- » The DBCLOB data type is not supported
- » Row size cannot exceed 32740 bytes
- » Partitioned tables are not supported
- » When the **Use table and schema system names** option is enabled (in the **Advanced** tab), only table/schema names that contain uppercase letters, digits, and underscores (\_) are supported.  
For more information on this option, see [Replicating System Names](#).
- » Usually, Replicate only applies source database changes to the target if the transactions with the changes were committed *before* the Full Load started. However,

due to a known issue with the DB2 iSeries database, records that were deleted from the source as *part of an uncommitted transaction* will not be replicated to the target during Full Load.

- » DELETE operations in auto-commit mode will be ignored for tables journaled with \*AFTER images. In such cases, DELETE operations will only be captured if one of the [Add RRN column](#) options is enabled and if the journaled tables do not have a primary key.

## IBM DB2 for iSeries Database Source Data Types

The following table shows the IBM DB2 for iSeries database source data types that are supported when using Attunity Replicate and the default mapping from Attunity Replicate data types.

For information on how to view the data type that is mapped in the target, see the section for the target database you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 8.22 | IBM DB2 for iSeries database Source Data Types with Mapping to Attunity Replicate Data Types**

IBM DB2 for iSeries Source Data Types	Attunity Replicate Data Types
INTEGER	INT4
SMALLINT	INT2
BIGINT	INT8
DECIMAL (p,s)	NUMERIC (p,s)
FLOAT	REAL8
DOUBLE	REAL8
REAL	REAL4
CHAR (n)	If n<=32 KB, then: STRING
VARCHAR (n)	If n<=32 KB, then: STRING
GRAPHIC (n)	If n<=16 KB, then: STRING
VARGRAPHIC (n)	If n<=16 KB double byte chars, then: STRING
DATE	DATE

**Table 8.22 | IBM DB2 for iSeries database Source Data Types with Mapping to Attunity Replicate Data Types (Cont.)**

IBM DB2 for iSeries Source Data Types	Attunity Replicate Data Types
TIME	TIME
TIMESTAMP	DATETIME (6)
BLOB	BLOB Maximum size: 2 GB
CLOB	CLOB Maximum size: 2 GB
DBCLOB	CLOB Maximum size: 1 GB double byte chars
ROWID	BYTES - This should be a user-defined column.
DATALINK	STRING
TIMESTAMP WITH TIME ZONE	NOT SUPPORTED

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

**Note** You can also use IBM DB2 for iSeries File Channel files as a source. For more information, see [Using the Attunity Replicate File Channel](#).

### To add an IBM DB2 for iSeries source endpoint to Attunity Replicate:

1. In the Attunity Replicate console, click **Add database** to open the Add Endpoints dialog box.
2. In the **Name** field, type a name for your database. This can be any name that will help to identify the database being used.
3. In the **Description** field, type a description that helps to identify the IBM DB2 for iSeries database. This is optional.
4. Select **SOURCE** as the database **role**.
5. Select **IBM DB2 for iSeries** as the database **Type**.
6. Choose one of the following:
  - » **Use ODBC DSN** - If you choose this option, specify the IBM DB2 for iSeries database ODBC DSN.

- » **Use these connection properties** - If you choose this option, enter the IBM DB2 for iSeries **Server** (hostname or IP address).
- 7. Enter the IBM DB2 for iSeries authentication information (**User Name, Password**) for the authorized user for this IBM DB2 for iSeries database. If you do not know this information, see your IBM DB2 for iSeries database administrator (DBA).

**Note** This information is case sensitive.

**Important:** Make sure that the specified user has the required access privileges.

- 8. In the **Journal Name** field, enter the name of the journal containing the source tables.  
See also: [Change Processing](#) prerequisites.
- 9. In the **Journal Library** field, enter the name of the library where the journal is located.  
See also: [Change Processing](#) prerequisites.

## Setting Advanced Connection Properties

In the **Advanced** tab, you can set advanced connection properties such as overriding CCSID to Character Set mapping and setting internal Replicate parameters.

### Overriding CCSID to Character Set Mapping

In some cases, character data in source tables may be encoded in a different CCSID than what is declared in the source database table definition. For example, a specific table or column definition might indicate that its uses CCSID 500 (EBCDIC International) whereas in fact, it uses CCSID 1148 (ENCDIC International with EURO). In this case, you can tell Replicate that the source definition CCSID 500 should be treated as CCSID 1148 (specifically, the character set named IBM-1148).

Note that when the source table definition specifies CCISD 65535 (meaning character set is unknown), you must specify what character set should be assumed when reading data from that table or column.

**Note** If there is a conflict between the character set mapping for a specific column and the character set mapping defined in the endpoint settings, the column-level character set mapping takes precedence.

For more information on overriding character set mapping at column level, see [Using the Transform Tab](#).

### To do this:

1. In the **Override CCSID to Character Set Mapping** section, click the **New** button.  
A row is added to the table.
2. Enter the CCSID in the **CCSID** column and the code page in the **Character set** column.
3. Repeat to map additional CCSID values.

## Converting to a Custom Code Page

Perform the following procedure if your source endpoint tables are defined with an incorrect CCSID and the correct definition is actually in a UCM file.

1. Create or [download](#) a mapping data file with the file extension **.ucm**.

**Note** If you edit an existing UCM file, you must also change the values of the `<code_set_name>` and `<icu:alias>` properties. If the file does not contain an `<icu:alias>` property, then you only need to change the value of the `<code_set_name>` property.

2. Create a CNV file for the UCM file by running the following command:

```
<product_dir>\bin\makeconv.exe -v <file_name>.ucm
```

#### Example:

```
"c:\Program Files\Attunity\Replicate\bin\makeconv.exe" -v 1047_EX.ucm
```

This will create a CNV file with the same name as the UCM file (e.g. **1047\_EX.cnv**).

3. Copy the file to the following location:

```
<product_dir>\bin\icudt581
```

4. Add a new character set mapping as follows:

- a. In **CCSID** column, enter the original source CCSID number (e.g. **1047**)
- b. In the **Character set column**, enter the name of the CNV file without the extension (e.g. **1047\_EX**).

5. Restart the Attunity Replicate UI Server service.

## Adding the RRN Column to Target Tables

Source tables that do not have a primary key, a unique index, or a combination of columns that can be used as a unique index, must be registered using the relative record numbers (RRN).

### Select one the following options:

- » Do not add RNN column to target tables
- » Add RRN column to target tables without a primary key or unique index
- » Add RRN column to all target tables

When you select one of the "Add RRN columns" options, both the Change Tables and the target tables will have an extra column, ATTREP\_RRN of type INTEGER, which contains a unique value for each row. This column contains the RRN that corresponds to each source table row.

## Replicating System Names

The IBM DB2 for iSeries source endpoint replicates tables based on their SQL names (unlimited length). If your IBM DB2 for iSeries database does not use SQL names, it's likely that you'll want to keep the replication based on system names.

To do this, select the **Use table and schema system names** check box.

## Skipping Journal Validation

From IBM DB2 for iSeries 7.3, Replicate automatically validates the specified journal. This involves checking that the journal exists and that it contains the tables selected for replication. When numerous tables are selected for replication, this process may take some time. In such cases, if you are sure that the specified journal exists and that it contains the correct tables, you may want to skip the validation phase.

To do this, select the **Skip journal validation** check box.

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

# Using IBM DB2 for z/OS as a Source

This section describes how to set up and use an IBM DB2 for z/OS database as the source endpoint in a replication task.

## In this section:

- [Prerequisites](#)
- [Limitations](#)
- [Controlling the CDC Process](#)
- [IBM DB2 for z/OS Database Source Data Types](#)
- [Setting General Connection Properties](#)
- [Setting Advanced Connection Properties](#)
- [Sample XMIT Files “Receive” Job](#)

## Prerequisites

The following topic lists the prerequisites for working with the Attunity Replicate IBM DB2 for z/OS endpoint.

In this topic:

- » [Install the R4Z Product on z/OS](#)
- » [ODBC Prerequisites](#)
- » [Required Permissions](#)
- » [Change Data Capture Prerequisites](#)

## Install the R4Z Product on z/OS

Before you can work with the IBM DB2 for z/OS Replicate endpoint, you must first install and configure the R4Z product on z/OS.

For instruction on how to accomplish this, refer to the *R4Z Installation and Configuration Guide*.

## ODBC Requirements

The Attunity Replicate IBM DB2 for z/OS source endpoint relies on the *IBM Data Server Driver for ODBC* for access to data, Change Data and metadata. This section describes the client side and server side ODBC prerequisites.

## Client Side ODBC Requirements (Linux, Unix and Windows)

Install "IBM Data Server Driver for ODBC and CLI" for DB2 11.1 for z/OS on the Attunity Replicate Server machine.

## Server Side ODBC Setup

Bind the plan to be used for ODBC, as specified in the `PLANNAME=` value in the ODBC initialization file. The default name is `DSNACLI`. The BIND job can be found in member `DSNTIJCL`, which is in the `SDSNSAMP` library of the source DB2 installation.

Use the DB2CLI bind command to bind the ODBC-supplied packages to your intended source z/OS DB2 subsystem. This action is described in [Configuring your developer and runtime environment](#) on the IBM website. For information about the DB2CLI utility, including an example for the bind utility, see [db2cli - DB2 interactive CLI command](#) on the IBM website.

## Required Permissions

To enable Replicate to extract data from the source tables (Full Load and Change Data Capture), the [user specified in the IBM DB2 for z/OS endpoint settings](#) must be granted the following permissions:

- » EXECUTE on the IFI reading the UDTF (only required for Change Data Capture)
- » SELECT on the source tables and on the DB2 catalog tables
- » MONITOR2 to be able to start IFI sessions (only required for Change Data Capture)

For additional details about these permissions, see [Change Data Capture Requirements](#).

## Change Data Capture Requirements

To capture changes from IBM DB2 for z/OS, Attunity Replicate uses a special program - invoked as an external routine - which is a user-defined table function (UDTF). This program (a load module) as well as the UDTF need to be installed and configured on the z/OS system before changes can be captured. The installation procedure, which should be performed by the DBA, is described in the *Attunity R4Z Installation and Configuration Guide*.

Additionally, the Data Capture Changes attribute must be set for every table whose changes you want to replicate. You can either do this manually or allow Replicate to do this by leaving the **Automatically enable Data Capture Changes (requires admin privileges)** option enabled (the default) in the **Advanced** tab.

## Limitations

The following limitations apply when using the IBM DB2 for z/OS endpoint in a Replicate task:

- » During a task with Full Load and Apply Changes enabled, duplicate keys may be replicated to the target. This is because records that were updated and cached during the Full Load stage of the task may have the same timestamp as the original records that were inserted during Full Load. Note that this usually only happens when the time difference between the inserted record and the updated (cached) record is very small (milliseconds).
- » DDL limitations:
  - » Drop column: Columns cannot be dropped from tables with the DATA CAPTURE CHANGES attribute.
  - » Change column data type: To capture changes to column data types:
    1. Stop the Replicate task.
    2. Change the data type(s).
    3. REORG the table with the modified data types.
    4. Resume the Replicate task.

## Controlling the CDC Process

Attunity Replicate uses ECSA memory structures - called R4Z CDC services - which are formed during CDC processing. Each z/OS LPAR may contain several such R4Z CDC services. To form the R4Z CDC services, a special utility program, R4ZCTL, is provided.

This program can also be used for managing the state of CDC processing, as well as the level of traffic on the z/OS side.

From Replicate 6.1, the CDC services (known as R4Z environment in previous versions), do not need to be "activated" prior to invocation of the CDC reader UDTF. The services are "auto-activated" by the UDTF (when inactive). This means that the R4Z control program is no longer responsible of activating the service. It is, however, required for the following

purposes: checking CDC and reporting the CDC service's status, pausing CDC processing, resuming a paused CDC, and terminating the CDC process, either normally or forcefully.

The command parameters available when running the R4ZCTL program are:

**Note** If you run the command without any parameters, it will return the current status of the CDC service.

- » CHECKCONFIG - Verifies that configuration parameters are valid
- » PAUSE\_TASK - Stops the service of a specific CDC task
- » PAUSE\_CDC - Stops the entire activity of a CDC service
- » RESUME\_TASK - Enables a paused task to continue
- » RESUME\_CDC - Enables a paused CDC service to continue
- » TERMINATE - Stops the CDC service, and, once stopped – releases its resources
- » FORCE - same as TERMINATE, when task holding resources "hangs"

As the R4ZCTL programs requires APF-authorization, all libraries in the STEPLIB must be APF- authorized.

When running R4ZCTL with no parameter, its completion-code is set based on whether the environment was initialized (CC=0) or not initialized (CC=1).

## Control Program Invocation Syntax

The R4ZCTL program is invoked as a job step, i.e. EXEC PGM=R4ZCTL, and accepts instructions via the invocation parameter of the job step.

The R4ZCTL invocation parameter is a string that can contain optional sub-parameters, separated by a comma as follows:

```
[SERVICE=CDC-service-qualifier,] [MSGlvl={0 | 1},] [action]
```

**Note** The order of the sub-parameters in the string is not important.

Where:

**SERVICE=CDC-service-qualifier** designates the logical scope of Replicate activity, upon which the control program is to act.

For more information on CDC services, see [Change Data Capture Requirements](#).

**MSGlvl={0 | 1 | 2}** designates the level of notifications to be displayed in the message file during the operation of the control program.

- » 0 = No notifications
- » 1 = Moderate
- » 2 = Maximum

**action-verb** can be one of the following:

- » PAUSE\_TASK (\*|ALL|task-qualifier)
 

Suspends CDC retrieval for the task(s) designated in parentheses.
- » PAUSE\_CDC
 

Suspends CDC retrieval for entire CDC service. Replication tasks suspended for more than a certain time are stopped will attempt recovery multiple times. No new tasks will be served.
- » RESUME\_TASK (\*|ALL|task-qualifier)
 

Resumes CDC retrieval for the task designated by *task-qualifier*.
- » RESUME\_CDC
 

Resumes CDC retrieval for all instances matching the *session-limits* qualifier.
- » DUMP\_TASK (\*|ALL|task-qualifier)
 

Requests formatted dumping of the control information in the resident memory structures. ALL designates all sessions; SUMMARYONLY designates only the anchor.
- » TERMINATE
 

Frees all the R4Z resident memory structures, terminates all active instances and deletes associated resources. From this point on, all CDC requests will return the inactive status until CDC service is auto-activated by an incoming call to the CDC reader UDF.

## Syntax Elements Reference

The elements used in the syntax descriptions above are as follows:

- » CDC-service-qualifier
 

A 4-character name (first character alphabetic, rest alphanumeric), which designates a CDC service.

“CDC service” refers to a group of resources – memory structures, a user-defined table-function (UDTF) defined in DB2 and an application environment (APPLENV) defined in the WLM policy. R4Z lets you specify properties – memory limits and processing thresholds – per each CDC service. It may be necessary to manage several CDC services also for another reason: provide for more than one Replicate release being used in a single LPAR, each maintain its memory structures independently on others.
- » task-qualifier
 

A 4-digit identifier being assigned upon initiation of the task. This identifier is aimed mainly for controlling and tracking CDC traffic of a specific task (defined in the client’s endpoint definitions). It is being used to form the CORRID (Correlation-ID) of the DB2 thread serving CDC – it occupies bytes 9-12 there.

## Control Program Completion Codes

- » 0 – Normal completion
- » 1 – Environment does not exit the *session-limits* qualifier (when no action is specified)
- » 4 – Warning
- » 8 – Error

## Sample Jobs (in the INSTALL library)

IV1CHECK – Checks the configuration of all CDC services

XMDUMP – Dumps all sessions

XMPAUSE – Pauses a session

XMRESUME – Resumes a session

XMTERMIN – Terminates all sessions

## Enabling the CDC Process (auto-activation)

To enable the CDC reader UDTF function to work, this function needs to be able to allocate and pre-format memory structures in ECSA when the UDTF is called and the first time after the z/OS system was started; it also needs to access the configurations set for the CDC service the UDTF is serving (or the “default” configurations, for values not specified at the CDC service level).

### **To account for this, the installation process ensures that:**

1. A special UDTF is created to serve the CDC service. The created UDTF has its name suffixed with a double-underscore (“\_\_”) followed by the *CDC-service-qualifier*, forming a name as such: <*schema*>.R4Z\_UDTF\_\_<*CDC-service-qualifier*>.
2. A WLM APPLENV is created to execute invocations of the above UDTF. The created APPLENV may also have its name suffixed with the CDC service qualifier, to ensure uniqueness of the APPLENV name – which is recommended; however, multiple UDTFs may use a single APPLENV.
3. A JCL procedure is created to “host” the WLM APPLENV executions. This JCL procedure differs from a usual WLM STC procedures in that a special DDNAME, R4ZCNFG, must be specified, its DSN referring to the CONFIG library of the R4Z product. In this library, there MUST be an existing member named “CDCS”, specifying the default CDC service configurations. There MAY also exist a member named “CDCS<*CDC-service-qualifier*>” with the configuration values you want to apply for this CDC service.
4. The content of each of the CDCS\* members in the CONFIG library is a list of assignment statements, one per card, in the format “keyword=value”. The statement may follow spaces, and are space-terminated; no spaces are allowed with the statement. Cards beginning with a hyphen (‘-’) are treated as comment cards; and the content following the terminating space is also treated as comment.

The following are the permitted configuration keywords, the permitted minimum and maximum values, and the default values:

<b>Keyword</b>	<b>Description</b>	<b>Minimum</b>	<b>Maximum</b>	<b>Default</b>
MAXSESSIONS	The maximum number of CDC sessions.	1	128	32
SESSIONTIMEOUTSECS	The number of seconds after which session is timed out.	1	3600	30
MAXIFIBUFKBYTES	The maximum buffer size allowed for IFI reads, in Kbytes.	64	1024	256
MAXRESULTSETMBYTES	The maximum size in Mbytes for the accumulated result set to reach; when reached, the result set is returned.	1	128	4
MAXRESULTSETSECS	The maximum time interval, in seconds, for accumulating the result set; when reached, the result set is returned.	30	7200	300

## Establishing R4Z CDC Services

**Deciding on the CDC services:** Based on predicting the need for independent replication processes (to allow different versions, to ensure sufficient ECSA memory, to account for different latencies allowed, etc.), determine which R4Z CDC services are to exist in each LPAR. For each service, choose the CDC service qualifiers (4 characters). You also need to decide whether each CDC service is to have its own WLM APPLENV (application environment), or a single APPLENV to serve all CDC services.

You need to set variable DEFWLMAE (DEFine WLM Applic. Env.) in DFSYMLST member to either PER (first option) or ONE (second option). Once set, you can proceed with the installation:

### Notes

- » If you select ONE for DEFWLMAE, jobs DO2\* and DO3SRVTF should be run one time ; if you select PER , these jobs should be run for each CDC service, after the JCL SET variable CDCSRV is set to the CDC service's qualifier.
- » Job DO3SRVDF creates a CONFIG library, and places a member named "CDCS", which serves as the default configuration file. After running job

DO3SRVTF the library will contain the configuration of all CDC services, making it possible to edit them and change the configurations of a specific CDC service.

## IBM DB2 for z/OS Database Source Data Types

The following table shows the IBM DB2 for z/OS database source data types that are supported when using Attunity Replicate and the default mapping from Attunity Replicate data types.

For information on how to view the data type that is mapped in the target, see the section for the target database you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 8.23 | IBM DB2 for z/OS Database Source Data Types with Mapping to Attunity Replicate Data Types**

### IBM DB2 for z/OS Attunity Replicate Data Types Source Data Types

INTEGER	INT4
SMALLINT	INT2
BIGINT	INT8
DECIMAL (p,s)	NUMERIC (p,s)

**Note** If a decimal point is set to a comma (,) in the DB2 configuration, you will need to configure Replicate to support the DB2 setting.

For information on how to configure Replicate, see [R4Z Configuration Dependency on Host](#).

FLOAT (8)	REAL8
DOUBLE	REAL8
REAL	REAL4
DECFLOAT (p)	If precision = 16, then: REAL8 If precision = 34, then: STRING
GRAPHIC	If n<=127, then:

**Table 8.23 | IBM DB2 for z/OS Database Source Data Types with Mapping to Attunity Replicate Data Types (Cont.)**

**IBM DB2 for z/OS Attunity Replicate Data Types**  
**Source Data Types**

	WSTRING
VARGRAPHIC	If n<=16k double byte chars, then: WSTRING
LONG VARGRAPHIC	CLOB
CHAR (n)	STRING n<=255
VARCHAR (n)	STRING n<=32k
LONG VARCHAR (n)	CLOB n<=32k
CHAR (n) FOR BIT DATA	BYTES
VARCHAR (n) FOR BIT DATA	CLOB
LONG VARCHAR FOR BIT DATA	BLOB
DATE	DATE
TIME	TIME
TIMESTAMP	DATETIME (6)
BLOB	BLOB
CLOB	CLOB Maximum size: 2 GB
DBCLOB	CLOB Maximum size: 1 G double byte chars
XML	CLOB
BINARY	BYTES
VARBINARY	BYTES
ROWID	IGNORED
TIMESTAMP WITH TIME ZONE	NOT SUPPORTED

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

**Note** You can also use IBM DB2 for z/OS File Channel files as a source. For more information, see [Using the Attunity Replicate File Channel](#).

### To add an IBM DB2 for z/OS source endpoint to Attunity Replicate:

1. In the Attunity Replicate Console, click **Manage Endpoint Connections** to open the **Manage Endpoints Connections** dialog box. Then click the **New Endpoint Connection** button. For more information on adding an endpoint to Attunity Replicate, see [Working with Endpoints](#).
2. In the **Name** field, type a name for your database. This can be any name that will help to identify the database being used.
3. In the **Description** field, type a description that helps to identify the Microsoft SQL Server database. This is optional.
4. Select **SOURCE** as the database **role**.
5. Select **IBM DB2 for z/OS** as the database **Type**.
6. Choose one of the following:
  - » **Use ODBC DSN** - If you choose this option, specify the IBM DB2 for z/OS ODBC DSN.
  - » **Use these connection properties** - If you choose this option, enter the IBM DB2 for z/OS **Server** (hostname or IP address), **Port** and **Location** in the designated fields.

If the **Server** is a parallel SysPlex and data sharing members reside on multiple LPARs, the host address may specify a DVIPA - a Dynamic Virtual IP Address (to utilize the system redundancy and load-balancing in Replicate processing). In this case, the port numbers must be identical for all members.

The **Location** should be the DB2 location name defined during the installation. This should be a relational database management system – under z/OS, either a subsystem or a group connection. This is the logical name which serves applications in order to designate resources managed by this system, either using SQL CONNECT instruction, or placing it as a qualifier of a table (preceding the schema name).

To see the location name, use “-DIS DDF” DB2 command (option 7 under the DB2I panel in ISPF), or look in message DSNL004I in the job log of the <ssid>MSTR address space.
7. Enter the **User name** and **Password** for an authorized user of the specified IBM DB2 for z/OS database. For a list of the permissions that need to be granted to this user, see [Required Permissions](#).

If you do not know this information, consult with your IBM DB2 for z/OS database administrator (DBA).

#### Notes

- » This information is case sensitive
- » Make sure that the specified user has the required access privileges

8. **Provider:** Leave the default unless it was changed during the driver installation. Note that this should be the same as the name specified in the ODBC Data Source Administrator.

## Setting Advanced Connection Properties

In the **Advanced** tab, you can set advanced connection properties such as overriding CCSID to Character Set mapping, setting Change Data Capture properties, and setting internal Replicate parameters.

### Overriding CCSID to Character Set Mapping

In some cases, character data in source tables may be encoded in a different CCSID than what is declared in the source database table definition. For example, a specific table or column definition might indicate that its uses CCSID 500 (EBCDIC International) whereas in fact, it uses CCSID 1148 (ENCDIC International with EURO). In this case, you can tell Replicate that the source definition CCSID 500 should be treated as CCSID 1148 (specifically, the character set named IBM-1148).

Note that when the source table definition specifies CCISD 65535 (meaning character set is unknown), you must specify what character set should be assumed when reading data from that table or column.

**Note** If there is a conflict between the character set mapping for a specific column and the character set mapping defined in the endpoint settings, the column-level character set mapping takes precedence.

For more information on overriding character set mapping at column level, see [Using the Transform Tab](#).

### To do this:

1. In the **Override CCSID to Character Set Mapping** section, click the **New** button.  
A row is added to the table.
2. Enter the CCSID in the **CCSID** column and the code page in the **Character set** column.
3. Repeat to map additional CCSID values.

## Converting to a Custom Code Page

Perform the following procedure if your source endpoint tables are defined with an incorrect CCSID and the correct definition is actually in a UCM file.

1. Create or [download](#) a mapping data file with the file extension **.ucm**.

**Note** If you edit an existing UCM file, you must also change the values of the <code\_set\_name> and <icu:alias> properties. If the file does not contain an <icu:alias> property, then you only need to change the value of the <code\_set\_name> property.

2. Create a CNV file for the UCM file by running the following command:

```
<product_dir>\bin\makeconv.exe -v <file_name>.ucm
```

**Example:**

```
"c:\Program Files\Attunity\Replicate\bin\makeconv.exe" -v 1047_EX.ucm
```

This will create a CNV file with the same name as the UCM file (e.g. **1047\_EX.cnv**).

3. Copy the file to the following location:

```
<product_dir>\bin\icudt581
```

4. Add a new character set mapping as follows:

- a. In **CCSID** column, enter the original source CCSID number (e.g. **1047**)

- b. In the **Character set column**, enter the name of the CNV file without the extension (e.g. **1047\_EX**).

5. Restart the Attunity Replicate UI Server service.

## Change Data Capture Properties

- » **Check for changes every:** How often to check for new changes when the database is quiet. When the database is active, changes are captured as soon as they are detected.
- » **CDC reader UDTF name:** The name of the Attunity-supplied User-Defined Table Function, which is to access CDC data. Specify the two-part name resulting from the values you have chosen for schema name, &R4ZSCNM and the function name, &R4ZIFITF.
- » **UDTF result set size (MB):** Specify the maximum size to be accumulated by result rows returned by the R4Z-supplied User-Defined Table Function, through CDC tasks using this endpoint. A larger result set will cause less overhead time establishing the IFI session, but will result in greater memory consumption by DB2. Specifically, because the result set is a LOB, you may need to increase the LOBVALA limit in DB2 configuration (DSNZPARM), specifying the maximum LOB size allowed per user. Assuming all CDC enabling tasks are specifying the same ODBC user-ID, to accommodate for all tasks running concurrently, LOBVALA should be set to  $2 \times 1024 \times$  the following size:

```
SUM[(i=all endpoints) : resultset size in endpoint(i) × #_tasks using  
endpoint(i)]
```

(Resultset size is in Mbytes, so it needs to be multiplied by 1024 to reflect LOBVALA size, which is in Kbytes).

Another DSNZPARM limit, LOBVALS, specifies the total size when across all user-IDs; so, in case multiple user IDs are being used, you need to monitor this value as well. Note, however, that LOBVALS is specified in Mbytes, unlike LOBVALA.

» **Automatically enable Data Capture Changes (requires admin privileges):**

For Attunity Replicate to be able to capture changes, the Data Capture Changes attribute needs to be set on all relevant source tables. You can either do this manually or allow Replicate to perform this action by leaving this option enabled (the default). When this option is enabled, the connecting user must have ALTER permission on the source tables being captured.

## Setting Internal Parameters

Internal parameters are parameters that are not exposed in the UI. With the exception of the parameters listed in [Authorized Internal Parameters](#) at the end of this section, you should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.  
The parameter is added to the table below the search box with its default value.
3. Change the default value as required.
4. To add more parameters, repeat steps 2 and 3 above.
5. To reset a parameter value to its default, click the "Restore default value" icon at the end of the row.

## Authorized Internal Parameters

The following table provides a list of internal parameters that can be used as required.

Parameter name	Values	Default; Max; Min.
ifi306MessageLevel	0 – No DEBUG traces; 1 – include DEBUG traces; 9 – full DEBUG	0; 0; 9.
ifi306BufferSize	Size (in bytes) of Log data buffer used for IFI reading	65536; 65536; 1048576.
additionalConnectionProperties	<keyword>=<value>;...	(empty string)

**Example:**  
`cursorhold=1;patch2=15`

## R4Z Configuration Dependency on Host

This table in this section provides a list of R4Z configuration values, which can be set during installation or as part of the CDC service setup, or as part of the endpoint definition.

R4Z Topic	Depends upon Property	Defined at/Inquired by	Resolution
Total Size of R4Z ECSA structures	Available ECSA size	/DNET,CSM,... OWNERID=A LL	Make sure ECSA size is not exceeded.
MAXRESULTSETSECS parameter in the CDC service	Maximum time DB2 thread waits for a locked resource	DSNZPARM IRLMRWT param. in SDSNSAMP (DSNTIJUZ)	Set at least two seconds below the SSID spec.
MAXRESULTSIZE-parameter in the CDC service	Maximum LOB size available per user-ID	DSNZPARM LOBVALA param. in SDSNSAMP (DSNTIJUZ)	2 * (resultset size * max. session)
Decimal point: period or comma	Designates the decimal editing separator	DSNHDECM DECIMAL= param. In DSNTIJUZ	If the decimal separator is a comma, set the <a href="#">additionalConnectionProperties</a> internal parameter to patch2=15.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

## Sample XMIT Files “Receive” Job

The following is a sample job for receiving the LOAD and INSTALL libraries.

```
//*****  
///*                      Sample JCL for receiving      *  
///* Attunity ReplicateIBM DB2 for z/OS endpoint installation kit      *  
///* 1. Add a jobcard          *  
///* 2. Replace all <xmit-HLQ> by the High Level Qualifier used      *  
///*      for receive files          *  
///* 3. Replace all <r4z-vn-hlq> by the High Level Qualifier chosen      *  
///*      for the installation files          *  
//*****  
//RCVLOAD EXEC PGM=IKJEFT01,DYNAMNBR=20  
//SYSPRINT DD SYSOUT=*  
//SYSTSPRT DD SYSOUT=*  
//SYSTSIN DD *  
RECEIVE INDSN('<xmit-HLQ>.LOAD.XMIT') NODISPLAY  
DATASET('<r4z-vn-hlq>.LOAD')  
/*  
//RCVINSTL EXEC PGM=IKJEFT01,DYNAMNBR=20  
//SYSPRINT DD SYSOUT=*  
//SYSTSPRT DD SYSOUT=*  
//SYSTSIN DD *  
RECEIVE INDSN('<xmit-HLQ>.INSTALL.XMIT') NODISPLAY  
DATASET('<r4z-vnd-hlq>.INSTALL')  
/*
```

# Using IBM Netezza as a Source

This section describes how to set up and use an IBM Netezza database as a source endpoint in a replication task.

**Note** The IBM Netezza source endpoint is supported in Full Load replication mode only.

## In this section:

[Prerequisites](#)

[IBM Netezza Data Types](#)

[Setting General Connection Properties](#)

[Setting Change Processing Parameters](#)

## Prerequisites

Prior to installing Attunity Replicate, make sure that the IBM Netezza ODBC 64-bit client is installed on the Attunity Replicate machine.

## IBM Netezza Data Types

The following table shows the IBM Netezza source data types that are supported when using Attunity Replicate and the default mapping to Attunity Replicate data types.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 8.24 | Supported IBM Netezza Data Types with Mapping to Attunity Replicate Data Types**

Attunity Replicate Data Types	IBM Netezza Data Types
BIGINT	INT8
SMALLINT	INT2
BYTEINT	INT1
INTEGER	INT4
DOUBLE	REAL8
REAL	REAL4
NUMERIC	NUMERIC(25,0)
TIME	TIME

**Table 8.24 | Supported IBM Netezza Data Types with Mapping to Attunity Replicate Data Types (Cont.)**

Attunity Replicate Data Types	IBM Netezza Data Types
TIMESTAMP	DATETIME
DATE	DATE
VCHAR	STRING(25)
CHAR	STRING(25)
BOOL	BOOLEAN

## Setting General Connection Properties

You can add an IBM Netezza endpoint to Attunity Replicate to use as a source. For more information on how to add endpoints, see [Working with Endpoints](#).

### To add an IBM Netezza source endpoint to Attunity Replicate:

1. In the Attunity Replicate console, click **Manage Endpoint Connections** to open the **Manage Endpoints Connections** dialog box.
2. In the **Name** field, type a name for your database. This can be any name that will help to identify the database being used.
3. In the **Description** field, optionally enter a description that helps to identify the IBM Netezza database.
4. Select **Source** as the database **role**.  
You can do this step before any of the other steps if you want, however before you can continue with the next step in this process, you must select the database **role**.
5. Select **IBM Netezza** as the database **Type**.
6. In the **Server** field, enter the name of the IBM Netezza server.
7. Optionally, change the default **Port** (5480).
8. Enter the IBM Netezza authentication information (**User Name**, **Password**) for the authorized user for this IBM Netezza database. If you do not know this information, see your IBM Netezza database Administrator (DBA).

**Note** This information is case sensitive.

9. In the **Database name** field, enter the name of the IBM Netezza database.
10. Click **Test Connection** to verify that the settings you entered are correct.

## Setting Internal Parameters

In the **Advanced** tab, you can set internal parameters.

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

## Setting Change Processing Parameters

The **Change Processing** tab lets you define change processing settings for the source database. Normally, Replicate scans a database's transaction logs for changes and then applies those changes to the target database. However, this method of change processing is not possible with Data Warehouse endpoint types since these endpoints do not generate transaction logs.

The good news is that you can still use Replicate to capture changes from the database - it just requires a little bit of preparation.

## Prerequisites

Before you can define the settings in the **Change Processing** tab, you need to ensure that at least one special "Context" column exists in your source database tables. Context column(s) are basically columns in a table that enable Replicate to determine whether the data has changed. You can add Context columns specifically for the purpose of change processing (either using a script or manually) or you can use existing columns that contain suitable "Context" data.

**Note** You can create and reference any number of Context columns in a table as long as the Context column names are the same for all source tables. Additionally, each value in the Context column(s) must be unique.

In the example below, the Context column **cf** has been added to the table. The **cf** column contains TIMESTAMPs that enable Replicate to determine whether a change occurred (by comparing the current TIMESTAMP with the TIMESTAMP stored in its repository).

By default, all changes are assumed to be INSERTs. If UPDATE and DELETE operations are also performed on the source tables, you can write an UPDATE and/or DELETE expression (described below) that will enable Replicate to identify the operation type.

**Figure 8.3 | Example of a Table with a Context Column**

a	first_name	cf	oper
1	may1	2014-12-29 14:52:2...	D
2	may2	2014-12-29 14:52:2...	D
6	omri6	2014-12-29 14:53:5...	D
8	omri8	2014-12-29 14:53:5...	D
9	omri9	2014-12-29 14:53:5...	U
10	omri10	2014-12-29 14:53:5...	U
11	omri11	2014-12-29 14:53:5...	U
3	pitz	2014-12-30 11:04:0...	U
7	gal	2014-12-30 13:27:1...	U
5	gal	2014-12-30 13:29:2...	U
12	gal	2014-12-30 13:41:5...	U

## Limitations

The following limitations apply when Change Processing is enabled:

- » The "Start from timestamp" run option is not supported. For more information, see [Using Advanced Run Options](#).
- » If one of the Context columns is part of the Primary Key or Unique Index, then UPDATE and DELETE operations are not supported.
- » Context columns cannot be LOB columns
- » DDLs are not supported
- » When inserting a record and then updating the same record, the task error handling settings should be set as follows:
  - » Open the **<Task Name> Settings** dialog box.
  - » Select the **Error Handling|Apply Conflicts** tab.
  - » Set a task-specific Apply Conflicts policy as described in [Error Handling Settings](#).
  - » From the **No record found for applying an update** drop-down list, select **INSERT the missing target record**.

For more information on error handling, see [Error Handling](#).

## Configuring Change Processing Settings

Perform the following steps to configure change processing settings.

### To configure change processing settings:

1. Select the endpoint's **Change Processing** tab.
2. In the **Columns** field, specify the names of the Context columns. The column names are case-sensitive and must be separated by commas.  
Example:  
context1,context2
3. Choose the sorting order of the Context columns as appropriate (**Ascending** or **Descending**). Note that if the order you select is not the same as the actual sorting order, an error will occur.
4. In the **Check for changes every** field, specify how often to check for changes.
5. Enter expressions that Replicate will use to identify UPDATE and DELETE operations. If you do not enter any expressions or if no match is found for an expression, any row whose context is higher (if the sorting order is **Ascending**) or lower (if the sorting order is **Descending**) than the previous context value will be considered an INSERT.

**Note** Expressions must be written in the native syntax of the source database. All examples in this section are written using PostgreSQL syntax.

» **Update expression** - Enter an expression for identifying UPDATE operations.

**Example (based on Figure "Example of a Table with a Context Column"):**

```
case when oper='U' then 1 else 0 end
```

**Tip:** Selecting the **UPDATE the existing target record** option in the [Apply Conflicts](#) tab, eliminates the need to provide an UPDATE expression.

» **Delete expression** - Enter an expression for identifying DELETE operations.

**Example (based on Figure "Example of a Table with a Context Column"):**

```
case when oper='D' then 1 else 0 end
```

**Important:** In addition to the DELETE expression, DELETE operations should be carried out as "Soft" deletes. This means that the row is not actually deleted from the table, but rather, marked as "deleted".

6. Select **Override connection string parameters** to append the connection string with parameters that are not exposed in the UI. As such parameters are normally not required, they should only be used after consulting with Attunity Support.

# Using SAP Application as a Source

This section describes how to define a SAP Application as a source endpoint in a replication task.

## In this section:

[Prerequisites](#)

[Limitations](#)

[SAP Application Source Data Types](#)

[Setting General Connection Properties](#)

[Setting Advanced Properties](#)

## Prerequisites

The following section describes the prerequisites for working with the Attunity Replicate SAP Application endpoint.

- » [Supported SAP Packages](#)
- » [Set up a Source Endpoint for your SAP Application](#)
- » [Install the SAP NetWeaver RFC Client](#)
- » [Install the Attunity Replicate for SAP Client on the SAP Machine](#)
- » [Managing Business Groups and Tables](#)
- » [Target Collation](#)

### Supported SAP Packages

- » Primarily SAP ERP / ECC 6.0 + all EhP levels
- » All modules are supported except for HR
- » Also support CRM, SRM, GTS and MDG SAP Applications

See also [Set up a Source Endpoint for your SAP Application](#).

### Set up a Source Endpoint for your SAP Application

Before you can configure the Attunity Replicate SAP endpoint, you first need to configure one of the following source endpoints, according to your SAP Package type:

- » Oracle  
See [Using Oracle as a Target](#).
- » Microsoft SQL Server  
See [Using Microsoft SQL Server as a Target](#).
- » DB2 for LUW  
See [Using IBM DB2 for LUW as a Source](#).

- » SAP HANA

See [Using SAP Application as a Source](#).

## Install the SAP NetWeaver RFC Client

This topic describes how to copy the required SAP NetWeaver RFC Client files to Attunity Replicate.

**Note** Replicate supports NetWeaver RFC SDK 7.20 and 7.50, which can be downloaded from the SAP Service Marketplace.

- » **Windows:** Extract the contents of the **NWRFC\_xxx.SAR** file and then copy the **.dll** files from the **nwrfc sdk/lib** directory to the Replicate bin directory.
- » **Linux:** Extract the contents of the **NWRFC\_xxx.SAR** file and then copy the **.so** files from the **nwrfc sdk/lib** directory to the Replicate lib directory.

## Install the Attunity Replicate for SAP Client on the SAP Machine

This section describes how to install the transports that make up the Attunity Replicate for SAP Client.

There are five transports in total, which are provided in the following ZIP files:

1. DeleteCode.zip - Required for uninstalling the Attunity Replicate for SAP Client.
2. DeletePackage.zip - Required for uninstalling the Attunity Replicate for SAP Client.
3. InstallCode.zip (e.g. K902086.ESD) - The main transport.
4. InstallCodeECC.zip (e.g. K901271.ESD) - A transport with additional logic for ECC SAP systems .
5. InstallConfig.zip (e.g. K900012.R4S) - The configuration transport.

### The Installation Procedure

**IMPORTANT** The transports must be installed in the order they appear below. Installing the transports in the incorrect order or omitting/skipping any of the transports will result in unexpected issues with replication tasks.

#### To install the transports on ECC systems:

1. Install the main transport file (InstallCode.zip).
2. Install the ECC-specific transport (InstallCodeECC.zip).
3. Install the configuration transport (InstallConfig.zip).

#### To install the transports on non-ECC systems (e.g. CRM):

1. Install the main transport file (InstallCode.zip).
2. Install the configuration transport (InstallConfig.zip).

**Note** If you are applying a patch or upgrading the Attunity Replicate for SAP Client, you should only install the main transport and the ECC-specific transport (if upgrading on an ECC system). Do not install the configuration transport again, or any customizations made to the configuration will be lost.

## Permissions Required for Installing Attunity Replicatefor SAP Client

Replicate for SAP delivers its own authorization object: ZR4SAP. In addition to this authorization object, there are additional authorizations that need to be enabled for the Attunity Replicate software.

### SAP Users for Replicate

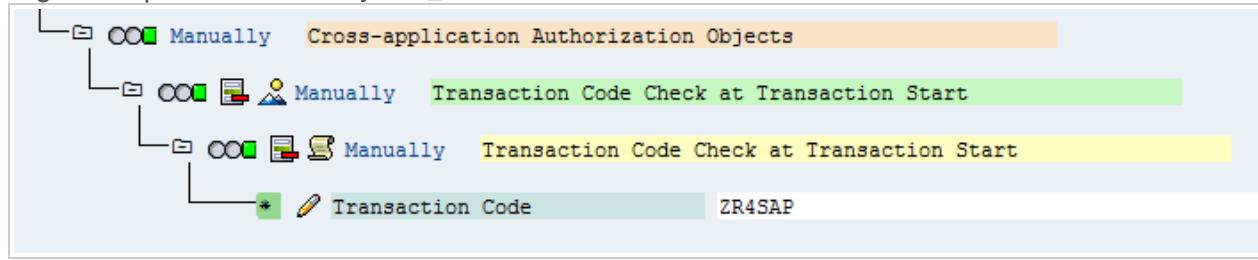
A dialog user in SAP is required to access the Attunity Replicate for SAP Client GUI in SAP. In addition, a communication user is required to support the RFC calls from the Attunity Replicate software to the SAP system.

Identify existing users in SAP or create dedicated users for the Attunity Replicate software.

### Authorizations for Replicate

Both the dialog and communication users will need to be assigned to a role with authorization object S\_TCODE and value ZR4SAP.

**Figure 8.4 | Authorization Object S\_TCODE with value ZR4SAP:**



The communication user will also require the following authorization objects: S\_RFC and S\_OC\_SEND.

Figure 8.5 | Authorization Object S\_RFC:

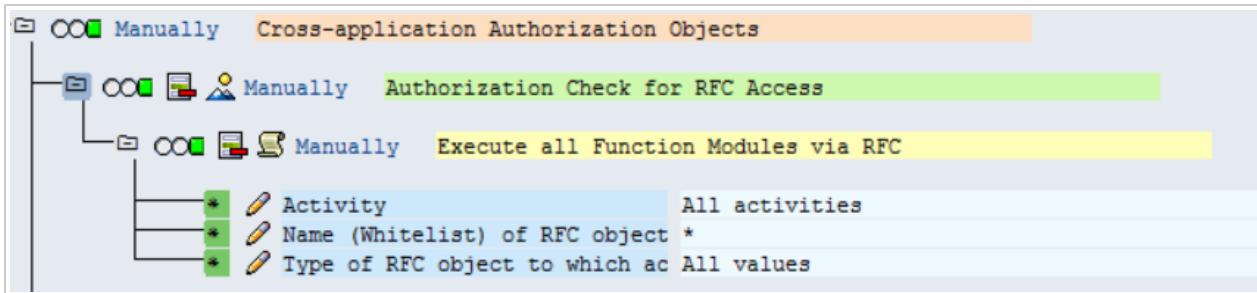
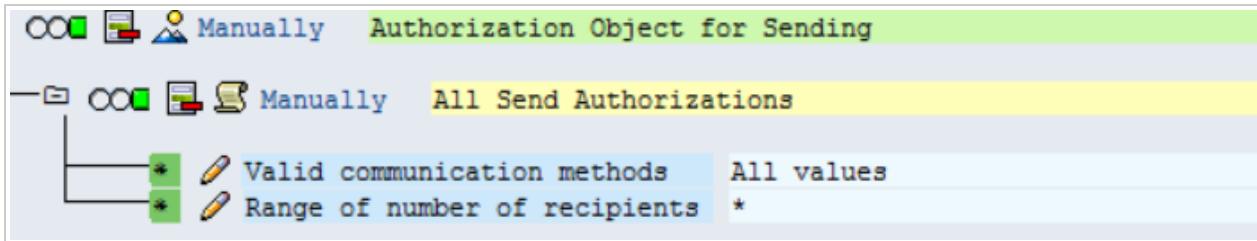


Figure 8.6 | Authorization Object S\_OC\_SEND:



## Importing the Attunity Replicate Transports into the SAP system

There are two types of files required to import the ABAP objects into the SAP system: the data-file and the co-file.

### Importing the Data-file

The data-file begins with an "R"

The data-file should be placed in the /usr/sap/trans/data file system or in the directory of the server where the transports are stored.

- » Typically this is a shared directory, but if not, individually place the file into that directory location for all SAP host servers.
- » This file must be accessible by all systems where the Attunity Replicate for SAP Client is to be installed.
- » Set the permissions on the file to All for the user, Read and Execute for the group, and Read and Execute for others.
- » The owner of the file should be the <sid>adm user of the system to be installed. The group ownership should be sapsys.

### Importing the Co-file

The co-file begins with a "K"

The co-file should be placed in the `/usr/sap/trans/cofiles` file system or in the directory of the server where the transports are stored.

- » Typically this is a shared directory, but if not, individually place the file into that directory location for all SAP host servers.
- » This file must be accessible by all systems where the Attunity Replicate for SAP Client is to be installed.
- » Set the permissions on the file to All for the user, Read and Execute for the group, and Read and Execute for others.
- » The owner of the file should be the `<sid>adm` user of the system to be installed. The group ownership should be `sapsys`.

Once the files are in the correct location, import the transport into the system using either the Operating System level transport tools (TP), or the Transport Management System (TMS) internally within SAP.

## Importing the Transports via TP

1. Log on to the system at the Operating System level as the `<sid> adm`.
2. Change the directory to `/usr/sap/trans`
3. Add the transport to the R/3 buffer with the following command:  
`# tp 'addtobuffer SID'`
4. Import the transport to the target R/3 system with the following command:  
`# tp 'import SID client=000 U16'`

The expected result of the `addtobuffer` step is a successful return code of `0'.

If problems occur during the `addtobuffer` step, it is likely there is a problem with the files. They may be missing, in the wrong location, or have incorrect ownership or permissions.

The expected result of the `import` step is a successful return code of either `0' or `4'. A return code of `8', `12' or `16' indicates transport failure. Return codes higher than `16' indicate a major failure within the transport tool. If this occurs, check the present working directory to ensure the correct location. Also, check the files for existence, location, and proper ownership and access.

If problems exist during the import, retry the import step. If problems persist, check the import and activation logs for failure reason. These files are in the `/usr/sap/trans/log` location and named.`R6U` (the `?' stands in as a wildcard).

## Importing the Transports via TMS

Beginning in R/3 version 4.0, SAP allows importing transports through the SAP system via transaction code STMS.

**Note** Security authorization in the SAP system must include proper access to import the transport request.

1. Sign-on to SAP system with a User ID that contains proper authority.
2. Execute transaction **STMS**.
3. Select the **Transport** (Truck) icon from the toolbar.
4. Select the desired system for import.
5. Add the Transport to the import queue by selecting the following path from the menu list:

#### **Extras > Other Requests > Add**

Add the transport request number to the proper import queue and execute. Re-authentication of the user.s SAP User ID is likely in order to complete the step.

If an Information message is received that the "Transport request is invalid" check that the transport number was typed correctly. Otherwise, it may indicate a problem with the files. Verification of existence, location, permissions, or ownership may be needed.

6. Import the Transport request by selecting the transport number from the queue, and clicking the **Import** (Truck) icon from the toolbar. Set the target client to either '000' or any other valid client within the system and execute with the truck icon. Once again, re-authentication of the SAP User ID may be necessary. The transport will execute in asynchronous mode; a record of success or failure can be found in the transport logs.
7. The system will return to the import queue screen, where the Transport results can be checked. Select the **Logs** icon from the toolbar, or follow the menu path:

#### **Request > Display > Logs**

Locate the source system and verify all relevant logs. For this transport there should be 5 logs:

- » **DD Import**
- » **DD Activation**
- » **Import**
- » **Check Versions**
- » **ABAP/scrn. Generation**

All logs should display **Ended OK** (return code 0) or **Ended with warning** (return code 4). If any logs are missing, or display a return code of 8 or higher, follow the instructions in step 6 to re-import the transport.

## Upgrading/Patching and Uninstalling the Attunity Replicate SAP Client

The following instructions explain how to upgrade/patch, and uninstall the Attunity Replicate SAP Client.

**Note** If you are applying a patch or upgrading the Attunity Replicate for SAP Client, you should only install the main transport and the ECC-specific transport (if upgrading on an ECC system). Do not install the configuration transport again, or any customizations made to the configuration will be lost.

#### To upgrade or patch the Attunity Replicate SAP Client on ECC Systems

1. Apply the new main transport (InstallCode.zip).
2. Apply the new ECC-specific transport (InstallCodeECC.zip).

#### To upgrade or patch the Attunity Replicate SAP Client on non-ECC systems

- » Apply the new main transport (InstallCode.zip).

#### To uninstall the Attunity Replicate SAP Client

1. Apply the "Delete Main" transport (DeleteCode.zip).
2. Apply the "Delete Package" transport (DeletePackage.zip).

**Note** Do not uninstall the Replicate for SAP Client if you are also running Attunity Gold Client, as this will uninstall some components that are shared by both products.

### Managing Business Groups and Tables

This prerequisite is only necessary if you want to edit the default Business Groups and/or tables before replicating them to the target endpoint.

Before you can manage business groups and tables, you first need to launch the SAP Client UI.

#### To launch the SAP Client UI:

1. Open your SAP client console.
2. Double-click one of the SAP Application Sources.  
You will be prompted for your user name and password.
3. Enter your credentials for logging in to the selected SAP Application Source.
4. Enter /nzs4sap in the drop-down list at the top of the console and then press [Enter].
5. Click the **Business Groups Configuration** button.

A list of Business Groups is displayed in the left pane.

## Managing Business Groups

### To add a new Business Group

1. Click the **Create** toolbar button.

The **Create Business Group** dialog box opens.

2. Enter a name for your Business Group and then press [Enter].

The new Business Group is added to the **Business Groups** list in the left pane.

### To duplicate a Business Group

1. Click the **Copy** toolbar button.

The **Business Group Configuration** dialog box opens.

2. In the **New Bus Object** field, enter a name for the new Business Group and then press [Enter].

The duplicated Business Group is added to the **Business Groups** list in the left pane.

### To delete a Business Group

- » Select the Business Group you want to delete and then click the **Delete** toolbar button.

The Business Group is deleted.

## Managing Tables

### To add a new table to a Business Group

1. In the left pane, expand the desired Business Group.

2. Double-click the **Tables** icon.

A list of tables is shown in the right pane.

3. Click the  button above the table list to enter Edit mode.

4. Click the  button that appears to the right of the  button.

An empty row is added to the tables list.

5. Enter the **Table Name** (i.e. the virtual ABAP table) and the name of the corresponding **Source Table** (i.e. the physical table).

6. To save your changes click the **Save** button in the main toolbar.

### To remove a table from a Business Group

1. In the left pane, expand the desired Business Group.

2. Double-click the **Tables** icon.

A list of tables is shown in the right pane.

3. Click the  button above the table list to enter Edit mode.

4. Select the table you want to delete.
5. Click the  button that appears to the right of the  button.  
The table is deleted.
6. To save your changes click the **Save** button in the main toolbar.

## Target Collation

As SAP is case-sensitive, when a Replicate task is defined with a SAP Application source, the target endpoints need to be set up with case-sensitive collation.

## Limitations

When using SAP Application as a source endpoint in a Replicate task, the following limitations apply:

- » A task with a SAP Application source and a File Channel target may replicate some tables twice - the requested table and the underlying table. To prevent this from happening, exclude the underlying table from the list of tables to be replicated.
- » When a task is defined with a SAP Application source, the **Applied Changes Details** monitoring metrics in the [Change Processing](#) tab may be incorrect for clustered and pooled tables.

## SAP Application Source Data Types

The SAP Application endpoint for Attunity Replicate supports most SAP data types. The table below shows the SAP source data types that are supported when using Attunity Replicate and the default mapping to the Attunity Replicate data types.

For information on how the data type is mapped to the target, see the chapter for the target endpoint you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 8.25 | Supported SAP Data Types with Mapping to Attunity Replicate Data Types**

ABAB Type	ABAB Type Description	SAP Type	Attunity Replicate Data Type
h	Table type		BYTES
V	Character string (old Dictionary type VARC)		STRING
C	Character string		STRING
N	Character string with only digits		STRING
D	Date (string: YYYYMMDD)		DATE

**Table 8.25 | Supported SAP Data Types with Mapping to Attunity Replicate Data Types (Cont.)**

<b>ABAB Type</b>	<b>ABAB Type Description</b>	<b>SAP Type</b>	<b>Attunity Replicate Data Type</b>
T	Time (string: HHMMSS)		TIME
X	Byte sequence	INT4 (4-byte integer)	I4
		INT2 (2-byte integer)	I2
		INT1 (1-byte integer)	I1
		ELSE	If backend type is NUMERIC: NUMERIC If length = 0: BLOB If length > 0: BYTES
I	Integer number (4-byte integer with sign)		INT4
b	2-byte integer		INT2
s	1-byte integer		INT1
P	Packed number		NUMERIC
F	Floating point number to accuracy of 8 bytes		R8
g	Character string with variable length		STRING
y	Byte sequence with variable length		BLOB BYTES
u	Structured type, flat		BYTES
v	Structured type, deep		BYTES
r	Reference to class/interface		BYTES
i	Reference to data object		BYTES
n	Numeric text	NUMC	STRING

# Setting General Connection Properties

This section describes how to set up connection parameters for a specific [SAP Application server](#) or for an [SAP system using load balancing](#).

## To connect to a specific SAP Application server

1. In the Attunity Replicate console, click the **Manage Endpoint Connections** toolbar button to open the **Manage Endpoints Connections** dialog box. Then click the **New Endpoint Connection** button.
2. In the **Name** field, enter a display name for your endpoint.
3. Optionally, in the **Description** field, enter a description for the SAP Application endpoint.
4. Select **Source** as the database **role**.
5. Select **SAP Application** as the database **Type**.
6. From the **Connection type** drop-down list, select **Type A**.
7. In the **Server name** field, enter the IP address of the Application Server on which the SAP Application source is located.
8. In the **Instance number** field, enter the instance number of the SAP Application source you want to replicate.
9. In the **Client** field, enter the System ID of the SAP Application source you want to replicate.
10. Enter your credentials (**User Name**, **Password**) for accessing the SAP Application source.

**Note:** These are the credentials for the [communication user created earlier in SAP](#).

11. In the **Backend endpoint** field, click the Browse button and then select the name of the Attunity Replicate endpoint you configured earlier. See also [Set up a Source Endpoint for your SAP Application](#).

## To connect to an SAP system using load balancing

1. In the Attunity Replicate console, click the **Manage Endpoint Connections** toolbar button to open the **Manage EndpointsConnections** dialog box.
2. In the **Name** field, enter a display name for your endpoint.
3. Optionally, in the **Description** field, enter a description for the SAP Application endpoint.
4. Select **Source** as the database **role**.
5. Select **SAP Application** as the database **Type**.
6. From the **Connection type** drop-down list, select **Type B**.
7. In the **Message server** field, enter the host name or IP address of the message server host.
8. In the **Application servers group name** field, enter the name of the SAP server group. This is an optional group of application servers in a load balancing connection.

9. In the **SAP system name** field, enter the SAP R/3 name.
10. In the **Message server service** field, enter the name of the SAP message server service as specified in the following file:  

```
<system drive>:\WINDOWS\system32\drivers\etc\services
```

If you do not specify a value, the Data Provider for SAP uses the following default name:

```
sapms<R/3 system name>
```
11. In the **Client** field, enter the System ID of the SAP Application source you want to replicate.
12. Enter your credentials (**User Name, Password**) for accessing the SAP Application source.  

**Note:** These are the credentials for the [communication user created earlier in SAP](#).
13. In the **Backend endpoint** field, click the Browse button and then select the name of the Attunity Replicate endpoint you configured earlier. See also [Set up a Source Endpoint for your SAP Application](#).

## Setting Advanced Properties

In the **Advanced** tab, you can set the following parameters:

- » **RFC call batch:** The number of concurrent RFC calls made from Replicate back to the SAP system. If you encounter performance issues, increasing this number may help, but may also adversely affect monitoring updates.

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

# Using SAP HANA as a Source

This section describes how to set up and use a SAP HANA endpoint as a source in a replication task.

**Note** The SAP HANA endpoint can either be accessed directly or via the SAP Application endpoint. For an explanation of how to set up the SAP Application endpoint, see [Using SAP Application as a Source](#)

## In this section:

[Prerequisites](#)

[Limitations](#)

[Permissions](#)

[Supported Data Types](#)

[Setting General Connection Properties](#)

[Setting Advanced Properties](#)

## Prerequisites

Before SAP HANA can be used as a source endpoint in a replication task, the prerequisites described in this section must be met.

### Port

Open inbound port number 3xx15 to the SAP HANA server where xx is the instance number of the SAP HANA database that contains the source tables.

For example, the port for instance 90 would be 39015.

### Required Clients

- » **Windows:** Install the SAP HANA ODBC 64-bit Driver 2.x for Windows on the Replicate Server machine. The driver name is HDBODBC.
- » **Linux:** Install the SAP HANA ODBC 64-bit Driver 2.x for Linux on the Replicate Server machine. The driver name is HDBODBC.

Add the following section to the `odbcinst.ini` file located in directory `/etc`:

```
[HDBODBC]
Description=64-bit HANA ODBC Driver
Driver=/opt/sap/hdbcclient/libodbcHDB.so
fileUsage=1
```

## Change Processing

To be able to capture changes committed to the source tables, Replicate requires the following artifacts to be created in the source database (either manually by the DBA or automatically by Replicate):

- » **Three triggers for each of the designated source tables:** The triggers capture changes to the source tables (INSERTs, UPDATEs, and DELETEs) and write them to the Replicate `attrep_cdc_changes` table described below. A separate trigger is required for each DML operation.  
The triggers will be created in the source table schema.
- » **The Replicate `attrep_cdc_changes` table:** This table will contain changes captured by the triggers and will either be created in the schema of the user specified in the SAP HANA endpoint settings, or in the [schema specified in the endpoint settings](#).

**Note** As Replicate periodically scans the `attrep_cdc_changes` table for changes, the number of UPDATEs shown in the monitor's **Change Processing** tab reflects the number of UPDATEs found (in the `attrep_cdc_changes` table) at the time of scanning. This may not be the actual number of UPDATEs performed on the source since UPDATEs are sometimes merged with INSERTs (depending on when the `attrep_cdc_changes` table was last scanned).

### To create the CDC artifacts automatically (the default):

When defining the SAP HANA source endpoint, make sure that the **Create CDC Artifacts** check box in the **Advanced** tab is selected (the default).

### To create the CDC artifacts manually:

1. Define the task as you would any other Replicate task, but when configuring the SAP HANA source endpoint, clear the **Create CDC Artifacts** check box in the **Advanced** tab.
2. Once the task is defined, select any of the **Metadata only** options in the **Advanced Run Options** window, and then click **OK**.

The task will run and generate the scripts for creating the CDC artifacts in the following location and then stop:

`~/data/tasks/<task_name>/scripts`

3. Execute the scripts in the source database.
4. Run the Replicate task normally.

## Limitations

The following limitations apply when using SAP HANA as a source:

- » Changes to a table's Primary Key will not be replicated to the target.
- » DDL operations are not supported.

**Note** This limitation does not apply when accessing SAP HANA via the SAP Application endpoint.

## Permissions

The following are the minimum permissions required:

- » Grant SELECT and TRIGGER on the SAP schema containing the selected source tables to the user specified in the SAP HANA source endpoint.
- » If the `attrep_cdc_changes` table is created in a schema owned by the user specified in the SAP HANA source endpoint settings (the default), no further permissions are required.
- » If the `attrep_cdc_changes` table is created in a schema not owned by the user specified in the endpoint settings, grant SELECT, INSERT, UPDATE and DELETE on the `attrep_cdc_changes` table to the specified user.

## Supported Data Types

The following table shows the SAP HANA source data types that are supported when using Attunity Replicate, and the default mapping to Attunity Replicate data types.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 8.26 | Supported SAP HANA Data Types with Mapping to Attunity Replicate Data Types**

SAP HANA Data Types	Attunity Replicate Data Types
DATE	DATE
TIME	TIME
SECONDDATE	TIMESTAMP
TIMESTAMP	TIMESTAMP
TINYINT	TINYINT
SMALLINT	SMALLINT

**Table 8.26 | Supported SAP HANA Data Types with Mapping to Attunity Replicate Data Types (Cont.)**

SAP HANA Data Types	Attunity Replicate Data Types
INTEGER	INTEGER
BIGINT	BIGINT
SMALLDECIMAL	DECIMAL
DECIMAL	DECIMAL
REAL	REAL
DOUBLE	DOUBLE
VARCHAR	VARCHAR
NVARCHAR	NVARCHAR
ALPHANUM	VARCHAR
SHORTTEXT	NVARCHAR
VARBINARY	VARBINARY
BLOB	BLOB
CLOB	CLOB
NCLOB	NCLOB
TEXT	NCLOB
BOOLEAN	TINYINT

## Unsupported Data Types

The following data types are not supported:

- » ARRAY
- » ST\_GeOMETRY
- » ST\_POINT

## Setting General Connection Properties

You can add a SAP HANA endpoint to Attunity Replicate to use as a source. For more information on how to add endpoints, see [Working with Endpoints](#).

### To add a SAP HANA source endpoint to Attunity Replicate:

1. In the Attunity Replicate console, click **Manage Endpoint Connections** to open the **Manage Endpoints Connections** dialog box.
2. In the **Name** field, type a name for your database. This can be any name that will help to identify the database being used.

3. In the **Description** field, optionally enter a description that helps to identify the SAP HANA database.
4. Select **Source** as the database **role**.  
You can do this step before any of the other steps if you want, however before you can continue with the next step in this process, you must select the database **role**.
5. Select **SAP HANA** as the database **Type**.
6. In the **Instance** field, enter the instance number of the SAP HANA database with the source tables.
7. Enter the **Username** and **Password** required to access the SAP HANA database. If you do not know this information, see your SAP HANA database Administrator (DBA).

**Note** This information is case sensitive.

8. Click **Test Connection** to verify that the specified settings are correct.

## Setting Advanced Properties

In the **Advanced** tab, you can set the following parameters:

- » **Create CDC artifacts:** When this option is enabled (the default), Replicate creates the [required CDC artifacts](#) in the source database. Clear this check box if you would rather [create the CDC artifacts manually](#).
- » **Create CDC table in schema:** The name of the schema in the source database where you want the [attrep\\_cdc\\_changes](#) table to be created.

**Note** The specified schema must already exist in the source database.

- » **Log cleanup interval (min):** Specify how often (in minutes) to check if Change Records need to be deleted from the [attrep\\_cdc\\_changes](#) table.
- » **Log retention period (min):** Specify how long (in minutes) to keep Change Records in the [attrep\\_cdc\\_changes](#) table before deleting them.

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.

5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

# Using ODBC to Connect to a Source

This section describes how to use ODBC connectivity to connect to a source endpoint.

## In this section:

[Prerequisites](#)

[Limitations](#)

[ODBC Source Data Types](#)

[Setting General Connection Properties](#)

[Setting Advanced Connection Properties](#)

## Prerequisites

The following section describes the prerequisites for working with Attunity Replicate and an ODBC endpoint.

### Attunity Replicate Server for Windows

You can connect an endpoint to Attunity Replicate using ODBC by indicating the DSN (Data Source Name). In this case you must be sure that a DSN is defined for the ODBC endpoint on the computer where Attunity Replicate is installed.

1. Install an endpoint client on the computer where Attunity Replicate is installed. The client you install depends on the ODBC provider you are using. For example, if you are using an IBM DB2 endpoint, install an IBM DB2 client.

**Note** You must use a 64-bit ODBC provider client to work with Attunity Replicate.

2. Use the ODBC Data Source Administrator to create a System DSN. The Data Source is located in the Windows control panel.

### Attunity Replicate Server for Linux

The following section describes the steps you need to perform to work with Attunity Replicate for Linux and ODBC as a source or target endpoint in a Attunity Replicate task.

1. On the Attunity Replicate Server machine, install the ODBC client that you want to use (e.g. PostgreSQL).
2. Makes sure that the `/etc/odbcinst.ini` file contains the correct entry for the driver you installed, as in the following example:

```
[PostgreSQL]
Description = ODBC for PostgreSQL
Driver = /usr/lib/pgsqlodbc.so
```

```
Setup = /usr/lib/libodbcpsqlS.so
Driver64 = /usr/lib64/psqlodbc.so
Setup64 = /usr/lib64/libodbcpsqlS.so
FileUsage = 1
```

**Note** To access an IBM DB2 for LUW target using ODBC, make sure that you specify the **libdb2o.so** driver (and not **libdb2.so**).

3. Define a DSN for the installed driver by editing the `/etc/odbc.ini` file, as in the following example:

```
[Postgre_DSN]
Description = Test
Driver = /usr/lib64/psqlodbc.so
Endpoint = MyDatabase
Servername = 12.3.45.678
Port = 5432
```

## Limitations

When using ODBC as a source, the following limitations apply:

- » **UPDATES** to primary key fields are not supported. To update the field, define it as a unique index instead.
- » The ODBC Source endpoint supports full-load operations only.
- » For providers that do not support batch operations, you must set the `RowByRow=true` internal parameter according to the description provided in [Internal Parameters](#).

## ODBC Source Data Types

The following table shows the ODBC source data types that are supported when using Attunity Replicate and the default mapping from Attunity Replicate data types.

For information on how to view the data type that is mapped in the target, see the section for the target endpoint you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 8.27 | Supported ODBC Source Data Types with Mapping to Attunity Replicate Data Types**

ODBC Data Types	Attunity Replicate Data Types
SQL_BIT	<b>BOOLEAN</b>
SQL_TINYINT	<b>INT1</b>

**Table 8.27 | Supported ODBC Source Data Types with Mapping to Attunity Replicate Data Types (Cont.)**

ODBC Data Types	Attunity Replicate Data Types
	<b>UINT1</b>
SQL_SMALLINT	<b>INT2</b> <b>UINT2</b>
SQL_INTEGER	<b>INT4</b> <b>UINT4</b>
SQL_BIGINT	<b>INT8</b> <b>UINT8</b>
SQL_DOUBLE	<b>REAL8</b>
SQL_FLOAT	<b>REAL8</b>
SQL_REAL	<b>REAL8</b>
SQL_NUMERIC (P,S)	<b>NUMERIC (P,S)</b> <b>REAL8</b>
	The SQL_NUMERIC data type is mapped to REAL8

**Table 8.27 | Supported ODBC Source Data Types with Mapping to Attunity Replicate Data Types (Cont.)**

ODBC Data Types	Attunity Replicate Data Types
	when <i>at least one</i> of the following is true: <ul style="list-style-type: none"> <li>» Precision &gt; 38</li> <li>» Scale &lt; 0</li> <li>» Scale &gt; 38</li> <li>» Scale &gt; Precision</li> </ul>
SQL_DECIMAL (P,S)	<b>NUMERIC (P,S)</b> <b>REAL 8</b> The SQL_NUMERIC data type is mapped to REAL8 when <i>at least one</i> of the following is true: <ul style="list-style-type: none"> <li>» Precision &gt; 38</li> <li>» Scale &lt; 0</li> <li>» Scale &gt; 38</li> <li>» Scale &gt; Precision</li> </ul>
SQL_DATE	<b>DATE</b>
SQL_TYPE_DATE	
SQL_TIME	<b>TIME</b>
SQL_TYPE_TIME	
SQL_TIMESTAMP	<b>DATETIME</b>
SQL_TYPE_TIMESTAMP	
SQL_CHAR	<b>STRING</b>
SQL_VARCHAR	
SQL_WCHAR	<b>WSTRING</b>
SQL_WVARCHAR	
SQL_LONGVARCHAR	<b>CLOB</b>
<p><b>Note</b> To use this data type with Attunity Replicate, you must enable the use of CLOBs for a specific task.</p> <p>During CDC, CLOB data types are supported only in tables that include a primary key.</p>	

**Table 8.27 | Supported ODBC Source Data Types with Mapping to Attunity Replicate Data Types (Cont.)**

ODBC Data Types	Attunity Replicate Data Types
For more information, see <a href="#">LOB support in Task Settings/Metadata</a> .	
SQL_WLONGVARCHAR	<b>NCLOB</b>
<p><b>Note</b> To use this data type with Attunity Replicate, you must enable the use of NCBLOBS for a specific task.</p> <p>During CDC, NCLOB data types are supported only in tables that include a primary key.</p> <p>For more information, see <a href="#">LOB support in Task Settings/Metadata</a>.</p>	
SQL_BINARY	<b>BYTES</b>
SQL_LONGVARBINARY	<b>BLOB</b>
<p><b>Note</b> To use this data type with Attunity Replicate, you must enable the use of BLOBS for a specific task.</p> <p>BLOB data types are supported only in tables that include a primary key.</p> <p>For more information, see <a href="#">LOB support in Task Settings/Metadata</a>.</p>	
SQL_GUID	<b>STRING</b>
SQL_INTERVAL_YEAR	<b>STRINGW</b>
SQL_INTERVAL_MONTH	
SQL_INTERVAL_DAY	
SQL_INTERVAL_MINUTE	

**Table 8.27 | Supported ODBC Source Data Types with Mapping to Attunity Replicate Data Types (Cont.)**

ODBC Data Types	Attunity Replicate Data Types
SQL_INTERVAL_HOUR	
SQL_INTERVAL_SECOND	
SQL_INTERVAL_YEAR_TO_MONTH	
SQL_INTERVAL_DAY_TO_HOUR	
SQL_INTERVAL_DAY_TO_MINUTE	
SQL_INTERVAL_DAY_TO_SECOND	
SQL_INTERVAL_HOUR_TO_MINUTE	
SQL_INTERVAL_HOUR_TO_SECOND	
SQL_INTERVAL_MINUTE_TO_SECOND	
Provider specific data types	If column length is < or = 4000: <b>BYTES</b> If column length is 0 or > 4000: <b>BLOB</b>
<b>Note</b> If column length is 0 or > 4000 then:  To use this data type with Attunity Replicate, you must enable the use of BLOBS for a specific task.  BLOB data types are supported only in tables that include a primary key.  For more information, see <b>LOB support in Task Settings/Metadata</b> .	

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

### To add an ODBC source endpoint to Attunity Replicate:

1. In the Attunity Replicate Console, click **Manage Endpoint Connections** to open the **Manage Endpoints Connections** dialog box. Then click the **New Endpoint Connection** button.
2. In the **Name** field, type a name for your ODBC endpoint. This can be any name that will help to identify the endpoint being used.

3. In the **Description** field, type a description that helps to identify the ODBC endpoint. This is optional.
4. Select **SOURCE** as the endpoint **role**.
5. Select **ODBC** as the endpoint **Type**.
6. Select *one* of the following:
  - » If the DSN you want to use is not included in the list, make sure that the endpoint client is installed on the computer with Attunity Replicate and that the DSN is defined. Note that the ODBC provider client must be 64-bit. For more information, see [Prerequisites](#) .

**Note** If you are using an ARC CDC Agent as the source in a Attunity Replicate task, you cannot select the DSN for the Attunity ODBC driver as the target. In this case, to use Attunity ODBC as a source, you must enter the connection string manually by selecting **Connection String** and following the directions for that option in this procedure.

- » **Connection String:** Select this to connect to an ODBC-supported endpoint using a connection string then type a valid connection string in the field below. For information on how to create a connection string, see the documentation for the ODBC endpoint provider you are using.

Note that if you specify a password in your connection string, it will be revealed as plain text in the task log files. It is therefore recommended to specify the password in the GUI **Password** field.

**Note**

- » You can use the **Advanced** tab to add specific properties and create a custom connect string. In this case, you do not need to enter information in this tab. For more information on using the **Advanced** tab, see [Setting Advanced Connection Properties](#).
- » To determine if you are connected to the endpoint you want to use or if the connection information you entered is correct, click **Test Connection**.

If the connection is successful a message in green is displayed. If the connection fails, an error message is displayed at the bottom of the dialog box.

To view the log entry if the connection fails, click **View Log**. The server log is displayed with the information for the connection failure. Note that this button is not available unless the test connection fails.

7. Type the authentication information (**User Name**, **Password**) for the authorized user for the ODBC endpoint being used. For example, the IBM DB2 system administrator if you are using a IBM DB2 provider. If you do not know this information, see your ODBC

Endpoint System Administrator.

#### Note

- » When you select **Connection String** be sure to include **User name/password** information in the connection string that you type in the box.  
If you are using the **Advanced** tab to create a custom string, make sure to include the **User Name** and **Password** properties. For more information, see [Setting Advanced Connection Properties](#).
- » This information is case sensitive.
- » You can set custom properties in the **Advanced** tab. For more information, see [Setting Advanced Connection Properties](#).

**Important:** Make sure that the ODBC endpoint user has the correct access privileges for the ODBC provider being used.

## Setting Advanced Connection Properties

In the **Advanced** tab, you can set the following properties:

- » **Provider syntax:** Select the name of the provider syntax if you are using an alternate provider syntax.

### Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

#### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

### Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

# Using ARC CDC Solutions in Attunity Replicate

This section describes how to use an ARC (Attunity Replicate Connect) CDC Solution as an Attunity Replicate endpoint.

## Notes

- » For better performance, it is strongly recommended that Replicate runs on Windows when working with an ARC-based source.
- » For all ARC sources, it is strongly recommended to install the ARC Agent in the same data center as the Replicate server.

## In this section:

[Prerequisites for Using ARC CDC Solutions](#)

[Additional Prerequisites when Using ARC Non-Relational Sources](#)

[ARC CDC Solution Security Considerations](#)

[Limitations](#)

[ARC Source Data Type Mapping](#)

[Working with ARC CDC Solutions](#)

[Setting Advanced Connection Properties](#)

## Prerequisites for Using ARC CDC Solutions

To use an ARC CDC Solution, you must have the following installed somewhere in your network in addition to the database you are working with.

- » **ARC version 5.5 or above:** This must be installed on the same computer as the database you are using. You will need the installation kit for the computer platform that your database runs on. For example, if you are using an IBM IMS database, install ARC on the same mainframe computer where your IBM IMS database is located. For information on how to install ARC, see the *Attunity Replicate Connect Installation Guide* for the computer platform that is relevant to the CDC Solution you are working with.
- » **Attunity Studio version 5.3.2 or above:** Attunity Studio is used to set up a CDC Solution. This will create the CDC Solution that can be used in the Attunity Replicate replication task. Attunity Studio must be installed on a Windows computer. For information on installing Attunity Studio, see the *Attunity Replicate Connect Studio Installation Guide*.
- » **When the ARC database is on DB400-AS4002:** To apply deletes to the target, journaling must be set to \*BOTH.
- » **ARC relational data sources that support table ownership:** If the table owner contains an underscore, you must create the ARC solution with a default table owner.

» **When the source endpoint is IBM IMS (ARC):** The ARC IMS Bulk data source is always created as IMS-DLI. You should specify the correct ARC IMS **Bulk started task** in the endpoint settings. The ARC USERLIB library contains the following started task examples:

- » NVIMSSRV for IMS DLI access
- » NVBMPSRV for IMS BMP access

For more information on creating ARC Solutions, please refer to the *Attunity Replicate Connect User Guide and Reference*.

**Note** For information about installing the database you are working with, see the installation guide for that database.

## Additional Prerequisites when Using ARC Non-Relational Sources

When using any of the [Using ARC CDC Agents as Endpoints](#), the following prerequisites also apply:

- » ARC 5.5 or above installed on the Attunity Replicate machine.
- » If the source tables contain Primary Keys, edit the source table metadata in Attunity Studio and mark the Primary Key columns as shown in the figure below. This should be done at the start of creating the CDC solution when importing the tables/files.

## Table Information



Name	Data Type	Size	Scale	Dimension	Offset	Fixed Offset	Primary Key
STUDENT_ID	int4			0	0	<input type="checkbox"/>	<input checked="" type="checkbox"/>
FIRST_NAME	string	32		0	4	<input type="checkbox"/>	<input type="checkbox"/>
LAST_NAME	string	32		0	36	<input type="checkbox"/>	<input type="checkbox"/>
DATE_OF_BIRTH	int_date			0	68	<input type="checkbox"/>	<input type="checkbox"/>
NUMOF_COURSES	int4			0	72	<input type="checkbox"/>	<input type="checkbox"/>
COURSES	group			0	76	<input type="checkbox"/>	<input type="checkbox"/>
COURSE	group			8	0	<input type="checkbox"/>	<input type="checkbox"/>
COURSE_ID	int4			0	0	<input type="checkbox"/>	<input checked="" type="checkbox"/>
COURSE_TITLE	string	48		0	4	<input type="checkbox"/>	<input type="checkbox"/>
INSTRUCTOR_ID	int4			0	52	<input type="checkbox"/>	<input type="checkbox"/>
NUMOF_ASSIGNMENTS	int4			0	56	<input type="checkbox"/>	<input type="checkbox"/>
ASSIGNMENT	group			4	60	<input type="checkbox"/>	<input type="checkbox"/>
ASSIGNMENT_TYPE	string	12		0	0	<input type="checkbox"/>	<input checked="" type="checkbox"/>
ASSIGNMENT_TITLE	string	48		0	12	<input type="checkbox"/>	<input type="checkbox"/>
DUE_DATE	int_date			0	60	<input type="checkbox"/>	<input type="checkbox"/>
GRADE	decimal	2	1	0	64	<input type="checkbox"/>	<input type="checkbox"/>
NUMOF_BOOKS	int4			0	2668	<input type="checkbox"/>	<input type="checkbox"/>
BOOK	group			5	2672	<input type="checkbox"/>	<input type="checkbox"/>
ISBN	string	10		0	0	<input type="checkbox"/>	<input checked="" type="checkbox"/>
RETURN_DATE	int_date			0	10	<input type="checkbox"/>	<input type="checkbox"/>

For more information on selecting Primary Keys in Attunity Studio, refer to the "Working with Metadata in Attunity Studio" chapter in the *Attunity Replicate Connect User Guide and Reference*.

## ARC CDC Solution Security Considerations

For an explanation of the security configurations and permissions necessary, see the CDC Solution reference in the *Attunity Replicate Connect User Guide and Reference*.

### Encrypting Communications Between Replicate and ARC Data Sources

You can encrypt sessions between Replicate and ARC data sources. When a session is encrypted, all communications between Replicate and the selected ARC data source will be encrypted using AES-256 bit encryption. When capturing changes from a relational data source, the encryption key needs to be defined in two locations: The Attunity Replicate ARC database and the ARC Agent machine. However, when capturing changes from a non-

relational database, the encryption key needs to be defined in *four* different locations: The Attunity Replicate ARC database, the ARC Agent machine, the ARC Router machine, and the Router Authenticator.

### To encrypt communications between Replicate and ARC data sources:

1. On the **Agent** machine, create an encryption key as follows:
  - a. Open Attunity Studio in **Design** view.
  - b. In the **Configuration** tab, expand the machine on which your ARC Solution's Agent is installed.
  - c. Expand the **Users** folder and select **NAV**.  
The **User: NAV** tab opens.
  - d. To the right of the **Encryption Keys** list (in the lower half of the screen), click the **Add** button.  
The **Encryption Key** dialog opens.
  - e. Enter an encryption key name and value and then click **OK**.

**Note** Steps 2-4 apply to *non-relational* ARC data sources only (e.g. VSAM). If you are working with a relational ARC data source, continue to Step 5.

2. On the **Router** machine, create an encryption key which has the same values as the encryption key that you created on the **Agent** machine. The procedure is the same as described in **Step 1**, but instead of expanding the machine on which your ARC Solution's Agent is installed, expand the machine on which your ARC Solution's Router is installed.
3. On the **Router** machine, define the Agent as an authenticator according to the following steps:
  - a. In the **Configuration** tab, expand the machine on which the Router is installed. Then, right-click your solution's Router binding (e.g vsam\_router) and select **Open**.
  - b. In the **Machines** tab, click the **Security** button.  
The **NAV** tab opens.
  - c. To the right of the **Authenticators** list, click the **Add** button.  
The **Add Authenticator** dialog box opens.
  - d. From the **Resource type**, drop-down list, select **Adapter**.
  - e. In the **Resource name** field, specify the name of your solution's Agent as it appears under the **Adapters** folder (e.g VSAM\_ag).
  - f. At the bottom of the dialog box, select the **Encryption key** check box and then specify the encryption key name and value in the designated fields. These values must be the same as the encryption key values defined in **Step 1**.
4. In the Router's **Properties** tab, expand the **comm** property and set the

**defaultEncryptionMethod** property to **AES**.

**Note** If the **Properties** tab is not displayed, open the **Preferences** dialog box (by selecting **Preferences** from the **Windows** menu), navigate to **Studio** and then select the **Show advanced environment parameters** option in the **Advanced** tab.

5. In the **Advanced** tab of the Replicate ARC database, specify the encryption key name and value. These values must be the same as the encryption key values defined in **Step 1**.

For more information on the Advanced tab, see [Using ARC CDC Agents as Endpoints](#).

See also: [Using ARC CDC Agents as Endpoints](#).

## Limitations

When working with ARC data sources, the following limitations apply:

- » **IBM DB2 on iSeries (ARC):** Table and field names that contain the "/" character are not supported.
- » Only one Replicate task can work with the same ARC Agent concurrently.
- » Replication of DDL changes to the target endpoint is not supported.

## ARC Source Data Type Mapping

The table below shows the ARC source data types that are supported when using Attunity Replicate and the default mapping to Attunity Replicate data types.

For an explanation of the supported data types for the ARC CDC Solution you are using, see the CDC Solution reference in the *Attunity Replicate Connect User Guide and Reference*.

For information on how to view the data type that is mapped in the target, see the section for the target database you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 8.28 | Supported ARC Data Types with Mapping to Attunity Replicate Data Types**

ARC Data Types	Attunity Replicate Data Types
<b>ARC SQL Server</b>	
INT	<b>REAL4</b>
REAL	<b>REAL4</b>
FLOAT	<b>REAL8</b>

**Table 8.28 | Supported ARC Data Types with Mapping to Attunity Replicate Data Types (Cont.)**

ARC Data Types	Attunity Replicate Data Types
BIT	<b>INT1</b>
TINYINT	<b>INT1</b>
SMALLINT	<b>INT2</b>
BIGINT	<b>NUMERIC</b>
DECIMAL	<b>NUMERIC</b>
NUMERIC	<b>NUMERIC</b>
MONEY	<b>NUMERIC</b>
SMALLMONEY	<b>NUMERIC</b>
DATETIME	<b>DATETIME</b>
SMALLDATETIME	<b>DATETIME</b>
CHAR	<b>STRING</b>
VARCHAR	<b>STRING</b>
NCHAR	<b>STRING</b>
NVARCHAR	<b>STRING</b>
BINARY	<b>BYTES</b>
VARBINARY	<b>BYTES</b>
TIMESTAMP	<b>BYTES</b>
UNIQUEIDENTIFIER	<b>STRING</b>

## Working with ARC CDC Solutions

To use a CDC Solution from the Attunity Integration Suite, you must first create a CDC Solution in Attunity Studio. Then create a new database using the CDC Solution you created as the Attunity Replicate database. You can then use this database as your source for any task that you create. To use ARC CDC Solutions, carry out the following:

- » [Create an ARC CDC Solution in Attunity Replicate Connect Studio](#)
- » [Add the ARC Data Source to Attunity Replicate](#)
- » [Add the ARC CDC Solution Endpoint to a Task](#)

### Create an ARC CDC Solution in Attunity Replicate Connect Studio

Before you can begin to work with an ARC CDC Solution in Attunity Replicate, you must create a CDC solution using one of the supported ARC CDC Solutions using Attunity

Replicate Connect Studio. For information on the required ARC installation necessary to create a CDC solution, see [Prerequisites for Using ARC CDC Solutions](#).

#### To create a CDC solution in Attunity Replicate Connect Studio:

1. Using Attunity Replicate Connect Studio, create a CDC Solution using the CDC Solution that you want to use as your source database in Attunity Replicate. For information on creating a CDC Solution, refer to the *Attunity Integration Suite User Guide and Reference*.
2. At the end of the process for creating a CDC solution, you must deploy the solution. Do *not* activate the solution. Attunity Replicate activates the solution automatically when you begin to work with the CDC Solution.

**Note** If you activate the solution, then disable the router and staging area workspaces and keep the agent workspace enabled. For more information, see the *Attunity Replicate Connect User Guide and Reference*.

### Add the ARC Data Source to Attunity Replicate

The next step is to add the ARC Data Source to Attunity Replicate. You do this by adding a database and selecting one of the supported ARC database types.

If you selected one of the supported relational data sources, continue from [Adding a Relational ARC Data Source to Attunity Replicate](#).

If you selected one of the supported non-relational data sources, continue from [Adding a Non-Relational ARC Data Source to Attunity Replicate](#). See also [Additional Prerequisites when Using ARC Non-Relational Sources](#).

For information on how to add endpoints, see [Working with Endpoints](#).

### Adding a Relational ARC Data Source to Attunity Replicate

#### To add a relational ARC data source to Attunity Replicate:

1. In the Attunity Replicate console, click **Manage Endpoint Connections** to open the **Manage Endpoint Connections** dialog box and then click **New Endpoint Connection**. For more information on adding an endpoint to Attunity Replicate, see [Working with Endpoints](#).
2. In the **Name** field, type a name for your database. This can be any name that will help to identify the database being used.
3. In the **Description** field, type a description that helps to identify the ARC CDC Solution. This is optional.
4. Select **Source** as the **role**.
5. Select a relational ARC data source from the **Type** list. The ARC data sources are listed as **<Data Source> (ARC)**. For a list of supported relational data sources, see [Using ARC CDC Agents as Endpoints](#).

6. In the **Host/IP** field, type the name or IP Address of the computer where the CDC Solution (data source) you defined in Attunity Studio is located.
7. In the **Port** field, type the port number for the port you used when creating the CDC Solution in Attunity Studio. The default port number is 2551.
8. In the **CDC Solution** field, enter the name of the solution you defined when you created the data source in Attunity Studio.
9. In the **User name** and **Password** fields, enter the username and password required to access the database.
10. Click **OK** to add the database to Attunity Replicate. You can use this database as the source database for any replication task that you create.

**Note** To determine if you are connected to the database you want to use or if the connection information you entered is correct, click **Test Connection**.

If the connection is successful a message in green is displayed. If the connection fails, an error message is displayed at the bottom of the dialog box.

To view the log entry if the connection fails, click **View Log**. The server log is displayed with the information for the connection failure. Note that this button is not available unless the test connection fails.

## Adding a Non-Relational ARC Data Source to Attunity Replicate

When you add a database to Attunity Replicate and you select a non-relational ARC data source as the database type, the following dialog box opens.

### To add an ARC source database to Attunity Replicate:

1. In the Attunity Replicate console, click **Manage Endpoint Connections** to open the **Add Endpoint Connections** dialog box and then click **New Endpoint Connection**. For more information on adding an endpoint to Attunity Replicate, see [Working with Endpoints](#).
2. In the **Name** field, type a name for your database. This can be any name that will help to identify the database being used.
3. In the **Description** field, type a description that helps to identify the ARC CDC Solution. This is optional.
4. Select **Source** as the **role**.
5. Select an ARC non-relational data source from the **Type** list. The ARC data sources are listed as <database> (**ARC**), for example **RMS (ARC)**. For a list of supported non-relational data sources, see [Using ARC CDC Agents as Endpoints](#).
6. When working with the **RMS (ARC)** data source, choose one of the following Change Processing modes:
  - » **Non relational** (the default) - When this mode is selected, Replicate reads the changes from a CSV file that contains the modified data records. Use this mode if

you need to retrieve changes to arrays and variant tables.

If you select this option, continue from Step 7 below.

- » **Relational** - When this mode is selected, Replicate reads the changes directly from the ARC Agent. Relational mode improves performance but does not support changes to complex data structures such as arrays and variant tables.

If you select this option, continue from Step 6 in [Adding a Relational ARC Data Source to Attunity Replicate](#).

7. In the **Port** field, type the port number for the port you used when creating the CDC Router in Attunity Studio. The default port number is 2551.
8. In the **CDC Solution** field, enter the name of the solution you defined when you created the data source in Attunity Studio.
9. If a username and password are required to access the CDC Solution Router, enter them in the **User name** and **Password** fields in the **Local ARC router** section.
10. If a username and password are required to access the CDC Solution, enter them in the **User name** and **Password** fields in the **ARC on <source> machine** section.
11. Required for **IBM IMS (ARC)** only: In the **Bulk started task** field, specify the correct z/OS Started Task name for IMS/BMP or IMS/DLI. This member was copied to the z/OS PROCLIB library from <ARC HLQ>.USERLIB. NVBMPSRV and NVIMSSRV are the provided member names.

**Note** If you choose IMS/DLI, you will need to close the database to IMS/TM or IMS/DBCTL. This option might be faster than using BMP. IMS/BMP does not require exclusive access to the database.

12. Click **OK** to add the database to Attunity Replicate. You can use this database as the source database for any replication task that you create.

**Note** To determine if you are connected to the database you want to use or if the connection information you entered is correct, click **Test Connection**.

If the connection is successful a message in green is displayed. If the connection fails, an error message is displayed at the bottom of the dialog box.

To view the log entry if the connection fails, click **View Log**. The server log is displayed with the information for the connection failure. Note that this button is not available unless the test connection fails.

## Add the ARC CDC Solution Endpoint to a Task

You can use any ARC CDC Solution that you define as the source in a task. To use an ARC CDC Solution as your source, drag the ARC database from the **Endpoints** pane to your task.

For information on how to create a task, see [Adding a Source and Target Endpoint to a Task](#).

## Setting Advanced Connection Properties

In the **Advanced** tab, you can set advanced properties.

- » **Encryption key name:** Enter name of the encryption key defined in the **User: NAV** tab in ARC.
- » **Encryption key value:** Enter value of the encryption key specified in the **Encryption key name** field above.

**Note** For a detailed explanation of how to encrypt session between Replicate and ARC endpoints, see [Encrypting Communications Between Replicate and ARC Data Sources](#).

- » **Fixed NAT:** Select this to indicate that the connection is made with a fixed network address translation.
- » **Timeout:** Enter the amount of time, in seconds, to wait for interactions before disconnecting. 0 indicates that the system does not timeout. The default value is **0**.
- » **Event wait:** Enter the maximum amount of time (in seconds) to wait for a change event to take place before the system times out. The default value is **300**.
- » **CDC batch size:** Enter the maximum number of change events that can be transferred in a single batch. The default value is **200**.
- » **Bulk batch size:** Enter the unloading batch size. The default value is **100**.
- » **Trace:** Select this to enable tracing for the change processing.

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

# 9 | Adding and Managing Target Endpoints

This chapter describes how to configure target endpoint settings.

## In this chapter:

- [Using Oracle as a Target](#)
- [Using Microsoft SQL Server as a Target](#)
- [Using Microsoft Azure SQL Database as a Target](#)
- [Using SAP Sybase ASE as a Target](#)
- [Using a MySQL-Based Database as a Target](#)
- [Using MemSQL as a Target](#)
- [Using Hadoop as a Target](#)
- [Using Microsoft Azure HDInsight as a Target](#)
- [Using Amazon EMR as a Target](#)
- [Using Teradata Database as a Target](#)
- [Using a PostgreSQL-Based Database as a Target](#)
- [Using a File as a Target](#)
- [Using SAP Sybase IQ as a Target](#)
- [Using SAP HANA as a Target](#)
- [Using Pivotal Greenplum as a Target](#)
- [Using Actian Vector as a Target](#)
- [Using Amazon Redshift as a Target](#)
- [Using Amazon S3 as a Target](#)
- [Using Microsoft Azure ADLS as a Target](#)
- [Using HP Vertica as a Target](#)
- [Using Microsoft APS PDW as a Target](#)
- [Using ODBC to Connect to a Target](#)
- [Using Microsoft Azure SQL Data Warehouse as a Target](#)
- [Using IBM Netezza as a Target](#)
- [Using Kafka as a Target](#)
- [Using MapR Streams as a Target](#)
- [Using Microsoft Azure Event Hubs as a Target](#)
- [Using Amazon Kinesis Data Streams as a Target](#)

# Using Oracle as a Target

This section describes how to set up and use an Oracle database as a target endpoint in a replication task.

**Note** When replicating to an Oracle database with a full disk and/or partition where Oracle is trying to write archived redo log files, insert operations may fail. In such a case, no error will be shown and the task will not progress past the loading stage. To confirm that this is indeed an Oracle Archiver error, stop and attempt to restart the task. The task will not start and an appropriate error should be shown.

## In this section:

[Prerequisites](#)

[Limitations](#)

[Security Requirements](#)

[Oracle Target Data Types](#)

[Setting General Connection Properties](#)

[Setting Advanced Connection Properties](#)

## Prerequisites

Before you can work with an Oracle endpoint, make sure the prerequisites listed in this section have been met.

- » On Windows systems, install Oracle Instant Client for Microsoft Windows (x64) Version 11.2.0.3.0 and above.

**Note** Support for the XMLTYPE data type requires the full Oracle Client.

- » On Linux systems, install Oracle Instant Client for Linux (x86-64) Version 11.2.0.3.0 and above.

**Note** Support for the XMLTYPE data type requires the full Oracle Client.

In addition, if not already included in your system, you need to create a symbolic link in the \$Oracle\_Home\lib directory. This link should be called libclntsh.so, and should point to a specific version of this file.

For example, on an Oracle 12c client:

```
lrwxrwxrwx 1 oracle oracle 63 Oct 2 14:16 libclntsh.so ->
/u01/app/oracle/home/lib/libclntsh.so.12.1
```

Additionally, append the `LD_LIBRARY_PATH` environment variable to the Oracle `lib` directory by copying the driver location to the `site_arep_login.sh` file as follows:

```
echo "export LD_LIBRARY_PATH=$LD_LIBRARY_
PATH:/u01/app/oracle/home/lib/" > site_arep_login.sh
```

## Limitations

The following limitations apply:

- » The Attunity Replicate Oracle database cannot create a new schema on the Oracle database. Therefore, if you are replicating data to an Oracle target and you want to change the schema name, the new schema name must already exist on the Oracle database. If it does not exist, you must create the schema on the database, then you can use that schema name in Attunity Replicate.
- » The **Use direct path full load** option does not support the following:
  - » Tables with INDEXTYPE CONTEXT  
Workaround:  
Use Array Load.
  - » Bidirectional replication
- » In Batch Optimized Apply mode, loading into the net changes table uses Direct Path which does not support XMLType.  
Workaround:  
Use Transactional Apply mode.
- » Attunity Replicate cannot create a new schema on the Oracle database. To replicate to a new schema, the new schema name must already exist on the Oracle target. You can then specify the new schema name in the Task Settings' **Target Metadata** and **Control Tables** tabs as required.

## Security Requirements

A user must have the following privileges granted in the Oracle database to use an Oracle target in an Attunity Replicate task:

**Note** If any of the required privileges cannot be granted to a `V$xxx`, then grant them to the `V_<xxx>`.

- » `SELECT ANY TRANSACTION`
- » `SELECT on V$NLS_PARAMETERS`
- » `SELECT on V$TIMEZONE_NAMES`
- » `SELECT on ALL_INDEXES`
- » `SELECT on ALL_OBJECTS`
- » `SELECT on DBA_OBJECTS`

- » SELECT on ALL\_TABLES
- » SELECT on ALL\_USERS
- » SELECT on ALL\_CATALOG
- » SELECT on ALL\_CONSTRAINTS
- » SELECT on ALL\_CONS\_COLUMNS
- » SELECT on ALL\_TAB\_COLS
- » SELECT on ALL\_IND\_COLUMNS
- » CREATE ANY TABLE
- » DROP ANY TABLE
- » SELECT ANY TABLE
- » INSERT ANY TABLE
- » DELETE ANY TABLE
- » UPDATE ANY TABLE
- » CREATE ANY VIEW
- » DROP ANY VIEW
- » CREATE ANY PROCEDURE
- » ALTER ANY PROCEDURE
- » DROP ANY PROCEDURE
- » CREATE ANY SEQUENCE
- » ALTER ANY SEQUENCE
- » DROP ANY SEQUENCE

You can add the following permissions to use a specific table list:

- » SELECT on <any-replicated-table>
- » ALTER on <any-replicated-table>

The following permission must be granted for logon:

- » CREATE SESSION

The following permission must be granted if you are using a direct path:

- » LOCK ANY TABLE

If the "DROP and CREATE table" or "TRUNCATE before loading" option is selected in the [Full Load Settings](#) tab and the target table schema is different from the Attunity Replicate user, the following permission must be granted:

- » DROP ANY TABLE

To store changes in Change Tables or in an Audit Table when the target table schema is different from the Attunity Replicate user, the following permission must be granted:

- » CREATE ANY INDEX

The Attunity Replicate user must also be granted read permissions for the following DBA tables:

- » SELECT on DBA\_USERS
- » SELECT on DBA\_TAB\_PRIVS
- » SELECT on DBA\_OBJECTS
- » SELECT on DBA\_SYNONYMS
- » SELECT on DBA\_SEQUENCES
- » SELECT on DBA\_TYPES
- » SELECT on DBA\_INDEXES
- » SELECT on DBA\_TABLES
- » SELECT on DBA\_TRIGGERS

## Oracle Target Data Types

The Oracle database for Attunity Replicate supports most Oracle data types. The following table shows the Oracle target data types that are supported when using Attunity Replicate and the default mapping from Attunity Replicate data types.

For information on how to view the data type that is mapped from the source, see the section for the source database you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 9.1 | Supported Oracle Data Types with Mapping from Attunity Replicate Data Types**

Attunity Replicate Data Types	Oracle Data Types
BOOLEAN	<b>NUMBER (1)</b>
BYTES	<b>RAW (length)</b>
DATE	<b>DATETIME</b>
TIME	<b>TIMESTAMP (0)</b>
DATETIME	<b>TIMESTAMP (scale)</b>
INT1	<b>NUMBER (3)</b>
INT2	<b>NUMBER (5)</b>
INT4	<b>NUMBER (10)</b>
INT8	<b>NUMBER (19)</b>
NUMERIC	<b>NUMBER (p,s)</b>
REAL4	<b>BINARY_FLOAT</b>
REAL8	<b>BINARY_DOUBLE</b>
STRING	With date indication: <b>DATE</b>

**Table 9.1 | Supported Oracle Data Types with Mapping from Attunity Replicate Data Types (Cont.)**

Attunity Replicate Data Types	Oracle Data Types
UINT1	With time indication: <b>TIMESTAMP</b>
UINT2	With timestamp indication: <b>TIMESTAMP</b>
UINT4	With timestamp_with_timezone indication: <b>TIMESTAMP WITH TIMEZONE</b>
UINT8	With timestamp_with_local_timezone indication: <b>TIMESTAMP WITH LOCAL TIMEZONE</b>
WSTRING	With interval_year_to_month indication: <b>INTERVAL YEAR TO MONTH</b> with interval_day_to_second indication: <b>INTERVAL DAY TO SECOND</b>
BLOB	If Length > 4000: <b>CLOB</b> In all other cases: <b>VARCHAR2 (Length)</b>
CLOB	<b>NUMBER (3)</b> <b>NUMBER (5)</b> <b>NUMBER (10)</b> <b>NUMBER (19)</b> <b>NVARCHAR2 (length)</b> Note that when length is greater than 2000, the column data type will be <b>NCLOB</b> . <b>BLOB</b> To use this data type with Attunity Replicate, you must enable the use of BLOBS for a specific task. BLOB data types are supported only in tables that include a primary key. For more information, see <b>LOB support</b> in <b>Task Settings/Metadata</b> .
	<b>CLOB</b> To use this data type with Attunity Replicate, you must enable the use of CLOBS for a specific task. During CDC, CLOB data types are supported only in tables that include a primary key.

**Table 9.1 | Supported Oracle Data Types with Mapping from Attunity Replicate Data Types (Cont.)**

Attunity Replicate Data Types	Oracle Data Types
NCLOB	<p>For more information, see <b>LOB support in Task Settings/Metadata</b>.</p> <p><b>NCLOB</b></p> <p>To use this data type with Attunity Replicate, you must enable the use of NCLOBs for a specific task.</p> <p>During CDC, NCLOB data types are supported only in tables that include a primary key.</p> <p>For more information, see <b>LOB support in Task Settings/Metadata</b>.</p>
The XMLTYPE target data type is only relevant in Oracle-to-Oracle replication tasks. See the note below.	<b>XMLTYPE</b>

**Note** When the source database is Oracle, the source data types will be replicated "as is" to the Oracle target. For example, an XMLTYPE data type on the source will be created as an XMLTYPE data type on the target.

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

**Note** The total number of columns per table supported in **Batch optimized apply** mode can be expressed using the following formula:

```
2 * columns_in_original_table + columns_in_primary_key <= 999
```

So, for example, if the original tables has 25 columns and its Primary Key consists of 5 columns, then the total number of columns would be 55. If a table exceeds the supported number of columns, Replicate will apply all of the changes in one-by-one mode.

### To add an Oracle target endpoint to Attunity Replicate:

1. In the Attunity Replicate console, click **Add database** to open the Add Endpoints dialog box. For more information on adding an endpoint to Attunity Replicate, see

### Working with Endpoints.

2. In the **Name** field, type a name for your database. This can be any name that will help to identify the database being used.
3. In the **Description** field, type a description that helps to identify the Oracle database. This is optional.
4. Select **TARGET** as the database **role**.
5. Select **Oracle** as the database **Type**.
6. Type the Oracle **Connection String** for the Oracle database you want to work with. You can type the connect string in any Oracle format, for example:

```
//host:port/service_name
```

Where:

- » **host**: This is the name or IP address for the computer with the Oracle database that you are using. For example, `johnboy_w7` or `255.255.255.0`.
- » **port**: (optional) This is the TNS Listener Port number for the computer with the Oracle database that you are using. If you do not enter a port number the default Oracle TNS Listener port is used.
- » **service name**: (optional) This is the service name for the computer with the Oracle database you are using. If you do not enter a service name the default service name is used.

You can also enter an Oracle Net keyword-value pair. For example:

```
"(DESCRIPTION=(ADDRESS=(PROTOCOL=tcp) (HOST=dlsun242) (PORT=5521))  
(CONNECT_DATA=(SERVICE_NAME=bjava21)))"
```

**Note** This information is case sensitive.

7. Type the Oracle authentication information (**User Name, Password**) for the authorized user for this Oracle database. If you do not know this information, see your Oracle database Administrator (DBA).

To prevent illicit database activity by unauthorized third-parties, Replicate can be configured to automatically replace the user-entered password with a strong random password. For more information, see [Configuring Replicate to Automatically Replace the User-Entered Password](#).

**Important:** Make sure that the Oracle user entered in the Oracle Authentication section has the correct access privileges. For information on how to provide the required privileges, see [Security Requirements](#).

**Note** This information is case sensitive.

**Note** To determine if you are connected to the database you want to use or if the connection information you entered is correct, click **Test Connection**.

If the connection is successful a message in green is displayed. If the connection fails, an error message is displayed at the bottom of the dialog box.

To view the log entry if the connection fails, click **View Log**. The server log is displayed with the information for the connection failure. Note that this button is not available unless the test connection fails.

## Setting Advanced Connection Properties

You can set additional properties in the **Advanced** tab of the Oracle database connection settings.

You can set the following properties:

- » **Use direct path full load:** Select this to use the OCI direct path protocol for bulk loading Oracle tables. This is the default selection.

**Note** Due to an issue with Oracle Direct Path, when this option is selected and **If target table already exists** is set to **Do nothing** in the **Full Load Settings**, the following occurs:

- » The first time the task runs, no error will be issued and rows with the same Primary Key may be added to the target table.
- » The second time the task runs, the setting will take effect.
- » Any subsequent times the task runs, an error will be generated.

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

# Using Microsoft SQL Server as a Target

This section describes how to set up and use a Microsoft SQL Server database as a target in a replication task.

## In this section:

- [Supported Editions](#)
- [Prerequisites](#)
- [Limitations](#)
- [Permissions](#)
- [Microsoft SQL Server Target Data Types](#)
- [Setting General Connection Properties](#)
- [Setting Advanced Connection Properties](#)

## Supported Editions

Attunity Replicate supports the following Microsoft SQL Server editions:

- » Enterprise Edition
- » Standard Edition
- » Workgroup Edition
- » Developer Edition

## Prerequisites

Make sure that the following prerequisites have been met:

- » Client prerequisites:

### Attunity Replicate for Windows:

For all versions of Microsoft SQL Server, Microsoft SQL Server Native Client 11.0 must be installed on the Attunity Replicate Server machine.

### Attunity Replicate for Linux:

You can either work with the Microsoft ODBC Driver or the Simba Microsoft SQL Server ODBC Driver. Instructions for both are provided below.

First, install Microsoft ODBC Driver 13.1 for Linux on the Attunity Replicate Server machine.

**Note** Microsoft ODBC Driver version 13.1.9.0-1 is not supported.

Then, on the Attunity Replicate Server machine, open a Unix shell and perform the following steps:

**Note** The procedure below assumes that you have installed a single default instance of Replicate on Linux (areplicate). If you have [installed multiple instances](#), replace areplicate with the name of the instance running the task with a Microsoft SQL Server target. If several instances are running such as task, the procedure needs to be repeated for each instance.

1. Change the working directory to:

```
cd <product_dir>/bin
```

2. Stop the Replicate service:

```
./areplicate stop
```

3. Optionally, confirm that the service has stopped:

```
./areplicate status
```

4. Copy the driver location to the site\_arep\_login.sh file:

```
echo "export LD_LIBRARY_PATH=$LD_LIBRARY_PATH:/opt/microsoft/msodbcsql/lib64/" >> site_arep_login.sh
```

5. Optionally, confirm that the driver location was copied:

```
cat site_arep_login.sh
```

6. Start the Replicate instance:

```
./areplicate start
```

7. Optionally confirm that the instance has started:

```
./areplicate status
```

**Note** Replicate requires the following ODBC library:

```
libmsodbcsql-13.1.so.0.0
```

If the existing library has a different version number (e.g. libmsodbcsql-13.1.so.0.2), you need to create a symbolic link between the existing library and the required library.

### To check which library version is currently installed

Issue the following command:

```
cd /opt/microsoft/msodbcsql/lib64/
```

### To create a symbolic link

Issue the following command:

```
ln -s <existing_library_name> libmsodbcsql-13.1.so.0.0
```

where <existing\_library\_name> is the name of the currently installed library (e.g. libmsodbcsql-13.1.so.0.2).

- » A Microsoft SQL Server account with the specific access privileges is required. See [Target Permissions](#) for more information.

## Limitations

When using a Microsoft SQL Server database as a target in a Replicate task, The following limitations apply:

- » When **Use BCP for loading tables** is selected in the **Advanced** tab (the default), unlimited LOB columns are not supported in **Batch optimized apply** change processing mode. You can work around this limitation by limiting LOB column size in the task settings, clearing the **Use BCP for loading tables** option or switching to **Transactional apply** mode.
- » When the **Use BCP for loading tables** option is enabled in the **Advanced** tab, triggers are not executed.
- » When Attunity Replicate is installed on Linux, the **Use BCP for loading tables** option in the **Advanced** tab is not supported.
- » Microsoft SQL Server 2012 Target: When the target table is created manually with a computed column, Full Load replication is not supported in BCP mode. Disabling the "Use BCP for loading tables" option in the **Advanced** tab will resolve this issue. For more information on BCP mode, see [Setting Advanced Connection Properties](#).

## Permissions

The following describes the security requirements for using Attunity Replicate with a Microsoft SQL Server target.

The Attunity Replicate user must have at least the `db_owner` user role on the Microsoft SQL Server database you are connecting to.

A Microsoft SQL Server system administrator must provide this permission for all Attunity Replicate users.

## Microsoft SQL Server Target Data Types

The Microsoft SQL Server target for Attunity Replicate supports most Microsoft SQL Server data types. The following table shows the Microsoft SQL Server target data types that are supported when using Attunity Replicate and the default mapping from Attunity Replicate data types.

For information on how to view the data type that is mapped from the source, see the section for the source database you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 9.2 | Microsoft SQL Server Target Data Types with Mapping from Attunity Replicate Data Types**

Attunity Replicate Data Types	Microsoft SQL Server Data Types
BOOLEAN	<b>TINYINT</b>
BYTES	<b>VARBINARY(length)</b>
DATE	For Microsoft SQL Server 2008 and later: <b>DATE</b> For earlier versions: If scale is < or = 3: <b>DATETIME</b> In all other cases: <b>VARCHAR (37)</b>
TIME	For Microsoft SQL Server 2008 and later: <b>DATETIME2 (%d)</b> For earlier versions: If scale is < or = 3: <b>DATETIME</b> In all other cases: <b>VARCHAR (37)</b>
DATETIME	For Microsoft SQL Server 2008 and later: <b>DATETIME2 (scale)</b> For earlier versions: If scale is < or = 3: <b>DATETIME</b> In all other cases: <b>VARCHAR (37)</b>
INT1	<b>SMALLINT</b>
INT2	<b>SMALLINT</b>
INT4	<b>INT</b>
INT8	<b>BIGINT</b>
NUMERIC	<b>NUMERIC (p,s)</b>
REAL4	<b>REAL</b>
REAL8	<b>FLOAT</b>
STRING	If column is date or time then: For Microsoft SQL Server 2008 and later: <b>DATETIME2</b> For earlier versions: If scale is < or = 3: <b>DATETIME</b> In all other cases: <b>VARCHAR (37)</b> If the column is <i>not</i> a date or time:

**Table 9.2 | Microsoft SQL Server Target Data Types with Mapping from Attunity Replicate Data Types (Cont.)**

Attunity Replicate Data Types	Microsoft SQL Server Data Types
	<b>VARCHAR (length)</b>
UINT1	<b>INT2</b>
UINT2	<b>INT4</b>
UINT4	<b>INT8</b>
UINT8	<b>NUMERIC (20)</b>
WSTRING	<b>NVARCHAR (length)</b>
BLOB	<b>VARBINARY (max)</b> <b>IMAGE</b> To use this data type with Attunity Replicate, you must enable the use of BLOBS for a specific task. BLOB data types are supported only in tables that include a primary key. For more information, see <a href="#">LOB support in Task Settings/Metadata</a> .
CLOB	<b>VARCHAR (max)</b> <b>TEXT</b> To use this data type with Attunity Replicate, you must enable the use of CLOBS for a specific task. During CDC, CLOB data types are supported only in tables that include a primary key. For more information, see <a href="#">LOB support in Task Settings/Metadata</a> .
NCLOB	<b>NVARCHAR (max)</b> <b>NTEXT</b> To use this data type with Attunity Replicate, you must enable the use of NCLOBS for a specific task. During CDC, NCLOB data types are supported only in tables that include a primary key. For more information, see <a href="#">LOB support in Task Settings/Metadata</a> .

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see [Setting Advanced Connection](#)

Properties below.

### To add a Microsoft SQL Server target endpoint to Attunity Replicate:

1. In the Attunity Replicate Console, click **Manage Endpoint Connections** to open the **Manage Endpoints Connections** dialog box and then click **New Endpoint Connection**. For more information on adding an endpoint to Attunity Replicate, see [Working with Endpoints](#).
2. In the **Name** field, type a name for your database. This can be any name that will help to identify the database being used.
3. In the **Description** field, type a description that helps to identify the Microsoft SQL Server database. This is optional.
4. Select **TARGET** as the database **role**.
5. Select **Microsoft SQL Server** as the database **Type**.
6. In the **Server name** field, specify the host name or IP address of the computer with the Microsoft SQL Server instance containing the target database.

**Note** To override the default port, add the port to the server name, separated by a comma. For example, if the server name is `myserver.company.local` and the port is `3333`, then the server name should be written like this:

```
myserver.company.local,3333
```

7. Select **Windows authentication** (only relevant when Replicate is installed on Windows) or **SQL Server authentication**.

If you select **Windows authentication**, you will work with the user credentials for the Windows domain. This privilege must be configured in the Microsoft SQL Server database by the system administrator. Note that this option is not relevant when Microsoft SQL Server is running on Linux.

**Note** When using Windows authentication, make sure that the user account that is associated with the Attunity Replicate **Server** service has Network read and write permissions. This must be configured by a Windows system administrator.

See also [Working with Windows Authentication](#).

If you select **SQL Server authentication**, type the Microsoft SQL Server authentication information (User name, Password) for the authorized user for this Microsoft SQL Server database. If you do not know this information, see the Microsoft SQL Server System Administrator.

To prevent illicit database activity by unauthorized third-parties, Replicate can be configured to automatically replace the user-entered password with a strong random password. For more information, see [Configuring Replicate to Automatically Replace the User-Entered Password](#).

**Note** This information is case sensitive.

**Important:** Make sure that the Microsoft SQL Server user has the correct access privileges. For information on how to provide the required privileges, see [Permissions](#).

**Note** To determine if you are connected to the database you want to use or if the connection information you entered is correct, click **Test Connection**.

If the connection is successful a message in green is displayed. If the connection fails, an error message is displayed at the bottom of the dialog box.

To view the log entry if the connection fails, click **View Log**. The server log is displayed with the information for the connection failure. Note that this button is not available unless the test connection fails.

8. Type the **Database name** or click **Browse** and select one from the list of available databases. This is the name of the database from where you are replicating the data.

## Setting Advanced Connection Properties

In the **Advanced** tab, you can set the following properties:

- » **Use BCP for loading tables:** Select this to transfer data for full-load operations using BCP.

**Note**

- » When the target table contains an identity column that does not exist in the source table, you must disable the **Use BCP for loading tables** option.
- » BCP is not supported by when Replicate is installed on Linux.

- » **BCP packet size:** The maximum size of the packets (in bytes) used to transfer data using BCP.
- » **Filegroup for Attunity Replicate internal tables:** Optionally, specify a filegroup for the Attunity Replicate internal tables. When the replication task starts, all of the internal Attunity Replicate [control tables](#) will be created in the specified filegroup.

The following is an example of a command for creating a filegroup:

```
ALTER database replicate  
ADD FILEGROUP Test1FG1;  
GO  
ALTER database replicate  
ADD FILE
```

```
(  
NAME = test1dat5,  
FILENAME = 'C:\temp\DATA\t1dat5.ndf',  
SIZE = 5MB,  
MAXSIZE = 100MB,  
FILEGROWTH = 5MB  
)  
TO FILEGROUP Test1FG1;  
GO
```

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

# Using Microsoft Azure SQL Database as a Target

This section describes how to set up a Microsoft Azure SQL Database as a target in a replication task.

## In this section:

- [Prerequisites](#)
- [Limitations](#)
- [Permissions](#)
- [Microsoft Azure SQL Database Target Data Types](#)
- [Setting General Connection Properties](#)
- [Setting Advanced Connection Properties](#)

## Prerequisites

Make sure that the following prerequisites have been met:

- » Ports:
  - » **When Replicate Server runs on a machine outside Azure** - Open port 1433 for outbound traffic.
  - » **When Replicate Server runs on an AzureVM** - Open the following ports for outbound traffic:
    - » 1433
    - » 11000-11999
    - » 14000-14999
- » Client prerequisites:

### Attunity Replicate for Windows:

For all versions of Microsoft SQL Server, Microsoft SQL Server Native Client 11.0 must be installed on the Attunity Replicate Server machine.

### Attunity Replicate for Linux:

You can either work with the Microsoft ODBC Driver or the Simba Microsoft SQL Server ODBC Driver. Instructions for both are provided below.

First, install Microsoft ODBC Driver 13.1 for Linux on the Attunity Replicate Server machine.

**Note** Microsoft ODBC Driver version 13.1.9.0-1 is not supported.

Then, on the Attunity Replicate Server machine, open a Unix shell and perform the following steps:

**Note** The procedure below assumes that you have installed a single default instance of Replicate on Linux (areplicate). If you have [installed multiple instances](#), replace areplicate with the name of the instance running the task with a Microsoft Azure SQL Database target. If several instances are running such as task, the procedure needs to be repeated for each instance.

1. Change the working directory to:

```
cd <product_dir>/bin
```

2. Stop the Replicate service:

```
./areplicate stop
```

3. Optionally, confirm that the service has stopped:

```
./areplicate status
```

4. Copy the driver location to the site\_arep\_login.sh file:

```
echo "export LD_LIBRARY_PATH=$LD_LIBRARY_PATH:/opt/microsoft/msodbcsql/lib64/" >> site_arep_login.sh
```

5. Optionally, confirm that the driver location was copied:

```
cat site_arep_login.sh
```

6. Start the Replicate instance:

```
./areplicate start
```

7. Optionally confirm that the instance has started:

```
./areplicate status
```

**Note** Replicate requires the following ODBC library:

```
libmsodbcsql-13.1.so.0.0
```

If the existing library has a different version number (e.g. libmsodbcsql-13.1.so.0.2), you need to create a symbolic link between the existing library and the required library.

### To check which library version is currently installed

Issue the following command:

```
cd /opt/microsoft/msodbcsql/lib64/
```

### To create a symbolic link

Issue the following command:

```
ln -s <existing_library_name> libmsodbcsql-13.1.so.0.0
```

where <existing\_library\_name> is the name of the currently installed library (e.g. libmsodbcsql-13.1.so.0.2).

- » A Microsoft Azure SQL Database account with the specific access privileges is required. See [Target Permissions](#) for more information.

## Limitations

When using a Microsoft Azure SQL Database as a target in a Replicate task, The following limitations apply:

- » When **Use BCP for loading tables** is selected in the **Advanced** tab (the default), unlimited LOB columns are not supported in **Batch optimized apply** change processing mode. You can work around this limitation by limiting LOB column size in the task settings, clearing the **Use BCP for loading tables** option or switching to **Transactional apply** mode.
- » When the **Use BCP for loading tables** option is enabled in the **Advanced** tab, triggers are not executed.
- » When Attunity Replicate is installed on Linux, the **Use BCP for loading tables** option in the **Advanced** tab is not supported.

## Permissions

The following describes the security requirements for using Attunity Replicate with a Microsoft Azure SQL Database target.

The Attunity Replicate user (i.e. the user specified in the Microsoft Azure SQL Database endpoint settings) must have at least the `db_owner` user role on the Microsoft Azure SQL Database you are connecting to.

A Microsoft Azure SQL Database system administrator must provide this permission for all Attunity Replicate users.

## Microsoft Azure SQL Database Target Data Types

The Microsoft Azure SQL Database target for Attunity Replicate supports most Microsoft Azure SQL Database data types. The following table shows the Microsoft Azure SQL Database target data types that are supported when using Attunity Replicate and the default mapping from Attunity Replicate data types.

For information on how to view the data type that is mapped from the source, see the section for the source database you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 9.3 | Microsoft Azure SQL Database Target Data Types with Mapping from Attunity Replicate Data Types**

Attunity Replicate Data Types	Microsoft Azure SQL Database Data Types
BOOLEAN	<b>TINYINT</b>
BYTES	<b>VARBINARY(length)</b>
DATE	<b>DATE</b>
TIME	<b>DATETIME2 (%d)</b>
DATETIME	<b>DATETIME2 (scale)</b>
INT1	<b>SMALLINT</b>
INT2	<b>SMALLINT</b>
INT4	<b>INT</b>
INT8	<b>BIGINT</b>
NUMERIC	<b>NUMERIC (p,s)</b>
REAL4	<b>REAL</b>
REAL8	<b>FLOAT</b>
STRING	<b>DATETIME2</b>
UINT1	<b>TINYINT</b>
UINT2	<b>SMALLINT</b>
UINT4	<b>INT</b>
UINT8	<b>BIGINT</b>
WSTRING	<b>NVARCHAR (length)</b>
BLOB	<b>VARBINARY (max)</b> <b>IMAGE</b> To use this data type with Attunity Replicate, you must enable the use of BLOBS for a specific task. BLOB data types are supported only in tables that include a primary key. For more information, see <b>LOB support in Task Settings/Metadata</b> .
CLOB	<b>VARCHAR (max)</b> <b>TEXT</b> To use this data type with Attunity Replicate, you must enable the use of CLOBS for a specific task.

**Table 9.3 | Microsoft Azure SQL Database Target Data Types with Mapping from Attunity Replicate Data Types (Cont.)**

Attunity Replicate Data Types	Microsoft Azure SQL Database Data Types
	<p>During CDC, CLOB data types are supported only in tables that include a primary key.</p> <p>For more information, see <b>LOB support in Task Settings/Metadata</b>.</p>
NCLOB	<p><b>NVARCHAR (max)</b></p> <p><b>NTEXT</b></p> <p>To use this data type with Attunity Replicate, you must enable the use of NCLOBs for a specific task.</p> <p>During CDC, NCLOB data types are supported only in tables that include a primary key.</p> <p>For more information, see <b>LOB support in Task Settings/Metadata</b>.</p>

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

### To add a Microsoft Azure SQL Database target endpoint to Attunity Replicate:

1. In the Attunity Replicate Console, click **Manage Endpoint Connections** to open the **Manage Endpoints Connections** dialog box and then click **New Endpoint Connection**. For more information on adding an endpoint to Attunity Replicate, see [Working with Endpoints](#).
2. In the **Name** field, type a name for your database. This can be any name that will help to identify the database being used.
3. In the **Description** field, type a description that helps to identify the Microsoft Azure SQL Database database. This is optional.
4. Select **TARGET** as the database **role**.
5. Select **Microsoft Azure SQL Database** as the database **Type**.
6. In the **SQL Azure server** field, specify the host name or IP address of the computer with the Microsoft Azure SQL Database instance containing the target database.

**Note** To override the default port, add the port to the server name, separated by a comma. For example, if the server name is `myserver.company.local` and the port is `3333`, then the server name should be written like this:

`myserver.company.local,3333`

7. Enter your user name and password for accessing the database.

**Note** This information is case sensitive.

**Important:** Make sure that the Microsoft Azure SQL Database user has the correct access privileges. For information on how to provide the required privileges, see [Permissions](#).

**Note** To determine if you are connected to the database you want to use or if the connection information you entered is correct, click **Test Connection**.

If the connection is successful a message in green is displayed. If the connection fails, an error message is displayed at the bottom of the dialog box.

To view the log entry if the connection fails, click **View Log**. The server log is displayed with the information for the connection failure. Note that this button is not available unless the test connection fails.

To prevent illicit database activity by unauthorized third-parties, Replicate can be configured to automatically replace the user-entered password with a strong random password. For more information, see [Configuring Replicate to Automatically Replace the User-Entered Password](#).

8. Type the **Database name** or click **Browse** and select one from the list of available databases. This is the name of the database from where you are replicating the data.

## Setting Advanced Connection Properties

In the **Advanced** tab, you can set the following properties:

- » **Use BCP for loading tables:** Select this to transfer data for full-load operations using BCP.

**Note**

- » When the target table contains an identity column that does not exist in the source table, you must disable the **Use BCP for loading tables** option.
- » BCP is not supported by when Replicate is installed on Linux.

- » **BCP packet size:** The maximum size of the packets (in bytes) used to transfer data using BCP.
- » **Filegroup for Attunity Replicate internal tables:** Optionally, specify a filegroup for the Attunity Replicate internal tables. When the replication task starts, all of the internal Attunity Replicate [control tables](#) will be created in the specified filegroup.

The following is an example of a command for creating a filegroup:

```
ALTER database replicate
ADD FILEGROUP Test1FG1;
GO
ALTER database replicate
ADD FILE
(
NAME = test1dat5,
FILENAME = 'C:\temp\DATA\t1dat5.ndf',
SIZE = 5MB,
MAXSIZE = 100MB,
FILEGROWTH = 5MB
)
TO FILEGROUP Test1FG1;
GO
```

- » **Additional ODBC connection properties:** Specify any additional ODBC connection parameters that you want to use.

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

# Using SAP Sybase ASE as a Target

This section describes how to set up and use a SAP Sybase ASE database as the target endpoint in a replication task.

## In this section:

- [Prerequisites](#)
- [Limitations](#)
- [Security Requirements](#)
- [SAP Sybase ASE Database Target Data Types](#)
- [Non-Supported Data Types](#)
- [Setting General Connection Properties](#)
- [Setting Advanced Connection Properties](#)

## Prerequisites

Make sure the following prerequisites have been met:

- » SAP Sybase ASE ODBC 64-bit client installed on the computer where Attunity Replicate is located.
- » SAP Sybase ASE replication enabled for tables using the `sp_setreptable` command or privileges to enable it automatically.
- » RepAgent must be disabled on the SAP Sybase ASE database.
- » When replicating to SAP Sybase ASE 15.7 installed on a Windows machine configured with a non-Latin language (e.g. Chinese), Attunity Replicate requires Sybase 15.7 SP121 to be installed on the SAP Sybase ASE machine.

## Limitations

The following limitations apply:

- » Only one Attunity Replicate task can be run per SAP Sybase ASE database.
- » Attunity Replicate tasks cannot run concurrently with SAP Sybase ASE Replication Server against the same SAP Sybase ASE database.
- » Zero values located at the end of binary data type strings are truncated when replicated to the target database. For example,  
0x00000000000000000000000000000000100000100000000 in the source table will become  
0x000000000000000000000000000000001000001 in the target table.
- » Attunity Replicate creates the target table with columns that do not allow NULL values, if the database default is *not* to allow NULL values. Consequently, if a Full Load or CDC replication task contains empty values, errors will occur.

To prevent this from happening:

- » Right-click the database name and select **Properties** from the context menu.
- » In the **Options** tab, select **Allow nulls by default** and then click **OK**.

## Security Requirements

You must provide SAP Sybase ASE account access to the Attunity Replicate user. This user must have read/write privileges in the SAP Sybase ASE database.

## SAP Sybase ASE Database Target Data Types

The following table shows the SAP Sybase ASE database target data types that are supported when using Attunity Replicate and the default mapping from Attunity Replicate data types.

**Note** SAP Sybase ASE does not support applying changes to binary data types in **Batch optimized apply** mode. For more information on **Batch optimized apply** mode, see [Change Processing Tuning](#).

For information on how to view the data type that is mapped from the source, see the section for the source endpoint you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 9.4 | Supported SAP Sybase ASE Data Types with Mapping from Attunity Replicate Data Types**

Attunity Replicate Data Types	SAP Sybase ASE Data Types
BOOLEAN	BIT
BYTES	VARBINARY (Length)
DATE	DATE
TIME	TIME
DATETIME	If scale is => 0 and = < 6, then: BIGDATETIME If scale is => 7 and = < 9, then: VARCHAR (37)
INT1	TINYINT
INT2	SMALLINT
INT4	INTEGER
INT8	BIGINT

**Table 9.4 | Supported SAP Sybase ASE Data Types with Mapping from Attunity Replicate Data Types (Cont.)**

Attunity Replicate Data Types	SAP Sybase ASE Data Types
NUMERIC	NUMERIC (p,s)
REAL4	REAL
REAL8	DOUBLE PRECISION
STRING	VARCHAR (Length)
UINT1	TINYINT
UINT2	UNSIGNED SMALLINT
UINT4	UNSIGNED INTEGER
UINT8	UNSIGNED BIGINT
WSTRING	VARCHAR (Length)
BLOB	IMAGE
CLOB	UNITEXT
NCLOB	TEXT

## Non-Supported Data Types

Target SAP Sybase ASE tables with columns of the following SAP Sybase ASE data types cannot be replicated. Replicated columns with these data types will show as null.

» UDT

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

### To add a SAP Sybase ASE target endpoint to Attunity Replicate:

1. In the Attunity Replicate Console, click **Manage Endpoint Connections** to open the **Manage Endpoints Connections** dialog box. Then click the **New Endpoint Connection** button. For more information on adding an endpoint to Attunity Replicate, see [Working with Endpoints](#).
2. In the **Name** field, type a name for your database. This can be any name that will help to identify the database being used.
3. In the **Description** field, type a description that helps to identify the SAP Sybase ASE database. This is optional.
4. Select **TARGET** as the database **role**.
5. Select **SAP Sybase ASE** as the database **Type**.

6. In the **Server Name** field, enter the host name or IP address of the computer on which the SAP Sybase ASE database is installed.

**Note** Consider the following:

- » This information is case sensitive.
- » You can use the **Advanced** tab to add specific properties and create a custom connect string. In this case, you do not need to enter information in this tab. For more information on using the **Advanced** tab, see [Setting Advanced Connection Properties](#).
- » To determine if you are connected to the database you want to use or if the connection information you entered is correct, click **Test Connection**. If the connection is successful a message in green is displayed. If the connection fails, an error message is displayed at the bottom of the dialog box.  
To view the log entry if the connection fails, click **View Log**. The server log is displayed with the information for the connection failure. Note that this button is not available unless the test connection fails.

7. Optionally, change the default port (5000).
8. Type the SAP Sybase ASE authentication information (**User Name**, **Password**) for the authorized user for this SAP Sybase ASE database. If you do not know this information, see your SAP Sybase ASE database Administrator (DBA).

**Note** Consider the following:

- » This information is case sensitive.
- » This information is required. If you are using the **Advanced** tab to create a custom string, make sure to include the **User Name** and **Password** properties. See [Setting Advanced Connection Properties](#) for more information.
- » If you want to set custom properties for this database, see [Setting Advanced Connection Properties](#).

**Important:** Make sure that the SAP Sybase ASE user entered in the SAP Sybase ASE Authentication section has the correct access privileges. For information on how to provide the required privileges, see [Security Requirements](#).

9. In the **Database name** field, enter the SAP Sybase ASE database name.

## Setting Advanced Connection Properties

In the **Advanced** tab, you can set advanced properties.

- » **Additional ODBC connection properties:** Specify any additional ODBC connection parameters that you want to use.

**Note** If the user name or password specified in the **General** tab contains non-Latin characters (e.g. Chinese), the following property is required:

```
charset=gb18030
```

### Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

#### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

### Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

# Using a MySQL-Based Database as a Target

This section describes how to set up and use a MySQL target endpoint in a replication task.

You need to configure a MySQL endpoint when replicating to any of the following databases:

- » MySQL
- » Microsoft Azure Database for MySQL
- » MariaDB
- » Google Cloud for MySQL
- » Amazon Aurora (MySQL)
- » Amazon RDS for MariaDB
- » Amazon RDS for MySQL

## In this section:

[Prerequisites](#)

[Limitations](#)

[Security Requirements](#)

[Supported Data Types](#)

[Setting General Connection Properties](#)

[Setting Advanced Connection Properties](#)

## Prerequisites

Make sure that the prerequisites described in this section have been met.

In this section:

- » [General Prerequisites](#)
- » [Attunity Replicate Server for Windows](#)
- » [Attunity Replicate Server for Linux](#)

## General Prerequisites

The following is required:

- » A MySQL account with the required [Security Requirements](#).
- » A MySQL database with the tables that you want to replicate should be accessible in your network.

The following MySQL editions are supported:

- » MySQL Community Edition
- » MySQL Standard Edition

- » MySQL Enterprise Edition
- » MySQL Cluster Carrier Grade Edition

## Limitations

The following limitations apply:

- » When only the LOB column in the source table is updated, Replicate will not update the corresponding target LOB column. The target LOB column will only be updated if at least one other column is also updated in the same transaction.
- » Due to the way MySQL operates, when loading data to a MySQL target during a Full Load task, duplicate key errors will not be reported to the logs.
- » When updating a column's value to its existing value, a zero rows affected is returned from MySQL (unlike Oracle and Microsoft SQL Server that perform an update of one row). This generates an entry in the `attrep_apply_exceptions` control table and the following warning:

Some changes from the source database had no impact when applied to the target database. See `attrep_apply_exceptions` table for details.

## Security Requirements

You must provide MySQL account access to the Attunity Replicate user. This user must have read/write privileges in the MySQL database.

## Supported Data Types

The following table shows the MySQL database target data types that are supported when using Attunity Replicate and the default mapping from Attunity Replicate data types.

For information on how to view the data type that is mapped from the source, see the section for the source endpoint you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 9.5 | Supported MySQL Data Types with Mapping from Attunity Replicate Data Types**

Attunity Replicate Data Types	MySQL Data Types
BOOL	BOOL
BYTES	If length is => 1 and =< 8095, then: VARBINARY (Length) If length is => 8096 and =< 65535, then: BLOB If length is => 65536 and =< 16777215, then:

**Table 9.5 | Supported MySQL Data Types with Mapping from Attunity Replicate Data Types (Cont.)**

Attunity Replicate Data Types	MySQL Data Types
	MEDIUMBLOB
	If length is => 16777216 and = < 2147483647, then: LONGLOB
DATE	DATE
TIME	TIME
DATETIME	If scale is => 0 and = < 6, then: DATETIME (Scale) If scale is => 7 and = < 9, then: VARCHAR (37)
INT1	TINYINT
INT2	SMALLINT
INT4	INTEGER
INT8	BIGINT
NUMERIC	If scale is => 0 and = < 30, then: DATETIME (p,s) If scale is => 31 and = < 100, then: VARCHAR (45)
REAL4	FLOAT
REAL8	DOUBLE
STRING	If length is => 1 and = < 8095, then: VARCHAR (Length) If length is => 8096 and = < 65535, then: TEXT If length is => 65536 and = < 16777215, then: MEDIUMTEXT If length is => 16777216 and = < 2147483647, then: LONGTEXT
UINT1	UNSIGNED TINYINT
UINT2	UNSIGNED SMALLINT
UINT4	UNSIGNED INTEGER
UINT8	UNSIGNED BIGINT

**Table 9.5 | Supported MySQL Data Types with Mapping from Attunity Replicate Data Types (Cont.)**

Attunity Replicate Data Types	MySQL Data Types
WSTRING	If length is => 1 and =< 8095, then: VARCHAR (Length) If length is => 8096 and =< 65535, then: TEXT If length is => 65536 and =< 16777215, then: MEDIUMTEXT If length is => 16777216 and =< 2147483647, then: LONGTEXT
BLOB	If length is => 1 and =< 65535, then: BLOB If length is => 65536 and =< 2147483647, then: LONGBLOB If length is => 0 and =< 0, then: LONGBLOB (Full Lob Support)
NCLOB	If length is => 1 and =< 65535, then: TEXT If length is => 65536 and =< 2147483647, then: LONGTEXT - CHARACTER SET: ucs2 If length is => 0 and =< 0, then: LONGTEXT - CHARACTER SET: ucs2 (Full Lob Support)
CLOB	If length is => 1 and =< 65535, then: TEXT If length is => 65536 and =< 2147483647, then: LONGTEXT If length is => 0 and =< 0, then: LONGTEXT (Full Lob Support)

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

## To add a MySQL target endpoint to Attunity Replicate:

1. In the Attunity Replicate Console, click **Manage Endpoint Connections** to open the **Manage EndpointsConnections** dialog box. Then click the **New Endpoint Connection** button. For more information on adding an endpoint to Attunity Replicate, see [Working with Endpoints](#).
2. In the **Name** field, type a name for your database. This can be any name that will help to identify the database being used.
3. In the **Description** field, type a description that helps to identify the MySQL database. This is optional.
4. Select **TARGET** as the database **role**.
5. From the **Type** drop-down list, select one of the following:
  - » For MySQL, MariaDB, Amazon Aurora (MySQL), Amazon RDS for MariaDB, and Amazon RDS for MySQL, select **MySQL**.
  - » For Google Cloud for MySQL, select **Google Cloud for MySQL**.
  - » For Microsoft Azure Database for MySQL, select **Microsoft Azure Database for MySQL**.
6. In the **Server** field, enter the host name or IP address of the computer on which the MySQL database is installed.

### Notes

- » This information is case sensitive.
- » To determine if you are connected to the database you want to use or if the connection information you entered is correct, click **Test Connection**.  
If the connection is successful a message in green is displayed. If the connection fails, an error message is displayed at the bottom of the dialog box.  
To view the log entry if the connection fails, click **View Log**. The server log is displayed with the information for the connection failure. Note that this button is not available unless the test connection fails.

7. Optionally, change the default port (3306).
8. Type the MySQL authentication information (**User Name**, **Password**) for the authorized user for this MySQL database. If you do not know this information, see your MySQL database Administrator (DBA).
9. Select one of the following **Load source schemas into** options:
  - » **The following database** - When this option is selected, all source schemas will be loaded into the selected database.
  - » **Multiple endpoints** - When this option is selected, each of the source schemas will be loaded into its corresponding database.

## Setting Advanced Connection Properties

In the **Advanced** tab, you can set advanced properties.

- » **Max file size (KB)**: Select or type the maximum size (in KB) of a CSV file before it is loaded into the MySQL target database. The default value is 32000 KB.
- » **Use parallel loading**: Select this option to improve performance when loading data into the MySQL target database.
  - » **Use the following number of threads**: Specify how many threads to use to load the data into the MySQL target database. Note that setting a large number of threads may have an adverse effect on database performance since a separate connection is required for each thread.

**Note** Attunity Replicate assumes that MySQL Client 5.2.6 to 5.3.x for Linux or MySQL ODBC Client 5.2.6 to 5.3.x 64-bit for Windows is installed on the Attunity Replicate Server machine. If a version later than 5.3.x is installed, you need to specify the version number as an internal parameter where `driver` is the **Parameter** and `MySQL ODBC <version> Unicode Driver` is the **Value** (where `<version>` is the client version e.g. 5.4).

For instructions on setting internal parameters, see [Internal Parameters](#) below.

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

# Using MemSQL as a Target

This section describes how to set up and use a MemSQL target endpoint in a replication task.

## In this section:

[Prerequisites](#)

[Limitations](#)

[Security Requirements](#)

[Supported Data Types](#)

[Setting General Connection Properties](#)

[Setting Advanced Connection Properties](#)

## Prerequisites

Make sure that the prerequisites described in this section have been met.

### In this section:

- » [Attunity Replicate Server for Windows](#)
- » [Attunity Replicate Server for Linux](#)

### Attunity Replicate Server for Windows

To be able to work with Attunity Replicate for Windows and MemSQL as a target endpoint in an Attunity Replicate task, you need to install MySQL ODBC 64-bit client version 5.2.6 or later on the same computer as Attunity Replicate.

### Attunity Replicate Server for Linux

To be able to work with Attunity Replicate for Linux and MemSQL as a target endpoint in a Replicate task, you need to:

- » Install MySQL Connector/ODBC for Linux, version 5.2.6 or later, on the Attunity Replicate machine.
- » Make sure that the `/etc/odbcinst.ini` file contains an entry for MySQL, as in the following example:

```
[MySQL ODBC 5.2.6 Unicode Driver]
Driver = /usr/lib64/libmyodbc5w.so
UsageCount = 1
```

## Limitations

When replicating to a MemSQL target, the following limitations apply:

- » When only the LOB column in the source table is updated, Replicate will not update the corresponding target LOB column. The target LOB column will only be updated if at least one other column is also updated in the same transaction.
- » Due to the way MemSQL operates, when loading data to a MemSQL target during a Full Load task, duplicate key errors will not be reported to the logs.
- » When updating a column's value to its existing value, a zero rows affected is returned from MemSQL (unlike Oracle and Microsoft SQL Server, for example, that perform an update of one row). This generates an entry in the `attrep_apply_exceptions` control table and the following warning:

Some changes from the source database had no impact when applied to the target database. See `attrep_apply_exceptions` table for details.

## Security Requirements

You must provide MemSQL account access to the Attunity Replicate user. This user must have read/write privileges in the MemSQL database.

## Supported Data Types

The following table shows the MemSQL database target data types that are supported when using Attunity Replicate and the default mapping from Attunity Replicate data types.

For information on how to view the data type that is mapped from the source, see the section for the source endpoint you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 9.6 | Supported MemSQL Data Types with Mapping from Attunity Replicate Data Types**

Attunity Replicate Data Types	MemSQL Data Types
BOOL	BOOL
BYTES	If length is => 1 and =< 8095, then: VARBINARY (Length) If length is => 8096 and =< 65535, then: BLOB If length is => 65536 and =< 16777215, then: MEDIUMBLOB If length is => 16777216 and =< 2147483647, then: LONGLOB

**Table 9.6 | Supported MemSQL Data Types with Mapping from Attunity Replicate Data Types (Cont.)**

Attunity Replicate Data Types	MemSQL Data Types
DATE	DATE
TIME	TIME
DATETIME	If scale is => 0 and =< 6, then: DATETIME (Scale) If scale is => 7 and =< 9, then: VARCHAR (37)
INT1	TINYINT
INT2	SMALLINT
INT4	INTEGER
INT8	BIGINT
NUMERIC	If scale is => 0 and =< 30, then: DATETIME (p,s) If scale is => 31 and =< 100, then: VARCHAR (45)
REAL4	FLOAT
REAL8	DOUBLE
STRING	If length is => 1 and =< 8095, then: VARCHAR (Length) If length is => 8096 and =< 65535, then: TEXT If length is => 65536 and =< 16777215, then: MEDIUMTEXT If length is => 16777216 and =< 2147483647, then: LONGTEXT
UINT1	UNSIGNED TINYINT
UINT2	UNSIGNED SMALLINT
UINT4	UNSIGNED INTEGER
UINT8	UNSIGNED BIGINT
WSTRING	If length is => 1 and =< 8095, then: VARCHAR (Length) If length is => 8096 and =< 65535, then:

**Table 9.6 | Supported MemSQL Data Types with Mapping from Attunity Replicate Data Types (Cont.)**

Attunity Replicate Data Types	MemSQL Data Types
	TEXT
	If length is => 65536 and =< 16777215, then:
	MEDIUMTEXT
	If length is => 16777216 and =< 2147483647, then:
	LONGTEXT
BLOB	If length is => 1 and =< 65535, then:
	BLOB
	If length is => 65536 and =< 2147483647, then:
	LONGBLOB
	If length is => 0 and =< 0, then:
	LONGBLOB (Full Lob Support)
NCLOB	If length is => 1 and =< 65535, then:
	TEXT
	If length is => 65536 and =< 2147483647, then:
	LONGTEXT - CHARACTER SET: ucs2
	If length is => 0 and =< 0, then:
	LONGTEXT - CHARACTER SET: ucs2 (Full Lob Support)
CLOB	If length is => 1 and =< 65535, then:
	TEXT
	If length is => 65536 and =< 2147483647, then:
	LONGTEXT
	If length is => 0 and =< 0, then:
	LONGTEXT (Full Lob Support)

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

### To add a MemSQL target endpoint to Attunity Replicate:

1. In the Attunity Replicate Console, click **Manage Endpoint Connections** to open the **Manage EndpointsConnections** dialog box. Then click the **New Endpoint Connection** button. For more information on adding an endpoint to Attunity Replicate,

see [Working with Endpoints](#).

2. In the **Name** field, type a name for your database. This can be any name that will help to identify the database being used.
3. In the **Description** field, type a description that helps to identify the MemSQL database. This is optional.
4. Select **TARGET** as the database **role**.
5. From the **Type** drop-down list, select MemSQL.
6. In the **Server** field, enter the host name or IP address of the computer on which the MemSQL database is installed.

#### Notes

- » This information is case sensitive.
- » To determine if you are connected to the database you want to use or if the connection information you entered is correct, click **Test Connection**.  
If the connection is successful a message in green is displayed. If the connection fails, an error message is displayed at the bottom of the dialog box.  
To view the log entry if the connection fails, click **View Log**. The server log is displayed with the information for the connection failure. Note that this button is not available unless the test connection fails.

7. Optionally, change the default port (3306).
8. Enter the **Username** and **Password** of a user authorized to access the MemSQL database specified below. If you do not know this information, see your MemSQL database Administrator (DBA).
9. In the **Database** field, specify the target MemSQL database.

## Setting Advanced Connection Properties

In the **Advanced** tab, you can set advanced properties.

**Max file size (KB):** Select or type the maximum size (in KB) of a CSV file before it is loaded into the MemSQL target database. The default value is 32000 KB.

### Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

#### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.

3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

# Using Hadoop as a Target

This section describes how to set up and use Hadoop as the target endpoint in a replication task.

## In this section:

[Prerequisites](#)

[Limitations](#)

[Change Data Partitioning on Hadoop](#)

[Security Requirements](#)

[Hadoop Endpoint Target Data Types](#)

[Setting General Connection Properties](#)

[Setting Advanced Connection Properties](#)

[Using Kerberos Authentication](#)

## Prerequisites

Before you begin to work with a Hadoop cluster as a target in Attunity Replicate, make sure that the following prerequisites have been met:

» **General:**

- » The Hadoop WebHDFS must be accessible from the Attunity Replicate machine.
- » The Hadoop Data Nodes must be accessible from the Attunity Replicate machine.
- » The Hadoop WebHDFS service must be running.

» **ODBC Access:**

When accessing Hive using ODBC, the following ODBC drivers are supported:

- » **Hortonworks:** ODBC driver 2.1.2 (which is actually 2.1.02) and above
- » **Cloudera:** ODBC driver 2.5.19 and above

**Note** Cloudera ODBC drivers 2.5.20 and above do not support the [Snappy](#) compression method.

- » **MapR:** ODBC driver 2.1.8 and above
- » **Amazon EMR:** Amazon Hive ODBC driver 1.1.1.1001
- » **SSL:** Before you can use SSL, you first need to perform the following tasks:
  - » Configure each NameNode and each DataNode with an SSL certificate (issued by the same CA).
  - » Place the CA certificate on the Replicate Server machine. The certificate should be a base64-encoded PEM (OpenSSL) file.

- » **Permissions:** The user specified in the Hadoop target settings must have write permission for the specified HDFS target directory.

## Prerequisites for using the Cloudera Distribution as a Hadoop Target

If you are replicating to a Cloudera Hadoop Distribution and you want to use **Snappy** compression and/or set a **File Format** that is **not** Text, you first need to install Cloudera's Hive ODBC driver on the Replicate Server machine. Then configure the Hadoop target endpoint to access Hive using ODBC. For more information on this setting, see [Setting General Connection Properties](#)

See also [Prerequisites for using a Linux ODBC Driver](#).

## Prerequisites for using Amazon EMR as a Hadoop Target

- » Install the [Amazon Hive ODBC driver](#) on the Replicate Server machine.
- » Configure the Hadoop target endpoint to access Hive using ODBC. For more information on this setting, see [Setting General Connection Properties](#)
- » Add the Names and Public IP addresses of the EMR cluster nodes to the hosts file on the Replicate Server machine. This is necessary because the names of the EMR cluster nodes are internal to AWS.

## Prerequisites for using a Linux ODBC Driver

To use a Linux ODBC driver, make sure to:

- » Install the latest 64-bit ODBC driver for your Hadoop distribution on the Replicate Server machine.
- » *After the driver is installed:* Edit the <distribution>.hiveodbc.ini file as follows:
  - » DriverManagerEncoding=UTF-16
  - » ODBCInstLib=libodbcinst.so

See also [Setting General Connection Properties](#).

## Limitations

The following limitations apply:

- » UPDATE/DELETE DMLs are not supported during change processing. If an UPDATE/DELETE DML was captured on the source, it will be ignored on the target and a warning will be written to the log. If the **Store Changes** option is enabled in the task settings, these records will be written to the Change Table.
- » Limited LOB support only.
- » Dropping columns and changing column data types are not supported.
- » Due to a Hive limitation, in Hive version 0.12 and earlier versions, only alphanumeric and underscore characters are allowed in table and column names. From Hive 0.13, column names can contain any Unicode character.
- » When loading data into partitioned tables, the following limitations apply:

- » The Apply Changes replication option is not supported.
- » Data can only be loaded into tables with existing partitions.
- » The **Drop and Create table** option in the task settings' [Full Load Settings](#) tab should not be selected.  
See also [Support for Partitions, Buckets and Skews](#).
- » The following Control Tables are not supported as they require UPDATE/DELETE operations (which are not supported by the Hadoop target endpoint):
  - » **Replication Status** (requires UPDATE).  
Name on target: attrep\_status
  - » **Suspended Tables** (requires DELETE).  
Name on target: attrep\_suspended\_tables  
For more information on Control Tables, see [Control Tables](#).
- » Primary keys are not supported on Hive versions prior to 2.1. From Hive 2.1, primary keys are supported when accessing Hive using ODBC only.

## Change Data Partitioning on Hadoop

When [Change Data Partitioning](#) is enabled, the Replicate Change Tables in Hive are partitioned by the `partition_name` column. Data files are uploaded to the storage (Blob/ADLS), according to the [maximum size and time definition](#), and then stored in a directory under the Change Table directory. Whenever the specified partition timeframe ends, a partition is created in Hive, pointing to the HDFS directory.

Information about the partitions is written to the [attrep\\_cdc\\_partitions](#) Control Table.

### Prerequisites

The prerequisites for using Change Data Partitioning with a Hadoop target endpoint are as follows:

- » The target file format must be set to Text or Sequence
- » Hive access must be set to ODBC

## Security Requirements

The Hadoop NameNode (and data nodes when using WebHDFS) must be accessible from the Attunity Replicate machine and the user specified in the Hadoop target settings must have write permission for the specified HDFS target directory.

## Hadoop Endpoint Target Data Types

The following table shows the Hadoop endpoint target data types that are supported when using Attunity Replicate and the default mapping from Attunity Replicate data types.

For information on how to view the data type that is mapped from the source, see the section for the source endpoint you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 9.7 | Supported Hadoop Data Types with Mapping from Attunity Replicate Data Types**

Attunity Replicate Data Types	Hadoop Data Types
BOOL	BOOLEAN
BYTES	STRING
TIME	TIMESTAMP
DATETIME	TIMESTAMP
DATE	DATE
<b>Note</b> When Avro is selected as the <a href="#">Target storage format</a> , the TIMESTAMP and DATE data types (which are not supported by Avro) are mapped to VARCHAR(37).	
INT1	TINYINT
INT2	SMALLINT
INT4	INT
INT8	BIGINT
NUMERIC	Hive 0.13 and above: DECIMAL (p,s) Hive 0.12 and below: DECIMAL
REAL4	FLOAT
REAL8	DOUBLE
STRING	Hive 0.13 and above: VARCHAR (Length) Hive 0.12 and below: STRING
UINT1	SMALLINT
UINT2	INT
UINT4	BIGINT
UINT8	Hive 0.13 and above: DECIMAL (20,0) Hive 0.12 and below:

**Table 9.7 | Supported Hadoop Data Types with Mapping from Attunity Replicate Data Types (Cont.)**

Attunity Replicate Data Types	Hadoop Data Types
	DECIMAL
WSTRING	Hive 0.13 and above: VARCHAR (Length) Hive 0.12 and below: STRING
BLOB	STRING
NCLOB	STRING
CLOB	STRING

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

**Support for Partitions, Buckets and Skews** To load data into tables with partitions, buckets or skews, you first need to perform the procedure described below.

### To load data into tables with partitions, buckets or skews:

1. Create the tables in Hive with these attributes (partitions, buckets or skews) *prior to* running the task.
2. Add the following values to the

`hive.security.authorization.sqlstd.confwhitelist.append` property in the Hive configuration file:

If the target tables are partitioned:

`|hive.exec.dynamic.partition|hive.exec.dynamic.partition.mode`

If the target tables have buckets:

`|hive.enforce.bucketing`

If the target tables have skews:

`|hive.mapred.supports.subdirectories`

**Note** In some Hadoop Distributions, you may need to specify the value without the "hive" prefix.

For example, `|enforce.bucketing` instead of `|hive.enforce.bucketing`.

**Note** If the value(s) already exist in the `hive.security.authorization.sqlstd.confwhitelist` property, you do not need to add them to the `hive.security.authorization.sqlstd.confwhitelist.append` property.

3. Set the **Target Table Preparation** task setting to **Truncate before loading** or **Do nothing**. For more information on this setting, see [Full Load Settings](#).

#### To add a Hadoop target endpoint to Attunity Replicate:

1. In the Attunity Replicate console, click **Manage Endpoint Connections** to open the **Manage Endpoint Connections** dialog box.  
For more information on adding an endpoint to Attunity Replicate, see [Working with Endpoints](#).
2. In the **Name** field, type a name for your endpoint. This can be any name that will help to identify the endpoint being used.
3. In the **Description** field, type a description that helps to identify the Hadoop endpoint. This is optional.
4. Select **Hadoop** as the endpoint **Type**.
5. In the **Hadoop NameNode** field, enter the host name or IP address of the Hadoop NameNode machine.

**Note** Consider the following:

- » This information is case sensitive.
- » To determine if you are connected to the endpoint you want to use or if the connection information you entered is correct, click **Test Connection**.  
If the connection is successful, a confirmation message is displayed. If the connection fails, an error is displayed at the bottom of the dialog box.  
To view the log entry if the connection fails, click **View Log**. The server log is displayed with the information for the connection failure. Note that this button is not available unless the test connection fails.

6. In the **Security** section, do the following:
  - a. To encrypt the data between the Replicate machine and HDFS, select **Use SSL**. In order to use SSL, first make sure that the [SSL prerequisites](#) described in [Prerequisites](#) been met.  
In the **CA path** field, either specify the directory containing the CA certificate.  
-OR-  
Specify the full path to a specific CA certificate.
  - b. Select one of the following authentication types:

- » **User name** - Select to connect to the Hadoop cluster with only a user name. Then, in the **User name** field, specify the name of a user authorized to access the Hadoop cluster.
- » **Kerberos** - Select to authenticate against the Hadoop cluster using Kerberos. Replicate automatically detects whether Attunity Replicate Server is running on Linux or on Windows and displays the appropriate settings.

**Note** In order to use Kerberos authentication on Linux, the Kerberos client (workstation) package should be installed.

#### Attunity Replicate Server on Linux:

When Attunity Replicate Server is running on Linux, select either **Ticket** or **Keytab** from the **Kerberos options** drop-down list.

If you selected **Ticket**, select one of the following options:

- » **Use global Kerberos ticket file** - Select this option if you want to use the same ticket for several Hadoop endpoints (source or target). In this case, you must make sure to select this option for each Hadoop endpoint instance that you define.
- » **Use specific Kerberos ticket file** - Select this option if you want to use a different ticket file for each Hadoop endpoint (source or target). Then specify the ticket file name in the designated field.

This option is especially useful if you need to perform a task-level audit of Replicate activity (using a third-party tool) on the Hadoop NameNode. To set this up, define several instances of the same Hadoop endpoint and specify a unique Kerberos ticket file for each instance. Then, for each task, simply select a different Hadoop endpoint instance.

**Note** You need to define a global Kerberos ticket file even if you select the **Use specific Kerberos ticket file** option. The global Kerberos ticket file is used for authentication when selecting a Hive endpoint, when testing the connection (using the **Test Connection** button), and when selecting which tables to replicate.

**Note** When replicating from a Hadoop source endpoint to a Hadoop target endpoint, both endpoints must be configured to use the same ticket file.

For additional steps required to complete setup for Kerberos ticket-based authentication, see [Using Kerberos Authentication](#).

If you selected **Keytab**, provide the following information:

- » **Realm:** The name of the realm in which your Hadoop cluster resides. For example, if the full principal name is john.doe@EXAMPLE.COM, then EXAMPLE.COM is the realm.
- » **Principal:** The user name to use for authentication. The principal must be a member of the realm entered above. For example, if the full principal name is john.doe@EXAMPLE.COM, then john.doe is the principal.
- » **Keytab file:** The full path of the Keytab file. The Keytab file should contain the key of the **Principal** specified above.

#### Attunity Replicate Server on Windows:

When Attunity Replicate Server is running on Windows, select one of the following:

- » **Use the following KDC:** Select **Active Directory** (default) if your KDC is Microsoft Active Directory or select **MIT** if your KDC is MIT KDC running on Linux/UNIX.

**Note** When the Replicate KDC and the Hadoop KDC are in different domains, a relationship of trust must exist between the two domains.

- » **Realm:** The name of the realm/domain in which your Hadoop cluster resides (where *realm* is the MIT term while *domain* is the Active Directory term).
- » **Principal:** The user name to use for authentication. The principal must be a member of the realm/domain entered above.
- » When **Active Directory** is selected - **Password:** The password for the principal entered above.
- » When **MIT** is selected - **Keytab file:** The keytab file containing the principal entered above.

**Note** When replicating from a Hadoop source endpoint to a Hadoop target endpoint, both endpoints must be configured to use the same parameters (KDC, realm, principal, and password).

If you are unsure about any of the above, consult your IT/security administrator.

For additional steps required to complete setup for Kerberos authentication, see [Using Kerberos Authentication](#).

- » **User name and password** - Select to connect to the Hadoop NameNode or to the Knox Gateway (when enabled - see below) with a user name and

password. Then, in the **User name** and **Password** fields, specify the required user name and password.

**Note** Consider the following:

- » A user name and password is required to access the MapR Control System.
- » This information is case sensitive.

**Important:** Make sure that the specified user has the required Hadoop access privileges. For information on how to provide the required privileges, see [Security Requirements](#).

7. If you need to access the Hortonworks Hadoop distribution through a Knox Gateway, select **Use Knox Gateway**. Then provide values for the following fields:

**Note** To be able to select this option, first select **Use SSL** and then select **Password** from the **Authentication type** drop-down list.

- » **Knox Gateway host** - The FQDN (Fully Qualified Domain Name) of the Knox Gateway host.
- » **Knox port** - The port number to use to access the host. The default is "8443".
- » **Knox Gateway path** - The context path for the gateway. The default is "gateway".

**Note** The port and path values are set in the **gateway-site.xml** file. If you are unsure whether the default values have been changed, contact your IT department.

- » **Cluster name** - The cluster name as configured in Knox. The default is "Default".
8. In the **HDFS section**, select **WebHDFS**, **HttpFS** or **NFS** as the HDFS access method. If you are accessing MapR, it is recommended to use HttpFS.

**Note** When the **Use Knox Gateway** option is selected, the **NameNode**, **HttpFS Host**, and **Port** fields described below are not relevant (and are therefore hidden).

» If you selected **WebHDFS**:

- » In the **NameNode** field, specify the IP address of the NameNode.

**Note** This is the Active node when High Availability is enabled (see below).

- » Replicate supports replication to an HDFS High Availability cluster. In such a configuration, Replicate communicates with the Active node, but switches to the Standby node in the event of failover. To enable this feature, select the **High Availability** check box. Then, specify the FQDN (Fully Qualified Domain Name) of the Standby NameNode in the **Standby NameNode** field.
- » In the **Port** field, optionally change the default port (50070).
- » In the **Target Folder** field, specify where to create the data files on HDFS.
- » If you selected **HttpFS**:
  - » In the **HttpFS Host** field, specify the IP address of the HttpFS host.
  - » In the **Port** field, optionally change the default port (14000).
  - » In the **Target Folder** field, specify where to create the data files on HDFS.
- » If you selected **NFS**:
  - » In the **Target folder** field, enter the path to the folder located under the MapR cluster mount point. For example: /mapr/my.cluster.com/data
  - » In order to do this, you first need to mount the MapR cluster using NFS. For information on how to do this, refer to the MapR help.

**Note** Due to a Hadoop limitation, the **Target folder** name can only contain ASCII characters.

9. In the **Hive Access section**, do the following:

- a. From the **Access Hive using** drop-down list, select one of the following options:

**Note** When the **Use Knox Gateway** option is selected, the **Host** and **Port** fields described below are not relevant (and are therefore hidden).

- » **ODBC** - Select this option to access Hive using an ODBC driver (the default). Then continue with the [Host field](#).

**Note** If you select this option, make sure that the latest 64-bit ODBC driver for your Hadoop distribution is installed on the Attunity Replicate Server machine.

- » **HQL scripts** - When this option is selected, Replicate will generate HQL

table creation scripts in the specified **Script folder**.

**Note** When this option is selected, the [target storage format](#) must be set to "Text".

- » **No Access** - When this option is selected, after the data files are created on HDFS, Replicate will take no further action.
- b. In the **Host** field, specify the IP address of the Hive machine.
- c. In the **Port** field, optionally change the default port.
- d. In the **Database** field, specify the name of the Hive target database.

## Setting Advanced Connection Properties

The table below describes the settings in the **Advanced** tab.

**Table 9.8 | Hadoop Target - Advanced Properties**

Setting	Description
<b>File Format</b>	<b>Expand this section to specify or view the file format settings.</b>
Target storage format	<p>Select one of the following target storage formats: Text (the default), Avro, ORC, Parquet, Sequence.</p> <p><b>Note</b> If <b>Avro</b>, <b>ORC</b> or <b>Parquet</b> is selected or if the target tables have skews/buckets, Replicate first converts the source data to a temporary sequence file and then runs a Hive process to convert the sequence file to the desired target format.</p> <p><b>Note</b> Unlike other binary formats that need to be converted to the desired target format (see above), when <b>Sequence</b> format is selected, the data is loaded directly to the target and stored in an external table (in sequence format).</p> <p>Note that <a href="#">Snappy</a> compression is not available for sequence format.</p>

**Table 9.8 | Hadoop Target - Advanced Properties (Cont.)**

Setting	Description
	<p>See also: <a href="#">Prerequisites for using the Cloudera Distribution as a Hadoop Target</a>.</p>
Control Tables storage format	<ul style="list-style-type: none"> <li>» <b>Text:</b> This is the default method.</li> <li>» <b>Same as the target storage format:</b> This method is only recommended if, for whatever reason, you cannot use Text format. For example, this may be the case if you have an existing process that only knows how to read/interpret the Control Table data in a different format).</li> </ul>
Use Default SerDe Other SerDe	<p>Choose the SerDe interface to use when accessing the Hive database tables. The default is <b>LazySimpleSerde</b>. <b>LazySimpleSerde</b> creates the target files in delimited text file format. To create the target files in a different format, select the <b>Other SerDe</b> field and then specify the name of the SerDe that you want to use.</p>
Field delimiter	<p>The delimiter that will be used to separate fields in the target file. The default is \001. Note that field delimiters must be in Octal format (e.g. \247)</p> <p><b>Note</b> When using other SerDe:  The default name for the field delimiter property is <code>field.delim</code>. If you selected <b>Other SerDe</b> and the specified SerDe uses a different property name (e.g. <code>separatorChar</code>), in addition to specifying the property value here, you also need to specify both the property name <b>and</b> its value in the <a href="#">SerDe properties</a> field (e.g. <code>separatorChar=\t</code>).</p>
Null value	<p>The value that will be used to indicate a null value in the target file. When using the default SerDe (LazySimpleSerde), setting the null value is supported from Hive 0.13.</p> <p><b>Example (where @ is the null value):</b>  mike,male,295678  sara,female,@</p> <p><b>Note</b> When using other SerDe:  The default name for the null value property is <code>serialization.null.format</code>. If you selected <b>Other SerDe</b></p>

**Table 9.8 | Hadoop Target - Advanced Properties (Cont.)**

Setting	Description
Escape character	<p>and the specified SerDe uses a different property name (e.g. <code>nullChar</code>), in addition to specifying the property value here, you also need to specify both the property name <b>and</b> its value in the <a href="#">SerDe properties</a> field (e.g. <code>nullChar=@</code>).</p> <p><b>When using LazySimpleSerde:</b> The escape character is used to escape the field delimiter character. When a field delimiter is escaped, it is interpreted as actual data, and not as a field delimiter.</p> <p><b>Example (where \ is the escape character and a comma is the field delimiter):</b></p> <pre>sunroof\,power-steering</pre> <p><b>When using Other SerDe:</b> The escape character is used to escape the quote character.</p> <p><b>Example (where \ is the escape character and double quotes is the quote character):</b></p> <pre>"\"sunroof, power-steering\""</pre> <p><b>Note</b> When using other SerDe:  The default name for the escape character property is <code>escape.delim</code>. If you selected <b>Other SerDe</b> and the specified SerDe uses a different property name (e.g. <code>escapeChar</code>), in addition to specifying the property value here, you also need to specify both the property name <b>and</b> its value in the <a href="#">SerDe properties</a> field (e.g. <code>escapeChar={}</code>).</p>
Record delimiter	<p>The <code>\n</code> delimiter is used to separate records (rows) in the target files. When using the default SerDe (LazySimpleSerde), the record delimiter cannot be changed.</p> <p><b>Note</b> When using other SerDe:  The default name for the record delimiter property is <code>line.delim</code>. If you selected <b>Other SerDe</b> and the specified SerDe uses a different property name (e.g. <code>recordChar</code>), in addition to specifying the property value here, you also need to specify both the property name <b>and</b> its value in the <a href="#">SerDe properties</a> field (e.g. <code>recordChar=\r</code>).</p>

**Table 9.8 | Hadoop Target - Advanced Properties (Cont.)**

Setting	Description
Quote character	<p>The quote character is used to escape the field delimiter character. When a field delimiter is escaped, it is interpreted as actual data, and not as a field delimiter. Note that the quote character is not available when using the default SerDe (LazySimpleSerde).</p> <p><b>Example (where double-quotes is the quote character):</b> "mike,male"</p> <div style="background-color: #e0f2ff; padding: 10px;"> <p><b>Note</b> When using other SerDe:            The default name for the quote character property is <code>quote.delim</code>. If you selected <b>Other SerDe</b> and the specified SerDe uses a different property name (e.g. <code>quoteChar</code>), in addition to specifying the property value here, you also need to specify both the property name <b>and</b> its value in the <b>Serde properties</b> field (e.g. <code>quoteChar=''</code>).</p> </div>
Serde properties	<p>Enter the SerDe properties if <b>Other SerDe</b> is selected and the SerDe properties are not the same as the Hadoop defaults (<code>field.delim</code>, <code>serialization.null.format</code>, <code>escape.delim</code>, <code>line.delim</code>, <code>quote.delim</code>).</p> <p>The properties should be written using the following format:  <code>"KEY1=VALUE1,KEY2=VALUE2,KEY3=VALUE3"</code>            The list of properties should begin and end with a quotation mark.</p> <p><b>Example:</b>  <code>"separatorChar=\t,escapeChar=｛,quoteChar=''"</code></p> <div style="background-color: #e0f2ff; padding: 10px;"> <p><b>Note</b> When " is specified as a value, it needs to be enclosed with quotation marks and escaped with a quotation mark, as follows: """"</p> </div>
Add metadata header	<p>You can optionally add a header row to the data files. The header row can contain the source column names and/or the intermediate (i.e. Replicate) data types.</p> <p>Example of a target file with a header row when both <b>With column names</b> and <b>With data types</b> are selected:</p> <pre>Position:DECIMAL(38,0),Color:VARCHAR(10) 1,"BLUE"</pre>

**Table 9.8 | Hadoop Target - Advanced Properties (Cont.)**

Setting	Description
	2,"BROWN" 3,"RED" ...
	<b>Note</b> This option is only available when "No Access" is selected as the Hive access method (in the <b>General</b> tab) and the <b>Target storage format</b> is "Text".
<b>File Attributes</b>	<b>Expand this section to specify or view the file attributes.</b>
Use Hadoop defaults	Select to work with the default block size of your Hadoop target.
Use this block size (MB)	Select to work with a different block size. The default value is 64.
Maximum file size	Specify the maximum file size of each target file. When the data reaches the maximum size, the file will be closed and written to the specified target folder.
Compress files using	Select the compression method to use on HDFS.
	<b>Note</b> Cloudera ODBC drivers 2.5.20 and above do not support the <a href="#">Snappy</a> compression method.
	<b>Note</b> To use Snappy compression when the <a href="#">Setting Advanced Connection Properties</a> is set to <b>Avro</b> , <b>Parquet</b> or <b>Text</b> , you must add the following values to the <code>hive.security.authorization.sqlstd.confwhitelist.app end</code> property in the Hive configuration file: <ul style="list-style-type: none"> <li>» <b>For Avro:</b> <code> hive.exec.compress.output avro.output.codec</code></li> <li>» <b>For Parquet:</b> <code> hive.exec.compress.output parquet.compression</code></li> <li>» <b>For Text:</b> <code> hive.exec.compress.output parquet.compression</code></li> </ul> Note that in some Hadoop Distributions, compression will only work if you specify the value without the "hive" prefix. For example <code> exec.compress.output</code> instead of <code> hive.exec.compress.output</code> .

**Table 9.8 | Hadoop Target - Advanced Properties (Cont.)**

Setting	Description
<p>If the value(s) already exist in the <code>hive.security.authorization.sqlstd.confwhitelist</code> property, you do not need to add them to the <code>hive.security.authorization.sqlstd.confwhitelist.append</code> property.</p> <p>See also: <a href="#">Prerequisites for using the Cloudera Distribution as a Hadoop Target</a>.</p>	
<b>Change Processing</b>	<b>Expand this section to specify or view change processing settings.</b>
Consider state idle when no changes have been processed for	Specify how long to wait before considering the state to be idle. In idle state, you can create files from data that has already been processed if the specified size and time conditions are met (see below).
File size reaches	Specify the minimum size of the data required to create a file in idle state.
Elapsed time reaches	Specify the maximum time to wait before applying the changes in idle state.
<p><b>Note</b> To facilitate rapid delivery of DDL messages, files are uploaded immediately, regardless of the specified <b>File size reaches</b> or <b>Elapsed time reaches</b> values.</p>	

## Preventing ODBC Connection Timeouts

The default query timeout value is 600 seconds, which should be sufficient for most situations. However, when loading very large tables, you may need to increase the value to prevent timeouts. This can be done using the following internal parameter:

`executeTimeout`

See below for instructions on setting internal parameters.

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.

3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

## Using Kerberos Authentication

Whether Attunity Replicate Server is running on Linux or Windows, you can configure it to authenticate itself against the Hadoop cluster using Kerberos (See [Setting General Connection Properties](#) and [Setting General Connection Properties](#)).

This requires you to perform the following steps on the Attunity Replicate machine before starting the Attunity Replicate Server.

### Using Kerberos Authentication on Linux

#### To use Kerberos authentication on Linux:

**Note** The commands described below should be issued under the "Attunity" user or under the user that was selected during the Replicate installation.

1. Obtain a valid TGT (Ticket-Granting Ticket) from the Kerberos KDC (Key Distribution Center) but save the TGT to a non-default cache file. Usually, a keytab file is used to perform non-interactive authentication to Kerberos.

#### Command Syntax:

```
kinit -kt [keytab_file] -c [cache_file_name] [principal_name]
```

2. This step is only required for the global Kerberos ticket file. Set the Kerberos cache environment variable (for Replicate to use later on).

#### To set the environment variable:

- a. Change the working directory to the Replicate "bin" directory by issuing the following command (assumes the default installation path):  

```
cd /opt/attunity/replicate/bin
```
  - b. Stop the Attunity Replicate Server services on the Linux by running:  

```
/opt/attunity/replicate/bin/areplicate stop
```
3. Create a file named `site_arep_login.sh` in the Attunity Replicate bin folder.
    - a. Add the following command to the file:  

```
export KRB5CCNAME=cache_file_name
```

**Example:**

- ```
export KRB5CCNAME=/temp/kerberos/global.ticket
```
- b. Save the file and
  - c. Start the Attunity Replicate Server services on the Linux by running:  
`/opt/attunity/replicate/bin/areplicate start`

Now, whenever Attunity Replicate needs to use Kerberos authentication, it will perform the following operations:

- » When **Use global Kerberos ticket file** is selected: Replicate will check whether the KRB5CCNAME environment variable is set and, if so, will use the ticket(s) inside the cache file specified by the environment variable.
- » When **Use specific Kerberos ticket file** is selected:
  - » During design-time (e.g. when selecting tables, testing the connection, etc.), Replicate will use the ticket(s) inside the cache file specified by the KRB5CCNAME environment variable.
  - » During runtime, Replicate will use the ticket file specified in the Hadoop endpoint settings.

**Note** If the ticket in the cache file expires or becomes invalid, repeating the `kinit` command shown in **Step 1** above will write a new TGT to the cache file and allow Attunity Replicate to continue working. This can be done without restarting the Attunity Replicate Server.

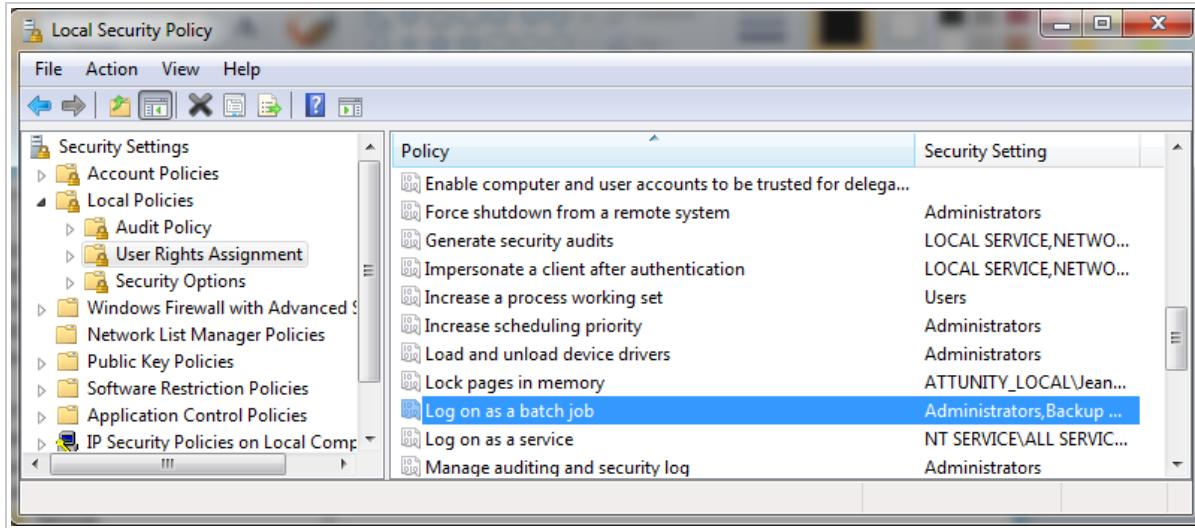
## Using Kerberos Authentication on Windows

Before beginning, make sure that the impersonated user (principal) has access to the Replicate **Data** directory (<product\_dir>\Data by default) on the Attunity Replicate server. For Active Directory KDC, the impersonated user is the user configured in the user interface. For MIT KDC, this is the Windows user to which the MIT principal is mapped.

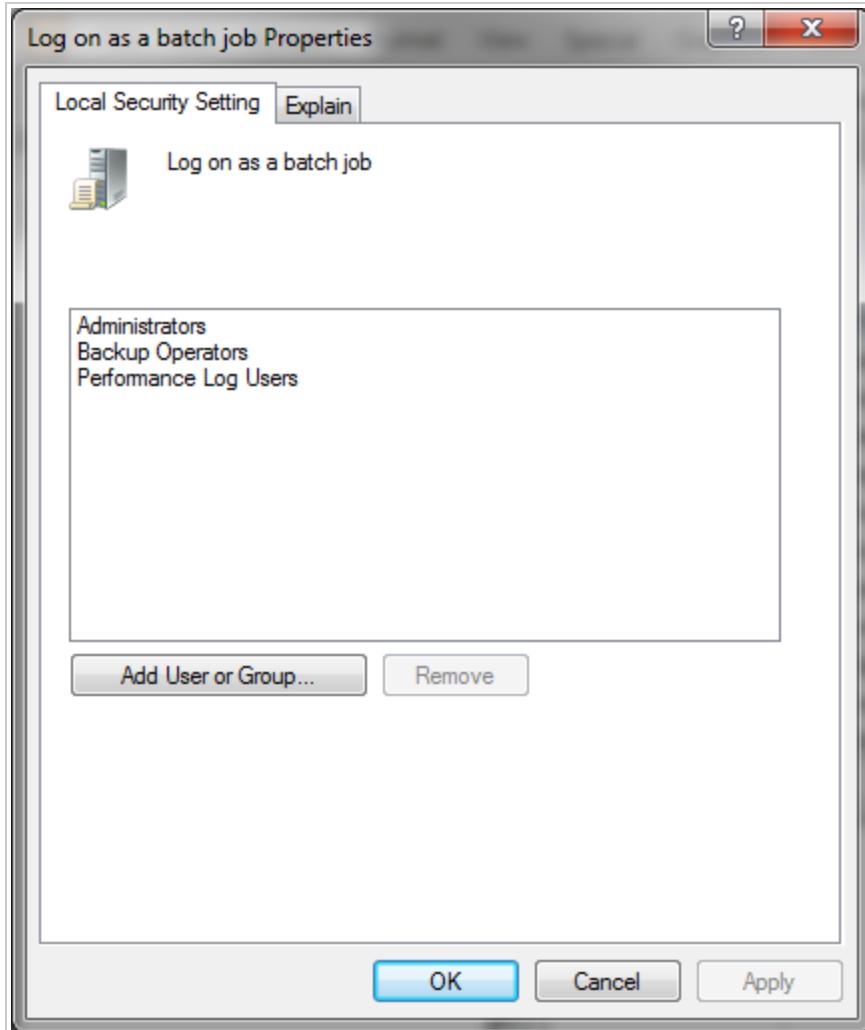
### To set Kerberos authentication on Windows:

Perform the following steps to ensure that the impersonated user (principal) has the **Log on as a batch job** privilege on the Attunity Replicate server.

1. On the Attunity Replicate server, open the **Local Security Settings (Control Panel > System Security > Administrative Tools > Local Security Policy)**.



2. In the console tree, expand **Local Policies** and select **User Rights Assignments**.
3. In the details pane, double-click **Log on as a batch job**.
4. In the **Log on as a batch job Properties** dialog box, on the **Local Security Settings** tab, verify that the respective user is listed. If it is not listed, click **Add User or Group**, then add the user and click **OK**.

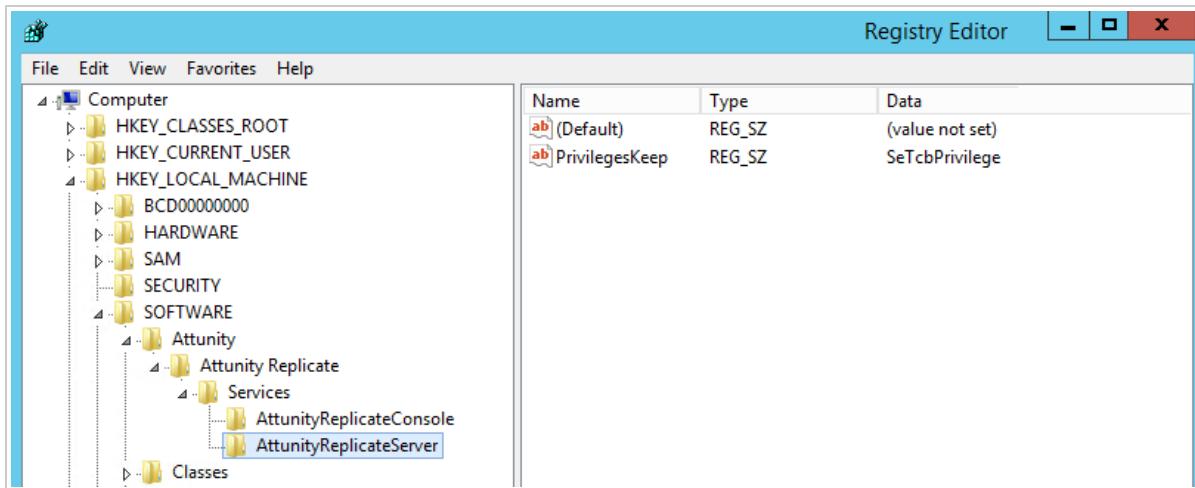


Your changes should take effect immediately.

**To set Kerberos authentication on Windows with MIT Kerberos set in one of the endpoints:**

If MIT Kerberos is set in one of the endpoints, you need to perform the following steps to allow the Attunity Replicate server process to keep a specific privilege on startup. By default, Attunity Replicate server drops all privileges on startup. These steps are not required if you use Active Directory KDC.

1. Open the Windows registry (regedit.exe).
2. Browse to: HKEY\_LOCAL\_MACHINE\SOFTWARE\Attunity\Attunity Replicate\Services\AttunityReplicateServer



3. Modify the **PrivilegesKeep** string to include the value **SeTcbPrivilege**.
4. Close the **Registry Editor** window.
5. Start the **Attunity Replicate Server service**.

# Using Microsoft Azure HDInsight as a Target

This section describes how to set up and use Microsoft Azure HDInsight as the target endpoint in a replication task.

## In this section:

[Prerequisites](#)

[Limitations](#)

[Change Data Partitioning on Microsoft Azure HDInsight](#)

[Microsoft Azure HDInsight Endpoint Target Data Types](#)

[Setting General Connection Properties](#)

[Setting Advanced Connection Properties](#)

## Prerequisites

Before you begin to work with Microsoft Azure HDInsight as a target in Attunity Replicate, make sure that the following prerequisites have been met:

» **General:**

- » The ADLS or Blob storage location (whichever you are using) must be accessible from the Attunity Replicate machine.
- » The user specified in the Microsoft Azure HDInsight target endpoint's [Hive access settings](#) must have access to HCatalog.

» **ODBC Driver when Replicate Server is running on Windows:** Microsoft Hive ODBC driver 2.1.12 or above must be installed on the Attunity Replicate Server machine.

» **ODBC Driver when Replicate Server is running on Linux:**

1. Install Hortonworks Hive ODBC driver 2.1.2 or above on the Replicate Server machine.
2. After the driver is installed, edit the **hortonworks.hiveodbc.ini** file as follows:

```
DriverManagerEncoding=UTF-16  
ODBCInstLib=libodbcinst.so
```

» **Permissions:** The "Storage account" (when using Blob storage) or "Azure Active Directory application ID" (when using ADLS) specified in the Microsoft Azure HDInsight endpoint's **Storage** settings must have write access to the specified Blob/ADLS storage target folder.

## Limitations

The following limitations apply:

- » UPDATE/DELETE DMLs are not supported during change processing. If an UPDATE/DELETE DML was captured on the source, it will be ignored on the target and a warning will be written to the log. If the **Store Changes** option is enabled in the task settings, these records will be written to the Change Table.
- » Limited LOB support only.
- » Dropping columns and changing column data types are not supported.
- » Writing to "special" tables such as tables with partitions, buckets, or skews is not supported.
- » The following Control Tables are not supported as they require UPDATE/DELETE operations (which are not supported by the Microsoft Azure HDInsight target endpoint):
  - » **Replication Status** (requires UPDATE).  
Name on target: attrep\_status
  - » **Suspended Tables** (requires DELETE).  
Name on target: attrep\_suspended\_tables  
For more information on Control Tables, see [Control Tables](#).
- » Blob storage limitations:
  - » Supported on Windows only
  - » Append operation is not supported
- » Proxy:
  - » Does not affect the ODBC (Hive) connection. Affects the storage connection only.
  - » When using Blob storage, the HTTPS scheme is not supported

## Change Data Partitioning on Microsoft Azure HDInsight

When [Change Data Partitioning](#) is enabled, the Replicate Change Tables in Hive are partitioned by the `partition_name` column. Data files are uploaded to the Blob/ADLS storage, according to the [maximum size and time definition](#), and then stored in a directory under the Change Table directory. Whenever the specified partition timeframe ends, a partition is created in Hive, pointing to the Blob/ADLS storage.

Information about the partitions is written to the [attrep\\_cdc\\_partitions](#) Control Table.

## Microsoft Azure HDInsight Endpoint Target Data Types

The following table shows the Microsoft Azure HDInsight endpoint target data types that are supported when using Attunity Replicate and the default mapping from Attunity Replicate data types.

For information on how to view the data type that is mapped from the source, see the section for the source endpoint you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 9.9 | Supported Microsoft Azure HDInsight Data Types with Mapping from Attunity Replicate Data Types**

| Attunity Replicate Data Types | Microsoft Azure HDInsight Data Types |
|-------------------------------|--------------------------------------|
| BOOL                          | BOOLEAN                              |
| BYTES                         | STRING                               |
| TIME                          | TIMESTAMP                            |
| DATETIME                      | TIMESTAMP                            |
| DATE                          | DATE                                 |
| INT1                          | TINYINT                              |
| INT2                          | SMALLINT                             |
| INT4                          | INT                                  |
| INT8                          | BIGINT                               |
| NUMERIC                       | DECIMAL (p,s)                        |
| REAL4                         | FLOAT                                |
| REAL8                         | DOUBLE                               |
| STRING                        | VARCHAR (Length)                     |
| UINT1                         | SMALLINT                             |
| UINT2                         | INT                                  |
| UINT4                         | BIGINT                               |
| UINT8                         | DECIMAL (20,0)                       |
| WSTRING                       | VARCHAR (Length)                     |
| BLOB                          | STRING                               |
| NCLOB                         | STRING                               |
| CLOB                          | STRING                               |

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

### To add a Microsoft Azure HDInsight target endpoint to Attunity Replicate:

1. In the Attunity Replicate console, click **Manage Endpoint Connections** to open the **Manage Endpoint Connections** dialog box.  
For more information on adding an endpoint to Attunity Replicate, see [Working with Endpoints](#).
2. In the **Name** field, type a name for your endpoint. This can be any name that will help to identify the endpoint being used.
3. In the **Description** field, type a description that helps to identify the Microsoft Azure HDInsight endpoint. This is optional.
4. Select **Microsoft Azure HDInsight** as the endpoint **Type**.
5. In the **Security** section, specify the location of the SSL CA certificate in the **SSL CA path** field. If you do not have your own CA certificate, you can specify the path to the cacerts.pem file provided with the ODBC driver installation.
6. In the **Azure Storage** section, select either **Blob storage** or **ADLS** and then provide the following information according to the selected storage type:

**Note** The **Blob storage** option is not supported when Attunity Replicate is running on Linux.

If you selected **Blob storage**:

- a. In the **Storage account** field, specify the name of an account with write permissions to the container.
- b. In the **Access key** field, specify the account access key.
- c. In the **Container name** field, specify the container name.
- d. In the **Target folder** field, specify where to create the data files on Blob storage.

If you selected **ADLS**:

- a. In the **Data Lake Store name** field, specify the full name of the ADLS storage.
- b. In the **Azure Active Directory ID** field, specify the Azure Active Directory ID.
- c. In the **Azure Active Directory application ID** field, specify the Azure Active Directory application ID.
- d. In the **Azure Active Directory application key** field, specify the Azure Active Directory application key.
- e. In the **Target folder** field, specify where to create the data files on ADLS.

**Note** Due to a Hadoop limitation, the **Target folder** name can only contain ASCII characters.

7. In the **Hive Access** section:
  - a. In the **Host** field, specify the host name of the Hive server.
  - b. Enter your **Username** and **Password** for accessing the Hive server in the designated fields.
  - c. In the **Database** field, specify the name of the Hive target database.

## Setting Advanced Connection Properties

The table below describes the settings in the **Advanced** tab.

**Table 9.10 | Microsoft Azure HDInsight Target - Advanced Properties**

| Setting                | Description                                                                                                                                                                                                                                                                                 |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>File Format</b>     | <b>Expand this section to specify or view the file format settings.</b>                                                                                                                                                                                                                     |
| Target storage format  | Select either <b>Text</b> or <b>Sequence</b> .                                                                                                                                                                                                                                              |
| Field delimiter        | The delimiter that will be used to separate fields in the target file. The default is \001. Note that field delimiters must be in Octal format (e.g. \247)                                                                                                                                  |
| Null value             | The value that will be used to indicate a null value in the target file. When using the default SerDe (LazySimpleSerde), setting the null value is supported from Hive 0.13.<br><b>Example (where @ is the null value):</b><br>mike,male,295678<br>sara,female,@                            |
| Escape character       | The escape character is used to escape the field delimiter character. When a field delimiter is escaped, it is interpreted as actual data, and not as a field delimiter.<br><b>Example (where \ is the escape character and a comma is the field delimiter):</b><br>sunroof\,power-steering |
| <b>File Attributes</b> | <b>Expand this section to specify or view the file attributes.</b>                                                                                                                                                                                                                          |
| Maximum file size      | Specify the maximum file size of each target file. When the                                                                                                                                                                                                                                 |

**Table 9.10 | Microsoft Azure HDInsight Target - Advanced Properties (Cont.)**

| Setting                                                                                                                                                                               | Description                                                                                                                                                             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                       | data reaches the maximum size, the file will be closed and written to the specified target folder.                                                                      |
| Compress files using                                                                                                                                                                  | Select the compression method to use on ADLS/Blob storage.                                                                                                              |
| <b>Change Processing</b>                                                                                                                                                              | <b>Expand this section to specify or view change processing settings.</b>                                                                                               |
| Apply/Store changes when:                                                                                                                                                             |                                                                                                                                                                         |
| File size reaches                                                                                                                                                                     | Specify the minimum size of the data required to create a file in idle state.                                                                                           |
| Elapsed time reaches                                                                                                                                                                  | Specify the maximum time to wait before applying the changes in idle state.                                                                                             |
| <b>Note</b> To facilitate rapid delivery of DDL messages, files are uploaded immediately, regardless of the specified <b>File size reaches</b> or <b>Elapsed time reaches</b> values. |                                                                                                                                                                         |
| <b>Proxy Server</b>                                                                                                                                                                   | <b>Expand this section to specify or view proxy settings.</b>                                                                                                           |
| Use proxy server                                                                                                                                                                      | Select this option to access Microsoft Azure HDInsight via a proxy server.                                                                                              |
| Host name                                                                                                                                                                             | The host name of the proxy server.                                                                                                                                      |
| Port                                                                                                                                                                                  | The port via which to access the proxy server.                                                                                                                          |
| User name                                                                                                                                                                             | The user name for accessing the proxy server.                                                                                                                           |
| Password                                                                                                                                                                              | The password for accessing the proxy server.                                                                                                                            |
| Scheme                                                                                                                                                                                | Select which protocol to use to access the server (HTTP or HTTPS). When using Blob storage, only HTTP is available. When using ADLS, both HTTP and HTTPS are available. |
| <b>Note</b> The proxy configuration applies to the storage (Blob/ADLS), but does not apply to the ODBC connection.                                                                    |                                                                                                                                                                         |
| SSL CA Path:                                                                                                                                                                          | The location of the CA certificate on the Replicate Server machine when <b>HTTPS</b> is the selected <b>Scheme</b> .                                                    |

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

**To add internal Attunity Replicate parameters:**

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

# Using Amazon EMR as a Target

The following topics describe how to use Amazon EMR as a target endpoint in an Attunity Replicate task:

**Note** Hive can be configured to use the AWS Glue Data Catalog as its metastore or its own metastore. The metastore that will be used depends on your Amazon EMR Cluster configuration and requires no special configuration from a Replicate perspective.

## In this section:

[Prerequisites](#)

[Limitations](#)

[Change Data Partitioning on Amazon EMR](#)

[Amazon EMR Endpoint Target Data Types](#)

[Setting General Connection Properties](#)

[Setting Advanced Connection Properties](#)

## Prerequisites

Before you begin to work with Amazon EMR as a target in Attunity Replicate, make sure that the following prerequisites have been met:

» **General:**

- » The Amazon S3 bucket you are using must be accessible from the Attunity Replicate machine.
- » The user specified in the Amazon EMR target endpoint's [Hive access settings](#) must have access to HCatalog.

» **ODBC Driver when Replicate Server is running on Windows:**

- » Install Amazon Hive ODBC driver 1.1.1.1001 on the Replicate Server machine.

» **ODBC Driver when Replicate Server is running on Linux:**

1. Install Amazon Hive ODBC driver 1.1.1.1001 on the Replicate Server machine.
2. After the driver is installed, edit the **amazon.hiveodbc.ini** file as follows:

```
DriverManagerEncoding=UTF-16  
ODBCInstLib=libodbcinst.so
```

» **Permissions:** The [Access type](#) selected in the Amazon EMR endpoint's **Storage** settings must have write access to the specified bucket folder.

## Limitations

The following limitations apply:

- » UPDATE/DELETE DMLs are not supported during change processing. If an UPDATE/DELETE DML was captured on the source, it will be ignored on the target and a warning will be written to the log. If the **Store Changes** option is enabled in the task settings, these records will be written to the Change Table.
  - » Limited LOB support only.
  - » Writing to "special" tables such as tables with partitions, buckets, or skews is not supported.
  - » Dropping columns and changing column data types are not supported.
  - » Replication of Primary Key metadata is not supported.
  - » The following Control Tables are not supported as they require UPDATE/DELETE operations (which are not supported by the Amazon EMR target endpoint):
    - » **Replication Status** (requires UPDATE).  
Name on target: attrep\_status
    - » **Suspended Tables** (requires DELETE).  
Name on target: attrep\_suspended\_tables
- For more information on Control Tables, see [Control Tables](#).

## Change Data Partitioning on Amazon EMR

When [Change Data Partitioning](#) is enabled, the Replicate Change Tables in Hive are partitioned by the `partition_name` column. Data files are uploaded to Amazon S3 storage, according to the [maximum size and time definition](#), and then stored in a directory under the Change Table directory. Whenever the specified partition timeframe ends, a partition is created in Hive, pointing to the Amazon S3 storage.

Information about the partitions is written to the [attrep\\_cdc\\_partitions](#) Control Table.

## Amazon EMR Endpoint Target Data Types

The following table shows the Amazon EMR endpoint target data types that are supported when using Attunity Replicate and the default mapping from Attunity Replicate data types.

For information on how to view the data type that is mapped from the source, see the section for the source endpoint you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 9.11 | Supported Amazon EMR Data Types with Mapping from Attunity Replicate Data Types**

| Attunity Replicate Data Types | Amazon EMR Data Types |
|-------------------------------|-----------------------|
| BOOL                          | BOOLEAN               |
| BYTES                         | STRING                |
| TIME                          | TIMESTAMP             |
| DATETIME                      | TIMESTAMP             |
| DATE                          | DATE                  |
| INT1                          | TINYINT               |
| INT2                          | SMALLINT              |
| INT4                          | INT                   |
| INT8                          | BIGINT                |
| NUMERIC                       | DECIMAL (p,s)         |
| REAL4                         | FLOAT                 |
| REAL8                         | DOUBLE                |
| STRING                        | VARCHAR (Length)      |
| UINT1                         | SMALLINT              |
| UINT2                         | INT                   |
| UINT4                         | BIGINT                |
| UINT8                         | DECIMAL (20,0)        |
| WSTRING                       | VARCHAR (Length)      |
| BLOB                          | STRING                |
| NCLOB                         | STRING                |
| CLOB                          | STRING                |

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

### To add an Amazon EMR target endpoint to Attunity Replicate:

1. In the Attunity Replicate console, click **Manage Endpoint Connections** to open the **Manage Endpoint Connections** dialog box.  
For more information on adding an endpoint to Attunity Replicate, see [Working with Endpoints](#).
2. In the **Name** field, type a name for your endpoint. This can be any name that will help to identify the endpoint being used.
3. In the **Description** field, type a description that helps to identify the Amazon EMR endpoint. This is optional.
4. Select **Amazon EMR** as the endpoint **Type**.
5. In the **Storage** section:
  - a. In the **Bucket name** field, enter the name of your Amazon S3 bucket.
  - b. In the **Bucket region** drop-down list, select the Amazon S3 region where your bucket is located.
  - c. From the **Access type** drop-down list, choose one of the following:
    - » Key pair  
Choose this method to authenticate with your Access Key and Secret Key.
    - » IAM Roles for EC2.  
Choose this method if the machine on which Attunity Replicate is installed is configured to authenticate itself using an IAM role.  
For information on IAM roles, see:  
[http://docs.aws.amazon.com/IAM/latest/UserGuide/id\\_roles.html](http://docs.aws.amazon.com/IAM/latest/UserGuide/id_roles.html)

- d. If you selected **Key pair** as your access method, in the **Access key** field, enter the access key information for Amazon S3.
- e. If you selected **Key pair** as your access method, in the **Secret key** field, enter the secret key information for Amazon S3.
- f. In the **Target folder** field, specify the target folder in your Amazon S3 bucket.

**Note** Due to a Hadoop limitation, the **Target folder** name can only contain ASCII characters.

6. In the **Data Encryption** section, choose one of the following:
  - » None
  - » Server-Side Encryption with Amazon S3-Managed Keys (SSE-S3). This is the default.

- » Server-Side Encryption with AWS KMS-Managed Keys (SSE-KMS)

This option also requires you to specify your **KMS Key ID**.

For more information on the available sever-side encryption methods, see:

<http://docs.aws.amazon.com/AmazonS3/latest/dev/serv-side-encryption.html>

7. In the **Hive Access** section:

- a. In the **Host** field, specify the public host name or IP address of the Hive server.
- b. In the **Port** field, optionally change the default port.
- c. From the **Authentication type** drop-down list, choose either **Username** or **Username and Password** and then enter the required information in the designated fields.
- d. To access Hive using SSL, select **Use SSL** and then specify the full path to a CA certificate file in PEM format in the **CA path** field.
- e. In the **Database** field, specify the name of the Hive target database.

## Setting Advanced Connection Properties

The table below describes the settings in the **Advanced** tab.

**Table 9.12 | Amazon EMR Target - Advanced Properties**

| Setting               | Description                                                                                                                                                                                                                                                                                 |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>File Format</b>    | <b>Expand this section to specify or view the file format settings.</b>                                                                                                                                                                                                                     |
| Target storage format | Select either <b>Text</b> or <b>Sequence</b> .                                                                                                                                                                                                                                              |
| Field delimiter       | The delimiter that will be used to separate fields in the target file. The default is \001. Note that field delimiters must be in Octal format (e.g. \247)                                                                                                                                  |
| Null value            | The value that will be used to indicate a null value in the target file. The null value is supported from Hive 0.13.<br><b>Example (where @ is the null value):</b><br>mike,male,295678<br>sara,female,@                                                                                    |
| Escape character      | The escape character is used to escape the field delimiter character. When a field delimiter is escaped, it is interpreted as actual data, and not as a field delimiter.<br><b>Example (where \ is the escape character and a comma is the field delimiter):</b><br>sunroof\,power-steering |

**Table 9.12 | Amazon EMR Target - Advanced Properties (Cont.)**

| Setting                   | Description                                                                                                                                                                                                                              |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                           | <p><b>When using Other SerDe:</b> The escape character is used to escape the quote character.</p> <p><b>Example (where \ is the escape character and double quotes is the quote character):</b></p> <p>"\"sunroof, power-steering\""</p> |
| <b>File Attributes</b>    | <b>Expand this section to specify or view the file attributes.</b>                                                                                                                                                                       |
| Maximum file size         | Specify the maximum file size of each target file. When the data reaches the maximum size, the file will be closed and written to the specified target folder.                                                                           |
| Compress files using      | Select the compression method to use on Amazon S3 storage.                                                                                                                                                                               |
| <b>Change Processing</b>  | <b>Expand this section to specify or view change processing settings.</b>                                                                                                                                                                |
| Apply/store changes when: |                                                                                                                                                                                                                                          |
| File size reaches         | Specify the minimum size of the data required to create a file in idle state.                                                                                                                                                            |
| Elapsed time reaches      | Specify the maximum time to wait before applying the changes in idle state.                                                                                                                                                              |

**Note** To facilitate rapid delivery of DDL messages, files are uploaded immediately, regardless of the specified **File size reaches** or **Elapsed time reaches** values.

| Proxy Server     | <b>Expand this section to specify or view proxy settings.</b>                                                                                                                                                                                                                                                                                                                               |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Use proxy server | Select this option to access Amazon S3 via a proxy server.                                                                                                                                                                                                                                                                                                                                  |
| Host name        | The host name of the proxy server.                                                                                                                                                                                                                                                                                                                                                          |
| Port             | The port via which to access the proxy server.                                                                                                                                                                                                                                                                                                                                              |
| User name        | The user name for accessing the proxy server.                                                                                                                                                                                                                                                                                                                                               |
| Password         | The password for accessing the proxy server.                                                                                                                                                                                                                                                                                                                                                |
| Scheme           | Select which protocol to use to access the server (HTTP or HTTPS). In order to use HTTPS, you must first install the CA certificate that signed the proxy's certificate on the Replicate Server machine, as follows:<br><ul style="list-style-type: none"> <li>» <b>On Windows:</b> Add the CA certificate to the Trusted Root Certification Authorities store of Local Computer</li> </ul> |

**Table 9.12 | Amazon EMR Target - Advanced Properties (Cont.)**

| Setting | Description                                                                                                                     |
|---------|---------------------------------------------------------------------------------------------------------------------------------|
|         | <ul style="list-style-type: none"> <li>» <b>On Linux:</b> Add the CA certificate to /etc/pki/tls/certs/ca-bundle.crt</li> </ul> |

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

# Using Teradata Database as a Target

This section describes how to set up and use Teradata Database as a target in a replication task.

## In this section:

- [An Overview of the Teradata Database Target](#)
- [Teradata Database Target Load Options](#)
- [Database Availability](#)
- [Required Teradata Database Software, Environments](#)
- [Providing Access to the Teradata Database](#)
- [Security Requirements](#)
- [Teradata Database Data Types](#)
- [Setting General Connection Properties](#)
- [Setting Advanced Connection Properties](#)

## An Overview of the Teradata Database Target

The Attunity Replicate database for Teradata Database is a powerful operational data warehousing solution that manages Big Data analytics and challenges. Attunity Replicate uses the Teradata Database Parallel Transporter (TPT) API to facilitate data loading. The ODBC API is used for other purposes such as metadata queries (DDL requests) and retrieving information from Teradata Database error tables.

Attunity Replicate for Teradata Database uses the TPT load to bulk load data into a Teradata Database target database. You can replicate data to the Teradata Database from any source database supported by Attunity Replicate. In addition, Attunity Replicate can replicate data from any source database that supports ODBC.

## Teradata Database Target Load Options

You can apply changes in one of two modes:

- » [TPT Stream Mode](#)
- » [TPT Load Mode](#)

### TPT Stream Mode

When using the TPT stream mode, the TPT Stream operator uses the Teradata Database TPump protocol to perform high-speed DML transactions in a near-real-time mode on tables. The TPT STREAM operator is less restrictive than the LOAD operator.

This mode lets tables be queried at the same time that a DML operation takes place.

## TPT Load Mode

When using the TPT load mode, the TPT LOAD operator uses the Teradata Database FastLoad protocol to load a large volume of data at high speed into an empty table on the Teradata Database.

The TPT LOAD operator has some restrictions that include the following:

- » The target table must be empty.
- » The target table cannot have secondary indexes defined.

## Database Availability

Teradata Database with the tables that are being used for replication must be available to the system. This can be installed on any computer in your network.

For more information about the requirements for working with Attunity Replicate, see [Installation Prerequisites](#).

## Required Teradata Database Software, Environments

The following describes the prerequisites necessary to prepare your environment to work with Attunity Replicate and Teradata Database.

**Note** Teradata Database must be installed in your network and be reachable from the computer where Attunity Replicate is installed.

### Replicate Server for Windows

You must install the following on the same computer where the Attunity Replicate Server is installed:

- » Teradata Database ODBC Driver for Windows version 15.00.
- » Teradata Database Parallel Processor API (TPT API) with the load and Stream TPT operators. Install either version 14.00 with the latest patch or version 15.10.

### Replicate Server for Linux

The following section describes the steps you need to perform to work with Attunity Replicate for Linux and Teradata Database as a target database in a Replicate task. Teradata Database Client requires the DataDirect ODBC driver manager (provided with Teradata Database Client).

**Important:** A Replicate task cannot be defined with endpoints that use different ODBC Driver Managers. Teradata Database target is accessed using the *DataDirect ODBC Driver Manager*. With the exception of Oracle, Hadoop, File and Replicate Connect

sources (which are not subject to the above limitation), all other source endpoints use the *unixODBC* Driver Manager.

To configure a task with a *unixODBC* source and a *DataDirect* target (e.g. Microsoft SQL Server to Teradata Database Target), you need to use the Replicate File Channel. For more information about setting up a task using the File Channel, see [Using the Attunity Replicate File Channel](#).

1. Install Replicate on the Linux machine as described in [Installing Attunity Replicate on Linux](#).

2. Install the following Teradata client components:

- » Teradata Database ODBC Driver 14.10 or 15.10 for Linux
- » Teradata Database Parallel Processor API (TPT API) with the Load and Stream TPT operators

3. Copy the **odbc.ini** file to your home directory and rename it to **.odbc.ini**:

```
cp $STD_CLIENT_DIR/odbc_64/odbc.ini ~/.odbc.ini
```

4. Open the Teradata odbcinst.ini file:

```
cat $STD_CLIENT_DIR/odbc_64/odbcinst.ini
```

Then verify that it contains a definition for the Teradata ODBC client:

```
[ODBC DRIVERS]
Teradata=Installed
[Teradata]
```

**Version 14.10:** Driver=/opt/teradata/client/14.10/odbc\_64/lib/tdata.so

**Version 15.10:** Driver=/opt/teradata/client/15.10/lib64/lib/tdata.so

```
DriverODBCVer=3.51
```

5. Check that directory **/usr/lib64** contains symbolic links to the DataDirect driver manager shared libraries:

```
ll /usr/lib64/libodbc*.so
```

The output should look like this (e.g. for version 14.10):

```
lrwxrwxrwx 1 root root 47 Oct 28 14:58 /usr/lib64/libodbcinst.so ->
/opt/teradata/client/ODBC_64/lib/libodbcinst.so
lrwxrwxrwx 1 root root 43 Oct 28 14:58 /usr/lib64/libodbc.so ->
/opt/teradata/client/ODBC_64/lib/libodbc.so
```

6. Add the Teradata Database name to the hosts file as described in [Editing the Hosts File](#).

7. Run the following commands:

```
export LD_LIBRARY_PATH=/usr/lib64:$STD_CLIENT_
DIR/tbuild/lib64:/opt/attunity/replicate/lib
export AREP_ODBC_DRIVER_MANAGER=/opt/teradata/client/14.10/odbc_64/lib/libodbc.so
export ODBCINI=/opt/teradata/client/14.10/odbc_64/odbc.ini
```

## Providing Access to the Teradata Database

The Attunity Replicate user who is working with the Teradata Database must be registered as a user in the Teradata Database. This is the user that is entered in the dialog box when [Setting General Connection Properties](#). You must grant Teradata Database access to this user before configuring the database in Attunity Replicate.

### Editing the Hosts File

To enable Attunity Replicate to access the Teradata Database, you need to add the Teradata Database machine IP/name and database mappings to the Windows/Linux hosts file.

#### To add the Teradata Database mappings to the hosts file:

1. Open the Windows/Linux hosts file on the Attunity Replicate machine.

On Windows, the default path for the hosts file is:

`~:\Windows\System32\drivers\etc\hosts`

On Linux, the default path for the hosts file is:

`/etc/hosts`

2. Add the following line (note the "cop1" after the database name):

`<Teradata Database IP address/hostname> <Teradata Database name>cop1`

#### Example:

`123.123.123.1 teradatadbonecop1`

**Note** Make sure that the database name added to the hosts files is the same as the database specified in the **Default database** field in the Teradata Database target database settings.

3. Save your changes.

## Security Requirements

A user must have the following privileges granted in the Teradata Database to use a Teradata Database target in an Attunity Replicate task:

- » GRANT SELECT ON <database>
- » GRANT INSERT ON <database>
- » GRANT DELETE ON <database>
- » GRANT UPDATE ON <database>
- » GRANT EXECUTE ON <database>
- » GRANT EXECUTE FUNCTION ON <database>
- » GRANT EXECUTE PROCEDURE ON <database>

- » GRANT CREATE TABLE ON <database>
  - » GRANT DROP TABLE ON <database>
  - » GRANT CREATE VIEW ON <database>
  - » GRANT DROP VIEW ON <database>
  - » GRANT NONTEMPORAL on <database>
  - » GRANT CHECKPOINT ON <database>
- When the Stream TPT Operator is selected (in the **Advanced** tab), the following privilege is also required:
- » GRANT CREATE MACRO ON <database>

## Teradata Database Data Types

The Teradata Database database for Attunity Replicate supports most Teradata Database data types. The following table shows the Teradata Database target data types that are supported when using Attunity Replicate and the default mapping from Attunity Replicate data types. Unsupported data types are listed below the table.

**Note** Teradata Database does not support applying changes to binary data types in **Batch optimized apply** mode. For more information on **Batch optimized apply** mode, see [Change Processing Tuning](#).

For information on how to view the data type that is mapped from the source, see the section for the source database you are using. For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 9.13 | Supported Teradata Database Data Types with Mapping from Attunity Replicate Data Types**

| Attunity Replicate Data Types | Teradata Database Data Types                   |
|-------------------------------|------------------------------------------------|
| BOOLEAN                       | BYTEINT                                        |
| BYTES                         | VARBYTE (Size)                                 |
|                               | <p><b>Note</b><br/>Maximum size is 640000.</p> |
| DATE                          | DATE                                           |
| TIME                          | <b>TIME (P)</b><br>Precision is not            |

**Table 9.13 | Supported Teradata Database Data Types with Mapping from Attunity Replicate Data Types (Cont.)**

| Attunity Replicate Data Types                                            | Teradata Database Data Types                                                |
|--------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| DATETIME                                                                 | <b>TIMESTAMP (P)</b><br>Precision is not included unless it is less than 0. |
| INT1                                                                     | <b>BYTEINT</b>                                                              |
| INT2                                                                     | <b>SMALLINT</b>                                                             |
| INT4                                                                     | <b>INTEGER</b>                                                              |
| INT8                                                                     | <b>BIGINT</b>                                                               |
| NUMERIC                                                                  | <b>NUMERIC (P, S)</b><br>Scale is not included unless it is less than 0.    |
| REAL4                                                                    | <b>FLOAT</b><br>FLOAT is equivalent to REAL and DOUBLE PRECISION.           |
| REAL8                                                                    | <b>FLOAT</b>                                                                |
| STRING                                                                   | <b>VARCHAR (Size)</b><br><b>Note:</b> Maximum size is 64000.                |
| See also the note in <a href="#">Teradata Database Data Types</a> below. |                                                                             |
| UINT1                                                                    | <b>BYTEINT</b>                                                              |
| UINT2                                                                    | <b>SMALLINT</b>                                                             |
| UINT4                                                                    | <b>INTEGER</b>                                                              |
| UINT8                                                                    | <b>BIGINT</b>                                                               |
| WSTRING                                                                  | <b>VARCHAR (Size)</b>                                                       |
| See also the note in <a href="#">Teradata Database Data Types</a> below. | <b>Note</b><br>Maximum size                                                 |

**Table 9.13 | Supported Teradata Database Data Types with Mapping from Attunity Replicate Data Types (Cont.)**

| Attunity Replicate Data Types                    | Teradata Database Data Types                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                  | is 640000.                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Note About Teradata Database LOB support:</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                                                  | <p>Full LOB data types are not supported in the Teradata Database. For information on including Limited-size LOB data types in the replication, see <a href="#">Metadata</a>. Note also that the size of a row in the Teradata Database <i>cannot exceed 64KB</i>. This should be taken into consideration when specifying the maximum LOB size in the <b>Metadata</b> tab.</p> <p>See also the note in <a href="#">CLOB</a> below.</p> |
| BLOB                                             | <b>VARBYTE</b><br><code>(\${MAX_LOB_SIZE})</code> <p>MAX_LOB_SIZE is the maximum LOB size specified in Limited-Size LOB Mode.</p>                                                                                                                                                                                                                                                                                                       |
| CLOB                                             | <b>VARCHAR</b><br><code>(\${MAX_LOB_SIZE})</code> <p>Unicode case-insensitive character set.</p> <p>MAX_LOB_SIZE is the maximum LOB size specified in Limited-Size LOB Mode.</p>                                                                                                                                                                                                                                                        |
| NCLOB                                            | <b>VARCHAR</b><br><code>(\${MAX_LOB_SIZE})</code> <p>Case-insensitive character set.</p>                                                                                                                                                                                                                                                                                                                                                |

**Table 9.13 | Supported Teradata Database Data Types with Mapping from Attunity Replicate Data Types (Cont.)**

| Attunity Replicate Data Types | Teradata Database Data Types                                             |
|-------------------------------|--------------------------------------------------------------------------|
|                               | MAX_LOB_SIZE is the maximum LOB size specified in Limited-Size LOB Mode. |

The following Teradata Database data types are not supported:

- » PERIOD

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

### To add a Teradata Database Target to Attunity Replicate:

1. In **Tasks** view, click **Manage Endpoint Connections** to open the **Manage Endpoints Connections** dialog box. Then click the **New Endpoint Connection** button. For more information on adding an endpoint to Attunity Replicate, see [Working with Endpoints](#).
2. In the **Name** field, type a name for your database. This can be any name that will help to identify the database being used.
3. In the **Description** field, type a description that helps to identify the Teradata Database. This is optional.
4. Select **TARGET** as the database **role**.
5. Select **Teradata Database** as the database **Type**.
6. Type the **Server** name. This is the name of the computer with the Teradata Database instance you want to work with.
7. Type the Teradata Database authentication information (**Username**, **Password**) for the authorized user for this Teradata Database. If you do not know this information, see your Teradata Database system manager.

**Note** Consider the following:

- » If you are using the **Advanced** tab to create a custom string, make sure to include the **USERNAME** property. A **Password** can also be included but is not

required. See [Setting Advanced Connection Properties](#) for more information.

- » This information is case sensitive.
- » If you want to set custom properties for this database, see [Setting Advanced Connection Properties](#).
- » To determine if you are connected to the database you want to use or if the connection information you entered is correct, click **Test Connection**.

If the connection is successful a message in green is displayed. If the connection fails, an error message is displayed at the bottom of the dialog box.

To view the log entry if the connection fails, click **View Log**. The server log is displayed with the information for the connection failure. Note that this button is not available unless the test connection fails.

**Important:** Make sure that the Teradata Database user entered in the Teradata Database Authentication section has the correct access privileges. For information on how to provide the required privileges, see [Security Requirements](#).

8. Type the **Default database** name or select one from the list of available endpoints. This is the name of the Teradata Database where you are replicating the data to.

For more information, see [Teradata Database Target Load Options](#).

## Setting Advanced Connection Properties

You can set custom properties or change the default settings for various parameters by adding them to a custom connect string in the **Advanced** tab of the Add Database dialog box.

You can set the following parameters:

- » **TPT Operator:** Select the TPT Operator used to access the Teradata Database. The possible options are:

- » **Load:** Select this to use the [TPT Load Mode](#).
- » **Stream:** Select this to use the [TPT Stream Mode](#).

See [Teradata Database Target Load Options](#).

- » **TPT Attributes:** You can define one or more of the following attributes:

- » **Account String:** The account (database server login) that the DBA assigned to the username for the Attunity Replicate user.

- » **Buffer Size:** The output buffer size (in KB) for sending Load parcels to the Teradata Database.

You can enter a value from 1 to 64.

- » **Buffers:** The number of request buffers used.

You can enter any value from 2 or higher.

- » **Explicit sessions range:** Select this if you want set a minimum and/or maximum number of sessions that can log on to the Teradata Database.
  - » **Maximum:** The maximum number of sessions that can log on to the Teradata Database. The default value is 1. The value cannot be higher than the number of Access Module Processors (AMPs) available.
  - » **Minimum:** The minimum number of sessions that can log on to the Teradata Database.
- » **Dynamic statement packing:** Select this check box if you want the stream driver to dynamically determine the maximum possible pack for the current STREAM job.
  - » **Statement packing:** Use the counter or type the number of statements that can be packed into a multiple-statement request (STREAM).  
You can enter a value from 2 to 600.  
This is available only if **Statement packing** is not selected.
- » **Additional ODBC connection properties:** Type any additional ODBC connection properties, if required.

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

# Using a PostgreSQL-Based Database as a Target

This section describes how to set up and use a PostgreSQL-based target endpoint in a replication task.

You need to configure a PostgreSQL-based endpoint when replicating to any of the following databases:

- » PostgreSQL
- » Amazon Aurora (PostgreSQL)
- » Amazon RDS for PostgreSQL
- » Microsoft Azure Database for PostgreSQL

## In this section:

[Prerequisites](#)

[Security Requirements](#)

[PostgreSQL Database Target Data Types](#)

[Setting General Connection Properties](#)

[Setting Advanced Connection Properties](#)

## Prerequisites

The following section describes the client prerequisites when replicating to a PostgreSQL target.

### » Attunity Replicate Server for Windows:

- » **The PostgreSQL ODBC Driver:** The PostgreSQL ODBC Driver `psqlodbc_09_03_0300-x64-1` or above must be installed on the Attunity Replicate machine.
- » **pgAdmin:** The pgAdmin Open Source administration and development platform for PostgreSQL must be installed on the Attunity Replicate machine.

**Note** Make sure that the `psql.exe` path (e.g. "C:\Program Files\PostgreSQL\9.6\bin") is added to the system PATH.

**Note** If PgAdmin and the Greenplum client are installed on the same Replicate Server, tasks configured to use a PostgreSQL target will fail.

### » Attunity Replicate Server for Linux:

- » Install `postgresql94-9.4.4-1PGDG.<OS Version>.x86_64.rpm`. This is the package that contains the `psql` executable.

For example, `postgresql94-9.4.4-1PGDG.rhel7.x86_64.rpm` is the package required for Red Hat 7.

- » Install unixODBC driver `postgresql94-odbc-09.03.0400-1PGDG.<OS version>.x86_64` or above for Linux, where `<OS version>` is the OS of the Replicate Server machine.
- For example, `postgresql94-odbc-09.03.0400-1PGDG.<rhel7>.x86_64` is the client required for Red Hat 7.
- » Makes sure that the `/etc/odbcinst.ini` file contains an entry for PostgreSQL, as in the following example:

```
[PostgreSQL]
Description = PostgreSQL ODBC driver
Driver = /usr/lib/odbc/psqlodbca.so
Setup = /usr/lib/odbc/libodbcpgsqlS.so
Debug = 0
CommLog = 1
UsageCount = 2
```

## Security Requirements

The user specified in the **General** tab when [Setting General Connection Properties](#) must be a registered user in the PostgreSQL database.

## PostgreSQL Database Target Data Types

The PostgreSQL endpoint for Attunity Replicate supports most PostgreSQL database data types. The following table shows the PostgreSQL database target data types that are supported when using Attunity Replicate and the default mapping from Attunity Replicate data types. Unsupported data types are listed below the table.

For information on how to view the data type that is mapped from the source, see the section for the source database you are using. For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 9.14 | Supported PostgreSQL database Data Types with Mapping from Attunity Replicate Data Types**

| Attunity Replicate Data Types | PostgreSQL database Data Types |
|-------------------------------|--------------------------------|
| BOOL                          | BOOL                           |
| BYTES                         | BYTEA                          |
| DATE                          | DATE                           |

**Table 9.14 | Supported PostgreSQL database Data Types with Mapping from Attunity Replicate Data Types (Cont.)**

| Attunity Replicate Data Types | PostgreSQL database Data Types                                                                                                                                                        |
|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TIME                          | <b>TIME</b>                                                                                                                                                                           |
| DATETIME                      | If scale is => 0 and =< 6, then:<br><br><b>TIMESTAMP</b><br>If scale is => 7 and =< 9, then:<br><br><b>VARCHAR (37)</b>                                                               |
| INT1                          | <b>SMALLINT</b>                                                                                                                                                                       |
| INT2                          | <b>SMALLINT</b>                                                                                                                                                                       |
| INT4                          | <b>INTEGER</b>                                                                                                                                                                        |
| INT8                          | <b>BIGINT</b>                                                                                                                                                                         |
| NUMERIC                       | <b>DECIMAL (P, S)</b>                                                                                                                                                                 |
| REAL4                         | <b>FLOAT4</b>                                                                                                                                                                         |
| REAL8                         | <b>FLOAT8</b>                                                                                                                                                                         |
| STRING                        | If length is 1 - 21845, then:<br><br><b>VARCHAR</b> (Length in Bytes = The STRING value multiplied by three)<br>If length is 21846 - 2147483647, then:<br><br><b>VARCHAR (65535)</b>  |
| UINT1                         | <b>SMALLINT</b>                                                                                                                                                                       |
| UINT2                         | <b>INTEGER</b>                                                                                                                                                                        |
| UINT4                         | <b>BIGINT</b>                                                                                                                                                                         |
| UINT8                         | <b>BIGINT</b>                                                                                                                                                                         |
| WSTRING                       | If length is 1 - 21845, then:<br><br><b>VARCHAR</b> (Length in Bytes = The WSTRING value multiplied by three)<br>If length is 21846 - 2147483647, then:<br><br><b>VARCHAR (65535)</b> |
| BLOB                          | <b>BYTEA</b>                                                                                                                                                                          |
| NCLOB                         | <b>TEXT</b>                                                                                                                                                                           |
| CLOB                          | <b>TEXT</b>                                                                                                                                                                           |

## Data Types when Replicating from a PostgreSQL Source

When replicating from a PostgreSQL source, the target table will be created with the same data types for all columns, apart from columns with user-defined data types. In such cases, the data type will be created as "character varying" in the target.

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

### To add a PostgreSQL target endpoint to Attunity Replicate:

1. In **Tasks** view, click **Manage Endpoint Connections** to open the **Manage Endpoints Connections** dialog box. Then click the **New Endpoint Connection** button. For more information on adding an endpoint to Attunity Replicate, see [Working with Endpoints](#).
2. In the **Name** field, type a name for your database. This can be any name that will help to identify the database being used.
3. In the **Description** field, type a description that helps to identify the PostgreSQL database. This is optional.
4. Select **TARGET** as the database **role**.
5. From the **Type** drop-down list, select one of the following:
  - » For PostgreSQL, Amazon Aurora (PostgreSQL), and Amazon RDS for PostgreSQL, select **PostgreSQL**.
  - » For Microsoft Azure Database for PostgreSQL, select **Microsoft Azure Database for PostgreSQL**.
6. Type the **Server** name. This is the name or IP address of the computer with the PostgreSQL database that you want to access.
7. Optionally, change the default port (5432).
8. Enter the PostgreSQL database authentication information (**User name**, **Password**) of an authorized PostgreSQL user. If you do not know this information, see your PostgreSQL database system manager.

**Note** Consider the following:

- » This information is case sensitive.
- » To determine if you are connected to the database you want to use or if the connection information you entered is correct, click **Test Connection**.

If the connection is successful a message in green is displayed. If the connection fails, an error message is displayed at the bottom of the dialog box.

To view the log entry if the connection fails, click **View Log**. The server log is displayed with the information for the connection failure. Note that this button is not available unless the test connection fails.

**Important:** Make sure that the specified PostgreSQL database user has the correct access privileges.

9. Type the **Database name** or select one from the list of available endpoints. This is the name of the PostgreSQL database to which you are replicating data.
10. Click **OK** to save your settings and close the dialog box.

## Setting Advanced Connection Properties

In the **Advanced** tab, you can set the following properties:

You can set the following properties:

- » **Max file size (KB):** Select or type the maximum size (in KB) of a CSV file before the file is loaded into the PostgreSQL target database. The default value is 32000 KB.

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

# Using a File as a Target

This section describes how to set up and use delimited text files as a target in a replication task. You can use the File target endpoint to export database tables to files, which can then be used as a source in a Replicate task with a File source endpoint.

## In this section:

- [File Target Overview](#)
- [Limitations](#)
- [Change Data Partitioning](#)
- [File Target Data Types](#)
- [Setting General Properties](#)
- [Setting Advanced Connection Properties](#)

## File Target Overview

The File target endpoint generates the data files either in delimited text file format (e.g. CSV) or in JSON format (according to the format selected in the endpoint settings).

Delimited text files are used to store data in tabular format. Examples of delimited text file formats include the CSV (Comma Separated Values) and TSV (Tab Separated Values) formats. Some organizations may implement procedures that export data from a database to a delimited text file while others may simply prefer this format as a convenient way of storing tabular data.

In a delimited text file, each record in the table occupies a separate row. Delimiters are used to mark the beginning of a new row or the beginning of a new column. Virtually any character can be used as a delimiter, although a newline (\n) is often used to separate rows, and commas are commonly used to separate columns.

In JSON files, each record is represented by a single line.

So, for example, the following table:

| book_id | title      | price | is_hardcover |
|---------|------------|-------|--------------|
| 123     | Angels     | 6.99  | false        |
| 456     | The Fallen | 6.49  | true         |
| 789     | Rise Up    | 7.23  | true         |

Will be represented as:

```
{ "book_id": 123, "title": "Angels", "price": 6.99, "is_hardcover": false }  
{ "book_id": 456, "title": "Fallen", "price": 6.49, "is_hardcover": true }
```

```
{ "book_id": 789, "title": "Rise Up", "price": 7.23, "is_hardcover": true }
```

When using a File as a target in a Replicate task, both the Full Load and the CDC data are written to CSV or JSON files (depending on the endpoint settings). While the explanations in this topic relate to CSV files, the same is true for JSON files.

Full Load files are named using incremental counters e.g. LOAD00001.csv, LOAD00002.csv, etc. whereas Apply Changes files are named using timestamps e.g. 20141029-1134010000.csv.

**Note** When [Parallel Load](#) is used, the naming convention for Full Load files is slightly different:

```
LOAD_$(SegmentID)_$(IncreasingCounter)
```

**Example:**

```
LOAD_1_00000001 | LOAD_1_00000002 | LOAD_1_00000003 | LOAD_2_00000001 |
LOAD_2_00000002
```

**Note**

- » The Apply Changes CSV files appear with a **.tmp** extension while they are in idle state. For more information on idle state, see [Change Processing](#).
- » When the [Create metadata files in the target folder](#) option is enabled, a corresponding metadata file is created using the same naming format, but with a **.dfm** extension.

For each source table, a folder is created under the specified target folder. All files - i.e. Full Load, Apply Changes, and Metadata (if enabled) - are written to the relevant folder, according to the settings defined in the File target's [General tab](#).

After a task completes, you can define another task with a File source endpoint that uses the generated CSV files.

## DDL Handling

When a DDL change is captured, Replicate will close the data file and also create a DFM file if the **Create metadata files in the target folder** option is enabled. When the next batch of changes arrives, Replicate will create a new data file containing the changes. Note that the DFM file created for the new data file will match the new table structure.

## Limitations

The following limitations apply to the File target endpoint:

- » Only the following DDLs are supported: Truncate table, Drop table, Create table, Add Column, Rename Column, Drop Column, and Convert Data Type.
- » Full LOB Mode is not supported
- » UPDATE and DELETE statements are not supported in Apply Changes replication mode

- » Batch Optimized Apply mode is not supported
- » Target lookup is not supported
- » The <target folder> parameter cannot include special characters
- » When the **When source table is altered** Apply Changes setting is set to **Ignore ALTER**, data files will be updated, but metadata files and metadata headers (if defined) will not.

## Change Data Partitioning

When replicating to a File target, for each of the source tables, a directory is created under the specified target directory. When **Change Data Partitioning** is enabled, an additional sub-directory is created under the corresponding table directory. The data and metadata (when the metadata option is enabled) files are located in the partition subdirectory, as in the following example:

```
{Target Directory}
    {Table_1}
        {Partition_1}
            Data files
            DFM files
        {Partition_2}
            Data files
            DFM files
        {Partition_3}
            Data files
            DFM files
    {Table_2}
        {Partition_1}
            Data files
            DFM files
        {Partition_2}
            Data files
            DFM files
        {Partition_3}
            Data files
            DFM files
```

Information about the partitions is written to the **attrrep\_cdc\_partitions** Control Table. For information about this table, see [Change Data Partitions](#).

## File Target Data Types

The following table shows the default mapping from Attunity Replicate data types to File target data types. Note that the data type mapping is only relevant if the [Create metadata files in the target folder](#) option is enabled.

For information on source data type mappings, see the section for the source endpoint you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 9.15 | Supported File Target Data Types with Mapping from Attunity Replicate Data Types**

| Attunity Replicate Data Types | File Target Data Types |
|-------------------------------|------------------------|
| DATE                          | DATE                   |
| TIME                          | TIME                   |
| DATETIME                      | DATETIME               |
| BYTES                         | BYTES (length)         |
| BLOB                          | BLOB                   |
| REAL4                         | REAL4 (7)              |
| REAL8                         | REAL8 (14)             |
| INT1                          | INT1 (3)               |
| INT2                          | INT2 (5)               |
| INT4                          | INT4 (10)              |
| INT8                          | INT8 (19)              |
| UINT1                         | UINT1 (3)              |
| UINT2                         | UINT2 (5)              |
| UINT4                         | UINT4 (10)             |
| UINT8                         | UINT8 (20)             |
| NUMERIC                       | NUMERIC (p,s)          |
| STRING                        | STRING (Length)        |
| WSTRING                       | STRING (Length)        |
| CLOB                          | CLOB                   |
| NCLOB                         | NCLOB                  |
| BOOLEAN                       | BOOLEAN (1)            |

## Setting General Properties

This section describes how to configure general properties. For an explanation of how to configure advanced properties, see **Setting Advanced Properties** below.

### To configure general properties for the File target endpoint:

1. In **Tasks** view, click **Manage Endpoint Connections** to open the **Manage Endpoints Connections** dialog box. Then click the **New Endpoint Connection** button. For more information on adding an endpoint to Attunity Replicate, see [Working with Endpoints](#).
2. In the **Name** field, type a name for your endpoint. This can be any name that will help to identify the endpoint being used.
3. In the **Description** field, type a description that helps to identify the File endpoint. This is optional.
4. Select **TARGET** as the endpoint **role**.
5. Select **File** as the endpoint **Type**.
6. In the **Target folder** field, specify the full path of the folder to which you the target files to be written.
7. Configure the remaining settings in the **General** tab as described in the following table.

**Table 9.16 | File Target Endpoint - General Tab Options**

| Option                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>File Format</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <p>Delimiters can be standard characters or a hexadecimal (hex) value. Note that the "0x" prefix must be used to denote a hexadecimal delimiter (e.g. 0x01 = SOH). In the <b>Field delimiter</b>, <b>Record delimiter</b> and <b>Null value</b> fields, the delimiter can consist of concatenated hex values (e.g. 0x0102 = SOHSTX), whereas in the <b>Quote character</b> and <b>Escape character</b> fields, it can only be a single hex value.</p> <p><b>Note</b> The hexadecimal number 0x00 is not supported (i.e. only 0x01-0xFF are supported).</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Format                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <p>You can choose to create the target files in <b>CSV</b> or <b>JSON</b> format.</p> <p>In a JSON file, each record is represented by a single line, as in the following example:</p> <pre>{ "book_id": 123, "title": "Alice in Wonderland", "price": 6.99, "is_hardcover": false } { "book_id": 456, "title": "Winnie the Pooh", "price": 6.49, "is_hardcover": true } { "book_id": 789, "title": "The Cat in the Hat", "price": 7.23, "is_hardcover": true }</pre> |

**Table 9.16 | File Target Endpoint - General Tab Options (Cont.)**

| Option                                                                                                                                                                                                                                                                                                    | Description                                                                                                                                                                                                                                                                                                                                                                               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Note</b> If you choose <b>JSON</b> format , the following fields will be hidden as they are only relevant to CSV format: <b>Field delimiter</b>, <b>Record delimiter</b>, <b>Null value</b>, <b>Quote character</b>, <b>Escape character</b>, <b>Code page</b>, and <b>Add metadata header</b>.</p> |                                                                                                                                                                                                                                                                                                                                                                                           |
| Field delimiter                                                                                                                                                                                                                                                                                           | <p>The delimiter that will be used to separate fields (columns) in the target files. The default is a comma.</p> <p><b>Example using a comma as a delimiter:</b></p> <p>"mike","male"</p>                                                                                                                                                                                                 |
| Record delimiter                                                                                                                                                                                                                                                                                          | <p>The delimiter that will be used to separate records (rows) in the target files. The default is a newline (\n).</p> <p><b>Example:</b></p> <p>"mike","male"\n</p> <p>"sara","female"\n</p>                                                                                                                                                                                              |
| Null value                                                                                                                                                                                                                                                                                                | <p>The string that will be used to indicate a null value in the target files.</p> <p><b>Example (where \n is the record delimiter and @ is the null value):</b></p> <p>"mike","male",295678\n</p> <p>"sara","female",@"\n</p>                                                                                                                                                             |
| Quote character                                                                                                                                                                                                                                                                                           | <p>The character that will be used at the beginning and end of a text column. The default is the double-quote character ("). When a column that contains column delimiters is enclosed in double-quotes, the column delimiter characters are interpreted as actual data, and not as column delimiters.</p> <p><b>Example (where a @ is the quote character):</b></p> <p>@mike@,@male@</p> |
| Escape character                                                                                                                                                                                                                                                                                          | <p>The character used to escape a quote character in the actual data.</p> <p><b>Example (where" is the quote character and \ is the escape character):</b></p> <p>1955,"old, \"rare\", Chevrolet","\$1000"</p>                                                                                                                                                                            |
| Code page                                                                                                                                                                                                                                                                                                 | <p>Specify the code page of your target files if it is different from the default (65001).</p>                                                                                                                                                                                                                                                                                            |

**Note** Windows and Linux systems use different code page

**Table 9.16 | File Target Endpoint - General Tab Options (Cont.)**

| Option                                                                                                    | Description                                                                                                                                                                                                                                                                                                                                                                                              |
|-----------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| conventions. The specified code page must comply with the code page convention of the source file system. |                                                                                                                                                                                                                                                                                                                                                                                                          |
| Add metadata header                                                                                       | <p>You can optionally add a header row to the data files. The header row can contain the source column names and/or the intermediate (i.e. Replicate) data types.</p> <p>Example of a target file with a header row when both <b>With column names</b> and <b>With data types</b> are selected:</p> <p>Position:DECIMAL(38,0),Color:VARCHAR(10)</p> <p>1,"BLUE"<br/>2,"BROWN"<br/>3,"RED"</p> <p>...</p> |
| <b>File Attributes</b>                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                          |
| Maximum file size                                                                                         | <p>The maximum size a file can reach before it is closed (and optionally compressed). This value applies both to data files and to Reference Files.</p> <p>For information on generating reference files, see <a href="#">Generating Reference Files</a>.</p>                                                                                                                                            |
| Compress files using                                                                                      | Choose <b>GZIP</b> to compress the target files or <b>NONE</b> (the default) to leave them uncompressed.                                                                                                                                                                                                                                                                                                 |
| <b>Change Processing</b>                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                          |
| Consider state idle when no changes have been processed for                                               | Specify how long to wait before considering the state to be idle. In idle state, you can apply changes to files using data that has already been processed if the specified size and time conditions are met (see below).                                                                                                                                                                                |
| File size reaches                                                                                         | Specify the maximum size of the data required in order to apply changes to the target file in idle state.                                                                                                                                                                                                                                                                                                |
| Elapsed time reaches                                                                                      | Specify the maximum time to wait before applying the changes in idle state.                                                                                                                                                                                                                                                                                                                              |
| Allow a single transaction to be split into multiple files                                                | By default, a single transaction will <b>not</b> be split across multiple files, regardless of the values specified in the <b>File size reaches</b> and <b>Elapsed time reaches</b> fields. This is important for organizations who require files to contain transactions in their entirety. However, this                                                                                               |

**Table 9.16 | File Target Endpoint - General Tab Options (Cont.)**

| Option                                     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                            | may also result in very large file sizes. For example, if the <b>File size reaches</b> value is <b>32 MB</b> and Replicate starts to apply changes for a new <b>2 GB</b> transaction at <b>31 MB</b> , the target file will only be closed at <b>2.031 GB</b> .<br>You should therefore select this option if it is critical that the values in the <b>File size reaches</b> and <b>Elapsed time reaches</b> fields are adhered to (even if it means splitting a transaction across multiple files).          |
| <b>Metadata Files</b>                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Create metadata files in the target folder | When this option is selected, for each data file, a matching metadata file with a <b>.dfm</b> extension will be created under the specified target folder. The metadata files (which are in standard JSON format) provide additional information about the task/data such as the source endpoint type, the source table name, the number of records in the data file, and so on.<br><br>For a full description of the metadata file as well as possible uses, see <a href="#">Metadata File Description</a> . |

**Note** To determine if you are connected to the endpoint you want to use or if the connection information you entered is correct, click **Test Connection**.

If the connection is successful a message in green is displayed. If the connection fails, an error message is displayed at the bottom of the dialog box.

To view the log entry if the connection fails, click **View Log**. The server log is displayed with the information for the connection failure. Note that this button is not available unless the test connection fails.

## Setting Advanced Connection Properties

In the **Advanced** tab, you can enable the creation of a reference file and set post-processing actions. These options are described in detail below.

**Table 9.17 | File Target Endpoint - Advanced Tab Options**

| Option                   | Description                                                                                               |
|--------------------------|-----------------------------------------------------------------------------------------------------------|
| Generate reference files | Select this option to generate a Reference File containing the full path to the Apply Changes data files. |

**Table 9.17 | File Target Endpoint - Advanced Tab Options (Cont.)**

| Option                | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                       | <p><b>Note</b> The reference file only points to the location of the Apply Changes files, and not the Full Load files.</p> <p>For more information on this feature, see <a href="#">Generating Reference Files</a>.<br/>         For information on using reference files with the File source endpoint, see <a href="#">Reference Files</a>.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Reference file folder | <p>The folder on the Replicate machine in which the Reference File will be created.</p> <p><b>Note</b> Multiple tasks with file target endpoints that have the same target directory are not supported (as each task will attempt to write to the same reference file).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|                       | <p><b>Example:</b><br/>         c:\temp\</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Post-process files    | <p>You can process the final target files using a custom command. The command will be run whenever a data file is created.</p> <p><b>Note</b> If the <b>Generate a reference file</b> option is selected, a row (specifying the file's location) will be added to the Reference File only <i>after</i> the command completes successfully.</p> <ul style="list-style-type: none"> <li>» <b>Command name</b> - The location of the command e.g.<br/>             C:\utils\move.exe.</li> <li>» <b>Working directory</b> - The directory where you want the command to run.</li> <li>» <b>Parameters</b> - Specify any parameters that need to be passed to the command during runtime. You can use the following built-in parameters:             <ul style="list-style-type: none"> <li>    \${FILENAME} - The full path to the CSV file containing the full load or CDC data.</li> <li>    \${METADATA_FILENAME} - The full path to the DFM file containing the metadata.</li> </ul> </li> </ul> <p><b>Note</b> If the CSV/DFM file paths contain spaces, you must enclose</p> |

**Table 9.17 | File Target Endpoint - Advanced Tab Options (Cont.)**

| Option                          | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                 | these parameters with quotation marks (e.g. "\${FILENAME}").                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|                                 | For information on creating metadata files, see <a href="#">Setting General Properties</a> .                                                                                                                                                                                                                                                                                                                                                                                                                             |
|                                 | <b>Standard Post Command Exit Codes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                                 | The post-processing command must return a proper exit code. You can either use the standard exit code values described below or set a custom exit code value as described in <a href="#">Setting Post Command Exit Codes with an Internal Parameter</a> .                                                                                                                                                                                                                                                                |
|                                 | <ul style="list-style-type: none"> <li>» <b>0</b> - Success</li> <li>» <b>1</b> - Recoverable error. The task will recover from the point of failure according to the settings in the <a href="#">Environmental Errors</a> tab.</li> <li>» <b>2</b> - Table error. If a table error occurs, Replicate will handle the error according to the settings in the <a href="#">Table Errors</a> tab.</li> <li>» <b>3</b> (or any other value e.g. -100) - Fatal error. The task will fail and not attempt recovery.</li> </ul> |
|                                 | <b>Setting Post Command Exit Codes with an Internal Parameter</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                 | You can use internal parameters to set exit codes with custom values. This is especially useful if your application already uses the standard exit code values.                                                                                                                                                                                                                                                                                                                                                          |
|                                 | See <a href="#">Standard Post Command Exit Codes</a> above for a description of the exit codes.                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                                 | <ul style="list-style-type: none"> <li>» successExitCode</li> <li>» recoverableErrorExitCode</li> <li>» tableErrorExitCode</li> <li>» fatalErrorExitCode</li> </ul>                                                                                                                                                                                                                                                                                                                                                      |
|                                 | For instructions on setting internal parameters, see <a href="#">Internal Parameters</a> .                                                                                                                                                                                                                                                                                                                                                                                                                               |
| After post processing completes | <p>You can decide what to do with the original target files after post-processing completes:</p> <ul style="list-style-type: none"> <li>» <b>Do nothing</b> - Leaves the files in their original location</li> <li>» <b>Delete files</b> - Deletes the files from the disk</li> <li>» <b>Replace file extension with</b> - Replaces the file extension with the specified extension.</li> </ul>                                                                                                                          |

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI and should only be used if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your setting by clicking the View Setting Summary link. This is useful if you need to send a summary of your setting to Attunity Support.

## Generating Reference Files

In the **Advanced** tab of the File Target endpoint, you can enable the **Generate a reference file** option. The Reference File contains a list of the **Change File** locations and is therefore only relevant if the task's Apply Changes or Store Changes options are enabled.

The reference file name format is as follows:

```
<file_target_endpoint_display_name><counter>.csv|json
```

### Example:

FileTarget00000001.csv

**Note** The counter suffix increases incrementally each time a new Reference File is generated (i.e. when the file reaches the maximum size defined [in the General tab](#)). Once a new Reference File has been generated, you can delete the old reference file(s) if required.

Whenever an Apply Changes data file is created, a new row is added to the Reference File in the following format:

```
<Source_Table_Name>, <full_path_to_data_file>
```

### Example:

MyTable, c:\temp\filetarget\dbo.MyTable\20170102-091759447.csv

Note that if the **Post-process files** option in the **Advanced** tab is also enabled, the Reference File will be generated *after* the post-processing completes.

**Note**

- » When both the **Post-process files** and the **Delete files** (after post-processing completes) options are enabled, the reference file will not be generated.
- » If the **Archive files to folder** (after post-processing completes) option is selected, the reference file will be updated to reflect the archive location of the data files.

# Using SAP Sybase IQ as a Target

This section describes how to set up and use a SAP Sybase IQ database as a target database in a replication task.

## In this section:

[Prerequisites](#)

[Limitations](#)

[Security Requirements](#)

[SAP Sybase IQ Target Data Types](#)

[Setting General Connection Properties](#)

[Setting Advanced Connection Properties](#)

## Prerequisites

Make sure the following prerequisites have been met:

- » Attunity Replicate is installed on any Windows computer in your network.
- » A Sybase account with the required access privileges exists.
- » SAP Sybase IQ 64-bit ODBC client installed on the computer where Attunity Replicate is located.

## Limitations

The following limitations apply:

- » Full LOB mode is not supported.
- » Replication of LOBs during Change Processing is not supported in Bulk Apply mode (LOB values are replicated to NULL).

## Security Requirements

You must provide SAP Sybase IQ account access to the Attunity Replicate user. This user must have read/write privileges in the SAP Sybase IQ database.

## SAP Sybase IQ Target Data Types

The following table shows the Sybase target data types that are supported when using Attunity Replicate and the default mapping from Attunity Replicate data types.

**Note** SAP Sybase IQ does not support applying changes to binary data types in **Batch optimized apply** mode. For more information on **Batch optimized apply** mode, see [Change Processing Tuning](#).

For information on how to view the data type that is mapped from the source, see the section for the source database you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 9.18 | Supported SAP Sybase IQ Data Types with Mapping from Attunity Replicate Data Types**

| Attunity Replicate Data Types | SAP Sybase IQ Data Types                                                                          |
|-------------------------------|---------------------------------------------------------------------------------------------------|
| BOOLEAN                       | BIT                                                                                               |
| BYTES                         | VARBINARY (Length)                                                                                |
| DATE                          | DATE                                                                                              |
| TIME                          | TIME                                                                                              |
| DATETIME                      | If scale is => 0 and =< 6, then:<br>TIMESTAMP<br>If scale is => 7 and =< 9, then:<br>VARCHAR (37) |
| INT1                          | TINYINT                                                                                           |
| INT2                          | SMALLINT                                                                                          |
| INT4                          | INTEGER                                                                                           |
| INT8                          | BIGINT                                                                                            |
| NUMERIC                       | NUMERIC (p,s)                                                                                     |
| REAL4                         | REAL                                                                                              |
| REAL8                         | DOUBLE                                                                                            |
| STRING                        | VARCHAR (Length)                                                                                  |
| UINT1                         | TINYINT                                                                                           |
| UINT2                         | SMALLINT                                                                                          |
| UINT4                         | INTEGER                                                                                           |
| UINT8                         | BIGINT                                                                                            |
| WSTRING                       | VARCHAR (Length)                                                                                  |

**Table 9.18 | Supported SAP Sybase IQ Data Types with Mapping from Attunity Replicate Data Types (Cont.)**

| Attunity Replicate Data Types                                                      | SAP Sybase IQ Data Types |
|------------------------------------------------------------------------------------|--------------------------|
| <b>Note</b> The SAP Sybase IQ database requires a special license to support LOBs. |                          |
| BLOB                                                                               | BLOB                     |
| CLOB                                                                               | CLOB                     |
| NCLOB                                                                              | CLOB                     |

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

### Note

- » Sybase can also be used as a source database. For information on using Sybase as a source, see [Using SAP Sybase ASE as a Target](#).
- » You can also use Sybase files as a source or target. For more information, see [Using the Attunity Replicate File Channel](#).

### To add a SAP Sybase IQ database to Attunity Replicate:

1. In **Tasks** view, click **Manage Endpoint Connections** to open the **Manage Endpoints Connections** dialog box. Then click the **New Endpoint Connection** button.
2. In the **Name** field, type a name for your database. This can be any name that will help to identify the database being used.
3. In the **Description** field, type a description that helps to identify the Sybase database. This is optional.
4. Select **TARGET** as the database **role**.
5. Select **SAP Sybase IQ** as the database **Type**.
6. In the **Host** field, enter the hostname or IP address of the computer on which SAP Sybase IQ is installed.
7. In the **Server** field, enter the name of the Sybase server.
8. Optionally, change the default port (7878).
9. Type the Sybase authentication information (**User Name**, **Password**) for the authorized user for this Sybase database. If you do not know this information, see your Sybase database Administrator (DBA).

**Note**

- » This information is required. If you are using the **Advanced** tab to create a custom string, make sure to include the **User Name** and **Password** properties. See [Setting Advanced Connection Properties](#) for more information.
- » This information is case sensitive.
- » If you want to set custom properties for this database, see [Setting Advanced Connection Properties](#).

**Important:** Make sure that the Sybase user entered in the Sybase Authentication section has the correct access privileges. For information on how to provide the required privileges, see [Security Requirements](#).

10. In the **database** field, enter the name of the SAP Sybase IQ database.

## Setting Advanced Connection Properties

In the **Advanced** tab, you can set the following parameters:

- » **Max file size:** Select or type the maximum size (in KB) of a CSV file before the file is loaded into the Sybase database. The default value is 32000 KB.
- » **Work in version 12 compatibility mode:** You must enable this option when SAP Sybase IQ version12.x is the replication target. When this option is enabled, you also need to create a shared folder (for the CSV files) that is accessible from the Attunity Replicate Server machine and from the SAP Sybase IQ machine.
  - » **Local shared folder path:** The path to the shared folder from the local (Attunity Replicate Server) machine.  
Example: C:\Shared
  - » **Remote shared folder path:** The path to the shared folder from the remote (SAP Sybase IQ) machine.  
Example: /mnt/shared

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.

5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

# Using SAP HANA as a Target

This section describes how to set up and use a SAP HANA database as a target database in a replication task.

## In this section:

[Prerequisites](#)

[Permissions](#)

[Supported Data Types](#)

[Setting General Connection Properties](#)

[Setting Advanced Connection Properties](#)

## Prerequisites

- » **Windows:** Install the SAP HANA ODBC 64-bit Driver 2.x for Windows on the Replicate Server machine. The driver name is HDBODBC.
- » **Linux:** Install the SAP HANA ODBC 64-bit Driver 2.x for Linux on the Replicate Server machine. The driver name is HDBODBC.

Add the following section to the `odbcinst.ini` file located in directory `/etc`:

```
[HDBODBC]
Description=64-bit HANA ODBC Driver
Driver=/opt/sap/hdbcclient/libodbcHDB.so
fileUsage=1
```

## Permissions

The user specified in the [SAP HANA endpoint settings](#) must be granted the following permissions:

- » CREATE TABLES
- » ALTER
- » SELECT
- » INSERT
- » DELETE
- » DROP

## Supported Data Types

The Attunity Replicate SAP HANA target endpoint supports most SAP HANA data types. The following table shows the SAP HANA target data types that are supported when using Attunity Replicate and the default mapping from Attunity Replicate data types.

For information on how to view the data type that is mapped from the source, see the section for the source database you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 9.19 | Supported SAP HANA Data Types with Mapping from Attunity Replicate Data Types**

| Attunity Replicate Data Types | SAP HANA Data Types |
|-------------------------------|---------------------|
| BOOL                          | BOOLEAN             |
| BYTES                         | VARBINARY (Length)  |
| DATE                          | DATE                |
| TIME                          | TIME                |
| TIMESTAMP                     | TIMESTAMP           |
| INT1                          | TINYINT             |
| INT2                          | SMALLINT            |
| INT4                          | INTEGER             |
| INT8                          | BIGINT              |
| NUMERIC                       | DECIMAL (p,s)       |
| REAL4                         | REAL                |
| REAL8                         | DOUBLE              |
| STRING                        | VARCHAR (Length)    |
| UINT1                         | TINYINT             |
| UINT2                         | SMALLINT            |
| UINT4                         | INTEGER             |
| UINT8                         | BIGINT              |
| WSTRING                       | NVARCHAR (Length)   |
| BLOB                          | BLOB                |
| NCLOB                         | NCLOB               |
| CLOB                          | CLOB                |

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see [Setting Advanced Connection Properties](#) below.

### To add a SAP HANA target endpoint to Attunity Replicate:

1. In the Attunity Replicate console, click **Manage Endpoint Connections** to open the **Manage Endpoints Connections** dialog box.
2. In the **Name** field, type a name for your database. This can be any name that will help to identify the database being used.
3. In the **Description** field, optionally enter a description that helps to identify the SAP HANA database.
4. Select **Target** as the database **role**.  
You can do this step before any of the other steps if you want, however before you can continue with the next step in this process, you must select the database **role**.
5. Select **SAP HANA** as the database **Type**.
6. In the **Instance** field, enter the instance number of the target SAP HANA database.
7. Enter the **Username** and **Password** required to access the SAP HANA database. If you do not know this information, see your SAP HANA database administrator (DBA).

**Note** This information is case sensitive.

8. Click **Test Connection** to verify that the specified settings are correct.

## Setting Advanced Connection Properties

In the **Advanced** tab, you can set internal parameters and view a summary of your settings for the SAP HANA target endpoint.

### Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

### Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.



# Using Pivotal Greenplum as a Target

This section describes how to set up and use a Pivotal Greenplum database as a target in a replication task.

## In this section:

- [An Overview of the Pivotal Greenplum Target](#)
- [Attunity Replicate Pivotal Greenplum Endpoint Architecture Overview](#)
- [Full Load](#)
- [Applying Changes to the Pivotal Greenplum Target](#)
- [Required Pivotal Greenplum Software, Environments](#)
- [Provide Pivotal Greenplum Account Access](#)
- [Security Requirements](#)
- [Limitations](#)
- [Pivotal Greenplum Data Types](#)
- [Setting up the gpfdist Program as a Service](#)
- [Using Multiple gpfdist Programs](#)
- [Setting General Connection Properties](#)
- [Setting Advanced Connection Properties](#)

## An Overview of the Pivotal Greenplum Target

The Attunity Replicate database for Pivotal Greenplum is a powerful operational data warehousing solution that manages Big Data analytics and challenges. Attunity Replicate uses Pivotal Greenplum's Scatter/Gather Streaming technology to help with data integration. This technology handles large amounts of data well.

The Attunity Replicate Pivotal Greenplum database makes it possible to load data from other heterogeneous data sources and maintain the most up to date information. This is done by capturing changes and streaming the changes to the Pivotal Greenplum data warehouse. This can be done with a very low impact on the source data.

The Attunity Replicate Pivotal Greenplum database provides full automation for:

- » Schema generation and data type mapping
- » Full load of source database tables
- » Incremental load of changes made to source tables
- » Application of schema changes (DDL) made to the source tables.
- » Synchronization between full load and CDC processes.

Manual control is also available if needed.

The Attunity Replicate Pivotal Greenplum database integrates with the Pivotal Greenplum database in two ways:

- » **Pivotal Greenplum ODBC API.** This is used for metadata management. The Pivotal Greenplum ODBC API lets Attunity Replicate test the database connection, get the table list and the table schema, build procedures that create external tables to process a file, and invoke the procedures that load the destination table or apply changes from the external table. During the schema generation, data types can be mapped, such as Pivotal Greenplum to Postgres. Primary keys and distribution clauses are generated based on the primary key.
- » **Pivotal Greenplum Parallel File Distribution Server (gpfdist).** This utility is used with read-only external tables for fast, parallel data loading into a Pivotal Greenplum data warehouse. gpfdist uses maximum parallelism while reading from external tables.

Attunity Replicate works closely with gpfdist to take advantage of its optimized fast, parallel loading facilities. Attunity Replicate uses the Pivotal Greenplum Parallel File Distribution Server to support both full load and incremental load activities.

See [Attunity Replicate Pivotal Greenplum Endpoint Architecture Overview](#) for a description of the system architecture used with the Pivotal Greenplum database.

## Attunity Replicate Pivotal Greenplum Endpoint Architecture Overview

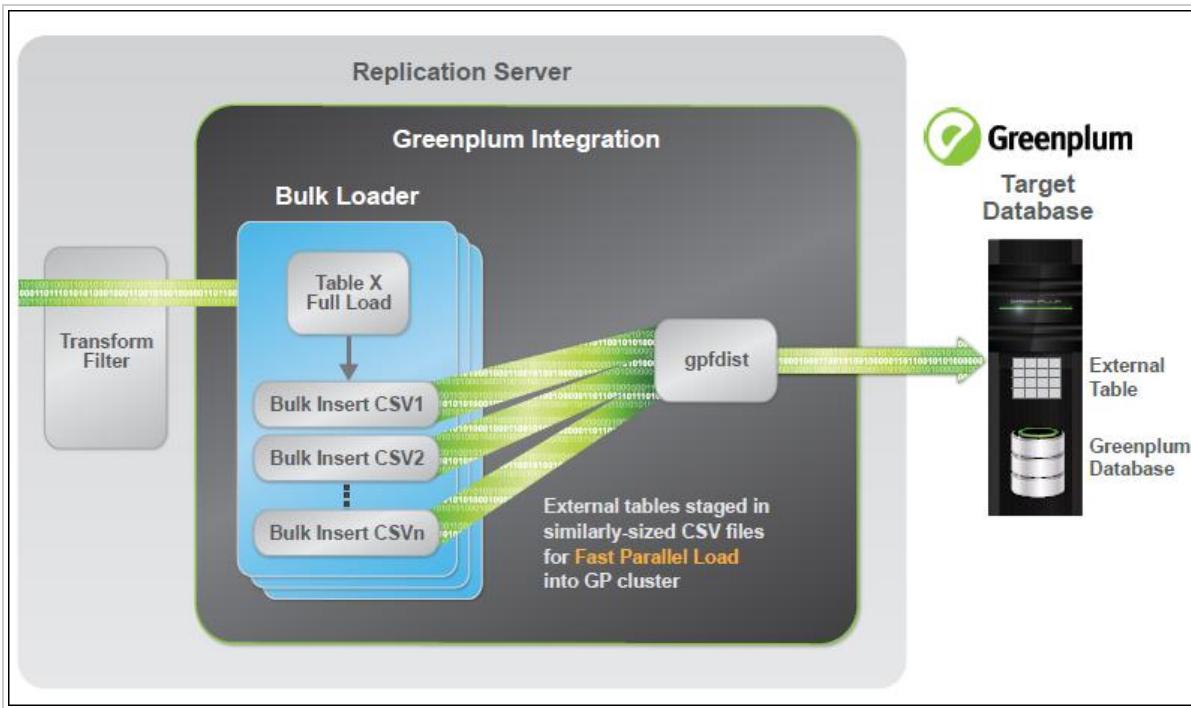
The following shows the Attunity Replicate Pivotal Greenplum endpoint system architecture for:

- » [Full Load](#)
- » [CDC](#)

### Full Load

Full load is used to setup or refresh a data warehouse on a target, by concurrently loading large amounts of data from source tables. High-speed data extraction is initiated from endpoints like Oracle or Microsoft SQL Server, then gpfdist and buffered load files are used for high-speed data loading into Pivotal Greenplum. The following shows the Pivotal Greenplum database architecture for full load.

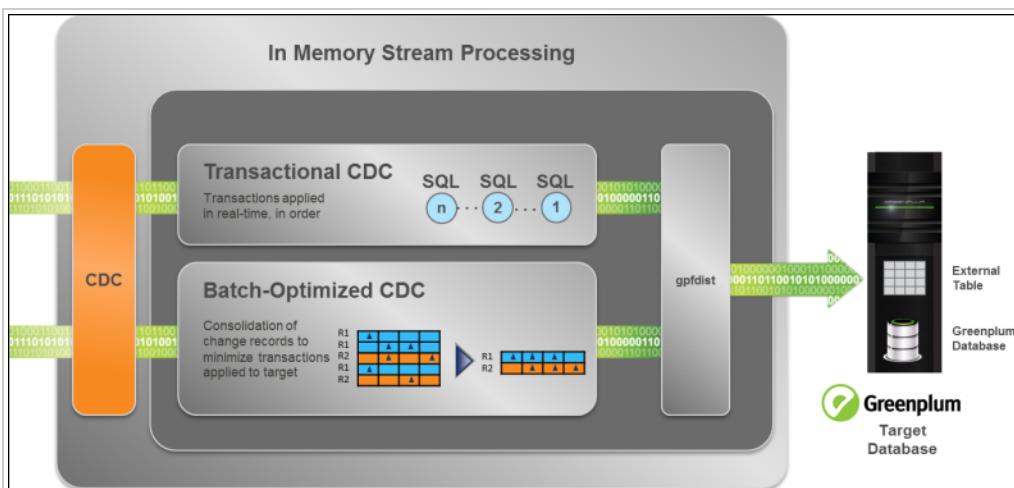
Figure 9.1 | Pivotal Greenplum database Full Load



## CDC

For incremental load, Attunity Replicate uses log-based change data capture (CDC). During CDC replication, Attunity Replicate creates external Web tables or external tables to load SQL statements into the target Pivotal Greenplum database. The statements are then applied to the target tables. The following shows the Pivotal Greenplum database architecture for CDC.

Figure 9.2 | Pivotal Greenplum database CDC



## Full Load

On the first run of a task the Pivotal Greenplum target writes the data being replicated to CSV files into a folder that is defined for the task. The CSV files are named sequentially, for example, loadNNNN, where NNNN is an incremental number starting from 0. The maximum file size of the CSV file is set by the user when configuring the Pivotal Greenplum database.

When the CSV file reaches its maximum size it is renamed and moved into a load folder. It is then read by the gpfdist utility, which executes an SQL statement that loads the data into the target table. Once the file loading is complete, the file is deleted.

## Applying Changes to the Pivotal Greenplum Target

You can apply changes in one of two modes:

- » [Transactional Apply Mode](#)
- » [Batch-Optimized Apply Mode](#)

For information on how to use the transactional apply mode, see [Apply Changes Settings](#).

### Transactional Apply Mode

In this mode, the Pivotal Greenplum database writes all the change records to CSV files as DML statement. When a file is ready, the Pivotal Greenplum database creates an external Web table that uses the gpfdist server to read changes from the file and executes the DML statements in each row returned from the external Web table. When the changes are applied, the file is deleted.

### Batch-Optimized Apply Mode

In this mode, the Pivotal Greenplum database writes net changes only to CSV files. When a file is ready, the Pivotal Greenplum database uses an external table that uses the gpfdist server to read the net changes from the file to a temporary table. The net changes are then applied to the target tables in the most efficient way. When the changes are applied, the file is deleted.

## Required Pivotal Greenplum Software, Environments

You can use the Pivotal Greenplum database with Attunity Replicate on either a Windows or Linux computer. The following sections describe the prerequisites necessary to prepare your environment to work with Attunity Replicate and a Pivotal Greenplum database.

- » [Windows Pivotal Greenplum Required Software](#)
- » [Linux Pivotal Greenplum Required Software](#)
- » [Required Pivotal Greenplum Configuration and Environment](#)

## Windows Pivotal Greenplum Required Software

You must install the following on the same computer where the Attunity Replicate Server is installed:

- » Pivotal Greenplum Client Tools 4.2.x
- » Pivotal Greenplum Connectivity Tools 4.2.x
- » Pivotal Greenplum Loaders 4.2.x (This will install the gpfdist program)
- » Pivotal Greenplum DataDirect ODBC Drivers Version 7.x (only).

You can download the ODBC drivers from [emc.subscribenet.com](http://emc.subscribenet.com).

**Important:** To prevent errors during replication tasks, make sure that the Pivotal Greenplum ODBC driver has a valid license.

## Linux Pivotal Greenplum Required Software

You must make sure to configure the Linux computer as follows:

- » Pivotal Greenplum Connectivity Tools 4.2.1.0. Unzip and install all of the components.
- » Install and configure **UnixODBC**.
- » Ensure that the following Pivotal Greenplum environment scripts are executed when logging into the account where Attunity Replicate is run:
  - » greenplum\_connectivity\_path.sh
  - » greenplum\_clients\_path.sh
  - » greenplum\_loaders\_path.sh
- » Make sure that port 8080 is open.

## Required Pivotal Greenplum Configuration and Environment

Attunity Replicate relies on the proper functioning of the Pivotal Greenplum's gpfdist program on the computer with Attunity Replicate (the local computer). gpfdist is a simple Web server program with special performance customization for concurrent access from Pivotal Greenplum database segment nodes to data files on the local computer.

Because gpfdist is a Web server program and because it needs to be accessible from the Pivotal Greenplum database segment nodes, there are some networking configuration settings that must be in place to allow for this access. This is documented in the *EMC Pivotal Greenplum database Administration Guide*.

For further information, see [Pivotal Greenplum Prerequisites for Attunity Replicate](#).

## Provide Pivotal Greenplum Account Access

The Attunity Replicate user who is working with the Pivotal Greenplum database must be registered as a user in the Pivotal Greenplum database. This is the user that is entered in the dialog box when [Setting General Connection Properties](#). You must grant Pivotal

Greenplum account access to this user before configuring the database in Attunity Replicate.

**Note** One of the Attunity Replicate computer network cards must be part of the Pivotal Greenplum database segments network to allow communication with the gpfdist program.

See [Required Pivotal Greenplum Configuration and Environment](#) for additional information about connecting to and configuring a Pivotal Greenplum database to work with Attunity Replicate.

## Security Requirements

A user must have the following privileges granted in the Pivotal Greenplum database to use a Pivotal Greenplum target in an Attunity Replicate task:

- » CREATE table/external table/Web external table
- » TRUNCATE table
- » ALTER table
- » INSERT/UPDATE/DELETE

## Limitations

Attunity Replicate cannot update columns that are part of the distribution key.

The Pivotal Greenplum target database has limited LOB support. You cannot use an unlimited LOB size for this database. For more information, see [Pivotal Greenplum Data Types](#).

## Pivotal Greenplum Data Types

The Pivotal Greenplum database for Attunity Replicate supports most Pivotal Greenplum data types. The following table shows the Pivotal Greenplum target data types that are supported when using Attunity Replicate and the default mapping from Attunity Replicate data types.

For information on how to view the data type that is mapped from the source, see the section for the source database you are using. For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 9.20 | Supported Pivotal Greenplum Data Types with Mapping from Attunity Replicate Data Types**

| Attunity Replicate Data Types | Pivotal Greenplum Data Types                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| BOOLEAN                       | bool                                                                                                                                                                                                                                                                                                                                                                                                     |
| BYTES                         | bytea                                                                                                                                                                                                                                                                                                                                                                                                    |
| DATE                          | date                                                                                                                                                                                                                                                                                                                                                                                                     |
| TIME                          | time (p)                                                                                                                                                                                                                                                                                                                                                                                                 |
| DATETIME                      | timestamp (p)                                                                                                                                                                                                                                                                                                                                                                                            |
| INT1                          | int2                                                                                                                                                                                                                                                                                                                                                                                                     |
| INT2                          | int2                                                                                                                                                                                                                                                                                                                                                                                                     |
| INT4                          | int4                                                                                                                                                                                                                                                                                                                                                                                                     |
| INT8                          | int8                                                                                                                                                                                                                                                                                                                                                                                                     |
| NUMERIC                       | numeric (p,s)                                                                                                                                                                                                                                                                                                                                                                                            |
| REAL4                         | float4                                                                                                                                                                                                                                                                                                                                                                                                   |
| REAL8                         | float8                                                                                                                                                                                                                                                                                                                                                                                                   |
| STRING                        | varchar (n); n=data length                                                                                                                                                                                                                                                                                                                                                                               |
| UINT1                         | int2                                                                                                                                                                                                                                                                                                                                                                                                     |
| UINT2                         | int4                                                                                                                                                                                                                                                                                                                                                                                                     |
| UINT4                         | int8                                                                                                                                                                                                                                                                                                                                                                                                     |
| UINT8                         | numeric (20)                                                                                                                                                                                                                                                                                                                                                                                             |
| WSTRING                       | varchar (n); n=length                                                                                                                                                                                                                                                                                                                                                                                    |
| BLOB                          | bytea<br><br>To use this data type with Attunity Replicate, you must enable the use of BLOBs for a specific task.<br><br>LOB data types are supported only in tables that include a primary key.<br><br>The Pivotal Greenplum target database has limited LOB support. You cannot use an unlimited LOB size for this database.<br><br>For more information, see <a href="#">Task Settings/Metadata</a> . |
| CLOB                          | text<br><br>To use this data type with Attunity Replicate, you must enable the use of CLOBs for a specific task.<br><br>LOB data types are supported only in tables that include a primary                                                                                                                                                                                                               |

**Table 9.20 | Supported Pivotal Greenplum Data Types with Mapping from Attunity Replicate Data Types (Cont.)**

| Attunity Replicate Data Types | Pivotal Greenplum Data Types                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                               | <p>key.</p> <p>The Pivotal Greenplum target database has limited LOB support. You cannot use an unlimited LOB size for this database.</p> <p>For more information, see <a href="#">Task Settings/Metadata</a>.</p>                                                                                                                                                                                             |
| NCLOB                         | <p>text</p> <p>To use this data type with Attunity Replicate, you must enable the use of NCLOBs for a specific task.</p> <p>LOB data types are supported only in tables that include a primary key.</p> <p>The Pivotal Greenplum target database has limited LOB support. You cannot use an unlimited LOB size for this database.</p> <p>For more information, see <a href="#">Task Settings/Metadata</a>.</p> |

## Setting up the gpfdist Program as a Service

You can use the gpfdist program as a service when replicating data to Pivotal Greenplum endpoints using Attunity Replicate. In this way it is assured that a replication task that is running will not lose its connection to gpfdist. This solution is best used when more than one task is using the same gpfdist program.

Note that you can set up Pivotal Greenplum endpoints as described in [Setting General Connection Properties](#) and test it without creating a service, but you should create the service before you begin to work with the Pivotal Greenplum endpoints.

**Note** If you want to use multiple gpfdist programs, then you should set them up on different ports. See [Using Multiple gpfdist Programs](#).

### To create use a gpfdist service:

- From the command-line console on the computer where Attunity Replicate is installed, change the directory to the directory where Attunity Replicate is installed.
- Type the following at the command-line prompt to create the service.

```
repctl service create <name of service (optional)> database=<name of
Pivotal Greenplum database>
```

**Note** The Pivotal Greenplum database that you use in this command must be configured in Attunity Replicate. If you have defined more than one Pivotal Greenplum database, you can use any of the database names. All of the defined endpoints on the same Attunity Replicate instance are included in the defined service.

3. Start the service before you run any Pivotal Greenplum tasks by typing the following at the command line prompt:

```
sc start AttunityReplicateServer_<name of database you defined the service with>
```

**Note** If you chose to create a data folder in a separate location from where you installed Attunity Replicate, you must add the prefix `-d <path to data folder>` before any command line task described in this section. For example, to start the service you must type:

```
-d <path to data folder> sc start AttunityReplicateServer_<name of database>
```

Working with a data folder in a different location is recommended when working with large Pivotal Greenplum endpoints. For more information, see [Attunity Replicate on Windows: Installing, Upgrading and Uninstalling](#).

#### To stop the service:

- » Type the following at the command-line prompt:

```
sc stop AttunityReplicateServer_<name of database you defined the service with>
```

#### To delete the service:

- » Type the following at the command-line prompt:

```
sc delete AttunityReplicateServer_<name of database you defined the service with>
```

**Note** A log file is available in the Attunity Replicate data folder and in the Pivotal Greenplum debug files, which is accessed through the Pivotal Greenplum database console.

## Using Multiple gpfdist Programs

You can define each replication task that has a Pivotal Greenplum database as a target to use a separate gpfdist program. In this case each gpfdist should run on a different port. If you want to use the same gpfdist program for each task, you may want to use the gpfdist

program as a service. For more information, see [Setting up the gpfdist Program as a Service](#).

#### To use gpfdist on multiple ports:

1. Install gpfdist programs on the computers you want to use them. See [Pivotal Greenplum Prerequisites for Attunity Replicate](#).
2. Make sure that you assign a different port number for the gpfdist program in each task. For more information, see [Setting General Connection Properties](#).

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see [Setting Advanced Connection Properties](#) below.

#### To add a Pivotal Greenplum Target endpoint to Attunity Replicate:

1. In **Tasks** view, click **Manage Endpoint Connections** to open the **Manage Endpoint Connections** dialog box.
2. In the **Manage database Connections** dialog box, click **New Endpoint Connection**.
3. In the **Name** field, type a name for your database. This can be any name that will help to identify the database being used.
4. In the **Description** field, type a description that helps to identify the Pivotal Greenplum database. This is optional.
5. Select **TARGET** as the database **role**.
6. Select **Pivotal Greenplum** as the database **Type**.
7. Type the **Database host name**. This is the name of the computer with the Pivotal Greenplum instance you want to work with.

**Note** Although the gpfdist program acts as a Webserver, it does not carry out security checks on any requests made to it. Therefore, when you define the path to the gpfdist program, it must be to a specific location so that no other data on the computer is accessed.

You can use the **Advanced** tab to add specific properties and create a custom connect string. In this case, you do not need to enter information in this tab. For more information on using the **Advanced** tab, see [Setting Advanced Connection Properties](#).

8. Type the Pivotal Greenplum database Port, where the Pivotal Greenplum instance you are working with is located. The default value is 5432.
9. Type the Pivotal Greenplum authentication information (**User Name, Password**) for

the authorized user for this Pivotal Greenplum database. If you do not know this information, see your Pivotal Greenplum system manager.

#### Note

- » If you are using the **Advanced** tab to create a custom string, make sure to include the **User Name** property. A **Password** can also be included but is not required. See [Setting Advanced Connection Properties](#) for more information.
- » This information is case sensitive.
- » If you want to set custom properties for this database, see [Setting Advanced Connection Properties](#).
- » To determine if you are connected to the database you want to use or if the connection information you entered is correct, click **Test Connection**.  
If the connection is successful a message in green is displayed. If the connection fails, an error message is displayed at the bottom of the dialog box.  
To view the log entry if the connection fails, click **View Log**. The server log is displayed with the information for the connection failure. Note that this button is not available unless the test connection fails.

**Important:** Make sure that the Pivotal Greenplum user entered in the Pivotal Greenplum Authentication section has the correct access privileges. For information on how to provide the required privileges, see [Security Requirements](#).

10. Type the **Database name** or select one from the list of available databases. This is the name of the Pivotal Greenplum database where you are replicating the data to.
11. Type the **gpfdist hostname** for the server where the gpfdist program is installed.
12. Type the **gpfdist port** number where the gpfdist program is listening. The default value is 8080.
13. In the **Security** section:
  - a. To enable SSL, select the **Use SSL** check box.
  - b. In the **CA Path**, specify the folder containing the certificate required to execute gpfdist.
  - c. In the **Public key file** field, specify the full path of the public key file (i.e. including the file name). The file can reside in the same folder as the CA certificate.
  - d. In the **Private key file** field, specify the full path of the private key file (i.e. including the file name). The file can reside in the same folder as the CA certificate.

## Setting Advanced Connection Properties

In the **Advanced** tab, you can set the following parameters:

- » **gpfdist max row length:** Select or type the maximum length of a row (number of characters) in the CSV file that is sent to the gpfdist program. This is the maximum row length read by gpfdist. The default value is 32,768. The larger the size of the rows the more resources the gpfdist program uses.
- » **Create tables in tablespace:** Type the name of the tablespace where you want create the target tables. This is optional. Note that the tablespace that you enter must exist in the Pivotal Greenplum database.
- » **Max file size (KB):** Select or type the maximum size (in KB) of a CSV file before the file is moved into the load folder. The default value is 32000 KB.
- » **Write buffer size:** (KB): Select or type the maximum amount of memory (in Kilobytes) used to store the data before moving it to the load folder. The default value is 1001.
- » **ODBC driver:** Type the name of the ODBC driver you are using to connect to the Pivotal Greenplum database you are working with. The default value is **DataDirect 7.0 Pivotal Greenplum Wire Protocol**.
- » **Additional ODBC connection properties:** Type any additional ODBC connection properties if required
- » **Use externally managed gpfdist:** Select this check box to use an external gpfdist with this Pivotal Greenplum database.
- » **Storage folder:** Type the name and location (enter full path) of the folder that holds the CSV files for loading. This is available only if you are using an externally managed gpfdist.

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.



# Using Actian Vector as a Target

This section describes how to set up and use an Actian Vector database as a target in a replication task.

## In this section:

[Prerequisites](#)

[Limitations](#)

[Permissions](#)

[Actian Vector Data Types](#)

[Setting General Connection Properties](#)

[Setting Advanced Connection Properties](#)

## Prerequisites

An Actian Vector database with the tables that are being used for replication must be available to the system. Attunity Replicate supports using an Actian Vector database on both Windows and Linux.

Actian Vector 3.0 must be installed on the same machine as Attunity Replicate Server. From Actian Vector 3.5, with the addition of remote load support, Replicate and Actian Vector do not need to be installed on the same machine. When Actian Vector is installed on a remote machine (i.e. *not* on the Replicate machine), Client Runtime 3.5.1 or above for Linux/Windows needs to be installed on the Replicate machine.

For more information about the requirements for working with Attunity Replicate, see [Installation Prerequisites](#).

The following sections describe the prerequisites necessary to prepare your environment to work with Attunity Replicate and an Actian Vector database:

- » [Actian Vector Windows Environment Prerequisites](#)
- » [Actian Vector Linux Environment Prerequisites](#)

## Actian Vector Windows Environment Prerequisites

The following must be installed:

- » Actian Vector database on any computer in your network. Make sure to configure the tables that you need for replication.
- » Actian Vector DBA Tools. This includes the Ingres ODBC driver 3.0 or above. You must install the DBA tools on the same computer as the Actian Vector database.

For more information, see the Actian Web site.

## Actian Vector Linux Environment Prerequisites

You must install the following:

- » Be sure to configure the Ingres ODBC driver. This driver supports unixODBC and is included in the Actian Vector database installation. unixODBC is built in to most Linux distributions.

Linux releases of Ingres include the ODBC CLI. The CLI is an ODBC manager/library that is built specifically for Ingres. The CLI is installed on Linux platforms at the same time as the ODBC driver. The CLI allows ODBC applications to be developed and deployed without the need to manage or use unixODBC. Use the iiocdbcadm tool to manage DSN definitions (or use a connection string that specifies the database name). IIocdbcadm can be used with either unixODBC or CLI applications. For information on configuring the ODBC driver, go to the following page on the Actian Web site:  
[http://community.actian.com/wiki/Ingres\\_UNIX\\_ODBC](http://community.actian.com/wiki/Ingres_UNIX_ODBC).

## Limitations

The following DDL operations cannot be made to the Actian Vector database using Attunity Replicate:

- » Change schema name
- » Change column type

The replication task fails when applying DDL changes that were initiated in source but not supported on target.

## Permissions

The Attunity Replicate user who is working with the Actian Vector database must be registered as a user in the Actian Vector database. This is the user that is entered in the dialog box when [Setting General Connection Properties](#). You must grant Actian Vector account access to this user before confiding the database in Attunity Replicate.

## Actian Vector Data Types

The Actian Vector database for Attunity Replicate supports most Actian Vector data types. The following table shows the Actian Vector target data types that are supported when using Attunity Replicate and the default mapping from Attunity Replicate data types.

**Note** Actian Vector does not support applying changes to binary data types in **Batch optimized apply** mode. For more information on **Batch optimized apply** mode, see [Change Processing Tuning](#).

For information on how to view the data type that is mapped from the source, see the section for the source database you are using. For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 9.21 | Supported Actian Vector Data Types with Mapping from Attunity Replicate Data Types**

| Attunity Replicate Data Types | Actian Vector Data Types                                                                                                                |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| BOOLEAN                       | VARCHAR (length)                                                                                                                        |
| BYTES                         | If length is => 1 and =< 16000, then:<br>VARCHAR (Length in Bytes)<br>If length is => 16001 and =< 2147483647, then:<br>VARCHAR (32000) |
| DATE                          | ANSIDATE                                                                                                                                |
| TIME                          | TIME                                                                                                                                    |
| DATETIME                      | TIMESTAMP                                                                                                                               |
| INT1                          | INTEGER1                                                                                                                                |
| INT2                          | SMALLINT                                                                                                                                |
| INT4                          | INTEGER                                                                                                                                 |
| INT8                          | INTEGER8                                                                                                                                |
| NUMERIC                       | DECIMAL (p,s)                                                                                                                           |
| REAL4                         | FLOAT4                                                                                                                                  |
| REAL8                         | FLOAT                                                                                                                                   |
| STRING                        | If length is => 1 and =< 32000, then:<br>VARCHAR (Length)<br>If length is => 32001 and =< 2147483647, then:<br>VARCHAR (32000)          |
| UINT1                         | SMALLINT                                                                                                                                |
| UINT2                         | INTEGER                                                                                                                                 |
| UINT4                         | INTEGER8                                                                                                                                |
| UINT8                         | INTEGER8                                                                                                                                |
| WSTR                          | If length is => 1 and =< 16000, then:<br>NVARCHAR (Length)<br>If length is => 16001 and =< 2147483647, then:<br>NVARCHAR (16000)        |

**Table 9.21 | Supported Actian Vector Data Types with Mapping from Attunity Replicate Data Types (Cont.)**

| Attunity Replicate Data Types               | Actian Vector Data Types                                                                                                                  |
|---------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Note About Actian Vector LOB support</b> |                                                                                                                                           |
| BLOB                                        | VARCHAR (16000)                                                                                                                           |
|                                             | <p><b>Note</b> The maximum LOB size in the <a href="#">Metadata</a> tab cannot exceed 15 KB.</p>                                          |
| NCLOB                                       | NVARCHAR (16000)                                                                                                                          |
|                                             | <p><b>Note</b> The maximum LOB size in the <a href="#">Metadata</a> tab cannot exceed 15 KB.</p>                                          |
| CLOB                                        | <p>In <b>Batch optimized apply</b> mode:<br/>VARCHAR (32000)</p>                                                                          |
|                                             | <p><b>Note</b> In <b>Batch optimized apply</b> mode, the maximum LOB size in the <a href="#">Metadata</a> tab cannot exceed 31 KB.</p>    |
|                                             | <p>In <b>Transactional apply</b> mode:<br/>VARCHAR (16000)</p>                                                                            |
|                                             | <p><b>Note</b> In <b>Transactional apply</b> mode, the maximum LOB size in the <a href="#">Metadata</a> tab cannot exceed 31 KB.</p>      |
|                                             | <p>For more information on <b>Transactional apply</b> and <b>Batch optimized apply</b>, see <a href="#">Change Processing Tuning</a>.</p> |

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

### To add an Actian Vector target endpoint to Attunity Replicate:

1. In **Tasks** view, click **Manage Endpoint Connections** to open the **Manage Endpoints Connections** dialog box. Then click the **New Endpoint Connection** button.
2. In the **Name** field, type a name for your database. This can be any name that will help to identify the database being used.
3. In the **Description** field, type a description that helps to identify the Greenplum database. This is optional.
4. Select **TARGET** as the database **role**.
5. Select **Actian Vector Target** as the database **Type**.
6. In the **Server** field, enter the hostname or IP address of the machine on which the Actian Vector database is installed.

**Note** You can use the **Advanced** tab to add specific properties and create a custom connect string. In this case, you do not need to enter information in this tab. For more information on using the **Advanced** tab, see [Setting Advanced Connection Properties](#).

7. Type the Actian Vector authentication information (**User name**, **Password**) for the authorized user for this Actian Vector database. If you do not know this information, see your Actian Vector system manager.

#### Note

- » If you are using the **Advanced** tab to create a custom string, make sure to include the **User Name** property. A **Password** can also be included but is not required. See [Setting Advanced Connection Properties](#) for more information.
- » This information is case sensitive.
- » If you want to set custom properties for this database, see [Setting Advanced Connection Properties](#).
- » To determine if you are connected to the database you want to use or if the connection information you entered is correct, click **Test Connection**.

If the connection is successful a message in green is displayed. If the connection fails, an error message is displayed at the bottom of the dialog box.

To view the log entry if the connection fails, click **View Log**. The server log is displayed with the information for the connection failure. Note that this button is not available unless the test connection fails.

## Setting Advanced Connection Properties

In the **Advanced** tab, you can set the following parameters:

- » **Max file size (KB)**: Select or type the maximum file size. When the Actian Vector file reaches this value, the data is loaded by the vmload utility. The default value is 300000 KB.

### Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

#### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

### Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

# Using Amazon Redshift as a Target

This section describes how to set up and use Amazon Redshift as a target in a replication task. Amazon Redshift is located in the cloud and is accessed through an Amazon Web Services (AWS) account.

## In this section:

[Introducing the Amazon Redshift Target Endpoint for Attunity Replicate](#)

[Limitations](#)

[Amazon Redshift Database Prerequisites](#)

[Amazon Redshift Data Types](#)

[Setting General Connection Parameters](#)

[Setting Advanced Connection Properties](#)

## Introducing the Amazon Redshift Target Endpoint for Attunity Replicate

Amazon Redshift is a fully-managed petabyte-scale data warehouse service in the cloud.

In the first stage of the replication process, Attunity Replicate moves the data files created by the source database into an Amazon S3 bucket. The files are then loaded into the proper tables in the Amazon Redshift data warehouse (using the "copy" command).

The Amazon Redshift database provides full automation for:

- » Schema generation and data type mapping
- » Full load of source database tables
- » Incremental load of changes made to source tables
- » Application of schema changes (DDL) made to the source tables.
- » Synchronization between full load and CDC processes.

Manual control is also available if needed.

## Limitations

The following limitations apply to the Amazon Target endpoint:

- » The ALTER TABLE <NAME> MODIFY COLUMN <NAME> <DATA\_TYPE> DDL is not supported.
- » Applying a DELETE statement to a table with a multi-column primary key is not supported if any of the primary key column names is a reserved word (e.g. "tag").  
For a list of reserved Amazon Redshift words, see  
[http://docs.aws.amazon.com/redshift/latest/dg/r\\_pg\\_keywords.html](http://docs.aws.amazon.com/redshift/latest/dg/r_pg_keywords.html)

## Amazon Redshift Database Prerequisites

The following sections describe the prerequisites necessary for working with the Amazon Redshift database:

- » [Get Started with Amazon Redshift](#)
- » [Sign up for an Amazon S3 Bucket](#)
- » [Open the Required Firewall Port](#)

### Get Started with Amazon Redshift

Once you register for an Amazon Web Services (AWS) account, you can launch an Amazon Redshift cluster and download the required SQL client tools. The following describes what you need to do to get started using Amazon Redshift as an Attunity Replicate target database.

- » Sign up for an Amazon Web Services account. Then use the AWS Management Console to launch an Amazon Redshift cluster. You should note the basic information about your AWS account and your Amazon Redshift cluster, such as your password and user name. You will need this information to configure Attunity Replicate to work with the Amazon Redshift database. For more information, see [Setting General Connection Parameters](#).
- » The Attunity Replicate Server machine must be set to the correct time (UTC).
- » Download and install the Windows or Linux SQL client tools (according to your Replicate Server platform) necessary to connect to the Amazon Redshift cluster. Attunity Replicate requires that you download a 64-bit ODBC driver.

For a list of drivers supported by Amazon Redshift, see

<http://docs.aws.amazon.com/redshift/latest/mgmt/configure-odbc-connection.html>.

By default, Attunity Replicate uses the Amazon Redshift (x64) driver. If you use a different driver, you must change this in the Amazon Redshift database settings in the Attunity Replicate Console. For more information, see [Setting Advanced Connection Properties](#).

**Note** To avoid conflicts when installing the driver on a Linux machine, Attunity Replicate must be installed *before* you install the driver. Install the Amazon Redshift ODBC driver with --force in the command, as in the following example:

```
rpm -ivh AmazonRedshiftODBC-64bit-1.2.6.1006-1.x86_64.rpm --force
```

Once the driver is installed, edit the **amazon.redshiftodbc.ini** file as follows:

```
DriverManagerEncoding=UTF-16  
ODBCInstLib=libodbcinst.so
```

For information on signing up for an Amazon Web Services account, launching an Amazon Redshift cluster, and installing the client tools, see the Amazon Redshift Getting Started page at <http://docs.aws.amazon.com>.

## Sign up for an Amazon S3 Bucket

You need to have an Amazon S3 bucket, preferably (for best performance) located in your Amazon Redshift cluster region. You must be able to access your Amazon S3 bucket directly from the machine.

For information on signing up for Amazon S3, see <http://aws.amazon.com/s3/>.

- » Bucket access credentials: Make a note of the bucket name, region, access key and secret access key - you will need to provide them in the Amazon Redshift target endpoint settings.
- » Bucket access permissions: requires read/write/delete permissions to the Amazon S3 bucket.

## Open the Required Firewall Port

Firewall port 5439 (Amazon Redshift Cluster) need to be opened for outbound communication.

## Amazon Redshift Data Types

The Amazon Redshift database for Attunity Replicate supports most Amazon Redshift data types. The following table shows the Amazon Redshift target data types that are supported when using Attunity Replicate and the default mapping from Attunity Replicate data types.

For information on how to view the data type that is mapped from the source, see the section for the source database you are using. For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 9.22 | Supported Amazon Redshift Data Types with Mapping from Attunity Replicate Data Types**

| Attunity Replicate Data Types | Amazon Redshift Data Types                                                                                                                     |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| BOOLEAN                       | BOOL                                                                                                                                           |
| BYTES                         | VARCHAR (Length)                                                                                                                               |
| DATE                          | DATE                                                                                                                                           |
| TIME                          | VARCHAR(20)                                                                                                                                    |
| DATETIME                      | If scale is => 0 and = < 6, then:<br>TIMESTAMP (s)<br>If scale is => 7 and = < 9, then:<br>VARCHAR (37)                                        |
| INT1                          | INT2                                                                                                                                           |
| INT2                          | INT2                                                                                                                                           |
| INT4                          | INT4                                                                                                                                           |
| INT8                          | INT8                                                                                                                                           |
| NUMERIC                       | If scale is => 0 and = < 37, then:<br>NUMERIC (p,s)<br>If scale is => 38 and = < 127, then:<br>VARCHAR (Length)                                |
| REAL4                         | FLOAT4                                                                                                                                         |
| REAL8                         | FLOAT8                                                                                                                                         |
| STRING                        | VARCHAR (Length multiplied by three)<br>For example, STRING (50) becomes<br>VARCHAR (150).                                                     |
| UINT1                         | INT2                                                                                                                                           |
| UINT2                         | INT2                                                                                                                                           |
| UINT4                         | INT4                                                                                                                                           |
| UINT8                         | NUMERIC (20,0)                                                                                                                                 |
| WSTRING                       | If length is => 1 and = < 65535, then:<br>NVARCHAR (Length in Bytes)<br>If length is => 65536 and = < 2147483647,<br>then:<br>NVARCHAR (65535) |

**Table 9.22 | Supported Amazon Redshift Data Types with Mapping from Attunity Replicate Data Types (Cont.)**

| Attunity Replicate Data Types                                                             | Amazon Redshift Data Types                                                                                                                                                                                  |                         |
|-------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| <b>Note About Amazon Redshift LOB support:</b>                                            | Full LOB data types are not supported. For information on including Limited-size LOB data types in the replication, see the <a href="#">Metadata</a> tab description in <a href="#">Customizing Tasks</a> . |                         |
| BLOB                                                                                      | VARCHAR (Max LOB Size *2)                                                                                                                                                                                   |                         |
| <b>Note</b> The maximum LOB size in the <a href="#">Metadata</a> tab cannot exceed 31 KB. | NCLOB                                                                                                                                                                                                       | NVARCHAR (Max LOB Size) |
| <b>Note</b> The maximum LOB size in the <a href="#">Metadata</a> tab cannot exceed 63 KB. | CLOB                                                                                                                                                                                                        | VARCHAR (Max LOB Size)  |
| <b>Note</b> The maximum LOB size in the <a href="#">Metadata</a> tab cannot exceed 63 KB. |                                                                                                                                                                                                             |                         |

## Setting General Connection Parameters

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

### To add an Amazon Redshift Target to Attunity Replicate:

1. In the Attunity Replicate Console, click Manage Endpoint Connections to open the **Manage Endpoints Connections** dialog box.
2. In the **Manage Endpoint Connections** dialog box, click **New Endpoint Connection**.
3. In the **Name** field, type a name for your Amazon Redshift data warehouse [service]. This can be any name that will help to identify your Amazon Redshift database.
4. Optionally, in the **Description** field, type a description that helps to identify the Amazon Redshift target database.
5. Select **TARGET** as the **role**.
6. Select **Amazon Redshift** as the **Type**.
7. Enter the following **Amazon Redshift target** information:

- » **Redshift cluster:** Type the name of the Amazon Redshift cluster you are using.
- » **Port:** Type the port number for Amazon Redshift.
- » **User name:** Type an Amazon Redshift user name for a registered user.
- » **Password:** Type the password for the user entered in the **User name** field.
- » **Database name:** Type the **database name** or select one from the list of available Amazon Redshift data warehouse [services].

The information for these properties is available from the account page for Amazon Web Services (AWS) with the Amazon Redshift cluster. If you do not have these values, refer to your AWS account or the Amazon Redshift System Administrator for your enterprise.

8. Enter the following **Amazon S3 staging** information. You may need to click the **Amazon S3 staging** header to see the information.
  - » **Bucket name:** Type the name of the Amazon S3 bucket where you are copying files to.
  - » **Bucket region:** Select the Amazon S3 region where the S3 buckets and folders you are using are hosted. The default value is **US East (N. Virginia)**.

**Note:** The bucket region specified must be the same region where your Amazon Redshift database is located.

- » **Access options:** Choose one of the following:
  - » **Key pair**

Choose this method to authenticate with your Access Key and Secret Key. When this option is selected, specify the following:
    - » **Access key:** Type the access key information for Amazon S3.
    - » **Secret key:** Type the secret key information for Amazon S3.
  - » **IAM Roles for EC2**

Choose this method if the machine on which Attunity Replicate is installed is configured to authenticate itself using an IAM role.

For more information about this access option, see:  
[http://docs.aws.amazon.com/IAM/latest/UserGuide/id\\_roles.html](http://docs.aws.amazon.com/IAM/latest/UserGuide/id_roles.html)
  - » **Security Token Service (STS)**

Choose this method to authenticate using SAML 2.0 with Active Directory Federation Services.

When this option is selected, specify the following:
    - » **ADFS URL:** The URL to an Active Directory Federation Services page, responsible for returning a SAML claims document to be sent over to AWS.
    - » **AD principal name:** The principal (user) name to use when identifying

against ADFS.

The format should be: user.name@domain

- » **AD principal password:** The principal password to use when identifying against ADFS
- » **IdP ARN:** The Amazon Resource Name (ARN) of the Active Directory issuing the SAML claims document. This is required as it enables AWS to identify the signer of the SAML document and verify its signature.
- » **Role ARN:** The Amazon Resource Name (ARN) of the specific role the returned credentials should be assigned.

For more information about this access option, see:

[https://docs.aws.amazon.com/IAM/latest/UserGuide/id\\_roles\\_providers\\_saml.html](https://docs.aws.amazon.com/IAM/latest/UserGuide/id_roles_providers_saml.html)

- » **Folder:** The name of the Amazon S3 folder to where you want your files to be copied.

The information for these properties is available from your Amazon Web Services (AWS) account. If you do not have these values, refer to your AWS account or the Amazon Redshift System Administrator for your enterprise

#### Note

- » This information is case sensitive.
- » To determine if you are connected to the database you want to use or if the connection information you entered is correct, click **Test Connection**.  
If the connection is successful a message in green is displayed. If the connection fails, an error message is displayed at the bottom of the dialog box.
- » To view the log entry if the connection fails, click **View Log**. The server log is displayed with the information for the connection failure. Note that this button is not available unless the test connection fails.

## Setting Advanced Connection Properties

In the **Advanced** tab, you can set the following parameters:

- » **Max file size (MB):** Select or type the maximum size of any CSV file used to transfer data to Amazon Redshift. The default value is 1024.
- » **Number of threads used to upload a file:** Select the number of threads used to upload a single file. The minimum number of threads is 1. The maximum value is 64. The default value is 10.
- » **ODBC driver:** The name of the default ODBC driver you are using to connect to Amazon Redshift. The default value is **Amazon Redshift (x64)**.
- » **Additional ODBC connection properties:** Type any additional ODBC connection properties if required.

» **Use proxy server:** Select this option to access Amazon Redshift via a proxy server.

» **Host name:** The host name of the proxy server.

» **Port:** The port via which to access the proxy server.

» **User name:** The user name for accessing the proxy server.

» **Password:** The password for accessing the proxy server.

» **Scheme:**

Select which protocol to use to access the server (HTTP or HTTPS). In order to use HTTPS, you must first install the CA certificate that signed the proxy's certificate on the Replicate Server machine, as follows:

» **On Windows:** Add the CA certificate to the Trusted Root Certification Authorities store of Local Computer

» **On Linux:** Add the CA certificate to /etc/pki/tls/certs/ca-bundle.crt

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

# Using Amazon S3 as a Target

This chapter describes how to set up and use Amazon S3 as a target in a replication task.

## In this section:

- [Prerequisites](#)
- [Amazon S3 Target Overview](#)
- [Limitations](#)
- [Change Data Partitioning](#)
- [Amazon S3 Target Data Types](#)
- [Setting General Connection Properties](#)
- [Setting Advanced Connection Properties](#)
- [Generating Reference Files](#)
- [Content-Type and Content-Encoding Properties](#)

## Prerequisites

Before you can use Amazon S3 as a target endpoint in a Replicate task, the following prerequisites must be met:

- » The Attunity Replicate Server machine must be set to the correct time (UTC).
- » You must have an Amazon S3 bucket that is accessible from the Replicate Server machine.  
For information on signing up for Amazon S3, see <http://aws.amazon.com/s3/>.
- » **Bucket access credentials:** Make a note of the bucket name, region, access key and secret access key - you will need to provide them in the Attunity Replicate Amazon S3 target settings.
- » **Bucket access permissions:** Attunity Replicate requires the following bucket access permissions:

```
{  
    "Version": "2012-10-17",  
    "Statement": [  
        {  
            "Sid": "Stmt1497347821000",  
            "Effect": "Allow",  
            "Action": [  
                "s3:GetBucketLocation",  
                "s3>ListBucket"  
            ],  
            "Resource": [  
                "arn:aws:s3:::mybucket",  
                "arn:aws:s3:::mybucket/*"  
            ]  
        }  
    ]  
}
```

```

        "arn:aws:s3:::YOUR_BUCKET_NAME"
    ],
},
{
    "Sid": "Stmt1497344984000",
    "Effect": "Allow",
    "Action": [
        "s3:PutObject",
        "s3:GetObject",
        "s3:DeleteObject"
    ],
    "Resource": [
        "arn:aws:s3:::YOUR_BUCKET_NAME/target_path",
        "arn:aws:s3:::YOUR_BUCKET_NAME/target_path/*"
    ]
}
]
}

```

Where `YOUR_BUCKET_NAME` is the name of your bucket and `target_path` is the intended location of the target files in your bucket.

**Note** If the target path is the bucket root, just specify `"/target_path"` with an empty string.

## Amazon S3 Target Overview

When using Amazon S3 as a target in a Replicate task, both the Full Load and CDC data are written to data files. Depending on the endpoint settings, data files can be either CSV or JSON files. While the explanations in this section relate to CSV files, the same is true for JSON files

Full Load files are named using incremental counters e.g. `LOAD00001.csv`, `LOAD00002.csv`, etc. whereas Apply Changes files are named using timestamps e.g. `20141029-1134010000.csv`.

**Note** When [Parallel Load](#) is used, the naming convention for Full Load files is slightly different:

`LOAD_${SegmentID}_${IncreasingCounter}`

**Example:**

```
LOAD_1_00000001 | LOAD_1_00000002 | LOAD_1_00000003 | LOAD_2_00000001 |
LOAD_2_00000002
```

**Note** When the [Create metadata files in the target folder](#) option is enabled, a corresponding metadata file is created using the same naming format, but with a **.dfm** extension.

For each source table, a folder is created in the specified Amazon S3 bucket. The data files are created on the Replicate Server machine and are then uploaded to the specified Amazon S3 bucket once the [File Attributes](#) (Full Load) and [Change Processing](#) upload conditions have been met.

## DDL Handling

When a DDL change is captured, Replicate will close the data file and also create a DFM file if the **Create metadata files in the target folder** option is enabled. When the next batch of changes arrives, Replicate will create a new data file containing the changes. Note that the DFM file created for the new data file will match the new table structure.

## Limitations

The following limitations apply to the Amazon S3 target endpoint:

- » Only the following DDLs are supported: Truncate table, Drop table, Create table, Add Column, Rename Column, Drop Column, and Convert Data Type.
- » Full LOB Mode is not supported
- » UPDATE and DELETE statements are not supported in Apply Changes replication mode
- » Batch Optimized Apply mode is not supported
- » Target lookup is not supported
- » The <target folder> parameter cannot include special characters

## Change Data Partitioning

When replicating to a Amazon S3 target, for each of the source tables, a directory is created under the specified target directory. When [Change Data Partitioning](#) is enabled, an additional sub-directory is created under the corresponding table directory. The data and metadata (when the metadata option is enabled) files are located in the partition subdirectory, as in the following example:

```
{Target Directory}
    {Table_1}
        {Partition_1}
            Data files
            DFM files
        {Partition_2}
            Data files
```

```

        DFM files
{Partition_3}
        Data files
        DFM files
{Table_2}
        {Partition_1}
        Data files
        DFM files
        {Partition_2}
        Data files
        DFM files
        {Partition_3}
        Data files
        DFM files

```

Information about the partitions is written to the **attrrep\_cdc\_partitions** Control Table. For information about this table, see [Change Data Partitions](#).

## Amazon S3 Target Data Types

The following table shows the default mapping from Attunity Replicate data types to Amazon S3 target data types. Note that the data type mapping is only relevant if the [Create metadata files in the target folder](#) option is enabled.

For information on source data type mappings, see the section for the source endpoint you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 9.23 | Supported Amazon S3 Target Data Types with Mapping from Attunity Replicate Data Types**

| Attunity Replicate Data Types | Amazon S3 Target Data Types |
|-------------------------------|-----------------------------|
| DATE                          | DATE                        |
| TIME                          | TIME                        |
| DATETIME                      | DATETIME                    |
| BYTES                         | BYTES (length)              |
| BLOB                          | BLOB                        |
| REAL4                         | REAL4 (7)                   |
| REAL8                         | REAL8 (14)                  |

**Table 9.23 | Supported Amazon S3 Target Data Types with Mapping from Attunity Replicate Data Types (Cont.)**

| Attunity Replicate Data Types | Amazon S3 Target Data Types |
|-------------------------------|-----------------------------|
| INT1                          | INT1 (3)                    |
| INT2                          | INT2 (5)                    |
| INT4                          | INT4 (10)                   |
| INT8                          | INT8 (19)                   |
| UINT1                         | UINT1 (3)                   |
| UINT2                         | UINT2 (5)                   |
| UINT4                         | UINT4 (10)                  |
| UINT8                         | UINT8 (20)                  |
| NUMERIC                       | NUMERIC (p,s)               |
| STRING                        | STRING (Length)             |
| WSTRING                       | STRING (Length)             |
| CLOB                          | CLOB                        |
| NCLOB                         | NCLOB                       |
| BOOLEAN                       | BOOLEAN (1)                 |

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

### To add an Amazon S3 target endpoint to Attunity Replicate:

1. In **Tasks** view, click **Manage Endpoint Connections** to open the **Manage Endpoints Connections** dialog box. Then click the **New Endpoint Connection** button. For more information on adding an endpoint to Attunity Replicate, see [Working with Endpoints](#).
2. In the **Name** field, type a name for your endpoint. This can be any name that will help to identify the endpoint being used.
3. Optionally, in the **Description** field, type a description that helps to identify the endpoint.
4. Select **TARGET** as the endpoint **role**.
5. Select **Amazon S3** as the endpoint **Type**.
6. Configure the remaining settings in the **General** tab as described in the table below.

**Table 9.24 | Amazon S3 Target Endpoint - General Tab Options**

| Option                                                         | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Amazon S3 Storage</b>                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Bucket name                                                    | Enter the name of your Amazon S3 bucket.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Bucket region                                                  | Select the Amazon S3 region where your bucket is located.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Access options                                                 | <p>Choose one of the following:</p> <ul style="list-style-type: none"> <li>» Key pair           <p>Choose this method to authenticate with your Access Key and Secret Key.</p> </li> <li>» IAM Roles for EC2.           <p>Choose this method if the machine on which Attunity Replicate is installed is configured to authenticate itself using an IAM role.</p> <p>For more information about this access option, see:<br/> <a href="http://docs.aws.amazon.com/IAM/latest/UserGuide/id_roles.html">http://docs.aws.amazon.com/IAM/latest/UserGuide/id_roles.html</a></p> </li> <li>» Security Token Service (STS)           <p>Choose this method to authenticate using SAML 2.0 with Active Directory Federation Services.</p> <p>For more information about this access option, see:<br/> <a href="https://docs.aws.amazon.com/IAM/latest/UserGuide/id_roles_providers_saml.html">https://docs.aws.amazon.com/IAM/latest/UserGuide/id_roles_providers_saml.html</a></p> </li> </ul> |
| When <b>Key pair</b> is the access option:                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Access key                                                     | Enter the access key information for Amazon S3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Secret key                                                     | Enter the secret key information for Amazon S3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| When <b>Security Token Service (STS)</b> is the access option: |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| ADFS URL                                                       | The URL to an Active Directory Federation Services page, responsible for returning a SAML claims document to be sent over to AWS.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| AD principal name                                              | The principal (user) name to use when identifying against ADFS<br>The format should be: user.name@domain                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| AD principal password                                          | The principal password to use when identifying against ADFS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| IdP ARN                                                        | The Amazon Resource Name (ARN) of the Active Directory issuing the SAML claims document. This is required as it enables AWS to identify the signer of the SAML document and verify its signature.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Role ARN                                                       | The Amazon Resource Name (ARN) of the specific role the returned credentials should be assigned.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

**Table 9.24 | Amazon S3 Target Endpoint - General Tab Options (Cont.)**

| Option                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| For all access options: |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Target folder           | Enter the target folder in your Amazon S3 bucket.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>File Attributes</b>  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|                         | <p>Delimiters can be standard characters or a hexadecimal (hex) value. Note that the "0x" prefix must be used to denote a hexadecimal delimiter (e.g. 0x01 = SOH). In the <b>Field delimiter</b>, <b>Record delimiter</b> and <b>Null value</b> fields, the delimiter can consist of concatenated hex values (e.g. 0x0102 = SOHSTX), whereas in the <b>Quote character</b> and <b>Escape character</b> fields, it can only be a single hex value.</p> <p><b>Note</b> The hexadecimal number 0x00 is not supported (i.e. only 0x01-0xFF are supported).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Format                  | <p>You can choose to create the target files in <b>CSV</b> or <b>JSON</b> format.</p> <p>In a JSON file, each record is represented by a single line, as in the following example:</p> <pre>{ "book_id": 123, "title": "Alice in Wonderland", "price": 6.99, "is_hardcover": false } { "book_id": 456, "title": "Winnie the Pooh", "price": 6.49, "is_hardcover": true } { "book_id": 789, "title": "The Cat in the Hat", "price": 7.23, "is_hardcover": true }</pre> <p>See also: <a href="#">Content-Type and Content-Encoding Properties</a>.</p> <p><b>Note</b> Changing the format (i.e. from CSV to JSON or from JSON to CSV) while the task is in a stopped state and then resuming the task, is not supported.</p> <p><b>Note</b> If you choose <b>JSON</b> format , the following fields will be hidden as they are only relevant to CSV format: <b>Field delimiter</b>, <b>Record delimiter</b>, <b>Null value</b>, <b>Quote character</b>, <b>Escape character</b>, and <b>Add metadata header</b>.</p> |
| Field delimiter         | <p>The delimiter that will be used to separate fields (columns) in the target files. The default is a comma.</p> <p><b>Example using a comma as a delimiter:</b></p> <p>"mike","male"</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Record delimiter        | <p>The delimiter that will be used to separate records (rows) in the target files. The default is a newline (\n).</p> <p><b>Example:</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

**Table 9.24 | Amazon S3 Target Endpoint - General Tab Options (Cont.)**

| Option               | Description                                                                                                                                                                                                                                                                                                                                                                     |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                      | "mike","male"\n"sara","female"\n                                                                                                                                                                                                                                                                                                                                                |
| Null value           | The string that will be used to indicate a null value in the target files.<br><b>Example (where \n is the record delimiter and @ is the null value):</b><br>"mike","male",295678\n"sara","female",@"\n                                                                                                                                                                          |
| Quote character      | The character that will be used at the beginning and end of a text column. The default is the double-quote character ("). When a column that contains column delimiters is enclosed in double-quotes, the column delimiter characters are interpreted as actual data, and not as column delimiters.<br><b>Example (where a @ is the quote character):</b><br>@mike@,@male@      |
| Escape character     | The character used to escape a quote character in the actual data.<br><b>Example (where " is the quote character and \ is the escape character):</b><br>1955,"old, \"rare\"",Chevrolet","\$1000"                                                                                                                                                                                |
| Add metadata header  | You can optionally add a header row to the data files. The header row can contain the source column names and/or the intermediate (i.e. Replicate) data types.<br>Example of a target file with a header row when both <b>With column names</b> and <b>With data types</b> are selected:<br>Position:DECIMAL(38,0),Color:VARCHAR(10)<br>1,"BLUE"<br>2,"BROWN"<br>3,"RED"<br>... |
| Maximum file size    | The maximum size a file can reach before it is closed (and optionally compressed). This value applies both to data files and to Reference Files.<br>For information on generating reference files, see .                                                                                                                                                                        |
| Compress files using | Choose <b>GZIP</b> to compress the target files or <b>NONE</b> (the default) to leave them uncompressed.                                                                                                                                                                                                                                                                        |

## Change Processing

**Table 9.24 | Amazon S3 Target Endpoint - General Tab Options (Cont.)**

| Option                                     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|--------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Apply/Store changes when:                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| File size reaches                          | Specify the maximum size of Change Data to accumulate before uploading the file to Amazon S3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Elapsed time reaches                       | Specify the maximum time to wait before applying the changes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Metadata Files</b>                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Create metadata files in the target folder | <p>When this option is selected, for each data file, a matching metadata file with a <b>.dfm</b> extension will be created under the specified target folder. The metadata files (which are in standard JSON format) provide additional information about the task/data such as the source endpoint type, the source table name, the number of records in the data file, and so on.</p> <p>For a full description of the metadata file as well as possible uses, see <a href="#">Metadata File Description</a>.</p>                                                             |
| <b>Data Encryption</b>                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Encryption options                         | <p>Choose one of the following:</p> <ul style="list-style-type: none"> <li>» Server-Side Encryption with Amazon S3-Managed Keys (SSE-S3). This is the default.</li> <li>» Server-Side Encryption with AWS KMS-Managed Keys (SSE-KMS) This option also requires you to specify your <b>KMS Key ID</b>. For more information on the available sever-side encryption methods, see:<br/> <a href="http://docs.aws.amazon.com/AmazonS3/latest/dev/serv-side-encryption.html">http://docs.aws.amazon.com/AmazonS3/latest/dev/serv-side-encryption.html</a></li> <li>» None</li> </ul> |

- To determine if the connection information you entered is correct, click **Test Connection**. If the connection test is successful, click **Save**.

**Note** As part of connection testing process, Replicate uploads a test file to the specified [Amazon S3 Target folder](#) and then deletes it once a connection has been established.

If the connection is successful a message in green is displayed. If the connection fails, an error message is displayed at the bottom of the dialog box.

To view the log entry if the connection fails, click **View Log**. The server log is displayed with the information for the connection failure. Note that this button is not available unless the test connection fails.

## Setting Advanced Connection Properties

In the **Advanced** tab, you can enable the creation of reference files and set post-processing actions. These options are described in detail below.

**Table 9.25 | Amazon S3 Target Endpoint - Advanced Tab Options**

| Option                                                   | Description |
|----------------------------------------------------------|-------------|
| <b>Post Upload Processing - Run command after upload</b> |             |

You can process the final target files using a custom command. The command will be run whenever a data file is created.

**Note** If the **Generate a reference file** option is selected, a row (specifying the file's location) will be added to the Reference File only *after* the command completes successfully.

- » **Command name** - The location of the command e.g. C:\utils\move.exe.
- » **Working directory** - The directory where you want the command to run.
- » **Parameters** - Specify any parameters that need to be passed to the command during runtime. You can use the following built-in parameters:  
 \${FILENAME} - The full path to the CSV file containing the full load or CDC data.  
 \${METADATA\_FILENAME} - The full path to the DFM file containing the metadata.

For information on creating metadata files, see [Setting General Connection Properties](#).

**Note** If the CSV/DFM file paths contain spaces, you must enclose these parameters with quotation marks (e.g. "\${FILENAME}").

### Standard Post Command Exit Codes

The post-processing command must return a proper exit code. You can either use the standard exit code values described below or set a custom exit code value as described in [Setting Post Command Exit Codes with an Internal Parameter](#).

- » **0** - Success
- » **1** - Recoverable error. The task will recover from the point of failure according to the settings in the [Environmental Errors](#) tab.
- » **2** - Table error. If a table error occurs, Replicate will handle the error according to the settings in the [Table Errors](#) tab.
- » **3** (or any other value e.g. -100) - Fatal error. The task will fail and not attempt recovery.

**Table 9.25 | Amazon S3 Target Endpoint - Advanced Tab Options (Cont.)**

| Option                                                                                                                                                              | Description                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Setting Post Command Exit Codes with an Internal Parameter</b>                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                           |
| You can use internal parameters to set exit codes with custom values. This is especially useful if your application already uses the standard exit code values.     |                                                                                                                                                                                                                                                                                                                                                                           |
| See <a href="#">Standard Post Command Exit Codes</a> above for a description of the exit codes.                                                                     |                                                                                                                                                                                                                                                                                                                                                                           |
| <ul style="list-style-type: none"> <li>» successExitCode</li> <li>» recoverableErrorExitCode</li> <li>» tableErrorExitCode</li> <li>» fatalErrorExitCode</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                           |
| For instructions on setting internal parameters, see <a href="#">Internal Parameters</a> .                                                                          |                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Post Upload Processing - Generate Reference Files</b>                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                           |
| Select this option to generate a Reference File (on Replicate Server) containing the full path to the Apply Changes data files.                                     |                                                                                                                                                                                                                                                                                                                                                                           |
| <p><b>Note</b> The reference file only points to the location of the Apply Changes files, and not the Full Load files.</p>                                          |                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Reference File(s) folder</b> - The folder on the Replicate machine in which the Reference File will be created.                                                  |                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Example:</b><br>c:\temp\                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Use proxy server</b>                                                                                                                                             | Select this option to access Amazon S3 via a proxy server.                                                                                                                                                                                                                                                                                                                |
| Host name                                                                                                                                                           | The host name of the proxy server.                                                                                                                                                                                                                                                                                                                                        |
| Port                                                                                                                                                                | The port via which to access the proxy server.                                                                                                                                                                                                                                                                                                                            |
| User name                                                                                                                                                           | The user name for accessing the proxy server.                                                                                                                                                                                                                                                                                                                             |
| Password                                                                                                                                                            | The password for accessing the proxy server.                                                                                                                                                                                                                                                                                                                              |
| Scheme                                                                                                                                                              | Select which protocol to use to access the server (HTTP or HTTPS). In order to use HTTPS, you must first install the CA certificate that signed the proxy's certificate on the Replicate Server machine, as follows:<br><ul style="list-style-type: none"> <li>» <b>On Windows:</b> Add the CA certificate to the Trusted Root Certification Authorities store</li> </ul> |

**Table 9.25 | Amazon S3 Target Endpoint - Advanced Tab Options (Cont.)**

| Option | Description                                                                                                       |
|--------|-------------------------------------------------------------------------------------------------------------------|
|        | <p>of Local Computer</p> <p>» <b>On Linux:</b> Add the CA certificate to<br/>/etc/pki/tls/certs/ca-bundle.crt</p> |

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI and should only be used if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your setting by clicking the View Setting Summary link. This is useful if you need to send a summary of your setting to Attunity Support.

## Generating Reference Files

In the **Advanced** tab of the Amazon S3 target endpoint, you can enable the **Generate a reference file** option. The Reference File contains a list of the Change File locations and is therefore only relevant if the task's Apply Changes or Store Changes options are enabled.

The format of the reference file name is as follows:

```
<amazon_s3_target_endpoint_display_name><counter>.csv|json
```

### Example:

AmazonS300000001.csv

**Note** The counter suffix increases incrementally each time a new Reference File is generated (i.e. when the file reaches the maximum size defined [in the General tab](#)). Once a new Reference File has been generated, you can delete the old reference file(s) if required.

Whenever an Apply Changes data file is created, a new row is added to the Reference File in the following format:

```
<Source_Table_Name>, <bucket_name>/<path>/<file_name>
```

### Example:

employees,bigdata/new/files/my.company/20170611-120144192.csv

Note that if the **Post-process files** option in the **Advanced** tab is also enabled, the Reference File will be generated *after* the post-processing completes.

## Content-Type and Content-Encoding Properties

The table below describes the content-type and content-encoding properties present in Files uploaded to Amazon S3.

| Replicate Artifact  | File Format  | Compression | Content-Type            | Content-Encoding |
|---------------------|--------------|-------------|-------------------------|------------------|
| Data file           | CSV          | None        | text/csv; charset=utf-8 | N/A              |
| Data file           | CSV          | gzip        | text/csv; charset=utf-8 | gzip             |
| Data file           | JSON (lines) | None        | application/x-ndjson    | N/A              |
| Data file           | JSON (lines) | gzip        | application/x-ndjson    | gzip             |
| Metadata file (DFM) | JSON         | None        | application/json        | N/A              |

# Using Microsoft Azure ADLS as a Target

This chapter describes how to set up and use Microsoft Azure ADLS as a target in a replication task.

## In this section:

[Prerequisites](#)

[Microsoft Azure ADLS Target Overview](#)

[Limitations](#)

[Change Data Partitioning](#)

[Data Types](#)

[Setting General Connection Properties](#)

[Setting Advanced Connection Properties](#)

[Generating Reference Files](#)

[Content-Type and Content-Encoding Properties](#)

## Prerequisites

Before you can use Microsoft Azure ADLS as a target endpoint in a Replicate task, the following prerequisites must be met:

- » **Permissions:** The "Azure Active Directory application ID" specified in the Microsoft Azure HDInsight endpoint's **Storage** settings must have write access to the specified ADLS storage target folder.
- » **Supported Platforms:** Attunity Replicate on Windows or Linux.

**Note** You do not need to install any drivers on the Attunity Replicate Server machine.

## Microsoft Azure ADLS Target Overview

When using Microsoft Azure ADLS as a target in a Replicate task, both the Full Load and CDC data are written to data files. Depending on the endpoint settings, data files can be either CSV or JSON files. While the explanations in this section relate to CSV files, the same is true for JSON files

Full Load files are named using incremental counters e.g. LOAD00001.csv, LOAD00002.csv, etc. whereas Apply Changes files are named using timestamps e.g. 20141029-1134010000.csv.

**Note** When [Parallel Load](#) is used, the naming convention for Full Load files is slightly different:

LOAD\_\$(SegmentID)\_\$(IncreasingCounter)

**Example:**

```
LOAD_1_00000001 | LOAD_1_00000002 | LOAD_1_00000003 | LOAD_2_00000001 |  
LOAD_2_00000002
```

**Note** When the [Create metadata files in the target folder](#) option is enabled, a corresponding metadata file is created using the same naming format, but with a **.dfm** extension.

For each source table, a folder is created in the specified Microsoft Azure ADLS target folder. The data files are created on the Replicate Server machine and are then uploaded to the specified Microsoft Azure ADLS target folder once the [File Attributes](#) (Full Load) and [Change Processing](#) upload conditions have been met.

## DDL Handling

When a DDL change is captured, Replicate will close the data file and also create a DFM file if the **Create metadata files in the target folder** option is enabled. When the next batch of changes arrives, Replicate will create a new data file containing the changes. Note that the DFM file created for the new data file will match the new table structure.

## Limitations

The following limitations apply to the Microsoft Azure ADLS target endpoint:

- » Only the following DDLs are supported: Truncate table, Drop table, Create table, Add Column, Rename Column, Drop Column, and Convert Data Type.
- » Full LOB Mode is not supported
- » UPDATE and DELETE statements are not supported in Apply Changes replication mode
- » Batch Optimized Apply mode is not supported
- » Target lookup is not supported
- » The <target folder> parameter cannot include special characters

## Change Data Partitioning

When replicating to a Microsoft Azure ADLS target, for each of the source tables, a directory is created under the specified target directory. When [Change Data Partitioning](#) is enabled, an additional sub-directory is created under the corresponding table directory. The data and metadata (when the metadata option is enabled) files are located in the partition subdirectory, as in the following example:

```

{Target Directory}
    {Table_1}
        {Partition_1}
            Data files
            DFM files
        {Partition_2}
            Data files
            DFM files
        {Partition_3}
            Data files
            DFM files
    {Table_2}
        {Partition_1}
            Data files
            DFM files
        {Partition_2}
            Data files
            DFM files
        {Partition_3}
            Data files
            DFM files

```

Information about the partitions is written to the **attrrep\_cdc\_partitions** Control Table. For information about this table, see [Change Data Partitions](#).

## Data Types

The following table shows the default mapping from Attunity Replicate data types to Microsoft Azure ADLS target data types. Note that the data type mapping is only relevant if the [Create metadata files in the target folder](#) option is enabled.

For information on source data type mappings, see the section for the source endpoint you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 9.26 | Supported Microsoft Azure ADLS Target Data Types with Mapping from Attunity Replicate Data Types**

| Attunity Replicate Data Types | Microsoft Azure ADLS Target Data Types |
|-------------------------------|----------------------------------------|
| DATE                          | DATE                                   |
| TIME                          | TIME                                   |

**Table 9.26 | Supported Microsoft Azure ADLS Target Data Types with Mapping from Attunity Replicate Data Types (Cont.)**

| Attunity Replicate Data Types | Microsoft Azure ADLS Target Data Types |
|-------------------------------|----------------------------------------|
| DATETIME                      | DATETIME                               |
| BYTES                         | BYTES (length)                         |
| BLOB                          | BLOB                                   |
| REAL4                         | REAL4 (7)                              |
| REAL8                         | REAL8 (14)                             |
| INT1                          | INT1 (3)                               |
| INT2                          | INT2 (5)                               |
| INT4                          | INT4 (10)                              |
| INT8                          | INT8 (19)                              |
| UINT1                         | UINT1 (3)                              |
| UINT2                         | UINT2 (5)                              |
| UINT4                         | UINT4 (10)                             |
| UINT8                         | UINT8 (20)                             |
| NUMERIC                       | NUMERIC (p,s)                          |
| STRING                        | STRING (Length)                        |
| WSTRING                       | STRING (Length)                        |
| CLOB                          | CLOB                                   |
| NCLOB                         | NCLOB                                  |
| BOOLEAN                       | BOOLEAN (1)                            |

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

### To add an Microsoft Azure ADLS target endpoint to Attunity Replicate:

1. In **Tasks** view, click **Manage Endpoint Connections** to open the **Manage Endpoints Connections** dialog box. Then click the **New Endpoint Connection** button. For more information on adding an endpoint to Attunity Replicate, see [Working with Endpoints](#).
2. In the **Name** field, type a name for your endpoint. This can be any name that will help to identify the endpoint being used.

3. Optionally, in the **Description** field, type a description that helps to identify the endpoint.
4. Select **TARGET** as the endpoint **role**.
5. Select **Microsoft Azure ADLS** as the endpoint **Type**.
6. Configure the remaining settings in the **General** tab as described in the table below.

**Table 9.27 | Microsoft Azure ADLS Target Endpoint - General Tab Options**

| Option                                                                                                                                                                                                                                                                                                                                                                                                                                          | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Microsoft Azure ADLS Storage</b>                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Data Lake Store name                                                                                                                                                                                                                                                                                                                                                                                                                            | The full name of the ADLS storage.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Azure Active Directory ID                                                                                                                                                                                                                                                                                                                                                                                                                       | The Azure Active Directory ID.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Azure Active Directory application ID                                                                                                                                                                                                                                                                                                                                                                                                           | The Azure Active Directory application ID.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Azure Active Directory application key                                                                                                                                                                                                                                                                                                                                                                                                          | The Azure Active Directory application key.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Target folder                                                                                                                                                                                                                                                                                                                                                                                                                                   | Specify where to create the data files on ADLS.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| SSL CA Path:                                                                                                                                                                                                                                                                                                                                                                                                                                    | The location of the CA file on the Replicate Server machine.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>File Attributes</b>                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Delimiters can be standard characters or a hexadecimal (hex) value. Note that the "0x" prefix must be used to denote a hexadecimal delimiter (e.g. 0x01 = SOH). In the <b>Field delimiter</b> , <b>Record delimiter</b> and <b>Null value</b> fields, the delimiter can consist of concatenated hex values (e.g. 0x0102 = SOHSTX), whereas in the <b>Quote character</b> and <b>Escape character</b> fields, it can only be a single hex value. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <p><b>Note</b> The hexadecimal number 0x00 is not supported (i.e. only 0x01-0xFF are supported).</p>                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Format                                                                                                                                                                                                                                                                                                                                                                                                                                          | <p>You can choose to create the target files in <b>CSV</b> or <b>JSON</b> format.</p> <p>In a JSON file, each record is represented by a single line, as in the following example:</p> <pre>{ "book_id": 123, "title": "Alice in Wonderland", "price": 6.99, "is_hardcover": false } { "book_id": 456, "title": "Winnie the Pooh", "price": 6.49, "is_hardcover": true } { "book_id": 789, "title": "The Cat in the Hat", "price": 7.23, "is_hardcover": true }</pre> <p>See also: <a href="#">Content-Type and Content-Encoding Properties</a>.</p> |

**Table 9.27 | Microsoft Azure ADLS Target Endpoint - General Tab Options (Cont.)**

| Option           | Description                                                                                                                                                                                                                                                                                                                                                                               |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                  | <p><b>Note</b> Changing the format (i.e. from CSV to JSON or from JSON to CSV) while the task is in a stopped state and then resuming the task, is not supported.</p>                                                                                                                                                                                                                     |
|                  | <p><b>Note</b> If you choose <b>JSON</b> format , the following fields will be hidden as they are only relevant to CSV format: <b>Field delimiter</b>, <b>Record delimiter</b>, <b>Null value</b>, <b>Quote character</b>, <b>Escape character</b>, and <b>Add metadata header</b>.</p>                                                                                                   |
| Field delimiter  | <p>The delimiter that will be used to separate fields (columns) in the target files. The default is a comma.</p> <p><b>Example using a comma as a delimiter:</b></p> <p>"mike","male"</p>                                                                                                                                                                                                 |
| Record delimiter | <p>The delimiter that will be used to separate records (rows) in the target files. The default is a newline (\n).</p> <p><b>Example:</b></p> <p>"mike","male"\n</p> <p>"sara","female"\n</p>                                                                                                                                                                                              |
| Null value       | <p>The string that will be used to indicate a null value in the target files.</p> <p><b>Example (where \n is the record delimiter and @ is the null value):</b></p> <p>"mike","male",295678\n</p> <p>"sara","female",@"\n</p>                                                                                                                                                             |
| Quote character  | <p>The character that will be used at the beginning and end of a text column. The default is the double-quote character ("). When a column that contains column delimiters is enclosed in double-quotes, the column delimiter characters are interpreted as actual data, and not as column delimiters.</p> <p><b>Example (where a @ is the quote character):</b></p> <p>@mike@,@male@</p> |
| Escape character | <p>The character used to escape a quote character in the actual data.</p> <p><b>Example (where " is the quote character and \ is the escape character):</b></p> <p>1955,"old, \"rare\"",Chevrolet","\$1000"</p>                                                                                                                                                                           |

**Table 9.27 | Microsoft Azure ADLS Target Endpoint - General Tab Options (Cont.)**

| Option                                     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Add metadata header                        | <p>You can optionally add a header row to the data files. The header row can contain the source column names and/or the intermediate (i.e. Replicate) data types.</p> <p>Example of a target file with a header row when both <b>With column names</b> and <b>With data types</b> are selected:</p> <p>Position:DECIMAL(38,0),Color:VARCHAR(10)</p> <p>1,"BLUE"<br/>2,"BROWN"<br/>3,"RED"<br/>...</p>                                                                                                                |
| Maximum file size                          | <p>The maximum size a file can reach before it is closed (and optionally compressed). This value applies both to data files and to Reference Files.</p> <p>For information on generating reference files, see .</p>                                                                                                                                                                                                                                                                                                  |
| Compress files using                       | Choose <b>GZIP</b> to compress the target files or <b>NONE</b> (the default) to leave them uncompressed.                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Change Processing</b>                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Apply/Store changes when:                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| File size reaches                          | Specify the maximum size of Change Data to accumulate before uploading the file to Microsoft Azure ADLS .                                                                                                                                                                                                                                                                                                                                                                                                            |
| Elapsed time reaches                       | Specify the maximum time to wait before applying the changes.                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Metadata Files</b>                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Create metadata files in the target folder | <p>When this option is selected, for each data file, a matching metadata file with a <b>.dfm</b> extension will be created under the specified target folder. The metadata files (which are in standard JSON format) provide additional information about the task/data such as the source endpoint type, the source table name, the number of records in the data file, and so on.</p> <p>For a full description of the metadata file as well as possible uses, see <a href="#">Metadata File Description</a> .</p> |

- To determine if the connection information you entered is correct, click **Test Connection**. If the connection test is successful, click **Save**.

**Note** As part of connection testing process, Replicate uploads a test file to the specified [Microsoft Azure ADLS Target folder](#) and then deletes it once a connection has been established.

If the connection is successful a message in green is displayed. If the connection fails, an error message is displayed at the bottom of the dialog box.

To view the log entry if the connection fails, click **View Log**. The server log is displayed with the information for the connection failure. Note that this button is not available unless the test connection fails.

## Setting Advanced Connection Properties

In the **Advanced** tab, you can enable the creation of reference files and set post-processing actions. These options are described in detail below.

**Table 9.28 | Microsoft Azure ADLS Target Endpoint - Advanced Tab Options**

| Option                                                   | Description |
|----------------------------------------------------------|-------------|
| <b>Post Upload Processing - Run command after upload</b> |             |

You can process the final target files using a custom command. The command will be run whenever a data file is created.

**Note** If the **Generate a reference file** option is selected, a row (specifying the file's location) will be added to the Reference File only *after* the command completes successfully.

- » **Command name** - The location of the command e.g. C:\utils\move.exe.
  - » **Working directory** - The directory where you want the command to run.
  - » **Parameters** - Specify any parameters that need to be passed to the command during runtime. You can use the following built-in parameters:
    - `\${FILENAME}` - The full path to the CSV file containing the full load or CDC data.
    - `\${METADATA\_FILENAME}` - The full path to the DFM file containing the metadata.
- For information on creating metadata files, see [Setting General Connection Properties](#).

**Note** If the CSV/DFM file paths contain spaces, you must enclose these parameters with quotation marks (e.g. `\${FILENAME}`).

## Standard Post Command Exit Codes

**Table 9.28 | Microsoft Azure ADLS Target Endpoint - Advanced Tab Options (Cont.)**

| Option | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|        | <p>The post-processing command must return a proper exit code. You can either use the standard exit code values described below or set a custom exit code value as described in <b>Setting Post Command Exit Codes with an Internal Parameter</b> below.</p> <ul style="list-style-type: none"> <li>» <b>0</b> - Success</li> <li>» <b>1</b> - Recoverable error. The task will recover from the point of failure according to the settings in the <a href="#">Environmental Errors</a> tab.</li> <li>» <b>2</b> - Table error. If a table error occurs, Replicate will handle the error according to the settings in the <a href="#">Table Errors</a> tab.</li> <li>» <b>3</b> (or any other value e.g. -100) - Fatal error. The task will fail and not attempt recovery.</li> </ul> |

### Setting Post Command Exit Codes with an Internal Parameter

You can use internal parameters to set exit codes with custom values. This is especially useful if your application already uses the standard exit code values.

See **Standard Post Command Exit Codes** above for a description of the exit codes.

- » successExitCode
- » recoverableErrorExitCode
- » tableErrorExitCode
- » fatalErrorExitCode

For instructions on setting internal parameters, see [Internal Parameters](#).

### Post Upload Processing - Generate Reference Files

Select this option to generate a Reference File (on Replicate Server) containing the full path to the Apply Changes data files.

**Note** The reference file only points to the location of the Apply Changes files, and not the Full Load files.

**Reference File(s) folder** - The folder on the Replicate machine in which the Reference File will be created.

**Example:**

c:\temp\

|                         |                                                            |
|-------------------------|------------------------------------------------------------|
| <b>Use proxy server</b> | Select this option to access Amazon S3 via a proxy server. |
| Host name               | The host name of the proxy server.                         |

**Table 9.28 | Microsoft Azure ADLS Target Endpoint - Advanced Tab Options (Cont.)**

| Option                                                                                                    | Description                                                                                                   |
|-----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| Port                                                                                                      | The port via which to access the proxy server.                                                                |
| User name                                                                                                 | The user name for accessing the proxy server.                                                                 |
| Password                                                                                                  | The password for accessing the proxy server.                                                                  |
| Scheme                                                                                                    | Select which protocol to use to access the server (HTTP or HTTPS).                                            |
| <p><b>Note</b> The selected Scheme applies to the storage, but does not apply to the ODBC connection.</p> |                                                                                                               |
| SSL CA Path:                                                                                              | The location of the CA file on the Replicate Server machine when <b>HTTPS</b> is the selected <b>Scheme</b> . |

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI and should only be used if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your setting by clicking the View Setting Summary link. This is useful if you need to send a summary of your setting to Attunity Support.

## Generating Reference Files

In the **Advanced** tab of the Microsoft Azure ADLS target endpoint, you can enable the **Generate a reference file** option. The Reference File contains a list of the Change File locations and is therefore only relevant if the task's Apply Changes or Store Changes options are enabled.

The format of the reference file name is as follows:

```
<microsoft_azure_adls_target_endpoint_display_name><counter>.csv|json
```

### Example:

MyAzureADLS00000001.csv

**Note** The counter suffix increases incrementally each time a new Reference File is generated (i.e. which occurs when the file reaches the maximum size defined [in the General tab](#)). Once a new Reference File has been generated, you can delete the old reference file(s) if required.

Whenever an Apply Changes data file is created, a new row is added to the Reference File in the following format:

```
<Source_Table_Name>, <Data_Lake_Store_name>/<path>/<file_name>
```

### Example:

employees,mydatalakestore/new/files/my.company/20170611-120144192.csv

Note that if the **Run command after upload** option in the **Advanced** tab is also enabled, the Reference File will be generated *after* the post-processing completes.

## Content-Type and Content-Encoding Properties

The table below describes the content-type and content-encoding properties present in Files uploaded to Microsoft Azure ADLS .

| Replicate Artifact  | File Format  | Compression | Content-Type            | Content-Encoding |
|---------------------|--------------|-------------|-------------------------|------------------|
| Data file           | CSV          | None        | text/csv; charset=utf-8 | N/A              |
| Data file           | CSV          | gzip        | text/csv; charset=utf-8 | gzip             |
| Data file           | JSON (lines) | None        | application/x-ndjson    | N/A              |
| Data file           | JSON (lines) | gzip        | application/x-ndjson    | gzip             |
| Metadata file (DFM) | JSON         | None        | application/json        | N/A              |

# Using HP Vertica as a Target

This section describes how to set up and use an HP Vertica database as a target database in a replication task.

## In this section:

[Prerequisites](#)

[Limitations](#)

[Security Requirements](#)

[HP Vertica Target Data Types](#)

[Setting General Connection Properties](#)

[Setting Advanced Connection Properties](#)

## Prerequisites

The following section describes the prerequisites for working with Attunity Replicate on Windows or Linux and the HP Vertica target database.

### Replicate Server for Windows

The following section describes the steps you need to perform to work with Attunity Replicate for Windows and HP Vertica as a target database in a Replicate task:

- » HP Vertica ODBC 64-bit client installed on the computer where Attunity Replicate is located.
- » VSQL CLI Client installed on the computer where Attunity Replicate is located.

### Replicate Server for Linux

The following section describes the steps you need to perform to work with Attunity Replicate for Linux and HP Vertica as a target database in a Replicate task:

1. On the Attunity Replicate machine, install the HP Vertica client for Linux:

```
vertica-client-<version>.x86_64
```

#### Example:

```
vertica-client-7.0.0-0.x86_64
```

**Note** HP Vertica 7.1 client is not compatible with database versions earlier than HP Vertica 7.1.

2. Makes sure that the `/etc/odbcinst.ini` file contains the following entry for HP Vertica, as in the following example:

```
[Vertica]
```

```
Driver = /opt/vertica/lib64/libverticaodbc.so
DriverODBCVer = 3.0
UsageCount = 1
```

## Limitations

The following limitations apply to the Vertica target endpoint:

- » In "Batch optimized apply" Change Processing mode, binary data types (e.g. VARBINARY) are limited to 32500 bytes on the target.

## Security Requirements

You must provide HP Vertica account access to the Attunity Replicate user. The Replicate user must also have the following privileges in the HP Vertica database:

- » CREATE TABLE Privileges:
  - » CREATE privilege on schema
- » DROP TABLE Privileges:
  - » USAGE privilege on the schema that contains the table or schema owner
- » TRUNCATE Privileges (If the task is configured to truncate existing tables):
  - » USAGE privilege on the schema that contains the table or schema owner
- » ALTER TABLE (ADD/DROP/ RENAME/ALTER-TYPE COLUMN) Privileges:
  - » USAGE privilege on the schema that contains the table or schema owner
- » INSERT Privileges:
  - » INSERT privilege on table
  - » USAGE privilege on the schema that contains the table
- » UPDATE Privileges:
  - » UPDATE privilege on table
  - » USAGE privilege on the schema that contains the table
  - » SELECT privilege on the table when executing an UPDATE statement that references table column values in a WHERE or SET clause
- » DELETE Privileges:
  - » DELETE privilege on table
  - » USAGE privilege on schema that contains the table
  - » SELECT privilege on the table when executing a DELETE statement that references table column values in a WHERE or SET clause

## HP Vertica Target Data Types

The HP Vertica database for Attunity Replicate supports most HP Vertica data types. The following table shows the HP Vertica target data types that are supported when using

Attunity Replicate and the default mapping from Attunity Replicate data types.

**Note** HP Vertica does not support applying changes to binary data types in **Batch optimized apply** mode. For more information on **Batch optimized apply** mode, see [Change Processing Tuning](#).

For information on how to view the data type that is mapped from the source, see the section for the source database you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 9.29 | Supported HP Vertica Data Types with Mapping from Attunity Replicate Data Types**

| Attunity Replicate Data Types | HP Vertica Data Types                                                                   |
|-------------------------------|-----------------------------------------------------------------------------------------|
| BOOLEAN                       | BOOLEAN                                                                                 |
| BYTES                         | VARBINARY (Length)                                                                      |
| DATE                          | DATE                                                                                    |
| TIME                          | TIME (p)                                                                                |
| DATETIME                      | TIMESTAMP                                                                               |
| INT1                          | INTEGER                                                                                 |
| INT2                          | INTEGER                                                                                 |
| INT4                          | INTEGER                                                                                 |
| INT8                          | INTEGER                                                                                 |
| NUMERIC                       | NUMERIC (p,s)                                                                           |
| REAL4                         | FLOAT                                                                                   |
| REAL8                         | FLOAT                                                                                   |
| STRING                        | VARCHAR (Length multiplied by three)<br>For example, STRING (50) becomes VARCHAR (150). |
| UINT1                         | INTEGER                                                                                 |
| UINT2                         | INTEGER                                                                                 |
| UINT4                         | INTEGER                                                                                 |
| UINT8                         | INTEGER                                                                                 |
| WSTRING                       | VARCHAR (Length in Bytes)                                                               |
| BLOB                          | VARBINARY (65,000)                                                                      |
| CLOB                          | VARCHAR (65,000)                                                                        |
| NCLOB                         | VARCHAR (65,000)                                                                        |

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see [Setting Advanced Connection Properties](#) below.

### To add an HP Vertica target endpoint to Attunity Replicate:

1. In **Tasks** view, click **Manage Endpoint Connections** to open the **Manage Endpoints Connections** dialog box. Then click the **New Endpoint Connection** button.
2. In the **Name** field, type a name for your database. This can be any name that will help to identify the database being used.
3. In the **Description** field, type a description that helps to identify the HP Vertica database. This is optional.
4. Select **TARGET** as the database **role**.
5. Select **HP Vertica** as the database **Type**.
6. In the **Server** field, enter the name of the HP Vertica server.
7. Optionally, change the default **Port** (5433).
8. Type the HP Vertica authentication information (**User Name**, **Password**) for the authorized user for this HP Vertica database. If you do not know this information, see your HP Vertica database Administrator (DBA).

#### Note

- » This information is required. If you are using the **Advanced** tab to create a custom string, make sure to include the **User Name** and **Password** properties. See [Setting Advanced Connection Properties](#) for more information.
- » This information is case sensitive.
- » If you want to set custom properties for this database, see [Setting Advanced Connection Properties](#).

**Important:** Make sure that the HP Vertica user entered in the HP Vertica Authentication section has the correct access privileges. For information on how to provide the required privileges, see [Security Requirements](#).]

9. In the **Database name** field, enter the name of the HP Vertica database.

## Setting Advanced Connection Properties

In the **Advanced** tab, you can set the following parameters:

- » **Max file size:** Select or type the maximum size (in KB) of a CSV file before the file is loaded into the HP Vertica database. The default value is 32000 KB.

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

# Using Microsoft APS PDW as a Target

This section describes how to set up and use Microsoft APS PDW as a target database in a replication task.

## In this section:

[Prerequisites](#)

[Limitations](#)

[Security Requirements](#)

[Microsoft APS PDW Target Data Types](#)

[Setting General Connection Properties](#)

[Setting Advanced Connection Properties](#)

## Prerequisites

### Note

- » Attunity Replicate must be installed on any Windows computer in your network.
- » A Microsoft APS PDW account with the required access privileges is required.

The following client components must be installed on the Attunity Replicate machine:

- » SQL Server Native Client 11.0
- » Microsoft SQL Server 2012 Parallel Data Warehouse Tools x64

## Limitations

The following section describes the limitations of using Microsoft APS PDW as a Replicate target.

- » Source columns with CHAR/VARCHAR data types and a non-Latin collation (e.g. "Chinese\_PRC\_CI\_AS") need to be mapped to NVARCHAR. This can be done by defining a global transformation for all tables in the replication task or by defining a single transformation for a specific table.  
For more information on defining transformations, see [Defining Global Transformations](#) and [Defining Transformations for a Single Table/View](#).
- » Microsoft APS PDW does not support empty (NULL) columns. Consequently, when replicating a source column with an empty value, Replicate inserts a space into the corresponding target column.

## Security Requirements

You must provide Microsoft APS PDW account access to the Attunity Replicate user. This user must have LOAD permission and applicable permissions (INSERT, UPDATE, DELETE) on the destination table.

## Microsoft APS PDW Target Data Types

The Microsoft APS PDW database for Attunity Replicate supports most Microsoft APS PDW data types. The following table shows the Microsoft APS PDW target data types that are supported when using Attunity Replicate and the default mapping from Attunity Replicate data types.

For information on how to view the data type that is mapped from the source, see the section for the source database you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 9.30 | Supported Microsoft APS PDW Data Types with Mapping from Attunity Replicate Data Types**

| Attunity Replicate Data Types | Microsoft APS PDW Data Types |
|-------------------------------|------------------------------|
| BOOLEAN                       | BIT                          |
| BYTES                         | VARBINARY (Length)           |
| DATE                          | DATE                         |
| TIME                          | TIME                         |
| DATETIME                      | DATETIME2 (scale)            |
| INT1                          | TINYINT                      |
| INT2                          | SMALLINT                     |
| INT4                          | INTEGER                      |
| INT8                          | BIGINT                       |
| NUMERIC                       | DECIMAL (p,s)                |
| REAL4                         | FLOAT (24)                   |
| REAL8                         | FLOAT (53)                   |
| STRING                        | VARCHAR (Length)             |
| UINT1                         | TINYINT                      |
| UINT2                         | SMALLINT                     |
| UINT4                         | INTEGER                      |
| UINT8                         | BIGINT                       |

**Table 9.30 | Supported Microsoft APS PDW Data Types with Mapping from Attunity Replicate Data Types (Cont.)**

| Attunity Replicate Data Types | Microsoft APS PDW Data Types |
|-------------------------------|------------------------------|
| WSTRING                       | NVARCHAR (Length)            |
| BLOB                          | VARBINARY (8000)             |
| NCLOB                         | NVARCHAR (4000)              |
| CLOB                          | VARCHAR (8000)               |

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

### To add a Microsoft APS PDW target endpoint to Attunity Replicate:

1. In **Tasks** view, click **Manage Endpoint Connections** to open the **Manage Endpoints Connections** dialog box. Then click the **New Endpoint Connection** button.
2. In the **Name** field, type a name for your database. This can be any name that will help to identify the database being used.
3. In the **Description** field, type a description that helps to identify the Microsoft APS PDW database. This is optional.
4. Select **TARGET** as the database **role**.
5. Select **Microsoft APS PDW** as the database **Type**.
6. In the **Server name** field, enter the hostname or IP address of the Microsoft APS PDW machine.
7. Optionally, change the default **Port** (5000).
8. Type the Microsoft APS PDW authentication information (**User Name**, **Password**) for the authorized user for this Microsoft APS PDW database. If you do not know this information, see your Microsoft APS PDW database Administrator (DBA).

#### Note

- » This information is required. If you are using the **Advanced** tab to create a custom string, make sure to include the **User Name** and **Password** properties. See [Setting Advanced Connection Properties](#) for more information.
- » This information is case sensitive.
- » If you want to set custom properties for this database, see [Setting Advanced Connection Properties](#).

**Important:** Make sure that the Microsoft APS PDW user entered in the Microsoft APS PDW Authentication section has the correct access privileges. For information on how to provide the required privileges, see [Security Requirements](#).

9. In the **Database name** field, enter the name of the Microsoft APS PDW database.

## Setting Advanced Connection Properties

In the **Advanced** tab, you can set the following parameters:

- » **Maximum file size:** Select or type the maximum size (in KB) of a CSV file before the file is loaded into the Microsoft APS PDW database. The default value is 32000 KB.
- » **Create hash distribution:** Enabling this option will turn on the Microsoft APS PDW hash distribution function.
- » **Additional ODBC connection properties:** Specify any additional ODBC connection parameters that you want to use.

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

# Using ODBC to Connect to a Target

This section describes how to use ODBC connectivity to connect to a target endpoint.

**Note** When using HP NonStop SQL/MP (ARC) as an ODBC target, several additional procedures must be performed. For a detailed explanation, see [Using HP NonStop SQL/MP as an ODBC Target](#).

## In this section:

- [Using ODBC to Connect to a Target](#)
- [ODBC Target Data Types](#)
- [Setting General Connection Properties](#)
- [Setting Advanced Connection Properties](#)

# Using ODBC to Connect to a Target

The following topics describe what you need to use an ODBC endpoint as a target endpoint in an Attunity Replicate task.

**Note** When using HP NonStop SQL/MP (ARC) as an ODBC target, several additional procedures must be performed. For a detailed explanation, see [Using HP NonStop SQL/MP as an ODBC Target](#).

- » [ODBC Target Data Types](#)
- » [Setting General Connection Properties](#)
- » [Setting Advanced Connection Properties](#)

## ODBC Target Data Types

The following table shows the ODBC target data types that are supported when using Attunity Replicate and the default mapping from Attunity Replicate data types.

**Note** ODBC does not support applying changes to binary data types in **Batch optimized apply** mode. For more information on **Batch optimized apply** mode, see [Change Processing Tuning](#).

For information on how to view the data type that is mapped from the source, see the section for the source endpoint you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 9.31 | Supported ODBC Target Data Types with Mapping from Attunity Replicate Data Types**

| Attunity Replicate Data Types | ODBC Data Types                                                                                                     |
|-------------------------------|---------------------------------------------------------------------------------------------------------------------|
| BOOLEAN                       | <b>SQL_BIT</b>                                                                                                      |
| BYTES                         | <b>SQL_VARBINARY</b>                                                                                                |
| DATE                          | <b>SQL_TYPE_DATE</b>                                                                                                |
| TIME                          | <b>SQL_TYPE_TIME</b>                                                                                                |
| DATETIME                      | <b>SQL_TYPE_TIMESTAMP</b>                                                                                           |
| INT1                          | <b>SQL_SMALLINT</b>                                                                                                 |
| INT2                          | <b>SQL_SMALLINT</b>                                                                                                 |
| INT4                          | If the target endpoint supports precision and scale then:<br><b>SQL_INTEGER</b><br>Otherwise:<br><b>SQL_VARCHAR</b> |
| INT8                          | <b>SQL_BIGINT</b>                                                                                                   |
| NUMERIC                       | <b>SQL_NUMBER</b>                                                                                                   |
| REAL4                         | <b>SQL_REAL</b>                                                                                                     |
| REAL8                         | <b>SQL_DOUBLE</b>                                                                                                   |
| STRING                        | <b>SQL_VARCHAR</b>                                                                                                  |
| UINT1                         | <b>SQL_TINYINT</b>                                                                                                  |
| UINT2                         | <b>SQL_SMALLINT</b>                                                                                                 |
| UINT4                         | <b>SQL_INTEGER</b>                                                                                                  |
| UINT8                         | <b>SQL_BIGINT</b>                                                                                                   |
| WSTRING                       | <b>SQL_WVARCHAR</b>                                                                                                 |

**Note** If the target endpoint does not support ODBC data types, data types are mapped to **SQL\_VARCHAR**.

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

## To add an ODBC endpoint to Attunity Replicate:

1. In **Tasks** view, click **Manage Endpoint Connections** to open the **Manage Endpoints Connections** dialog box. Then click the **New Endpoint Connection** button.
2. In the **Name** field, type a name for your ODBC endpoint. This can be any name that will help to identify the endpoint being used.
3. In the **Description** field, type a description that helps to identify the ODBC endpoint. This is optional.
4. Select **TARGET** as the endpoint **role**.
5. Select **ODBC** as the endpoint **Type**.
6. Select *one* of the following:
  - » **DSN:** Select this to connect to an ODBC-supported endpoint using a DSN. When you select DSN you must select the DSN you are using from the list.

**Note** When connecting to SQL/MP, you must use a connection string, which should include the name of the Replicate ARC Unicode ODBC driver. See [Connection String](#) for an example.

If the DSN you want to use is not included in the list, make sure that the endpoint client is installed on the computer with Attunity Replicate and that the DSN is defined. Note that the ODBC provider client must be 64-bit. For more information, see [Prerequisites](#).

**Note** If you are using an ARC CDC Agent as the source in a Replicate task, you cannot select the DSN for the Attunity ODBC driver as the target. In this case, to use Attunity ODBC as a target, you must enter the connection string manually by selecting **Connection String** and following the directions for that option in this procedure.

- » **Connection String:** Select this to connect to an ODBC-supported endpoint using a connection string then type a valid connection string in the field below. For information on how to create a connection string, see the documentation for the ODBC endpoint provider you are using.

### Example of an SQL/MP Connection String:

```
Driver={Attunity Replicate ARC ODBC Driver 3.5
(Unicode)};BindUrl=attconnect://ais_server_ip:ais_server_port/ais_
workspace;DefTdpName=ais_target_datasource_
name;OneTdpMode=1;qptdpname=BINDURL1;queryProcessor/noThreads=true;}}
```

Note that if you specify a password in your connection string, it will be revealed as plain text in the task log files. It is therefore recommended to specify the password in the GUI **Password** field.

**Note**

- » You can use the **Advanced** tab to add specific properties and create a custom connect string. In this case, you do not need to enter information in this tab. For more information on using the **Advanced** tab, see [Setting Advanced Connection Properties](#).
- » To determine if you are connected to the endpoint you want to use or if the connection information you entered is correct, click **Test Connection**.  
If the connection is successful a message in green is displayed. If the connection fails, an error message is displayed at the bottom of the dialog box.  
To view the log entry if the connection fails, click **View Log**. The server log is displayed with the information for the connection failure. Note that this button is not available unless the test connection fails.

7. Type the authentication information (**User Name, Password**) for the authorized user for the ODBC endpoint being used. For example, the IBM DB2 system administrator if you are using a IBM DB2 provider. If you do not know this information, see your ODBC Endpoint System Administrator.

**Note**

- » When you select **Connection String** be sure to include **User name/password** information in the connection string that you type in the box.  
If you are using the **Advanced** tab to create a custom string, make sure to include the **User Name** and **Password** properties. For more information, see [Setting Advanced Connection Properties](#).
- » This information is case sensitive.
- » You can set custom properties in the **Advanced** tab. For more information, see [Setting Advanced Connection Properties](#).

**Important:** Make sure that the ODBC endpoint user has the correct access privileges for the ODBC provider being used.

## Setting Advanced Connection Properties

In the **Advanced** tab, you can set the following properties:

- » **Provider syntax:** Select the name of the provider syntax. Note that when replicating to an HP NonStop SQL/MP target, you must select **SQLMP (ARC)** as the provider type.
- » **Load using CSV:** Select to load the data using a CSV file.

- » **Max file size (KB):** Select or type the maximum size (in KB) of a CSV file before the file is moved into the load folder. The default value is 32000 KB.

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

# Using Microsoft Azure SQL Data Warehouse as a Target

This section describes how to set up and use Microsoft Azure SQL Data Warehouse as a target in a replication task. Microsoft Azure SQL Data Warehouse is located in the cloud and is accessed through your Microsoft Azure account.

## In this section:

[Overview](#)

[Limitations](#)

[Microsoft Azure SQL Data Warehouse Endpoint Prerequisites](#)

[Microsoft Azure SQL Data Warehouse Data Types](#)

[Setting General Connection Properties](#)

[Setting Advanced Connection Properties](#)

## Overview

In the first stage of the replication process, Attunity Replicate moves the data files created by the source database into Microsoft Azure Blob Storage where they are stored as CSV files. The files are then loaded into the proper tables in the Microsoft Azure SQL Data Warehouse data warehouse (using PolyBase).

The Replicate Microsoft Azure SQL Data Warehouse database provides full automation for:

- » Schema generation and data type mapping
- » Full load of source database tables
- » Incremental load of changes made to source tables
- » Application of schema changes (DDL) made to the source tables.
- » Synchronization between full load and CDC processes.

Manual control is also available if needed.

## Limitations

The following section describes the limitations of using Microsoft Azure SQL Data Warehouse as a Replicate target.

- » Source columns with CHAR/VARCHAR data types and a non-Latin collation (e.g. "Chinese\_PRC\_CI\_AS") need to be mapped to NVARCHAR. This can be done by defining a global transformation for all tables in the replication task or by defining a single transformation for a specific table.  
For more information on defining transformations, see [Defining Global Transformations](#) and [Defining Transformations for a Single Table/View](#).
- » Microsoft Azure SQL Data Warehouse does not support empty (NULL) columns. Consequently, when replicating a source column with an empty value, Replicate inserts a space into the corresponding target column.
- » The rename column DDL is not supported.

## Microsoft Azure SQL Data Warehouse Endpoint Prerequisites

The following sections describe the prerequisites necessary for using Microsoft Azure SQL Data Warehouse as a target endpoint in a Replicate task.

- » [Sign up for Microsoft Azure Blob Storage](#)
- » [Sign up for Microsoft Azure SQL Data Warehouse](#)
- » [Open the Required Firewall Port\(s\)](#)
- » [Install the Required Client](#)

### Sign up for Microsoft Azure Blob Storage

Sign up for an Azure Blob Storage account and make a note of the account name, account key, container name and target folder - you will need to provide them later.

**Note** For best performance, the Azure Blob Storage container should be in the same region as your Microsoft Azure SQL Data Warehouse.

### Required Permissions

Attunity Replicate performs the following operations on the Azure Blob Storage container/folder:

- » On the Azure Blob Storage container: LIST
- » On the Azure Blob Storage folder: READ, WRITE and DELETE

The user specified in the Microsoft Azure SQL Data Warehouse endpoint settings must be granted the above permissions.

## Sign up for Microsoft Azure SQL Data Warehouse

Sign up for Microsoft Azure SQL Data Warehouse and make a note of the server name, port, user name, password, database name and Azure Blob Storage access Credential - you will need to provide them later. Note that if you have not already created an Azure Blob Storage access Credential, you can configure Replicate to create one automatically as described in [Setting General Connection Properties](#).

## Required Permissions

Attunity Replicate performs the following operations on the replicated tables within Microsoft Azure SQL Data Warehouse:

- » SELECT, INSERT, UPDATE and DELETE
- » Bulk Load
- » CREATE, ALTER, DROP (if required by the task's definition)

Unless the user is the DB Owner, the user specified in the Microsoft Azure SQL Data Warehouse endpoint settings must be granted the above permissions.

## Open the Required Firewall Port(s)

- » **When Replicate Server runs on a machine outside Azure** - Open port 1433 for outbound traffic.
- » **When Replicate Server runs on an AzureVM** - Open the following ports for outbound traffic:
  - » 1433
  - » 11000-11999
  - » 14000-14999

## Install the Required Client

Install SQL Server Native Client 11 (for connecting to Microsoft Azure SQL Data Warehouse) on the Attunity Replicate machine.

## Microsoft Azure SQL Data Warehouse Data Types

The Microsoft Azure SQL Data Warehouse database for Attunity Replicate supports most Microsoft Azure SQL Data Warehouse data types. The following table shows the Microsoft Azure SQL Data Warehouse target data types that are supported when using Attunity Replicate and the default mapping from Attunity Replicate data types.

For information on how to view the data type that is mapped from the source, see the section for the source database you are using. For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 9.32 | Supported Microsoft Azure SQL Data Warehouse Data Types with Mapping from Attunity Replicate Data Types**

| Attunity Replicate Data Types | Microsoft Azure SQL Data Warehouse Data Types                                                                                                |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| BOOL                          | BIT                                                                                                                                          |
| BYTES                         | If length is => 1 and =< 8000, then:<br>VARBINARY (Length in Bytes)<br><br>If length is => 8001 and =< 2147483647, then:<br>VARBINARY (8000) |
| DATE                          | DATE                                                                                                                                         |
| TIME                          | TIME                                                                                                                                         |
| DATETIME                      | DATETIME2 (s)                                                                                                                                |
| INT1                          | TINYINT                                                                                                                                      |
| INT2                          | SMALLINT                                                                                                                                     |
| INT4                          | INTEGER                                                                                                                                      |
| INT8                          | BIGINT                                                                                                                                       |
| NUMERIC                       | DECIMAL (p,s)                                                                                                                                |
| REAL4                         | FLOAT(24)                                                                                                                                    |
| REAL8                         | FLOAT(53)                                                                                                                                    |
| STRING                        | If length is => 1 and =< 8000, then:<br>VARCHAR (Length in Bytes)<br><br>If length is => 8001 and =< 2147483647, then:<br>VARCHAR (8000)     |
| UINT1                         | TINYINT                                                                                                                                      |
| UINT2                         | SMALLINT                                                                                                                                     |
| UINT4                         | INTEGER                                                                                                                                      |
| UINT8                         | BIGINT                                                                                                                                       |
| WSTRING                       | If length is => 1 and =< 4000, then:<br>NVARCHAR (Length in Bytes)<br><br>If length is => 4001 and =< 2147483647, then:<br>NVARCHAR (4000)   |

**Table 9.32 | Supported Microsoft Azure SQL Data Warehouse Data Types with Mapping from Attunity Replicate Data Types (Cont.)**

| Attunity Replicate Data Types | Microsoft Azure SQL Data Warehouse Data Types                                                                                                                                                                                                                                           |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                               | <p><b>Note</b> About Microsoft Azure SQL Data Warehouse LOB support:<br/>Full LOB data types are not supported. For information on including Limited-size LOB data types in the replication, see the <a href="#">Metadata</a> tab description in <a href="#">Customizing Tasks</a>.</p> |
| BLOB                          | VARBINARY (Max LOB Size * 2)                                                                                                                                                                                                                                                            |
| NCLOB                         | NVARCHAR (Max LOB Size)                                                                                                                                                                                                                                                                 |
| CLOB                          | VARCHAR (Max LOB Size)                                                                                                                                                                                                                                                                  |

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

### To add an Microsoft Azure SQL Data Warehouse Target to Attunity Replicate:

1. In the Attunity Replicate Console, click **Manage Endpoint Connections** to open the **Manage Endpoints Connections** dialog box.
2. In the **Manage Endpoint Connections** dialog box, click **New Endpoint Connection**.
3. In the **Name** field, type a name for your Microsoft Azure SQL Data Warehouse data warehouse [service]. This can be any name that will help to identify your Microsoft Azure SQL Data Warehouse database.
4. In the **Description** field, type a description that helps to identify the Microsoft Azure SQL Data Warehouse target database. This is optional.
5. Select **TARGET** as the **role**.
6. Select **Microsoft Azure SQL Data Warehouse** as the **Type**.

7. Enter the following **Microsoft Azure SQL Data Warehouse** information:
  - » **Server name:** Specify the name of the Microsoft Azure SQL Data Warehouse server you are using.
  - » **Port:** Specify the port number for Microsoft Azure SQL Data Warehouse.
  - » **User name:** Specify the user name of a registered Microsoft Azure SQL Data Warehouse user.
  - » **Password:** Specify the password for the user entered in the **User name** field.
  - » **Database name:** Specify the target database name.  
If you do not have these values, contact the Microsoft Azure account owner or your company's Microsoft Azure SQL Data Warehouse System Administrator.
  - » **Azure Blob Storage Access:** During a replication task, Microsoft Azure SQL Data Warehouse authenticates itself to Azure Blob Storage using an SQL Server Credential. You can either configure Replicate to create the Credential automatically during runtime (the default) or use an existing Credential.
    - » **Automatically create SQL Server Credential**
    - » **Use existing SQL Server Credential**
8. Enter the following Microsoft Azure Blob Storage information. You may need to click the **Microsoft Azure Blob Storage** header to see the information.
  - » **Account name:** Specify the name of the Azure Blob Storage account to which you want the files copied.
  - » **Container name:** Specify the name of the Azure Blob Storage container to which you want the files copied.
  - » **Account key:** Specify the key for your Azure Blob Storage account.
  - » **Folder:** Specify the name of the Azure Blob Storage folder to which you want the files copied.

If you do not have these values, contact the Microsoft Azure Blob Storage account owner or your company's IT department.

#### Note

- » This information is case sensitive.
- » To determine if you are connected to the database you want to use or if the connection information you entered is correct, click **Test Connection**.  
If the connection is successful a message in green is displayed. If the connection fails, an error message is displayed at the bottom of the dialog box.
- » To view the log entry if the connection fails, click **View Log**. The server log is displayed with the information for the connection failure. Note that this button is not available unless the test connection fails.

## Setting Advanced Connection Properties

In the **Advanced** tab, you can set the following properties:

- » **Max file size (MB)**: Select or type the maximum size of any CSV file used to transfer data to Microsoft Azure SQL Data Warehouse. The default value is 1024.
- » **Number of threads used to upload a file**: Select the number of threads used to upload a single file. The minimum number of threads is 1. The maximum value is 64. The default value is 10.
- » **ODBC driver**: The name of the default ODBC driver you are using to connect to Microsoft Azure SQL Data Warehouse. The default driver is **SQL Server Native Client 11.0**.
- » **Additional ODBC connection properties**: Enter additional ODBC connection properties if required.

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

# Using IBM Netezza as a Target

This section describes how to set up and use an IBM Netezza database as a target database in a replication task.

## In this section:

[Prerequisites](#)

[Limitations](#)

[Security Requirements](#)

[IBM Netezza Target Data Types](#)

[Setting General Connection Properties](#)

[Setting Advanced Connection Properties](#)

## Prerequisites

### Note

- » Attunity Replicate must be installed on any Windows computer in your network.
- » An IBM Netezza account with the required access privileges is required.

Make sure the following prerequisites have been met:

- » IBM Netezza ODBC 64-bit client installed on the Attunity Replicate machine.
- » IBM Netezza Tools 7.0.4.2 or above installed on the Attunity Replicate machine. Make sure that the Windows `Path` environment variable includes the `bin` folder of IBM Netezza Tools (i.e. `installation directory\bin`).

## Limitations

Using IBM Netezza as a target database in an Attunity Replicate task is subject to the following limitations:

- » The IBM Netezza target database uses the IBM Netezza NZLOAD utility, which does not support loading tables with non-Latin names (e.g. Chinese). If any of your source tables has a non-Latin name, you can map it to a table with a Latin name.  
For more information on mapping table names, see [Performing General Tasks for a Single Table/View](#) and [Defining Global Transformations](#).
- » For IBM Netezza versions before 7.0.3, you need to define a default target schema.  
For information about defining a target schema, see [Target Metadata](#).

## Security Requirements

The Attunity Replicate user must be granted access to the IBM Netezza account as well as the following privileges:

### Database Privileges

- » LIST on <database> to <ATTUNITY USER>
- » SELECT on <database> to <ATTUNITY USER>

### Table Privileges

- » CREATE TABLE to <ATTUNITY USER>
- » LIST on TABLE to <ATTUNITY USER>

### Schema Privileges

- » CREATE SCHEMA to <ATTUNITY USER>
- » LIST on SCHEMA to <ATTUNITY USER>

### View Privileges

- » SELECT on \_T\_DATABASE to <ATTUNITY USER>
- » SELECT on \_V\_SCHEMA to <ATTUNITY USER>
- » SELECT on \_V\_USER to <ATTUNITY USER>
- » SELECT on \_V\_TABLE to <ATTUNITY USER>
- » SELECT on \_V\_TABLE\_DIST to <ATTUNITY USER>
- » SELECT on \_V\_RELATION\_KEYDATA to <ATTUNITY USER>
- » LIST on \_T\_DATABASE to <ATTUNITY USER>
- » LIST on \_V\_SCHEMA to <ATTUNITY USER>
- » LIST on \_V\_USER to <ATTUNITY USER>
- » LIST on \_V\_TABLE to <ATTUNITY USER>
- » LIST on \_V\_TABLE\_DIST to <ATTUNITY USER>
- » LIST on \_V\_RELATION\_KEYDATA to <ATTUNITY USER>

## IBM Netezza Target Data Types

The IBM Netezza database for Attunity Replicate supports most IBM Netezza data types. The following table shows the IBM Netezza target data types that are supported when using Attunity Replicate and the default mapping from Attunity Replicate data types.

**Note** IBM Netezza does not support applying changes to binary data types in **Batch optimized apply** mode. For more information on **Batch optimized apply** mode, see [Change Processing Tuning](#).

For information on how to view the data type that is mapped from the source, see the section for the source database you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Table 9.33 | Supported IBM Netezza Data Types with Mapping from Attunity Replicate Data Types**

| Attunity Replicate Data Types | IBM Netezza Data Types                                               |
|-------------------------------|----------------------------------------------------------------------|
| BOOLEAN                       | BOOLEAN                                                              |
| BYTES                         | VARCHAR (Length in Bytes)                                            |
| DATE                          | DATE                                                                 |
| TIME                          | TIME                                                                 |
| DATETIME                      | If scale < 7:<br>TIMESTAMP<br>If scale 7-9:<br>CHARACTER VARYING(37) |
| INT1                          | BYTEINT                                                              |
| INT2                          | SMALLINT                                                             |
| INT4                          | INTEGER                                                              |
| INT8                          | BIGINT                                                               |
| NUMERIC                       | NUMERIC (p,s)                                                        |
| REAL4                         | REAL                                                                 |
| REAL8                         | DOUBLE                                                               |
| STRING                        | VARCHAR (Length)                                                     |
| UINT1                         | SMALLINT                                                             |
| UINT2                         | INTEGER                                                              |
| UINT4                         | BIGINT                                                               |
| UINT8                         | BIGINT                                                               |
| WSTRING                       | NVARCHAR (Length)                                                    |

**Note About IBM Netezza LOB support:**

Full LOB data types are not supported in the IBM Netezza database. For information on including Limited-size LOB data types in the replication, see the [Metadata tab](#) section in [Customizing Tasks](#). Note also that the size of a row in the IBM Netezza database *cannot exceed 64KB*. This should be taken into consideration when specifying the maximum LOB size in the [Metadata tab](#).[second paragraph if needed]

**Table 9.33 | Supported IBM Netezza Data Types with Mapping from Attunity Replicate Data Types (Cont.)**

| Attunity Replicate Data Types | IBM Netezza Data Types |
|-------------------------------|------------------------|
| BLOB                          | VARCHAR (64,000)       |
| NCLOB                         | NVARCHAR (16,000)      |
| CLOB                          | VARCHAR (64,000)       |

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

### To add an IBM Netezza target endpoint to Attunity Replicate:

1. In **Tasks** view, click **Manage Endpoint Connections** to open the **Manage Endpoints Connections** dialog box. Then click the **New Endpoint Connection** button.
2. In the **Name** field, type a name for your database. This can be any name that will help to identify the database being used.
3. In the **Description** field, type a description that helps to identify the IBM Netezza database. This is optional.
4. Select **TARGET** as the database **role**.
5. Select **IBM Netezza** as the database **Type**.
6. In the **Server** field, enter the name of the IBM Netezza server.
7. Optionally, change the default **Port** (5480).
8. Type the IBM Netezza authentication information (**User Name**, **Password**) for the authorized user for this IBM Netezza database. If you do not know this information, see your IBM Netezza database Administrator (DBA).

#### Note

- » This information is required. If you are using the **Advanced** tab to create a custom string, make sure to include the **User Name** and **Password** properties. See [Setting Advanced Connection Properties](#) for more information.
- » This information is case sensitive.
- » If you want to set custom properties for this database, see [Setting Advanced Connection Properties](#).

**Important:** Make sure that the IBM Netezza user entered in the IBM Netezza Authentication section has the correct access privileges. For information on how to

provide the required privileges, see [Security Requirements](#).

9. In the **Database name** field, enter the name of the IBM Netezza database.

## Setting Advanced Connection Properties

In the **Advanced** tab, you can set the following parameters:

- » **Max file size:** Select or type the maximum size (in KB) of a CSV file before the file is loaded into the IBM Netezza database. The default value is 32000 KB.

### Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

#### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

### Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

# Using Kafka as a Target

This section describes how to set up and use Kafka as a target endpoint in a replication task. In a task with a Kafka target endpoint, each source record is transformed into a message which is then written (with an optional message key) to a partition in the specified topic.

## In this section:

- [Transaction Processing by the Consumer](#)
- [Prerequisites](#)
- [Limitations](#)
- [Kafka Target Data Types](#)
- [Setting General Connection Properties](#)
- [Setting Advanced Connection Properties](#)
- [The Attunity Envelope](#)
- [Metadata and Data Messages](#)

## Transaction Processing by the Consumer

When configuring the Attunity Replicate Kafka endpoint, users can configure various settings that affect where messages are published within the Kafka infrastructures (topics/partitions).

During a task's CDC stage, committed changes that are detected by the Attunity Replicate source endpoint are grouped by transaction, sorted internally in chronological order, and then propagated to the target endpoint. The target endpoint can handle the changes in various ways such as applying them to the target tables or storing them in dedicated Change Tables.

Each CDC message has both a transaction ID as well as change sequence. As the change sequence is a monotonically growing number, sorting events by change sequence always achieves chronological order. Grouping the sorted events by transaction ID then results in transactions containing chronologically sorted changes.

However, as Kafka is a messaging infrastructure, applying changes is not feasible while storing changes in tables is meaningless. The Replicate Kafka endpoint, therefore, takes a different approach, which is to report all transactional events as messages.

## How it Works

Each change in the source system is translated to a data message containing the details of the change including the transaction ID and change sequence in the source. The data message also includes the changed columns before and after the change. As explained above, the order in which the Kafka target writes the messages is the same as order of changes within each transaction.

Once a data message is ready to be sent to Kafka, the topic and partition it should go to are determined by analyzing the [endpoint settings](#) as well as potentially [transformation settings](#). For example, the user might decide to configure the endpoint in such a way that every table is sent to a different topic and set the partition strategy to "Random", meaning that each message (within the same table) will be sent to a different partition.

## Transaction Consistency from a Consumer Perspective

If maintaining transaction consistency is important for the consumer implementation, it means that although the transaction ID exists in all data messages, the challenge is to gather the messages in a way that would facilitate identifying a whole transaction. An additional challenge is getting the transaction in the original order they were committed, which could be an even greater challenge if transactions are spread across multiple topics and partitions.

The simplest way of achieving the above goal is to direct Replicate to a specific topic and a specific partition (in the [endpoint settings](#)). This means that all data messages will end up in a single partition, thus guaranteeing ordered delivery both of transactions *and* of changes within a transaction. The consuming application could then consume messages - accumulating a transaction in some intermediate memory buffer - and when a new transaction ID is detected, mark the previous transaction as completed.

Although the simple way may work, it's not very efficient at the task level as all messages end up in the same topic and partition, not necessarily utilizing the full parallelism of the Kafka cluster. This may be a non-issue if there are multiple tasks, each taking advantage of a different topic/partition. In such a scenario, the gathering of messages from those tasks may very well utilize the cluster optimally.

The more generic way where data may be spread over multiple topics and partitions means that some intermediate buffer such as memory, a table in a relational database, or even other Kafka topics would need to be used to collect information about transactions. Then, the transactions would need to be rebuilt by periodically (every few minutes/hours) sorting the events collected from Replicate's Kafka output by the change sequence and grouping them by transaction ID.

## Prerequisites

Before you can use Kafka as a target endpoint in a Replicate task, the following prerequisites must be met:

- » Open TCP ports to all the brokers from the Replicate Server machine
- » Set permissions that will allow Attunity Replicate to write to the target topics. One way to do this is to use the Kafka ACLs script (`kafka-acls`).
- » Either create a topic named **attrep\_apply\_exceptions** before starting the replication task or configure the brokers with `auto.create.topics.enable=true`.

Note that if this topic does not exist, the task will always fail when it encounters a data error, regardless of the [error handling policy](#).

For a description of the **attrep\_apply\_exceptions** table, see [Apply Exceptions](#)

## Limitations

When defining a task with Kafka as the target endpoint, the following limitations apply:

- » The Kafka target endpoint does not support unlimited LOB size. Therefore, when replicating from source tables with LOB columns, *do not* select the **Allow unlimited LOB size** option.

For more information on defining LOB settings, see [Target Metadata](#).

- » **Batch optimized apply** mode is not supported. If this mode is set, the task will automatically switch to **Transactional apply** mode and issue an appropriate warning.

For more information on these modes, see [Change Processing Tuning](#).

- » Store Changes mode is not supported.

For more information on Store Changes mode, see [Adding Tasks](#).

- » Kafka topic names cannot exceed 255 characters (249 from Kafka 0.10) and can only contain the following characters:

a-z|A-Z|0-9|. (dot)|\_(underscore)|-(minus)

If the source table names exceed the maximum permitted length or contain unsupported characters, you need to either modify the names before starting the task or define a global transformation. For information on defining global transformations, see [Defining Global Transformations](#).

- » The **Ignore ALTER** Apply Changes setting is not supported for changes to source data types and table renaming.

- » Column names must begin with [A-Za-z\_] (letters or an underscore) followed by [A-Za-z0-9\_] (letters, digits, or an underscore). For example, **\_Test\_** is a valid column name whereas **&Test** is not.

If a source column name does not adhere to this rule, then [a transformation should be used](#) to rename the column.

## Kafka Target Data Types

The following table shows the default mapping from Attunity Replicate data types to Kafka data types.

For information on source data type mappings, see the section for the source endpoint you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Note** When using the JSON message format, binary values are represented as hexadecimal digits.

**Table 9.34 | Supported Kafka Target Data Types with Mapping from Attunity Replicate Data Types**

| Attunity Replicate Data Types                                | Kafka Target Data Types |
|--------------------------------------------------------------|-------------------------|
| DATE                                                         | DATE                    |
| TIME                                                         | TIME                    |
| DATETIME                                                     | DATETIME                |
| BYTES                                                        | BYTES (length)          |
| BLOB                                                         | BLOB                    |
| REAL4                                                        | REAL4 (7)               |
| REAL8                                                        | REAL8 (14)              |
| INT1                                                         | INT1 (3)                |
| INT2                                                         | INT2 (5)                |
| INT4                                                         | INT4 (10)               |
| INT8                                                         | INT8 (19)               |
| UINT1                                                        | UINT1 (3)               |
| UINT2                                                        | UINT2 (5)               |
| UINT4                                                        | UINT4 (10)              |
| <b>Note</b> Values larger than $2^{31}-1$ are not supported. |                         |
| UINT8                                                        | UINT8 (20)              |
| <b>Note</b> Values larger than $2^{63}-1$ are not supported. |                         |
| NUMERIC                                                      | NUMERIC (p,s)           |
| STRING                                                       | STRING (Length)         |
| WSTRING                                                      | STRING (Length)         |
| CLOB                                                         | CLOB                    |
| NCLOB                                                        | NCLOB                   |
| BOOLEAN                                                      | BOOLEAN (1)             |

## Mapping from Attunity Replicate Data types to Avro

When Avro is set as the message format, due to the limited number of data types supported by Avro, the data type mappings will be as shown in the table below.

**Note** Replicate data types will only be mapped to supported Avro logical data types if the [Use logical data types for specific data types](#) check box is selected.

**Table 9.35 | Supported Avro Data Types with Mapping from Attunity Replicate Data Types**

| Attunity Replicate Data Types | Avro Primitive Data Types (When not using logical data types) | Avro Logical Data Types                     |
|-------------------------------|---------------------------------------------------------------|---------------------------------------------|
| DATE                          | STRING                                                        | DATE<br>Annotates an Avro INT.              |
| TIME                          | STRING                                                        | TIME-MILLIS<br>Annotates an Avro INT.       |
| TIMESTAMP                     | STRING                                                        | TIMESTAMP-MICROS<br>Annotates an Avro LONG. |
| STRING                        | STRING                                                        |                                             |
| WSTRING                       | STRING                                                        |                                             |
| CLOB                          | STRING                                                        |                                             |
| NCLOB                         | STRING                                                        |                                             |
| NUMERIC                       | STRING                                                        | DECIMAL (p,s)<br>Annotates an Avro BYTES.   |
| BYTES                         | BYTES                                                         |                                             |
| BLOB                          | BYTES                                                         |                                             |
| REAL4                         | FLOAT                                                         |                                             |
| REAL8                         | DOUBLE                                                        |                                             |
| INT1                          | INT                                                           |                                             |
| INT2                          | INT                                                           |                                             |
| INT4                          | INT                                                           |                                             |
| UINT1                         | INT                                                           |                                             |
| UINT2                         | INT                                                           |                                             |
| UINT4                         | LONG                                                          |                                             |
| INT8                          | LONG                                                          |                                             |
| UINT8                         | STRING                                                        | DECIMAL (20,0)<br>Annotates an Avro BYTES.  |
| BOOLEAN                       | BOOLEAN                                                       |                                             |

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

### To define the general connection properties:

1. Click the **Manage Endpoint Connections** toolbar button.  
The **Manage Endpoints Connections** dialog box opens.
2. Click the **New Endpoint Connection** toolbar button.  
The **Name**, **Description**, **Type** and **Role** fields are displayed on the right.
3. In the **Name** field, specify a display name for the endpoint.
4. In the **Description** field, optionally type a description for the Kafka endpoint.
5. Select **Target** as the endpoint **Role**.
6. Select **Kafka** as the endpoint **Type**.  
The dialog box is divided into **General** and **Advanced** tabs.
7. In the **Broker servers** field, specify one or more broker servers using the following format (for high availability):  
`server1[:port1][,server2[:port2]]`

#### Example:

`192.168.1.100:9092,192.168.1.101:9093`

Replicate will connect to the first available host. If a host is specified without a port then port 9092 will be used as the default.

**Note** When using SSL or Kerberos authentication, you must specify the broker FQDN (i.e. not the IP address).

**Note** All of the broker servers in your cluster need to be accessible to Replicate. However, you do not need to specify all of the servers in the **Broker servers** field. This is because Replicate only need to connect to one of the servers in order to retrieve the connection details for the other servers in the cluster. It is therefore best practice to specify the servers that are most likely to be available when the task is run. The servers to which Replicate produces messages is determined by the topic and partitioning [topic and partitioning settings](#) described below.

8. In the **Security** section, set the following properties:

### Note

- » The **Use SSL** and **Certificate** authentication options are only supported from Kafka 0.9 and above.
- » The CA file, public key file and private key file must all be in PEM format.
- » The **Kerberos** and **User name and password** authentication methods are only supported from Kafka 0.10 and above.
- » All of the broker servers in the cluster must be configured to accept connection requests using the selected **Authentication** method.

- » **Use SSL** (supports TLS 1.0, 1.1 and 1.2): Select this option to encrypt the communication between the Replicate machine and the broker server(s). If the brokers are configured to require SSL, then you *must* select this option.
  - » **CA path:** Specify the directory containing the CA (Certificate Authority) certificate or the full path to a specific CA certificate.
- » **Authentication:** Select one of the following:
  - » **None** - To send messages without authentication.
  - » **Certificate** - If you select this option, you also need to provide the following information:
    - » **Public key file** - The full path to the public key file on the Replicate Server machine.
    - » **Private key file** - The full path to the private key file on the Replicate Server machine.
    - » **Private key password** - The password for the private key file.
  - » **Kerberos** - Select to authenticate against the Kafka cluster using Kerberos. Replicate automatically detects whether Attunity Replicate Server is running on Linux or on Windows and displays the appropriate settings.

### Attunity Replicate Server on Linux:

**Note** In order to use Kerberos authentication on Linux, the Kerberos client (workstation) package should be installed.

- » **Principal** - The Kerberos principal used to authenticate against the broker server(s).
- » **Keytab file** - The full path to the keytab file (that contains the specified principal) on the Replicate Server machine.

### Attunity Replicate Server on Windows:

**Note** Both Replicate Server and the Kafka brokers must be connected to

Active Directory KDC.

- » **Realm** - The name of the domain in which the broker servers reside.
- » **Principal** - The user name to use for authentication. The principal must be a member of the domain entered above.
- » **Password** - The password for the principal entered above.

For additional steps required to complete setup for Kerberos authentication, see [Using Kerberos Authentication on Windows](#) below.

- » **User name and password** - Currently this option is only supported when Replicate Server is installed on a Linux machine. You can select this option to authenticate yourself using a user name and password (SASL/PLAIN). To prevent the password from being sent in clear text, it is strongly recommended to enable the [Use SSL](#) option as well.

9. In the **Message Properties** section, set the following properties:

- a. Choose **JSON** or **Avro** as the message format.

**Note** Attunity provides an Avro Message Decoder SDK for consuming Avro messages produced by Attunity Replicate. You can download the SDK together with the Avro Message Decoder Developer's Guide as a ZIP file from the [Customer Zone](#).

An understanding of the Attunity envelope schema is a prerequisite for consuming Avro messages produced by Attunity Replicate. If you do not wish to use the SDK, see [The Attunity Envelope](#) for a description of the Attunity envelope schema.

- b. From the **Compression** drop-down list, optionally select one of the available compression methods (**Snappy** or **gzip**). The default is **None**.
- c. When the **Include Before-image in UPDATE messages** check box is selected (the default), both pre- and post-UPDATE data will be included in UPDATE messages. To include only the post-UPDATE data in messages, clear the check box.
- d. Select the **Include external Schema ID header** check box to include the Schema ID in the data message. As the Schema ID changes whenever a DDL is performed on the source table, consumer applications can use this information to determine if the message schema has changed.
- e. If you selected Avro, optionally select the **Use logical data types for specific data types** check box to map some of the number-based Attunity Replicate data types to Avro logical data types. When this option is *not* selected (the default), all Attunity Replicate data types will be mapped to Avro primitive data types.

For more information on Attunity Replicate to Avro data type mapping, see [Mapping from Attunity Replicate Data Types to Avro](#).

10. In the **Data Message Publishing** section, set the following properties:

- In the **Publish the data to** field, choose one of the following:
  - » **Specific topic** - to publish the data to a single topic. Either type a topic name or use the browse button to select the desired topic.
  - » **Specific topic for each table** - to publish the data to multiple topics corresponding to the source table names.

The target topic name consists of the source schema name and the source table name, separated by a period (e.g. "dbo.Employees"). The format of the target topic name is important as you will need to prepare these topics in advance.

**Note** If the topics do not exist, configure the brokers with `auto.create.topics.enable=true` to enable Replicate to create the topics during runtime. Otherwise, the task will fail.
- From the **Partition strategy** drop-down list, field, select either **Random** or **By message key**. If you select **Random**, each message will be written to a randomly selected partition. If you select **By message key**, messages will be written to partitions based on the selected **By message key** (described below).
- From the **Message key** drop-down list, field, select one of the following:

**Note** The message key is represented as a string, regardless of the selected data message format (JSON/Avro).

- » **None** - To create messages without a message key.
- » **Schema and table name** - For each message, the message key will contain a combination of schema and table name (e.g. "dbo+Employees"). When **By message key** is selected as the **Partition strategy**, messages consisting of the same schema and table name will be written to the same partition.
- » **Primary key columns** - For each message, the message key will contain the value of the primary key column. When **By message key** is selected as the **Partition strategy**, messages consisting of the same primary key value will be written to the same partition.

11. In the **Metadata Message Publishing** section, specify whether or where to publish the message metadata.

From the **Publish** drop-down list, select one of the following options:

- » **Do not publish metadata messages**

When this option is selected, only the data messages will be published.

Additionally, the **Wrap data messages with the Attunity Envelope** option

(enabled by default) will be displayed. This option is useful for organizations that wish to leverage the [Attunity Envelope](#) structure to process the data messages. If you do not require the additional information provided by the Attunity Envelope (e.g. due to existing message consumption processes), then disable this option.

#### » **Publish metadata messages to a dedicated metadata topic**

If you select this option, either type the **Topic name** or use the Browse button to select the desired topic. This option is required if the message format is set to **Avro** since Avro-formatted messages can only be opened using the Avro schema.

**Note** It is strongly recommended *not* to publish schema messages to the same topic as data messages.

**Note** If the topics do not exist, configure the brokers with `auto.create.topics.enable=true` to enable Replicate to create the topics during runtime. Otherwise, the task will fail.

#### » **Publish data schemas to the Confluent Schema Registry**

If you select this option, you must also configure the properties described below.

##### **Schema Registry Connection Properties:**

- » **Schema Registry servers:** Specify one or more Schema Registry servers using the following format (for high availability):

```
server1[:port1][,server2[:port2]]
```

##### **Example:**

```
192.168.1.100:8081,192.168.1.101:8082
```

Replicate will connect to the first available host. If a host is specified without a port then port 8081 will be used as the default.

##### **Schema Registry Security:**

- » **Use Kafka Security settings:** Select this option if you want to use the security settings that you defined for Kafka. Note that this option will only be available if the security settings that you defined for Kafka are also supported by the Confluent Schema Registry.
- » **Use SSL** (supports TLS 1.0, 1.1 and 1.2): Select this option to encrypt the data between the Replicate machine and the Schema Registry server(s). If the servers are configured to require SSL, then you *must* select this option.
  - » **CA path:** Specify the directory containing the CA (Certificate Authority) certificate or the full path to a specific CA certificate.
- » **Authentication:** Select one of the following:

- » **None** - To send messages without authentication.
- » **Certificate** - If you select this option, you also need to provide the following information:
  - » **Public key file** - The full path to the public key file on the Replicate Server machine.
  - » **Private key file** - The full path to the private key file on the Replicate Server machine.
  - » **Private key password** - The password for the private key file.

#### **Schema Registry Subjects:**

- » Select a compatibility mode from the **Subject Compatibility Mode** drop-down list. A description of the selected mode will appear below the drop-down list.

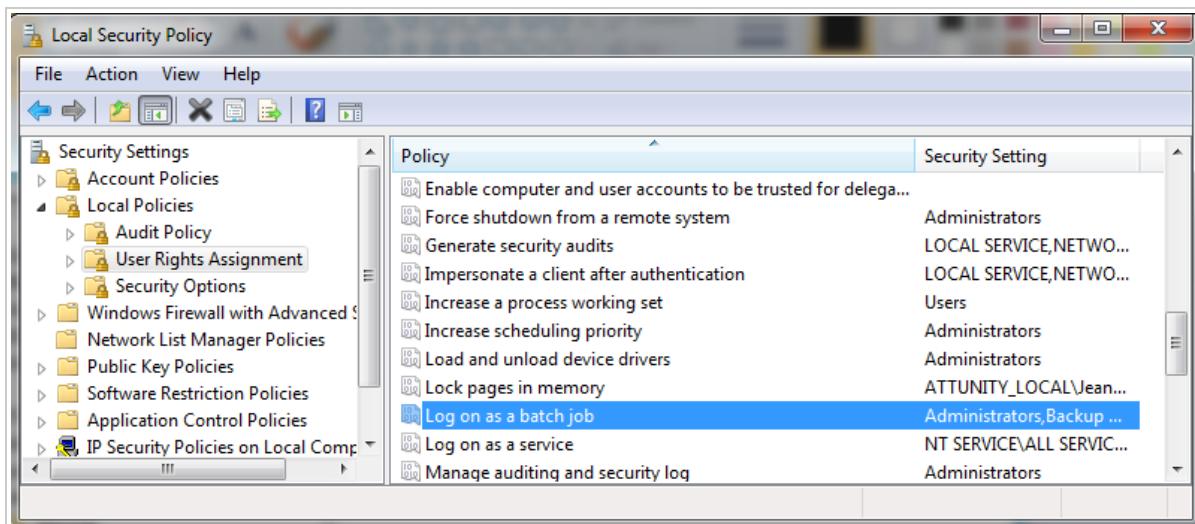
## Using Kerberos Authentication on Windows

Before beginning, make sure that the impersonated user (principal) has access to the Replicate **Data** directory (<product\_dir>\Data by default) on the Attunity Replicate server. For Active Directory KDC, the impersonated user is the user configured in the user interface.

#### **To set Kerberos authentication on Windows:**

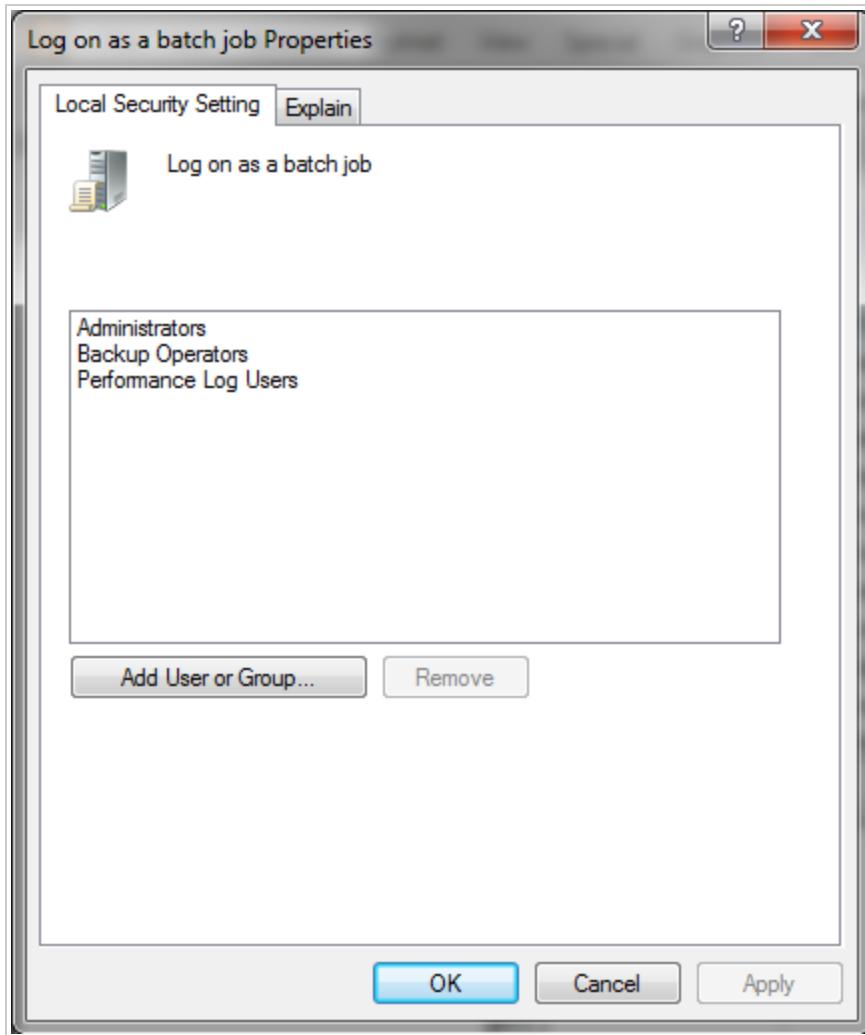
Perform the following steps to ensure that the impersonated user (principal) has the **Log on as a batch job** privilege on the Attunity Replicate server.

1. On the Attunity Replicate server, open the **Local Security Settings (Control Panel > System Security > Administrative Tools > Local Security Policy)**.



2. In the console tree, expand **Local Policies** and select **User Rights Assignments**.
3. In the details pane, double-click **Log on as a batch job**.

4. In the **Log on as a batch job Properties** dialog box, on the **Local Security Settings** tab, verify that the respective user is listed. If it is not listed, click **Add User or Group**, then add the user and click **OK**.



Your changes should take effect immediately.

## Overriding the Default Settings

A transformation can be defined that overrides the topic, partition and message key settings defined in the **General** tab.

**Note** Before you can define such a transformation, you first need to add a source endpoint to the task and select the tables you want to replicate.

**To define a transformation:**

1. Open the task you defined.
2. If you are defining a transformation for a single table, select one of the source tables. Otherwise, skip to Step 3.
3. Define a transformation that adds one of the following columns:

**Note** The columns listed below (prefixed with a \$) instruct Replicate to route the message to the desired topic and/or partition, and will *not* be included in the actual message itself.

- » `$topic` - To write messages to a specific topic.
- » `$partition` - To write messages to a specific partition.
- » `$key` - To create a custom message key.

For information on creating a transformation for a single table, see [Defining Transformations for a Single Table/View](#).

For information on creating a global transformation rule, see [Defining Global Transformations](#).

4. Define an expression for the new column that returns the following values:

- » For a `$topic` column, the expression should return the topic name.
- » For a `$partition` column, the expression should return the partition number. Note that an error will be returned during runtime if the partition number does not exist.
- » For a `$key` column, the expression should return the message key contents.

For information on creating expressions, see [Using the Expression Builder \(for Filters, Transformations, and Global Transformations\)](#).

## Setting Advanced Connection Properties

In the **Advanced** tab, you can define advanced properties for the Kafka target endpoint:

» **Message Maximum Size**

In the **Message maximum size** field, specify the maximum size of messages that the broker(s) are configured to receive (`message.max.bytes`). Replicate will not send messages larger than the maximum size.

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

**To add internal Attunity Replicate parameters:**

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.

2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

## The Attunity Envelope

All Attunity message types covered in this section are encapsulated in a single message schema called the Attunity Envelope. The schema of the Attunity envelope is as following:

```
{
    "type": "record",
    "name": "MessageEnvelope",
    "fields": [
        {"name": "magic", "type": {"type": "fixed", "name": "Magic", "size": 5}},
        {"name": "type", "type": "string"},
        {"name": "headers", "type": ["null", {"type": "map", "values": "string"}]},
        {"name": "messageSchemaId", "type": ["null", "string"]},
        {"name": "messageSchema", "type": ["null", "string"]},
        {"name": "message", "type": "bytes"}
    ]
}
```

The fields in the envelope are as follows:

- » **magic** (5 bytes fixed field)

The constant "atMSG" is used to identify this form of message. The "atMSG" constant should be used to validate that this message is indeed an Attunity envelope message.

- » **type** (string field)

Describes the enveloped message type. This can be one of two values: **MD** which stands for metadata message and **DT** which stands for data message.

- » **headers** (map of string key and value)

A free for use map for various properties set at the application level. Currently, no headers are set by Attunity Replicate but this may change in future versions.

- » **messageSchemaId** (null or string)

A reference to a schema defined elsewhere, which can be used to deserialize the bytes in the message field. This specification does not explain how the schema ID is used for

looking up the actual schema - it is an application level detail. This field is used exclusively with the `messageSchema` field.

- » `messageSchema` (null or string)

An embedded UTF-8 encoded Avro JSON schema with which the message field can be serialized. This field is used exclusively with the `messageSchemaId` field.

- » `message` (bytes)

An Avro encoded message, which is the payload of the message envelope.

Given the envelope schema, it is possible for anyone using this schema to properly decode the envelope messages from Kafka.

Once the envelope message has been decoded, there are two possible scenarios:

- » **Scenario 1:** Decoding a self-describing message such as the metadata message

- » **Scenario 2:** Decoding a message by referenced schema ID such as data messages

The method for logically decoding messages in both scenarios is described below.

## Decoding a Self-Describing Message

When the `messageSchema` field is not null, it means the `message` field can be decoded using the schema included in the `messageSchema` field. This is fairly straightforward to perform programatically since the only thing you need to usually supply Avro is a schema and a message, both of which are provided in the envelope message.

The Attunity metadata messages which include both table metadata, lineage and data schema description (to be referenced later by data messages) are enveloped in the self-describing envelope.

## Decoding a Message by Referenced Schema ID

Avro schemas are JSON documents which can be quite large, usually much larger than the data encoded by Avro conforming to the schema. For example, a schema of a 10 column table could be a JSON document of more than 100 characters while an actual row encoding of 10 columns may be only 10 bytes (depending of course on the type and length of fields). It is therefore typically not recommended to include schema and data together in a Kafka message because the schema information is redundant and is the same for all data messages while the actual data is the only thing which differs between data messages.

To avoid sending schema with each data message, each schema has a 32 bytes long ID. When a data message based on a previously sent data message schema (via the metadata message) is constructed, the `messageSchema` field is set to null and the `messageSchemaId` field is set to the 32 bytes ID of the schema instead. The application responsibility is to locate the data schema sent earlier in the metadata message and use that schema to decode the data message contained in the `message` field.

## Typical Consumer Logic

A typical scenario involving Kafka involves Attunity Replicate as the Producer of messages into Kafka and customer code as the Consumer. Attunity Replicate offers the ability to define a specific topic as the schema topic and different topics for the table data.

The customer's consumer code should read metadata messages from the schema topic and then save the data schemas and any other information the consumer wishes to access later in a customer defined zone. Another set of customer consumers should read data messages from the various data topics, and access the data schemas zone as required to retrieve the data schemas required for decoding the data messages.

When consuming data messages and metadata messages from several topics and partitions in a multi-thread/process manner, a situation may arise where a given consumer may attempt to read a data message *before* the corresponding metadata message has been read. As it is not possible to read a data message before its corresponding metadata message, the consumer's logic should wait a reasonable amount of time until the corresponding metadata message has been read. If the metadata message is still not available after waiting for a reasonable amount of time, the consumer should handle this as an unexpected error and activate the planned error policy. An example of such a policy could be saving the message in a dedicated "delayed" topic for later processing.

As a rule of thumb, the number of metadata messages will be much lower (in the magnitude of 1:10000 or more) than the number of data messages. So, assuming a metadata consumer is active, the gap between metadata message and data message should be no more than a few seconds (usually, milliseconds).

## Metadata and Data Messages

This topic describes the structure and content of the Metadata and Data messages produced by the Replicate Kafka endpoint.

### Metadata Message

| Field        | Type      | Description                                                                                                                                                            |
|--------------|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| schemaId     | String    | The unique identifier of the Avro schema.                                                                                                                              |
| lineage      | Structure | Information about the origin of the data (Replicate server, task, table, and so on)                                                                                    |
| server       | String    | The name of the Replicate server.                                                                                                                                      |
| task         | String    | The name of the task.                                                                                                                                                  |
| schema       | String    | The name of the database schema.                                                                                                                                       |
| table        | String    | The name of the table.                                                                                                                                                 |
| tableVersion | Integer   | Replicate maintains a version number of the structure of source table. Upon DDL change on the source, the version is increased and a new metadata message is produced. |
| timestamp    | String    | The date and time of the metadata message.                                                                                                                             |

| Field              | Type      | Description                                                                                                                                     |
|--------------------|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| tableStructure     | Structure | Describes the structure of the table.                                                                                                           |
| tableColumns       | Structure | Contains the list of columns and their properties.                                                                                              |
| {columns}          | Structure | For each column, a record with the below properties.                                                                                            |
| ordinal            | Integer   | The position of the column in the record.                                                                                                       |
| type               | String    | The column data type.                                                                                                                           |
| length             | Integer   | The maximum size of the data (in bytes) permitted for the column.                                                                               |
| precision          | Integer   | For NUMERIC data type, the maximum number of digits required to represent the value.                                                            |
| scale              | Integer   | For NUMERIC data type, the maximum number of digits to the right of the decimal point permitted for a number.                                   |
| primaryKeyPosition | Integer   | The position of the column in the table's Primary Key, or Unique Index. The value is zero if the column is not part of the table's Primary Key. |
| dataSchema         | String    | The Avro schema for deserializing the Data messages.                                                                                            |

## Data Message

| Field          | Type      | Description                                                                                                                                                                                                                                                                                                                                                |
|----------------|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| headers        | Structure | Information about the current record                                                                                                                                                                                                                                                                                                                       |
| operation      | Enum      | <p>The operation type.</p> <p>Full Load (Replicate transfers the existing records from source table)</p> <p>REFRESH – insert of a record during Full Load stage.</p> <p>CDC (Replicate transfers the changes from source table)</p> <p>INSERT – insertion of new record</p> <p>UPDATE – update of existing record</p> <p>DELETE – deletion of a record</p> |
| changeSequence | String    | <p>A monotonically increasing change sequencer that is common to all change tables of a task.</p> <p>Use this field to order the records in chronological order.</p>                                                                                                                                                                                       |

| Field          | Type   | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|----------------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                |        | Applicable to CDC operations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| timestamp      | String | The original change UTC timestamp.<br>Applicable to CDC operations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| streamPosition | String | The source CDC stream position.<br>Applicable to CDC operations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| transactionId  | String | The ID of the transaction that the change record belongs to.<br>Use this field to gather all changes of a specific transaction.<br>Applicable to CDC operations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| changeMask     | String | <p>Indicates which data columns were changed in the source table.</p> <p>The change mask is a string of hexadecimal digits, representing a bitmask of data columns in little-endian order. The bit position in the change mask is based on the ordinal of the column in the metadata message of that table.</p> <p>This means that if there are 10 data columns, they occupy bits 0 to 9 in the bitmask.</p> <p>If UPDATE mask is 0B hexadecimal, which is 1011 binary – it means that the columns at ordinals 1, 2 and 4 were changed.</p> <p>The following describes the bit semantics:</p> <ul style="list-style-type: none"> <li>» For INSERT records, all non-null columns have the associated bits set.</li> <li>» For DELETE records, only primary-key (or unique index) columns have the associated bits set. This allows an applier to construct a DELETE statement without having to find the primary key fields from another source.</li> <li>» For UPDATE records, each column with a changed value will have the associated bit set.</li> </ul> |
| columnMask     | String | Indicates which data columns are present in the message. Usually, this will include all of the table columns.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

**Note** When replicating from an Oracle source without full supplemental logging, some columns might not be present in the data, since they could not be replicated.

The column mask is a string of hexadecimal digits, representing a bitmask of data columns in little-endian

| Field      | Type      | Description                                                                                                                                                                                           |
|------------|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|            |           | order. The bit position in the column mask is based on the ordinal of the column in the metadata message for that table.                                                                              |
|            |           | This allows the applier to distinguish a null value that is the <i>actual</i> value of the column, from a null value that represents a column which could not be replicated from the source database. |
| data       | Structure | The data of the table record                                                                                                                                                                          |
| {columns}  |           | The column names and values in the current record.                                                                                                                                                    |
| beforeData | Structure | The data of the table record, before the change                                                                                                                                                       |
| {columns}  |           | The column names and values, before the change.<br>Applicable to UPDATE operation.                                                                                                                    |

# Using MapR Streams as a Target

This section describes how to set up and use MapR Streams as a target endpoint in a replication task. In a task with a MapR Streams target endpoint, each source record is transformed into a message which is then written (with an optional message key) to a partition in the specified topic.

## In this section:

- [Transaction Processing by the Consumer](#)
- [Prerequisites](#)
- [Limitations](#)
- [Supported Data Types](#)
- [Setting General Connection Properties](#)
- [Setting Advanced Connection Properties](#)
- [The Attunity Envelope](#)
- [Metadata and Data Messages](#)

## Transaction Processing by the Consumer

When configuring the Attunity Replicate MapR Streams endpoint, users can configure various settings that affect where messages are published within the MapR Streams infrastructures (topics/partitions).

During a task's CDC stage, committed changes that are detected by the Attunity Replicate source endpoint are grouped by transaction, sorted internally in chronological order, and then propagated to the target endpoint. The target endpoint can handle the changes in various ways such as applying them to the target tables or storing them in dedicated Change Tables.

Each CDC message has both a transaction ID as well as change sequence. As the change sequence is a monotonically growing number, sorting events by change sequence always achieves chronological order. Grouping the sorted events by transaction ID then results in transactions containing chronologically sorted changes.

However, as MapR Streams is a messaging infrastructure, applying changes is not feasible while storing changes in tables is meaningless. The Replicate MapR Streams endpoint, therefore, takes a different approach, which is to report all transactional events as messages.

## How it Works

Each change in the source system is translated to a data message containing the details of the change including the transaction ID and change sequence in the source. The data message also includes the changed columns before and after the change. As explained

above, the order in which the MapR Streams target writes the messages is the same as order of changes within each transaction.

Once a data message is ready to be sent to MapR Streams, the topic and partition it should go to are determined by analyzing the endpoint settings and any transformation settings. For example, the user might decide to configure the endpoint in such a way that every table is sent to a different topic and set the partition strategy to "Random", meaning that each message (within the same table) will be sent to a different partition.

## Transaction Consistency from a Consumer Perspective

If maintaining transaction consistency is important for the consumer implementation, it means that although the transaction ID exists in all data messages, the challenge is to gather the messages in a way that would facilitate identifying a whole transaction. An additional challenge is getting the transaction in the original order they were committed, which could be an even greater challenge if transactions are spread across multiple topics and partitions.

The simplest way of achieving the above goal is to direct Replicate to a specific topic and a specific partition (in the endpoint settings). This means that all data messages will end up in a single partition, thus guaranteeing ordered delivery both of transactions *and* of changes within a transaction. The consuming application could then consume messages - accumulating a transaction in some intermediate memory buffer - and when a new transaction ID is detected, mark the previous transaction as completed.

Although the simple way may work, it's not very efficient at the task level as all messages end up in the same topic and partition, not necessarily utilizing the full parallelism of the MapR Streams cluster. This may be a non-issue if there are multiple tasks, each taking advantage of a different topic/partition. In such a scenario, the gathering of messages from those tasks may very well utilize the cluster optimally.

The more generic way where data may be spread over multiple topics and partitions means that some intermediate buffer such as memory, a table in a relational database, or even other topics would need to be used to collect information about transactions. Then, the transactions would need to be rebuilt by periodically (every few minutes/hours) sorting the events collected from Replicate's MapR Streams output by the change sequence and grouping them by transaction ID.

## Prerequisites

Before you can use MapR Streams as a target endpoint in a Replicate task, the following prerequisites must be met:

- » Install and configure MapR Client 5.2.1 or above on the Attunity Replicate Server machine.

To verify the configuration, issue the following command in a Linux shell:

```
hadoop fs -ls maprfs://<cluster_name>/
```

The command should return a directory listing.

- » Install the **mapr-librdkafka** package on the Attunity Replicate Server machine.

- » Create a topic named **attrep\_apply\_exceptions** before starting the replication task. Note that if this topic does not exist, the task will always fail when it encounters a data error, regardless of the [error handling policy](#).  
For a description of the **attrep\_apply\_exceptions** table, see [Apply Exceptions](#)
- » Add the following files to the **/opt/attunity/replicate/lib** directory:
  - » **librdkafka.so**, **libMapRClient\_c.so**, and **libMapRClient.so** (copy from the **/opt/mapr/lib** directory)
  - » **libjvm.so** (copy from the **\$JAVA\_HOME/lib/amd64/server/lib** directory)

## Limitations

When defining a task with MapR Streams as the target endpoint, the following limitations apply:

- » Unlimited LOB size is not supported. Therefore, when replicating from source tables with LOB columns, *do not* select the **Allow unlimited LOB size** option.  
For more information on defining LOB settings, see [Target Metadata](#).
- » **Batch optimized apply** mode is not supported. If this mode is set, the task will automatically switch to **Transactional apply** mode and issue an appropriate warning.  
For more information on these modes, see [Change Processing Tuning](#).
- » Store Changes mode is not supported.  
For more information on Store Changes mode, see [Adding Tasks](#).
- » MapR Streams topic names cannot exceed 255 characters and can only contain the following characters:  
a-z|A-Z|0-9|. (dot)|\_(underscore)|-(minus)  
If the source table names exceed the maximum permitted length or contain unsupported characters, you need to either modify the names before starting the task or define a global transformation. For information on defining global transformations, see [Defining Global Transformations](#).
- » The [Ignore ALTER](#) Apply Changes setting is not supported for changes to source data types and table renaming.
- » Column names must begin with [A-Za-z\_] (letters or an underscore) followed by [A-Za-z0-9\_] (letters, digits, or an underscore). For example, **\_Test\_** is a valid column name whereas **&Test** is not.  
If a source column name does not adhere to this rule, then [a transformation should be used](#) to rename the column.

## Supported Data Types

The following table shows the default mapping from Attunity Replicate data types to MapR Streams data types.

For information on source data type mappings, see the section for the source endpoint you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Note** When using the JSON message format, binary values are represented as hexadecimal digits.

**Table 9.36 | Supported MapR Streams Target Data Types with Mapping from Attunity Replicate Data Types**

| Attunity Replicate Data Types | MapR Streams Target Data Types |
|-------------------------------|--------------------------------|
| DATE                          | DATE                           |
| TIME                          | TIME                           |
| DATETIME                      | DATETIME                       |
| BYTES                         | BYTES (length)                 |
| BLOB                          | BLOB                           |
| REAL4                         | REAL4 (7)                      |
| REAL8                         | REAL8 (14)                     |
| INT1                          | INT1 (3)                       |
| INT2                          | INT2 (5)                       |
| INT4                          | INT4 (10)                      |
| INT8                          | INT8 (19)                      |
| UINT1                         | UINT1 (3)                      |
| UINT2                         | UINT2 (5)                      |
| UINT4                         | UINT4 (10)                     |
| UINT8                         | UINT8 (20)                     |
| NUMERIC                       | NUMERIC (p,s)                  |
| STRING                        | STRING (Length)                |
| WSTRING                       | STRING (Length)                |

**Note** Values larger than  $2^{31}-1$  are not supported.

**Note** Values larger than  $2^{63}-1$  are not supported.

**Table 9.36 | Supported MapR Streams Target Data Types with Mapping from Attunity Replicate Data Types (Cont.)**

| Attunity Replicate Data Types | MapR Streams Target Data Types |
|-------------------------------|--------------------------------|
| CLOB                          | CLOB                           |
| NCLOB                         | NCLOB                          |
| BOOLEAN                       | BOOLEAN (1)                    |

### Mapping from Attunity Replicate Data types to Avro

When Avro is set as the message format, due to the limited number of data types supported by Avro, the data type mappings will be as shown in the table below.

**Table 9.37 | Supported Avro Data Types with Mapping from Attunity Replicate Data Types**

| Attunity Replicate Data Types | Avro Primitive Data Types |
|-------------------------------|---------------------------|
| DATE                          | STRING                    |
| TIME                          | STRING                    |
| TIMESTAMP                     | STRING                    |
| STRING                        | STRING                    |
| WSTRING                       | STRING                    |
| CLOB                          | STRING                    |
| NCLOB                         | STRING                    |
| NUMERIC                       | STRING                    |
| BYTES                         | BYTES                     |
| BLOB                          | BYTES                     |
| REAL4                         | FLOAT                     |
| REAL8                         | DOUBLE                    |
| INT1                          | INT                       |
| INT2                          | INT                       |
| INT4                          | INT                       |
| UINT1                         | INT                       |
| UINT2                         | INT                       |
| UINT4                         | LONG                      |

**Table 9.37 | Supported Avro Data Types with Mapping from Attunity Replicate Data Types (Cont.)**

| Attunity Replicate Data Types | Avro Primitive Data Types |
|-------------------------------|---------------------------|
| INT8                          | LONG                      |
| UINT8                         | STRING                    |
| BOOLEAN                       | BOOLEAN                   |

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

### To define the general connection properties:

1. Click the **Manage Endpoint Connections** toolbar button.  
The **Manage Endpoints Connections** dialog box opens.
  2. Click the **New Endpoint Connection** toolbar button.  
The **Name**, **Description**, **Type** and **Role** fields are displayed on the right.
  3. In the **Name** field, specify a display name for the endpoint.
  4. In the **Description** field, optionally type a description for the Kafka endpoint.
  5. Select **Target** as the endpoint **Role**.
  6. Select **MapR Streams** as the endpoint **Type**.  
The dialog box is divided into **General** and **Advanced** tabs.
  7. In the **Cluster name** field, specify the MapR Streams cluster name.  
To check if the cluster is valid, execute the following command in a Linux shell:  
`hadoop fs -ls maprfs://cluster_name/`  
If there is a directory listing for the cluster, the cluster is valid.
  8. In the **Data Publishing** section, set the following properties:
    - a. In the **Publish the data to** field, choose one of the following:
      - » **Specific topic** - to publish the data to a single topic. Type the stream name followed by a colon and the topic name.
      - » **Example:**  
MapRStreamName:MapRTopicName
      - » **Specific topic for each table** - to publish the data to multiple topics corresponding to the source table names.
- In the **Stream name** field, enter the stream name only (i.e. *stream-name* as opposed to *stream name:topic-name*).

**Note** If the topics do not exist, the stream must be configured with `autocreate=true` to enable Replicate to create the topics during runtime. Otherwise, the task will fail.

- b. From the **Partition strategy** drop-down list, field, select either **Random** or **By message key**. If you select **Random**, each message will be written to a randomly selected partition. If you select **By message key**, messages will be written to partitions based on the selected **By message key** (described below).
- c. From the **Message key** drop-down list, field, select one of the following:

**Note** The message key is represented as a string, regardless of the selected data message format (JSON/Avro).

- » **None** - To create messages without a message key.
- » **Schema and table name** - For each message, the message key will contain a combination of schema and table name (e.g. "dbo+Employees"). When **By message key** is selected as the **Partition strategy**, messages consisting of the same schema and table name will be written to the same partition.
- » **Primary key columns** - For each message, the message key will contain the value of the primary key column. When **By message key** is selected as the **Partition strategy**, messages consisting of the same primary key value will be written to the same partition.

10. In the **Message Properties** section, set the following properties:

- a. Choose **JSON** or **Avro** as the message format.

**Note** Attunity provides an Avro Message Decoder SDK for consuming Avro messages produced by Attunity Replicate. You can download the SDK together with the Avro Message Decoder Developer's Guide as a ZIP file from the [Customer Zone](#).

An understanding of the Attunity envelope schema is a prerequisite for consuming Avro messages produced by Attunity Replicate. If you do not wish to use the SDK, see [The Attunity Envelope](#) for a description of the Attunity envelope schema.

- b. To publish the schema message (for the corresponding data message) to a topic, select the **Use Schema Messages** check box and then type the stream name followed by a colon and the topic name.

**Example:**

MapRStreamName : MapRTopicName

This option is required if the message format is set to **Avro** since Avro-formatted messages can only be opened using the Avro schema.

**Note** It is strongly recommended *not* to publish schema messages to the same topic as data messages.

**Note** If the topics do not exist, the stream must be configured with `autocreate=true` to enable Replicate to create the topics during runtime. Otherwise, the task will fail.

## Overriding the Default Settings

A transformation can be defined that overrides the topic, partition and message key settings defined in the **General** tab.

**Note** Before you can define such a transformation, you first need to add a source endpoint to the task and select the tables you want to replicate.

### To define a transformation:

1. Open the task you defined.
2. If you are defining a transformation for a single table, select one of the source tables. Otherwise, skip to Step 3.
3. Define a transformation that adds one of the following columns:

**Note** The columns listed below (prefixed with a \$) instruct Replicate to route the message to the desired topic and/or partition, and will *not* be included in the actual message itself.

- » `$topic` - To write messages to a specific topic.
- » `$partition` - To write messages to a specific partition.
- » `$key` - To create a custom message key.

For information on creating a transformation for a single table, see [Defining Transformations for a Single Table/View](#).

For information on creating a global transformation rule, see [Defining Global Transformations](#).

4. Define an expression for the new column that returns the following values:
  - » For a `$topic` column, the expression should return the topic name.
  - » For a `$partition` column, the expression should return the partition number. Note that an error will be returned during runtime if the partition number does

not exist.

- » For a \$key column, the expression should return the message key contents.  
For information on creating expressions, see [Using the Expression Builder \(for Filters, Transformations, and Global Transformations\)](#).

## Setting Advanced Connection Properties

In the **Advanced** tab, you can define advanced properties for the Mapr Streams target endpoint:

### » Message Maximum Size

In the **Message maximum size** field, specify the maximum size of messages. Replicate will not send messages larger than the maximum size.

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

## The Attunity Envelope

All Attunity message types covered in this section are encapsulated in a single message schema called the Attunity Envelope. The schema of the Attunity envelope is as following:

```
{  
  "type": "record",  
  "name": "MessageEnvelope",  
  "fields": [  
    {"name": "magic", "type": {"type": "fixed", "name": "Magic", "size": 5}},  
    {"name": "type", "type": "string"},  
    {"name": "headers", "type": [{"type": "map", "values": "string"}]}]  
}
```

```

        {"name":"messageSchemaId","type":["null","string"]},
        {"name":"messageSchema","type":["null","string"]},
        {"name":"message","type":"bytes"}
    ]
}

```

The fields in the envelope are as follows:

- » **magic** (5 bytes fixed field)

The constant "atMSG" is used to identify this form of message. The "atMSG" constant should be used to validate that this message is indeed an Attunity envelope message.

- » **type** (string field)

Describes the enveloped message type. This can be one of two values: `MD` which stands for metadata message and `DT` which stands for data message.

- » **headers** (map of string key and value)

A free for use map for various properties set at the application level. Currently, no headers are set by Attunity Replicate but this may change in future versions.

- » **messageSchemaId** (null or string)

A reference to a schema defined elsewhere, which can be used to deserialize the bytes in the message field. This specification does not explain how the schema ID is used for looking up the actual schema - it is an application level detail. This field is used exclusively with the `messageSchema` field.

- » **messageSchema** (null or string)

An embedded UTF-8 encoded Avro JSON schema with which the message field can be serialized. This field is used exclusively with the `messageSchemaId` field.

- » **message** (bytes)

An Avro encoded message, which is the payload of the message envelope.

Given the envelope schema, it is possible for anyone using this schema to properly decode the envelope messages from MapR Streams.

Once the envelope message has been decoded, there are two possible scenarios:

- » **Scenario 1:** Decoding a self-describing message such as the metadata message
- » **Scenario 2:** Decoding a message by referenced schema ID such as data messages

The method for logically decoding messages in both scenarios is described below.

## Decoding a Self-Describing Message

When the `messageSchema` field is not null, it means the `message` field can be decoded using the schema included in the `messageSchema` field. This is fairly straightforward to perform programatically since the only thing you need to usually supply Avro is a schema and a message, both of which are provided in the envelope message.

The Attunity metadata messages which include both table metadata, lineage and data schema description (to be referenced later by data messages) are enveloped in the self-describing envelope.

## Decoding a Message by Referenced Schema ID

Avro schemas are JSON documents which can be quite large, usually much larger than the data encoded by Avro conforming to the schema. For example, a schema of a 10 column table could be a JSON document of more than 100 characters while an actual row encoding of 10 columns may be only 10 bytes (depending of course on the type and length of fields). It is therefore typically not recommended to include schema and data together in a MapR Streams message because the schema information is redundant and is the same for all data messages while the actual data is the only thing which differs between data messages.

To avoid sending schema with each data message, each schema has a 32 bytes long ID. When a data message based on a previously sent data message schema (via the metadata message) is constructed, the `messageSchema` field is set to null and the `messageSchemaId` field is set to the 32 bytes ID of the schema instead. The application responsibility is to locate the data schema sent earlier in the metadata message and use that schema to decode the data message contained in the `message` field.

## Typical Consumer Logic

A typical scenario involving MapR Streams involves Attunity Replicate as the Producer of messages into MapR Streams and customer code as the Consumer. Attunity Replicate offers the ability to define a specific topic as the schema topic and different topics for the table data.

The customer's consumer code should read metadata messages from the schema topic and then save the data schemas and any other information the consumer wishes to access later in a customer defined zone. Another set of customer consumers should read data messages from the various data topics, and access the data schemas zone as required to retrieve the data schemas required for decoding the data messages.

When consuming data messages and metadata messages from several topics and partitions in a multi-thread/process manner, a situation may arise where a given consumer may attempt to read a data message *before* the corresponding metadata message has been read. As it is not possible to read a data message before its corresponding metadata message, the consumer's logic should wait a reasonable amount of time until the corresponding metadata message has been read. If the metadata message is still not available after waiting for a reasonable amount of time, the consumer should handle this as an unexpected error and activate the planned error policy. An example of such a policy could be saving the message in a dedicated "delayed" topic for later processing.

As a rule of thumb, the number of metadata messages will be much lower (in the magnitude of 1:10000 or more) than the number of data messages. So, assuming a metadata consumer is active, the gap between metadata message and data message should be no more than a few seconds (usually, milliseconds).

## Metadata and Data Messages

This topic describes the structure and content of the Metadata and Data messages produced by the Replicate MapR Streams endpoint.

## Metadata Message

| Field              | Type      | Description                                                                                                                                                            |
|--------------------|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| schemaId           | String    | The unique identifier of the Avro schema.                                                                                                                              |
| lineage            | Structure | Information about the origin of the data (Replicate server, task, table, and so on)                                                                                    |
| server             | String    | The name of the Replicate server.                                                                                                                                      |
| task               | String    | The name of the task.                                                                                                                                                  |
| schema             | String    | The name of the database schema.                                                                                                                                       |
| table              | String    | The name of the table.                                                                                                                                                 |
| tableVersion       | Integer   | Replicate maintains a version number of the structure of source table. Upon DDL change on the source, the version is increased and a new metadata message is produced. |
| timestamp          | String    | The date and time of the metadata message.                                                                                                                             |
| tableStructure     | Structure | Describes the structure of the table.                                                                                                                                  |
| tableColumns       | Structure | Contains the list of columns and their properties.                                                                                                                     |
| {columns}          | Structure | For each column, a record with the below properties.                                                                                                                   |
| ordinal            | Integer   | The position of the column in the record.                                                                                                                              |
| type               | String    | The column data type.                                                                                                                                                  |
| length             | Integer   | The maximum size of the data (in bytes) permitted for the column.                                                                                                      |
| precision          | Integer   | For NUMERIC data type, the maximum number of digits required to represent the value.                                                                                   |
| scale              | Integer   | For NUMERIC data type, the maximum number of digits to the right of the decimal point permitted for a number.                                                          |
| primaryKeyPosition | Integer   | The position of the column in the table's Primary Key. or Unique Index. The value is zero if the column is not part of the table's Primary Key.                        |
| dataSchema         | String    | The Avro schema for deserializing the Data messages.                                                                                                                   |

## Data Message

| Field          | Type      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----------------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| headers        | Structure | Information about the current record                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| operation      | Enum      | <p>The operation type.</p> <p>Full Load (Replicate transfers the existing records from source table)</p> <p>REFRESH – insert of a record during Full Load stage.</p> <p>CDC (Replicate transfers the changes from source table)</p> <p>INSERT – insertion of new record</p> <p>UPDATE – update of existing record</p> <p>DELETE – deletion of a record</p>                                                                                                                                                                                                                                                                                                                                                               |
| changeSequence | String    | <p>A monotonically increasing change sequencer that is common to all change tables of a task.</p> <p>Use this field to order the records in chronological order.</p> <p>Applicable to CDC operations.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| timestamp      | String    | <p>The original change UTC timestamp.</p> <p>Applicable to CDC operations.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| streamPosition | String    | <p>The source CDC stream position.</p> <p>Applicable to CDC operations.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| transactionId  | String    | <p>The ID of the transaction that the change record belongs to.</p> <p>Use this field to gather all changes of a specific transaction.</p> <p>Applicable to CDC operations.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| changeMask     | String    | <p>Indicates which data columns were changed in the source table.</p> <p>The change mask is a string of hexadecimal digits, representing a bitmask of data columns in little-endian order. The bit position in the change mask is based on the ordinal of the column in the metadata message of that table.</p> <p>This means that if there are 10 data columns, they occupy bits 0 to 9 in the bitmask.</p> <p>If UPDATE mask is 0B hexadecimal, which is 1011 binary – it means that the columns at ordinals 1, 2 and 4 were changed.</p> <p>The following describes the bit semantics:</p> <ul style="list-style-type: none"> <li>» For INSERT records, all non-null columns have the associated bits set.</li> </ul> |

| Field      | Type      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|            |           | <ul style="list-style-type: none"> <li>» For DELETE records, only primary-key (or unique index) columns have the associated bits set. This allows an applier to construct a DELETE statement without having to find the primary key fields from another source.</li> <li>» For UPDATE records, each column with a changed value will have the associated bit set.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                 |
| columnMask | String    | <p>Indicates which data columns are present in the message. Usually, this will include all of the table columns.</p> <p><b>Note</b> When replicating from an Oracle source without full supplemental logging, some columns might not be present in the data, since they could not be replicated.</p> <p>The column mask is a string of hexadecimal digits, representing a bitmask of data columns in little-endian order. The bit position in the column mask is based on the ordinal of the column in the metadata message for that table.</p> <p>This allows the applier to distinguish a null value that is the <i>actual</i> value of the column, from a null value that represents a column which could not be replicated from the source database.</p> |
| data       | Structure | The data of the table record                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| {columns}  |           | The column names and values in the current record.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| beforeData | Structure | The data of the table record, before the change                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| {columns}  |           | The column names and values, before the change.<br>Applicable to UPDATE operation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

# Using Microsoft Azure Event Hubs as a Target

This section describes how to set up and use Microsoft Azure Event Hubs as a target endpoint in a replication task. In a task with a Microsoft Azure Event Hubs target endpoint, each source record is transformed into a message which is then written (with an optional message key) to a partition in the specified hub.

## In this section:

[Prerequisites](#)

[Transaction Processing by the Consumer](#)

[Limitations](#)

[Supported Target Data Types](#)

[Setting General Connection Properties](#)

[Setting Advanced Connection Properties](#)

[The Attunity Envelope](#)

[Metadata and Data Messages](#)

## Prerequisites

Before you can use Microsoft Azure Event Hubs as a target endpoint in a Replicate task, the following prerequisites must be met:

- » The target hubs must already exist before starting the replication task. Note that if you intend to use the [Separate hub for each table](#) option in the endpoint settings, the hub name must adhere to the following format:

`SourceSchemaName . HubName`

where `HubName` must be identical to the source table name.

### Example:

`HR . Employees`

- » Create a hub named **attrep\_apply\_exceptions** before starting the replication task. Note that if this hub does not exist, the task will always fail when it encounters a data error, regardless of the [error handling policy](#).  
For a description of the **attrep\_apply\_exceptions** table, see [Apply Exceptions](#)
- » To be able to browse for hubs (in the [General tab](#)), the namespace Shared Access Policy must have "Manage" permission.
- » If the namespace shared access policy does not have "Manage" permission, then the hub Shared Access Policy must have at least "Send" permission.

## Transaction Processing by the Consumer

When configuring the Attunity Replicate Microsoft Azure Event Hubs endpoint, users can configure various settings that affect where messages are published within the Microsoft Azure Event Hubs infrastructures (hubs/partitions).

During a task's CDC stage, committed changes that are detected by the Attunity Replicate source endpoint are grouped by transaction, sorted internally in chronological order, and then propagated to the target endpoint. The target endpoint can handle the changes in various ways such as applying them to the target tables or storing them in dedicated Change Tables.

Each CDC message has both a transaction ID as well as change sequence. As the change sequence is a monotonically growing number, sorting events by change sequence always achieves chronological order. Grouping the sorted events by transaction ID then results in transactions containing chronologically sorted changes.

However, as Microsoft Azure Event Hubs is a messaging infrastructure, applying changes is not feasible while storing changes in tables is meaningless. The Replicate Microsoft Azure Event Hubs endpoint, therefore, takes a different approach, which is to report all transactional events as messages.

### How it Works

Each change in the source system is translated to a data message containing the details of the change including the transaction ID and change sequence in the source. The data message also includes the changed columns before and after the change. As explained above, the order in which the Microsoft Azure Event Hubs target writes the messages is the same as order of changes within each transaction.

Once a data message is ready to be sent to Microsoft Azure Event Hubs, the hub and partition it should go to are determined by analyzing the [endpoint settings](#) as well as potentially [transformation settings](#). For example, the user might decide to configure the endpoint in such a way that every table is sent to a different hub and set the partition strategy to "Random", meaning that each message (within the same table) will be sent to a different partition.

### Transaction Consistency from a Consumer Perspective

If maintaining transaction consistency is important for the consumer implementation, it means that although the transaction ID exists in all data messages, the challenge is to gather the messages in a way that would facilitate identifying a whole transaction. An additional challenge is getting the transaction in the original order they were committed, which could be an even greater challenge if transactions are spread across multiple hubs and partitions.

The simplest way of achieving the above goal is to direct Replicate to a specific hub and a specific partition (in the [endpoint settings](#)). This means that all data messages will end up in a single partition, thus guaranteeing ordered delivery both of transactions *and* of changes within a transaction. The consuming application could then consume messages -

accumulating a transaction in some intermediate memory buffer - and when a new transaction ID is detected, mark the previous transaction as completed.

Although the simple way may work, it's not very efficient at the task level as all messages end up in the same hub and partition, not necessarily utilizing the full parallelism of the Microsoft Azure Event Hubs cluster. This may be a non-issue if there are multiple tasks, each taking advantage of a different hub/partition. In such a scenario, the gathering of messages from those tasks may very well utilize the cluster optimally.

The more generic way where data may be spread over multiple hubs and partitions means that some intermediate buffer such as memory, a table in a relational database, or even other hubs would need to be used to collect information about transactions. Then, the transactions would need to be rebuilt by periodically (every few minutes/hours) sorting the events collected from Replicate's Microsoft Azure Event Hubs output by the change sequence and grouping them by transaction ID.

## Limitations

When defining a task with Microsoft Azure Event Hubs as the target endpoint, the following limitations apply:

- » The Microsoft Azure Event Hubs target endpoint does not support unlimited LOB size. Therefore, when replicating from source tables with LOB columns, *do not* select the **Allow unlimited LOB size** option.  
For more information on defining LOB settings, see [Target Metadata](#).
- » **Batch optimized apply** mode is not supported. If this mode is set, the task will automatically switch to **Transactional apply** mode and issue an appropriate warning.  
For more information on these modes, see [Change Processing Tuning](#).
- » Store Changes replication mode is not supported.  
For more information on Store Changes mode, see [Adding Tasks](#).
- » The **Ignore ALTER** Apply Changes setting is not supported for changes to source data types and table renaming.
- » Column names must begin with [A-Za-z\_] (letters or an underscore) followed by [A-Za-z0-9\_] (letters, digits, or an underscore). For example, **\_Test** is a valid column name whereas **&Test** is not.  
If a source column name does not adhere to this rule, then [a transformation should be used](#) to rename the column.

## Supported Target Data Types

The following table shows the default mapping from Attunity Replicate data types to Microsoft Azure Event Hubs data types.

For information on source data type mappings, see the section for the source endpoint you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Note** When using the JSON message format, binary values are represented as hexadecimal digits.

**Table 9.38 | Supported Microsoft Azure Event Hubs Target Data Types with Mapping from Attunity Replicate Data Types**

| Attunity Replicate Data Types | Microsoft Azure Event Hubs Target Data Types |
|-------------------------------|----------------------------------------------|
| DATE                          | DATE                                         |
| TIME                          | TIME                                         |
| DATETIME                      | DATETIME                                     |
| BYTES                         | BYTES (length)                               |
| BLOB                          | BLOB                                         |
| REAL4                         | REAL4 (7)                                    |
| REAL8                         | REAL8 (14)                                   |
| INT1                          | INT1 (3)                                     |
| INT2                          | INT2 (5)                                     |
| INT4                          | INT4 (10)                                    |
| INT8                          | INT8 (19)                                    |
| UINT1                         | UINT1 (3)                                    |
| UINT2                         | UINT2 (5)                                    |
| UINT4                         | UINT4 (10)                                   |
| UINT8                         | UINT8 (20)                                   |
| NUMERIC                       | NUMERIC (p,s)                                |
| STRING                        | STRING (Length)                              |
| WSTRING                       | STRING (Length)                              |
| CLOB                          | CLOB                                         |
| NCLOB                         | NCLOB                                        |
| BOOLEAN                       | BOOLEAN (1)                                  |

**Note** Values larger than  $2^{31}-1$  are not supported.

**Note** Values larger than  $2^{63}-1$  are not supported.

## Mapping from Attunity Replicate Data types to Avro

When Avro is set as the message format, due to the limited number of data types supported by Avro, the data type mappings will be as shown in the table below.

**Table 9.39 | Supported Avro Data Types with Mapping from Attunity Replicate Data Types**

| Attunity Replicate Data Types | Avro Primitive Data Types |
|-------------------------------|---------------------------|
| DATE                          | STRING                    |
| TIME                          | STRING                    |
| TIMESTAMP                     | STRING                    |
| STRING                        | STRING                    |
| WSTRING                       | STRING                    |
| CLOB                          | STRING                    |
| NCLOB                         | STRING                    |
| NUMERIC                       | STRING                    |
| BYTES                         | BYTES                     |
| BLOB                          | BYTES                     |
| REAL4                         | FLOAT                     |
| REAL8                         | DOUBLE                    |
| INT1                          | INT                       |
| INT2                          | INT                       |
| INT4                          | INT                       |
| UINT1                         | INT                       |
| UINT2                         | INT                       |
| UINT4                         | LONG                      |
| INT8                          | LONG                      |
| UINT8                         | STRING                    |
| BOOLEAN                       | BOOLEAN                   |

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

**To define the general connection properties:**

1. Click the **Manage Endpoint Connections** toolbar button.  
The **Manage Endpoints Connections** dialog box opens.
2. Click the **New Endpoint Connection** toolbar button.  
The **Name**, **Description**, **Type** and **Role** fields are displayed on the right.
3. In the **Name** field, specify a display name for the endpoint.
4. In the **Description** field, optionally type a description for the Microsoft Azure Event Hubs endpoint.
5. Select **Target** as the endpoint **Role**.
6. Select **Microsoft Azure Event Hubs** as the endpoint **Type**.  
The dialog box is divided into **General** and **Advanced** tabs.
7. In the **Access Details** section, set the following properties:
  - » **Namespace:** Enter the name of your Event Hubs namespace.  
Example: eventhubdemo
  - » **Shared Access Policy Level:** Select either **Namespace level** or **Event Hub level** according to the level defined for your Shared Access Policy.
  - » **Shared Policy Name:** Enter the name of your shared access policy.  
Example: RootManageSharedAccessKey
  - » **Shared Access Key:** Enter your shared access primary or secondary key.  
Example: BZLreXGxiWiRpGAog9Zf6b3K7ycRsImfBWqsR+SJp34=
8. In the **Message Properties** section, select either **JSON** or **Avro** as the message format.

**Note** Attunity provides an Avro Message Decoder SDK for consuming Avro messages produced by Attunity Replicate. You can download the SDK together with the Avro Message Decoder Developer's Guide as a ZIP file from the [Customer Zone](#).

An understanding of the Attunity envelope schema is a prerequisite for consuming Avro messages produced by Attunity Replicate. If you do not wish to use the SDK, see [The Attunity Envelope](#) for a description of the Attunity envelope schema.

9. Optionally, in the **Namespace Settings** section, adjust the number of **Throughput units**. Increasing the number of throughput units may improve performance in certain scenarios.
10. In the **Data Message Publishing** section, set the following properties:
  - a. In the **Publish the data to** field, choose one of the following:
    - » **Specific hub** - to publish the data to a single hub. Either type a hub name or use the browse button to select the desired hub.
    - » **Separate hub for each table** - to publish the data to multiple hubs

corresponding to the source table names. If you select this option, the hub name format must be [as described in the prerequisites](#).

**Note** Microsoft Azure Event Hubs supports a maximum of ten hubs, which *includes* hubs that are required for storing Replicate Control Table data. At least one of the ten hubs must be set aside for the mandatory attrep\_apply\_exceptions Control Table, leaving nine hubs to which source data can be published (providing that no other Control Tables are set).

The target hub name consists of the source schema name and the source table name, separated by a period (e.g. "dbo.Employees"). The format of the target hub name is important as you will need to prepare these hubs in advance.

- b. From the **Partition strategy** drop-down list, field, select either **Random** or **By message key**. If you select **Random**, each message will be written to a randomly selected partition. If you select **By message key**, messages will be written to partitions based on the selected **Message key** (described below).
- c. From the **Message key** drop-down list, field, select one of the following:

**Note** The message key is represented as a string, regardless of the selected data message format (JSON/Avro).

- » **Schema and table name** - For each message, the message key will contain a combination of schema and table name (e.g. "dbo+Employees"). When **By message key** is selected as the **Partition strategy**, messages consisting of the same schema and table name will be written to the same partition.
- » **Primary key columns** - For each message, the message key will contain the value of the primary key column. When **By message key** is selected as the **Partition strategy**, messages consisting of the same primary key value will be written to the same partition.

11. In the **Metadata Message Publishing** section, specify whether or where to publish the message metadata.

From the **Publish** drop-down list, select one of the following options:

- » **Do not publish metadata messages** - When this option is selected, only data messages will be published.
- » **Publish metadata messages to a dedicated metadata hub**

If you select this option, either type the **Hub name** or use the Browse button to select the desired hub. Note that the Browse button will only be available if the **Shared Access Policy Level** described above is set to **Namespace level**.

**Note** It is strongly recommended *not* to publish metadata messages to the same stream as data messages.

## Overriding the Default Settings

A transformation can be defined that overrides the topic, partition and message key settings defined in the **General** tab.

**Note** Before you can define such a transformation, you first need to add a source endpoint to the task and select the tables you want to replicate.

### To define a transformation:

1. Open the task you defined.
2. If you are defining a transformation for a single table, select one of the source tables. Otherwise, skip to Step 3.
3. Define a transformation that adds one of the following columns:

**Note** The columns listed below (prefixed with a \$) instruct Replicate to route the message to the desired hub and/or partition, and will *not* be included in the actual message itself.

- » \$hub - To write messages to a specific hub.
- » \$partition - To write messages to a specific partition.
- » \$key - To create a custom message key.

For information on creating a transformation for a single table, see [Defining Transformations for a Single Table/View](#).

For information on creating a global transformation rule, see [Defining Global Transformations](#).

4. Define an expression for the new column that returns the following values:
  - » For a \$hub column, the expression should return the topic name.
  - » For a \$partition column, the expression should return the partition number. Note that an error will be returned during runtime if the partition number does not exist.
  - » For a \$key column, the expression should return the message key contents.

For information on creating expressions, see [Using the Expression Builder \(for Filters, Transformations, and Global Transformations\)](#).

## Setting Advanced Connection Properties

In the **Advanced** tab, you can set the following advanced properties for the Microsoft Azure Event Hubs target endpoint:

**Table 9.40 | Advanced Tab Options**

| Option               | Description                                                                                                                                                                                                                   |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Message Maximum Size | In the <b>Message maximum size</b> field, specify the maximum size of messages that the namespace is configured to receive ( <code>message.max.bytes</code> ). Replicate will not send messages larger than the maximum size. |
| Use proxy server     | Select this option to access the namespace via a proxy server.                                                                                                                                                                |
| Host name            | The host name of the proxy server.                                                                                                                                                                                            |
| Port                 | The port via which to access the proxy server.                                                                                                                                                                                |
| User name            | The user name for accessing the proxy server.                                                                                                                                                                                 |
| Password             | The password for accessing the proxy server.                                                                                                                                                                                  |

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

## The Attunity Envelope

All Attunity message types covered in this section are encapsulated in a single message schema called the Attunity Envelope. The schema of the Attunity envelope is as following:

```
{
    "type": "record",
    "name": "MessageEnvelope",
    "fields": [
        {"name": "magic", "type": {"type": "fixed", "name": "Magic", "size": 5}},
        {"name": "type", "type": "string"},
        {"name": "headers", "type": [{"null", {"type": "map", "values": "string"}}]},
        {"name": "messageSchemaId", "type": [{"null", "string"}]},
        {"name": "messageSchema", "type": [{"null", "string"}]},
        {"name": "message", "type": "bytes"}
    ]
}
```

The fields in the envelope are as follows:

- » **magic** (5 bytes fixed field)

The constant "atMSG" is used to identify this form of message. The "atMSG" constant should be used to validate that this message is indeed an Attunity envelope message.

- » **type** (string field)

Describes the enveloped message type. This can be one of two values: `MD` which stands for metadata message and `DT` which stands for data message.

- » **headers** (map of string key and value)

A free for use map for various properties set at the application level. Currently, no headers are set by Attunity Replicate but this may change in future versions.

- » **messageSchemaId** (null or string)

A reference to a schema defined elsewhere, which can be used to deserialize the bytes in the message field. This specification does not explain how the schema ID is used for looking up the actual schema - it is an application level detail. This field is used exclusively with the `messageSchema` field.

- » **messageSchema** (null or string)

An embedded UTF-8 encoded Avro JSON schema with which the message field can be serialized. This field is used exclusively with the `messageSchemaId` field.

- » **message** (bytes)

An Avro encoded message, which is the payload of the message envelope.

Given the envelope schema, it is possible for anyone using this schema to properly decode the envelope messages from Microsoft Azure Event Hubs.

Once the envelope message has been decoded, there are two possible scenarios:

- » **Scenario 1:** Decoding a self-describing message such as the metadata message

- » **Scenario 2:** Decoding a message by referenced schema ID such as data messages

The method for logically decoding messages in both scenarios is described below.

## Decoding a Self-Describing Message

When the `messageSchema` field is not null, it means the `message` field can be decoded using the schema included in the `messageSchema` field. This is fairly straightforward to perform programatically since the only thing you need to usually supply Avro is a schema and a message, both of which are provided in the envelope message.

The Attunity metadata messages which include both table metadata, lineage and data schema description (to be referenced later by data messages) are enveloped in the self-describing envelope.

## Decoding a Message by Referenced Schema ID

Avro schemas are JSON documents which can be quite large, usually much larger than the data encoded by Avro conforming to the schema. For example, a schema of a 10 column table could be a JSON document of more than 100 characters while an actual row encoding of 10 columns may be only 10 bytes (depending of course on the type and length of fields). It is therefore typically not recommended to include schema and data together in a Microsoft Azure Event Hubs message because the schema information is redundant and is the same for all data messages while the actual data is the only thing which differs between data messages.

To avoid sending schema with each data message, each schema has a 32 bytes long ID. When a data message based on a previously sent data message schema (via the metadata message) is constructed, the `messageSchema` field is set to null and the `messageSchemaId` field is set to the 32 bytes ID of the schema instead. The application responsibility is to locate the data schema sent earlier in the metadata message and use that schema to decode the data message contained in the `message` field.

## Typical Consumer Logic

A typical scenario involving Microsoft Azure Event Hubs involves Attunity Replicate as the Producer of messages into Microsoft Azure Event Hubs and customer code as the Consumer. Attunity Replicate offers the ability to define a specific hub as the schema hub and different hubs for the table data.

The customer's consumer code should read metadata messages from the schema hub and then save the data schemas and any other information the consumer wishes to access later in a customer defined zone. Another set of customer consumers should read data messages from the various data hubs, and access the data schemas zone as required to retrieve the data schemas required for decoding the data messages.

When consuming data messages and metadata messages from several hubs and partitions in a multi-thread/process manner, a situation may arise where a given consumer may attempt to read a data message *before* the corresponding metadata message has been read. As it is not possible to read a data message before its corresponding metadata message, the consumer's logic should wait a reasonable amount of time until the corresponding metadata message has been read. If the metadata message is still not available after waiting for a reasonable amount of time, the consumer should handle this as an unexpected error and activate the planned error policy. An example of such a policy could be saving the message in a dedicated "delayed" hub for later processing.

As a rule of thumb, the number of metadata messages will be much lower (in the magnitude of 1:10000 or more) than the number of data messages. So, assuming a metadata consumer is active, the gap between metadata message and data message should be no more than a few seconds (usually, milliseconds).

## Metadata and Data Messages

This topic describes the structure and content of the Metadata and Data messages produced by the Replicate Microsoft Azure Event Hubs endpoint.

### Metadata Message

| Field          | Type      | Description                                                                                                                                                            |
|----------------|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| schemaId       | String    | The unique identifier of the Avro schema.                                                                                                                              |
| lineage        | Structure | Information about the origin of the data (Replicate server, task, table, and so on)                                                                                    |
| server         | String    | The name of the Replicate server.                                                                                                                                      |
| task           | String    | The name of the task.                                                                                                                                                  |
| schema         | String    | The name of the database schema.                                                                                                                                       |
| table          | String    | The name of the table.                                                                                                                                                 |
| tableVersion   | Integer   | Replicate maintains a version number of the structure of source table. Upon DDL change on the source, the version is increased and a new metadata message is produced. |
| timestamp      | String    | The date and time of the metadata message.                                                                                                                             |
| tableStructure | Structure | Describes the structure of the table.                                                                                                                                  |
| tableColumns   | Structure | Contains the list of columns and their properties.                                                                                                                     |
| {columns}      | Structure | For each column, a record with the below properties.                                                                                                                   |
| ordinal        | Integer   | The position of the column in the record.                                                                                                                              |
| type           | String    | The column data type.                                                                                                                                                  |
| length         | Integer   | The maximum size of the data (in bytes) permitted for the column.                                                                                                      |
| precision      | Integer   | For NUMERIC data type, the maximum number of digits required to represent the value.                                                                                   |
| scale          | Integer   | For NUMERIC data type, the maximum number of digits to the right of the decimal point permitted for                                                                    |

| Field              | Type    | Description                                                                                                                                     |
|--------------------|---------|-------------------------------------------------------------------------------------------------------------------------------------------------|
|                    |         | a number.                                                                                                                                       |
| primaryKeyPosition | Integer | The position of the column in the table's Primary Key, or Unique Index. The value is zero if the column is not part of the table's Primary Key. |
| dataSchema         | String  | The Avro schema for deserializing the Data messages.                                                                                            |

## Data Message

| Field          | Type      | Description                                                                                                                                                                                                                                                                                                                                                |
|----------------|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| headers        | Structure | Information about the current record                                                                                                                                                                                                                                                                                                                       |
| operation      | Enum      | <p>The operation type.</p> <p>Full Load (Replicate transfers the existing records from source table)</p> <p>REFRESH – insert of a record during Full Load stage.</p> <p>CDC (Replicate transfers the changes from source table)</p> <p>INSERT – insertion of new record</p> <p>UPDATE – update of existing record</p> <p>DELETE – deletion of a record</p> |
| changeSequence | String    | <p>A monotonically increasing change sequencer that is common to all change tables of a task.</p> <p>Use this field to order the records in chronological order.</p> <p>Applicable to CDC operations.</p>                                                                                                                                                  |
| timestamp      | String    | <p>The original change UTC timestamp.</p> <p>Applicable to CDC operations.</p>                                                                                                                                                                                                                                                                             |
| streamPosition | String    | <p>The source CDC stream position.</p> <p>Applicable to CDC operations.</p>                                                                                                                                                                                                                                                                                |
| transactionId  | String    | <p>The ID of the transaction that the change record belongs to.</p> <p>Use this field to gather all changes of a specific transaction.</p> <p>Applicable to CDC operations.</p>                                                                                                                                                                            |
| changeMask     | String    | <p>Indicates which data columns were changed in the source table.</p> <p>The change mask is a string of hexadecimal digits, representing a bitmask of data columns in little-endian</p>                                                                                                                                                                    |

| Field      | Type      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|            |           | <p>order. The bit position in the change mask is based on the ordinal of the column in the metadata message of that table. This means that if there are 10 data columns, they occupy bits 0 to 9 in the bitmask.</p> <p>If UPDATE mask is 0B hexadecimal, which is 1011 binary – it means that the columns at ordinals 1, 2 and 4 were changed.</p> <p>The following describes the bit semantics:</p> <ul style="list-style-type: none"> <li>» For INSERT records, all non-null columns have the associated bits set.</li> <li>» For DELETE records, only primary-key (or unique index) columns have the associated bits set. This allows an applier to construct a DELETE statement without having to find the primary key fields from another source.</li> <li>» For UPDATE records, each column with a changed value will have the associated bit set.</li> </ul> |
| columnMask | String    | <p>Indicates which data columns are present in the message. Usually, this will include all of the table columns.</p> <p><b>Note</b> When replicating from an Oracle source without full supplemental logging, some columns might not be present in the data, since they could not be replicated.</p> <p>The column mask is a string of hexadecimal digits, representing a bitmask of data columns in little-endian order. The bit position in the column mask is based on the ordinal of the column in the metadata message for that table.</p> <p>This allows the applier to distinguish a null value that is the <i>actual</i> value of the column, from a null value that represents a column which could not be replicated from the source database.</p>                                                                                                         |
| data       | Structure | The data of the table record                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| {columns}  |           | The column names and values in the current record.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| beforeData | Structure | The data of the table record, before the change                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| {columns}  |           | <p>The column names and values, before the change.</p> <p>Applicable to UPDATE operation.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

# Using Amazon Kinesis Data Streams as a Target

This section describes how to set up and use Amazon Kinesis Data Streams as a target endpoint in a replication task. In a task with a Amazon Kinesis Data Streams target endpoint, each source record is transformed into a message which is then written (with an optional message key) to a shard in the specified stream.

## In this section:

[Prerequisites](#)

[Transaction Processing by the Consumer](#)

[Limitations](#)

[Supported Data Types](#)

[Setting General Connection Properties](#)

[Setting Advanced Connection Properties](#)

[The Attunity Envelope](#)

[Metadata and Data Messages](#)

## Prerequisites

Before you can use Amazon Kinesis Data Streams as a target endpoint in a Replicate task, the following prerequisites must be met:

- » The target streams must already exist before starting the replication task.
- » Create a stream named **attrep\_apply\_exceptions** before starting the replication task. Note that if this stream does not exist, the task will always fail when it encounters a data error, regardless of the [error handling policy](#).  
For a description of the **attrep\_apply\_exceptions** table, see [Apply Exceptions](#)
- » The AWS account [specified in the General tab](#) must have the following permissions:

**Note** All strings that begin with YOUR should be replaced with the actual value.

```
{  
    "Version": "2012-10-17",  
    "Statement": [  
        {  
            "Sid": "VisualEditor0",  
            "Effect": "Allow",  
            "Action": [  
                "kinesis:PutRecord",  
                "kinesis:PutRecords",  
                "kinesis:DescribeStream"  
            ]  
        }  
    ]  
}
```

```

        ],
        "Resource": "arn:aws:kinesis:YOUR_AWS_REGION:YOUR_ACCOUNT_
NAME:stream/YOUR_STREAM_NAME"
    },
    {
        "Sid": "VisualEditor1",
        "Effect": "Allow",
        "Action": "kinesis>ListStreams",
        "Resource": "*"
    }
]
}

```

Additionally, if the Kinesis Stream was configured in Amazon to encrypt the data at rest, the following additional KMS permissions should be set:

```

{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Sid": "VisualEditor0",
            "Effect": "Allow",
            "Action": [
                "kms:Encrypt",
                "kms:DescribeKey"
            ],
            "Resource": "arn:aws:kms:YOUR_AWS_REGION:YOUR_ACCOUNT_
NAME:key/YOUR_KEY_GUID"
        },
        {
            "Sid": "VisualEditor1",
            "Effect": "Allow",
            "Action": "kms:GenerateDataKey",
            "Resource": "*"
        }
    ]
}

```

## Transaction Processing by the Consumer

When configuring the Attunity Replicate Amazon Kinesis Data Streams endpoint, users can configure various settings that affect where messages are published within the Amazon Kinesis Data Streams infrastructures (streams/shards).

During a task's CDC stage, committed changes that are detected by the Attunity Replicate source endpoint are grouped by transaction, sorted internally in chronological order, and then propagated to the target endpoint. The target endpoint can handle the changes in

various ways such as applying them to the target tables or storing them in dedicated Change Tables.

Each CDC message has both a transaction ID as well as change sequence. As the change sequence is a monotonically growing number, sorting events by change sequence always achieves chronological order. Grouping the sorted events by transaction ID then results in transactions containing chronologically sorted changes.

However, as Amazon Kinesis Data Streams is a messaging infrastructure, applying changes is not feasible while storing changes in tables is meaningless. The Replicate Amazon Kinesis Data Streams endpoint, therefore, takes a different approach, which is to report all transactional events as messages.

## How it Works

Each change in the source system is translated to a data message containing the details of the change including the transaction ID and change sequence in the source. The data message also includes the changed columns before and after the change.

Once a data message is ready to be sent to Amazon Kinesis Data Streams, the stream and shard it should go to are determined by analyzing the endpoint settings and any transformation settings. For example, the user might decide to configure the endpoint in such a way that every table is sent to a different stream and set the partition strategy to "Random", meaning that each message (within the same table) will be sent to a different shard.

## Transaction Consistency from a Consumer Perspective

If maintaining transaction consistency is important for the consumer implementation, it means that although the transaction ID exists in all data messages, the challenge is to gather the messages in a way that would facilitate identifying a whole transaction. An additional challenge is getting the transaction in the original order they were committed, which could be an even greater challenge if transactions are spread across multiple streams and shards.

Although the simple way may work, it's not very efficient at the task level as all messages end up in the same stream and shard, not necessarily utilizing the full parallelism of the Amazon Kinesis Data Streams cluster. This may be a non-issue if there are multiple tasks, each taking advantage of a different stream/shard. In such a scenario, the gathering of messages from those tasks may very well utilize the cluster optimally.

The more generic way where data may be spread over multiple streams and shards means that some intermediate buffer such as memory, a table in a relational database, or even other streams would need to be used to collect information about transactions. Then, the transactions would need to be rebuilt by periodically (every few minutes/hours) sorting the events collected from Replicate's Amazon Kinesis Data Streams output by the change sequence and grouping them by transaction ID.

## Limitations

When defining a task with Amazon Kinesis Data Streams as the target endpoint, the following limitations apply:

- » The Amazon Kinesis Data Streams target endpoint does not support unlimited LOB size. Therefore, when replicating from source tables with LOB columns, *do not* select the **Allow unlimited LOB size** option.

For more information on defining LOB settings, see [Target Metadata](#).

- » **Batch optimized apply** mode is not supported. If this mode is set, the task will automatically switch to **Transactional apply** mode and issue an appropriate warning.

For more information on these modes, see [Change Processing Tuning](#).

- » Store Changes replication mode is not supported.

For more information on Store Changes mode, see [Adding Tasks](#).

- » The **Ignore ALTER** Apply Changes setting is not supported for changes to source data types and table renaming.

- » Column names must begin with [A-Za-z\_] (letters or an underscore) followed by [A-Za-z0-9\_] (letters, digits, or an underscore). For example, **\_Test\_** is a valid column name whereas **&Test** is not.

If a source column name does not adhere to this rule, then [a transformation should be used](#) to rename the column.

## Supported Data Types

The following table shows the default mapping from Attunity Replicate data types to Amazon Kinesis Data Streams data types.

For information on source data type mappings, see the section for the source endpoint you are using.

For additional information about Attunity Replicate data types, see [Replicate Data Types](#).

**Note** When using the JSON message format, binary values are represented as hexadecimal digits.

**Table 9.41 | Supported Amazon Kinesis Data Streams Target Data Types with Mapping from Attunity Replicate Data Types**

| Attunity Replicate Data Types | Amazon Kinesis Data Streams Target Data Types |
|-------------------------------|-----------------------------------------------|
| DATE                          | DATE                                          |

**Table 9.41 | Supported Amazon Kinesis Data Streams Target Data Types with Mapping from Attunity Replicate Data Types (Cont.)**

| Attunity Replicate Data Types                                | Amazon Kinesis Data Streams Target Data Types |
|--------------------------------------------------------------|-----------------------------------------------|
| TIME                                                         | TIME                                          |
| DATETIME                                                     | DATETIME                                      |
| BYTES                                                        | BYTES (length)                                |
| BLOB                                                         | BLOB                                          |
| REAL4                                                        | REAL4 (7)                                     |
| REAL8                                                        | REAL8 (14)                                    |
| INT1                                                         | INT1 (3)                                      |
| INT2                                                         | INT2 (5)                                      |
| INT4                                                         | INT4 (10)                                     |
| INT8                                                         | INT8 (19)                                     |
| UINT1                                                        | UINT1 (3)                                     |
| UINT2                                                        | UINT2 (5)                                     |
| UINT4                                                        | UINT4 (10)                                    |
| <b>Note</b> Values larger than $2^{31}-1$ are not supported. |                                               |
| UINT8                                                        | UINT8 (20)                                    |
| <b>Note</b> Values larger than $2^{63}-1$ are not supported. |                                               |
| NUMERIC                                                      | NUMERIC (p,s)                                 |
| STRING                                                       | STRING (Length)                               |
| WSTRING                                                      | STRING (Length)                               |
| CLOB                                                         | CLOB                                          |
| NCLOB                                                        | NCLOB                                         |
| BOOLEAN                                                      | BOOLEAN (1)                                   |

## Mapping from Attunity Replicate Data types to Avro

When Avro is set as the message format, due to the limited number of data types supported by Avro, the data type mappings will be as shown in the table below.

**Table 9.42 | Supported Avro Data Types with Mapping from Attunity Replicate Data Types**

| Attunity Replicate Data Types | Avro Primitive Data Types |
|-------------------------------|---------------------------|
| DATE                          | STRING                    |
| TIME                          | STRING                    |
| TIMESTAMP                     | STRING                    |
| STRING                        | STRING                    |
| WSTRING                       | STRING                    |
| CLOB                          | STRING                    |
| NCLOB                         | STRING                    |
| NUMERIC                       | STRING                    |
| BYTES                         | BYTES                     |
| BLOB                          | BYTES                     |
| REAL4                         | FLOAT                     |
| REAL8                         | DOUBLE                    |
| INT1                          | INT                       |
| INT2                          | INT                       |
| INT4                          | INT                       |
| UINT1                         | INT                       |
| UINT2                         | INT                       |
| UINT4                         | LONG                      |
| INT8                          | LONG                      |
| UINT8                         | STRING                    |
| BOOLEAN                       | BOOLEAN                   |

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

### To define the general connection properties:

1. Click the **Manage Endpoint Connections** toolbar button.  
The **Manage Endpoints Connections** dialog box opens.
2. Click the **New Endpoint Connection** toolbar button.

The **Name**, **Description**, **Type** and **Role** fields are displayed on the right.

3. In the **Name** field, specify a display name for the endpoint.
4. In the **Description** field, optionally type a description for the Kafka endpoint.
5. Select **Target** as the endpoint **Role**.
6. Select **Amazon Kinesis Data Streams** as the endpoint **Type**.

The dialog box is divided into **General** and **Advanced** tabs.

7. In the **Access Details** section, set the following properties:

**Region:** Select your Amazon Kinesis Data Streams region.

**Access options:** Choose one of the following:

- » Key pair

Choose this method to authenticate with your Access Key and Secret Key.

- » IAM Roles for EC2.

Choose this method if the machine on which Attunity Replicate is installed is configured to authenticate itself using an IAM role.

For information on IAM roles, see:

[http://docs.aws.amazon.com/IAM/latest/UserGuide/id\\_roles.html](http://docs.aws.amazon.com/IAM/latest/UserGuide/id_roles.html)

**Access key:** If you selected **Key pair** as your access method, enter your access key for Amazon Kinesis Data Streams.

**Secret key:** If you selected **Key pair** as your access method, enter your secret key for Amazon Kinesis Data Streams.

8. In the **Message Properties** section, select **JSON** or **Avro** as the message **Format**.

**Note** Attunity provides an Avro Message Decoder SDK for consuming Avro messages produced by Attunity Replicate. You can download the SDK together with the Avro Message Decoder Developer's Guide as a ZIP file from the [Customer Zone](#).

An understanding of the Attunity envelope schema is a prerequisite for consuming Avro messages produced by Attunity Replicate. If you do not wish to use the SDK, see [The Attunity Envelope](#) for a description of the Attunity envelope schema.

9. In the **Data Message Publishing** section, set the following properties:
    - a. In the **Publish the data to** field, choose one of the following:
      - » **Specific stream** - to publish the data to a single stream. Either type a stream name or use the browse button to select the desired stream.
      - » **Separate stream for each table** - to publish the data to multiple streams corresponding to the source table names.
- The target stream name consists of the source schema name and the source table name, separated by a period (e.g. "dbo.Employees"). The format of the target stream name is important as you will need to prepare these streams in advance.

- b. From the **Partition strategy** drop-down list, field, select either **Random** or **By Partition Key**. If you select **Random**, each message will be written to a randomly selected partition. If you select **By Partition Key**, messages will be written to partitions based on the selected **Partition key** (described below).
- c. From the **Partition key** drop-down list, field, select one of the following:

**Note** The partition key is represented as a string, regardless of the selected data message format (JSON/Avro).

- » **Schema and table name** - For each message, the partition key will contain a combination of schema and table name (e.g. "dbo+Employees"). Messages consisting of the same schema and table name will be written to the same partition.
- » **Primary key columns** - For each message, the partition key will contain the value of the primary key column. Messages consisting of the same primary key value will be written to the same partition.

10. In the **Metadata Message Publishing** section, specify whether or where to publish the message metadata.

From the **Publish** drop-down list, select one of the following options:

- » **Do not publish metadata messages.**
- » **Publish metadata messages to a dedicated metadata stream**

If you select this option, either type the **Specific stream** name or use the Browse button to select the desired stream.

**Note** It is strongly recommended *not* to publish metadata messages to the same stream as data messages.

## Overriding the Default Settings

A transformation can be defined that overrides the topic and message key settings defined in the **General** tab.

**Note** Before you can define such a transformation, you first need to add a source endpoint to the task and select the tables you want to replicate.

### To define a transformation:

1. Open the task you defined.
2. If you are defining a transformation for a single table, select one of the source tables. Otherwise, skip to Step 3.
3. Define a transformation that adds one of the following columns:

**Note** The columns listed below (prefixed with a \$) instruct Replicate to route the message to the desired stream and will *not* be included in the actual message itself.

- » `$stream` - To write messages to a specific stream.
- » `$key` - To create a custom message key.

For information on creating a transformation for a single table, see [Defining Transformations for a Single Table/View](#).

For information on creating a global transformation rule, see [Defining Global Transformations](#).

4. Define an expression for the new column that returns the following values:

- » For a `$stream` column, the expression should return the topic name.
- » For a `$key` column, the expression should return the message key contents.

For information on creating expressions, see [Using the Expression Builder \(for Filters, Transformations, and Global Transformations\)](#).

## Setting Advanced Connection Properties

In the **Advanced** tab, you can set the following advanced properties for the Amazon Kinesis Data Streams target endpoint:

**Table 9.43 | Advanced Tab Options**

| Option               | Description                                                                                                                                                                                                                                 |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Message Maximum Size | In the <b>Message maximum size</b> field, specify the maximum size of messages that Amazon Kinesis Data Streams is configured to receive ( <code>message.max.bytes</code> ). Replicate will not send messages larger than the maximum size. |
| Use proxy server     | Select this option to access Amazon Kinesis Data Streams via a proxy server.                                                                                                                                                                |
| Host name            | The host name of the proxy server.                                                                                                                                                                                                          |
| Port                 | The port via which to access the proxy server.                                                                                                                                                                                              |
| User name            | The user name for accessing the proxy server.                                                                                                                                                                                               |
| Password             | The password for accessing the proxy server.                                                                                                                                                                                                |
| Scheme               | Select which protocol to use to access the server (HTTP or HTTPS). In order to use HTTPS, you must first install the CA certificate that signed the proxy's certificate on the Replicate Server machine, as follows:                        |

**Table 9.43 | Advanced Tab Options (Cont.)**

| Option | Description                                                                                                                                                                                                                                                |
|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|        | <ul style="list-style-type: none"> <li>» <b>On Windows:</b> Add the CA certificate to the Trusted Root Certification Authorities store of Local Computer</li> <li>» <b>On Linux:</b> Add the CA certificate to /etc/pki/tls/certs/ca-bundle.crt</li> </ul> |

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

## The Attunity Envelope

All Attunity message types covered in this section are encapsulated in a single message schema called the Attunity Envelope. The schema of the Attunity envelope is as following:

```
{
  "type": "record",
  "name": "MessageEnvelope",
  "fields": [
    {"name": "magic", "type": {"type": "fixed", "name": "Magic", "size": 5}},
    {"name": "type", "type": "string"},
    {"name": "headers", "type": [{"null", {"type": "map", "values": "string"}}]},
    {"name": "messageSchemaId", "type": [{"null", "string"}]},
    {"name": "messageSchema", "type": [{"null", "string"}]},
    {"name": "message", "type": "bytes"}
  ]
}
```

}

The fields in the envelope are as follows:

» `magic` (5 bytes fixed field)

The constant "atMSG" is used to identify this form of message. The "atMSG" constant should be used to validate that this message is indeed an Attunity envelope message.

» `type` (string field)

Describes the enveloped message type. This can be one of two values: `MD` which stands for metadata message and `DT` which stands for data message.

» `headers` (map of string key and value)

A free for use map for various properties set at the application level. Currently, no headers are set by Attunity Replicate but this may change in future versions.

» `messageSchemaId` (null or string)

A reference to a schema defined elsewhere, which can be used to deserialize the bytes in the message field. This specification does not explain how the schema ID is used for looking up the actual schema - it is an application level detail. This field is used exclusively with the `messageSchema` field.

» `messageSchema` (null or string)

An embedded UTF-8 encoded Avro JSON schema with which the message field can be serialized. This field is used exclusively with the `messageSchemaId` field.

» `message` (bytes)

An Avro encoded message, which is the payload of the message envelope.

Given the envelope schema, it is possible for anyone using this schema to properly decode the envelope messages from Amazon Kinesis Data Streams.

Once the envelope message has been decoded, there are two possible scenarios:

» **Scenario 1:** Decoding a self-describing message such as the metadata message

» **Scenario 2:** Decoding a message by referenced schema ID such as data messages

The method for logically decoding messages in both scenarios is described below.

## Decoding a Self-Describing Message

When the `messageSchema` field is not null, it means the `message` field can be decoded using the schema included in the `messageSchema` field. This is fairly straightforward to perform programmatically since the only thing you need to usually supply Avro is a schema and a message, both of which are provided in the envelope message.

The Attunity metadata messages which include both table metadata, lineage and data schema description (to be referenced later by data messages) are enveloped in the self-describing envelope.

## Decoding a Message by Referenced Schema ID

Avro schemas are JSON documents which can be quite large, usually much larger than the data encoded by Avro conforming to the schema. For example, a schema of a 10 column table could be a JSON document of more than 100 characters while an actual row encoding

of 10 columns may be only 10 bytes (depending of course on the type and length of fields). It is therefore typically not recommended to include schema and data together in a Amazon Kinesis Data Streams message because the schema information is redundant and is the same for all data messages while the actual data is the only thing which differs between data messages.

To avoid sending schema with each data message, each schema has a 32 bytes long ID. When a data message based on a previously sent data message schema (via the metadata message) is constructed, the `messageSchema` field is set to null and the `messageSchemaId` field is set to the 32 bytes ID of the schema instead. The application responsibility is to locate the data schema sent earlier in the metadata message and use that schema to decode the data message contained in the `message` field.

## Typical Consumer Logic

A typical scenario involving Amazon Kinesis Data Streams involves Attunity Replicate as the Producer of messages into Amazon Kinesis Data Streams and customer code as the Consumer. Attunity Replicate offers the ability to define a specific stream as the schema stream and different streams for the table data.

The customer's consumer code should read metadata messages from the schema stream and then save the data schemas and any other information the consumer wishes to access later in a customer defined zone. Another set of customer consumers should read data messages from the various data streams, and access the data schemas zone as required to retrieve the data schemas required for decoding the data messages.

When consuming data messages and metadata messages from several streams and partitions in a multi-thread/process manner, a situation may arise where a given consumer may attempt to read a data message *before* the corresponding metadata message has been read. As it is not possible to read a data message before its corresponding metadata message, the consumer's logic should wait a reasonable amount of time until the corresponding metadata message has been read. If the metadata message is still not available after waiting for a reasonable amount of time, the consumer should handle this as an unexpected error and activate the planned error policy. An example of such a policy could be saving the message in a dedicated "delayed" stream for later processing.

As a rule of thumb, the number of metadata messages will be much lower (in the magnitude of 1:10000 or more) than the number of data messages. So, assuming a metadata consumer is active, the gap between metadata message and data message should be no more than a few seconds (usually, milliseconds).

## Metadata and Data Messages

This topic describes the structure and content of the Metadata and Data messages produced by the Replicate Amazon Kinesis Data Streams endpoint.

## Metadata Message

| Field              | Type      | Description                                                                                                                                                            |
|--------------------|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| schemaId           | String    | The unique identifier of the Avro schema.                                                                                                                              |
| lineage            | Structure | Information about the origin of the data (Replicate server, task, table, and so on)                                                                                    |
| server             | String    | The name of the Replicate server.                                                                                                                                      |
| task               | String    | The name of the task.                                                                                                                                                  |
| schema             | String    | The name of the database schema.                                                                                                                                       |
| table              | String    | The name of the table.                                                                                                                                                 |
| tableVersion       | Integer   | Replicate maintains a version number of the structure of source table. Upon DDL change on the source, the version is increased and a new metadata message is produced. |
| timestamp          | String    | The date and time of the metadata message.                                                                                                                             |
| tableStructure     | Structure | Describes the structure of the table.                                                                                                                                  |
| tableColumns       | Structure | Contains the list of columns and their properties.                                                                                                                     |
| {columns}          | Structure | For each column, a record with the below properties.                                                                                                                   |
| ordinal            | Integer   | The position of the column in the record.                                                                                                                              |
| type               | String    | The column data type.                                                                                                                                                  |
| length             | Integer   | The maximum size of the data (in bytes) permitted for the column.                                                                                                      |
| precision          | Integer   | For NUMERIC data type, the maximum number of digits required to represent the value.                                                                                   |
| scale              | Integer   | For NUMERIC data type, the maximum number of digits to the right of the decimal point permitted for a number.                                                          |
| primaryKeyPosition | Integer   | The position of the column in the table's Primary Key. or Unique Index. The value is zero if the column is not part of the table's Primary Key.                        |
| dataSchema         | String    | The Avro schema for deserializing the Data messages.                                                                                                                   |

## Data Message

| Field          | Type      | Description                                                                                                                                                                                                                                                                                                                                                |
|----------------|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| headers        | Structure | Information about the current record                                                                                                                                                                                                                                                                                                                       |
| operation      | Enum      | <p>The operation type.</p> <p>Full Load (Replicate transfers the existing records from source table)</p> <p>REFRESH – insert of a record during Full Load stage.</p> <p>CDC (Replicate transfers the changes from source table)</p> <p>INSERT – insertion of new record</p> <p>UPDATE – update of existing record</p> <p>DELETE – deletion of a record</p> |
| changeSequence | String    | <p>A monotonically increasing change sequencer that is common to all change tables of a task.</p> <p>Use this field to order the records in chronological order.</p> <p>Applicable to CDC operations.</p>                                                                                                                                                  |
| timestamp      | String    | <p>The original change UTC timestamp.</p> <p>Applicable to CDC operations.</p>                                                                                                                                                                                                                                                                             |
| streamPosition | String    | <p>The source CDC stream position.</p> <p>Applicable to CDC operations.</p>                                                                                                                                                                                                                                                                                |
| transactionId  | String    | <p>The ID of the transaction that the change record belongs to.</p> <p>Use this field to gather all changes of a specific transaction.</p> <p>Applicable to CDC operations.</p>                                                                                                                                                                            |
| data           | Structure | The data of the table record                                                                                                                                                                                                                                                                                                                               |
| {columns}      |           | The column names and values in the current record.                                                                                                                                                                                                                                                                                                         |
| beforeData     | Structure | The data of the table record, before the change                                                                                                                                                                                                                                                                                                            |
| {columns}      |           | <p>The column names and values, before the change.</p> <p>Applicable to UPDATE operation.</p>                                                                                                                                                                                                                                                              |

# 10 | Using the Attunity Replicate File Channel

This section describes how to use the Attunity Replicate File Channel as a source or target in a replication task.

## In this chapter:

- [Setting Up Attunity Replicate File Channel Tasks](#)
- [Working with the File Channel Data Files](#)
- [Attunity Replicate Installation Requirements for the File Channel](#)
- [Security](#)
- [Limitations](#)
- [Using the File Channel as a Source](#)
- [Using the File Channel as a Target](#)

## Setting Up Attunity Replicate File Channel Tasks

To replicate data using the file channel, you must set up two tasks of the following type:

- » [Local Task](#)
- » [Remote Task](#)

**Note** When using file channel, Change Tables can be enabled for the remote task *but not for the local task* (enabling Change Tables for the local task will result in remote task failure).

## Local Task

You set up the local task using the File-Channel endpoint as a target. The binary file created in this task is used as the source for one or more remote tasks using the File-Channel source endpoint.

The local task replicates data from an Attunity Replicate supported endpoint to the file channel. If you changed the default folder for storing data files (during the installation), then you must specify the location of the binary file created by the file channel. This location can be anywhere in your system. For more information on setting up a local task, see [Using the File Channel as a Target](#).

## Remote Task

Remote tasks use the File Channel as a source endpoint. You use the file created by the local task for this source. You can replicate the data to any endpoint that is supported by Attunity Replicate. You define the location of the File-Channel file as the remote location where the file was created. The data is pushed over the network to the defined location anywhere in your system. You can also define more than one location for the replicated data. In this case, define a separate remote task for each location.

If you want to push the data to an endpoint that is not in your LAN, use the [File Transfer Service](#) to send the files created in the local task to the remote location.

When you run the remote task, data is sent to the target in the following instances:

- » The first time you run the task as a full load.
- » Each time changes are made to the file. In this case, change processing takes place.

When the remote task runs, it will continuously look for the source file until the task is stopped. When the file is found, the data is replicated to the target endpoint. If no source file is found, an error is displayed; however, the task will continue to check for the correct file. Therefore, it is recommended that you run the local task first to ensure that the file exists.

**Note** To replicate tables that were added to the local file channel task after the initial full load, you need to reload both the local and the remote file channel tasks.

For more information on setting up a remote task, see [Using the File Channel as a Source](#).

## Replicating to Multiple Targets (Distribution)

You can use the File Channel to distribute from a single source endpoint to multiple targets, either of the same type (e.g. Microsoft SQL Server to Microsoft SQL Server) or of different types (e.g. Microsoft SQL Server to Oracle and SAP Sybase ASE).

### To do this:

1. For each of the target endpoints, define a separate (remote) task that replicates from the File Channel source to the target endpoint. In the **Advanced** tab of the File Channel source settings, make sure to clear the **Delete processed files** check box. This ensures that the File Channel files will be available for distribution as required.
2. Define a local task that replicates from the source endpoint to a File Channel target.
3. Run the local task (this will create the File Channel files required by the remote task).
4. For each of the remote tasks, select which tables to replicate (from the File Channel source) and optionally apply Filters and Transformations to them.
5. Run the remote tasks.

For more information on defining tasks, see [Designing Tasks](#).

For information on Filters and Transformations, see [Customizing Tasks](#).

**Note** By default, all the metadata for the selected source tables is replicated from the [Local Task](#) to the [Remote Task](#). This allows you to remove, add and transform tables in the remote task as needed. However, if you want the tables in the source and target endpoints to be identical, you can prevent replication of the metadata (and thereby shorten the processing time) by specifying `provideremotemetadata=N` in the **Override connection string parameters** field of the File Channel target's [Advanced](#) tab.

## Adding Tables to a Running Remote Task

When distributing to multiple targets, it is possible to replicate a different subset of tables to each target if necessary. Before starting the task, you can select which tables to replicate using the standard procedure described in [Adding Tables and/or Views to a Task](#). However, if the task is already running, you need to perform the following procedure:

1. Stop the remote task.
2. Add the desired tables (as described in [Adding Tables and/or Views to a Task](#)).
3. Resume the remote task. The newly added tables will be marked as "Queued".
4. Reload the newly added tables in the local task (by selecting the tables and clicking the **Reload** icon in Monitor view).

For information on removing specific tables from a replication task, see [Removing Specific Tables/Views from a Replication Task](#).

**Note** Adding tables to the remote task is not supported in Apply Changes (CDC-only) replication tasks. For more information on the available replication options, see [Adding Tasks](#).

## Working with the File Channel Data Files

The File Channel stream data files are encoded in an internal binary format. For full-load operations, the File Channel binary files contain packed data records for each of the table records and an end-of-file (EOF) record. For change-processing operations, the file contains:

- » A packed data record for each DDL and/or DML change.
- » A **begin-load-table** record with the stream name that marks the beginning of table loading.
- » A packed table-definition record with the table metadata. These records come before each DDL and **begin-load-table** record.

You do not need to work directly with the file-channel files, however if you find it necessary to work with them they are located in the [File-Channel Directory Structure](#).

## File-Channel Directory Structure

The file-channel directory contains the following files and folders:

- » **s\_msgs**: This folder contains messages sent from the source side to the replication server on the remote target side.

Messages are removed from this folder at the source side when an acknowledgment message is received stating that the file was transferred successfully or possibly with a timeout.

Messages are removed from this folder at the target side after they are read.

This folder contains the following files:

- » **s\_msgs/xxxxxxxx.fcm**: This file contains a JSON message from the source side to the target side.
- » **yyyymmddhhMMss.mtd**: This file contains the captured tables list.
- » **s\_status**: This folder contains status updates from the source side to the target side. Status updates appear as a fixed name file that is periodically updated. This file lists the last processed target status file. It receives the **t\_status/ccccc.fcs** file. These files are deleted when the file-channel source endpoint finishes reading the file. You can configure the file-channel source to keep the files, if necessary. See [Setting Advanced Connection Properties](#) for more information.
- » **t\_status**: This folder contains status updates from the target side to the source side. Status updates appear as an infinite set of data files that are created according to a specific schedule. These files are sent from the target by the source. The folder contains also a fixed name file that is updated with the last created status file name. It contains the following file:
  - » **t\_status/ccccc.fcs**: This is a file channel status file (.fcs) where the file name is a hexadecimal counter of length 8. These files will be transferred in order with the lower numbers transferred first. If you need to view them, you should order them by timestamp because alphabetical ordering will not be consistent with the hexadecimal name.

File channel status files are deleted by the source after being read and by the target when source status file indicates that this file was already processed.

You can configure the maximum amount of time that the files are kept before a new file is created as well as the maximum file size for each file. The minimum file size is 50 MB.

For more information, see [Setting Advanced Connection Properties](#).

- » **streams/<stream-name>**: This folder contains stream sub-folder, one sub-folder per stream. A stream represents a finite or infinite set of data files being sent from the source to the target. The file channel allows creating and destroying named streams dynamically. For example, there can be a fixed-named stream `cdc` (`streams/cdc`) and there could be a dynamically created stream `loadXXXXXXXX` that can be removed at the source side when a status update from the target is received (for example, when processing completed) in the **t\_status** folder.

You can configure the maximum number of streams and the maximum disc space for each stream. For more information, see [Change Processing](#).

This folder contains the following file:

» **streams/<stream-name>/cccccccc.fcd**: This is a file channel data file (.fcd)

where the file name is a hexadecimal counter of length 8. These files are processed at the target in order or in parallel depending on the case. However, the files are transferred in order with the lower numbers transferred first.

File channel data files are deleted by the source when transferred successfully and by the target when processed.

You can configure the maximum amount of time that the files are kept before being creating a new file and the maximum file size for each file. The minimum file size is 10 MB and the minimum time that a file is kept is 5 seconds.

## Attunity Replicate Installation Requirements for the File Channel

To work with the file-channel endpoint, you must install Attunity Replicate anywhere on the network for each LAN that you are working with.

## Security

When using the File Transfer Service, file-channel files are always transferred over an encrypted session.

The session is encrypted as follows:

The client and server create an AES-256 session key using the Diffie-Hellman key exchange protocol (using the OpenSSL library). After the key is created, all file transfers between the client and the server will take place over a secure and encrypted communication channel.

However, even though the session is encrypted, communication between the client and the server may still be susceptible to man-in-the-middle attacks. A man-in-the-middle in possession of the session key would be able to intercept any data transferred between the client and the server.

To eliminate man-in-the-middle attacks, a "shared password" needs to be provided when configuring the local and remote file channel endpoints. Once the session is established, both the client and the server use the shared password to re-key the session key during the next packet exchange, thereby preventing the original session key from being used for man-in-the-middle attacks.

### To sum up:

1. Strong encryption is used regardless of whether a password was provided.
2. Providing a password eliminates the risk of a man-in-the-middle attack.

For more information about the File Transfer Service, see [File Transfer Service](#).

## Limitations

The following limitations apply:

- » The File Channel endpoint does not support Full LOB mode.
- » You cannot use the Full Load resume function if you are using the File Channel endpoint. To resume a Full Load operation, you must delete the original data and then run the task again.
- » You must delete the File Channel folder before restarting an Apply Changes task.
- » After modifying an existing transformation in a remote File Channel task, both the local and the remote File Channel tasks need to be *restarted* (by selecting the **Reload Target** run option in both tasks).
- » Control tables defined for the local File Channel task but not for the remote File Channel task will not be created on the remote task's target endpoint.  
For information on defining Control Tables, see [Control Tables](#).
- » The remote File Channel task does not support the [Metadata only](#) run options.
- » The remote File Channel task does not support the [Stopping the Task after Full Load](#) task options.
- » If the local task fails, or is stopped, it is possible that the Full Load operation in the remote task will not complete successfully.

## Using the File Channel as a Source

The File Channel source endpoint is an Attunity Replicate endpoint that consumes and applies the contents of a file channel directory structure that was produced by a corresponding File Channel target endpoint.

This section contains the following topic:

- » [Setting General Connection Properties](#)

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

### To add the File Channel source to Attunity Replicate:

1. In **Tasks** view, click **Manage Endpoint Connections** toolbar button to open the **Manage Endpoint Connections** window.

2. In the **Name** field, type a name for your endpoint. This can be any name that will help to identify the endpoint being used.
3. In the **Description** field, type a description that helps to identify the information being replicated to the file. This is optional.
4. Select **SOURCE** as the endpoint **Role**.
5. Select **File Channel** as the endpoint **Type**.
6. Type the full path to the **Storage Folder** where the File Channel files will be created.

The default path when *not* using the File Transfer Service is:

C:\Program Files\Attunity\Replicate\data\tasks\<task\_name>

If you are using the File Transfer Service, the default path is:

C:\Program Files\Attunity\Replicate\data\endpoints\<file-channel\_db\_name>\fc

**Note** The Replicate File Transfer Service always transfers the local file channel task's files to the *default directory* on the remote system (C:\Program Files\Attunity\Replicate\data\endpoints\<remote\_file-channel\_db\_name>\fc). Consequently, if you are using the File Transfer Service, ensure that the default directory always has enough space for the incoming files.

For more information on using the File Transfer Service, see [File Transfer Service](#) and [Using Advanced Properties for a File-Channel Source](#).

**Note** The actual size of the File Channel files is usually three-to-four times larger than the size of the source data. You should therefore make sure that the location of the specified **Storage Folder** has sufficient disk space.

This folder should be in a location that is accessible from anywhere in the WAN you are working with.

**Note**

- » You can use the **Advanced** tab to define specific properties and create a custom connect string. In this case, you do not need to enter information in this tab. For more information on using the **Advanced** tab, see [Using Advanced Properties for a File-Channel Source](#).
- » To determine if you are connected to the endpoint you want to use or if the connection information you entered is correct, click **Test Connection**.  
If the connection is successful a message in green is displayed. If the connection fails, an error message is displayed at the bottom of the dialog box.

To view the log entry if the connection fails, click **View Log**. The server log is displayed with the information for the connection failure. Note that this button is not available unless the test connection fails.

7. Click **OK** to finish the setup and save the changes.

## Using Advanced Properties for a File-Channel Source

You can set the following properties in the **Advanced** tab:

- » **Input files are received via file transfer service:** Select this check box to receive the source input files using the Replicate File Transfer Service.
  - » **Password:** The password that will be used to establish a secure connection with the File Channel Target.

**Important:** When using the File Transfer Service, an agreed upon password is required in order to establish a secure connection between the File Channel Source and the File Channel Target. Accordingly, the password specified in the File Channel Source settings and the password specified in the File Channel Target settings *must be identical*.

For more information about the File Transfer Service, see [File Transfer Service](#).

- » **Delete processed files:** Select this check box to delete the File Channel files after the data has been replicated to the target endpoint.

You should clear this check box if other tasks need to use the files.

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

# Using the File Channel as a Target

The File-Channel target endpoint is an Attunity Replicate endpoint that creates and maintains a file-based directory structure containing replication artifacts (task definitions, metadata, full load data, CDC data and status updates). This file channel directory structure is consumed by a corresponding File-Channel source endpoint in a different task and possibly in a remote location.

This section contains the following topic:

- » [Setting General Connection Properties](#)

## Setting General Connection Properties

This section describes how to configure general connection properties. For an explanation of how to configure advanced connection properties, see **Setting Advanced Connection Properties** below.

### Note

- » The **Type** is different depending on the type of file you are creating, however the information you enter is the same for all file types.
- » All files are used as targets, however you can use an Attunity Replicate file as a source only after you created the file by loading data into it as a target.

### To add the File Channel target to Attunity Replicate:

1. In the Attunity Replicate Console, click the **Manage Endpoint Connections** toolbar button to open the **Manage Endpoints Connections** dialog box. Then click the **New Endpoint Connection** button.
2. In the **Name** field, type a name for your endpoint. This can be any name that will help to identify the endpoint being used.
3. In the **Description** field, type a description that helps to identify the information being replicated to the file. This is optional.
4. Select **TARGET** as the endpoint **role**.
5. Select **File Channel** as the endpoint **Type**.
6. If you changed the default data folder during installation, type the full path to the **Storage Folder** (e.g. D:\data\tasks\ ) where the file is being created. Otherwise, you can leave this field empty. Note that this field will be ignored when the **Transfer files to remote file channel** option is enabled in the **Advanced** tab.

**Note**

- » You can use the **Advanced** tab to define specific properties and create a custom connect string. In this case, you do not need to enter information in this tab. For more information on using the **Advanced** tab, see [Setting Advanced Connection Properties](#).
  - » To determine if you are connected to the endpoint you want to use or if the connection information you entered is correct, click **Test Connection**. If the connection is successful a message in green is displayed. If the connection fails, an error message is displayed at the bottom of the dialog box.
- To view the log entry if the connection fails, click **View Log**. The server log is displayed with the information for the connection failure. Note that this button is not available unless the test connection fails.

7. Click **OK** to finish the setup and save the changes.

## Setting Advanced Connection Properties

You can set the following properties in the **Advanced** tab:

- » **Max file size (KB)**: Click the arrows to select, or type the maximum file size (in kilobytes) allowed for the files created in the target.
- » **Limit storage size to (MB)**: To allocate a specific amount of disk space to the File Channel files, enable this option and then specify the amount of disk space to set aside (using the arrows or by typing). When the limit is reached, Attunity Replicate will stop writing the files to the designated storage.
- » **Max batching time interval (seconds)**: Click the arrows to select, or type the maximum time (in seconds) for files to be batched before being written in a single operation.
- » **Transfer files to remote file channel**: Select this check box to transfer files to the File Channel Source (on the remote Attunity Replicate Server) using the Attunity Replicate File Transfer Service. This can dramatically improve transfer speeds when the source endpoint and the target endpoint are located on different LANs. For more information about the Attunity Replicate File Transfer Service, see [File Transfer Service](#).
  - » **Remote file transfer service host**: The host name or IP address of the computer on which the Attunity Replicate File Transfer Service is running.
  - » **Remote file transfer service port**: The port on the remote computer through which the files will be transferred (from the storage folder to the remote file channel).
  - » **Remote file transfer service endpoint name**: The name of the File Channel Source endpoint on the remote machine.

- » **Additional remote file channels:** When sending to multiple File Channel Source endpoints, specify the target destinations using the following format:  
`file_channel_db_name@host:port,file_channel_db_name@host:port`
- » **Max transfer streams:** The maximum number of streams to use when transferring the files. Adjust the number of streams as required to optimize transfer speeds.
- » **Password:** The password that will be used to establish a secure connection with the File Channel Source.

**Important:** When using the File Transfer Service, an agreed upon password is required in order to establish a secure connection between the File Channel Source and the File Channel Target. Accordingly, the password specified in the File Channel Target settings and the password specified in the File Channel Source(s') settings *must be identical*.

## Internal Parameters

Internal parameters are parameters that are not exposed in the UI. You should only use them if instructed by Attunity Support.

### To add internal Attunity Replicate parameters:

1. Click the **Internal Parameters** link.  
The **Internal Parameters** dialog box opens.
2. In the edit box, type the name of the parameter you need to add and then click it.
3. The parameter is added to the table below the search box with its default value.
4. Change the default value as required.
5. To reset the parameter value to its default, click the "Restore default value" icon at the end of the row.

## Settings Summary

You can view a summary of your settings by clicking the **Setting Summary** link. This is useful if you need to send a summary of your settings to Attunity Support.

# 11 | Customizing Tasks

This section describes how to customize a replication task. For example, you can create new tables or columns for the target endpoint or select only some of the data from each column to be replicated. This is done using transformations and filters.

**Note** Although the descriptions in this section only refer to tables, the procedures described herein are applicable to views as well. When a transformation is defined for a view, the word "View(s)" appears in the UI instead of the word "Table(s)".

## In this chapter:

[Table Settings](#)

[Defining Global Transformations](#)

[Using the Expression Builder \(for Filters, Transformations, and Global Transformations\)](#)

[Task Settings](#)

For more information about replication tasks, see [Replication Tasks](#).

## Table Settings

In the **<Table\_Name> - Table Settings** window, you can define how the data for each individual table/view is replicated to the target.

### To open the Table Settings window:

1. Open the task you are working with.

For information on opening a task, see [Editing a Replication Task](#).

2. In Designer view, select the desired table from one of the following tabs on the right of the console:
  - » The **Patterns and Selected Tables** tab - if the desired table was explicitly selected.
  - » The **Full Table List** tab - if the desired table was selected using a table inclusion pattern.

For information on how to define table selection patterns, see [Creating Table/View Selection Patterns](#).

3. Click the **Table Settings** button above the table list.

The **<Table\_Name> - Table Settings** window opens.

4. In the **Table Settings** window, perform any of the following tasks:
  - » Performing General Tasks for a Single Table/View
  - » Defining Transformations for a Single Table/View
  - » Using Filters
  - » Define Parallel Load Settings
  - » Define LOB Column Replication Settings
5. Click **OK** to close the **Table Settings** window.
6. Click **Save** to preserve the table and column information for this task.

**To restore the default table values:**

- » Click **Restore Table Defaults** at the bottom left of the **Table Settings** window. This option is available in all tabs.  
Any changes you made will be discarded and the table's default settings will be restored.

**Note** The names of modified tables will be followed by the word (**changed**), enabling you to easily identify which tables have been modified.

## Performing General Tasks for a Single Table/View

**Note** Although the descriptions in this section only refer to tables, the procedures describe herein are applicable to views as well. When a task is being performed for a view, the word "View(s)" will appear in the UI instead of the word "Table(s)"

The **General** tab in the Table Settings window displays basic information about the selected table and allows you to define new names for the table/schema on the target as well as override the default tablespace for the table and its index (Oracle target only).

**To edit the general table settings:**

1. Open the [Table Settings](#) window.
2. Click the **General** tab on the left side of the window, as shown below.

DEMO.EMPLOYEE - Table Settings

| General                    | Source Table Details                                    |
|----------------------------|---------------------------------------------------------|
| Transform                  | Table Schema: DEMO                                      |
| Filter                     | Table Name: EMPLOYEE                                    |
| Parallel Load              | Record identifier: Non clustered primary key            |
| LOB Column Handling        | Identifier key/index name: _SYS_TREE_RS_#8726962_#0_#P0 |
|                            | Table tablespace:                                       |
|                            | Index tablespace:                                       |
|                            | Approximate record size (Byte): 79                      |
|                            | Estimated record count: 15                              |
|                            | Estimated table size (MB): 0                            |
|                            | Load Order: Normal Priority                             |
| <b>Map to target table</b> |                                                         |
|                            | Table Schema: <input type="text"/>                      |
|                            | Table Name: <input type="text"/>                        |
|                            | Table tablespace: <input type="text"/>                  |
|                            | Index tablespace: <input type="text"/>                  |

[Restore Table Defaults](#) OK Cancel

In the **Map to target table** section, the following options are available:

- » **Table Schema:** Specify the schema in which you want the table to be created on the target.
- » **Table Name:** Specify a new name for the table on the target.
- » **Table tablespace:** This option is only available when the task is defined with an Oracle target endpoint.

Specify the name of the tablespace in which you want the table to be created on the target. By default (i.e. when this field is empty), the table will either be created in the source table tablespace on the target (when replicating from an Oracle source) or in the default tablespace (when replicating from any other source).

- » **Index tablespace:** This option is only available when the task is defined with an Oracle target endpoint.

Specify the name of the tablespace in which you want the table's index to be created on the target. By default (i.e. when this field is empty), the index will either be created in the source table tablespace on the target (when replicating from an Oracle source) or in the default tablespace (when replicating from any other source).

## Defining Transformations for a Single Table/View

**Note** Although the descriptions in this section only refer to tables, the procedures describe herein are applicable to views as well. When a transformation is defined for a view, the word "View(s)" will appear in the UI instead of the word "Table(s)".

This section describes how to define data transformations. Data transformations are performed when the task is run. They are optional. If you do not define any transformations, the data is replicated "as is" from the source to the target.

Attunity Replicate lets you make the following changes to the tables and columns:

- » Rename any column for the target table
- » Delete a target column
- » Change the data type and/or the length of any target column
- » Add additional target columns
- » Designate which target columns (i.e. segments) will comprise the Unique Index
- » Recalculate the data

### Limitations

Transformations are subject to the following limitations:

- » They are not supported for calculating columns of Right-to-Left languages.
- » They cannot be performed on columns that have a pound character (#) in their name.
- » The only supported transformation for LOB/CLOB data types is to drop the column on the target.

You can use the method described here for transformations that are specific to a single table or a few tables in your task. To make a similar change over multiple tables, see [Defining Global Transformations](#).

For an explanation of how to configure transformations, see [Using the Transform Tab](#).

#### To define a data transformation for a single table:

1. Select the table you want to transform and open the [Table Settings](#) window.
2. Click **Transform** on the left side of the window.

The following figure shows the information in the **Transform** tab of the **Table Settings** window.

HR.DEPARTMENTS Table Settings

General
Source table: HR.DEPARTMENTS
 By default include all columns

Transform
Add Column

Filter

**Input**

|  |                 |
|--|-----------------|
|  | DEPARTMENT_ID   |
|  | DEPARTMENT_NAME |
|  | MANAGER_ID      |
|  | LOCATION_ID     |

> < >> <<

**Output**

| Key | Name           | Type       | Expression |
|-----|----------------|------------|------------|
|     | DEPARTMENT_ID  | INT2       |            |
|     | DEPARTMENT_NAM | STRING(30) |            |
|     | MANAGER_ID     | INT4       |            |
|     | LOCATION_ID    | INT2       |            |

Restore Table Defaults
OK
Cancel

## Using the Transform Tab

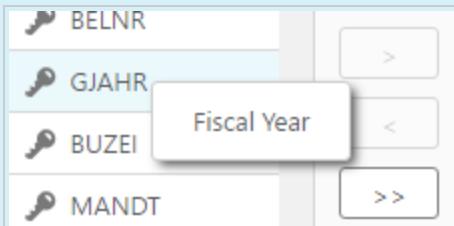
In the **Transform** Tab, you can define transformations using Replicate's built-in functionality.

**Note** Customers that require functionality not provided by Replicate's built-in transformations can write their own transformations, and then access them from the [Replicate Expression Builder](#). For an explanation of how to create user-defined transformations (requires basic programming skills), see [User-Defined Transformations](#).

The **Transform** Tab in the **Table Settings** window has the following components:

- » **Input:** This lists the columns on which you can perform transformations.

**Note** When creating a transformation for the SAP Application source endpoint, you can hover your mouse cursor over an **Input** column to see a tooltip with the table's actual name:



- » **Output:** This table shows the defined output for the columns in the table where you are performing the transformations. It contains the following columns:

- » **Key:** This indicates whether the column is a segment of the Unique Index. A key icon is displayed next to columns that are segments of the Unique Index. Click the column to add and remove keys.
- » **Name:** The name of the column. To change the name of the column, select the field with the column name you want to change and type a new name in this column if you want to change the name of the column or if the column is calculated (added to the table). See the table [Transformation Actions](#) for more information.
- » **Type:** The data type for the column. To change the data type for the column, select the field with the data type you want to change and select a new data type. See the following table for more information.
- » **Expression:** An expression using SQLite operators to define the data in the column. For information on how to create an expression, see the table below.

The following table describes the actions you can carry out in the Transform Table window.

**Table 11.1 | Transformation Actions**

| To                               | Do This                                                                                                                                                                                                                                                           |
|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Rename a column                  | Select the <b>Name</b> column for the table column you want to change. Type in a new name.<br><br>The top right corner turns blue when the name is changed. To view the original name, hover the mouse pointer over the field and the original name is displayed. |
| Set a column as a primary key or | 1. Select the desired row in the <b>Output</b> table and then click the cell in the <b>Key</b>                                                                                                                                                                    |

**Table 11.1 | Transformation Actions (Cont.)**

| To                                | Do This                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| disable a column's primary key    | <p>column.</p> <p>A key icon will be displayed.</p> <ol style="list-style-type: none"> <li>2. Repeat to set primary keys for additional columns.</li> <li>3. To disable the primary key, click the key icon.</li> </ol>                                                                                                                                                                                                                                                                                                                                                       |
| Change the data type for a column | <p>Select the <b>Type</b> column for the table column you want to change and select a new data type from the drop-down list. Make sure that the data type you select is compatible with the data in that column.</p> <p>For a description of Attunity Replicate data types, see <a href="#">Replicate Data Types</a>.</p> <p>For information about data-type mapping from the native endpoint to Attunity Replicate data types, see the chapter for the endpoint you are using. For a list of supported databases, see <a href="#">Supported Platforms and Endpoints</a>.</p> |
| Add a new column                  | <p>Click <b>Add Column</b> to add a new column. When you add a column, the <b>Name</b> is blank and the <b>Type</b> is listed as <code>string(50)</code>.</p> <p>Type a name for the new column in the <b>Name</b> column. If needed (according to the column data), click in the <b>Type</b> column and select a data type from the list.</p>                                                                                                                                                                                                                                |
| Add an existing column            | <p>From the <b>Input</b> pane, select one or more columns and click the right facing arrow button.</p> <p>To add all of the columns, click the right-facing double arrow.</p> <p><b>Note:</b> By default all tables columns are included in the <b>Output</b> list. To include only some of the columns clear the <b>By default include all columns</b> check box at the top of the <b>Transform</b> tab. This removes all of the columns from the list. You can then add back any existing column.</p>                                                                       |

**Table 11.1 | Transformation Actions (Cont.)**

| To                                                                      | Do This                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Delete a column                                                         | <p>From the <b>Output</b> list, select the row with the column you want to delete and click the left-facing arrow button.</p> <p>To remove all columns, click the left-facing double arrow. Note that all the columns except for columns defined as a primary key are deleted.</p>                                                                                                                                                                                                                                         |
| Add/Remove a Unique Index segment to/from a target column               | <p>A key icon indicates which target columns segments of the Unique Index.</p> <p>To add a Unique Index segment, click in the <b>Key</b> column to the left of target column to which you want to add the segment. A key icon will appear.</p> <p>To remove a Unique Index segment, click the key icon to the left of the target column from which you want to remove the segment. The key icon will disappear.</p>                                                                                                        |
| Recalculate the data for a column in the target endpoint                | <p>Click in the <b>Expression</b> column in the row with the table column you want to change the data for. Enter an expression using SQLite syntax.</p> <p>See <a href="#">Creating an Expression for Transformations</a> and <a href="#">Using SQLite Syntax with Transformations</a> for information on creating expressions.</p> <p>Once you add a calculated expression, you can test the expression. See <a href="#">Using the Expression Builder (for Filters, Transformations, and Global Transformations)</a>.</p> |
| Change the data type for a specific input column                        | This is required if a source column is defined as character type but the data stored in that column is binary or vice versa.                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Note</b> Supported with the IBM DB2 for iSeries and IBM DB2 for z/OS | <b>Note</b> When the source column type is STRING, WSTRING, CLOB, or NCLOB, you must also select a <b>Character Set</b> ,                                                                                                                                                                                                                                                                                                                                                                                                  |

**Table 11.1 | Transformation Actions (Cont.)**

| To                                                   | Do This                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| source endpoints only.                               | <p>otherwise an error will be shown and the <b>OK</b> button will be disabled.</p> <p>In the <b>Input</b> table, click the relevant cell in the <b>Type</b> column and then select either <b>STRING</b> or <b>BYTES</b> from the drop-down list as required.</p> <p><b>Note</b> If you change a column's <b>Type</b> in the <b>Input</b> table, you also need to set the same <b>Type</b> for the corresponding column in the <b>Output</b> table.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Change the Character Set for a specific input column | <p>Note that if you select STRING, you can also change the character set, as explained below.</p> <p><b>Note</b> Modified cells will display a triangle in the top right corner. To see the original value, click the triangle.</p> <p>This is required if a source character column is wrongly encoded. For example, if a source character column is described as encoded in CCSID X, but the data stored in that column is actually encoded in CCSID Y. You can also set a custom character set as described in <a href="#">Setting a Custom Character Set</a> below.</p> <p>In the <b>Input</b> table:</p> <ol style="list-style-type: none"> <li>1. Click the relevant cell in the <b>Type</b> column and select <b>STRING</b> from the drop-down list.</li> <li>2. Click the relevant cell in the <b>Character Set</b> column and then select the appropriate character set from the drop-down list.</li> </ol> |

**Table 11.1 | Transformation Actions (Cont.)**

| To | Do This                                                                                                                           |
|----|-----------------------------------------------------------------------------------------------------------------------------------|
|    | <p><b>Note</b> Only character sets compatible with the selected <b>Type</b> will be available for selection.</p>                  |
|    | <p><b>Note</b> Modified cells will display a triangle in the top right corner. To see the original value, click the triangle.</p> |

For a description of the various list actions that you can perform, see [List Actions](#).

## Setting a Custom Character Set

The following procedure is supported with the IBM DB2 for iSeries and IBM DB2 for z/OS source endpoints only.

Perform the steps below if the source table is defined with an incorrect CCSID and the correct definition is actually in a UCM file.

1. Create or [download](#) a mapping data file with the file extension **.ucm**.

**Note** If you edit an existing UCM file, you must also change the values of the `<code_set_name>` and `<icu:alias>` properties. If the file does not contain an `<icu:alias>` property, then you only need to change the value of the `<code_set_name>` property.

2. Create a CNV file for the UCM file by running the following command:

```
<product_dir>\bin\makeconv.exe -v <file_name>.ucm
```

**Example:**

```
"c:\Program Files\Attunity\Replicate\bin\makeconv.exe" -v 1047_EX.ucm
```

This will create a CNV file with the same name as the UCM file (e.g. **1047\_EX.cnv**).

3. Copy the file to the following location:

```
<product_dir>\bin\icudt581
```

4. Restart the Attunity Replicate UI Server service.

5. Select the custom character set from the **Character Set** drop-down list; it will appear as the CNV file name followed by the word "Custom" e.g. **1047\_EX.cnv (Custom)**.

## Creating an Expression for Transformations

Use an expression to define the contents of a new or re-calculated column.

### To create an expression:

1. In the **Transform** tab, select the row with the column for which you want to create an expression.  
or  
Click **Add Column** to add a new column.
2. Click the  button in the **Expression** column.  
The **Expression Builder** opens.
3. Build an expression as described in [Using the Expression Builder \(for Filters, Transformations, and Global Transformations\)](#).

## Using SQLite Syntax with Transformations

The following table lists the SQLite operators that are supported with transformations.

**Table 11.2 | SQLite Operators used by Attunity Replicate**

| Operator | Description                                                                                                                                                                              |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          | Concatenate strings.<br><br>FIRST_NAME    LAST_NAME<br><br>PHONE_NUMBER  <Office Only> (adds the string Office Only to the telephone number).                                            |
| +        | Adds two values together.<br><br>DEPARTMENT_ID+100 (adds 100 to each ID number). Any column used in an expression with this operator must be a numeric data type.                        |
| -        | Subtracts a value from another value.<br><br>MANAGER_ID-100 (subtracts 100 from each ID number). Any column used in an expression with this operator must be a numeric data type.        |
| %        | Uses the remainder of a division expression as the value.<br><br>%SALARY/7 (Divides the value of the Salary column by 7 and uses any remainder from the expression as the column value). |
| /        | Divides one value into another.<br><br>SALARY/.16 (Divides the value of the Salary column by .16).                                                                                       |

**Note** If the two values in the division expression are integers (two NUMERIC columns with no digits after the decimal) and the result is a fractional value, the result returned will be 0.

**Table 11.2 | SQLite Operators used by Attunity Replicate (Cont.)**

| Operator | Description                                                                                                                             |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------|
| *        | SALARY*.16 (Multiplies the value of the Salary column by .16. This could be used to calculate taxes that are subtracted from a salary). |

For more information about SQLite syntax, see the SQLite documentation.

## Using Filters

Filters let you include or exclude records from a replication task based on the value(s) of the source table columns, thereby allowing you to replicate only the specific data that you need.

### In this section:

- » [Filter Limitations](#)
- » [Opening the Filter Tab](#)
- » [Creating a Filter Condition for a Specified Column](#)
- » [Creating a Record Selection Condition for One or More Columns](#)
- » [Adding or Removing Filter Ranges](#)
- » [Using SQLite Syntax with Filtering](#)

### Filter Limitations

When creating a filter, the following limitations apply:

- » Filters are not supported for calculating columns of Right-to-Left languages.
- » Filters can only be applied to immutable columns.
- » Filters on mutable columns:

When a filter is created to exclude/include specific rows in a column, the specified rows will always be excluded/included, even if the rows that were originally excluded/included are later changed. For example, if you chose to exclude/include rows "1-10" in a column named "Age" and those rows were later changed to "11-20", the rows will continue to be excluded/included, even though the data is no longer the same.

Additionally, if a row outside the filter scope was changed (i.e. updated or updated and then deleted) so that it should now be excluded/included (as defined by the filter), it will not be replicated to the target. So, for example if you created a filter to exclude/include rows less than 5 and then changed row 6 to -6, it will not be replicated (even though it is included in the filter's criteria range).

- » Filter cannot be applied to LOB columns.

## Opening the Filter Tab

The Filter Table tab contains the following information:

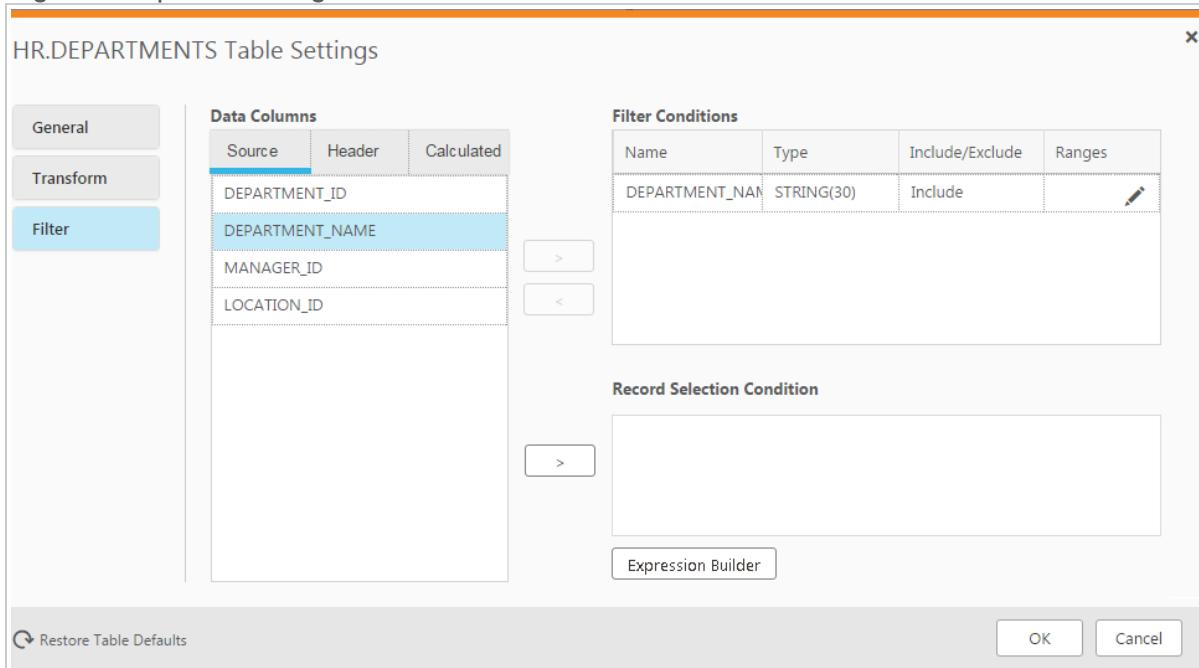
- » **Data Columns** list: This list contains a list of the columns for the table where you filtering data. You can use these to select the columns to use in the filtering operations.

This list has the following tabs:

- » **Source**: This tab lists the original source columns in the table.
- » **Header**: This tab lists the available header columns. You can create filters using these columns and include them in expressions. For information on these header columns, see [Headers](#).
- » **Calculated**: This tab lists the columns added to the table. You add columns through transformations. For more information, see [Defining Transformations for a Single Table/View](#).
- » **Filter Conditions** table: This table has the following columns:
  - » **Name**: The name of the column where you are filtering the data.
  - » **Type**: The data type for the column.
  - » **Include/Exclude**: Indicate whether to include or exclude the filtered data for this column.
  - » **Ranges**: Click the button on the right of the **Ranges** field to open the Range Builder. For information on creating a value or ranges with the Range Builder, see [Adding or Removing Filter Ranges](#).  
For more information on typing in the filter ranges manually, see [Using SQLite Syntax with Filtering](#).
- » **Record Selection Condition**: Enter a complex condition that can include multiple columns. The condition must evaluate to TRUE to be accepted. You can create a condition using SQLite operators or by [Using the Expression Builder \(for Filters, Transformations, and Global Transformations\)](#). For information on using the SQLite operators, see [Creating a Record Selection Condition for One or More Columns](#).

The following figure is an example of the information in the **Filter** tab of the **Table Settings** window.

Figure 11.1 | Table Settings: Filter



### To open the Filter tab:

1. Select the table you want to filter and then open the [Table Settings](#) window.
2. Click the **Filter** tab on the left side of the window.

### Creating a Filter Condition for a Specified Column

You can create a simple condition for a single column in the table you are working with. You can include any combination of ranges or specific values in the filter and determine whether to include or exclude the defined data.

### To create a filter condition:

1. Select a column from the data columns list and then click the right-facing arrow next to the **Filter Conditions** table.  
To remove the column, click on it in the **Filter Conditions** table and then click the left-facing arrow. Any data entered for this column in the **Include/Exclude** or Values columns is also deleted.
2. Click in the **Include/Exclude** column to select whether to include or exclude the data that meets this condition.
3. Click the Edit Ranges button in the **Ranges** column.
4. The **<Name> <Include|Exclude> Ranges** window opens. Continue from [Adding or Removing Filter Ranges](#).

### Creating a Record Selection Condition for One or More Columns

You can create a record selection condition manually and/or by using the Expression Editor.

When entering a string, you can use the following special characters:

- » %: Matches any string of zero or more characters. For example, `Mc%` searches for every name that begins with **Mc** or `%bob%` includes every name that contains **bob**.
- » \_: Matches a single character (as a wildcard). For example: `'Sm_th'` includes names that begin with **Sm** and end with **th**, such as **Smith** or **Smyth**. To search for an underscore character, use `[_]`".
- » [...]: Includes a range or set of characters. For example, `[CK]ars[eo]` includes names **Carsen**, **Karsen**, **Carson**, and **Karson** or `[M-Z]inger` includes all words that end in **inger** with the first letter between **M** and **Z**, such as Ringer, Singer, or Zinger.

For more information, see documentation on how to use Transact-SQL.

For information on what SQLite operators can be used to create Record Selection Condition filters, see [Using SQLite Syntax with Filtering](#).

#### To create a record selection condition:

1. From the **Data Columns** list, select a source column, header column or calculated column and then click the arrow to the left of the **Record Selection Condition** pane.
2. Use SQLite operators, such as < or = to create the condition. Use any amount of strings or columns as you need to create a condition.

For example `$EMPLOYEE_ID < 100 AND $SALARY > 100,000`

In this case only rows that satisfy both of these conditions are replicated in the replication task.

The following example provides an example using SQL search pattern strings. Only rows that satisfy this condition are replicated.

```
$EMPLOYEE_NAME IS 'Sm_th'
```

#### To create a record selection condition using the Expression Builder:

- » Click **Open Expression Builder**. This button is located directly under the record selection condition box. Follow the directions for creating an expression in the section [Using the Expression Builder \(for Filters, Transformations, and Global Transformations\)](#).

#### Adding or Removing Filter Ranges

You can add one or more values to the Ranges column using the Range Builder. Values that match *any* of the ranges in the list are included in the replication.

You can also delete a filter range using the Range Builder.

**Note** Filter ranges that you enter manually are also displayed in the Filter Builder. You can use the Filter Builder to delete them.

## To use the Range Builder:

1. In the **Filter** tab of the [Table Settings](#) window, select a column to filter. For more information, see [Using Filters](#).
2. Click the button to the right of the **Ranges** column.

The **Ranges Builder** opens.

3. Click **Add Range**. Select any of the following from the drop-down list displayed.

» **Equal to:** Select **Equal to** to enter a single value. The following is displayed in the range list.

### **Equal to = [N]**

Click the **[N]** and type a value in the field that is displayed.

When the value in the selected column equals the value you enter, the result is included or excluded in the replication task depending on the option selected in the **Include/Exclude** column.

» **Between:** Click **Between** to enter a range of values. The following is displayed in the range list.

### **Between [N] - [N]**

Click each **[N]** and type a value in the fields that are displayed.

When the column contains the values between the two values entered, the result is included or excluded in the replication task depending on the option selected in the **Include/Exclude** column.

» **Less than or equal to:** Select **Less than or equal to** and enter a maximum value. The following is displayed in the range list.

### **Less than or Equal to =< [N]**

Click the **[N]** and type a value in the field that is displayed.

When the value in the selected column is equal to or less than the value you enter, the result is included or excluded in the replication task depending on the option selected in the **Include/Exclude** column.

» **Greater than or equal to:** Select **Greater than or equal to** and enter a minimum value. The following is displayed in the range list.

### **Greater than or Equal to => [N]**

Click the **[N]** and type a value in the field that is displayed.

When the value in the selected column is equal to or more than the value you enter, the result is included or excluded in the replication task depending on the option selected in the **Include/Exclude** column.

## To delete a filter range from the Range Builder:

1. In the **Filter** tab of the [Table Settings](#) window, select the column with the filter condition you want to delete.
2. Click the button to the right of the **Ranges** column. The Ranges Builder opens.
3. Click the **X** next to the range you want to delete. The deleted range is removed from the list.

## Using SQLite Syntax with Filtering

Attunity Replicate supports the following SQLite operators when creating Record Selection Condition filters.

**Note** You must put the (\$) in front of each input as shown below.

**Table 11.3 | SQLite Operators used by Attunity Replicate for Filtering**

| Operator | Description                                                                                                                                                                                                                                                                                                               |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <        | Is less than.<br>\$SALARY<100000                                                                                                                                                                                                                                                                                          |
| <=       | Is less than or equal to<br>\$SALARY<=100000                                                                                                                                                                                                                                                                              |
| >        | Is greater than<br>\$SALARY>100000                                                                                                                                                                                                                                                                                        |
| >=       | Is more than or equal to<br>\$SALARY>=100000                                                                                                                                                                                                                                                                              |
| =        | Is equal to<br>\$SALARY=100000                                                                                                                                                                                                                                                                                            |
| != or <> | Is not equal to<br>\$SALARY!=100000                                                                                                                                                                                                                                                                                       |
| IS       | Is the same as<br>\$HIRE_DATE IS 2014-09-29<br><br>IS functions the same as = unless one or both of the operands are NULL. In this case, if both operands are NULL, then the IS operator evaluates to 1 (true). If one operand is NULL and the other is not, then the IS operator evaluates to 0 (false).                 |
| IS NOT   | Is not the same as<br>\$HIRE_DATE IS NOT 2014-09-29<br><br>IS NOT functions the same as != unless one or both of the operands are NULL. In this case, if both operands are NULL, the IS NOT operator evaluates to 0 (false). If one operand is NULL and the other is not, then the IS NOT operator evaluates to 1 (true). |
| AND      | Both operands are true.<br>\$MANAGER_ID AND EMPLOYEE_ID >100                                                                                                                                                                                                                                                              |
| OR       | Either operand is true.<br>\$MANAGER_ID OR EMPLOYEE_ID >100                                                                                                                                                                                                                                                               |

For more information on how to use the SQLite syntax, see the SQLite documentation.

## Parallel Load

In Full Load replication mode, you can accelerate the replication of large tables by splitting the table into segments and loading the segments in parallel. Tables can be segmented by data ranges, by partitions, or by sub-partitions.

### Supported Endpoints

The task must be defined with a combination of the following source and target endpoints:

- » **Supported source endpoints:** Oracle, Microsoft SQLServer, MySQL, PostgreSQL, IBM DB2 for LUW, SAP Sybase ASE, and SAP Application.
- » **Supported target endpoints:** Oracle, Microsoft SQL Server, Hadoop, PostgreSQL, Sybase ASE, MySQL, File, Amazon S3, Amazon Redshift, Microsoft Azure Database for MySQL, Microsoft Azure Database for PostgreSQL, and Google Cloud for MySQL.

### Setting Up Parallel Load

#### To define segment boundaries by data range

1. In the **Parallel Load** tab's **Select Parallel Load Method** section, select **Use Data Ranges**.
2. In the **Select Details** section, click **Select Segment Columns**.  
The **Columns** window opens
3. For all endpoints, the Unique Index column is automatically selected. Select which additional columns whose data you wish to use to delineate the ranges and then click **OK**.

#### Notes

- » Selecting indexed columns will significantly improve performance
- » You can select up to ten columns (multi-selection is supported)
- » Records with null values will not be replicated
- » The following data types cannot be used to define segments by ranges:  
DOUBLE, FLOAT, and LOB (BLOB, CLOB, NCLOB)

4. In the **Define Segment Boundaries** section:
  - a. Click **Add Segment** to add a segment.  
The columns that you selected will appear as table headings.
  - b. Enter the upper data range for the segment in the selected columns.

**Note** Values in DATE columns must be entered in the format supported by the source.

- c. Add additional segments as required.

- d. Click **Validate** to validate that the specified data corresponds to the source column data type and that all of the defined segments contain values.
  - e. To delete a segment, select the desired segment and then click **Delete**.
5. Click **OK** to save your settings.

**Note** When **Use Data Ranges** is selected, all of the table data will be replicated, even if data ranges are not defined for all of the columns.

## Usage Example

Let's assume that the following segments are defined in the **Define Segment Boundaries** table:

| Column_1 | Column_2 | Column_3 |
|----------|----------|----------|
| 10       | 30       | 105      |
| 20       | 20       | 120      |
| 100      | 12       | 99       |

In this case, the following "WHERE" clauses will be created for each load segment:

- » **Segment 1:** ((COL1 < 10) OR ((COL1 = 10) AND (COL2 < 30)) OR ((COL1 = 10) AND (COL2 = 30) AND (COL3 < 105)))
- » **Segment 2:** NOT ((COL1 < 10) OR ((COL1 = 10) AND (COL2 < 30)) OR ((COL1 = 10) AND (COL2 = 30) AND (COL3 < 105))) AND ((COL1 < 20) OR ((COL1 = 20) AND (COL2 < 20)) OR ((COL1 = 30) AND (COL2 = 20) AND (COL3 < 120)))
- » **Segment 3:** NOT ((COL1 < 20) OR ((COL1 = 20) AND (COL2 < 20)) OR ((COL1 = 30) AND (COL2 = 20) AND (COL3 < 120))) AND ((COL1 < 100) OR ((COL1 = 100) AND (COL2 < 12)) OR ((COL1 = 100) AND (COL2 = 12) AND (COL3 < 99)))
- » **Segment 4:** NOT ((COL1 < 100) OR ((COL1 = 100) AND (COL2 < 12)) OR ((COL1 = 100) AND (COL2 = 12) AND (COL3 < 99)))

## To define segment boundaries by all of the table partitions

**Note** Only select this method if you are sure that the table is already partitioned.

1. In the **Parallel Load** tab's **Select Parallel Load Method** section, select **Use Partitions**.
2. In the **Select Partitions** section, select **Use all table partitions**. This will segment the table according to partitions that already exist in the source database.
3. Select one the following:
  - » Use main partitions

- » Use sub partitions

**Note** This option will be disabled if the source database does not support sub-partitions.

4. Click **OK**.

### To define segment boundaries by specific partitions

**Note** Only select this method if you are sure that the table is already partitioned.

1. In the **Parallel Load** tab's **Select Parallel Load Method** section, select **Use Partitions**.
2. In the **Select Partitions** section, select **Specify partitions**. This will split the data according to the specified source partitions.

**Note** When **Specify partitions** is selected, only the specified partitions will be replicated.

3. Click **Add Partition**.
4. Specify the name of an existing partition or sub-partition.
5. If you specified the name of a sub-partition, select the check box in the **Sub-Partition** column.

**Note** The check box will be disabled if the source database does not support sub-partitions.

6. Add additional partitions/sub-partitions as required.
7. To delete a partition/sub-partition, select the partition/sub-partition and then click **Delete**.
8. Click **OK** to save your settings.

### Adjusting the Number of Segments that can be Loaded in Parallel

You can increase or decrease the number of segments that will be loaded in parallel. For example, if you selected the **Use all table partitions** option and the source table has 20 partitions, increasing the default number of concurrent tasks (5) may improve performance.

The currently set value is displayed at the bottom of the **Parallel Load** tab. You can modify this value in the **Maximum number of tables to load in parallel** field in the [Full Load Tuning](#) tab.

## Handling LOB Columns

You can override the [task's LOB settings](#) for individual tables.

**Note** This option is only available for tasks defined with any combination of the following source and target endpoints: Oracle source, Oracle target, PostgreSQL source, PostgreSQL target, Microsoft SQL Server source, Microsoft SQL Server target, MySQL source, and MySQL target.

**Note** LOB data types are supported only in tables that include a primary key.

The following LOB handling options are available:

| Option                                            | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Replicate LOB columns                             | <p>When this option is selected (the default), LOB columns will be replicated.</p> <p>Note that replicating LOBs may impact performance. This is especially true in the case of the large LOBs which require Replicate to perform a lookup from the source table in order to retrieve the source LOB value.</p>                                                                                                                                            |
| Allow unlimited LOB size                          | Select this option - also known as Full LOB mode - to ensure that all LOBs are replicated without being truncated. This option should be selected when all (or nearly all) of the LOBs you wish to replicate are large (i.e. exceed 1 GB).                                                                                                                                                                                                                 |
| Optimize handling when LOB size is less than (KB) | <p>Select this option when you need to replicate both small and large LOBs, and most of the LOBs are small.</p> <p>When this option is selected, during Full Load, Replicate will transfer the small LOBs "inline" (which is more efficient), and the large LOBs by performing a lookup from the source table.</p> <p>During Change Processing, however, both small and large</p> <p><b>Note</b> This option is supported with the following endpoints</p> |

**Note** If the task's **Change Processing Mode** is set to "Batch optimized apply" (the default), Replicate will switch to "Transactional apply" mode to apply tables with LOBs.

only:

- » **Sources:** Oracle, Microsoft SQL server, MySQL, PostgreSQL, IBM DB2 for LUW, and Sybase ASE.
- » **Targets:** Oracle, Microsoft SQL Server, MySQL, PostgreSQL, and Sybase ASE.

LOBs will be replicated by performing a lookup from the source table.

**Note** When this option is selected, Replicate will check all of the LOB sizes to determine which ones to transfer "inline". LOBs larger than the specified size will be replicated using Full LOB mode.

Therefore, if you know that most of the LOBs are larger than the specified setting, it is better to use the **Allow unlimited LOB size** option instead.

Chunk size (KB)

Optionally, change the size of the LOB chunks to use when replicating the data to the target. The default chunk size should suffice in most cases, but if you encounter performance issues, adjusting the size may improve performance.

**Note** With some databases, data type validation occurs when the data is inserted or updated. In such cases, replication of structured data types (e.g. XML, JSON, GEOGRAPHY, etc.) may fail if the data is bigger than the specified chunk size.

Limit LOB size to (KB)

Select this option if you only need to replicate small LOBs or if the target endpoint does not support unlimited LOB size. The maximum permitted value for this field is 102400 KB (100 MB).

When replicating small LOBs, this option is more efficient than the **Allow unlimited LOB size** option since the LOBs are replicated "inline" as opposed to via "lookup" from the source.

#### Notes

- » Any LOBs larger than the specified size will be truncated.
- » During Change Processing, small LOBs will be replicated via "lookup" from the source.
- » As Replicate converts LOBs to binary format, it's

recommended to specify the size of the largest LOB you need to replicate, multiplied by three. For example, if the largest LOB is 2 MB, specify 6 MB.

**Important** In some scenarios, tasks configured to replicate tables with multiple LOB columns may consume a large amount of memory. This is because Replicate allocates memory by multiplying the **Limit LOB size to** value by the **Commit rate during full load** value, the sum of which it multiplies by the number of LOB columns being replicated. So, for example, if LOB size is limited to 5 MB and the default commit rate is used (10000 events), a task replicating 6 LOB columns will consume 30 GB of memory.

Should you encounter memory consumption issues and suspect that a combination of the above factors may be the cause, stop the task and lower the value in the **Commit rate during full load** field. Then resume the task. Repeat this process until acceptable performance/memory levels are reached.

These instructions apply to Change Processing and Full Load tasks.

**Note** Changes to a column's LOB size while a task is running will not be reflected in the Change Table, unless the target tables are created by Attunity Replicate. In such cases, the task must be configured to drop and create the Change Table (the default) and the target tables need to be reloaded (after the LOB size has changed).

For more information on the Change Table, see [Store Changes Settings](#). For information on reloading target tables, see [Reload Target](#) and [Reload](#).

## Defining Global Transformations

Use Global transformations to make similar changes to multiple tables, owners, and columns in the same task.

You may need to use this option when you want to change the names of all tables. You can change the names using wildcards and patterns. For example, you may want to change the names of the tables from `account_%` to `ac_%`. This is helpful when replicating data from an Microsoft SQL Server endpoint to an Oracle endpoint where the Microsoft SQL Server endpoint has a limit of 128 characters for a table name and the Oracle endpoint has a limit of 31 characters.

You may also need to change a specific data type in the source to a different data type in the target for many or all of the tables in the task. Global transformation will accomplish this without having to define a transformation for each table individually.

**Note** Table-specific transformations override global transformations. For example, you can define a global transformation that changes the data type for all tables from DATE to DATETIME(6) and then define another transformation for a specific table that changes the data type from DATE to STRING(50).

For information on defining a transformation for a specific table, see [Defining Transformations for a Single Table/View](#).

This section includes the following topics:

- » [Limitations for Global Transformations](#)
- » [Starting the New Transformation Rule Wizard](#)
- » [Selecting the Transformation Type](#)
- » [Under what Conditions to Transform](#)
- » [Defining the Transformation Rule](#)
- » [Viewing all Global Transformation Rules](#)

## Limitations for Global Transformations

The following limitations apply to global transformations:

- » Transformations are not supported for columns with Right-to-Left languages.
- » Transformations cannot be performed on columns that contain special characters (e.g. #, \, /, -) in their name.
- » The only supported transformation for columns that are mapped to BLOB/CLOB data types (by Replicate) is to drop the column on the target.

## Starting the New Transformation Rule Wizard

You define a rule for global transformation using the New Transformation Rule wizard. The transformation affects all of the tables in the task as you define them using the wizard.

### To start the New transformation Rule wizard:

1. Open the task for which you want to create a global transformation.  
You can click **Open** above the Tasks list or double-click the task.
2. If you are not in the Designer mode, click **Designer** at the top right of the screen.  
For more information on the Task View and the Designer mode, see [Designer Mode](#).
3. In Designer mode, click **Global Transformations**.  
The [Global Transformation Rules](#) window opens.
4. From the top of the **Global Transformation Rules** window, click **New Global Transformation**.  
The **New Transformation Rules** wizard opens.

5. Enter the information to define a global transformation rule. The first step is [Selecting the Transformation Type](#).

## Selecting the Transformation Type

In the **Which Global Transformation** step of the **New Transformation Rule** wizard, you define the type of transformation you want to be performed.

**Note** You can only create one rule for each transformation type *on the same object* (e.g. a column). If you create multiple rules for a single transformation type *on the same object*, only the last rule you create will be valid. For example, if you create the following rules (in order) to rename a schema:

**Rename Schema: Add Prefix**

**Rename Schema: Add Suffix**

-OR-

**Rename Column: Add Prefix**

**Rename Column: Add Suffix**

Only the second rule (adding a suffix) will be executed.

### To select the transformation type:

1. Enter a name for the rule.

The name cannot exceed 32 characters, contain non-Latin characters, or contain any of the following characters: \/:\*?"<>|

2. Select one of the following:

#### Table or Schema:

- » **Rename schema:** Select this to change the schema name for multiple tables. For example, if you want all `HR` tables to be renamed `PERS`.
- » **Rename table:** Select this to change the name of multiple tables. For example, if you want all tables named `SALARY` to be called `WAGES`.

#### Tablespace:

- » **Change table tablespace:** Select this to change the table tablespace on the target. You can change the table tablespace regardless of what objects it contains or you can specify a condition for it to be renamed. For example, change all table tablespaces that contain the table `Employees` in the schema `Company`.  
By default (i.e. when this option is not selected), the tables will either be created in the source table tablespace on the target (when replicating from an Oracle source) or in the default database tablespace (when replicating from any other source).

**Note** This option is only available for tasks with an Oracle target endpoint.

- » **Change index tablespace:** Select this to change the index tablespace on the target. You can change the index tablespace regardless of what objects it contains or you can specify a condition for it to be renamed. For example, change all table tablespaces that contain the table Employees in the schema Company. By default (i.e. when this option is not selected), the indexes will either be created in the source table tablespace on the target (when replicating from an Oracle source) or in the default database tablespace (when replicating from any other source).

**Note** This option is only available for tasks with an Oracle target endpoint.

#### Column:

- » **Rename column:** Select this to change the name of multiple columns. For example, if you want to change all columns with word MINIMUM to MIN.
- » **Add column:** Select this to add a column with a similar name to multiple tables.
- » **Drop column:** Select this to drop a column with a similar name from multiple tables.
- » **Convert data type:** Select this if you want to change a specific data type to a different one across multiple tables. For example, if you want to change all Integer data types to a string.

#### Change Table:

Change Table transformations are only available when the [Store Changes](#) replication option is enabled.

For more information on Change Tables, see [Using Change Tables](#).

- » **Rename Change Table:** Select this to rename the Replicate Change Table for all tables or for any table that matches the specified schema name and/or table name.
- » **Rename Change Table schema:** Select this to change the schema under which the Replicate Change Table will be created, for all tables or for any table that matches the specified schema name and/or table name.

3. Click **Next** to proceed to the [Under what Conditions to Transform](#) step.

## Under what Conditions to Transform

In the **Under what conditions to transform?** step of the **New Transformation Rule** wizard, you define to which tables the transformation rule is applied. For example, you can apply the rule to all tables that contain the word SALARY as part of its name.

**Note** The options displayed in this screen depend on the [Transformation Type](#) selected.

The following table describes the available options.

**Table 11.4 | Apply transformation rule if...**

| Option                | Available when transformation type is: | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----------------------|----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Schema name is like % |                                        | <p>Leave the % sign to include all schemas in your global transformation.</p> <p>Click the % sign to add a filter. In this case you can enter any name combination to include only that schema in your global transformation rule.</p> <p>For example, enter <code>HR</code> to include only tables that have the schema <code>HR</code>.</p> <p>You can use the % sign as a wildcard. For example, <code>H%</code> includes all tables with a schema that begins with the letter H, such as <code>HR</code>, <code>HELLO</code>, or <code>HQ</code>.</p> <p>The % wildcard can be used in any position. For example, if you use it at the beginning, <code>%H</code>, then all table names that end in H are included in the transformation rule. The % can also be used in a middle position.</p> |
| Table name is like %  |                                        | <p>Leave the % sign to include all table names in your global transformation rule.</p> <p>Click the % sign to add a filter. In this case you can enter any name combination to include only tables with that specific name in your global transformation rule.</p> <p>You can use the % sign as a wildcard. For example, <code>J%</code> includes all tables with a name that begins with the letter J, such as <code>JOBS</code>, <code>JOBS_HISTORY</code>, or <code>JACKSONVILLE</code>.</p> <p>The % wildcard can be used in any position. For example, if</p>                                                                                                                                                                                                                                  |

**Note** If you are using an Oracle target, you must enter a schema that exists on the target endpoint. Attunity Replicate does not create new schemas on an Oracle endpoint. If you want to use a new schema for the target, create the schema on the Oracle endpoint before running the task. For more information, see [Using Oracle as a Target](#).

**Table 11.4 | Apply transformation rule if... (Cont.)**

| Option                | Available when transformation type is:            | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-----------------------|---------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Column name is like % | Rename Column<br>Drop Column<br>Convert Data Type | <p>you use it at the beginning, %H, then all table names that end in H are included in the transformation rule. The % can also be used in a middle position.</p> <p>Leave the % sign to include all column names in your global transformation rule.</p> <p>Click the % sign to add a filter. In this case you can enter any name combination to include only columns with that specific name in your global transformation rule.</p> <p>You can use the % sign as a wildcard. For example, N% includes all columns with a name that begins with the letter N, such as NAME, NAME_FIRST, or NAME_LAST.</p> <p>The % wildcard can be used in any position. For example, if you use it at the beginning, %IES, then all column names that end in with the string "IES" are included in the transformation rule. The % can also be used in a middle position.</p> |
| Data type is          | Convert Data Type                                 | <p>Select a new data type from the drop-down list. Make sure that the data type you select is compatible with the data in that column.</p> <p>For a description of Attunity Replicate data types, see <a href="#">Replicate Data Types</a>.</p> <p>For information about data type mapping from the native endpoint to Attunity Replicate data types, see the chapter for the endpoint you are using. For a list of endpoints supported by Attunity Replicate, see <a href="#">Supported Platforms and Endpoints</a></p>                                                                                                                                                                                                                                                                                                                                       |

After you complete defining the transformation rule definitions, click **Next** to go to the [Defining the Transformation Rule](#) step.

**Note** If the global transformation type you are defining is **Drop Column**, you do not need to create a [Transformation Rule](#). In this case, click **Finish** to add the rule to the [Global Transformation Rules](#) list.

## Defining the Transformation Rule

In the **How to transform** screen, you define what happens to the objects that the transformation rule is applied to. For example, you can define a new name for the affected objects or add a prefix to the table names. For more information on defining the affected tables, see [Under what Conditions to Transform](#).

You define the rule to be carried out using the options on this page. [Limitations for Transformation Rules](#) apply. See the section for any of the following transformation types you are using:

- » [Rename Schema](#)
- » [Change Table Tablespace](#)
- » [Change Index Tablespace](#)
- » [Rename Table](#)
- » [Rename Column](#)
- » [Add Column](#)
- » [Drop Column](#)
- » [Convert Data Type](#)
- » [Rename Change Table Schema](#)
- » [Rename Change Table](#)

When done, click **Next**.

## Limitations for Transformation Rules

The following limitations apply to transformation rules:

- » Transformations are not supported for columns with Right-to-Left languages.
- » Transformations cannot be performed on columns that contain special characters (e.g. #, \, /, -) in their name.
- » The only supported transformation for columns that are mapped to BLOB/CLOB data types (by Replicate) is to drop the column on the target.

**Note** The options displayed in this screen depend on the [Transformation Type](#) selected.

## Rename Schema

If your transformation type is **Rename Schema**, you can do the following:

- » [Rename schema to \(string\)](#)
- » [Add a Prefix or Suffix](#)
- » [Remove a Prefix or Suffix](#)
- » [Replace a Prefix or Suffix with Different Characters](#)
- » [Convert Schema Name to Uppercase](#)

- » Convert Schema Name to Lowercase
- » Rename Schema (Expression)

### Rename schema to (string)

Use the **Rename schema to: [string]** option to change the name of all table schemas that you defined in the [Under what Conditions to Transform](#) step to a different name. For example, if you have a schema called `Human_Resources` and want to change all instances of this name to `HR` then enter the string `HR`. You can enter any string in this field.

### Add a Prefix or Suffix

Use the **Add a prefix or suffix** option to add additional characters to the beginning or end of the schema name for all schemas that fit the definition you created in the [Under what Conditions to Transform](#) step. For example, if the schema name is `HR`, you can add a suffix, such as `TAR` or `_TAR` to the schema name for all tables with that schema name. In this case, the resulting schema name will be `HRTAR` or `HR_TAR`.

**Note** If you are using Oracle as your target endpoint, Attunity Replicate does not create a new schema. Therefore, the schema name that is the result of replacing a prefix or suffix with a different string of characters must exist in the Oracle target endpoint. If the resulting schema name does not exist, you must create the schema in the Oracle endpoint before carrying out this task.

For more information, see [Limitations](#) for using Oracle as a Source or Target.

### To globally add a prefix or suffix

1. Select **Add <Prefix/Suffix> Insert Characters to matching schema names**.
2. Click the word **Prefix** or **Suffix** and select one of these two from the list.
3. Click **[string]** to activate the field.
4. Type the characters you want as the prefix or suffix. If you want to include an underscore or other legal character to separate the prefix/suffix from the original name, you must add it as part of the character string.
5. Click **Finish** to add the rule to the [Global Transformation Rules](#) list.

### Remove a Prefix or Suffix

Use the **Remove a prefix or suffix** option to remove a string of characters from the beginning or end of a schema name for all schema that fit the definition you created in the [Under what Conditions to Transform](#) step.

For example, you can use this option to remove the letters `_REV` from the schema name for all tables in the schema `HR_REV`. In this case the schema name in the target will be `HR`.

**Note** If you are using Oracle as your target endpoint, Attunity Replicate does not create a new schema. Therefore, the schema name that is the result of replacing a prefix or suffix with a different string of characters must exist in the Oracle target endpoint. If the resulting schema name does not exist, you must create the schema in the Oracle endpoint before carrying out this task.

For more information, see [Limitations](#) for using Oracle as a Source or Target.

### To globally remove a prefix or suffix

1. Select **Remove <Prefix/Suffix> Insert Characters from matching schema names**.
2. Click the word **Prefix** or **Suffix** and select one of these two from the list.
3. Click **[string]** to activate the field.
4. Type the characters you want to remove. If you want to remove an underscore or other legal character from the original name, you must add it as part of the character string.
5. Click **Finish** to add the rule to the [Global Transformation Rules](#) list.

### Replace a Prefix or Suffix with Different Characters

Use the **Replace a prefix or suffix** option to replace a string of characters with a different string of characters. You determine whether to replace the characters at the beginning or end of a schema name for all schema that fit the definition you created in the [Under what Conditions to Transform](#) step.

For example, you can use this option to replace the letters `_ORIG` with `_REPL` in the schema name for all tables in the schema `HR_ORIG`. In this case the schema name in the target will be `HR_REPL`.

**Note** If you are using Oracle as your target endpoint, Attunity Replicate does not create a new schema. Therefore, the schema name that is the result of replacing a prefix or suffix with a different string of characters must exist in the Oracle target endpoint. If the resulting schema name does not exist, you must create the schema in the Oracle endpoint before carrying out this task.

For more information, see [Limitations](#) for using Oracle as a Source or Target.

### To globally replace a prefix or suffix

1. Select **Replace <Prefix/Suffix> Insert Characters by Insert Characters for all matching schema names**.
2. Click the word **Prefix** or **Suffix** and select one of these two from the list.
3. Click the first **[string]** to activate the field.

4. Type the characters from the existing (source) schema that you want to replace. If you want to include an underscore or other legal character from the original name in the string that you want to replace, you must add it as part of the character string.
5. Click the second **[string]** to activate the field.
6. Type the characters you want to use in the target. These characters replace the original (source) characters in the target.
7. Click **Finish** to add the rule to the [Global Transformation Rules](#) list.

## Convert Schema Name to Uppercase

Use the convert to uppercase option to convert all of the letters in a schema name to uppercase. For example:

Schema\_cat, becomes SCHEMA\_CAT

schema\_cat, becomes SCHEMA\_CAT

sChEMa\_Cat, becomes SCHEMA\_CAT

### To globally change the schema name to all uppercase

1. Select **Convert schema name to uppercase**.
2. Click **Finish** to add the rule to the [Global Transformation Rules](#) list.

## Convert Schema Name to Lowercase

Use the convert to lowercase option to convert all of the letters in a schema name to lowercase. For example:

Schema\_cat, becomes schema\_cat

SCHEMA\_CAT, becomes schema\_cat

sChEMa\_Cat, becomes schema\_cat

### To globally change the schema name to all uppercase

1. Select **Convert schema name to lowercase**.
2. Click **Finish** to add the rule to the [Global Transformation Rules](#) list.

## Rename Schema (Expression)

Use the **Rename schema to [expression]** option to change the name of all table schemas that you defined in the [Under what Conditions to Transform](#) step to a different name. For example, if you have a schema called `Human_Resources` and want to change all instances of this name to `HR`.

**Note** If you are using Oracle as your target endpoint, Attunity Replicate does not create a new schema. Therefore, the schema name that is the result of replacing a prefix or suffix with a different string of characters must exist in the Oracle target endpoint. If the resulting schema name does not exist, you must create the schema in the Oracle endpoint before carrying out this task.

For more information, see [Limitations](#) for using Oracle as a Source or Target.

### To globally change a schema name

1. Select **Rename schema to [expression]**
2. Click the button to the right of the **Rename schema** option to open the Expression Editor. For information on how to use the Expression Editor, see [Using the Expression Builder \(for Filters, Transformations, and Global Transformations\)](#). Then go to step 4.  
or  
Click **[expression]** to activate the field and continue with step 3.
3. Type an SQLite expression or a string (in quotes) to rename the schema. For example:
  - » "New\_Schema"
  - » 'PREF\_'||\$SCHEMA\_NAME\_VAR||'\_SUFF'

You can use the following variables in the SQLite expression:

- » \$SCHEMA\_NAME\_VAR
- » \$TABLE\_NAME\_VAR
- » \$COLUMN\_NAME\_VAR
- » \$COLUMN\_DATATYPE\_VAR

4. Click **Finish** to add the rule to the [Global Transformation Rules](#) list.

### Change Table Tablespace

If your transformation type is **Change table tablespace**, you can change the table tablespace on an Oracle target. You can also set certain conditions that must exist in the source for the table tablespace to be changed. These include schema name, table name and table tablespace name.

For more information, see the following topics:

- » [Selecting the Transformation Type](#)
- » [Defining the Transformation Rule](#)

## Change Index Tablespace

If your transformation type is **Change index tablespace**, you can change the index tablespace on an Oracle target. You can also set certain conditions that must exist in the source for the tablespace to be changed. These include schema name, table name and index tablespace name.

For more information, see the following topics:

- » [Selecting the Transformation Type](#)
- » [Defining the Transformation Rule](#)

## Rename Table

If your transformation type is **Rename Table**, you can do the following:

- » [Rename table to \(string\)](#)
- » [Add a Prefix or Suffix](#)
- » [Remove a Prefix or Suffix](#)
- » [Replace a Prefix or Suffix with Different Characters](#)
- » [Convert table name to uppercase](#)
- » [Convert table name to lowercase](#)
- » [Rename table \(expression\)](#)

### Rename table to (string)

Use the **Rename table to: [string]** option to change the name of all tables that you defined in the [Under what Conditions to Transform](#) step to a different name. For example, if you have a table called `EMPLOYEE` and want to change all instances of this name to `EMP` then enter the string `EMP`. You can enter any string in this field.

### Add a Prefix or Suffix

Use the **Add a prefix or suffix** option to add additional characters to the beginning or end of the table name for all tables that fit the definition you created in the [Under what Conditions to Transform](#) step. For example, if the table name is `EMPLOYEES`, you can add a suffix, such as `TAR` or `_TAR` to the table name for all tables with that table name. In this case, the resulting table name will be `EMPLOYEESTAR` or `EMPLOYEES_TAR`.

#### To globally add a prefix or suffix:

1. Select **Add <Prefix/Suffix> Insert Characters to matching table names**.
2. Click the word **Prefix** or **Suffix** and select one of these two from the list.
3. Click **[string]** to activate the field.

4. Type the characters you want as the prefix or suffix. If you want to include an underscore or other legal character to separate the prefix/suffix from the original name, you must add it as part of the character string.
5. Click **Finish** to add the rule to the [Global Transformation Rules](#) list.

## Remove a Prefix or Suffix

Use the **Remove a prefix or suffix** option to remove a string of characters from the beginning or end of a table name for all tables that fit the definition you created in the [Under what Conditions to Transform](#) step.

For example, you can use this option to remove the letters `_REV` from the table name for all tables with the name `EMPLOYEES`. In this case the table name in the target will be `EMPLOYEES`.

### To globally remove a prefix or suffix:

1. Select **Remove <Prefix/Suffix> Insert Characters from matching table names**.
2. Click the word **Prefix** or **Suffix** and select one of these two from the list.
3. Click **[string]** to activate the field.
4. Type the characters you want to remove. If you want to remove an underscore or other legal character from the original name, you must add it as part of the character string.
5. Click **Finish** to add the rule to the [Global Transformation Rules](#) list.

## Replace a Prefix or Suffix with Different Characters

Use the **Replace a prefix or suffix** option to replace a string of characters with a different string of characters. You determine whether to replace the characters at the beginning or end of a table name for all tables that fit the definition you created in the [Under what Conditions to Transform](#) step.

For example, you can use this option to replace the letters `_ORIG` with `_REPL` in the table names for all tables called `EMPLOYEE_ORIG`. In this case the table name in the target will be `EMPLOYEE_REPL`.

### To globally replace a prefix or suffix:

1. Select **Replace <Prefix/Suffix> Insert Characters by Insert Characters for all matching schema names**.
2. Click the word **Prefix** or **Suffix** and select one of these two from the list.
3. Click the first **[string]** to activate the field.
4. Type the characters from the existing (source) schema that you want to replace. If you want to include an underscore or other legal character from the original name in the string that you want to replace, you must add it as part of the character string.

5. Click the second **[string]** to activate the field.
6. Type the characters you want to use in the target. These characters replace the original (source) characters in the target.
7. Click **Finish** to add the rule to the [Global Transformation Rules](#) list.

### Convert table name to uppercase

Use the convert to uppercase option to convert a table name to all upper case. For example:

Table\_cat, becomes TABLE\_CAT

table\_cat, becomes TABLE\_CAT

taBLe\_Cat, becomes TABLE\_CAT

#### To globally change the table name to all uppercase:

1. Select **Convert table name to uppercase**.
2. Click **Finish** to add the rule to the [Global Transformation Rules](#) list.

### Convert table name to lowercase

Use the convert to lowercase option to convert a table name to all lower case. For example:

Table\_cat, becomes table\_cat

TABLE\_CAT, becomes table\_cat

taBLe\_Cat, becomes table\_cat

#### To globally change the table name to all lowercase:

1. Select **Convert table name to lowercase**.
2. Click **Finish** to add the rule to the [Global Transformation Rules](#) list.

### Rename table (expression)

Use the **Rename table to [expression]** option to change the name of all tables that fit the definition you created in the [Under what Conditions to Transform](#) step. For example, if you have a table called `EMPLOYEE` and want to change all instances of this name as defined in the previous step it to `EMP`.

#### To change the table name:

1. Select **Rename table to: [expression]**
2. Click the button to the right of the **Rename table** option to open the Expression Editor. For information on how to use the Expression Editor, see [Using the Expression](#)

Builder (for Filters, Transformations, and Global Transformations). Then go to step 4.

or

Click **[expression]** to activate the field and continue with step 3.

3. Type an SQLite expression or a string (in quotes) to rename the table. For example:

- » "New\_Table"
- » 'PREF\_'||\$TABLE\_NAME\_VAR||'\_SUFF'

3. You can use the following variables in the SQLite expression:

- » \$SCHEMA\_NAME\_VAR
- » \$TABLE\_NAME\_VAR
- » \$COLUMN\_NAME\_VAR
- » \$COLUMN\_DATATYPE\_VAR

## Rename Column

If your transformation type is **Rename Column**, you can do the following:

- » [Rename column to \(string\)](#)
- » [Add a Prefix or Suffix](#)
- » [Remove a Prefix or Suffix](#)
- » [Replace a Prefix or Suffix with Different Characters](#)
- » [Convert column name to uppercase](#)
- » [Convert column name to lowercase](#)
- » [Rename Column \(expression\)](#)

### Rename column to (string)

Use the **Rename column to: [string]** option to change the name of all columns that you defined in the [Under what Conditions to Transform](#) step to a different name. For example, if you have a table called `SALARY` and want to change all instances of this name to `EMP` then enter the string `SAL`. You can enter any string in this field.

### Add a Prefix or Suffix

Use the **Add a prefix or suffix** option to add additional characters to the beginning or end of the column name for all columns that fit the definition you created in the [Under what Conditions to Transform](#) step. For example, if the column name is `SALARY`, you can add a suffix, such as `TAR` or `_TAR` to the table name for all tables with that table name. In this case, the resulting table name will be `SALARYTAR` or `SALARY_TAR`.

#### To globally add a prefix or suffix:

1. Select **Add <Prefix/Suffix> Insert Characters to matching column names**.
2. Click the word **Prefix** or **Suffix** and select one of these two from the list.

3. Click the **[string]** to activate the field.
4. Type the characters you want as the prefix or suffix. If you want to include an underscore or other legal character to separate the prefix/suffix from the original name, you must add it as part of the character string.
5. Click **Finish** to add the rule to the [Global Transformation Rules](#) list.

## Remove a Prefix or Suffix

Use the **Remove a prefix or suffix** option to remove a string of characters from the beginning or end of a column name for all columns that fit the definition you created in the [Under what Conditions to Transform](#) step.

For example, you can use this option to remove the letters `_REV` from the column name for all columns with the name `SALARY`. In this case the column name in the target will be `SALARY`.

### To globally remove a prefix or suffix:

1. Select **Remove <Prefix/Suffix> Insert Characters from matching column names**.
2. Click the word **Prefix** or **Suffix** and select one of these two from the list.
3. Click **[string]** to activate the field.
4. Type the characters you want to remove. If you want to remove an underscore or other legal character from the original name, you must add it as part of the character string.
5. Click **Finish** to add the rule to the [Global Transformation Rules](#) list.

## Replace a Prefix or Suffix with Different Characters

Use the **Replace a prefix or suffix** option to replace a string of characters with a different string of characters. You determine whether to replace the characters at the beginning or end of a column name for all columns that fit the definition you created in the [Under what Conditions to Transform](#) step.

For example, you can use this option to replace the letters `_ORIG` with `_REPL` in the column names for all columns called `SALARY_ORIG`. In this case the column name in the target will be `SALARY_REPL`.

### To globally replace a prefix or suffix:

1. Select **Replace <Prefix/Suffix> Insert Characters by Insert Characters for all matching schema names**.
2. Click the word **Prefix** or **Suffix** and select one of these two from the list.
3. Click the first **[string]** to activate the field.

4. Type the characters from the existing (source) column that you want to replace. If you want to include an underscore or other legal character from the original name in the string that you want to replace, you must add it as part of the character string.
5. Click the second **[string]** to activate the field.
6. Type the characters you want to use in the target. These characters replace the original (source) characters in the target.
7. Click **Finish** to add the rule to the [Global Transformation Rules](#) list.

### Convert column name to uppercase

Use the convert to uppercase option to convert a column name to all upper case. For example:

Column\_cat, becomes COLUMN\_CAT  
column\_cat, becomes COLUMN\_CAT  
coLUMnM\_Cat, becomes COLUMN\_CAT

#### To globally change the table name to all uppercase

1. Select **Convert column name to uppercase**.
2. Click **Finish** to add the rule to the [Global Transformation Rules](#) list.

### Convert column name to lowercase

Use the convert to lowercase option to convert a column name to all lower case. For example:

Column\_cat, becomes column\_cat  
column\_cat, becomes column\_cat  
coLUMnM\_Cat, becomes column\_cat

#### To globally change the column name to all lowercase:

1. Select **Convert column name to lowercase**.
2. Click **Finish** to add the rule to the [Global Transformation Rules](#) list.

### Rename Column (expression)

Use the **Rename column to [expression]** option to change the name of all tables that fit the definition you created in the [Under what Conditions to Transform](#) step. For example, if you have a column called **SALARY** and want to change it to **SAL**.

#### To change the column name:

1. Select **Rename column to: [expression]**
2. Click the button to the right of the **Rename column** option to open the Expression

Editor. For information on how to use the Expression Editor, see [Using the Expression Builder \(for Filters, Transformations, and Global Transformations\)](#). Then go to step 4.

or

Click **[expression]** to activate the field and continue with step 3.

3. Type an SQLite expression or a string (in quotes) to rename the column. For example:

```
» "New_Column"  
» 'PREF_' || $COLUMN_NAME_VAR || '_SUFF'
```

You can use the following variables in the SQLite expression:

```
» $SCHEMA_NAME_VAR  
» $TABLE_NAME_VAR  
» $COLUMN_NAME_VAR  
» $COLUMN_DATATYPE_VAR
```

## Add Column

When you add a column to multiple tables, you must provide a name, define the data type for the column and define the data that the column contains. The column that you define here is added to all tables that fit the definition you created in step [Under what Conditions to Transform](#).

The following describes the information you must enter in the transformation rule page for adding a column.

- » **Column name:** Click the **[string]** to activate the field. Type the name for the column in the field. A column with this name is added to all tables that fit the definition you created in step [Under what Conditions to Transform](#).
- » **Column data type:** Click the drop-down for a list of data types and select a new data type from the drop-down list. Make sure that the data type you select is compatible with the data in that column.

For a description of available data types, see [Replicate Data Types](#). For information about data type mapping from the native endpoint to Attunity Replicate data types, see the chapter for the endpoint you use. For a list of supported databases, see [Supported Platforms and Endpoints](#).

- » **Computation expression:** Click the button to the right of this field to open the Expression Editor or type an expression using SQLite operators to define the data in the column.

For information on how to use the Expression Editor to create an expression, see [Using the Expression Builder \(for Filters, Transformations, and Global Transformations\)](#).

For more information on creating expressions, see [Creating an Expression for Transformations](#) and [Using SQLite Syntax with Transformations](#).

## Drop Column

This option does not require a transformation rule. For this option you complete the Global transformation Rule after the [Under what Conditions to Transform](#) step.

## Convert Data Type

When you convert the data type for a column, use this page to select the data type you want to convert to. The data type that you define in this step is applied to all columns and tables that fit the definition you created in the [Under what Conditions to Transform](#) step. Make sure that the data type you select is compatible with the data in columns you defined.

### To select a converted data type:

- » Select an Attunity Replicate data type from the drop-down list.

For a description of Attunity Replicate data types, see [Replicate Data Types](#).

For information about data type mapping from the native endpoint to Attunity Replicate data types, see the chapter for the endpoint you are using. For a list of supported databases, see [Supported Platforms and Endpoints](#).

## Rename Change Table

If your transformation type is **Rename Change Table**, you can do the following:

- » [Rename Change Table to \(string\)](#)
- » [Add a Prefix or Suffix](#)
- » [Remove a Prefix or Suffix](#)
- » [Replace a Prefix or Suffix with Different Characters](#)
- » [Convert Change Table Name to Uppercase](#)
- » [Convert Change Table Name to Lowercase](#)
- » [Rename Change Table \(expression\)](#)

### Note

- » Globally renaming a Change Table will override the Change Table [suffix defined in the task settings](#).
- » The Change Table name must be different from the source table names. Otherwise, a table error will occur.

### Rename Change Table to (string)

Use the **Rename Change Table to: [string]** option to change the name of all Change Tables that you defined in the [Under what Conditions to Transform](#) step to a different name. For example, if you have a Change Table called `EMPLOYEE` and want to change all instances of this name to `EMP` then enter the string `EMP`. You can enter any string in this field.

## Add a Prefix or Suffix

Use the **Add a prefix or suffix** option to add additional characters to the beginning or end of the Change Table name for all Change Tables that fit the definition you created in the [Under what Conditions to Transform](#) step. For example, if the Change Table name is EMPLOYEES, you can add a suffix, such as TAR or \_TAR to the Change Table name for all Change Tables with that name. In this case, the resulting Change Table name will be EMPLOYEESTAR or EMPLOYEES\_TAR.

### To globally add a prefix or suffix:

1. Select **Add <Prefix/Suffix> <String> to matching Change Table names**.
2. Click the word **Prefix** or **Suffix** and select one of these two from the list.
3. Click **[string]** to activate the field.
4. Type the characters you want as the prefix or suffix. If you want to include an underscore or other legal character to separate the prefix/suffix from the original name, you must add it as part of the character string.
5. Click **Finish** to add the rule to the [Global Transformation Rules](#) list.

## Remove a Prefix or Suffix

Use the **Remove a prefix or suffix** option to remove a string of characters from the beginning or end of a Change Table name for all Change Tables that fit the definition you created in the [Under what Conditions to Transform](#) step.

For example, you can use this option to remove the letters \_REV from the Change Table name for all Change Tables with the name EMPLOYEES. In this case the Change Table name in the target will be EMPLOYEES.

### To globally remove a prefix or suffix:

1. Select **Remove <Prefix/Suffix> <String> from matching Change Table names**.
2. Click the word **Prefix** or **Suffix** and select one of these two from the list.
3. Click **[string]** to activate the field.
4. Type the characters you want to remove. If you want to remove an underscore or other legal character from the original name, you must add it as part of the character string.
5. Click **Finish** to add the rule to the [Global Transformation Rules](#) list.

## Replace a Prefix or Suffix with Different Characters

Use the **Replace a prefix or suffix** option to replace a string of characters with a different string of characters. You determine whether to replace the characters at the

beginning or end of a Change Table name for all Change Tables that fit the definition you created in the [Under what Conditions to Transform](#) step.

For example, you can use this option to replace the letters `_ORIG` with `_REPL` in the Change Table names for all Change Tables called `EMPLOYEE_ORIG`. In this case the Change Table name in the target will be `EMPLOYEE_REPL`.

#### To globally replace a prefix or suffix:

1. Select **Replace <Prefix/Suffix> <String> by <String> for all matching Change Table names**.
2. Click the word **Prefix** or **Suffix** and select one of these two from the list.
3. Click the first **[string]** to activate the field.
4. Type the characters from the existing (source) schema that you want to replace. If you want to include an underscore or other legal character from the original name in the string that you want to replace, you must add it as part of the character string.
5. Click the second **[string]** to activate the field.
6. Type the characters you want to use in the target. These characters replace the original (source) characters in the target.
7. Click **Finish** to add the rule to the [Global Transformation Rules](#) list.

#### Convert Change Table Name to Uppercase

Use the convert to uppercase option to convert a Change Table name to all upper case. For example:

Table\_cat, becomes TABLE\_CAT

Change Table\_cat, becomes TABLE\_CAT

taBLE\_Cat, becomes TABLE\_CAT

#### To globally change the Change Table name to all uppercase:

1. Select **Convert Change Table name to uppercase**.
2. Click **Finish** to add the rule to the [Global Transformation Rules](#) list.

#### Convert Change Table Name to Lowercase

Use the convert to lowercase option to convert a Change Table name to all lower case. For example:

Table\_cat, becomes Change Table\_cat

TABLE\_CAT, becomes Change Table\_cat

taBLE\_Cat, becomes Change Table\_cat

### To globally change the Change Table name to all lowercase:

1. Select **Convert Change Table name to lowercase**.
2. Click **Finish** to add the rule to the [Global Transformation Rules](#) list.

### Rename Change Table (expression)

Use the **Rename Change Table to [expression]** option to change the name of all Change Tables that fit the definition you created in the [Under what Conditions to Transform](#) step. For example, if you have a Change Table called `EMPLOYEE` and want to change all instances of this name as defined in the previous step it to `EMP`.

### To change the Change Table name:

1. Select **Rename Change Table to: [expression]**
2. Click the button to the right of the **Rename Change Table** option to open the Expression Editor. For information on how to use the Expression Editor, see [Using the Expression Builder \(for Filters, Transformations, and Global Transformations\)](#). Then go to step 4.  
or  
Click **[expression]** to activate the field and continue with step 3.
3. Type an SQLite expression or a string (in quotes) to rename the table. For example:
  - » "New\_Change\_Table\_Name"
  - » 'PREF\_'||\$AR\_M\_SOURCE\_TABLE\_NAME||'\_SUFF'You can use the following metadata in the SQLite expression:
  - » \$AR\_M\_SOURCE\_COLUMN\_DATATYPE
  - » \$AR\_M\_SOURCE\_COLUMN\_NAME
  - » \$AR\_M\_SOURCE\_SCHEMA
  - » \$AR\_M\_SOURCE\_TABLE\_NAME

### Rename Change Table Schema

If your transformation type is **Rename Change Table schema**, you can do the following:

[Rename Change Table Schema to \(string\)](#)

[Add a Prefix or Suffix](#)

[Remove a Prefix or Suffix](#)

[Replace a Prefix or Suffix with Different Characters](#)

[Convert Change Table Schema Name to Uppercase](#)

[Convert Change Table Schema Name to Lowercase](#)

[Rename Change Table schema \(expression\)](#)

## Rename Change Table Schema to (string)

Use the **Rename Change Table schema to: [string]** option to change the name of all Change Table schemas that you defined in the [Under what Conditions to Transform](#) step to a different name. For example, if you have a Change Table schema called `EMPLOYEE` and want to change all instances of this name to `EMP` then enter the string `EMP`. You can enter any string in this field.

## Add a Prefix or Suffix

Use the **Add a prefix or suffix** option to add additional characters to the beginning or end of the Change Table schema name for all tables that fit the definition you created in the [Under what Conditions to Transform](#) step. For example, if the Change Table schema name is `EMPLOYEES`, you can add a suffix, such as `TAR` or `_TAR` to the Change Table schema name for all Change Table schemas with that Change Table schema name. In this case, the resulting Change Table schema name will be `EMPLOYEESTAR` or `EMPLOYEES_TAR`.

### To globally add a prefix or suffix:

1. Select **Add <Prefix/Suffix> Insert Characters to matching Change Table schema names**.
2. Click the word **Prefix** or **Suffix** and select one of these two from the list.
3. Click **[string]** to activate the field.
4. Type the characters you want as the prefix or suffix. If you want to include an underscore or other legal character to separate the prefix/suffix from the original name, you must add it as part of the character string.
5. Click **Finish** to add the rule to the [Global Transformation Rules](#) list.

## Remove a Prefix or Suffix

Use the **Remove a prefix or suffix** option to remove a string of characters from the beginning or end of a Change Table schema name for all tables that fit the definition you created in the [Under what Conditions to Transform](#) step.

For example, you can use this option to remove the letters `_REV` from the Change Table schema name for all Change Table schemas with the name `EMPLOYEES`. In this case the Change Table schema name in the target will be `EMPLOYEES`.

### To globally remove a prefix or suffix:

1. Select **Remove <Prefix/Suffix> <String> from matching Change Table schema names**.
2. Click the word **Prefix** or **Suffix** and select one of these two from the list.
3. Click **[string]** to activate the field.

4. Type the characters you want to remove. If you want to remove an underscore or other legal character from the original name, you must add it as part of the character string.
5. Click **Finish** to add the rule to the [Global Transformation Rules](#) list.

## Replace a Prefix or Suffix with Different Characters

Use the **Replace a prefix or suffix** option to replace a string of characters with a different string of characters. You determine whether to replace the characters at the beginning or end of a Change Table schema name for all tables that fit the definition you created in the [Under what Conditions to Transform](#) step.

For example, you can use this option to replace the letters `_ORIG` with `_REPL` in the Change Table schema names for all Change Table schemas called `EMPLOYEE_ORIG`. In this case the Change Table schema name in the target will be `EMPLOYEE_REPL`.

### To globally replace a prefix or suffix:

1. Select **Replace <Prefix/Suffix> <String> by <String> for all matching schema names**.
2. Click the word **Prefix** or **Suffix** and select one of these two from the list.
3. Click the first **[string]** to activate the field.
4. Type the characters from the existing (source) Change Table schema name that you want to replace. If you want to include an underscore or other legal character from the original name in the string that you want to replace, you must add it as part of the character string.
5. Click the second **[string]** to activate the field.
6. Type the characters you want to use in the target. These characters replace the original (source) characters in the target.
7. Click **Finish** to add the rule to the [Global Transformation Rules](#) list.

## Convert Change Table Schema Name to Uppercase

Use the convert to uppercase option to convert a Change Table schema name to all uppercase. For example:

Table\_cat, becomes TABLE\_CAT

table\_cat, becomes TABLE\_CAT

taBLE\_Cat, becomes TABLE\_CAT

### To globally change the Change Table schema name to all uppercase:

1. Select **Convert Change Table schema name to uppercase**.
2. Click **Finish** to add the rule to the [Global Transformation Rules](#) list.

## Convert Change Table Schema Name to Lowercase

Use the convert to lowercase option to convert a Change Table schema name to all lowercase. For example:

Table\_cat, becomes table\_cat

TABLE\_CAT, becomes table\_cat

taBLE\_Cat, becomes table\_cat

### To globally change the Change Table schema name to all lowercase:

1. Select **Convert Change Table schema name to lowercase**.
2. Click **Finish** to add the rule to the [Global Transformation Rules](#) list.

## Rename Change Table schema (expression)

Use the **Rename Change Table schema to [expression]** option to change the name of all tables that fit the definition you created in the [Under what Conditions to Transform](#) step. For example, if you have a Change Table schema called `EMPLOYEE` and want to change all instances of the Change Table schema name as defined in the previous step to `EMP`.

### To change the table name:

1. Select **Rename Change Table schema to: [expression]**
2. Click the button to the right of the **Rename table** option to open the Expression Editor. For information on how to use the Expression Editor, see [Using the Expression Builder \(for Filters, Transformations, and Global Transformations\)](#). Then go to step 4.  
or  
Click **[expression]** to activate the field and continue with step 3.
3. Type an SQLite expression or a string (in quotes) to rename the table. For example:
  - » "New\_Change\_Table\_Schema"
  - » 'PREF\_'||\$AR\_M\_SOURCE\_SCHEMA||'\_SUFF'You can use the following metadata in the SQLite expression:
  - » \$AR\_M\_SOURCE\_COLUMN\_DATATYPE
  - » \$AR\_M\_SOURCE\_COLUMN\_NAME
  - » \$AR\_M\_SOURCE\_SCHEMA
  - » \$AR\_M\_SOURCE\_TABLE\_NAME

## Viewing all Global Transformation Rules

The **Global Transformation Rules** dialog box lists the name and description of all notification rules that are defined for the Attunity Replicate instance you are working with. This is where you go to edit or delete a transformation rule.

**In this section:**

- » [Edit a Global Transformation Rule](#)
- » [Delete a Global transformation Rule](#)

## Edit a Global Transformation Rule

You can make changes to any transformation rule.

**Note** You cannot change the name of a transformation rule

**To edit a global transformation rule:**

1. In the **Global Transformation Rules** dialog box, select the transformation rule you want to edit.
2. Click **Open** (at the top of the list).  
The **Edit Existing Transformation Rule** wizard opens.
3. Make any changes you need in the wizard. For information on how to work with each of the pages in the New transformation Rule wizard, see [Defining Global Transformations](#).

## Delete a Global transformation Rule

You can delete a Global transformation rule.

**To delete a global transformation rule:**

1. In the **Global Transformation Rules** dialog box, select the transformation rule you want to edit.
2. Click **Delete** (above the list).
3. When prompted for confirmation, click **OK**.

The transformation rule is removed from the list and deleted from the system.

# Using the Expression Builder (for Filters, Transformations, and Global Transformations)

The Attunity Replicate Expression Builder provides an easy way to build an expression. It provides you with easy access to the required elements for your expression without having to type out any information manually. You access the Expression Builder through the dialog boxes where you define [Filters](#), [Defining Transformations for a Single Table/View](#), and Global Transformations when you do any of the following:

- » [Rename Schema](#)
- » [Rename Table](#)
- » [Rename Column](#)

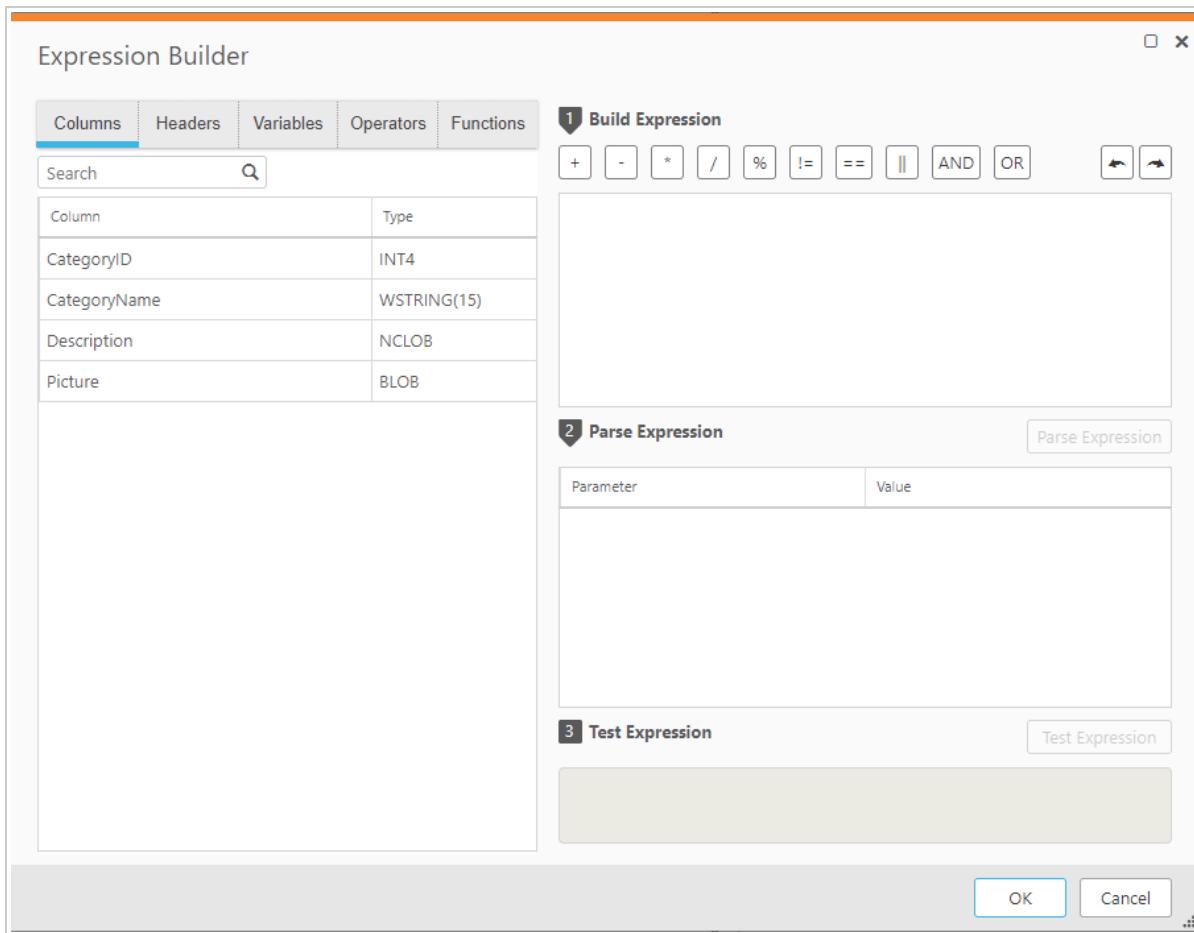
The following topics describe the Expression Builder:

- » [Overview of the Expression Builder](#)
- » [Build an Expression](#)
- » [Parse an Expression](#)
- » [Test an Expression](#)
- » [Using Elements in the Expression Builder](#)

## Overview of the Expression Builder

The following is an example of the Expression Builder with its four main parts shown. The Expression Builder you are working with may look different depending on whether you want to build an expression for a filter, a transformation, or a global transformation.

**Figure 11.2 | Expression Builder for Filters, Transformations, and Global Transformations**



The following sections describe the tasks you can perform in each part of the Expression Builder:

- » **Elements Pane (on the left):** This pane contains elements that you can add to an expression. Select elements and move them into the Expression Builder box to create the expression. For more information, see [Build an Expression](#).

The Elements Pane contains the following tabs:

- » **Metadata** (available only when working with Global transformations)
- » **Input** (available only when working with transformations or filters)
- » **Header** (for Global transformations, this tab is available only when you select **Add Column**)
- » **Variables**
- » **Operators**
- » **Functions**

For more information on these elements, see [Using Elements in the Expression Builder](#).

- » **Build Expression Panel:** The Build Expression Panel is where you put together the expression you are building. You move elements, such as columns or operators into the box. You can also type all or part of an expression in this box.

For more information, see [Build an Expression](#).

- » **Parse Expression Panel:** This panel displays the parameters for the expression. After you build the expression, click **Parse Expression** to list the expression parameters. You can then enter a value or argument for each of the parameters. For more information, see [Parse an Expression](#).

The top part of the Expression panel contains the **Operator** toolbar. This toolbar contains the most common operators. Click the operator you want to use to add it to the expression. You can also add operators from the Element Pane, **Operators** tab.

- » **Test Expression Panel:** This panel displays the results of a test that you can run after you provide values to each of the parameters in your expression. For more information, see [Test an Expression](#).

## Build an Expression

The first step in using the expression builder is to build an expression. The expression that you build is displayed in the top section of the right pane. You can open the Expression when:

- » You define [Defining Transformations for a Single Table/View](#) for a single table.
- » You define [Filters](#) for a single table.
- » You use the Global transformations dialog box to [Rename Schema](#), [Rename Table](#), [Rename Column](#), or [Add Column](#).

**Note:** To add operators to your expression, you can use the **Operator** tab in the Element pane or the Operator buttons at the top of the Build Expression panel or any combination of these. See [Operators](#) and [Operator toolbar](#).

For example, to create an expression that will combine the first name and last name, do the following:

1. In the **Input Columns** tab add the FIRST\_NAME column to the **Build Expression** box.
2. Click the concatenate (||) operator from the **Operator** bar at the top of the Build Expression box.
3. In the Input Columns tab add the LAST\_NAME column into the **Build Expression** box.

#### To build an expression:

1. In the Elements Pane, select any element you want to include in your expression. For information on the elements you can use in an expression, see [Functions](#).
2. Add an element to the **Build Expression** panel by selecting it and then clicking the arrow to the right of the element.
3. Continue to add elements as needed.

#### Operator toolbar

The Operator toolbar is above the Build Expression box. It contains the most common operators so you can easily add them to an expression.

The following operators are available in the Operator toolbar:



For information on these operators, see [Operators](#).

#### To use the Operator toolbar:

1. Click the place in the Build Expression box where you want to add the operator.
2. Click the operator you want to add. It is added to the expression.

## Parse an Expression

You can parse an expression to determine its parameters and to determine whether the expression is valid.

#### To parse an expression:

1. In the Expression Builder window, create an expression as described in [Build an Expression](#).
2. Click **Parse Expression**.

If the expression is *not* valid, an error message is written in red at the bottom of the Expression Builder window.

If the expression is valid, the expression parameters are displayed in the **Parameter** column in the **Parse Expression** section. See the figure under [Test an Expression](#).

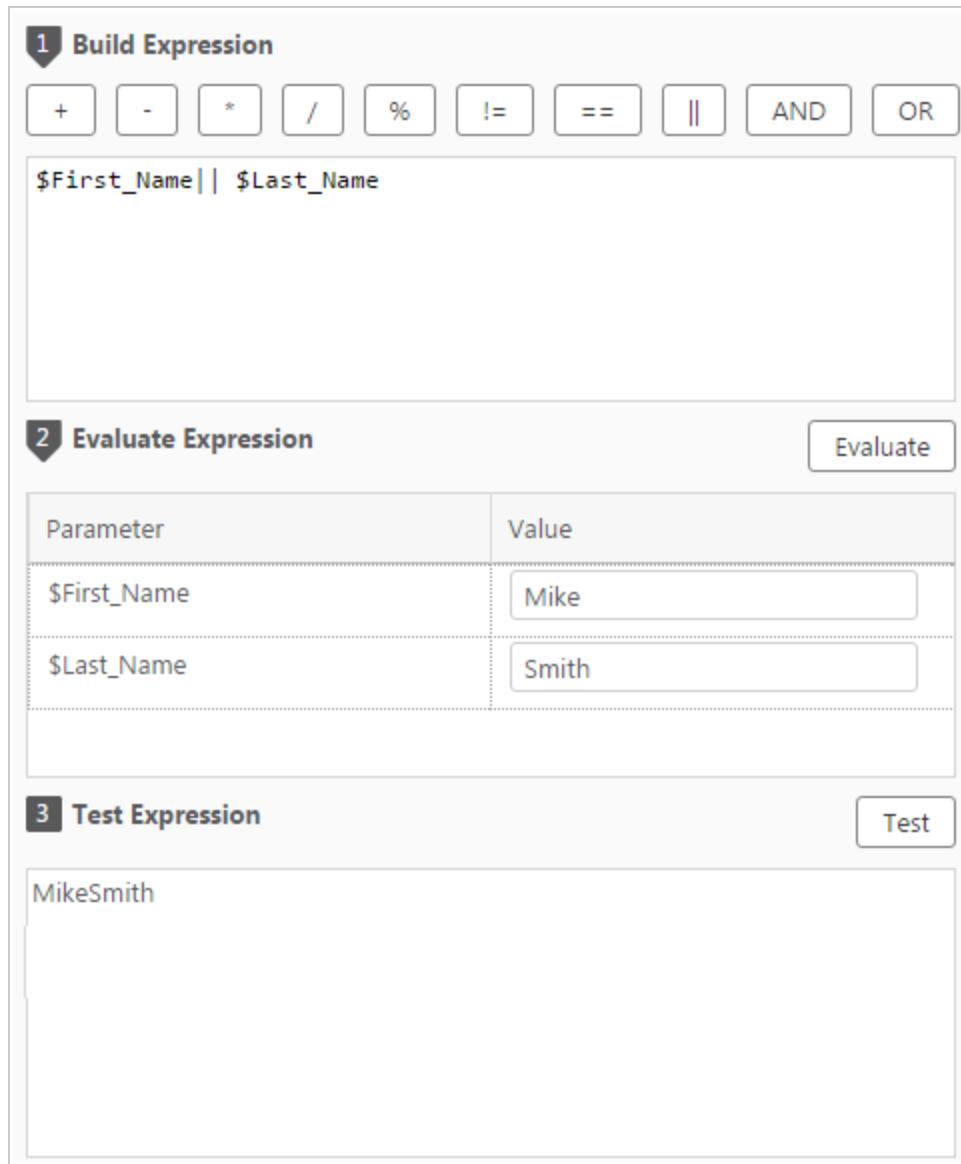
3. Type a valid value for each of the parameters in the **Value** column to [Test an Expression](#).

For example, type John for the FIRST\_NAME and Smith for the LAST\_NAME in the **Value** column. Once you type in values, you can [Test an Expression](#).

## Test an Expression

You can use the Attunity Replicate Test procedure to display the results of a test expression. The following figure is an example of a built expression that is evaluated and contains a test result.

Figure 11.3 | Test Expression



The screenshot shows the Attunity Replicate Expression Builder interface with three main sections:

- 1 Build Expression:** A toolbar with operators (+, -, \*, /, %, !=, ==, ||, AND, OR) and a text input field containing the expression `$First_Name || $Last_Name`.
- 2 Evaluate Expression:** A table for setting parameter values:
 

| Parameter                 | Value |
|---------------------------|-------|
| <code>\$First_Name</code> | Mike  |
| <code>\$Last_Name</code>  | Smith |

 A **Evaluate** button is located to the right of the table.
- 3 Test Expression:** A text input field containing the result `MikeSmith`. A **Test** button is located to the right of the field.

#### To test an expression:

1. From the Expression Builder window, [Build an Expression](#).
2. Click **Evaluate**. See [Parse an Expression](#) for more information.
3. View the parameters that are displayed. If your expression is not valid, an error message is displayed. See [Parse an Expression](#).
4. Type values for each parameter then click **Test** to see the calculated expression.  
 For example, type `John` for `FIRST_NAME` and `Smith` for `LAST_NAME`. The result displayed is `JohnSmith`. If you want a space between the words add it to the end of the `FIRST_NAME` value or the beginning of the `LAST_NAME` value.

**Note:** Testing calls to the `source_lookup` and `target_lookup` functions is not supported.

## Using Elements in the Expression Builder

You can use the following types of elements to build expressions for transformations, filters, and global transformations. Select the appropriate tab to select the elements.

- » [Columns \(transformations and Filters only\)](#)
- » [Metadata \(Global Transformations Only\)](#)
- » [Variables](#)
- » [Operators](#)
- » [Functions](#)
- » [Headers](#)
- » [User-Defined Transformations](#)

### Columns (transformations and Filters only)

This section lists the columns for the table you are working with. The table you are working with is the table you selected when you opened the Table Settings dialog box.

### Metadata (Global Transformations Only)

The **Metadata** tab contains the following variables that you can use in an expression:

- » `AR_M_SOURCE_SCHEMA` - The name of the source schema.
- » `AR_M_SOURCE_TABLE_NAME` - The name of the source table.
- » `AR_M_SOURCE_COLUMN_NAME` - The name of a column in the source table.
- » `AR_M_SOURCE_COLUMN_DATATYPE` - The data type of a column in the source table.

For example, to rename all columns named "metadata" to "source\_schema.table\_name", enter "metadata" in the **Column name is like** field (in the [What to transform?](#) screen) and then enter the following expression in the **Rename column to** field (in the [How to transform?](#) screen):

```
$AR_M_SOURCE_SCHEMA || "." || $AR_M_SOURCE_TABLE_NAME
```

### Variables

Your expression can contain any of the variables (which will be replaced during runtime) described in the table below.

**Table 11.5 | Variables**

| Variable Name               | Description                                                                   | Data Type   |
|-----------------------------|-------------------------------------------------------------------------------|-------------|
| <code>AR_V_HOST_NAME</code> | The host name of the machine on which Attunity Replicate Server is installed. | STRING (50) |

**Table 11.5 | Variables (Cont.)**

| Variable Name    | Description                                                               | Data Type    |
|------------------|---------------------------------------------------------------------------|--------------|
| AR_V_SOURCE_NAME | The logical name of the source endpoint defined in the endpoint settings. | STRING (50)  |
| AR_V_TARGET_NAME | The logical name of the target endpoint defined in the endpoint settings. | STRING (50)  |
| AR_V_TASK_NAME   | The task name.                                                            | STRING (50)  |
| AR_V_RELOAD_TIME | The time the source tables were reloaded.                                 | DATETIME (6) |
| AR_V_START_TIME  | The time the task started.                                                | DATETIME (6) |
| AR_V_TASK_UUID   | A unique string (Universal Unique Identifier) that identifies the task.   | STRING (50)  |

## Operators

The sections below describe the SQLite operators you can use to build an expression with the Expression builder. The Expression builder divides the operators into the following categories:

- » [Strings](#)
- » [Logical](#)
- » [Mathematical](#)

**Note** All operator symbols must be preceded and followed by a space. For example, the expression for concatenating a first and last name should be specified like this:

```
FIRST_NAME || LAST_NAME
```

And not like this:

```
FIRST_NAME || LAST_NAME
```

## Strings

You can use the following string:

||

**Name:** Concatenate strings.

**Examples:**

```
FIRST_NAME || LAST_NAME
```

PHONE\_NUMBER || <Office Only> (adds the string Office Only to the telephone number).

## Logical

The following table describes the logical SQLite operators used by the Attunity Replicate Expression Builder.

**Table 11.6 | Logical SQLite Operators used by Attunity Replicate Expression Builder**

| Operator                                                                                                                                                                                                                                           | Description                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| != or <>                                                                                                                                                                                                                                           | Is not equal to<br><code>\$SALARY!=100000</code>                                                                                                                                                                                                                                                                                                                                                                      |
| IS                                                                                                                                                                                                                                                 | Is the same as<br><code>\$HIRE_DATE IS 2014-09-29</code><br>IS functions the same as = unless one or both of the operands are NULL. In this case, if both operands are NULL, then the IS operator evaluates to 1 (true). If one operand is NULL and the other is not, then the IS operator evaluates to 0 (false).                                                                                                    |
| IS NOT                                                                                                                                                                                                                                             | Is not the same as<br><code>\$HIRE_DATE IS NOT 2014-09-29</code><br>IS NOT functions the same as != unless one or both of the operands are NULL. In this case, if both operands are NULL, the IS NOT operator evaluates to 0 (false). If one operand is NULL and the other is not, then the IS NOT operator evaluates to 1 (true).                                                                                    |
| IN                                                                                                                                                                                                                                                 | The IN operator takes a single scalar operand on the left and a vector operand on the right formed by an explicit list of zero or more scalars or by a single subquery. When the right operand of an IN operator is a subquery, the subquery must have a single result column. When the right operand is an empty set, the result of IN is false regardless of the left operand and even if the left operand is NULL. |
| <p><b>Note</b> SQLite allows the parenthesized list of scalar values on the right-hand side of an IN operator to be an empty list but most other SQL endpoint engines and the SQL92 standard require the list to contain at least one element.</p> |                                                                                                                                                                                                                                                                                                                                                                                                                       |
| LIKE                                                                                                                                                                                                                                               | The LIKE operator does a pattern matching comparison. The operand to the right of the LIKE operator contains the pattern                                                                                                                                                                                                                                                                                              |

**Table 11.6 | Logical SQLite Operators used by Attunity Replicate Expression Builder (Cont.)**

| Operator | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          | <p>and the left operand contains the string to match against the pattern. A percent symbol ("%) in the LIKE pattern matches any sequence of zero or more characters in the string. An underscore ("_") in the LIKE pattern matches any single character in the string. Any other character matches itself or its lower/upper case equivalent. (By default SQLite only understands upper/lower case for ASCII characters. The LIKE operator is case sensitive by default for unicode characters that are beyond the ASCII range.</p> <p>For example, the expression 'a' LIKE 'A' is TRUE but 'æ' LIKE 'Æ' is FALSE.)</p> <p>LIKE can be preceded by the NOT keyword.</p> |
| CASE     | Evaluates a list of conditions and returns one of multiple possible result expressions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|          | <p><b>Example 1:</b></p> <pre>WHEN \$NEWEST = 'Y' THEN '1' ELSE '0' END</pre> <p><b>Example 2:</b></p> <pre>case length(\$month) when 2 then \$year  \$month when 1 then \$year  0  \$month end</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| GLOB     | <p>The GLOB operator acts in the same way as the LIKE operator but uses the UNIX file globbing syntax for its wildcards. GLOB is case sensitive.</p> <p>GLOB can be preceded by the NOT keyword to invert the sense of the test. The infix GLOB operator is implemented by calling the function glob(Y,X) and can be modified by overriding that function.</p>                                                                                                                                                                                                                                                                                                          |
| MATCH    | The MATCH operator is a special syntax for the match() application-defined function. The default match() function implementation raises an exception and is not really useful for anything. But extensions can override the match() function with more helpful logic.                                                                                                                                                                                                                                                                                                                                                                                                   |
| REGEXP   | The REGEXP operator is a special syntax for the regexp() user function. No regexp() user function is defined by default and so use of the REGEXP operator will normally result in an error message.                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

**Table 11.6 | Logical SQLite Operators used by Attunity Replicate Expression Builder (Cont.)**

| Operator | Description                                                                    |
|----------|--------------------------------------------------------------------------------|
| AND      | Both operands are true.<br>\$MANAGER_ID AND EMPLOYEE_ID >100                   |
| OR       | Either operand is true.<br>\$MANAGER_ID OR EMPLOYEE_ID >100                    |
| <<       | Bitwise shift left.<br>x << n<br>A bitwise shift to the left of x by n bits.   |
| >>       | Bitwise shift right.<br>x >> n<br>A bitwise shift to the right of x by n bits. |
| &        | Unary and                                                                      |
|          | Unary or                                                                       |
| <        | Is less than.<br>\$SALARY<100000                                               |
| <=       | Is less than or equal to<br>\$SALARY<=100000                                   |
| >        | Is greater than<br>\$SALARY>100000                                             |
| >=       | Is more than or equal to<br>\$SALARY>=100000                                   |
| = or ==  | Is equal to<br>\$SALARY=100000                                                 |

## Mathematical

The following table describes the mathematical SQLite operators used by the Attunity Replicate Expression Builder.

**Table 11.7 | SQLite Mathematical Operators used by the Attunity Replicate Expression Builder**

| Operator | Description                                                                                                                                |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------|
| +        | Adds two values together.<br>DEPARTMENT_ID+100 (adds 100 to each ID number). Any column used in an expression with this operator must be a |

**Table 11.7 | SQLite Mathematical Operators used by the Attunity Replicate Expression Builder (Cont.)**

| Operator | Description                                                                                                                                                                                                                                                                                          |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          | numeric data type.                                                                                                                                                                                                                                                                                   |
| -        | Subtracts a value from another value.<br>MANAGER_ID-100 (subtracts 100 from each ID number). Any column used in an expression with this operator must be a numeric data type.                                                                                                                        |
| %        | Uses the remainder of a division expression as the value.<br>%SALARY/7 (Divides the value of the Salary column by 7 and uses any remainder from the expression as the column value).                                                                                                                 |
| /        | Divides one value into another.<br>SALARY/.16 (Divides the value of the Salary column by .16).<br><b>Note:</b> If the two values in the division expression are integers (two NUMERIC columns with no digits after the decimal) and the result is a fractional value, the result returned will be 0. |
| *        | SALARY*.16 (Multiplies the value of the Salary column by .16). This could be used to calculate taxes that are subtracted from a salary.                                                                                                                                                              |

## Functions

The sections below describe the SQLite functions you can use to build an expression with the Expression builder. The Expression builder divides the functions into the following categories:

- » [Strings](#)
- » [LOBs](#)
- » [Numeric](#)
- » [NULL check](#)
- » [Date and Time](#)
- » [Data Enrichment](#)
- » [Operation](#)
- » [Other Functions](#)
- » [Hash](#)
- » [User-Defined Transformations](#)

## Strings

The following table describes the string functions used by the Expression Builder in Attunity Replicate .

**Table 11.8 | SQLite String Functions used by the Expression Builder**

| Function           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| lower(x)           | The lower(x) function returns a copy of string x with all characters converted to lower case. The default built-in lower() function works for ASCII characters only.                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| ltrim<br>(x,y)     | The ltrim(x,y) function returns a string formed by removing all characters that appear in y from the left side of x. If there is no value for y, ltrim(x) removes spaces from the left side of x.                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| replace<br>(x,y,z) | The replace(x,y,z) function returns a string formed by substituting string z for every occurrence of string y in string x.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| rtrim<br>(x,y)     | The rtrim(x,y) function returns a string formed by removing all characters that appear in y from the right side of x. If there is no value for y, rtrim(x) removes spaces from the right side of x.                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| substr<br>(x,y,z)  | The substr(x,y,z) function returns a substring of input string x that begins with the y-th character and which is z characters long. If z is omitted then substr(x,y) returns all characters through the end of the string x beginning with the y-th. The left-most character of x is number 1. If y is negative then the first character of the substring is found by counting from the right rather than the left. If z is negative then the abs(z) characters preceding the y-th character are returned. If x is a string then characters indices refer to actual UTF-8 characters. If x is a BLOB then the indices refer to bytes. |
| trim(x,y)          | The trim(x,y) function returns a string formed by removing all characters that appear in y from both sides of x. If there is no value for y, trim(x) removes spaces from both sides of x.                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| upper(x)           | The upper(x) function returns a copy of string x with all characters converted to upper case.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

## LOBs

The following table describes the LOB functions used by the Expression Builder in Attunity Replicate .

**Table 11.9 | SQLite Lob Functions used by the Expression Builder**

| Function          | Description                                                                                                                                     |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| hex(x)            | The hex() function receives an argument as a BLOB and returns an upper-case hexadecimal string version of the BLOB content.                     |
| randomblob<br>(N) | The randomblob(N) function returns an N-byte BLOB that contains pseudo-random bytes. If N is less than 1 then a 1-byte random BLOB is returned. |
| zeroblob(N)       | The zeroblob(N) function returns a BLOB that consists of N bytes of 0x00.                                                                       |

## Numeric

The following table describes the numeric functions used by the Expression Builder in Attunity Replicate .

**Table 11.10 | SQLite Numeric Functions used by the Expression Builder**

| <b>Function Description</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| abs(x)                      | The abs(x) function returns the absolute value of the numeric argument X. Abs(x) returns NULL if x is NULL. Abs(x) returns 0.0 if x is a string or BLOB that cannot be converted to a numeric value.                                                                                                                                                                                                                                                                                                                                                                    |
| random()                    | The random() function returns a pseudo-random integer between -9223372036854775808 and +9223372036854775807.                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| round(x,y)                  | The round(x,y) function returns a floating-point value x rounded to y digits to the right of the decimal point. If there is no value for y, it is assumed to be 0.                                                                                                                                                                                                                                                                                                                                                                                                      |
| max(x,y...)                 | The multi-argument max() function returns the argument with the maximum value, or returns NULL if any argument is NULL. The multi-argument max() function searches its arguments from left to right for an argument that defines a collating function and uses that collating function for all string comparisons. If none of the arguments to max() define a collating function, then the BINARY collating function is used. Note that max() is a simple function when it has two or more arguments but operates as an aggregate function if it has a single argument. |
| min(x,y...)                 | The multi-argument min() function returns the argument with the minimum value. The multi-argument min() function searches its arguments from left to right for an argument that defines a collating function and uses that collating function for all string comparisons. If none of the arguments to min() define a collating function, then the BINARY collating function is used. Note that min() is a simple function when it has two or more arguments but operates as an aggregate function if it has a single argument                                           |

## NULL check

The following table describes the NULL check functions used by the Expression Builder in Attunity Replicate .

**Table 11.11 | SQLite NULL Check Functions used by the Attunity Replicate Expression Builder**

| <b>Function Description</b> |                                                                                                                                                           |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| coalesce(x,y...)            | The coalesce() function returns a copy of its first non-NULL argument, it returns NULL if all arguments are NULL. Coalesce() have at least two arguments. |

**Table 11.11 | SQLite NULL Check Functions used by the Attunity Replicate Expression Builder (Cont.)**

| Function        | Description                                                                                                                                                                                                                                                                                                                                                                                                          |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ifnull<br>(x,y) | The ifnull() function returns a copy of its first non-NUL argument, it returns NULL if both arguments are NULL. Ifnull() must have exactly two arguments. The ifnull() function is the same as coalesce() with two arguments.                                                                                                                                                                                        |
| nullif<br>(x,y) | The nullif(x,y) function returns a copy of its first argument if the arguments are different and returns NULL if the arguments are the same. The nullif(x,y) function searches its arguments from left to right for an argument that defines a collating function and uses that collating function for all string comparisons. If neither argument to nullif() defines a collating function then the BINARY is used. |

## Date and Time

The following table describes the Date and Time functions used by the Expression Builder in Attunity Replicate .

**Table 11.12 | SQLite Date and Time Functions used by the Attunity Replicate Expression Builder**

| Function                                                 | Description                                                                                                                                                                                                                                                                                                    |
|----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| date(timestamp,<br>modifier, modifier...)                | Returns the date in the format YYYY-MM-DD.                                                                                                                                                                                                                                                                     |
| time(timestamp,<br>modifier, modifier...)                | Returns the time in the format HH:MM:SS.                                                                                                                                                                                                                                                                       |
| datetime(timestamp,<br>modifier, modifier...)            | Returns the date and time in the format YYYY-MM-DD HH:MM:SS.                                                                                                                                                                                                                                                   |
| julianday<br>(timestamp, modifier,<br>modifier...)       | The julianday() function returns the number of days since noon in Greenwich on November 24, 4714 B.C.                                                                                                                                                                                                          |
| strftime(format,<br>timestamp, modifier,<br>modifier...) | The strftime() routine returns the date formatted according to the format string specified as the first argument. It supports the following variables:<br><br>%d: day of month<br>%H: hour 00-24<br>%f: ** fractional seconds SS.SSS<br>%j: day of year 001-366<br>%J: ** Julian day number<br>%m: month 01-12 |

**Table 11.12 | SQLite Date and Time Functions used by the Attunity Replicate Expression Builder (Cont.)**

| Function | Description               |
|----------|---------------------------|
| %M:      | minute 00-59              |
| %s:      | seconds since 1970-01-01  |
| %S:      | seconds 00-59             |
| %w:      | day of week 0-6 sunday==0 |
| %W:      | week of year 00-53        |
| %Y:      | year 0000-9999            |
| %%:      | %                         |

Time strings can be in the following formats:

- » YYYY-MM-DD
- » YYYY-MM-DD HH:MM
- » YYYY-MM-DD HH:MM:SS
- » YYYY-MM-DD HH:MM:SS.SSS
- » YYYY-MM-DDTHH:MM (T is a literal character that separates the date and time)
- » YYYY-MM-DDTHH:MM:SS (T is a literal character that separates the date and time)
- » YYYY-MM-DDTHH:MM:SS.SSS (T is a literal character that separates the date and time)
- » HH:MM
- » HH:MM:SS
- » HH:MM:SS.SSS
- » now (Converted to current date and time using UTC)
- » DDDD.DDDD (The Julian day number expressed as a floating point value).

## Data Enrichment

Data Enrichment functions allow the selected source tables to be augmented with data from other records located in either the source or target endpoints. Practical applications of data enrichment functions include code lookup or master record lookup (e.g. social security number lookup to find a person's name).

You can enrich the target tables with supplemental data retrieved from the source or target endpoint by defining a transformation on the table. For more information about defining transformations on a single table, see [Defining Transformations for a Single Table/View](#).

## Limitations

Amazon Redshift is not supported.

## Data Enrichment Functions

The table below describes the source and target lookup functions, which can be used both for table transformations and for global transformations. For a description of the parameters available for these functions, see [Input Parameters](#).

**Table 11.13 | SQLite Data Enrichment Functions used by Expression Builder**

| Function                                                         | Description                                               |
|------------------------------------------------------------------|-----------------------------------------------------------|
| source_lookup<br>(TTL,'SCHM','TBL','EXP','COND',<br>COND_PARAMS) | Use to retrieve additional data from the source endpoint. |
| target_lookup<br>(TTL,'SCHM','TBL','EXP','COND',<br>COND_PARAMS) | Use to retrieve additional data from the target endpoint. |

## Input Parameters

The possible input parameters for the lookup functions are described in the table below. For a usage example, see [Functions](#).

**Table 11.14 | Lookup Input Parameters for Data Enrichment Functions**

| Parameter | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TTL       | TTL (Time to Live) is the amount of time the 'COND' return value will be cached. Caching the 'COND' return value improves performance by reducing the frequency that Attunity Replicate needs to access the source/target endpoint. As there is no default, you must specify a TTL value, which can be one of the following:<br><br><SECONDS> - The time to cache the 'COND' return value in seconds. Specify a short caching time (e.g. 3) for data that is frequently updated or a long caching time for data that rarely changes.<br><br>'NO_CACHING'- Specify 'NO_CACHING' if you do not want to cache the 'COND' return value. This is recommended for data that is constantly updated (e.g. share prices).<br><br>'NO_EXPIRATION'- For data that is never updated (e.g. a street name), specify 'NO_EXPIRATION' to store the <a href="#">Functions</a> return value permanently in the cache. |
| 'SCHM'    | The schema name.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 'TBL'     | The table on which to perform the lookup.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 'EXP'     | The expression to retrieve data from the lookup table.<br><br><b>Note:</b> The expression syntax must be native to the endpoint it accesses.<br>The result should be a single column. Possible expressions include: col1,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

**Table 11.14 | Lookup Input Parameters for Data Enrichment Functions (Cont.)**

| Parameter   | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | col1+5, max(col1).<br><br><b>Note:</b> Full LOB columns are not supported. For information on including Limited-size LOB columns in the replication, see the description of the <a href="#">Metadata</a> tab.<br><br><a href="#">Columns (transformations and Filters only)</a> , <a href="#">Headers</a> , and <a href="#">Metadata (Global Transformations Only)</a> can also be used in the expression and are evaluated before the lookup statement is performed against the endpoint.                                                                                                                                                                                                                                         |
| 'COND'      | The condition for the lookup statement.<br><br><b>Note:</b> The condition syntax must be native to the endpoint it accesses.<br>The COND is a single field referencing all required fields.<br><br><b>Example if the lookup table is located in Oracle:</b><br>'Fieldname1=:1 and Fieldname2=:2 and Fieldname3 =:3'<br><br><b>Example if the lookup table is located in Microsoft SQL Server:</b><br>'Fieldname1=? and Fieldname2=? and Fieldname3=?'<br><br><a href="#">Columns (transformations and Filters only)</a> , <a href="#">Headers</a> , and <a href="#">Metadata (Global Transformations Only)</a> can also be used in the expression and are evaluated before the lookup statement is performed against the endpoint. |
| COND_PARAMS | Any parameters required by the COND parameter.<br>The COND_PARAMS (condition parameters) is not a single field, but a list of fields.<br><br><b>Syntax:</b><br>\$FIELDNAME1 , \$FIELDNAME2 , \$FIELDNAME3<br><br><b>Full example:</b><br>source_lookup(<br>10000 ,<br>'HR' ,<br>'DEPARTMENTS' ,<br>'DEPARTMENT_NAME' ,<br>'COMPANY_ID=? and DIVISION_ID=? and DEPT_ID=?' ,<br><b>\$COMP_ID , \$DIV_ID , \$DEPT_ID )</b>                                                                                                                                                                                                                                                                                                            |

**Note** To improve efficiency, the source/target lookup tables should be indexed for the specified lookup fields.

## Data Enrichment Example

In the following example, Mike needs to add the `DEPARTMENT_NAME` column to the `HR.JOB_HISTORY` table. The `DEPARTMENT_NAME` column is located in the `HR.DEPARTMENTS` table in the source endpoint.

This is how the `HR.JOB_HISTORY` table appears before the column is added:

| EMPLOYEE_ID | ↓ Σ | START_DATE          | END_DATE            | JOB_ID     | ↓ Σ | DEPARTMENT_ID | ↓ Σ |
|-------------|-----|---------------------|---------------------|------------|-----|---------------|-----|
| 102         |     | 2001-01-13 00:00:00 | 2006-07-24 00:00:00 | IT_PROG    |     | 60            |     |
| 101         |     | 1997-09-21 00:00:00 | 2001-10-27 00:00:00 | AC_ACCOUNT |     | 110           |     |
| 101         |     | 2001-10-28 00:00:00 | 2005-03-15 00:00:00 | AC_MGR     |     | 110           |     |
| 201         |     | 2004-02-17 00:00:00 | 2007-12-19 00:00:00 | MK_REP     |     | 20            |     |
| 114         |     | 2006-03-24 00:00:00 | 2007-12-31 00:00:00 | ST_CLERK   |     | 50            |     |
| 122         |     | 2007-01-01 00:00:00 | 2007-12-31 00:00:00 | ST_CLERK   |     | 50            |     |
| 200         |     | 1995-09-17 00:00:00 | 2001-06-17 00:00:00 | AD_ASST    |     | 90            |     |
| 176         |     | 0001-09-09 09:30:25 | 2010-09-09 09:30:00 | SA_REP     |     | 60            |     |
| 176         |     | 2007-01-01 00:00:00 | 2010-09-09 09:30:00 | SA_MAN     |     | 60            |     |
| 200         |     | 2002-07-01 00:00:00 | 2006-12-31 00:00:00 | AC_ACCOUNT |     | 90            |     |

This is how the `HR.JOB_HISTORY` table appears after the Full Load completes:

| EMPLOYEE_ID | ↓ Σ | START_DATE          | END_DATE            | JOB_ID     | ↓ Σ | DEPARTMENT_ID | ↓ Σ | DEPARTMENT_NAME   | ↓ Σ |
|-------------|-----|---------------------|---------------------|------------|-----|---------------|-----|-------------------|-----|
| 102         |     | 2001-01-13 00:00:00 | 2006-07-24 00:00:00 | IT_PROG    |     | 60            |     | Warehouse         |     |
| 101         |     | 1997-09-21 00:00:00 | 2001-10-27 00:00:00 | AC_ACCOUNT |     | 110           |     | ProductManagement |     |
| 101         |     | 2001-10-28 00:00:00 | 2005-03-15 00:00:00 | AC_MGR     |     | 110           |     | ProductManagement |     |
| 201         |     | 2004-02-17 00:00:00 | 2007-12-19 00:00:00 | MK_REP     |     | 20            |     | HR                |     |
| 114         |     | 2006-03-24 00:00:00 | 2007-12-31 00:00:00 | ST_CLERK   |     | 50            |     | Bookkeeping       |     |
| 122         |     | 2007-01-01 00:00:00 | 2007-12-31 00:00:00 | ST_CLERK   |     | 50            |     | Bookkeeping       |     |
| 200         |     | 1995-09-17 00:00:00 | 2001-06-17 00:00:00 | AD_ASST    |     | 90            |     | Management        |     |
| 176         |     | 0001-09-09 09:30:25 | 2010-09-09 09:30:00 | SA_REP     |     | 60            |     | Warehouse         |     |
| 176         |     | 2007-01-01 00:00:00 | 2010-09-09 09:30:00 | SA_MAN     |     | 60            |     | Warehouse         |     |
| 200         |     | 2002-07-01 00:00:00 | 2006-12-31 00:00:00 | AC_ACCOUNT |     | 90            |     | Management        |     |

### To add the `DEPARTMENT_NAME` column, Mike needs to:

1. Create a new task and select the `HR.JOB_HISTORY` table for replication.
2. Apply a “New Column” transformation to the `HR.JOB_HISTORY` table. For more information on defining transformations, see [Defining Transformations for a Single Table/View](#).
3. Open the **Expression Builder** and choose **Data Enrichment** from the **Functions** tab. For more information on the Expression Builder, see [Using the Expression Builder \(for Filters, Transformations, and Global Transformations\)](#).
4. Select the `source_lookup` function and configure it as follows (using the native syntax of the source endpoint):

#### If the lookup table is located in Oracle:

```
source_lookup(10000, 'HR', 'DEPARTMENTS', 'DEPARTMENT_NAME',
'DEPARTMENT_ID=:1', $DEPARTMENT_ID)
```

### If the lookup table is located in Microsoft SQL Server:

```
source_lookup
(10000, 'HR', 'DEPARTMENTS', '[DEPARTMENT_NAME]',
'[DEPARTMENT]=?', $DEPARTMENT_ID)
```

Where:

- » 10000 is the TTL parameter.
- » HR is the schema name.
- » DEPARTMENTS is the table name.
- » DEPARTMENT\_NAME is the expression.
- » DEPARTMENT\_ID=:1 (or ? on Microsoft SQL Server) is the condition.
- » \$DEPARTMENT\_ID is the condition parameter.

5. Run the task.

## Operation

The following table describes the Operation functions used by the Expression Builder in Attunity Replicate .

**Table 11.15 | SQLite Operation Functions used by the Attunity Replicate Expression Builder**

| Function                                                                         | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| operation_indicator<br>(value_on_delete,<br>value_on_update,<br>value_on_insert) | <p>When the <code>operation_indicator</code> function is invoked on its own or as part of an expression, records deleted from the source endpoint will <i>not</i> be deleted from the target endpoint. Instead, the corresponding target record will be flagged (with a user-provided value) to indicate that it was deleted from the source. The <code>operation_indicator</code> function also requires you to provide values to indicate records that were inserted or updated in the source endpoint.</p> <p><b>Note:</b> The <code>operation_indicator</code> function is not supported on tables that do not have a Primary Key.</p> <p><b>Note:</b> It is recommended to add a dedicated column for the flag values, for example, <code>OPERATION</code>. For an explanation of how to add a column, see <a href="#">Using the Transform Tab</a>.</p> <p><b>To specify the function values:</b></p> <p>Replace <code>value_on_delete</code>, <code>value_on_insert</code> and <code>value_on_update</code> with the values that you want to appear in the target endpoint.</p> <p>Values should be formatted according to the corresponding column type.</p> <p>Example when the column type is INT4:</p> <pre>operation_indicator('1', '0', '0')</pre> <p>Example when the column type is STRING:</p> <pre>operation_indicator('Deleted', 'Updated', 'Inserted')</pre> |

## Other Functions

The following table describes additional functions used by the Expression Builder in Attunity Replicate .

**Table 11.16 | SQLite Functions used by the Attunity Replicate Expression Builder**

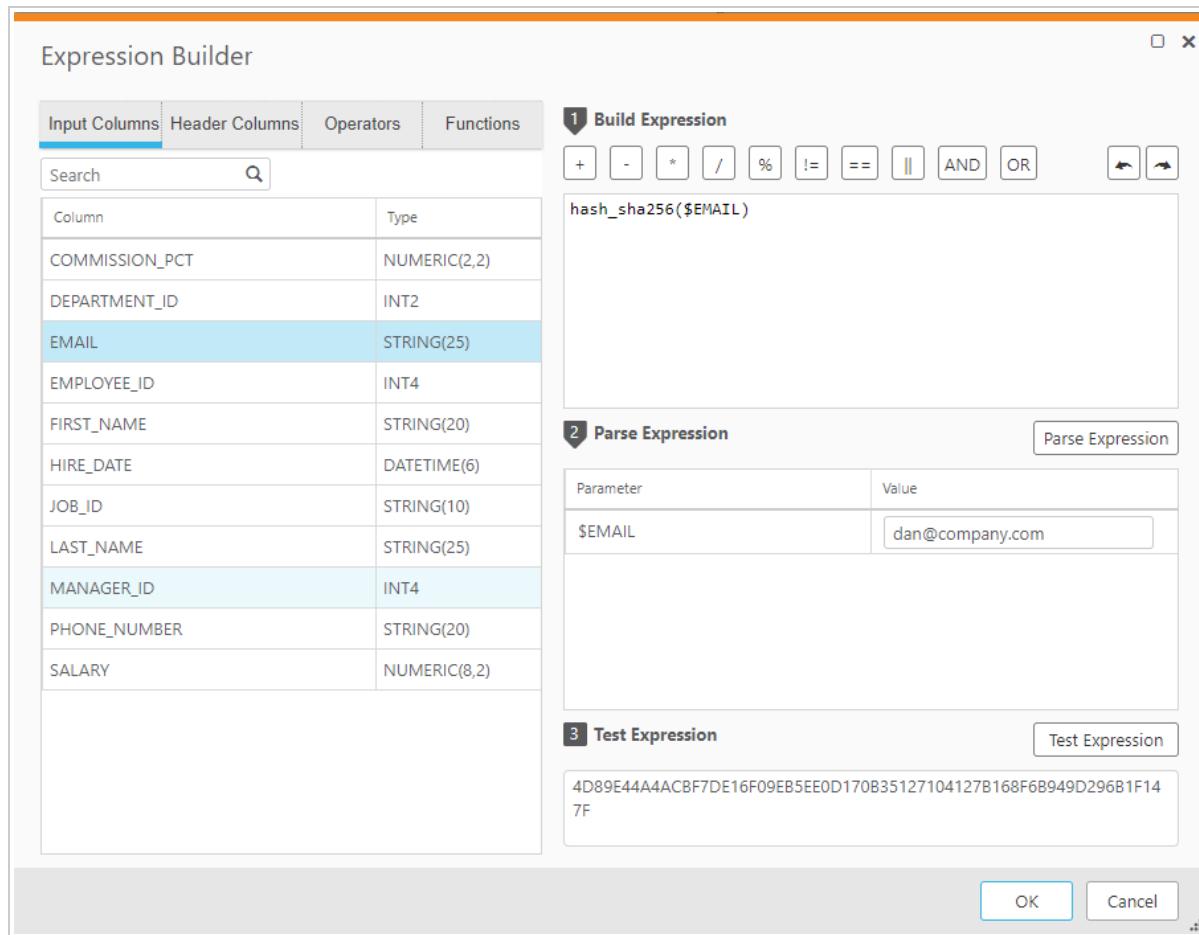
| Function        | Description                                                                                                                                                                                                                                                   |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| length(x)       | For a string value x, the length(x) function returns the number of characters (not bytes) in x before to the first NULL character.<br>If x is NULL then length(x) is NULL. If x is numeric then length(X) returns the length of a string representation of X. |
| like<br>(x,y,z) | The like() function is used to implement the "Y LIKE X [ESCAPE Z]" expression. The ESCAPE (z) clause is optional. If there is a z clause, then the like() function is invoked with three arguments. Otherwise, it is invoked with two arguments.              |
| typeof(x)       | The typeof(x) function returns a string that indicates the datatype of the expression x: null, integer, real, text, or BLOB.                                                                                                                                  |

## Hash

The Hash function generates a hash value for an inputted column (using the SHA-256 algorithm) and then returns the hex value of the generated hash value.

To use the function in an expression, add the `hash_sha256(x)` function to the **Build Expression** pane and then replace the "x" with the desired source column name (from the **Input Columns** tab).

The function is especially useful for masking sensitive information. In the expression below, for example, the Hash function has been used to obfuscate employees' email addresses.



The screenshot shows the Expression Builder dialog with the following details:

- Input Columns:** A table listing columns from a source table:
 

| Column         | Type         |
|----------------|--------------|
| COMMISSION_PCT | NUMERIC(2,2) |
| DEPARTMENT_ID  | INT2         |
| EMAIL          | STRING(25)   |
| EMPLOYEE_ID    | INT4         |
| FIRST_NAME     | STRING(20)   |
| HIRE_DATE      | DATETIME(6)  |
| JOB_ID         | STRING(10)   |
| LAST_NAME      | STRING(25)   |
| MANAGER_ID     | INT4         |
| PHONE_NUMBER   | STRING(20)   |
| SALARY         | NUMERIC(8,2) |
- Build Expression:** The expression `hash_sha256($EMAIL)` is entered in the text area.
- Parse Expression:** A parameter \$EMAIL is defined with the value `dan@company.com`.
- Test Expression:** The resulting hash value is `4D89E44A4ACBF7DE16F09EB5EE0D170B35127104127B168F6B949D296B1F147F`.
- Buttons:** OK, Cancel, and Help.

## Headers

By default, headers for source tables are not replicated to the target. You can determine which, if any, headers to replicate when you define a transformation by creating an expression that includes the header.

You can create a filter using header values. Header filters are applied during change processing. See [Using Filters](#) for additional information.

**Note** The **Headers** tab in the Expression builder is available for Filters and transformations. It is available for Global transformations only when you select **Add Columns**. See [Selecting the Transformation Type](#).

The following table describes the available headers.

**Table 11.17 | Header**

| Header Name           | Value in Change Process                                                                                                                                                                                                                                | Value in Full Load | Data Type |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-----------|
| AR_H_STREAM_POSITION  | The stream position value from the source (For example, the SCN or LSN depending on the source endpoint).                                                                                                                                              | Empty string       | STRING    |
| AR_H_TIMESTAMP        | Change timestamp                                                                                                                                                                                                                                       | Current timestamp  | DATETIME  |
| AR_H_COMMIT_TIMESTAMP | Commit timestamp                                                                                                                                                                                                                                       | Current timestamp  | DATETIME  |
| AR_H_OPERATION        | INSERT/UPDATE/DELETE                                                                                                                                                                                                                                   | INSERT             | STRING    |
| AR_H_USER             | The user name, ID or any other information that the source provides about the change initiator.<br><br>This header is supported on the Microsoft SQL Server, IBM DB2 on iSeries (ARC), and Oracle (version 11.2.0.3 and higher) source endpoints only. | Empty              | STRING    |

## User-Defined Transformations

Customers that require functionality not provided by Replicate's built-in transformations can write their own transformations, and then access them from the [Replicate Expression Builder](#).

The procedure below is based on the sample files located in:

<installation\_dir>\addons\samples\MyTransformation

### To create a user-defined transformation:

1. Create a shared library that implements the following exported initialization function:

```
typedef int AR_ADDON_INIT_FUNC(AR_ADDON_CONTEXT *context);
```

All of the types and prototypes are defined in the **ar\_addon.h** and **ar\_addon\_transformation.h** files located under <installation\_dir>\addons\include.

2. Make sure your shared library is in the following location:

<installation\_dir>\addons\samples\addon\_name

**Note** When working in a [High Availability](#) setup, the created binaries should be installed on all of the cluster instances.

3. Compile the transformation.

The DLL/SO is automatically created in the following location:

<installation\_dir>\addons\addon\_name\addon\_name.[dll/so]

4. Register the library in the **addons\_def.json** file located under <installation\_dir>\addons.

```
{
    "addons": [
        {
            "name": "MyTransformation",
            "type": "STARTUP",
            "lib_name": "MyTransformation/MyTransformation.dll",
            "init_function": "my_transformation_init_func"
        }
    ]
}
```

5. Register the new function in the addon initialization function (mentioned in Step 1) as in the following example:

```
USER_DEFINED_TRANSFORMATION_DEF *transdef = GET_AR_AO_TRANSFORMATION_DEF();
transdef->displayName = "prefix_with(X, Y)";
transdef->functionName = "prefix_with";
transdef->description = "prefix_with adds the prefix <Y> to a given string X";
transdef->func = trans_prefix_with;
transdef->nArgs = 2;
AR_AO_REGISTRATION->register_user_defined_transformation(transdef);
```

6. Restart the Attunity Replicate Server service.

The new "prefix\_with" function will be available in the Expression Builder under **Functions->User Defined**.

## Task Settings

Task-specific replication settings can be configured in the **Task Settings** dialog box.

### To open the Task Settings dialog box:

1. Open the desired task.

For information on opening a task, see [Editing a Replication Task](#).

2. Click the **Task Settings** toolbar button.

3. In the **Task Settings** dialog box, select one of the following tabs according to the setting(s) you want to configure:

[Metadata](#)

[Target Metadata](#)

[Control Tables](#)

[Bidirectional](#)

[Full Load](#)

[Full Load Settings](#)

[Full Load Tuning](#)

[Change Processing](#)

[Apply Changes Settings](#)

[Store Changes Settings](#)

[Change Processing Tuning](#)

[Error Handling](#)

[Error Handling Settings](#)

[Environmental Errors](#)

[Data Errors](#)

[Table Errors](#)

[Apply Conflicts](#)

[Logging](#)

[Storing Trace and Verbose Logging in Memory](#)

[Character Substitution](#)

## Metadata

When you click **Metadata** in the Task Settings dialog box, you can configure the **Target Metadata Settings** for a replication task.

### Target Metadata

**Target table schema: (if empty, use the schema from the source table):** This will automatically add the owner prefix for the target endpoint to all tables if no source schema is defined.

**Note** When replicating to a Hadoop target endpoint, the value specified in this field will be interpreted as a database name (as opposed to a schema name).

### LOB Handling Options

For information on how to override these settings for individual tables, see [Handling LOB Columns](#).

**Note** LOB data types are supported only in tables that include a primary key.

The following LOB handling options are available:

| Option                                                                                                                                                                                                                                                                                                               | Description                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Replicate LOB columns                                                                                                                                                                                                                                                                                                | <p>When this option is selected (the default), LOB columns will be replicated.</p> <p>Note that replicating LOBs may impact performance. This is especially true in the case of the large LOBs which require Replicate to perform a lookup from the source table in order to retrieve the source LOB value.</p>                                                                                                                                         |
| Allow unlimited LOB size                                                                                                                                                                                                                                                                                             | <p>Select this option - also known as Full LOB mode - to ensure that all LOBs are replicated without being truncated. This option should be selected when all (or nearly all) of the LOBs you wish to replicate are large (i.e. exceed 1 GB).</p>                                                                                                                                                                                                       |
| Optimize handling when LOB size is less than (KB)                                                                                                                                                                                                                                                                    | <p>Select this option when you need to replicate both small and large LOBs, and most of the LOBs are small.</p> <p>When this option is selected, during Full Load, Replicate will transfer the small LOBs "inline" (which is more efficient), and the large LOBs by performing a lookup from the source table.</p> <p>During Change Processing, however, both small and large LOBs will be replicated by performing a lookup from the source table.</p> |
| <p><b>Note</b> This option is supported with the following endpoints only:</p> <ul style="list-style-type: none"> <li>» <b>Sources:</b> Oracle, Microsoft SQL server, MySQL, PostgreSQL, IBM DB2 for LUW, and Sybase ASE.</li> <li>» <b>Targets:</b> Oracle, Microsoft SQL Server, MySQL, PostgreSQL, and</li> </ul> | <p><b>Note</b> When this option is selected, Replicate will check all of the LOB sizes to determine which ones to transfer "inline". LOBs larger than the specified size will be replicated using Full LOB mode.</p> <p>Therefore, if you know that most of the LOBs are larger than the specified setting, it is better to use the <b>Allow unlimited LOB size</b> option instead.</p>                                                                 |

## Sybase ASE.

## Chunk size (KB)

Optionally, change the size of the LOB chunks to use when replicating the data to the target. The default chunk size should suffice in most cases, but if you encounter performance issues, adjusting the size may improve performance.

**Note** With some databases, data type validation occurs when the data is inserted or updated. In such cases, replication of structured data types (e.g. XML, JSON, GEOGRAPHY, etc.) may fail if the data is bigger than the specified chunk size.

## Limit LOB size to (KB)

Select this option if you only need to replicate small LOBs or if the target endpoint does not support unlimited LOB size. The maximum permitted value for this field is 102400 KB (100 MB).

When replicating small LOBs, this option is more efficient than the **Allow unlimited LOB size option** since the LOBs are replicated "inline" as opposed to via "lookup" from the source.

**Notes**

- » Any LOBs larger than the specified size will be truncated.
- » During Change Processing, small LOBs will be replicated via "lookup" from the source.
- » As Replicate converts LOBs to binary format, it's recommended to specify the size of the largest LOB you need to replicate, multiplied by three. For example, if the largest LOB is 2 MB, specify 6 MB.

**Important** In some scenarios, tasks configured to replicate tables with multiple LOB columns may consume a large amount of memory. This is because Replicate allocates memory by multiplying the **Limit LOB size to** value by the **Commit rate during full load** value, the sum of which it multiplies by the number of LOB columns being replicated. So, for example, if LOB size is limited to 5 MB and the default commit rate is used (10000 events), a task replicating 6 LOB columns will consume 30 GB of memory.

Should you encounter memory consumption issues and suspect that a combination of the above factors may be the cause, stop the task and lower the value in the [Commit rate during full load](#) field. Then resume the task. Repeat this process until acceptable performance/memory levels are reached.

These instructions apply to Change Processing and Full Load tasks.

**Note** Changes to a column's LOB size while a task is running will not be reflected in the Change Table, unless the target tables are created by Attunity Replicate. In such cases, the task must be configured to drop and create the Change Table (the default) and the target tables need to be reloaded (after the LOB size has changed).

For more information on the Change Table, see [Store Changes Settings](#). For information on reloading target tables, see [Reload Target](#) and [Reload](#).

## Control Tables

Control Tables provide information about the replication task as well as useful statistics that can be used to plan and manage both the current replication task and future replication tasks. Aside from the **Apply Exceptions** table which is always created, you can [choose which Control Tables to create on the target](#).

**Create target control tables in schema:** Enter the endpoint schema for the target Control Tables. If you do not enter any information in this field, then the tables will be created in the default location in the endpoint.

**Note** When this field is left empty, the target endpoint is MySQL, and the Multiple Endpoints option is enabled, a default database named `attrrep_control` will be created on the MySQL server. The selected control tables will be created in this database.

For more information on the Multiple Endpoints option, see [Setting General Connection Properties](#).

**Note** When replicating to a Hadoop target endpoint, the value specified in this field will be interpreted as a database name (as opposed to a schema name).

**Create target control tables in tablespace:** When the target endpoint is Oracle, specify the tablespace where you want the target control tables to be created. If you do not enter any information in this field, the tables will be created in the default tablespace in the target database.

**Create target control table indexes in tablespace:** When the target endpoint is Oracle, specify the tablespace where you want the control table indexes to be created. If you do not enter any information in this field, the indexes will be created in the same tablespace as the control tables.

**Replication history time slot (minutes):** The length of each time slot in the Replication History table. The default is 5 minutes.

## Table Selection

In addition to the **Apply Exceptions** table (required), select which of the following Control Tables you want Attunity Replicate to create on the target endpoint:

- » **Replication Status:** Provides details about the current task including task status, amount of memory consumed by the task, number of changes not yet applied to the target and the position in the source endpoint from which Attunity Replicate is currently reading.
- » **Suspended Tables:** Provides a list of suspended tables as well as the reason they were suspended.
- » **Replication History:** Provides information about the replication history including the number and volume of records processed during a replication task, latency at the end of a CDC task, among others.
- » **Change Data Partitions:** The **attrep\_cdc\_partitions** table contains records of partitions created on the target database when [Change Data Partitioning](#) is enabled for a Replicate task. You can use this information to identify partitioned data that needs to be further processed.
- » **DDL History:** The **attrep\_ddl\_history** table contains a history of all supported DDL changes that occurred during a task.

For a list of DDL changes supported by Replicate, see [Supported DDL Statements](#). Note that DDL changes written to this Control Table are also subject to the limitations described in the section in [Limitations when Capturing DDL Changes](#).

**Note** Currently, the DDL History table is only supported with the Hadoop target endpoint.

For a detailed description of these tables, see [Control Tables](#).

## Bidirectional

This tab is only applicable to bidirectional replication tasks. When you click **Bidirectional** in the **Task Settings** dialog box, the **Loopback Prevention** tab is displayed. In bidirectional replication, loopback prevention is a mechanism that prevents the same data from being replicated back and forth in an endless loop. To enable loopback prevention, you need to specify a source and target **Loopback prevention table schema**.

Bidirectional replication consists of two separate tasks: Task 1 captures changes made to Endpoint A and replicates them to Endpoint B. Task 2 captures changes made to Endpoint B and replicates them to Endpoint A. When configuring Task 1 of a bidirectional replication setup, the source loopback prevention table schema must be identical to the target

loopback prevention table schema specified in the **Loopback Prevention** settings of Task 2.

Likewise, when configuring Task 2 of a bidirectional replication setup, the source loopback prevention table schema must be identical to the target loopback prevention table schema specified in the **Loopback Prevention** settings of Task 1.

**Note** Oracle schemas are case-sensitive. Therefore, when specifying an Oracle table schema, make sure to use the *correct case* in the **Loopback Prevention** settings in both Tasks.

For instructions on setting up bidirectional replication, see [Bidirectional Replication](#).

## Full Load

When you click **Full Load** in the Task Settings dialog box, you can configure the following:

- » [Full Load Settings](#)
- » [Full Load Tuning](#)

### Full Load Settings

Click the **Full Load Settings** sub-tab to configure the following:

#### Full is ON/OFF.

Click this button to toggle full load on or off. The initial setting is determined when [Adding Tasks](#).

When full load is ON, Attunity Replicate loads the initial source data to the target endpoint.

**Note** Full load can be turned on or off at any stage even if change processing is on. Once the task begins to process changes, the full load on/off switch is used only as additional protection against accidental or unauthorized reload.

### Target table preparation:

**If target table already exists:** Select one of the following from the list to determine how you want to handle loading the target at *full-load start up*:

**Note** The option to drop or truncate the target tables is relevant only if such operations are supported by the source endpoint.

- » **DROP and Create table:** The table is dropped and a new table is created in its place.
- » **TRUNCATE before loading:** Data is truncated without affecting the table metadata.  
Note that when this option is selected, enabling the [Create primary key or unique index after full load completes](#) option will have no effect.

- » **ARCHIVE and CREATE table:** A copy of the existing table will be saved to the same schema before the new table is created. The archived table name will be appended with a timestamp, indicating when the archiving operation occurred (e.g. `Customers_20170605175601`).

**Note** Currently this option is only available for the [Hadoop target endpoint](#).

- » **Do nothing:** Existing data and metadata of the target table will not be affected. New data will be added to the table.

**Note** Replicate expects the source column data types to be compatible with the corresponding target column data types. If you choose either **TRUNCATE before loading** or **Do nothing** and one or more target data types are different than the data types for the corresponding source columns, use a transformation to convert the data types as required.

For information on creating data type transformations, see [Defining Transformations for a Single Table/View](#).

**Create primary key or unique index after full load completes:** Select this option if you want to delay primary key or unique index creation on the target until after full load completes.

**After Full Load completes, stop the task:** You can set the task to stop automatically after Full Load completes. This is useful if you need to perform DBA operations on the target tables before the task's Apply Changes (i.e. CDC) phase begins.

During Full Load, any DML operations executed on the source tables are cached. When Full Load completes, the cached changes are automatically applied to the target tables (as long as the **Before/After cached changes have been applied** option(s) described below are disabled).

**Note** This feature is not available for bidirectional replication tasks.

Select **Before cached changes have been applied** to stop the task before the cached changes are applied and/or **After cached changes have been applied** to stop the task after the cached changes are applied.

Selecting the **Before cached changes have been applied** option will stop the task immediately after Full Load completes. Selecting the **After cached changes have been applied** option will stop the task as soon as data is consistent across all tables in the task.

### Note

When configuring Replicate to stop the task after Full Load completes, note the following:

- » The task will stop after Full Load completes even if there are no cached changes to apply.
- » Choosing to stop the task *before* cached changes have been applied may adversely affect performance, since the cached changes will only be applied to tables (even those that have already completed Full Load) *after* the last table completes Full Load.
- » When the **Before/After cached changes have been applied** option is selected and a DDL is executed on one of the source tables during the Full Load process (in a Full Load and Apply Changes task), Replicate will reload the table. This effectively means that any DML operations executed on the source tables will be replicated to the target *before* the task stops.
- » When working with the File Channel endpoint, these options should be set in the remote File Channel task and not in the local File Channel task.

For more information on the File Channel endpoint, see [Using the Attunity Replicate File Channel](#).

## Full Load Tuning

Click the **Full Load Tuning** sub-tab to configure the following:

### Tuning settings

- » **Maximum number of tables to load in parallel:** Enter the maximum number of tables to load into the target at one time. The default value is **5**.
- » **Transaction consistency timeout (seconds):** Enter the number of seconds that Attunity Replicate waits for transactions to close, if they are open when the task starts, before beginning the Full Load operation. The default value is **600** (10 minutes). Attunity Replicate will begin the full load after the timeout value is reached even if there are open transactions.

**Note:** To replicate transactions that were open when Full Load started but were only committed *after* the timeout value was reached, you need to reload the target tables.

- » **Commit rate during full load:** The maximum number of events that can be transferred together. The default value is **10000**.

## Change Processing

When you click **Change Processing** in the **Task Settings** dialog box, you can configure the following:

- » [Apply Changes Settings](#)
- » [Store Changes Settings](#)
- » [Change Processing Tuning](#)

### Apply Changes Settings

Click the **Apply Changes Settings** sub-tab to configure the following:

#### **Apply Changes is ON/OFF.**

Click this button to toggle Apply Changes (Change Processing) on or off. The initial setting is determined when [Adding Tasks](#).

When Apply Changes is ON, Attunity Replicate processes the changes. You can view the change processing in the Monitor. For more information, see [Monitoring Change Processing Operations](#).

**Note** When you turn on apply changes you must reload the task or position back to the point of the previous reload.

**DDL handling policy:** Determine how to handle the target table for the change capture:

#### **Notes**

- » Executing a DDL on a source table during the Full Load process in a Full Load and Apply Changes task will cause Replicate to reload the table.
- » The option to drop or truncate the target tables is relevant only if such operations are supported by the source endpoint.

- » When source table is dropped, select one of the following:
  - » **DROP target table**
  - » **Ignore Drop**
- » When source table is truncated, select one of the following:
  - » **TRUNCATE target table**
  - » **Ignore TRUNCATE**
- » When source table is altered, select one of the following:
  - » **ALTER target table**
  - » **Ignore ALTER**

## Store Changes Settings

When you click **Store Changes** in the Task Settings dialog box, you can configure the **Store Changes Settings** for a replication task.

### Store changes processing is ON/OFF

Click this button to toggle **Store Changes** on or off. The initial setting is determined when [Adding Tasks](#). If this option is ON, changes are stored in either Change Tables or an audit table.

For more information about storing and applying changes, see [Using an Audit Table](#) and [Using the Change Table Model](#).

**Note** Store Changes can be turned on or off at any time without affecting anything in the task. Changes that are processed and not stored as a result of change storage being turned off can be recovered only by setting the task to an earlier point in time.

If Store Changes is **ON**, use the following options to determine how to store changes. Changes can be stored in Change Tables or in a single Audit table. From the **Store changes in** drop-down list, choose either **Change tables** or **Audit table** according to your needs.

## Storing Changes in Change Tables

The following section describes the options that are available when storing changes in Change Tables.

- » **Suffix:** Type a string to use as the suffix for all Change Tables. The default value is `_ct`.

The Change Table names are the name of the target table with the suffix appended. For example, if you have a table called HR and use the default value, the name of the Change Table will be `HR_ct`.

For more information, see [Working with Change Tables](#).

- » **Header column prefix:** Type a string to use as the prefix for all of the Change Table header columns. The default value is `header_`.

For example, the header column `stream_position` when using the default value is called `header_stream_position`.

For more information, see [Change Tables](#).

- » **DDL options:** Select one of the following options to determine how to handle DDL operations on the source tables:

» **Apply to Change Table:** Apply the DDL to the Change Table as well. For example, when this option is enabled and a column is added to one of the source endpoint tables, the column will also be added to the corresponding Change Table.

» **Ignore:** The change event from any DDL is ignored.

- » **On UPDATE:** Select one of the following options to determine how to store UPDATES to the source tables:
  - » **Store before and after image:** To store both the pre-UPDATE data and the post-UPDATE data.
  - » **Store after image only:** To store only the post-UPDATE data.

#### Change table creation:

**If Change Table exists when full load starts:** Select one of the following from the list to determine how you want to handle loading the Change Tables at *full-load startup*:

- » **DROP and CREATE Change Table:** The table is dropped and a new table is created in its place.
- » **ARCHIVE and CREATE Change Table:** A copy of the existing table will be saved to the same schema before the new table is created. The archived table name will be appended with a timestamp, indicating when the archiving operation occurred (e.g. `Customers__ct_20170605175601`).

**Note** Currently this option is only available for the [Hadoop target endpoint](#).

- » **Delete old changes and store new changes in existing Change Table:** Data is truncated and added without affecting the table metadata.
- » **Keep old changes and store new changes in existing Change Table:** Data and metadata of the existing Change table are not affected.

## Change Data Partitioning

**Note** This feature is supported with the following endpoints only:

- » Hadoop target
- » File target
- » Amazon S3 target
- » Microsoft Azure HDInsight

In a standard replication task, changes are replicated to the target in no particular order. Change Data Partitioning enables processing of Change Data from many tables in a consistent fashion. You can define the duration of partitions as well as the partitioning base time, thereby ensuring overall consistency of the partitioned data (i.e. no partial transactions, no order headers without order lines, and so on.)

The partitioned data is stored in the Replicate Change Tables. When the [Change Data Partitions](#) table is selected (in the [Control Tables](#) tab), information about the partitions will be recorded in the [atrep\\_cdc\\_partitions](#) Control Table on the target database. This information can be used to identify partitioned data that needs to be further processed.

The partitioning options are as follows:

- » **Off** - Replicate Change Data without partitioning.
- » **Partition every** - Specify the length (in hours and minutes) of each partition.

**Note** It is recommended to specify a partition length in excess of one hour. Although specifying a partition length less than one hour may improve latency, creating many partitions on the target may also impact (target) performance.

- » **Partition base time** - Partitions are created during a 24 hour time period, which is calculated according to the specified "Partitioning base time" on the source database (in UTC time). For example, a partition interval of 8 hours with a "Partitioning base time" time of 02:00 will create the following partitions: 02:00-10:00, 10:00-18:00, 18:00-02:00 - but not necessarily in that order. For instance, if a task started at 01:00, then the timeframe of the first partition will be 18:00-02:00. Additionally, if a task started in the middle of a partition (e.g. at 04:00), its Change Data will be inserted into the 02:00-10:00 partition (even though no changes were captured before 04:00).

**Note** If there are existing Change Tables that were created before Change Data Partitioning was enabled, you need to drop/rename them so that they can be recreated with the [additional "partition\\_name" column](#).

## Selecting Change Table Header Columns

The Change Table header columns provide information about the Change Processing operation such as the type of operation (e.g. INSERT), the commit time, and so on. If you do not need this information, you can configure Replicate to create the Change Tables without some or all of the header columns, thereby reducing their footprint in the target database. To do this, clear the check boxes next to the header columns that you wish to exclude.

Note that you cannot remove additional columns or restore columns while a task is running. To change your initial selection, you first need to stop the task, then modify your selection, and finally reload the target tables.

**Note** When [Change Data Partitioning](#) is enabled, an extra header column named "partition\_name" is added to the Change Tables and automatically selected in the UI. As this column is required, it cannot be excluded.

For a description of the header columns, see [Change Tables](#).

## Storing Changes in an Audit Table

The following section describes the options that are available for storing changes in an Audit table.

**Note** LOB columns with unlimited size are not supported in the CHANGE\_RECORD and BU\_CHANGE\_RECORD fields. The other fields will be recorded but the LOB will have a NULL value.

For a description of the audit table structure, see [Using an Audit Table](#).

- » **Audit table schema:** Specify a schema if you do not want the Audit table to be created under the target endpoint's default schema.

The default schema are as follows:

| Endpoint          | Default Schema                  |
|-------------------|---------------------------------|
| Pivotal Greenplum | Public                          |
| Amazon Redshift   | Public                          |
| Oracle            | The connected user's user name. |
| Teradata          | The endpoint name.              |
| All others        | The user's default schema.      |

- » **Audit table tablespace:** This option is only available when the task's target endpoint is Oracle. Enter the tablespace name on the target where you want the Audit table to be created. If you do not enter any information in this field, then the tables will be created in the default permanent tablespace.

- » **Audit table name:** Specify a name for the Audit table.

The default value is `attrep_audit_table`.

#### Audit table creation:

**If audit table exists when the target is reloaded:** Select one of the following to determine how you want to handle the Audit table when the target is reloaded:

- » **DROP and CREATE audit table:** The Audit table is dropped and a new table is created in its place.
- » **ARCHIVE and CREATE audit table:** A copy of the existing table will be saved to the same schema before the new table is created. The archived table name will be appended with a timestamp, indicating when the archiving operation occurred (e.g. `attrep_audit_table_20170605175601`).

**Note** Currently this option is only available for the [Hadoop target endpoint](#).

- » **Delete old changes and store new changes in existing audit table:** Data is truncated and added without affecting the Audit table metadata.
- » **Keep old changes and store new changes in existing audit table:** Data and metadata of the existing Audit table are not affected.

For a description of the audit table structure, see [Using an Audit Table](#).

## Change Processing Tuning

Click the **Change Processing Tuning** sub-tab to fine-tune the Apply Changes settings.

### Change Processing Mode

Determine which method will be used to apply changes.

**Note** Changes to tables without a Unique Index or Primary Key will always be applied in **Transactional apply** mode.

» **Transactional apply:** Select this to apply each transaction individually, in the order it is committed. In this case, strict referential integrity is ensured for all tables.

**Note** Applying cached events in transactional mode to endpoints that do not enforce constraints (such as HP Vertica and IBM Netezza), may result in duplicate records on the target. This is because such endpoints do not return duplicate errors.

» **Batch optimized apply:** Select this to commit the changes in batches. In this case, a pre-processing action occurs to group the transactions into batches in the most efficient way. This may affect transactional integrity. Therefore, you must select one of the following to determine how the system will handle referential integrity issues:

» Preserve transactional integrity

**Note** This option is only supported when replicating to an Oracle target.

» Allow temporary lapses in transactional integrity to improve performance

**Note** These options are not displayed in bidirectional tasks since such tasks always use the "Preserve transactional integrity" option.

**Note** The following target endpoints do not support applying binary data types in Batch Optimized Apply mode:

ODBC, SAP Sybase IQ, SAP Sybase ASE, HP Vertica, IBM Netezza, Teradata, and Amazon Redshift.

**Note** When LOB columns are included in the replication, **Batch optimized apply** can only be used with the **Limit LOB size to** option. For more information about including LOB columns in the replication, see [Metadata](#).

## Batch Tuning

The following options are available when **Batch optimized apply** is selected as the **Change Processing Mode**:

» **Apply batched changes in intervals:**

- » **Longer than:** The minimum amount of time to wait between each application of batch changes. The default value is **1**.

Increasing the **Longer than** value decreases the frequency with which changes are applied to the target while *increasing* the size of the batches. This can improve performance when applying changes to target endpoints that are optimized for processing large batches, such as Teradata, HP Vertica, and Pivotal Greenplum.

- » **But less than:** The maximum amount of time to wait between each application of batch changes (before declaring a timeout). In other words, the maximum acceptable latency. The default value is **30**. This value determines the maximum amount of time to wait before applying the changes, after the **Longer than** value has been reached.

- » **Force apply a batch when processing memory exceeds (MB):** The maximum amount of memory to use for pre-processing in **Batch optimized apply mode**. The default value is **500**.

For maximum batch size, set this value to the highest amount of memory you can allocate to Attunity Replicate. This can improve performance when applying changes to target endpoints that are optimized for processing large batches, such as Teradata, HP Vertica, and Pivotal Greenplum.

- » **Limit the number of changes applied per change processing statement to:**  
To limit the number of changes applied in a single change processing statement, select this check box and then optionally change the default value. The default value is **10,000**.

The following options are available when **Transactional apply** is selected as the **Change Processing Mode**:

- » **Minimum number of changes per transaction:** The minimum number of changes to include in each transaction. The default value is **1000**.

**Note** Replicate applies the changes to the target either when the number of changes is equal to or greater than the **Minimum number of changes per transaction** value OR when the batch timeout value is reached (see below) - whichever occurs first. Because the frequency of changes applied to the target is controlled by these two parameters, changes to the source records may not immediately be reflected in the target records.

- » **Maximum time to batch transactions before applying (seconds):** The maximum time to collect transactions in batches before declaring a timeout. The default value is **60**.

## Transaction Offload Tuning

The following tuning options are available, regardless of which **Change processing mode** is selected:

- » **Offload transaction in progress to disk if:**

Attunity Replicate usually keeps transaction data in memory until it is fully committed to the source and/or target. However, transactions that are larger than the allocated memory or that are not committed within the specified time limit will be offloaded to disk.

- » **Transaction memory size exceeds (MB):** The maximum size that all transactions can occupy in memory before being offloaded to disk. The default value is **1000**.
- » **Transaction duration exceeds (seconds):** The maximum time that each transaction can stay in memory before being offloaded to disk. The duration is calculated from the time that Attunity Replicate started capturing the transaction. The default value is **60**.

## Miscellaneous Tuning

- » **Statements cache size (number of statements):** The maximum number of prepared statements to store on the server for later execution (when applying changes to the target). The default is 50. The maximum is 200.
- » **Store task recovery data in target database:** Select this option to store task-

specific recovery information in the target database. When this option is selected, Replicate creates a table named `attrep_txn_state` in the target database. This table contains transaction data that can be used to recover a task in the event that the files in the **Data** folder are corrupted or if the storage device containing the **Data** folder has failed.

For more information about this option, see [Recovering from Data Folder Loss or Corruption](#).

## Error Handling

Attunity Replicate handles different types of errors during its operation. The way the system should respond to these errors depends on several aspects, including the component where the error occurred, the type of error, and the scope of the error. Because different sites may have different requirements for error behavior, Attunity Replicate lets you configure the error handling.

You can also add an environment variable that instructs Replicate to create dump files in the event of a crash. The dump files can then be used by Attunity Support to troubleshoot the cause of the crash. For more information, see [Creating Dump Files](#).

When you click **Error Handling** in the **Task Settings** dialog box, you can configure the following:

- » [Error Handling Settings](#): You can determine whether or not to override the global error handling settings.
- » [Environmental Errors](#): An error that is caused by an environmental problem in the source or target endpoint or on the network. Some examples of environmental errors are loss of communication with the source or target endpoint, restarting a database, or network problems.
- » [Data Errors](#): An error related to data processing at the record level. Some examples of data errors are conversion errors, errors in transformations, or bad data.
- » [Table Errors](#): An error in processing data or metadata for a specific table. This only includes general table data and not an error that relates to a specific record.
- » [Apply Conflicts](#): Errors that occur when the target endpoint is not synchronized with the source endpoint when processing changes.

This can cause duplicate key errors on INSERT operations or zero rows affected on UPDATE/DELETE operations.

### Error Handling Settings

The option to switch between the Global Error Handling policy and a Task Error Handling policy is available in each of the **Error Handling** sub-tabs. However, the policy you enable will be applied to all error types, regardless of where it was enabled. For example, you cannot enable a Task Error Handling policy for Data Errors and then enable the Global Error Handling policy for Table Errors and Environmental Errors.

For information on setting the global error handling policy, see [Global Error Handling](#).

**To set a Task-Specific Error Handling policy:**

- » Click the **Change to Task Policy** button in any of the **Error Handling** sub-tabs.

**To revert to the Global Error Handling policy:**

1. Click the **Change to Global Policy** button in any of the **Error Handling** sub-tabs.
2. Click **OK** when prompted to confirm your action.

## Environmental Errors

Click the **Environmental Errors** sub-tab and then click [Change to Task Policy](#) to configure the following:

- » **Maximum retry count:** Select this option and then specify the maximum number of attempts to retry a task when a recoverable environmental error occurs.
  - » To never retry a task, specify "0".
  - » To retry the task an infinite number of times, clear the check box or specify "-1" (the global error handling default).
- When the system attempts to retry the task the designated number of times, the task is stopped and manual intervention is required.
- » **Interval between retry attempts:** Use the counter to select or type the number of seconds that the system waits between attempts to retry a task.
- » **Increase retry interval for long outages:** Select this check box to increase the retry interval for long outages. When this option is enabled, Replicate doubles the interval between each retry attempt and the next, until the **Maximum retry interval** is reached (and continues retrying according to the specified maximum interval).
- » **Maximum retry interval:** Use the counter to select or type the number of seconds to wait between attempts to retry a task when the **Increase retry interval for long outages** option is enabled.

## Data Errors

Click the **Data Error** sub-tab and then click [Change to Task Policy](#) to configure the following:

- » **For a data truncation error:** Click the triangle to open the list and select what happens when an truncation occurs in one or more specific records. You can select one of the following from the list:
  - » **Ignore record:** The task continues and the error is ignored.
  - » **Log record to the exceptions table** (default): The task continues and the error is written to the exceptions table.
  - » **Suspend table:** The task continues but data from the table with the error record is moved into an error state and its data is not replicated
  - » **Stop task:** The task is stopped and manual intervention is required.

**Notes** Data truncation error handling is only supported in the following cases:

- » Replication is to the following target endpoints: MySQL, PostgreSQL, Oracle, Microsoft SQL Server, SAP Sybase ASE, File, and Amazon Redshift.
- » Change Processing replication only (i.e. not Full Load)
  
- » **For other data errors:** Click the triangle to open the list and select what happens when an error occurs in one or more specific records. You can select one of the following from the list:
  - » **Ignore record:** The task continues and the error is ignored.
  - » **Log record to the exceptions table** (default): The task continues and the error is written to the exceptions table.
  - » **Suspend table:** The task continues but data from the table with the error record is moved into an error state and its data is not replicated
  - » **Stop task:** The task is stopped and manual intervention is required.
- » **Escalate error handling when other data errors reach (per table):** Select this check box to escalate error handling when the number of non-truncation data errors (per table) reaches the specified amount.
  - » **Escalation action:** Choose what action Replicate should perform when error handling is escalated. Note that the available actions are dependent on the action selected from the **For other data errors** drop-down list described above.
    - » **Log record to the exceptions table:** The task continues and the error is written to the exceptions table.
    - » **Suspend table** (default): The task continues but data from the table with the error record is moved into an error state and its data is not replicated.

**Notes** The behavior differs according to the Change Processing Mode:

- » In **Transactional apply** mode, the last changes will not be replicated
- » In **Batch optimized apply** mode, a situation is possible where there will be no replication of data or data replication will occur in part

- » **Stop task:** The task is stopped and manual intervention is required.

## Table Errors

Click the **Table Errors** sub-tab and then click [Change to Task Policy](#) to configure the following:

- » **When encountering a table error:** Select one of the following from the drop-down list:
  - » **Suspend table** (default): The task continues but data from the table with the error record is moved into an error state and its data is not replicated

- » **Stop task:** The task is stopped and manual intervention is required.
- » **Escalate error handling when table errors reach (per table):** Select this check box to escalate error handling when the number of table errors (per table) reaches the specified amount.
- » **Escalation action:** The escalation policy for table errors is set to **Stop task** and cannot be changed.

## Apply Conflicts

Click the **Apply Conflicts** sub-tab and then click [Change to Task Policy](#) to configure the following:

- » **No record found for applying a DELETE:** Click the triangle to open the list and select what happens when there is a conflict with a DELETE operation. You can select one of the following from the list:
  - » **Ignore record** (default): The task continues and the error is ignored.
  - » **Log record to the exceptions table:** The task continues and the record is written to the exceptions table.
  - » **Suspend table:** The task continues but data from the table with the error record is moved into an error state and its data is not replicated.
  - » **Stop task:** The task is stopped and manual intervention is required.
- » **Duplicate key when applying an INSERT:** Click the triangle to open the list and select what happens when there is a conflict with an INSERT operation. You can select one of the following from the list:
  - » **Ignore record:** The task continues and the error is ignored.
  - » **Log record to the exceptions table** (default): The task continues and the record is written to the exceptions table.
  - » **Suspend table:** The task continues but data from the table with the error record is moved into an error state and its data is not replicated.
  - » **Stop task:** The task is stopped and manual intervention is required.
  - » **Update the existing target record:** The target record with the same primary key as the INSERTED source record is updated.
- » **No record found for applying an UPDATE:** Click the triangle to open the list and select what happens when there is a conflict with an UPDATE operation. You can select one of the following from the list:
  - » **Ignore record:** The task continues and the error is ignored.
  - » **Log record to the exceptions table** (default): The task continues and the record is written to the exceptions table.
  - » **Suspend table:** The task continues but data from the table with the error record is moved into an error state and its data is not replicated
  - » **Stop task:** The task is stopped and manual intervention is required.
  - » **Insert the missing target record:** The missing target record will be inserted

into the target table. When the source endpoint is Oracle, selecting this option requires supplemental logging to be enabled for all the source table columns.

**Note** When this option is selected, LOB columns in the source tables will not be replicated to the target.

- » **Escalate handling when apply conflicts reach (per table):** Select this check box to escalate error handling when the number of apply conflicts (per table) reaches the specified amount.

**Note** When working in [Batch optimized apply](#) Change Processing mode, the calculation of the Apply Conflicts amount does not include DELETE and UPDATE conflicts that were ignored (as a result of enabling the **Ignore Record** option described above).

- » **Escalation action:** Choose what action Replicate should perform when handling is escalated. Note that the available actions are dependent on the action selected in the [drop-down lists described above](#).
  - » **Log error** (default): The task continues and the error is written to the task log.
  - » **Suspend table:** The task continues but data from the table with the error record is moved into an error state and its data is not replicated
  - » **Stop task:** The task is stopped and manual intervention is required.

**Note** When you select **Fix record** you must be sure that you are using full supplemental logging to ensure that an UPDATE is not turned into an INSERT. In other cases, FIX\_RECORD can cause an async full load of a record similar to the LOB channel.

## Logging

You can set the logging level for task logs by selecting the **Logging** tab in the **Task Settings** dialog box and then selecting the **Logging Level** sub-tab. The level you set determines what information is written to the log.

**Note** You can also set the task logging level from the **Tools** menu in Monitor view.

For more information, see [Monitor Mode](#) and [Setting the Task Logging Level](#).

The following are the available logging levels. The list is in order from the lowest level to the highest level.

1. Error
2. Warning
3. Info

4. Trace
5. Verbose

The higher levels always include the messages from the lower levels. Therefore, if you select **Error**, only error messages are written to the log. However, if you select **Info**, informational messages, warnings, and error messages are included. Selecting **Verbose** writes all possible messages to the log.

For information on how to set the logging level, see [Setting the Task Logging Level](#).

## Storing Trace and Verbose Logging in Memory

When the logging level is set to "Trace" or "Verbose", you can instruct Replicate to store the logging information in memory until an error occurs. On detecting an error, Replicate will begin writing to the physical logs and continue to do so for a few minutes after the initial occurrence of the error.

If *no* error occurs before the allocated memory is used up, Replicate will empty the memory buffer and start afresh.

This option is useful for tasks that fail unpredictably and for no obvious reason. The problem with continually writing large amounts of information to the logs is twofold:

- » Running in "Trace" or "Verbose" logging mode will quickly use up available disk space (unless the logging settings have been configured to prevent this).
- » Continually writing large amounts of data to the logs will affect performance.

### To use this option

1. Select the **Store trace/verbose logging in memory, but if an error occurs, write to the logs** check box at the top of the tab.
2. In the **Allocate memory up to (MB)** field, specify the amount of memory you want to allocate for storing logging information.

## Character Substitution

You can substitute or delete source characters in the target database and/or you can substitute or delete source characters that are not supported by a selected character set.

### Notes

- » All characters must be specified as Unicode code points.
- » Character substitution will also be performed on Replicate Control Tables.
- » Invalid values will be indicated by a red triangle in the top right of the table cell. Hovering your mouse cursor over the triangle will show the error message.
- » Any table-level or global transformations defined for the task will be performed *after* the character substitution has been completed.

- » Substitutions actions defined in the **Substitute or Delete Source Characters** table are performed *before* the substitution action defined in the **Substitute or Delete Source Characters Unsupported by the Selected Character Set** table.

## Substituting or Deleting Source Characters

Use the **Substitute or Delete Source Characters** table to define replacements for specific source characters. This may be useful, for example, when the Unicode representation of a character is different on the source and target platforms. For example, on Linux, the minus character in the Shift\_JIS character set is represented as U+2212, but on Windows it is represented as U+FF0D.

| To                                            | Do This                                                                                                                                                                                                                                                                                                                                                       |
|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Define substitution actions.                  | <ol style="list-style-type: none"><li>1. Click the <b>Add Character</b> button above the table.</li><li>2. Specify a source character and a target character in the <b>Source Character</b> and <b>Substitute Character</b> fields respectively.<br/>For example to replace the letter "a" with the letter "e", specify 0061 and 0065 respectively.</li></ol> |
|                                               | <p><b>Note</b> To delete the specified source character, enter 0 in the <b>Substitute Character</b> column.</p>                                                                                                                                                                                                                                               |
|                                               | <ol style="list-style-type: none"><li>3. Repeat steps 1-2 to replace or delete additional characters.</li></ol>                                                                                                                                                                                                                                               |
| Edit the specified source or target character | Click anywhere in the relevant column and change the character as required.                                                                                                                                                                                                                                                                                   |
| Delete entries from the table                 | Select the desired entry or entries and click the <b>Delete</b> button.                                                                                                                                                                                                                                                                                       |

## Substituting or Deleting Source Characters Unsupported by the Selected Character Set

Use the **Substitute or Delete Source Characters Unsupported by the Selected Character Set** table to define a single replacement character for all characters not supported by the selected character set.

| To                                    | Do This                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Define or edit a substitution action. | <ol style="list-style-type: none"><li>1. Select a character set from the <b>Character Set</b> drop-down list in the table.<br/>Any characters not supported by the selected character set will be replaced on the target by the character specified in step 2 below.</li><li>2. In the <b>Substitute Character</b> column, click anywhere in the column and specify the replacement character. For example, to replace all unsupported characters with the letter "a", enter 0061.</li></ol> |
| Disable the substitution action.      | Select the blank entry from the <b>Character Set</b> drop-down list.                                                                                                                                                                                                                                                                                                                                                                                                                         |

**Note** To delete all unsupported characters, enter 0.

# 12 | Working with Tasks at Runtime

This section describes how to work with tasks that you design. For information on how to design a task, see [Designing Tasks](#). This chapter contains information on running tasks, viewing the task status, and viewing messages about the task. Information on monitoring and working with tasks during runtime is in the section [Monitoring and Controlling Replication Tasks](#).

## In this chapter:

[Running a Task](#)

[Viewing the Task Status](#)

[Reading Messages about a Task](#)

## Running a Task

After you design a task (see [Designing Tasks](#)), you can run and monitor its progress with one click in Attunity Replicate. This simple Click-2-Replicate function is described in this topic. In addition, the various types of run options available are also described. This topic has the following sub-topics.

- » [How to Run a Task](#)
- » [Using the Run Button Options](#)

**Note** The task run buttons area available in the toolbar at the top of the console in the following views:

- » [Tasks View](#) (in both [Designer Mode](#) and [Monitor Mode](#))
- » When [Viewing Specific Tasks](#)

## How to Run a Task

Click the **Run** button to execute a replication task. The task process continues to run until you click the **Stop** button to stop the task.

**Note** When you click **Run**, the following occurs:

- » If this is the first time that a task is run, the [Start Processing](#) operation is run.
- » If the task has been started and stopped, the **Resume Processing** operation described in [Using Advanced Run Options](#) is run.

- » If changes were made to the endpoint, change processing takes place after the full load operation. If you do not want change processing to occur or if you want to start change processing from a predetermined point, you must make the appropriate [Using Advanced Run Options](#) selection.

In some cases, task replication may stop due to an error although the task process is still running.

See [Tasks View](#) for information on the task status and how Attunity Replicate displays information on the current task status.

The **Run** button is available in the following views:

- » The Tasks view when you select a task from the Task List.
- » For the individual task, both the Designer mode and Monitor mode have the **Run** and **Stop** buttons available.

**Note** You must be in the Monitor mode to view the task progress.

## Using the Run Button Options

Clicking the **Run** button runs a full-load replication task from the source to the target. This is a first time task that creates the target endpoints and loads the source data to the target according to your task definitions.

Subsequent runs allow you to resume processing from a specific point and process changes. In addition, you can also specify from what point you want the replication to start.

The following options are available:

- » [Start Processing](#) (switches to **Resume Processing** after the task has started)
- » **Resume Processing:** Resumes task execution from the point that it was stopped. You can also resume processing by clicking the **Run** button if the task has been stopped.

**Note** If the schema or a filter was changed after the task stopped, the task should be reloaded as opposed to resumed (see below).

- » [Reload Target](#) (Only available when the **Full Load** or **Full Load and Apply Changes** replication options are enabled)
- » [Using Advanced Run Options](#)

## Start Processing

This is available the first time you run the task only. This will execute the initial full load operation. If Change Processing is also enabled for the task or if it is an Apply Changes only task type, change processing will start as soon as any changes are made to the source endpoint.

## Reload Target

Starts the Full Load and Change Processing (if enabled) from the beginning. Tables that have already been processed are handled according to the [relevant "Target table preparation" setting](#).

**Note** To replicate tables that were added to the local file channel task after the initial full load, you need to reload both the local and the remote file channel tasks.

## Using Advanced Run Options

Advanced Run Options provide you with additional options for resuming and restarting tasks.

To use Advanced Run Options, click the triangle next to the **Run** button and select **Advanced Run Options**.

The **Advanced Run Options** dialog box opens.

The **Advanced Run Options** dialog box lets you do the following:

- » **\*\*Restart task and start processing changes from current time:** This starts the Apply Changes replication task from the beginning (as if the task has not run before).  
    **\*\*Only available for Apply Changes replication tasks.**
- » **Tables are already loaded. Start processing changes from:**

**Note** When resuming a task from MySQL, the **Date and Time** or **Source change position** must always correspond to the beginning of a transaction.

- » **Date and Time:** Select the date and time from where you want to Replicate to start processing changes.

### Notes

- » When logs are deleted from the database (e.g. due to a purge policy), a log matching the specified date and time may not exist. In this case, Replicate will resume the task from the earliest point it can after the specified date and time.
- » The timestamp uses the local time of the browser machine.
- » This option is not relevant for the File Source endpoint.

- » **Source change position (e.g. SCN or LSN):** Specify the position in the log from where to resume change processing. The source change position format differs according to your source endpoint. For instance, to resume processing from a Microsoft SQL Server database, you would need to specify the LSN (e.g. 000000c1:00001d6f:0004). However, if your source endpoint is Oracle, you would need to specify the SCN (e.g. 10737419121).

**Note** The Source change position option is supported with the following source endpoints only:

Oracle, Microsoft SQL Server, MySQL, and PostgreSQL.

### Metadata Only:

The "Metadata only" options described below allow you to:

- » Create empty tables on the target and then manually edit them.
- » Create tables during a task.

Enabling the options will also ensure that supplemental logging is set up correctly on the source tables before starting the actual replication task.

- » **Recreate all tables and stop:** Select this option to recreate the target tables as defined in the **Full Load Settings** tab. When "Store Changes" is enabled, the Change tables/The Audit table will be created as defined in the **Store Changes Settings** tab. To use this option, stop the existing task, run the task with this option enabled (the task will stop automatically) and finally, resume the task.
- » **Create missing tables and stop:** Select this option to create missing target tables including Change Tables. You can use this option to create Change Tables on the target after enabling the "Store Changes" option (in the **Store Changes Settings** tab) for an existing task. To use this option, stop the existing task, run the task with this option enabled (the task will stop automatically) and finally, resume the task.

#### Recovery:

- » **Recover using locally stored checkpoint:** Use this option if recovery is not possible using the **Resume Processing** or **Start process changes from** options (due to corrupt swap files, for example). When this option is selected, Replicate uses the checkpoint data stored in <Data\_Folder\_Path>\data\tasks\<task\_name>\StateManager to recover the task.

**Note** When using this option, the following limitations apply:

- » The following source endpoints are supported only:
  - » Oracle
  - » Microsoft SQL Server
  - » MySQL
  - » PostgreSQL
  - » IBM DB2 for z/OS
  - » SAP HANA
- » Tasks can only be recovered during Change Processing (i.e. after Full Load Completes)
- » With the exception of the File Channel endpoint, all target endpoints are supported. The following limitations apply:
  - » **In Transactional apply Change Processing mode:** All target endpoints that support transactions are supported.
  - » **In Batch optimized apply Change Processing mode:** Oracle target endpoint only is supported. Also requires the **Preserve transactional integrity** option to be enabled.
  - » For all other target endpoints or Change Processing modes, recovery is supported, but may cause duplicates on the target.

- » **Recover using checkpoint stored on target:** Select to recover a task using the CHECKPOINT value from the `attrep_txn_state` table (created in the target database).

**Note** When using this option, the following limitations apply:

- » Only the following source and target endpoints are supported:
  - » Oracle
  - » Microsoft SQL Server
- » Tasks can only be recovered during Change Processing (i.e. after Full Load Completes)
- » The task Change Processing mode must be set to either:  
[Batch optimized apply](#) with the **Preserve transactional integrity** option enabled. Note that this mode is only supported with the Oracle target endpoint.  
-OR-

#### [Transactional apply](#)

For information about setting the Change Processing mode, see [Changes Processing Tuning](#).

This option will only be available if the **Store task recovery data in target database** option was enabled in the Task Settings' [Change Processing Tuning](#) tab before Change Processing completed.

Select this option (as opposed to the **Recover using locally stored checkpoint** option) if the files in the **Data** folder are corrupted or if the storage device containing the **Data** folder has failed.

For a detailed explanation of how to set up and implement recovery using the `attrep_txn_state` table, see [Recovering from Data Folder Loss or Corruption](#).

## Recovering from Data Folder Loss or Corruption

During normal operation, Attunity Replicate maintains the replication state in the following location:

`<Data_Folder_Path>\data\tasks\<task_name>\StateManager`

This enables tasks that cannot be resumed normally (due to corrupt swap files, for example) to be recovered using the **Recover using locally stored checkpoint** option described in [Using Advanced Run Options](#).

However, if the files in the **data** folder become corrupted or if the storage device containing the **data** folder fails, tasks must be recovered using the means described below.

### Setting Up and Initiating Task Recovery

For recovery to be successful, the source database transaction logs must be available from the time the task failed.

## To set up a task for recovery

1. Design a task. Make sure to enable the **Store task recovery data in target database** option in the Task Settings' [Change Processing Tuning](#) tab. This option can be enabled at any time during Change Processing, although it must be enabled *before* Change Processing completes.
2. Export the task definitions as described [Exporting Tasks](#).
3. Run the task.

In addition to the selected source tables, the task will write the checkpoint data to the following table in the target database (and automatically create the table if it has not already been created by another task):

```
attrep_txn_state
```

## To initiate recovery

1. Import the task definition exported when you set up the task.
2. Enter the passwords in the endpoint connection settings.
3. Access the `attrep_txn_state` table on the target database and locate the failed task in the `TASK_NAME` column. If there are tasks with the same name running on multiple Replicate Servers, you will also need to locate the appropriate server in the `SERVER_NAME` column. After locating the relevant task, copy the value in the corresponding `CHECKPOINT` column.
4. Select the **Recover using checkpoint stored on target** option and then provide the `CHECKPOINT` value (preferably by pasting) as described in [Using Advanced Run Options](#).
5. Click **OK** to start the recovery.

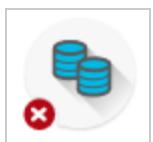
During recovery, Replicate does not write anything to the target database until it identifies the commit event corresponding to the `CHECKPOINT` value. Once it identifies the `CHECKPOINT` commit event, recovery is performed and the task reverts to standard operation.

## Viewing the Task Status

In the Tasks View, you can see the task status by viewing the icon for the task. After a task is run, the task icons in the Task view display the current status of the task. For additional information on the possible statuses, see [Tasks View](#).

The following icon represents a task that is in an error status.

There are two types of errors:

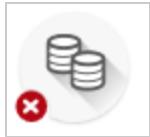


**Recoverable error:** A recoverable error indicates that there is a temporary problem, such as a missing connection. The task icon is blue indicating that the task is still active. In this case, Attunity Replicate attempts to restart the task

automatically. As soon as the error state is resolved, the task is restarted.

The task remains active but paused throughout the error state. You can stop the task at any time and resolve the error manually, if necessary.

**Note** Attunity Replicate will continue to check the task for 30 minutes to determine whether it is no longer in an error status. If the error is not resolved in 30 minutes the error becomes a fatal error and you must resolve the error manually.



**Fatal Error:** When a fatal error occurs, the task stops and you must resolve the error manually. You cannot start the task again until the error is resolved. Use the logs or the messages in the Alerts pane to see the error type.

**See also:**

[View Log Messages for a Task](#)

[Viewing Notifications](#)

## Reading Messages about a Task

Task messages are displayed in the **Messages** section of the Attunity Replicate Console. The **Messages** section is located at the bottom right of the console in the [Monitor Mode](#) and when [Viewing Specific Tasks](#).

The Message section has two types of messages that provide information about events that occur in a task. Each type of message is displayed in the following tabs:

- » [Viewing Notifications](#)
- » [View Log Messages for a Task](#)

## Viewing Notifications

The **Notifications** tab displays notifications about the task. These messages alert you to specific events encountered by a task, such as the task starting or stopping, a specific error type, or information about latency and disk space.

The **Notifications** tab displays the time of a notification and a description of the notification. You define the notifications that are sent for each task and a description for each notification in the Settings area. For more information, see [Define the Notification Message](#).

## Using the Notifications List

When a notification is sent, it is displayed in the **Notifications** tab. This section describes the tasks that can be performed in the **Notifications** tab.

### Opening a Notification

When you open a notification, you can see the full message presented in a dialog box. The dialog box contains a button to copy the text so that you can use it somewhere else for troubleshooting and the timestamp for the notification.

#### To open a notification:

1. In the Messages section of the console, click the **Notifications** tab. The **Notifications** tab opens.
2. Select the notification you want to open from the list.
3. Double-click the notification or click **Open** from the toolbar at the top of the list.

### Clearing a Notification

You can clear notifications from the list to make sure that you are seeing only those that are relevant to you.

#### To clear a notification:

1. In the Messages section of the console, click the **Notifications** tab.
2. Select the notification you want to clear from the list.
3. Click **Clear** from the toolbar at the top of the list.

### Sorting Notifications

You can sort log messages according to Date and Time and Message.

#### To sort the notifications:

1. In the **Messages** section of the console, click the **Notifications** tab.
2. Click the **Date and Time** or **Message** column according to how you want to sort the messages.

An upward arrow indicates that the column is sorted in ascending order whereas a downward arrow indicates that the column is sorted in descending order.

## View Log Messages for a Task

The **Log Messages** tab displays log messages for errors or warnings from a task. The errors are listed in this tab with the time of the error or warning and the log entry for the event. You can choose to view both errors and warnings or only one of them.

If errors or warnings exist in the task, a red circle with the total number of errors and warnings is displayed. The number displayed may be the number of errors, the number of warnings, or the total of number of errors and warnings depending on what you select to view in this tab. The **Log Messages** tab is shown in the figure below.

### Using the Log Messages List

When a log error or warning is sent, it is displayed in the **Log Messages** tab. This section describes the tasks that can be performed in the **Log Messages** tab.

#### Selecting the Log Message Type

Two types of log messages are displayed in the Log Messages List. You can view Errors, Warnings, or both.

##### To select the log message type:

- » Select the check box or boxes for the type messages you want to view. The check boxes are located at the top of the Log Messages List.

#### Opening a Log Message

When you open a log message, you can see the full log text presented in a dialog box. The dialog box contains a button to copy the text so that you can use it somewhere else for trouble shooting and the timestamp for the log message.

##### To open a log message:

1. In the **Messages** section of the console, click the **Log Messages** tab.
2. Select the log message you want to open from the list.
3. Double-click the log message or click **Open** from the toolbar at the top of the list.

#### Clearing a Log Message

You can clear log messages from the list to make sure that you are seeing only those that are relevant to you.

##### To clear a log message:

1. In the Messages section of the console, click the **Log Messages** tab.
2. Select the log message you want to clear from the list.

3. Click **Clear** from the toolbar at the top of the list.

## Sorting Log Messages

You can sort log messages according to Date and Time, Level and Message.

### To sort the log messages:

1. In the Messages section of the console, click the **Log Messages** tab.
2. Click the **Date and Time**, **Level** or **Message** column according to how you want to sort the messages.

An upward arrow indicates that the column is sorted in ascending order whereas a downward arrow indicates that the column is sorted in descending order.

## Viewing the Log file in the Log Viewer

In addition to viewing the log messages, you can view the entire log file in the log viewer.

### To view the log in the log viewer:

- » From the **Messages** section, click **View Logs**.

The Log Viewer opens.

For a description of actions you can perform in the Log Viewer, see [Viewing the Task Log Files and Manually Rolling them Over](#) .

# 13 | Monitoring and Controlling Replication Tasks

When you monitor and run a task, you can use the Click-2-Replicate function to carry out the replication task and view its functions in near real time. This section describes how to run and monitor a replication task.

## In this chapter:

- [Viewing Information in the Monitor](#)
- [Monitoring Full-Load Operations](#)
- [Monitoring Change Processing Operations](#)
- [Viewing Messages](#)
- [Using the Monitor Tools](#)

## Viewing Information in the Monitor

You access the Monitor view when you open a specific task. The monitor provides near real-time information for the task you select.

### To access the Monitor:

1. When [Viewing Specific Tasks](#), select the task you want to monitor.
2. From the toolbar at the top of the console, click **Open**.
3. From the toolbar at the top right, click **Monitor**.

The Monitor opens. To view the information in real time, you need to run the task (if the task has not already started). For information on running a task, see [Running a Task](#).

## Monitoring Full-Load Operations

You can view the progress of a full-load operation in the left side of the Monitor.

To make sure you are viewing the information for a full-load operation, select the **Full Load** tab.

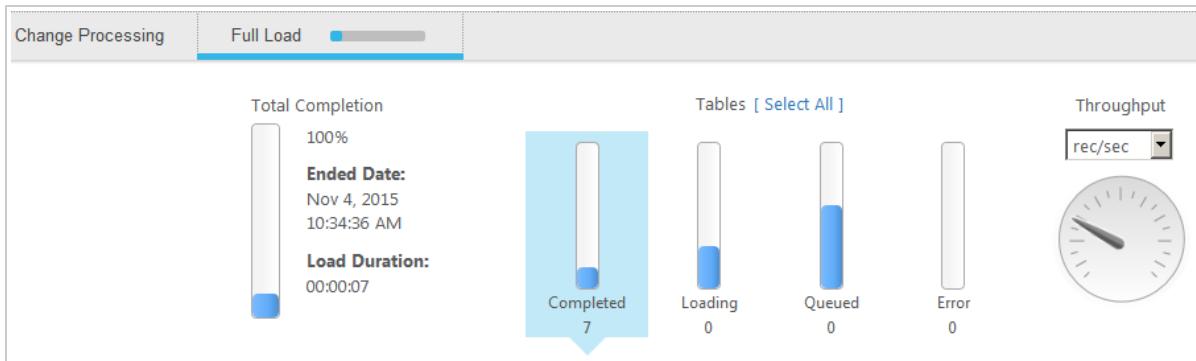
You can view the following:

- » [General Information for a Full Load](#)
- » [Detailed Information for the Full Load](#)
- » [Monitoring Throughput in a Full Load Operation](#)

## General Information for a Full Load

General information about the full load is presented in a graphical format. The following figure shows the graphical information displayed when a task is running.

**Figure 13.1 | Full Load Status Bars**



This section has the following information:

- » Status bars: Indicates the status of the tables being loaded.
  - » **Completed:** The number of tables that finished loading into the target endpoint.
  - » **Loading:** The number of tables that are in the process of loading into the target endpoint.
  - » **Queued:** The number of tables that are waiting to load into the target endpoint.
  - » **Error:** The number of tables that could not be loaded due to an error. See [Reading Messages about a Task](#) for information about error messages.
- » Full-load total completion bar: Displays the progress of all records being loaded to the target endpoint. The bar is located in the **Full Load** tab at the top of the graph section.
- » Throughput gauge: Displays the current throughput. Throughput displays the number of events read in the task for a specified amount of time.

You can also view [Detailed Information for the Full Load](#).

## Detailed Information for the Full Load

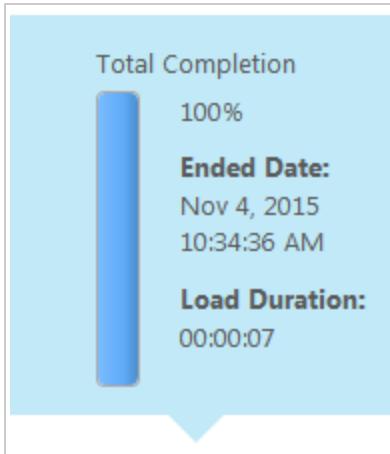
For each of the status bars displayed in the [General Information for a Full Load](#) graphs, a table is displayed in the section below with specific information about the current loading status. The following information is available:

- » [General Information for a Completed Task](#)
- » [Information for Each Table in the Task](#)
- » [Information for Tables that have Completed Loading](#)
- » [Information for Tables that are Currently Loading](#)
- » [Information for Tables that are in the Loading Queue](#)
- » [Information for Tables with Errors](#)

## General Information for a Completed Task

This section displays a table with information for all of the completed tables in a task. To view this table, click the **Total Completion** bar, shown in the figure below.

**Figure 13.2 | Total Completion Status**



This table displays the following Progress Details:

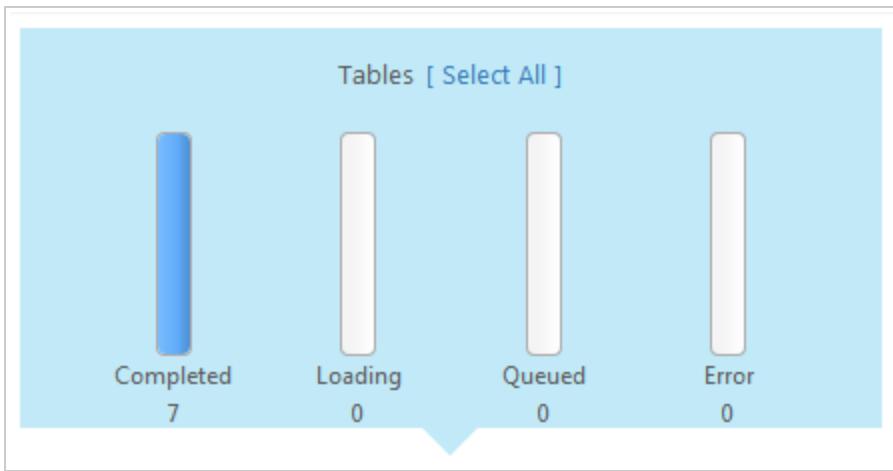
**Table 13.1 | Progress Details for all Tables in the Task**

|         | <b>Total</b>                                                       | <b>Completed</b>                                                        | <b>Remaining</b>                                           | <b>Notes</b>            |
|---------|--------------------------------------------------------------------|-------------------------------------------------------------------------|------------------------------------------------------------|-------------------------|
| Tables  | The total number of tables that are included in the task.          | The total number of tables that completed loading at the current time.  | The total number of tables waiting to be loaded.           | Additional information. |
| Records | The total records that completed loading at the current time.      | The total number of records that completed loading at the current time. | The total number of records waiting to be loaded.          | Additional information. |
| Time    | The estimated time to load all of the selected tables in the task. | The total elapsed time.                                                 | The estimated amount of time to load the remaining tables. | Additional information. |

## Information for Each Table in the Task

This section describes the progress of each of the tables being processed for the task. To display this information, click the **[Select all]** link above the

Figure 13.3 | Select All Tables



The information is displayed in a table that has the following columns:

- » **Table Name:** The names of the source tables that are included in the task.
- » **Status:** This is a statement that describes the status for the table. The following are the statuses that can be displayed:
  - » **Queued:** The table is in the queue waiting to be loaded to the target endpoint.
  - » **Loading:** The table is being processed but is not finished loading.
  - » **Completed:** All of the table records are loaded to the target.
  - » **Error:** The table stopped loading due to an error. See [Reading Messages about a Task](#) for more information about task errors.
- » **Estimated Count:** The number of records that are loaded to the target.
- » **Elapsed Time:** The total elapsed time since the table records began processing.
- » **Progress:** The table status and the time the table entered that status.
- » **Reload:** To reload selected tables, select the tables you want to reload and then click the **Reload** button above the table list. When prompted to confirm the operation, click **OK**. The data in the selected tables will be reloaded to the target endpoint. Note that this option is not available for **Apply Changes Only** tasks.

### Information for Tables that have Completed Loading

This section displays a table with information for each of the completed tables. To view this table, click the **Completed** bar, shown in the figure below.

Figure 13.4 | Completed Tables Status



The information is displayed in a table that has the following columns:

- » **Table name:** The names of the source tables that have completed loading.
- » **Loaded On:** The time that the table completed loading all of its records to the target.
- » **Transferred Count:** The number of records loaded to the target.

**Note** When [exclude filters](#) are applied to SAP Application tables, the number shown in this column will reflect the total number of records *before* the exclude filter was applied. Consequently, the "Transferred Count" number may be higher than the actual number of records that were replicated to the target.

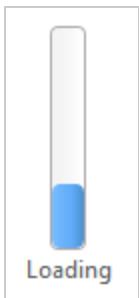
- » **Transferred Volume:** The volume of the records (in KB) loaded to the target.
- » **Load Duration:** The amount of time that it took for all records to load to the target.
- » **Throughput Records:** The average throughput rate for the table. Throughput describes the number of records read per second. For more information on throughput, see [Monitoring Throughput in a Full Load Operation](#).
- » **Throughput Volume:** The average throughput rate for the table. Throughput describes the volume of records (in KB) read per second. For more information on throughput, see [Monitoring Throughput in a Full Load Operation](#).
- » **Reload:** Click the **Reload** icon to reload the data for selected tables and run the full-load operation again.

### Information for Tables that are Currently Loading

This section displays a table with information for each of the tables that are currently loading. To view this table, click the **Loading** bar, shown in the figure below.

**Note** When replicating to an Oracle database with a full disk and/or partition where Oracle is trying to write archived redo log files, insert operations may fail. In such a case, no error will be shown and the task will not progress past the loading stage. To confirm that this is indeed an Oracle Archiver error, stop and attempt to restart the task. The task will not start and an appropriate error should be shown.

Figure 13.5 | Loading Tables Status



The information is displayed in a table that has the following columns:

- » **Table Name:** The names of the source tables that are currently loading.
- » **Load Duration:** The amount of time that it took for all records to load to the current point in time.
- » **Estimated Count:** The estimated number of rows that are to be loaded in the full load operation.
- » **Transferred Count:** The number of records that are loaded to the target endpoint.
- » **Current Throughput:** The current throughput rate for the table. Throughput describes the number of records read per second. For more information on throughput, see [Monitoring Throughput in a Full Load Operation](#).
- » **Estimated Finish Time:** The approximate time the task finished loading the tables. The timestamp displayed indicates the date and time.

**Note** There may sometimes be a discrepancy between the "Estimated Finish Time" and the "Time Remaining (Estimated)" values.

The "Time Remaining (Estimated)" value is calculated by the combined transfer rate of all the records of the task, while the "Estimated Finish Time" is calculated per table.

The discrepancy arises when the table transfer rate at the beginning of the task is very fast, but slows down towards the end of the task.

In this situation, the "Time Remaining (Estimated)" value will be greater and less accurate than the "Estimated Finish Time" value.

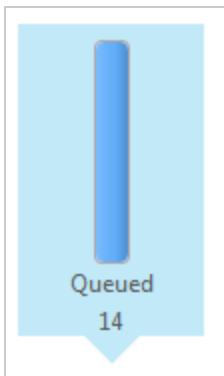
- » **Progress:** The table status and the time the table entered that status.

- » **Reload:** Click the **Reload** icon to reload the data for selected tables and run the full-load operation again.

## Information for Tables that are in the Loading Queue

This section displays a table with information for each of the tables that are waiting to be loaded. To view this table, click the **Queued** bar, shown in the figure below.

Figure 13.6 | Queued Tables Status



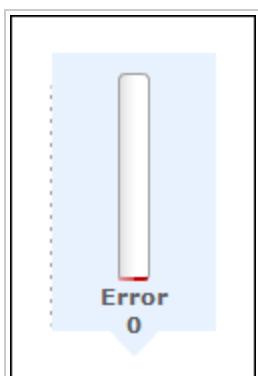
The information is displayed in a table that has the following columns:

- » **Table Name:** The names of the source tables that are currently in the queue waiting to be loaded.
- » **Estimated Count:** The estimated number of rows that are waiting to be loaded in the full load operation.

## Information for Tables with Errors

This section displays a table with information for each of the tables that stopped loading or suspended CDC due to an error. To view this table, click the Error bar, shown in the figure below.

Figure 13.7 | Error Tables Status



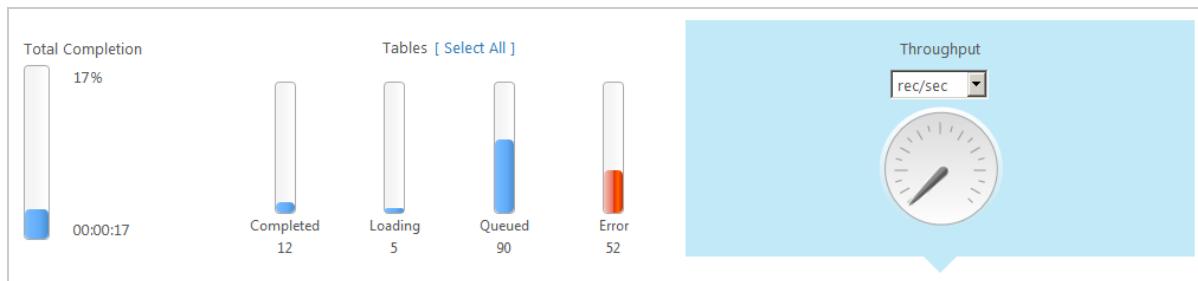
The information is displayed in a table that has the following columns:

- » **Table Name:** The names of the source tables that stopped due to an error.
- » **Failed On:** The time that the error occurred.
- » **Loaded Count:** The number of records loaded when the error occurred.

## Monitoring Throughput in a Full Load Operation

Throughput values for a full-load operation provide information on how fast the table records are being replicated to the target endpoint. The information is displayed in a gauge on the right side of the full-load graph section. The following figure shows the throughput gauge.

**Figure 13.8 | Throughput Gauge**



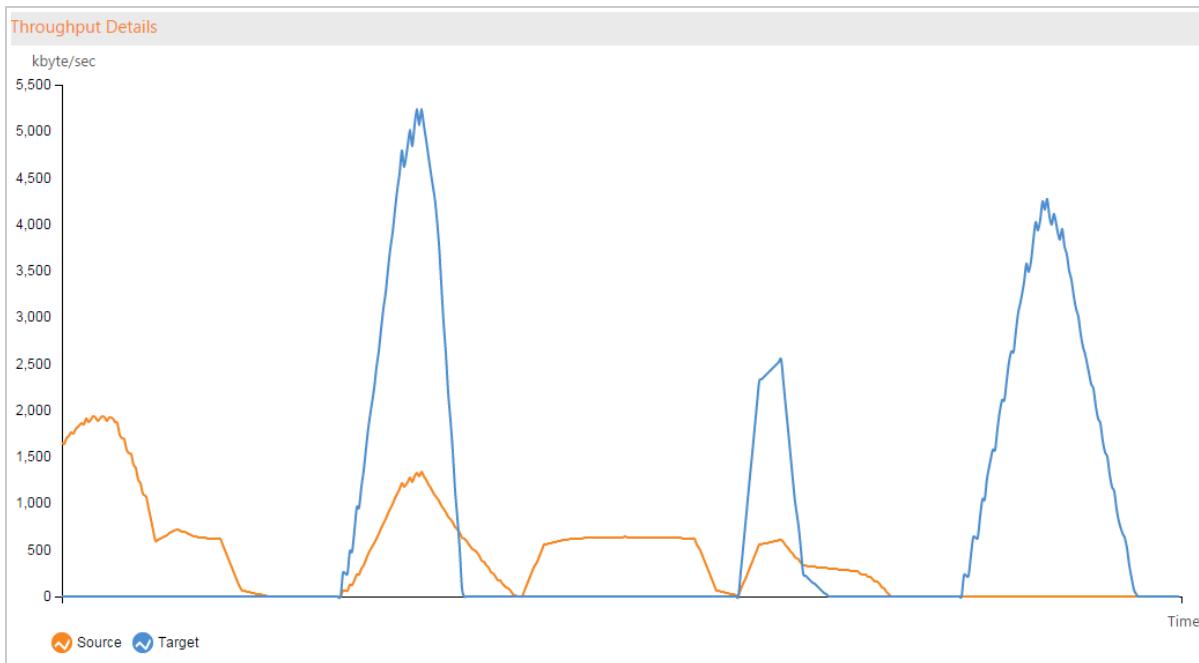
You can set the throughput measurement values either to the number of records replicated per second, or to the number of kilobytes replicated per second. The display is always based on the current load operation.

### To set the unit of throughput measurement:

- » Select either **rec/sec** or **kbyte/sec** from the drop-down menu above the Throughput gauge.

Click the **Throughput** gauge to display a graph with the throughput details as shown in the figure below. To view the graph only, click the expand/collapse arrow in right side of the gray bar above the graph. Click the arrow again to restore the status bars and throughput gauge.

Figure 13.9 | Throughput Details



## Monitoring Change Processing Operations

You can view the progress of the change-processing operation in the left section of the Monitor.

To make sure you are viewing the information for a change-processing operation, select the **Change Processing** tab.

You can view the following:

- » [General Change Processing Information](#)
- » [Detailed Change Processing Information](#)

## General Change Processing Information

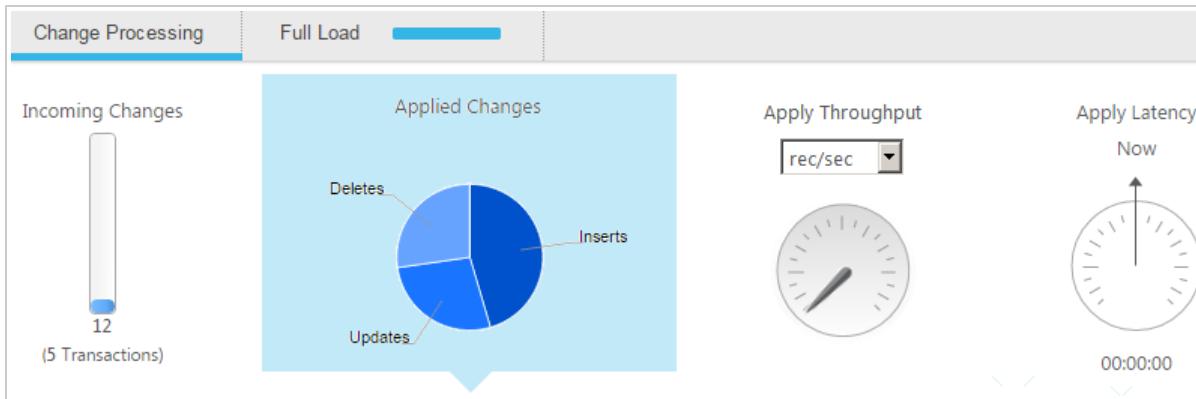
General information about the Change Processing task is presented in a graphical format. The following figure shows the graphical information displayed.

- Note** In an Apply Changes only task, Replicate performs the following operations depending on whether or not the target tables already exist:
- » If a target table does not exist, Replicate will create it (metadata only).
  - » After the table is created, only INSERT operations will be supported. Other operations (e.g. UPDATE) will fail since the data does not exist (unless it has been

inserted earlier).

- » If the table already exists, Replicate will behave according to the [If target table already exists](#) setting in the task settings' **Full Load Settings** tab.

**Figure 13.10 | Change Processing Status**



This section has the following information:

- » **Incoming Changes:** The total number of records that were processed for the task.
- » **Applied Changes:** A circle graph that shows information about the processed changes. It displays the following:
  - » The number of INSERT operations processed. Hover over the Insert section with your mouse to see the number and percentage of the accumulated inserts.
  - » The number of UPDATE operations processed. Hover over the Update section with your mouse to see the number and percentage of the accumulated updates.
  - » The number of DELETE operations processed. Hover over the Delete section with your mouse to see the number and percentage of the accumulated deletes.
  - » The number of metadata changes (DDL) processed. DDL changes include information about events like changes to table names or to column names.
- » **Apply Throughput** gauge: A gauge that describes the number of change events read per second. For additional details, you can also view a graph with [Information about Change Processing Throughput](#).
- » **Apply Latency** gauge: A gauge that displays the latency information.

The latency values displayed in the Attunity Replicate Console measure the time delay (latency) between the time when a change is visible to the source (and committed), and the time when this same change is visible to the target. The display is always based on the current change being applied.

You should take the following into consideration:

- » Latency when applying large transactions:

For example, when the most recent latency value was 10 seconds and now a transaction of one million rows gets committed at the source endpoint, Attunity

Replicate starts to apply that transaction to the selected target and it will take some time to write all the changes to the target (for example 60 seconds). During the next 60 seconds, the latency value gradually grows to 70 seconds for the last change in the transaction. Once the transaction is committed, the latency drops back to the 'regular' latency (10 seconds in this case).

- » Latency when no transactions are being applied:

When a time period passes with no changes applied to the target, the latency calculation is based on the time difference between the current time and the timestamp of the last change event read from the transaction log. This could happen if, for example, there is high activity on tables which are not selected for replication in the current task.

For additional details, you can also view a graph with [Information about Apply Latency](#).

## Detailed Change Processing Information

For each of the status indicators displayed in the [General Change Processing Information](#) section, a table or graph is displayed in the section below with detailed information about the change processing status. The following information is available:

- » [Information about Incoming Changes](#)
- » [Information about Applied Changes](#)
- » [Information about Change Processing Throughput](#)
- » [Information about Apply Latency](#)

### Information about Incoming Changes

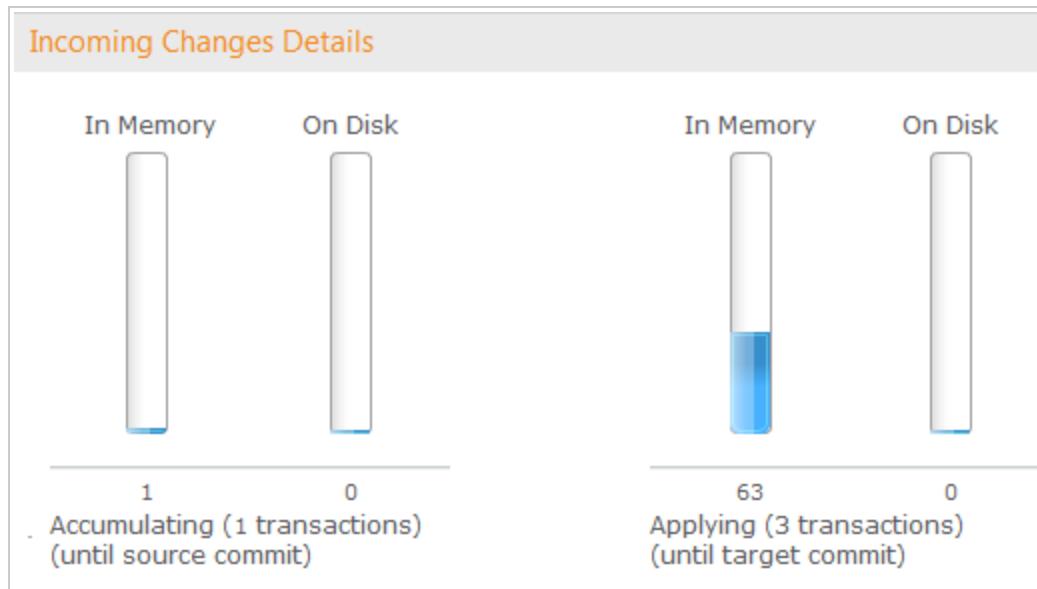
This section displays two bar graphs with information about incoming changes. Incoming changes displays a snapshot of the number of change records currently being read from the source endpoint and written to the target endpoint. To view these graphs, click the **Incoming Changes** bar, shown in the figure below.

**Figure 13.11 | Incoming Changes**



The following graphs are displayed.

Figure 13.12 | Incoming Change Graphs



The graphs have the following information:

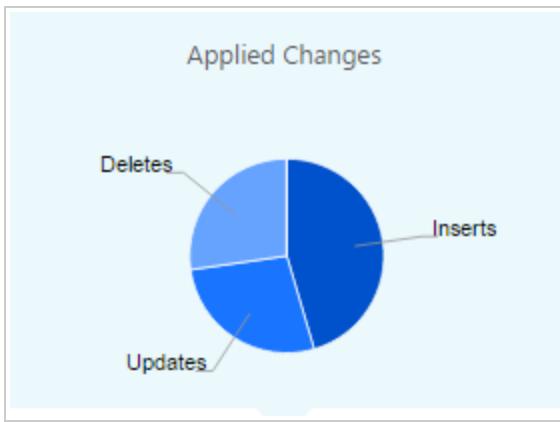
- » **Accumulating:** These bars display the number of records currently being read from the source endpoint. These records are accumulated in a queue until they are applied to the target. The following is displayed:
  - » **In Memory:** The number of accumulating records that are currently in the computer memory.
  - » **On Disk:** The number of accumulating records that are currently stored on disk.
- » **Applying:** The number of records currently being written to the target. These are the applied changes. The following is displayed:
  - » **In Memory:** The number of records being applied that are currently in the computer memory.
  - » **On Disk:** The number of records being applied that are currently stored on disk.

## Information about Applied Changes

This section displays two tables with information about the applied changes.

To view these tables, click the Applied Changes pie graph, shown in the figure below.

Figure 13.13 | Applied Changes



The following tables are available when you select Applied Changes:

- » [Recent Activity](#)
- » [Aggregates](#)

## Recent Activity

Click **Recent Activity** at the top of the Applied Changes Details section to view information about which changes occurred in each table. It has the following information:

- » **Table Name:** The names of the source tables that are included in the task.
- » **Insert:** The number of INSERT operations processed for the specific table.
- » **Delete:** The number of DELETE operations processed for the specific table.
- » **Update:** The number of UPDATE operations processed for the specific table.
- » **DDL:** The number of metadata changes (DDL) processed. DDL changes include information about events like changes to table names or to column names.
- » **Total Applied:** The total number of changes applied to the target.
- » **Data Errors:** The number of data processing errors for the specific table. Data errors occur at the record level and include conversion errors, errors in transformations, and bad data.

### Resetting the Data Errors Count

After you have resolved the data errors it is recommended to reset the data errors count. This is especially important if you have configured Replicate to perform an escalation action when the number of errors reaches a certain amount.

Details about the errors can be found in the `attrep_apply_exceptions` control table.

To reset the error count for a specific table, select the table and then click the **Reset data errors** button above the table list. Note that resetting the error count does not delete the error information from the `attrep_apply_exceptions` table.

For information about setting a data error escalation policy, see [Data Errors](#).

For information about the `attrep_apply_exceptions` table, see [Apply Exceptions](#)

**Note** Reloading a table resets the data error count for that table.

- » **Last Modified:** The time the last change occurred for the specific table.
- » **Reload:** To reload selected tables, select the tables you want to reload and then click the **Reload** button above the table list. When prompted to confirm the operation, click **OK**. The data in the selected tables will be reloaded to the target endpoint. Note that this option is not available for **Apply Changes Only** tasks.

## Aggregates

Click Aggregates at the top of the Applied Changes Details section to view information about total changes for each change type and transaction type.

The Aggregate table displays the total changes (for all tables) applied for each of the following types of operations:

- » INSERT
- » UPDATE
- » DELETE
- » DDL

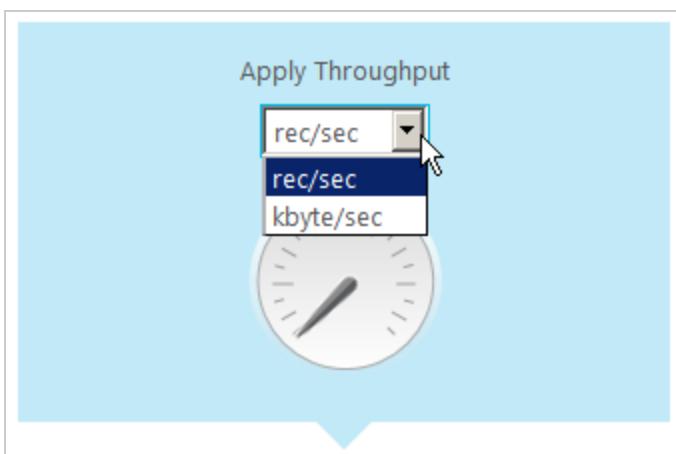
The Aggregate table also displays the information about transactions. It displays the total number and volume of:

- » COMMITS
- » ROLLBACKS

## Information about Change Processing Throughput

Throughput values for apply throughput in a change-processing operation provide information on how fast the change records are loaded to the target endpoint. The information is displayed in a gauge in the Change-Processing graph section. The following figure shows the Apply Throughput gauge:

Figure 13.14 | Apply Throughput Gauge



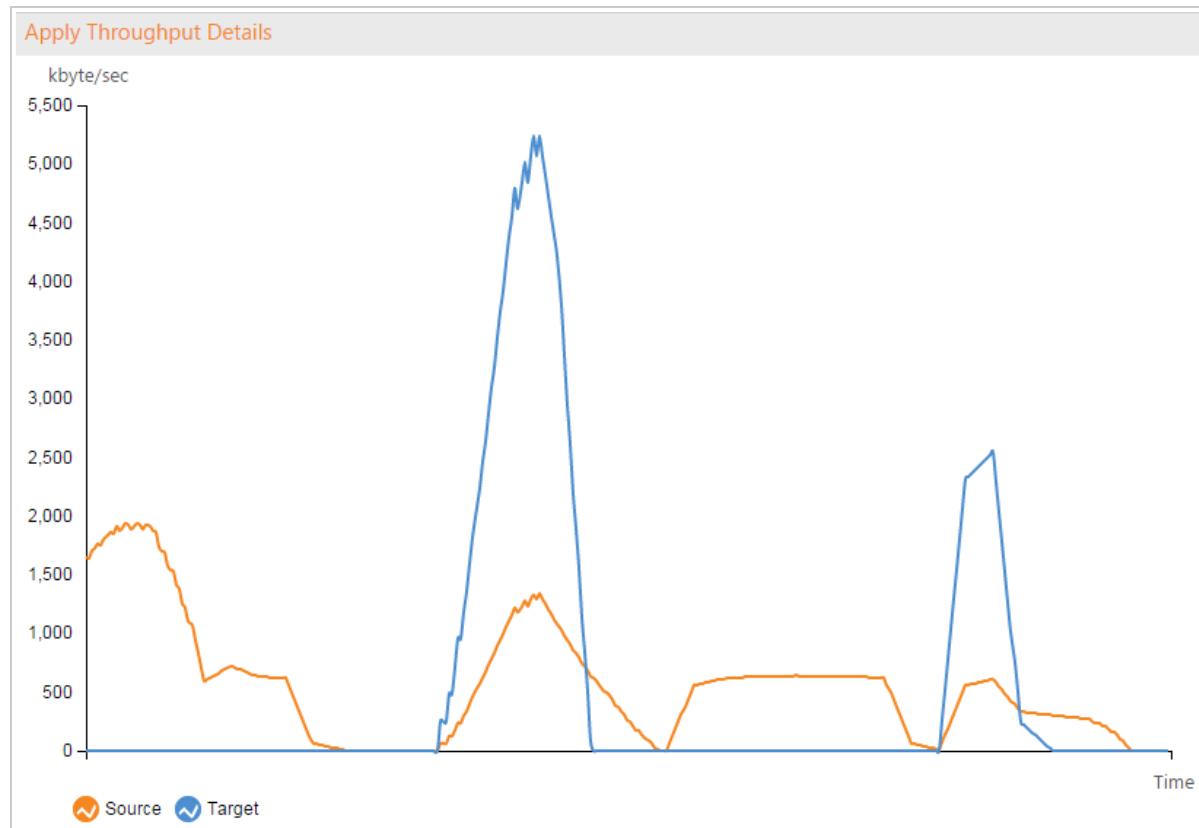
You can set the Apply Throughput measurement values either to the number of change records replicated per second, or to the number of kilobytes replicated per second. The display is always based on the current load operation.

#### To set the unit of throughput measurement:

- » Select either **rec/sec** or **kbyte/sec** from the drop-down menu below the **Apply Throughput** gauge.

Click the **Apply Throughput** gauge to display a graph with the throughput details as shown in the figure below. To view the graph only, click the expand/collapse arrow in right side of the gray bar above the graph. Click the arrow again to restore the progress bars and Change Processing gauges.

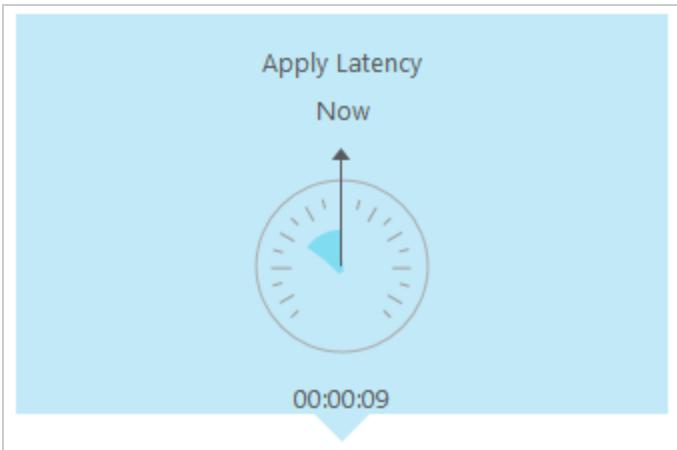
**Figure 13.15 | Apply Throughput Details Graph**



#### Information about Apply Latency

Latency values for apply latency in a change-processing operation provide information about the time delay (latency) between the time when a change is visible to the source (and committed), and the time when this same change is visible to the target. The information is displayed in a gauge in the Change-Processing graph section. The following figure shows the Apply Latency gauge.

Figure 13.16 | Apply Latency

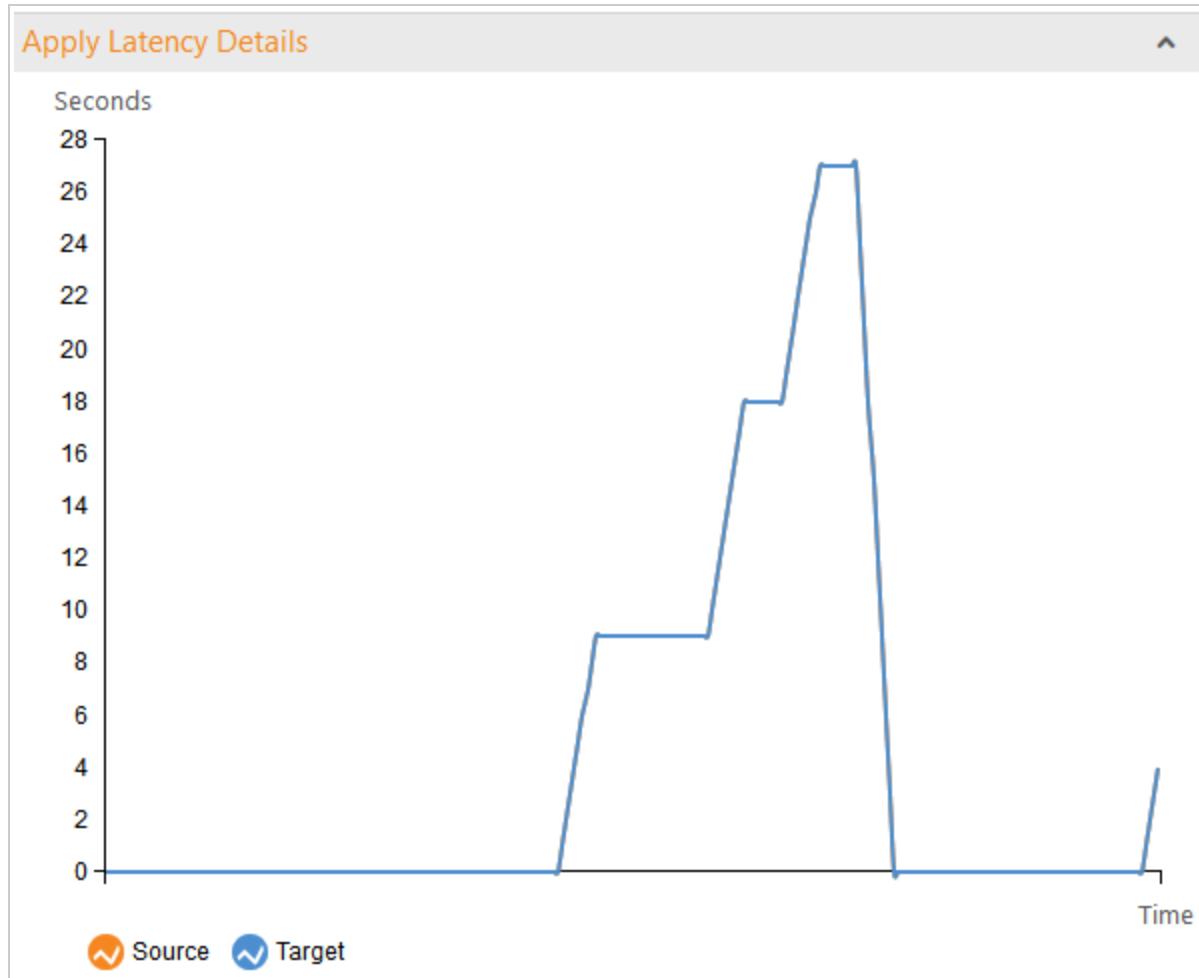


The latency values displayed in the Attunity Replicate Console measure the time delay (latency) between the time when a change is visible to the source (and committed), and the time when this same change is visible to the target. The display is always based on the current change being applied. For more information about latency, see [Apply Latency gauge](#).

Select the Apply Latency gauge to display a graph with the latency details. To view the graph only, click the expand/collapse arrow in right side of the gray bar above the graph. Click the arrow again to restore the progress bars and Change Processing gauges.

**Note** During data capture, the target latency will always be equal to the source latency (even though no data has reached the target yet). This is simply because target latency is the sum of source latency + apply latency, and can therefore never be less than the source latency.

Figure 13.17 | Apply Latency Details Graph



## Viewing Messages

You can see messages sent for the task while in the monitor view. For information on viewing messages, see [Reading Messages about a Task](#).

## Using the Monitor Tools

The monitor tools let you view additional information about the task. The following topics describe the information available through these tools:

- » [Viewing History Information](#)
- » [Setting the Task Logging Level](#)
- » [Viewing the Task Log Files and Manually Rolling them Over](#)
- » [Deleting Log Files](#)

- » [Downloading a Diagnostics Package](#)
- » [Downloading a Memory Report](#)

## Viewing History Information

The **History** window displays information for each event carried out in the task. To access the **History** information, from [Monitor Mode](#), click **Tools** in the toolbar and then select **History**.

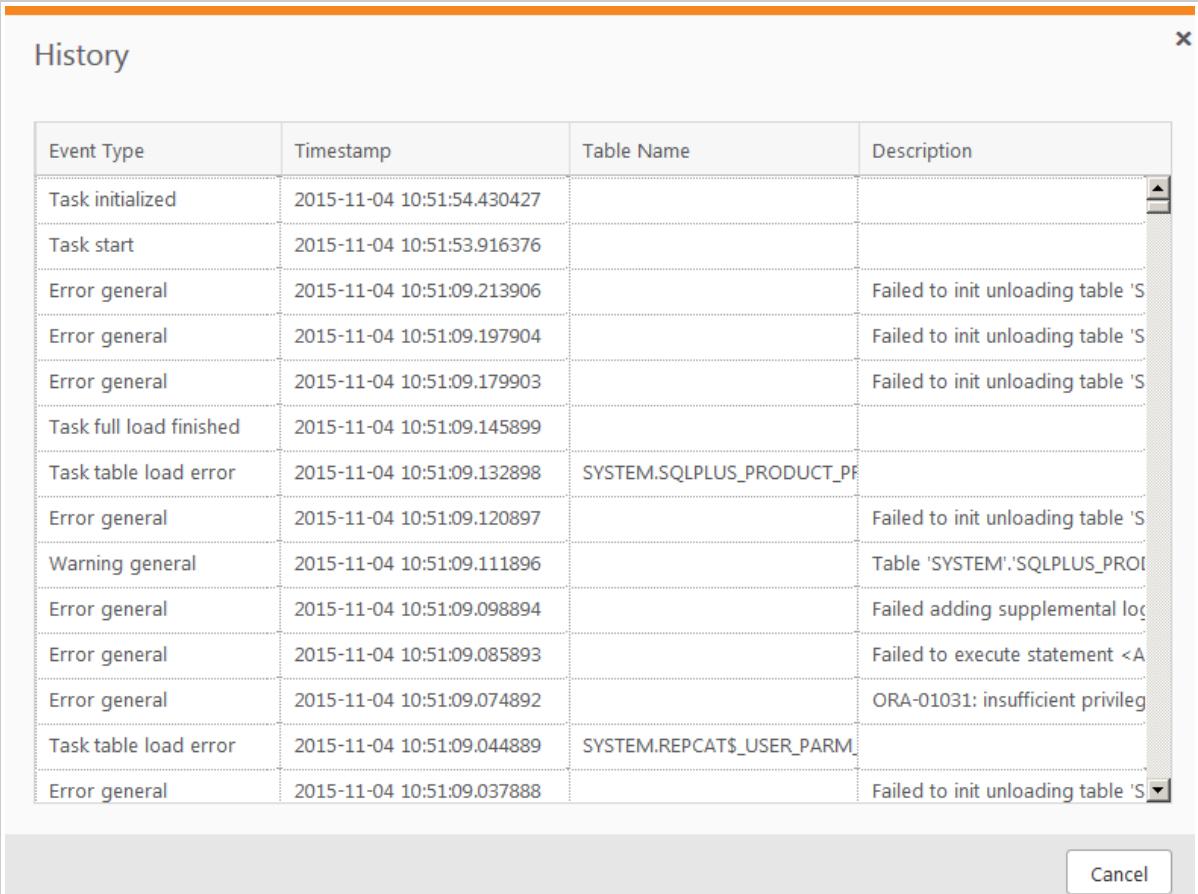
You can view the following information in the **History** window:

- » **Event type:** The type of event that occurred, for example **Task started** or **Task table load finished**.
- » **Timestamp:** A timestamp that indicates when the event took place. The timestamp is in the format, `YYYY-MM-DD hh:mm:ss.milliseconds` (to six places).
- » **Table Name:** The name of the table where the event takes place if the event is related to a table.
- » **Description:** A description of the event. This is not displayed for all events.

You can double-click the description cell to view a window with the full message if the entire description is not available.

The following figure shows the History window.

Figure 13.18 | History Window



| Event Type              | Timestamp                  | Table Name                | Description                       |
|-------------------------|----------------------------|---------------------------|-----------------------------------|
| Task initialized        | 2015-11-04 10:51:54.430427 |                           |                                   |
| Task start              | 2015-11-04 10:51:53.916376 |                           |                                   |
| Error general           | 2015-11-04 10:51:09.213906 |                           | Failed to init unloading table 'S |
| Error general           | 2015-11-04 10:51:09.197904 |                           | Failed to init unloading table 'S |
| Error general           | 2015-11-04 10:51:09.179903 |                           | Failed to init unloading table 'S |
| Task full load finished | 2015-11-04 10:51:09.145899 |                           |                                   |
| Task table load error   | 2015-11-04 10:51:09.132898 | SYSTEM.SQLPLUS_PRODUCT_PR |                                   |
| Error general           | 2015-11-04 10:51:09.120897 |                           | Failed to init unloading table 'S |
| Warning general         | 2015-11-04 10:51:09.111896 |                           | Table 'SYSTEM'.'SQLPLUS_PRODUC    |
| Error general           | 2015-11-04 10:51:09.098894 |                           | Failed adding supplemental log    |
| Error general           | 2015-11-04 10:51:09.085893 |                           | Failed to execute statement <A    |
| Error general           | 2015-11-04 10:51:09.074892 |                           | ORA-01031: insufficient privileg  |
| Task table load error   | 2015-11-04 10:51:09.044889 | SYSTEM.REPCAT\$_USER_PARM |                                   |
| Error general           | 2015-11-04 10:51:09.037888 |                           | Failed to init unloading table 'S |

Cancel

## Setting the Task Logging Level

In the **Log Management** window, you can set the logging level for the task you are currently monitoring as well as view, download, and delete log files.

### Note

- » The logging level can also be set in the **Logging Level** sub-tab in the **Task Settings** dialog box. For more information, see [Logging](#).

### To set logging levels:

1. Open the task you are working with if it is not displayed in the Attunity Replicate Console. For information on opening a task, see [Editing a Replication Task](#).
2. Switch to **Monitor** view. Then, click the **Tools** toolbar button and select **Log Management**.

The **Log Management** window opens.

3. At the top of the **Log Management** window, set the **Component Logging Level** slider to the log level you want. This sets the logging level for all log modules. Note that all of the sliders for the individual modules move to the same position that you set in the main slider.
4. Make any changes to the sliders for the individual modules. This is optional. Note that if you change the main slider, all of the individual sliders are reset to the new position. If you want to maintain a different logging level for a specific module, you need to reset it.

## Storing Trace and Verbose Logging in Memory

When the logging level is set to "Trace" or "Verbose", you can instruct Replicate to store the logging information in memory until an error occurs. On detecting an error, Replicate will begin writing to the physical logs and continue to do so for a few minutes after the initial occurrence of the error.

If *no* error occurs before the allocated memory is used up, Replicate will empty the memory buffer and start afresh.

This option is useful for tasks that fail unpredictably and for no obvious reason. The problem with continually writing large amounts of information to the logs is twofold:

- » Running in "Trace" or "Verbose" logging mode will quickly use up available disk space (unless the logging settings have been configured to prevent this).
- » Continually writing large amounts of data to the logs will affect performance.

### To use this option

1. Select the **Store trace/verbose logging in memory, but if an error occurs, write to the logs** check box at the top of the tab.
2. In the **Allocate memory up to (MB)** field, specify the amount of memory you want to allocate for storing logging information.

## Viewing the Task Log Files and Manually Rolling them Over

In the **Log Viewer** window, you can view the logs for the task you are currently monitoring and manually roll them over if necessary.

### Viewing and Downloading the Task Log Files

Follow the steps below to view or download the task log files.

#### To open the Log Viewer window:

1. Open the task whose log files you want to view or download.  
For information on opening a task, see [Editing a Replication Task](#).
2. Switch to **Monitor** view.
3. Either, click the **Tools** toolbar button and then select **View Logs**.

-OR-

Click the **View Logs** button in the **Messages** pane in the lower right of the console.

The **Log Viewer** window opens.

4. Select the log file you want to view or download from the list in the **Log Files** pane. If you want to download the file, skip to [Step 8](#).
5. The contents of the log file will be displayed in the right pane. When you select a row in the log file, a tooltip will be displayed the full message of the selected row.
6. You can browse through the log file using the scroll bar on the right and the navigation buttons at the top of the window.
7. To search for a specific string in the log file, enter the search string in the search box at the top of the window.

Any terms that match the specified string will be highlighted blue.

8. To download the log file, click the  toolbar button.

Depending on your browser settings, one of the following will occur:

- » The task JSON file will be automatically downloaded to the default download location
- » You will be prompted for a download location. In this case, save the JSON file to your preferred location.

## Manually Rolling Over Task Log Files

You can manually roll the log file for the task you are monitoring in the Log Viewer. This lets you stop logging to the current log file and begin to log to a new log file. The current log file is called `reptask_<name of task>` and saved (older) log files have the file name `reptask_<name of task>_xxxxxxxxxxxx` where `xxxxxxxxxxxx` represents a 12-digit timestamp.

To immediately roll over the selected log file, click the **Roll Log File** button in the top right of the window.

## Deleting Log Files

In the **Delete Logs** window, you can manually delete log files older than the specified number of days.

### To delete the logs:

1. Open the task whose log files you want to delete.  
For information on opening a task, see [Editing a Replication Task](#).
2. Switch to **Monitor** view.
3. Click the **Tools** toolbar button and then select **Delete Logs**.

The **Delete Logs** window opens.

4. Optionally change the default number of days (45) and then click the **Delete** button.  
All log files older than the specified number of days will be deleted.

## Downloading a Memory Report

The memory report is a diagnostics tool that can be used to diagnose memory-related issues, such as unusually high memory consumption by a specific task.

Usually, multiple memory reports showing the gradual increase in memory consumption will need to be generated.

### To download a memory report:

1. Open the task you are working with if it is not displayed in the Attunity Replicate Console. For information on opening a task, see [Editing a Replication Task](#).
2. Click the **Tools** toolbar button and then select **Support > Download Memory Report**.

Depending on your browser settings, the following file will either be automatically downloaded to your designated download folder or you will be prompted to download it:

#### File name:

<task\_name>\_diagnostics\_<timestamp>.memp

#### Example:

MyTask\_diagnostics\_20180109161333.memp

3. Send the report to Attunity.

## Downloading a Diagnostics Package

You can generate a task-specific diagnostics package for Support to review. The diagnostics package contains the task log files and various debugging data that may assist in troubleshooting task-related issues.

### To download a diagnostics package:

1. Open the task you are working with if it is not displayed in the Attunity Replicate Console. For information on opening a task, see [Editing a Replication Task](#).
2. Click the **Tools** toolbar button and then select **Support > Download Diagnostics Package**.

Depending on your browser settings, the following file will either be automatically downloaded to your designated download folder or you will be prompted to download it:

#### File name:

<task\_name>\_diagnostics\_<timestamp>.zip

**Example:**

MyTask\_\_diagnostics\_\_20180109161333.zip

# 14 | Attunity Replicate Server Settings

This chapter describes how to configure the Attunity Replicate Server settings. Server settings are managed in **SERVER** view.

## To switch to SERVER view:

- » From the drop-down list in the top left corner of the console (below the product logo) select **Server**.

### Note

- » Server settings affect all Tasks that are created in the Attunity Replicate instance you are working with.
- » Changes to server settings will not affect running tasks.

### In this chapter:

- [Notifications Settings](#)
- [License Settings](#)
- [Global Error Handling](#)
- [Logging](#)
- [File Transfer Service](#)
- [Scheduling Jobs](#)
- [User Permissions](#)
- [Resource Control](#)

## Notifications Settings

The following can be defined in the Notifications settings:

- » [Defining Notifications](#)
- » [Setting up Mail Parameters](#)
- » [Creating a Default Recipient List](#)

## To view and edit the Notification settings:

- » In **Server** view, click the **Notifications** tab on the left. Then click the **Notifications** sub-tabs to enter your settings.

## Defining Notifications

To configure and create notifications, click the **Notifications** sub-tab.

You use notifications to send messages about events that occur when running tasks in Attunity Replicate. Notifications are sent to inform users of any change in the system state, including:

- » A task is started or stopped
- » Latency is too high
- » Memory utilization is too high
- » Disk utilization is too high
- » An error or a specific type of error occurred

You can manage notifications that you create from the Notifications list. This list provides you with information about each notification defined and lets you activate/deactivate a notification. In addition, you can make changes to the definitions of existing notifications or delete them.

The following topics describe how to define notifications in Attunity Replicate:

- » [Creating a New Notification](#)
- » [Using the Notification List](#)
- » [Editing a Notification](#)
- » [Deleting a Notification](#)

### To open the Notifications page:

From the Server view, click **Notifications** from the menu list at the left. The **Notifications** sub-tab is displayed.

Notifications are sent by:

- » An email message to the default list of users and/or to a custom list of users.
- » Writing an entry in the Windows Event Log.
- » Displaying a message in the Attunity Replicate Console.

### Creating a New Notification

Use the **New Notification** wizard to determine the notifications that are sent and who receives them.

### To start the New Notification Wizard:

1. In Server view, click the **Notifications** tab on the left and then click the **New Notification** toolbar button.
2. From the drop-down menu, select **Task Events** or **Server Events** according to the notification you want to define.
3. The **New Notification** wizard opens displaying either the **Task Events** or **Server Events** screen (according to your earlier selection).

4. Continue from [Creating a Notification for a Task Event](#) or [Define the Recipients](#) as appropriate.
5. In the **Notification Name** field, type a name for this notification.
6. Perform the following steps to define the notification:
  - » [Define the Action that Triggers the Notification](#)
  - » [Define Which Changes of Status Trigger the Notification](#)
  - » [Define Errors That Trigger the Notification](#)
  - » [Define the Notification Distribution Properties](#)
  - » [Determine the Email-Message Recipients for the Notification](#)
  - » [Define the Notification Message](#)
  - » [Associate Tasks with the Notification](#)
  - » [Review the Notification Rule](#)

## Define the Action that Triggers the Notification

In the **Operator** section of the **Task Events** page, you can determine the action that triggers the notification. If the Operator section is not displayed, click on the header with the word Operator to display the options for this section. Select one of the following:

- » **Task was started:** To send the notification when the task starts.
- » **Task was stopped manually or scheduled:** To send the notification when the task is stopped manually or by the Scheduler.
- » **Task was stopped after Full Load: Cached changes were not applied:** To send the notification when the task is stopped after Full Load completes but before cached changes (changes to the source tables that occurred during Full Load) are applied to the target.
- » **Task was stopped after Full Load: Cached changes were applied:** To send the notification when the task is stopped after Full Load completes and cached changes (changes to the source tables that occurred during Full Load) have been applied to the target.
- » **Full load started:** To send the notification when the Full Load process starts.
- » **Full load completed:** To send the notification when the Full Load process completes.

Once you determine when to send the notification, you can decide whether specific changes in status trigger the notification.

If you want to send a message about problems in latency, memory utilization, or disk utilization, click **Performance/Resources**. See [Define Which Changes of Status Trigger the Notification](#) for an explanation.

If you want to send the notification when certain errors occur, click **Errors**. See [Define Errors That Trigger the Notification](#) for an explanation.

Or you can click **Next** to [Define the Notification Distribution Properties](#).

## Define Which Changes of Status Trigger the Notification

In the **Performance/Resources** section of the **Task Events** page, you can define specific parameters for latency, disk utilization, or memory utilization that trigger a notification.

**To set up notifications about latency, disk utilization, or memory utilization:**

1. In the [New Notification Wizard, Task Events](#) page, click **Performance/Resources**.
2. Select one of the following:
  - » **Latency is higher than Value seconds.**
  - » **Memory utilization exceeded Value MB**
  - » **Disk utilization exceeded Value MB**
3. Define the value for the option you select. See the table below for an explanation on each of these options and how to set the value.

**Note** If you select one of these options, the notification is sent only when the selected parameter is true. However, you must also [Define the Action that Triggers the Notification](#).

**Table 14.1 | Set Values for Latency, Disk Utilization, Memory Utilizations**

| Notification                                             | Set Value                                                                                                                                                                                                                                     | Notes                                                                                                                                                                                                                                                                                                                     |
|----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Latency is higher than Value seconds                     | Click <b>[N]</b> and enter a value in the field that is displayed.<br><br>Latency is the time interval in seconds between the time a change was committed in the source system and the time it is applied and committed in the target system. |                                                                                                                                                                                                                                                                                                                           |
| Clear notification when latency drops below <n> seconds. | Use this to set the value that determines when latency returns to "normal limits."<br><br>Click <b>[N]</b> and enter a value.                                                                                                                 | When latency is below the value entered in this field, it is considered to be in the "normal" range and the notification status ends.<br><br>If selected, a notification is sent to indicate that latency returned to "normal" status.<br><br>For more information, see <a href="#">Define the Notification Message</a> . |
| Memory utilization                                       | Click <b>[N]</b> and enter a value in the field that is displayed.                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                           |

**Table 14.1 | Set Values for Latency, Disk Utilization, Memory Utilizations (Cont.)**

| Notification                                               | Set Value                                                                                                                                                                                                                                               | Notes                                                                                                                                                                                                                           |
|------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| exceeded Value MB                                          | Memory utilization is the amount of memory used by the task.                                                                                                                                                                                            |                                                                                                                                                                                                                                 |
| Clear notification when memory utilization is below <n> MB | Use this to set the value that determines when memory utilization returns to "normal limits." Click <b>[N]</b> and enter a value.                                                                                                                       | When memory utilization is below the value entered in this field, it is considered to be in the "normal" range and the notification status ends.<br>For more information, see <a href="#">Define the Notification Message</a> . |
| Disk utilization exceeded Value MB                         | Click <b>[N]</b> and enter a value in the field that is displayed.<br><br>Disk utilization is the amount of disk space used.<br><br>Set a value that indicates that the current amount of disk space used is problematic to running a replication task. |                                                                                                                                                                                                                                 |
| Clear notification when disk utilization is below <n> MB   | Use this to set the value that determines when disk utilization returns to "normal limits." Click <b>[N]</b> and enter a value.                                                                                                                         | When disk utilization is below the value entered in this field, it is considered to be in the "normal" range and the notification status ends.<br>For more information, see <a href="#">Define the Notification Message</a> .   |

Once you determine the status changes that trigger a notification, you can decide whether specific errors trigger a notification.

If you want to send the notification when certain errors occur, click **Errors**. See [Define Errors That Trigger the Notification](#) for an explanation.

Or you can click **Next** to [Define the Notification Distribution Properties](#).

## Define Errors That Trigger the Notification

In the **Errors** section of the **Task Events** page, you can determine whether notifications are sent when an error occurs. You can determine whether to send the notification for all errors or only for specific error types.

### To set up notifications for errors:

1. In the [New Notification Wizard, Task Events](#) page, click **Errors**.
2. Select one of the following:
  - » **Task encountered a non-retriable error and was stopped:** Select this to receive a notification when an error that cannot be retried is returned and a task or tasks are stopped due to this error.
  - » **Table encountered more than [N] apply errors:** Select this to receive a notification when a specified number of errors that occur in a CDC operation are applied to a table. In this case, the table is not loaded but the task continues to run.
  - » Click **Value** and type the number of errors to trigger the notification. For example, type 50 to send a notification after fifty records fail to be applied to the target table. All apply errors are logged in the `attrep_apply_exceptions` table. The count of apply errors is reset each time the task starts.
  - » **Table processing suspended due to errors:** Select this to receive a notification when an error causes a table to stop processing during a full-load operation or suspend CDC. In this case, the table process stops, but the task continues.
  - » **Any Error:** Select this to receive a notification when an error occurs in the system.
  - » **Any Warning:** Select this to receive a notification when a warning is issued in the system.

Once you determine the error types that trigger a notification, you can:

- » [Define the Action that Triggers the Notification](#), if you have not done this already.
- » [Define Which Changes of Status Trigger the Notification](#) if you have not done this.
- » Or you can click **Next** to [Define the Notification Distribution Properties](#).

## Define the Notification Distribution Properties

In the **Recipients** page of the New Notification Rule wizard, you determine which users receive the notification and how the notification is sent.

### To determine the delivery notification properties:

Select any of the following to determine where (how) the notification is sent:

- » **Replication Console:** This selection is selected by default. You cannot change this selection. All notifications are sent to the Replication Console. Notifications are displayed in the **Messages** section for a specific task. This section is displayed in:
  - » The Monitor for a specific task. For more information, see [Reading Messages about a Task](#).
  - » The right pane of the Tasks page. For more information, see [Tasks View](#).

- » **Event Log:** Select this if you want the notification message to be written to the Windows/Linux Event log. For information on how to view the Windows/Linux Event log, see the online help for the version of Windows or Linux you are using.
- » **Default Notification Email List:** Select this option if you want to send an email message to all the recipients on the Default Notification Email List. For more information, see [Creating a Default Recipient List](#).

If you choose to add additional recipients to email notifications or send the email message only to a custom list of recipients, then stay on the **Recipients** page to [Determine the Email-Message Recipients for the Notification](#).

If you do not need to create a custom email recipient list for this notification, click **Next** to [Define the Notification Message](#).

## Determine the Email-Message Recipients for the Notification

In addition to sending an email message for a specific notification to the default notification list, you can also create a custom notification list of users who receive this notification only or you can also send the email message to a custom list of users only.

This section describes how:

- » [To create a custom list of users:](#)
- » [To send notification email messages to a custom list of recipients only:](#)

### To create a custom list of users:

1. In the [New Notification Wizard](#), **Recipients** page, click **Add**. The add button and custom list are in the middle of the **Recipients** page.  
The **Name** field in the first available row in the list is activated.
2. Type the name of the user that you want to receive the message.
3. In the **Name** column of the activated cell, type the name of the user you want to add to the list of default recipients.

**Note** If you click another part of the Attunity Replicate Console, the cell will become inactive. You can double-click the cell to enter additional information.

4. Press the [tab] key or double click in the **Email** cell, then type the email address for the user you entered in the **Name** cell.
5. Click **Next** to [Define the Notification Message](#).

### To send notification email messages to a custom list of recipients only:

1. In the [New Notification Wizard](#), make sure that the **Default Notification Email List** option is *not* selected.
2. Create a Custom Notification list as described in [To create a custom list of users](#):

## Define the Notification Message

You can create a message for your notification. By default, a standard message is created based on the definitions you entered when [Define Which Changes of Status Trigger the Notification](#) and [Define Errors That Trigger the Notification](#).

### To create a notification message:

1. In the [New Notification Wizard](#), **Message** page, double-click in any of the table cells to open the Edit Notification Message dialog box. See the table [Creating a Notification Message](#) for an explanation of the information to enter in each field.
2. Click in the right pane of the dialog box and begin to type your message. In some cases a default message is displayed based on the information you entered in the previous pages of the New Notification Rule wizard. You can edit or delete the message, or create a new message to be sent with the notification in this dialog box.
3. Add variables in messages and email headers you define for notifications, if necessary. You can enter variables in one of two ways:
  - » Type a variable into the message pane on the right using the following format:  
 `{{<VARIABLE_NAME>}}`  
 For example:  `{{TASK_NAME}}`.
  - » Use the variables from the left pane of the **Edit Notification** dialog box. To add a variable to the notification message, you can:
 

Double-click the variable. The variable is inserted where your cursor is located in the notification message in the right pane.

Select the variable you want to use and click the arrow key in the middle of the Edit Notification Message dialog box. The variable is inserted where your cursor is located in the notification message in the right pane.

Drag the variable from the left pane to the location you want to place it in the notification message in the right pane.

For more information, see the [Supported Notification Variables](#).
4. Click **OK** to enter the message.
5. After you define the message sent with the notification, click **Next** to [Associate Tasks with the Notification](#).

The following table describes how to enter the information in the **Message** page.

**Table 14.2 | Creating a Notification Message**

| To where:                                        | Notification On Message                                                        | Notification Off Message                                                                                 |
|--------------------------------------------------|--------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| This column describes where the message is sent. | The <b>Notification On</b> Message is sent when the replication task meets the | The <b>Notification Off</b> Message is sent when the replications task returns to its normal state. This |

**Table 14.2 | Creating a Notification Message (Cont.)**

| To where:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Notification On Message                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Notification Off Message                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| For more information, see <a href="#">Define the Notification Distribution Properties</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <p>conditions for the notification to be sent.</p> <p>For more information, see <a href="#">Define the Action that Triggers the Notification</a>, <a href="#">Define Which Changes of Status Trigger the Notification</a>, and <a href="#">Define Errors That Trigger the Notification</a>.</p>                                                                                                                                                                                                         | <p>type of message is sent for notifications about latency, disk utilization, and memory utilization.</p> <p>For more information, see <a href="#">Define Which Changes of Status Trigger the Notification</a>.</p>                                                                                                                                                                                                                                                                                                                                         |
| <b>Console:</b><br>The messages in this row are sent to the Attunity Replicate Console. They are displayed in the <b>Messages</b> section for a specific task. This section is displayed in: <ul style="list-style-type: none"> <li>» The Monitor for a specific task. For more information, see <a href="#">Reading Messages about a Task</a>.</li> <li>» The right pane of the Tasks page. For more information, see <a href="#">Tasks View</a>.</li> </ul> <div style="background-color: #e0f2fd; padding: 10px; border-radius: 10px; margin-top: 10px;"> <b>Note</b> This message is also sent to the Windows Event log if you select this option. For more information, see         </div> | <p>In this field, you can edit, change or delete the message that is sent to the Attunity Replicate Console when the replication task meets the conditions for the notification to be sent.</p> <p><b>Example:</b></p> <pre>[{{ SERVER_NAME }}] \ {{ NOTIFICATION_NAME }} ] {{ TASK_NAME }} replication task latency exceeds defined limits. Current latency is {{ LATENCY }} seconds.</pre> <p>This message is sent to the console when latency reaches a value higher than the value you defined.</p> | <p>In this field, you can edit, change, or delete the message that is sent to the Attunity Replicate Console when the replication task returns to the normal range as you defined when you <a href="#">Define Which Changes of Status Trigger the Notification</a>.</p> <p>This field is relevant only for notifications about latency, disk utilization, and memory utilization.</p> <p><b>Example:</b></p> <p>Latency is back to normal, latency is {{LATENCY}} seconds</p> <p>This message is sent when latency returns to within its normal limits.</p> |

**Table 14.2 | Creating a Notification Message (Cont.)**

| To where:                                                                                                                                                                                                                                                                                       | Notification On Message                                                                                                                                                                                                                                                                                                                                                                                                       | Notification Off Message                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Define the Notification Distribution Properties.</p> <p><b>Email Subject:</b><br/>This is the subject of the email messages sent for the notification.<br/>See <a href="#">Define the Notification Distribution Properties</a> for information about sending a notification as an email.</p> | <p>In this field, you can edit, change or delete the subject line for an email that is sent when the replication task meets the conditions for the notification to be sent.</p> <p><b>Example:</b><br/> <code>[{{SERVER_NAME}}]\{{NOTIFICATION_NAME}}]{{TASK_NAME}} high latency notification</code></p> <p>This is the subject for an email message sent when latency reaches a value higher than the value you defined.</p> | <p>In this field, you can edit, change or delete the subject line for an email that is sent when the replication task returns to the normal range as you defined when you <a href="#">Define Which Changes of Status Trigger the Notification</a>.</p> <p>This field is relevant only for notifications about latency, disk utilization, and memory utilization.</p> <p><b>Example:</b><br/> <code>Replicate notification '{{NOTIFICATION_NAME}}' for task '{{TASK_NAME}}'</code></p> <p>This is the subject for an email message sent when latency returns to within its normal limits.</p> |
| <p><b>Email Message:</b><br/>This is the body of the email message sent for the notification.<br/>See <a href="#">Define the Notification Distribution Properties</a> for information about sending a notification as an email.</p>                                                             | <p>In this field, you can edit, change or delete the message that is sent by email when the replication task meets the conditions for the notification to be sent.</p> <p><b>Example:</b><br/> <code>The latency for replication task {{TASK_NAME}} exceeds defined limits.</code><br/> <code>The current latency is {{LATENCY}} seconds.</code></p> <hr/> <hr/>                                                              | <p>In this field, you can edit, change, or delete the message that is sent by email when the replication task returns to the normal range as you defined when you <a href="#">Define Which Changes of Status Trigger the Notification</a>.</p> <p>This field is relevant only for notifications about latency, disk utilization, and memory utilization.</p> <p><b>Example</b><br/> <code>Latency is back to normal, latency is {{LATENCY}} seconds</code></p> <p>This is an email message sent when</p>                                                                                     |

**Table 14.2 | Creating a Notification Message (Cont.)**

| To where:    | Notification On Message                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Notification Off Message                     |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
|              | <pre>-----<br/>This is an automated<br/>message generated by<br/>Attunity Replicate<br/>server {{SERVER_NAME}}<br/>for notification<br/>{{NOTIFICATION_NAME}}.</pre> <p>This is an email message sent when latency reaches a value higher than the value you defined.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | latency returns to within its normal limits. |
| Event viewer | <p>In this field, you can edit, change or delete the message that is sent to the Windows/Linux event viewer when the replication task meets the conditions for the notification to be sent.</p> <p>Note: This field is available only when you select <b>Event log</b> when you <a href="#">Define the Notification Distribution Properties</a>.</p> <p><b>Example:</b></p> <pre>[{{SERVER_NAME}}\<br/>{{NOTIFICATION_NAME}}]<br/>{{TASK_NAME}} high<br/>latency notification<br/><br/>The latency for<br/>replication task<br/>{{TASK_NAME}} exceeds<br/>defined limits.<br/><br/>The current latency is<br/>{{LATENCY}} seconds.</pre> <p>This message is sent to the event viewer when latency reaches a value higher than the value you defined.</p> |                                              |

After you define the message sent with the notification, click **Next** to [Associate Tasks with the Notification](#).

## Supported Notification Variables

The table below describes which variables can be included in notification messages.

**Table 14.3 | Supported Notification Variables**

| Variable                        | Description                                                                                                                           |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| LATENCY                         | The task latency.<br>For a definition of latency, see the <a href="#">Glossary</a> .                                                  |
| MEMORY_USAGE                    | The amount of memory being consumed by all tasks on the Replicate Server machine.                                                     |
| DISK_USAGE                      | The amount of disk space being utilized by the task on the Replicate Server machine.                                                  |
| COUNT_ERROR_TABLES              | The number of tables in the task with an error status.                                                                                |
| ERROR_TABLES                    | The names of the tables in the task with an error status.                                                                             |
| COUNT_ACTIVE_TRANSACTION        | The number of open transactions in the task.                                                                                          |
| COUNT_DATA_ERRORS               | The number of data errors encountered by the task.<br>For more information on apply errors, see <a href="#">Global Error Handling</a> |
| LOADED_RECORDS                  | The number of records loaded to the target database during the task.                                                                  |
| CHANGES_RECORDS                 | The number of change records processed during the task.                                                                               |
| FULLLOAD_COUNT_REQUESTED_TABLES | The number of tables that are queued for loading to the target.                                                                       |
| FULLLOAD_COUNT_COMPLETED_TABLES | The number of tables that were loaded to the target.                                                                                  |
| FULLLOAD_COUNT_ERROR_TABLES     | The number of tables that could not be loaded to the target due to                                                                    |

**Table 14.3 | Supported Notification Variables (Cont.)**

| <b>Variable</b>                | <b>Description</b>                                                                                                                                                                               |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                | error.                                                                                                                                                                                           |
| FULLLOAD_REQUESTED_TABLES_LIST | The names of the tables that are queued for loading to the target.                                                                                                                               |
| FULLLOAD_COMPLETED_TABLES_LIST | The names of the tables that were loaded to the target.                                                                                                                                          |
| FULLLOAD_ERROR_TABLES          | The names of the tables that could not be loaded to the target due to error.                                                                                                                     |
| TABLE_NAME                     | The name of the table being processed when the notification was sent.                                                                                                                            |
| TABLE_OWNER                    | The owner of the table being processed when the notification was sent.                                                                                                                           |
| RECORD_COUNTER                 | The number of records that had been processed when the notification was sent.                                                                                                                    |
| ERROR_TEXT                     | The error message when a task ends with an error.                                                                                                                                                |
| TASK_NAME                      | The name of the task.                                                                                                                                                                            |
| NOTIFICATION_NAME              | The name of the notification.                                                                                                                                                                    |
| TABLE_COUNT_APPLY_ERRORS       | The number of tables with apply errors.<br>For more information on apply errors, see <a href="#">Global Error Handling</a>                                                                       |
| SERVER_NAME                    | The host name of the Replicate Server machine.                                                                                                                                                   |
| STORAGE_UTILIZATION_OLD_STATE  | The storage utilization state before it moved to the "new" state described below.<br>For a description of possible states, see <a href="#">Define the Event that Triggers the Notification</a> . |
| STORAGE_UTILIZATION_NEW_STATE  | The storage utilization state after it moved from the "old" state                                                                                                                                |

**Table 14.3 | Supported Notification Variables (Cont.)**

| Variable                  | Description                                                                                                                     |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------|
|                           | described above.<br>For a description of possible states, see <a href="#">Define the Event that Triggers the Notification</a> . |
| USED_STORAGE_UTILIZATION  | The amount of disk space (on the drive where the Replicate Data folder is located) used by all tasks.                           |
| TOTAL_STORAGE_UTILIZATION | The total amount of disk space available on the drive where the Replicate Data folder is located.                               |

## Associate Tasks with the Notification

By default, notifications are sent for all tasks that are defined in the Attunity Replicate instance you are using. You can determine whether to send the notification to specific tasks defined in the Attunity Replicate instance you are using. For example, you can define a different latency rate for a specific task that is replicating from a slow system.

### To associate the notification with tasks:

1. In the [New Notification Wizard, Associate](#) page, select one of the following:
  - » **All Tasks:** To associate this notification with all tasks that are defined in the Attunity Replicate instance you are working with. In this case all tasks that were previously defined and any future task will be associated with this notification. If you choose to associate this notification with All Tasks, then click Next to [Review the Notification Rule](#).
  - » **Selected Tasks:** To associate this notification with one or more specific tasks only. Continue with the next step.
2. Select the check box next to any of the tasks you want to associate with this notification. You can select one or more tasks.

**Note** The Task check box at the top of the check-box column lets you select all of the tasks that are displayed. When you select this check box it is as if you select each of the tasks individually. Therefore, if you add tasks in the future they will not be included.

3. Click **Next** to [Review the Notification Rule](#).

## Review the Notification Rule

The **Summary** page lets you review the notification rule that you defined so that you can determine whether the selections you made in the wizard are correct. If you want to make changes, click **Back** and go to the page or pages you want to change.

When you are sure that the notification rule is defined in the way that you want, click **Finish** to close the wizard and add the rule to the notification list (see [Using the Notification List](#)).

After you close the wizard, make sure to click **Save** at the top of the **Settings** page. This will save the information for *all* settings, not only for the notification rule that you created. If you made changes that you do not want to keep, click **Discard** to discard all changes before you make changes to any of the other settings.

## Creating a Notification for a Task Event

Use the **New Notification** wizard to create notifications for task-based events.

**Note** For changes to task notification settings to take effect, the task(s) needs to be stopped and resumed.

### To create a notification for a task event

1. Launch the New Notification wizard as described in [Creating a New Notification](#).
2. In the **Notification Name** field, type a name for the notification.
3. Perform the following steps to define the notification:
  - » [Define the Action that Triggers the Notification](#)
  - » [Define Which Changes of Status Trigger the Notification](#)
  - » [Define Errors That Trigger the Notification](#)
  - » [Define the Recipients](#)
  - » [Define the Notification Message](#)
  - » [Associate Tasks with the Notification](#)
  - » [Review the Notification Rule](#)

## Define the Action that Triggers the Notification

In the **Operator** section of the **Task Events** page, you can determine the action that triggers the notification. If the Operator section is not displayed, click on the header with the word Operator to display the options for this section. Select one of the following:

- » **Task was started:** To send the notification when the task starts.
- » **Task was stopped manually or scheduled:** To send the notification when the task is stopped manually or by the Scheduler.

- » **Task was stopped after Full Load: Cached changes were not applied:** To send the notification when the task is stopped after Full Load completes but before cached changes (changes to the source tables that occurred during Full Load) are applied to the target.
- » **Task was stopped after Full Load: Cached changes were applied:** To send the notification when the task is stopped after Full Load completes and cached changes (changes to the source tables that occurred during Full Load) have been applied to the target.
- » **Full load started:** To send the notification when the Full Load process starts.
- » **Full load completed:** To send the notification when the Full Load process completes. Once you determine when to send the notification, you can decide whether specific changes in status trigger the notification.  
If you want to send a message about problems in latency, memory utilization, or disk utilization, click **Performance/Resources**. See [Define Which Changes of Status Trigger the Notification](#) for an explanation.  
If you want to send the notification when certain errors occur, click **Errors**. See [Define Errors That Trigger the Notification](#) for an explanation.  
Or you can click **Next** to [Define the Recipients](#).

## Define Which Changes of Status Trigger the Notification

In the **Performance/Resources** section of the **Task Events** page, you can define specific parameters for latency, disk utilization, or memory utilization that trigger a notification.

### To set up notifications about latency, disk utilization, or memory utilization:

1. In the [New Notification Wizard, Task Events](#) page, click **Performance/Resources**.
2. Select one of the following:
  - » **Latency is higher than Value seconds.**
  - » **Memory utilization exceeded Value MB**
  - » **Disk utilization exceeded Value MB**
3. Define the value for the option you select. See the table below for an explanation on each of these options and how to set the value.

**Note** If you select one of these options, the notification is sent only when the selected parameter is true. However, you must also [Define the Action that Triggers the Notification](#).

**Table 14.4 | Set Values for Latency, Disk Utilization, Memory Utilization**

| Notification                                               | Set Value                                                                                                                                                                                                                                | Notes                                                                                                                                                                                                                                                                                                            |
|------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Latency is higher than Value seconds                       | Click [N] and enter a value in the field that is displayed.<br>Latency is the time interval in seconds between the time a change was committed in the source system and the time it is applied and committed in the target system.       |                                                                                                                                                                                                                                                                                                                  |
| Clear notification when latency drops below <n> seconds.   | Use this to set the value that determines when latency returns to "normal limits."<br>Click [N] and enter a value.                                                                                                                       | When latency is below the value entered in this field, it is considered to be in the "normal" range and the notification status ends.<br>If selected, a notification is sent to indicate that latency returned to "normal" status.<br><a href="#">For more information, see Define the Notification Message.</a> |
| Memory utilization exceeded Value MB                       | Click [N] and enter a value in the field that is displayed.<br>Memory utilization is the amount of memory used by the task.                                                                                                              |                                                                                                                                                                                                                                                                                                                  |
| Clear notification when memory utilization is below <n> MB | Use this to set the value that determines when memory utilization returns to "normal limits."<br>Click [N] and enter a value.                                                                                                            | When memory utilization is below the value entered in this field, it is considered to be in the "normal" range and the notification status ends.<br><a href="#">For more information, see Define the Notification Message.</a>                                                                                   |
| Disk utilization exceeded Value MB                         | Click [N] and enter a value in the field that is displayed.<br>Disk utilization is the amount of disk space used.<br>Set a value that indicates that the current amount of disk space used is problematic to running a replication task. |                                                                                                                                                                                                                                                                                                                  |
| Clear                                                      | Use this to set the value that                                                                                                                                                                                                           | When disk utilization is below the                                                                                                                                                                                                                                                                               |

**Table 14.4 | Set Values for Latency, Disk Utilization, Memory Utilization (Cont.)**

| Notification                                       | Set Value                                                                                 | Notes                                                                                                                                                                                      |
|----------------------------------------------------|-------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| notification when disk utilization is below <n> MB | determines when disk utilization returns to "normal limits." Click [N] and enter a value. | value entered in this field, it is considered to be in the "normal" range and the notification status ends.<br>For more information, see <a href="#">Define the Notification Message</a> . |

Once you determine the status changes that trigger a notification, you can decide whether specific errors trigger a notification.

If you want to send the notification when certain errors occur, click **Errors**. See [Define Errors That Trigger the Notification](#) for an explanation.

Or you can click **Next** to [Define the Recipients](#).

## Define Errors That Trigger the Notification

In the **Errors** section of the **Task Events** page, you can determine whether notifications are sent when an error occurs. You can determine whether to send the notification for all errors or only for specific error types.

### To set up notifications for errors:

1. In the [New Notification Wizard, Task Events](#) page, click **Errors**.
2. Select one of the following:
  - » **Task encountered a non-retriable error and was stopped:** Select this to receive a notification when an error that cannot be retried is returned and a task or tasks are stopped due to this error.
  - » **Table encountered more than [N] apply errors:** Select this to receive a notification when a specified number of errors that occur in a CDC operation are applied to a table. In this case, the table is not loaded but the task continues to run.
  - » Click **Value** and type the number of errors to trigger the notification. For example, type 50 to send a notification after fifty records fail to be applied to the target table. All apply errors are logged in the `attrep_apply_exceptions` table. The count of apply errors is reset each time the task starts.
  - » **Table processing suspended due to errors:** Select this to receive a notification when an error causes a table to stop processing during a full-load operation or suspend CDC. In this case, the table process stops, but the task continues.
  - » **Any Error:** Select this to receive a notification when an error occurs in the system.

- » **Any Warning:** Select this to receive a notification when a warning is issued in the system.

Once you determine the error types that trigger a notification, you can:

- » [Define the Action that Triggers the Notification](#), if you have not done this already.
- » [Define Which Changes of Status Trigger the Notification](#) if you have not done this.
- » Or you can click **Next** to [Define the Recipients](#).

## Define the Recipients

Notifications are always displayed in **Notifications** tab in the **Messages** panel of the Replicate Console. In the **Recipients** page of the New Notification wizard, you can determine whether to also send the notification to Windows Event Log and/or email recipients.

### To determine the notification recipients:

Select any of the following to determine the notification recipients:

- » **Event log:** Select this if you want the notification message to be written to the Windows/Linux Event log. For information on how to view the Windows/Linux Event log, see the online help for the version of Windows or Linux you are using.
- » **Default notification email list:** Select this option if you want to send an email message to all the recipients on the Default Notification Email List. For more information, see [Creating a Default Recipient List](#). To see the current list of default recipients, click **Show List**.
- » **Custom email recipients:** Select this option to send the email notification to specific recipients.

Then:

- » Click the **Add Recipient** button.  
The **Name** field in the first available row in the list is activated.
- » Type the name of the user that you want to receive the message.

**Note** If you click another part of the Attunity Replicate Console, the cell will become inactive. You can double-click the cell to enter additional information.

- » Press the [tab] key or double click in the **Email** cell, then type the email address for the user you entered in the **Name** cell.
- » Repeat the above to add more recipients.

When you have finished, click **Next** to [Define the Notification Message](#).

## Define the Notification Message

You can create a custom message for your notification. By default, a standard message is created based on your settings in the Task Events screen.

### To create a notification message:

1. In the [New Notification Wizard, Message](#) page, double-click in any of the table cells to open the Edit Notification Message dialog box. See the table [Creating a Notification Message](#) for an explanation of the information to enter in each field.
2. Click in the right pane of the dialog box and begin to type your message. In some cases a default message is displayed based on the information you entered in the previous pages of the New Notification Rule wizard. You can edit or delete the message, or create a new message to be sent with the notification in this dialog box.
3. Add variables in messages and email headers you define for notifications, if necessary. You can enter variables in one of two ways:
  - » Type a variable into the message pane on the right using the following format:  
`{}<VARIABLE_NAME>{}`  
 For example: `{}TASK_NAME{}`.
  - » Use the variables from the left pane of the **Edit Notification** dialog box. To add a variable to the notification message, you can:
 

Double-click the variable. The variable is inserted where your cursor is located in the notification message in the right pane.

Select the variable you want to use and click the arrow key in the middle of the **Edit Notification Message** dialog box. The variable is inserted where your cursor is located in the notification message in the right pane.

Drag the variable from the left pane to the location you want to place it in the notification message in the right pane.

For more information, see the [Supported Notification Variables](#).
4. Click **OK** to enter the message.
5. After you define the message sent with the notification, click **Next** to [Associate Tasks with the Notification](#).

The following table describes how to enter the information in the **Message** page.

**Table 14.5 | Creating a Notification Message**

| To where:                                                                                                                 | Notification On Message                                                                                                                                                                                                                                                | Notification Off Message                                                                                                                                                                                                                                                                                              |
|---------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| This column describes where the message is sent.<br><br>For more information, see <a href="#">Define the Recipients</a> . | The <b>Notification On</b> Message is sent when the replication task meets the conditions for the notification to be sent.<br><br>For more information, see <a href="#">Define the Action that Triggers the Notification</a> , <a href="#">Define Which Changes of</a> | The <b>Notification Off</b> Message is sent when the replication task returns to its normal state. This type of message is sent for notifications about latency, disk utilization, and memory utilization.<br><br>For more information, see <a href="#">Define Which Changes of Status Trigger the Notification</a> . |

**Table 14.5 | Creating a Notification Message (Cont.)**

| To where:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Notification On Message                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Notification Off Message                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <p>Status Trigger the Notification, and Define Errors That Trigger the Notification.</p>                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Console:</b><br>The messages in this row are sent to the Attunity Replicate Console. They are displayed in the <b>Messages</b> section for a specific task. This section is displayed in: <ul style="list-style-type: none"> <li>▪ The Monitor for a specific task. For more information, see <a href="#">Reading Messages about a Task</a>.</li> <li>▪ The right pane of the Tasks page. For more information, see <a href="#">Tasks View</a>.</li> </ul> <p><b>Note</b> This message is also sent to the Windows Event log if you select this option. For more information, see <a href="#">Define the Recipients</a>.</p> | <p>In this field, you can edit, change or delete the message that is sent to the Attunity Replicate Console when the replication task meets the conditions for the notification to be sent.</p> <p><b>Example:</b></p> <pre>[{{ SERVER_NAME }}\{{NOTIFICATION_NAME}}]{{TASK_NAME}} replication task latency exceeds defined limits. Current latency is {{LATENCY}} seconds.</pre> <p>This message is sent to the console when latency reaches a value higher than the value you defined.</p> | <p>In this field, you can edit, change, or delete the message that is sent to the Attunity Replicate Console when the replication task returns to the normal range as you defined when you <a href="#">Define Which Changes of Status Trigger the Notification</a>.</p> <p>This field is relevant only for notifications about latency, disk utilization, and memory utilization.</p> <p><b>Example:</b></p> <p>Latency is back to normal, latency is {{LATENCY}} seconds</p> <p>This message is sent when latency returns to within its normal limits.</p> |
| <b>Email Subject:</b><br>This is the subject of the email messages sent for the notification.<br>See <a href="#">Define the Recipients</a> for                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <p>In this field, you can edit, change or delete the subject line for an email that is sent when the replication task meets the conditions for the notification to be sent.</p>                                                                                                                                                                                                                                                                                                              | <p>In this field, you can edit, change or delete the subject line for an email that is sent when the replication task returns to the normal range as you defined when you <a href="#">Define Which Changes of Status Trigger the Notification</a>.</p>                                                                                                                                                                                                                                                                                                      |

**Table 14.5 | Creating a Notification Message (Cont.)**

| To where:                                                                                                                                                                                                      | Notification On Message                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Notification Off Message                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| information about sending a notification as an email.                                                                                                                                                          | <p><b>Example:</b></p> <pre>[{{SERVER_NAME}}\{{NOTIFICATION_NAME}}]{{TASK_NAME}} high latency notification</pre> <p>This is the subject for an email message sent when latency reaches a value higher than the value you defined.</p>                                                                                                                                                                                                                                                                                                                                                        | <p>This field is relevant only for notifications about latency, disk utilization, and memory utilization.</p> <p><b>Example:</b></p> <pre>Replicate notification '{{NOTIFICATION_NAME}}' for task '{{TASK_NAME}}'</pre> <p>This is the subject for an email message sent when latency returns to within its normal limits.</p>                                                                                                                                                                                                             |
| <p><b>Email Message:</b><br/>This is the body of the email message sent for the notification.<br/><br/>See <a href="#">Define the Recipients</a> for information about sending a notification as an email.</p> | <p>In this field, you can edit, change or delete the message that is sent by email when the replication task meets the conditions for the notification to be sent.</p> <p><b>Example:</b></p> <pre>The latency for replication task {{TASK_NAME}} exceeds defined limits.</pre> <p>The current latency is {{LATENCY}} seconds.</p> <hr/> <hr/> <hr/> <p>This is an automated message generated by Attunity Replicate server {{SERVER_NAME}} for notification {{NOTIFICATION_NAME}}.</p> <p>This is an email message sent when latency reaches a value higher than the value you defined.</p> | <p>In this field, you can edit, change, or delete the message that is sent by email when the replication task returns to the normal range as you defined when you <a href="#">Define Which Changes of Status Trigger the Notification</a>.</p> <p>This field is relevant only for notifications about latency, disk utilization, and memory utilization.</p> <p><b>Example</b></p> <p>Latency is back to normal, latency is {{LATENCY}} seconds</p> <p>This is an email message sent when latency returns to within its normal limits.</p> |
| Event viewer                                                                                                                                                                                                   | In this field, you can edit,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

**Table 14.5 | Creating a Notification Message (Cont.)**

| To where: | Notification On Message                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Notification Off Message |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
|           | <p>change or delete the message that is sent to the Windows/Linux event viewer when the replication task meets the conditions for the notification to be sent.</p> <p>Note: This field is available only when you select <b>Event log</b> when you <a href="#">Define the Recipients</a>.</p> <p><b>Example:</b></p> <pre>[{{ SERVER_NAME }}\{{NOTIFICATION_NAME}}] {{TASK_NAME}} high latency notification The latency for replication task {{TASK_NAME}} exceeds defined limits. The current latency is {{LATENCY}} seconds.</pre> <p>This message is sent to the event viewer when latency reaches a value higher than the value you defined.</p> |                          |

After you define the message sent with the notification, click **Next** to [Associate Tasks with the Notification](#).

## Supported Notification Variables

For information on the variables that can be included in a notification, see [Supported Notification Variables](#).

## Associate Tasks with the Notification

By default, notifications are sent for all tasks that are defined in the Attunity Replicate instance you are using. You can determine whether to send the notification to specific tasks

defined in the Attunity Replicate instance you are using. For example, you can define a different latency rate for a specific task that is replicating from a slow system.

#### To associate the notification with tasks:

1. In the [New Notification Wizard, Associate](#) page, select one of the following:
  - » **All Tasks:** To associate this notification with all tasks that are defined in the Attunity Replicate instance you are working with. In this case all tasks that were previously defined and any future task will be associated with this notification.  
If you choose to associate this notification with All Tasks, then click [Next](#) to [Review the Notification Rule](#).
  - » **Selected Tasks:** To associate this notification with one or more specific tasks only. Continue with the next step.
2. Select the check box next to any of the tasks you want to associate with this notification. You can select one or more tasks.

**Note** The Task check box at the top of the check-box column lets you select all of the tasks that are displayed. When you select this check box it is as if you select each of the tasks individually. Therefore, if you add tasks in the future they will not be included.

3. Click [Next](#) to [Review the Notification Rule](#).

## Review the Notification Rule

The **Summary** page lets you review the notification rule that you defined so that you can determine whether the selections you made in the wizard are correct. If you want to make changes, click **Back** and go to the page or pages you want to change.

When you are sure that the notification rule is defined in the way that you want, click **Finish** to close the wizard and add the rule to the notification list (see[Using the Notification List](#)).

After you close the wizard, make sure to click **Save** at the top of the **Settings** page. This will save the information for *all* settings, not only for the notification rule that you created. If you made changes that you do not want to keep, click **Discard** to discard all changes before you make changes to any of the other settings.

## Creating a Notification for a Server Event

Use the **New Notification** wizard to create notifications for server-based events.

#### To create a notification for a server event

1. Launch the New Notification wizard as described in [Creating a New Notification](#).
2. In the **Notification Name** field, type a name for the notification.

3. Perform the following steps to define the notification:
  - a. [Define the Event that Triggers the Notification](#)
  - b. [Define the Recipients](#)
  - c. [Define the Notification Message](#)
  - d. [Review the Notification Rule](#)

## Define the Event that Triggers the Notification

In the **Disk Space** section, you can determine the disk space utilization event that triggers the notification.

Select one of the following:

- » **Disk space utilization reaches the high threshold:** The notification will be triggered when disk space utilization reaches the percentage defined for the high threshold.
- » **Disk space utilization reaches the critical threshold:** The notification will be triggered when disk space utilization reaches the percentage defined for the critical threshold.
- » **Disk space utilization returns to normal:** The notification will be triggered when disk space utilization returns to normal percentage (i.e. not high or critical).
- » **Disk space utilization reaches any of the defined thresholds or returns to normal:** The notification will be triggered in any of the following scenarios:
  - » Disk space utilization increases from normal to the high threshold
  - » Disk space utilization increases from normal to the critical threshold
  - » Disk space utilization increases from the high threshold to the critical threshold
  - » Disk space utilization returns to normal from the high threshold
  - » Disk space utilization returns to normal from the critical threshold
  - » Disk space utilization returns to the high threshold from the critical threshold

In the **System Memory** section, you can determine the system memory utilization event that triggers the notification.

Select one of the following:

- » **System memory utilization reaches the high threshold:** The notification will be triggered when system memory utilization reaches the percentage defined for the high threshold.
- » **System memory utilization reaches the critical threshold:** The notification will be triggered when system memory utilization reaches the percentage defined for the critical threshold.
- » **System memory utilization returns to normal:** The notification will be triggered when system memory utilization returns to normal percentage (i.e. not high or critical).
- » **System memory utilization reaches any of the defined thresholds or returns to normal:** The notification will be triggered in any of the following scenarios:

- » System memory utilization increases from normal to the high threshold
- » System memory utilization increases from normal to the critical threshold
- » System memory utilization increases from the high threshold to the critical threshold
- » System memory utilization returns to normal from the high threshold
- » System memory utilization returns to normal from the critical threshold
- » System memory utilization returns to the high threshold from the critical threshold

Click **Next** to [Define the Recipients](#).

## Define the Recipients

For more information, see [Define the Recipients](#).

## Define the Notification Message

You can create a custom message for your notification. By default, a standard message is created based on your settings in the **Server Events** screen.

### To edit the default notification message:

1. In the [New Notification Wizard](#), **Message** page, click the message text to open the **Edit Notification Message** dialog box. See the table [Creating a Notification Message](#) for an explanation of the information to enter in each field.
2. Click in the right pane of the dialog box and begin to type your message. In some cases a default message is displayed based on the information you entered in the previous pages of the New Notification Rule wizard. You can edit the message or create a new message to be sent with the notification in this dialog box.
3. Optionally, add variables in messages and email headers you define for notifications. You can enter variables in one of two ways:
  - » Type a variable into the message pane on the right using the following format:  
`{ {<VARIABLE_NAME >} }`  
For example: `{ {TASK_NAME} }`.
  - » Use the variables from the left pane of the **Edit Notification Message** dialog box. To add a variable to the notification message, you can:  
Double-click the variable. The variable is inserted where your cursor is located in the notification message in the right pane.  
Select the variable you want to use and click the arrow key in the middle of the **Edit Notification Message** dialog box. The variable is inserted where your cursor is located in the notification message in the right pane.  
Drag the variable from the left pane to the location you want to place it in the

notification message in the right pane.

For more information, see the [Supported Notification Variables](#).

4. Click **OK** to enter the message.
5. After you define the message sent with the notification, click **Next** to [Review the Notification Rule](#).

The following table describes how to enter the information in the **Message** page.

**Table 14.6 | Creating a Notification Message**

| To where:                                                                                                                                                                                                    | Notification Message                                                                                                                                         |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| This column describes where the message is sent.<br><br>For more information, see <a href="#">Define the Recipients</a> .                                                                                    | Sent when the server meets the conditions for the notification to be sent.                                                                                   |
| <b>Console:</b><br><br>The messages in this row are sent to the Console.                                                                                                                                     | In this field, you can edit the message that is sent to the Attunity Replicate Console when the server meets the conditions for the notification to be sent. |
| <b>Note</b> The same message is also sent to the Windows Event Log if you chose to send messages to the Windows Event Log. For more information, see <a href="#">Define the Recipients</a> .                 |                                                                                                                                                              |
| <b>Email Subject:</b><br><br>This is the subject of the email messages sent for the notification.<br><br>See <a href="#">Define the Recipients</a> for information about sending a notification as an email. | In this field, you can edit the subject line for an email that is sent when the server meets the conditions for the notification to be sent.                 |
| <b>Email Message:</b><br><br>This is the body of the email message sent for the notification.<br><br>See <a href="#">Define the Recipients</a> for information about sending a notification as an email.     | In this field, you can edit the message that is sent by email when the server meets the conditions for the notification to be sent.                          |

## Supported Notification Variables

For information on the variables that can be included in a notification, see [Supported Notification Variables](#).

## Review the Notification Rule

The **Summary** page lets you review the notification rule that you defined so that you can determine whether the selections you made in the wizard are correct. If you want to make changes, click **Back** and go to the page or pages you want to change.

When you are sure that the notification rule is defined in the way that you want, click **Finish** to close the wizard and add the rule to the notification list (see [Using the Notification List](#)).

After you close the wizard, make sure to click **Save** at the top of the **Settings** page. This will save the information for *all* settings, not only for the notification rule that you created. If you made changes that you do not want to keep, click **Discard** to discard all changes before you make changes to any of the other settings.

## Using the Notification List

The Notification List lists all of the notification rules that are defined for the Attunity Replicate instance you are working with. It has the following information:

- » **Name:** Displays the name of the notification rule.
- » **Condition:** Displays the condition that triggers the notification to be sent. For more information, see [Define Which Changes of Status Trigger the Notification](#).
- » **Send Message To:** Displays custom users that receive the message. For more information, see [Determine the Email-Message Recipients for the Notification](#).
- » **Tasks:** Displays the tasks that are associated with this notification rule. For more information, see [Associate Tasks with the Notification](#).
- » **Active:** Select the check box in this column to activate the notification. If this check box is cleared, notifications defined by this rule are not sent. This check box is selected by default.

## Editing a Notification

You can make changes to any notification rule.

### To edit a notification rule:

1. From the [Notification List](#), select the notification you want to edit.
2. Click **Open** (at the top of the list).  
or  
Double-click the notification you want to edit.  
The Edit Notification Rule wizard opens.
3. Make any changes you need in the wizard. For information on how to work with each

of the pages in the New Notification Rule wizard, see [Creating a New Notification](#).

**Note** You can only make changes to those sections that you defined when [Creating a New Notification](#).

- » You cannot change name of the notification.
- » If you defined a notification to let you know when the task or full load started or stopped, this cannot be edited. For example, if you created a notification rule for starting a task and you now also want to get notified when the task stops, you must create a new notification rule.
- » In the Notify When? page, you can make changes to the data you defined in the original notification rule. For example, if you defined a **Memory utilization** message in the **Notify when?** page, **Performance/Resources** section, you can only change this parameter. If you want to add information about something that was not defined in the original notification rule, for example you want to add errors to your notification or you want to get information about latency, you must create a new notification rule.

## Deleting a Notification

You can delete notification rules that you no longer want to use.

**Note** When you delete a notification, it is deleted permanently.

### To delete a notification:

1. From the [Notification List](#) select the notification you want to delete.
2. Click **Delete** (at the top of the list).

## Setting up Mail Parameters

The Mail parameters define the mail server used to send notifications.

### To set the Mail parameters:

1. Click the **Mail Settings** sub-tab and enter the following information:
  - » **Mail server:** Type the outgoing mail server you are using to send the notifications that you define in Attunity Replicate, for example, `smtp.example.com`.
  - » **Port:** Type the port number where the mail server is located. The default value is **25**.
  - » **Use SSL:** Select this check box if you want to use SSL security to connect to the mail server for the notifications that are sent.

- » **Anonymous login:** Check this to allow an Attunity Replicate user to access the mail server to receive messages without having to provide any user credentials.
  - » **User name:** Type an email user name for the user account that is sending the notifications. For SMTP authentication be sure to supply a valid user name.
  - » **Password:** Type the password for the email user account that is sending the notifications. For SMTP authentication be sure that password provided is valid.
  - » **Sender email address:** Enter the email address that sends the email notifications. This is the address that appears in the **From** field of the email notification.
  - » **Send test email:** Click to open the **Send Test Email** dialog box.
  - » **Email address for test email:** Type an email address to receive a test email message from the server you configured. Use this to determine that the **Mail Parameters** you defined are valid.
2. Click **Save** at the top of the screen to save *all* of the changes you made, not only for the recipient list.

**Note** If you made changes that you do not want to keep, click **Discard** to discard all changes before you make changes to any of the other settings.

## Creating a Default Recipient List

Click the **Default Recipients List** sub-tab to create a default recipient list.

A default recipient list is a list of recipients that receive all of the notifications that you define for task-based or server-based events. This allows you to use one list for all email notifications without having to define the list each time you create a notification.

**Note** You can choose to send notifications to a different list or to additional users for any specific notification. You define these exceptions when you create the specific notification. For more information, see [Define the Notification Distribution Properties](#).

### To create a Default Recipient List:

1. At the top of the **Default Recipient List** settings page, click **Add Recipient**.  
The next row in the Recipient List table becomes available.
2. Type the name of the user you want to add to the list of default recipients. Continue to enter a name and email address for each recipient you want to include in the default list.
3. Press the [tab] key or double click in the **Email** cell, then type the email address for the user you entered in the **Name** cell.
4. Click **Save** at the top of the screen to save all of the changes you made.

**Note** Click **Save** to save the information for *all* settings, not only for the recipient list. If you made changes that you do not want to keep, click **Discard** to discard all changes before you make changes to any of the other settings.

## License Settings

You need to register the software before you can use Attunity Replicate. Your Attunity vendor should provide you with a text file called license.txt. This file contains details such as the product expiration date (if any).

Use the License settings page for:

- » [Requesting a License](#)
- » [Registering a License](#)
- » [Viewing a License](#)

**To open the License settings page:**

- » From the Server view, click **License** from the menu list at the left. The **License** sub-tab is displayed.

## Requesting a License

You must have a valid license to work with Attunity Replicate. You can request a license from the License settings page in the Attunity Replicate Console. In the License Request dialog box, fill out the required information and submit the request by email. Once your request is approved, the license file is sent to you by email. To use Attunity Replicate, register the license by using the procedure described in [Registering a License](#).

**To request a license:**

1. From the **Server** page, click **License**.
2. At the top of the **License** tab, click **Request License**.

The **Replication License Request** dialog box opens.

**Attunity Replicate License Request**

|                                                                                                                                                                                                                                                                |                                               |   |                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|---|----------------------|
| Request type:                                                                                                                                                                                                                                                  | New License                                   | ▼ |                      |
| License to:                                                                                                                                                                                                                                                    |                                               |   |                      |
| License type:                                                                                                                                                                                                                                                  | Permanent                                     | ▼ |                      |
| Expiration date:                                                                                                                                                                                                                                               |                                               |   |                      |
| Hosts:                                                                                                                                                                                                                                                         | davidg-win7.attunity.local                    |   |                      |
| Source types:                                                                                                                                                                                                                                                  | ORACLE_COMPONENT_TYPE                         |   | <a href="#">Edit</a> |
| Target types:                                                                                                                                                                                                                                                  | GREENPLUM_COMPONENT_TYPE,SQL_SERVER_COMPONENT |   | <a href="#">Edit</a> |
| <a href="#">Advanced</a>                                                                                                                                                                                                                                       |                                               |   |                      |
| <a href="#"> Send by Mail</a> <a href="#"> Copy to Clipboard</a> <a href="#">Close</a> |                                               |   |                      |

3. Enter the requested information:

- » **Request type:** Select one of the following:
  - » **New License:** Select this if this is your initial license request.
  - » **Extend License:** Select this if you have a license and want to extend its period of validity.
  - » **Alter License:** Select this if you want to make changes to an existing license. For example, if you want to add additional sources or targets or change the host computer.
- » **License to:** Type the name of the company or group that is requesting a license to use Attunity Replicate.
- » **License type:** Select one of the following:
  - » **Permanent:** Select this if the license will always be valid. Permanent licenses do not require an expiration date.

- » **Evaluation:** Select this if you are requesting a temporary license to use Attunity Replicate for a trial period.
  - » **Term:** Select this if you are requesting a license that is valid for a specific period of time. In this case you must be sure to include an expiration date in your request.
  - » **Expiration date:** Click in this field to select the expiration date using the pop-up calendar. This is required only if you selected **Evaluation** or **Term** in as the License type.
  - » **Hosts:** Type the name of the local computer where Attunity Replicate is installed. By default the name of the local computer is displayed in this field. You can change this or add additional computers if you are installing Attunity Replicate in a different or an additional location.
  - » **Source Types:** Click **Edit** to open the Edit Source Types dialog box. Check the endpoint types you are working with as your replication sources. You can select one or more endpoint endpoints as necessary. If you need to work with all available endpoints, click **All**.
  - » **Target Types:** Click **Edit** to open the Edit Target Types dialog box. Check the endpoint types you are working with as your replication targets. You can select one or more endpoint endpoints as necessary. If you need to work with all available sources, click **All**.
4. Click **Send by Mail** to open an email request for the license. Send the email to the address entered in the recipient field of your default email client.

**Note** If you have not registered a default email client, clicking the **Send by Mail** button will not open your email client. For instructions on registering a default email client, refer to your browser's or operating system's online help.

Click **Copy to Clipboard** to copy the information to the computer's clipboard. You can paste this information into the Advanced license request and edit it as necessary. For more information, see [Using the Advanced License Request Option](#).

## Using the Advanced License Request Option

The advanced license request option lets you request a license by manually typing the information. Make sure to include all of the information required as described in [Requesting a License](#). The following is a suggested format for the advanced option:

```
Request type:New License
License to: <company name>
License type: Permanent
Expiration date:
Hosts: bee01-xp.company.local
Source Types: Oracle
Target Types: SQLServer
```

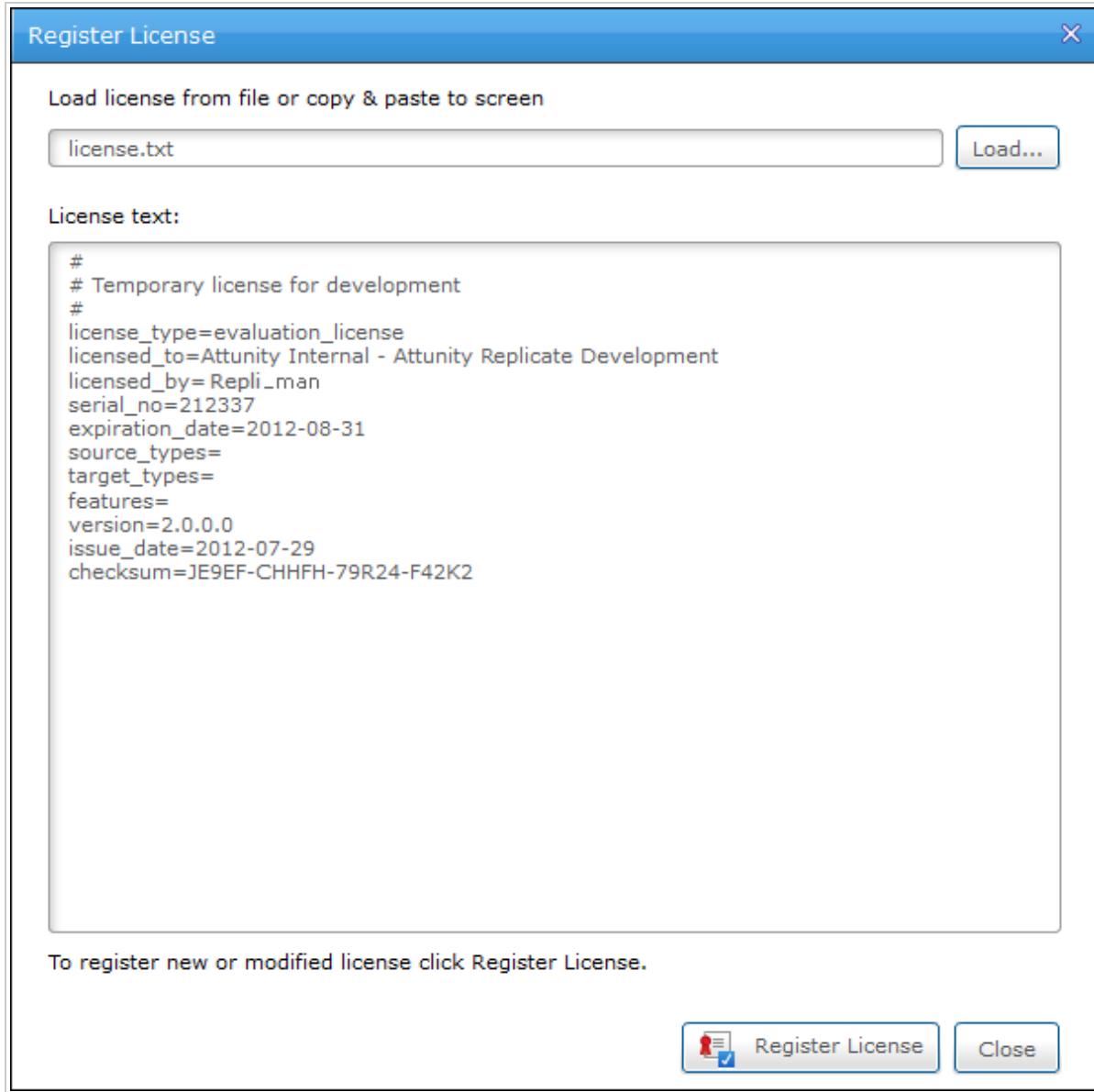
## Registering a License

You must have a valid license to work with Attunity Replicate. If you did not receive a license.txt file, you can request a license using the procedure described in [Requesting a License](#). Once you receive the license, you must register it to work with Attunity Replicate.

### To register a license:

1. Copy the license.txt file to your computer or any computer in your network you have access to.
2. From the Server page, click **License**.
3. At the top of the **License** tab, click **Register License**.

The **Register License** dialog box opens.



4. Click **Load** and browse to find and select the license file.

The license text is displayed in the dialog box as shown above. Check to be sure that the details are correct.

5. Click **Register License** to register the license. A message indicating the license was registered successfully is displayed.

**Note** A message is displayed at the top of the Attunity Replicate Console that indicates that you have a valid license and when it expires. If the license is expired or invalid, the message indicates this.

You can also click on this message link to request, register, or view license information.

## Viewing a License

You can view the license information in the Attunity Replicate Console at any time.

### To view the license information:

- » From the Server page, click **License**.

The **License** tab is displayed. All of the license information is displayed in the **License** tab.

The screenshot shows the 'License' tab in the Attunity Replicate interface. At the top, there are two buttons: 'Request License' (with a mail icon) and 'Register License' (with a checkmark icon). Below these buttons is a section titled 'Registered License' containing a table of license information. The table has 13 rows, each with a key-value pair. The data is as follows:

|                 |                                                    |
|-----------------|----------------------------------------------------|
| Checksum        | R8H65-8J933-5R5E3-9C933                            |
| Expiration Date | 2012-05-31                                         |
| Features        |                                                    |
| Hosts           |                                                    |
| issue_date      | 2012-05-13                                         |
| License Type    | EVALUATION_LICENSE                                 |
| License By      | Repli_man                                          |
| License To      | Attunity Internal - Attunity Replicate Development |
| Serial Number   | 212334                                             |
| Source Types    |                                                    |
| Target Types    |                                                    |
| Version         | 2.0.0.0                                            |
|                 |                                                    |

## Global Error Handling

You can configure how Attunity Replicate responds to specific types of errors. You can define error handling on the task level or the server level. The configurations you make in the Server Settings affect all tasks created for this instance of Attunity Replicate unless

you define a task to use the definitions you create for that task. For information on how to configure error handling for a specific task, see [Error Handling](#) in the [Customizing Tasks](#) chapter.

### To open the Error Handling page:

From the Server view, click **Global Error Handling** from the menu list on the left.

The following tabs are available:

- » **Environmental Errors:** An error that is caused by an environmental problem in the source or target endpoint or on the network. Environmental errors can be restarted. The information you enter in this tab is the same as the information you enter in the **Environmental Errors** tab for tasks. For information about the options available in this tab, see [Environmental Errors](#).
- » **Data Error:** An error related to data processing at the record level. The information you enter in this tab is the same as the information you enter in the **Data Error** tab for tasks. For information about the options available in this tab, see [Data Errors](#) in the Customizing Tasks chapter.
- » **Table Error:** An error in processing data or metadata for a specific table. This only includes general table data and not an error that relates to a specific record. The information you enter in this tab is the same as the information you enter in the **Table Error** tab for tasks. For information about the options available in this tab, see [Table Errors](#) in the Customizing Tasks chapter.
- » **Apply Conflicts:** Errors that occur when the target endpoint is not synchronized with the source endpoint when processing changes. This can cause duplicate key errors on INSERT operations or zero rows affected on UPDATE/DELETE operations. The information you enter in this tab is the same as the information you enter in the **Apply Conflicts** tab for tasks. For information about the options available in this tab, see [Apply Conflicts](#) in the Customizing Tasks chapter.

## Logging

The following topics describe the server logging management options:

- » [Setting Logging Levels for the Server and File Transfer Service](#)
- » [Setting Automatic Roll Over and Cleanup](#)
- » [Viewing and Downloading Log Files](#)
- » [Deleting Server, Task and FTS Log Files](#)

## Setting Logging Levels for the Server and File Transfer Service

You set the logging level for the Replicate Serverlogs and File Transfer Service logs in **Server** view. The level you set determines what information is written to the logs. The Server logs provide information about the Attunity Replicate Server instance you are

working with as opposed to individual tasks. For information on configuring the task logs, see [Setting the Task Logging Level](#).

The following logging levels are available, ordered from the lowest level to the highest:

1. Errors
2. Warnings
3. Info
4. Trace
5. Verbose

The higher levels always include the messages from the lower levels. Therefore, if you select **Error**, only error messages are written to the log. However, if you select **Info**, informational messages, warnings, and error messages are included. Selecting **Verbose** writes all possible messages to the log.

You can set a global logging level for all components or you can set a separate logging level for each component.

#### To set the logging levels:

1. On the left side of the **Server** view, click **Logging** and then click the **Server Logging Levels** or **File Transfer Service Logging Levels** sub-tab as required.  
The **Component Logging Level** sliders are displayed.
2. To set a global logging level, move the top slider (the slider with the labels) to the log level you want. Note that all of the sliders for the individual modules move to the same position that you set in the main slider.
3. Make any changes to the sliders for the individual modules. This is optional. Note that if you change the main slider, all of the individual sliders are reset to the new position. If you want to maintain a different logging level for a specific module, you need to reset it.
4. Click **Save** at the top of the screen. Changes to the logging level take place immediately. There is no need to restart the Attunity Replicate Server.

**Note** Click **Save** to save the information for *all* settings, not only for the logging settings. If you made changes that you do not want to keep, click **Discard Changes** to discard all changes before you make changes to any of the other settings.

#### Storing Trace and Verbose Logging in Memory

When the logging level is set to "Trace" or "Verbose", you can instruct Replicate to store the logging information in memory until an error occurs. On detecting an error, Replicate will begin writing to the physical logs and continue to do so for a few minutes after the initial occurrence of the error.

If *no* error occurs before the allocated memory is used up, Replicate will empty the memory buffer and start afresh.

This option is useful for tasks that fail unpredictably and for no obvious reason. The problem with continually writing large amounts of information to the logs is twofold:

- » Running in "Trace" or "Verbose" logging mode will quickly use up available disk space (unless the logging settings have been configured to prevent this).
- » Continually writing large amounts of data to the logs will affect performance.

### To use this option

1. Select the **Store trace/verbose logging in memory, but if an error occurs, write to the logs** check box at the top of the tab.
2. In the **Allocate memory up to (MB)** field, specify the amount of memory you want to allocate for storing logging information.

## Setting Automatic Roll Over and Cleanup

In the **Log File Management** sub-tab, you can define when Replicate should roll over the server log files (`repsrv` and `repclm`) and tasks log files (`reptask_<task_name>`) and when to delete old log files from the system.

### Automatic Rollover

You can determine when to stop logging to the current log file and begin to log to a new log file. Rolled over log files are appended with a 12-digit timestamp. The current server log file is named `repsrv` while saved (older) server log files are named `repsrv_xxxxxxxxxxxxxx`.

The current running task log file is named `reptask_<task_name>` while saved (older) task log files are named `reptask_<task_name>_xxxxxxxxxxxxxx`.

For both server and task saved log file names, `xxxxxxxxxxxxxx` represents a 12-digit timestamp.

- » **Roll over the log if the log file is older than (days):** Select the check box and then specify the maximum number of days the current log file is allowed to exist before being rolled over.  
The default value is **7** days.
- » **Roll over the log if the log file is larger than (MB):** Select the check box and then specify the maximum number of megabytes the current log file is allowed to reach before being rolled over.

**Note** When the **Store trace/verbose logging in memory, but if an error occurs, write to the logs** option is enabled, the actual size of the **repsrv.log** may reach the sum of the **Allocate memory up to (MB)** size and the **Roll over the log if the log file is larger than (MB)** size, before it is rolled over.

For more information on the "Store trace/verbose logging in memory" option, see [Setting Logging Levels for the Server and File Transfer Service](#)

The default value is **100** megabytes.

#### Notes

- » If you edit this setting while tasks are running, the new setting will not affect the task log files until the tasks are stopped and then resumed. The server log files are not affected by this limitation.
- » The scheduled process (`LogFileCleanLogs`) that checks the log file size runs every five minutes. Consequently, the actual size/age of the rolled over log file may deviate slightly from the specified value(s).

## Automatic Cleanup

You can determine the maximum number of days old log files (i.e. log files that have been rolled over) are retained before being deleted.

- » **Delete log files that are older than (days):** Select the check box and then specify the maximum number of days to retain a saved log file. Log files that are older than the specified number of days will be automatically deleted from the system. For example, if you specify **4**, then on the fifth day, any log file older than **4** days will be deleted.

The default value is **45** days.

## Viewing and Downloading Log Files

You can view log files and download them if necessary.

#### To view or download the log files:

1. Select the **Server Logging Levels** or **File Transfer Service Logging Level** sub-tab as required.
2. Click the **Log Viewer** toolbar button.  
The **Log Viewer** window opens.
3. Continue from step 4 in [Viewing and Downloading the Task Log Files](#).

## Manually Rolling Over the Log Files

You can manually roll over the Replicate Server log files if necessary. This lets you stop logging to the current log file and begin to log to a new log file. The currently open log file does not have a timestamp. The name of saved (older) log files is appended with a 12-digit timestamp.

### To roll over the log files:

1. Select the **Server Logging Levels** sub-tab.
2. Click the **View Logs** toolbar button.  
The **Log Viewer** window opens.
3. Select the log file without a timestamp and then click the **Roll Log File** toolbar button in the top right of the window.

## Deleting Server, Task and FTS Log Files

You can manually delete task, server, and File Transfer Service log files older than the specified number of days.

### To delete the log files:

1. Select the **Logging** tab.
2. Click the **Delete Logs** toolbar button.  
The **Delete Logs** window opens.
3. Select which logs to delete and, for each log, optionally change the default number of days (45).
4. Click **Delete**.  
Selected logs older than the specified number of days will be immediately deleted.

## File Transfer Service

The Attunity File Transfer Service (FTS) is a robust and reliable file transfer engine designed to efficiently transfer files over the WAN. This can dramatically improve transfer speeds when the source endpoint and the target endpoint are located on different LANs.

## How it Works

A solution using FTS consists of two Attunity Replicate Servers: A local Attunity Replicate Server installed on the source endpoint LAN and a remote Attunity Replicate Server installed on the target endpoint.

A local task on the local server is defined from the source endpoint to a File Channel target. A remote task on the remote Attunity Replicate Server is defined from a File Channel source to the target endpoint.

The FTS runs on the remote Attunity Replicate Server only and transfers the File Channel files from the storage location defined in the local task to the storage location defined in the remote task.

Upon file transfer, and before [Compression](#) and [Encryption](#), large files are split into smaller blocks which form recoverable transport units, and small files are merged into bigger blocks to be sent at the same time. The blocks are then transferred and reconstructed into File Channel files when received by the FTS server.

For information on setting up a File Channel source or target to use FTS, see [Using Advanced Properties for a File-Channel Source](#) and [Setting Advanced Connection Properties](#) respectively.

## Compression

File Channel files are compressed upon sending using GZIP. You can disable the compression and control the compression level.

## Encryption

After compression, File Channel files are encrypted using a randomly generated AES-256 session key. The session key is exchanged between the client and server using the Diffie-Hellman key exchange protocol which is authenticated using a secret key that is shared between the client and the server.

**Note** The File Transfer Service should be configured on the remote Attunity Replicate Server *only*.

## Defining a File Transfer Service

Define a File Transfer Service as described below.

### To add a File Transfer Service:

1. Switch to **Server** view as described in [Server View](#).
2. In the left side of the **Server** view, click **File Transfer Service**.  
The File Transfer Service list is displayed.
3. In the Actions toolbar, click **Add File Transfer Service**.  
The **Add File Transfer Service** window opens.
4. Edit the values in the **Name**, **Host** and **Port** columns as follows:

- » **Name:** The name of the File Transfer Service.
- » **Host:** The host name or IP address of machine on which the remote Attunity Replicate Server is installed. The default is 0.0.0.0 (all interfaces). If the server has multiple NICs (Network Interface Cards), you can define a different File Transfer Service for each card.
- » **Port:** The port through which the File Channel files are received.
- » **Enabled:** select the check box to enable the File Transfer Service.

5. Click **Save** to save your settings.

| SERVER                |                                                                                        |                                                                                                   |                                                                                                             |                                                                                          |
|-----------------------|----------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
|                       |  Save |  Discard Changes |  Add File Transfer Service |  Remove |
| Notifications         | Name                                                                                   | Host                                                                                              | Port                                                                                                        | Enabled                                                                                  |
| License               | defaultFts                                                                             | <input type="text"/>                                                                              | <input type="text" value="9090"/>                                                                           | <input type="checkbox"/>                                                                 |
| Global Error Handling |                                                                                        |                                                                                                   |                                                                                                             |                                                                                          |
| Logging               |                                                                                        |                                                                                                   |                                                                                                             |                                                                                          |
| File Transfer Service |                                                                                        |                                                                                                   |                                                                                                             |                                                                                          |
| File Transfer Service |                                                                                        |                                                                                                   |                                                                                                             |                                                                                          |
| Scheduler             |                                                                                        |                                                                                                   |                                                                                                             |                                                                                          |

## Editing a File Transfer Service

You can edit a File Transfer Service as described below.

### To edit a File Transfer Service:

1. Select the File Transfer Service you want to edit.
2. Edit the values in the **Name**, **Host** and **Port** columns as follows:
  - a. Click the cell to make it editable.
  - b. Change the value as required and then click **Save**.

**Note** When you edit a File Transfer Service, make sure that any File Channel targets configured to use the File Transfer Service are also updated accordingly. For more information on File Channel Targets, see [Setting General Connection Properties](#).

## Deleting a File Transfer Service

You can delete File Transfer Services that you no longer want to use.

### To delete a File Transfer Service:

1. In the File Transfer Services List, select the item you want to delete.
2. Click the **Remove** toolbar button.

## Scheduling Jobs

Use the Attunity Replicate Scheduler to schedule a one-time job or a recurrent job for specific task operations. A job is essentially an operation that can be scheduled to occur once, daily, weekly or monthly.

The following operations can be scheduled:

- » Run/Resume a task
- » Stop a task
- » Reload a task

### To schedule a new job:

1. Switch to **Server** view as described in [Server View](#).
2. In the left side of the **Server** view, click the **Scheduler** tab.

The **Scheduler** tab consists of two sub-tabs: **Scheduled Jobs** and **Executed Jobs**.

The **Scheduled Jobs** tab contains a list of jobs that are scheduled to run periodically or once only while the **Executed Jobs** tab contains a list of jobs that have already run.

**Note** The **Executed Jobs** tab will only show executed jobs that were scheduled to run once only. In other words, jobs scheduled to run periodically (e.g. Daily, Weekly, Monthly) will not be shown.

3. Click the **New Scheduled Job** toolbar button.  
The **New Scheduled Job** window opens.
4. Specify a **Job Name** and then, from the **Select scheduled job type** drop-down list, select one of the following:
  - » **Run task** to run or resume the task(s) at the scheduled time.

**Note** For Full Load only tasks, it is preferable to select **Reload target** rather than **Run task** when the scheduling is set to Daily, Weekly or Monthly. This will update the table's data whereas **Run task** will replace the existing table.

- » **Stop task**
- » **Reload target**

**Note** Selecting **Reload target** will execute the task according to the task's replication settings. For example, if the task's **Full Load** and **Apply Changes** options are enabled, **Reload target** will reload the target tables and apply any subsequent changes.

5. Select one of the following time conventions:

- » **Use server local time** - When this option is selected (the default), the job will run when the specified time is reached *in the server's location*.  
See also: [Impact of DST Change on Attunity Replicate](#).
- » **Use universal time (UTC)** - When this option is selected, the job will run at the specified UTC time. So, for example, if the server is located in a UTC + 2 timezone, a job scheduled to run at 13:00 UTC time will actually run at 15:00 local server time. Scheduling a job to run in UTC mode may be useful if you need tasks on several Replicate servers (located in different timezones) to run concurrently.

**Note** For reference, both the server local time and the UTC time are displayed to the right of the **Scheduled Time** heading.

6. Select and define one of following scheduling options:

- » Once (Run the job once on the specified day and at the specified time)
- » Daily - (Run the job every day at the specified time)
- » Weekly - (Run the job on the specified days and at the specified time)
- » Monthly - (Run the job on the specified day of the month)

**Note** To run the job on the last day of every month, select **Last day of every month** from the **Day of month** drop-down list.

Optionally, select the **Run job as soon as possible after scheduled time is missed** check box. If the Attunity Replicate Server is offline for whatever reason (e.g. for maintenance), any jobs that were scheduled to run during that time, will be submitted after the machine is brought back online (at the earliest opportunity).

7. For the **Apply to tasks** option, select which tasks to schedule. Select either **All tasks** to apply the job to all current and future tasks or **Selected tasks** to apply the job to specific tasks. If you choose **Selected tasks**, a list of currently defined tasks is displayed. Select which tasks to apply the job to.
8. Click **OK** to save your settings.

### To enable or disable a scheduled job:

- » In the **Scheduled Jobs** tab, select or clear the check box in the **Enabled** column as required.

### To edit a scheduled job:

1. Select the job in the **Scheduled Jobs** or **Executed Jobs** list.
2. Click the **Open** toolbar button and edit the job as required.

### To delete a scheduled job:

1. Select the job in the **Scheduled Jobs** or **Executed Jobs** list.
2. Click the **Delete** toolbar button.

## User Permissions

You can grant Attunity Replicate users different permissions according to the tasks you want them to perform. Four predefined "roles" are available: Admin, Designer, Operator and Viewer. Each role has its own set of permissions, which are described in the following table.

### Default User Permissions According to Roles

| Permissions                                                         | Admin | Designer | Operator | Viewer |
|---------------------------------------------------------------------|-------|----------|----------|--------|
| <a href="#">View task history</a>                                   | Yes   | Yes      | Yes      | Yes    |
| Download a memory report                                            | Yes   | Yes      | Yes      | No     |
| <a href="#">Download a Diagnostics Package</a>                      | Yes   | Yes      | Yes      | No     |
| <a href="#">View and download log files</a>                         | Yes   | Yes      | Yes      | No     |
| Perform runtime operations (such as start, stop, or reload targets) | Yes   | Yes      | Yes      | No     |
| Create and design tasks                                             | Yes   | Yes      | No       | No     |
| <a href="#">Edit task description</a> in Monitor View               | Yes   | Yes      | No       | No     |
| Delete tasks                                                        | Yes   | Yes      | No       | No     |
| <a href="#">Export tasks</a>                                        | Yes   | Yes      | Yes      | No     |
| <a href="#">Change logging level</a>                                | Yes   | Yes      | Yes      | No     |
| <a href="#">Delete logs</a>                                         | Yes   | Yes      | Yes      | No     |
| Manage endpoint connections (add, edit, duplicate, and delete)      | Yes   | Yes      | No       | No     |

| Permissions                                                                                                                                                                                                     | Admin | Designer | Operator | Viewer |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|----------|----------|--------|
| Open the <b>Manage Endpoint Connections</b> window and view the following endpoint settings: Name, type, description, and role.                                                                                 | Yes   | Yes      | Yes      | Yes    |
| Click the <b>Test Connection</b> button in the <b>Manage Endpoint Connections</b> window.                                                                                                                       | Yes   | Yes      | Yes      | No     |
| View all of the endpoint settings in the <b>Manage Endpoint Connections</b> window.                                                                                                                             | Yes   | Yes      | Yes      | No     |
| Edit the following server settings: Notifications, scheduled jobs, and executed jobs.                                                                                                                           | Yes   | Yes      | Yes      | No     |
| Edit the following server settings: Mail server settings, default notification recipients, license registration, global error handling, logging, file transfer service, user permissions, and resource control. | Yes   | No       | No       | No     |

**Note** The user under whose account Attunity Replicate is installed will be associated with the Admin role by default.

You can set user permissions using Active Directory Groups or Local Groups. To set user permissions using Active Directory groups, you can either create Active Directory groups with the names listed in the following table or you can create Active Directory groups with different names. Then, add users to the groups according to the role you want them to perform.

**Table 14.7 | Roles and Their Corresponding Active Directory Names**

| Role          | Active Directory Groups   |
|---------------|---------------------------|
| Administrator | AttunityReplicateAdmins   |
| Designer      | AttunityReplicateDesigner |
| Operator      | AttunityReplicateOperator |
| Viewer        | AttunityReplicateViewer   |

For information on encrypting user permissions, see [Encrypting the User Permissions File](#).

**Note** If you create Active Directory groups with different names, you need to add them to the **User Permissions** window and set their permissions as described in [Managing User Permissions](#).

## Managing User Permissions

This section explains how to edit user permissions as well as how to add or remove users and groups.

### To edit the user permissions:

1. Switch to **Server** view as described in [Server View](#).
2. In the left side of the **Server** view, click the **User Permissions** tab.
3. Adjust the permission sliders as desired.
4. Click **Save** to save your settings or **Discard** to revert them.

### To add new users or groups:

1. Switch to **Server** view as described in [Server View](#).
2. In the left side of the **Server** view, click the **User Permissions** tab.
3. Click the **Add toolbar** button.  
The **Add User/Group** dialog box opens.
4. Select **User** or **Group** as appropriate.
5. Enter the user or group name in the following format:

**For domain users/groups:** domain\group\_name or domain\user\_name

**Note** Active Directory distribution groups are not supported.

**For local users/groups:** computer\_name\group\_name or computer\_name\user\_name

Then click **OK**.

The user/group is added to the **User/Group** list.

6. Click **Save** to save your settings or **Discard** to revert them.

### To remove a user or group:

1. Switch to **Server** view as described in [Server View](#).
2. In the left side of the Server view, click the **User Permissions** tab.
3. Select the user/group you want to remove and then click the **Delete** toolbar button.  
The user/group is deleted.
4. Click **Save** to save your settings or **Discard** to revert them.

## Resource Control

You can set high and critical disk space and memory utilization thresholds. Thresholds are calculated as a percentage of total capacity. So, for example, a disk space utilization threshold of 80% would mean that 20% of available disk space remains. After setting the

thresholds, you can click the **New Notification** button to [define a notification](#) that will be sent whenever a given threshold is exceeded and/or returns to normal.

## Disk Space

In the **High Disk Space Utilization Threshold** section, specify the high disk space utilization threshold (in terms of percentage). When the threshold is reached, a notification will be sent (if defined).

In the **Critical Disk Space Utilization Threshold** section, specify the critical disk space utilization threshold (in terms of percentage). When the threshold is reached, all tasks will be stopped and a notification will be sent (if enabled). Replicate will resume the tasks automatically when there is sufficient disk space to do so.

## System Memory

Memory utilization is calculated using the following formula (note that “swap file” is used generically to refer to both page file memory on Windows and swap file memory on Linux):

$$\frac{(\text{used\_swap\_file} + \text{used\_physical\_memory})}{(\text{total\_swap\_file} + \text{total\_physical\_memory})} * 100$$

### Example:

$$(5 \text{ GB} + 5 \text{ GB}) / (10 \text{ GB} + 10 \text{ GB}) * 100 = 50\%$$

In the **High System Memory Utilization Threshold** section, specify the high system memory utilization threshold (in terms of percentage). When the threshold is reached, a notification will be sent (if defined).

In the **Critical System Memory Utilization Threshold** section, specify the critical system memory utilization threshold (in terms of percentage). When the threshold is reached, Replicate will start stopping tasks and a notification will be sent (if enabled). The tasks will be resumed automatically when there is sufficient memory to do so.

# A | Using Change Tables

You can use Attunity Replicate tasks to save the change events in change tables. This section describes how to use Attunity Replicate with change tables.

## In this appendix:

[Working with Change Tables](#)

[Reading the Change Tables](#)

[Use Example](#)

## Working with Change Tables

In addition to replicating changes from source endpoint tables to corresponding tables in a target endpoint, Attunity Replicate can also replicate changes to corresponding change tables in the target endpoint. This process occurs simultaneously when applying changes to the target tables. Attunity Replicate lets you determine whether to replicate the changes to the target only, store changes in the change tables, or both. See [Using the Change Table Model](#) below for more information.

The change tables have the same names as the tables that are being replicated, however a suffix is added to each table name. By default the suffix is `_ct`, however you can change the suffix name in the Attunity Replicate Console. For more information on changing the suffix added to the change table names, see [Store Changes Settings](#).

In addition to the selected columns from the source table, the change table also includes special header columns that provide more information on the change the row represents such as the operation, the transaction and the timestamp. This lets you use SQL Query Language to carry out various analysis of the change events, such as fraud detection, trend analysis, triggering of business processes, and Disaster Recovery. For more information about reading the change tables, see [Reading the Change Tables](#).

## Handling Truncate Operations

`TRUNCATE` operations will *not* truncate the Change Table. Instead, an additional record will be added to the table with `operation=TRUNCATE`. This also means that, when replicating to a Hadoop target, the HDFS files corresponding to the Change Table will *not* be deleted.

Regarding the actual target table, if both the `Apply Changes` and `Store Changes` replication options are enabled, the target table will be truncated. This also means that, when replicating to a Hadoop target, the HDFS files corresponding to the Change Table will also be deleted.

## To apply TRUNCATE operations to both the Change Table and the Target Table (for sources that support TRUNCATE):

1. In the task settings' [Store Changes Settings tab](#), make sure that **Apply to change table** (the default) is selected from the **DDL options** drop-down list.
2. In the task settings' [Apply Changes Settings tab](#), make sure that **TRUNCATE target table** (the default) is selected from the **When source table is truncated** drop-down list.

## Using the Change Table Model

When you work with Change Tables you can determine whether to store the changes into the change tables, apply the changes to the target tables, or both store and apply the changes. You determine this when you define the replication task. For more information on this setting, see [Store Changes Settings](#).

In cases where you are both applying and storing the changes, the following is true:

- » The target and change tables must be in the same endpoint although they can have different schemas. For example, the Change Tables will contain the metadata headers.
- » Changes applied to the Change Table will be handled exactly the same as the changes performed in the corresponding transaction in the source database. Therefore, when using **Transactional apply mode** or **Batch optimized apply** mode with the **Preserve transaction consistency** option selected, the changes will be processed as a single transaction.

The exception to this is when an error is encountered and Replicate switches to "one-by-one" apply mode in order to determine which of the Change operations is responsible for the error.

- » The same data columns are both applied and stored with the exception of the change header columns, which are only added to the stored change tables.

## Reading the Change Tables

You can use the tools for your target endpoint to get information using the metadata in the change tables. This data is defined by the header columns added to the change table schema. For information on these headers, see [Change Tables](#).

## Change Tables

For every target table in the replication task, a change table with the corresponding name is maintained by Attunity Replicate in the endpoint with the target tables. For more information, see [Working with Change Tables](#). A change table contains the original table columns, and header columns. The header columns contain a prefix so that the name does not conflict with the source table column names. The default prefix is `header_`. For

information on how to change this prefix, see the **Change tables** listing under [Metadata](#) in [Task Settings](#). The following table lists the default change table header columns.

**Table A.1 | Change Table Headers**

| Column Name          | Type         | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------------------|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [header_]change_seq  | varchar (35) | <p>A monotonically increasing change sequencer that is common to all change tables of a task. The change sequence has the following format:</p> <p>YYYYMMDDHHmmSShhxxxxxxxxxxxxxx</p> <p>Where:</p> <ul style="list-style-type: none"> <li>» YYYY is the four-digit year (such as 2012)</li> <li>» MM is the two-digit month (range from 01-12)</li> <li>» HH is the hour in the day (range from 00-23)</li> <li>» mm is the minute in the hour (range from 00-59)</li> <li>» SS is the second in the minute (range from 00-59)</li> <li>» hh is the hundredth of the second (range from 00-99)</li> <li>» xxxxxxxxxxxxxxxxxx is a 19-digit, zero prefixed change number (global per task).</li> </ul> <p>The time part usually refers to the commit time of the transaction that includes the change record. Attunity Replicate contains logic that maintains the monotonicity of the sequence number so modifying or adjusting the endpoint time may result in multiple changes to seem that they are within the same timestamp but with increasing change number.</p> <p>The xxx...xxx is usually the internal change number from the data record except that for BEFORE-IMAGE records it is the same as the change number of the matching UPDATE record (for example, if the change number of BEFORE-IMAGE is 1000 and that of the UPDATE is 1001, then both have 1001). This allows a simple left-outer-join between the table and itself where on the left we scan until the point in time but filter out <code>operation=before-image</code>, and on the right we join on the same <code>change_seq</code> with the <code>change_oper</code> being 'B' .</p> |
| [header_]change_oper | varchar (1)  | <p>The operation type. This can be one of the following:</p> <ul style="list-style-type: none"> <li>» I: INSERT</li> <li>» D: DELETE</li> <li>» U: UPDATE</li> <li>» B: Before Image</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

**Table A.1 | Change Table Headers (Cont.)**

| Column Name                | Type            | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------------------|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [header__] change_mask     | varbinary (128) | <p>The change mask indicates which data columns in the change table are associated with columns that changed in the source table.</p> <p>The bit position in the change mask is based on the column ordinal in the change table. This means that if there are 5 header columns, they occupy bits 0 to 4 and the first data column is bit 5 in the change mask.</p> <p>The change mask is a binary column (a byte array) representing the change mask in little-endian order:</p> <p><b>Byte 0</b> bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0</p> <p><b>Byte 1</b> bit15 bit14 bit13 bit12 bit11 bit10 bit9 bit8</p> <p>In this example, bit#N indicates that the change table column of ordinal N relates to a column that changed in the source table. If update mask is 11000 and the column ordinal is 3 the column did not change.</p> <p>The following describes the bit semantics:</p> <ul style="list-style-type: none"> <li>» For INSERT records, all non-null columns have the associated bits set.</li> <li>» For DELETE records only primary-key (or unique index) columns have the associated bits set. This allows an applier to construct a DELETE statement without having to find the primary key fields from another source.</li> <li>» For BEFORE-IMAGE records, all bits are clear (the change mask can be empty).</li> <li>» For UPDATE records, each column whose value changed between the BEFORE-IMAGE and the UPDATE will have the associated bit set.</li> </ul> <p>For space and processing efficiency, the actual number of bytes stored in the change-mask can be null-trimmed. This means that trailing zeros do not need to be stored. The handling logic should take this into consideration.</p> |
| [header__] stream_position | varchar (128)   | The source CDC stream position.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| [header__] operation       | varchar (12)    | <p>The operation associated with the change record. It can be one of the following:</p> <ul style="list-style-type: none"> <li>» INSERT</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

**Table A.1 | Change Table Headers (Cont.)**

| <b>Column Name</b>       | <b>Type</b>  | <b>Description</b>                                                                                                                                                                                                                                                                               |
|--------------------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                          |              | <ul style="list-style-type: none"> <li>» UPDATE</li> <li>» DELETE</li> <li>» BEFOREIMAGE</li> </ul>                                                                                                                                                                                              |
| [header_] transaction_id | varchar (32) | <p>The ID of the transaction that the change record belongs to.</p> <p>The value is a hex-string of the 128-bit transaction ID.</p>                                                                                                                                                              |
| [header_] timestamp      | timestamp    | <p>The original change UTC timestamp (the value may be approximate).</p> <p><b>Note:</b> With PostgreSQL source, the timestamp is only known after the commit occurs. Therefore, until the changes are committed to the source tables, the default date will be displayed (e.g. 1970-01-01).</p> |
| [header_] partition_name | string       | <p>The name of the partition created on the target when <a href="#">Change Data Partitioning</a> is enabled. The partition name consists of the partition start and end time.</p> <p><b>Example:</b></p> <p>20170313T123000_20170313T170000</p>                                                  |

## Use Example

The following SQL statement returns a range of changes that starts after the last handled event (of change sequence "20120723144522110000000000000901203") and until the event committed on 23-Jul-2012 at 23:00:00.00. For update we also get the before image value (here for the salary before and after).

```

SELECT CHANGE.[header_change_seq]
      ,CHANGE.[header_stream_position]
      ,CHANGE.[header_operation]
      ,CHANGE.[header_transaction_id]
      ,CHANGE.[header_timestamp]
      ,CHANGE.[EMPLOYEE_ID]
      ,CHANGE.[FIRST_NAME]
      ,CHANGE.[LAST_NAME]
      ,CHANGE.[SALARY]
      ,BI.[SALARY]
FROM [Replication].[HR].[EMPLOYEES_ct] CHANGE LEFT OUTER JOIN
      [Replication].[HR].[EMPLOYEES_ct] BI ON

```

```
BI.[header__change_seq] = CHANGE.[header$__change_seq] AND
BI.[header__change_oper] = 'B'
WHERE CHANGE.header__oper <> 'B' AND
CHANGE.[header__stream_position] >
'2012072314452211000000000000901203' AND
CHANGE.[header__stream_position] <= '201207232300000z' AND
ORDER BY
CHANGE.[header__stream_position], CHANGE.[header$__stream_oper]
```

# B | Using an Audit Table

When defining a replication task, you can choose to store changes to all tables in a single audit table (located in the target endpoint). The changes can then be pushed from a single stream to any queue (JMS for example).

The following table describes the structure of the Audit table.

**Table B.1 | Audit Table Headers**

| Column Name | Type          | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| task_name   | varchar (128) | The name of the Attunity Replicate replication task.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| change_seq  | bigint        | <p>A monotonically increasing change sequencer. The change sequence has the following format:</p> <p>YYYYMMDDHHmmSShhxxxxxxxxxxxxxxxxxxxxxx</p> <p>Where:</p> <p>YYYY is the four-digit year (such as 2012)</p> <p>MM is the two-digit month (range from 01-12)</p> <p>HH is the hour in the day (range from 00-23)</p> <p>mm is the minute in the hour (range from 00-59)</p> <p>SS is the second in the minute (range from 00-59)</p> <p>hh is the hundredth of the second (range from 00-99)</p> <p>xxxxxxxxxxxxxxxxxxxxxx is a 19-digit, zero prefixed change number (global per task).</p> <p>The time part usually refers to the commit time of the transaction that includes the change record. Attunity Replicate contains logic that maintains the monotonicity of the sequence number so modifying or adjusting the endpoint time may result in multiple changes appearing as if they are within the same timestamp, but with increasing change number.</p> <p>The xxx...xxx is usually the internal change number from the data record except that for BEFORE-IMAGE records it is the same as the change number of the matching UPDATE record (for example, if the change number of BEFORE-IMAGE is 1000 and that of the UPDATE is 1001, then both have 1001).</p> |
| change_oper | varchar (1)   | The operation type. This can be one of the following:<br>I: INSERT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

**Table B.1 | Audit Table Headers (Cont.)**

| <b>Column Name</b>                             | <b>Type</b>    | <b>Description</b>                                                                                                                                                              |
|------------------------------------------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                |                | D: DELETE<br>U: UPDATE<br>B: Before Image                                                                                                                                       |
| stream_position                                | varchar (128)  | The source CDC stream position.                                                                                                                                                 |
| schema_name                                    | nvarchar (128) | The name of the source table schema.                                                                                                                                            |
| table_name                                     | nvarchar       | The name of the source table.                                                                                                                                                   |
| operation                                      | varchar (12)   | The operation associated with the change record. It can be one of the following:<br>» INSERT<br>» UPDATE<br>» DELETE<br>» BEFOREIMAGE                                           |
| transaction_id                                 | varchar (32)   | The ID of the transaction that the change record belongs to.<br>The value is a hex-string of the 128-bit transaction ID.                                                        |
| timestamp                                      | timestamp      | The original change timestamp (the value may be approximate).                                                                                                                   |
| change_record                                  | nclob          | The new data.                                                                                                                                                                   |
| <b>Note</b> The data is stored in JSON format. |                | <b>Note</b> LOB columns with unlimited size are not supported in the <code>change_record</code> field. The other fields will be recorded but the LOB will have a NULL value.    |
| bu_change_record                               | nclob          | The data before the update.                                                                                                                                                     |
| <b>Note</b> The data is stored in JSON format. |                | <b>Note</b> LOB columns with unlimited size are not supported in the <code>bu_change_record</code> field. The other fields will be recorded but the LOB will have a NULL value. |

For more information on storing changes in an audit table, see [Store Changes Settings](#).

# C | Creating Dump Files

Dump files are created when a component crashes and creates an exception code. They are useful for troubleshooting such crashes as they state at exactly what line or area of memory the crash occurred.

## To create a dump file:

1. Create a new environment variable with the following name and value:

**Variable:** AREP\_CRASH\_DUMP\_TYPE

**Possible values:** FULL, MINI or NONE

2. Restart both Replicate services.

3. This step is optional. If AREP\_CRASH\_DUMP\_TYPE is set to FULL or MINI, navigate to the following registry key:

HKEY\_LOCAL\_MACHINE\SOFTWARE\Microsoft\Windows\Windows Error Reporting\LocalDumps\repctl.exe

Verify that the data value for the **DumpType** Binary Value is either 1 (MINI) or 2 (FULL).

4. After a crash occurs the dump files will be created in the following directory:

<Product\_Dir>\minidumps

**Note** When AREP\_CRASH\_DUMP\_TYPE is set to NONE, no dump files will be created in the event of a crash.

# D | Pivotal Greenplum Prerequisites for Attunity Replicate

This section specifies the requirements for working with a Pivotal Greenplum database or endpoints with Attunity Replicate.

## In this appendix:

[Required Pivotal Greenplum Software Environments](#)

[Required Pivotal Greenplum Configuration and Environment](#)

[Troubleshooting gpfdist Issues](#)

## Required Pivotal Greenplum Software Environments

You can use the Pivotal Greenplum database with Attunity Replicate on either a Windows or Linux computer. The following sections describe the prerequisites necessary to prepare your environment to work with Attunity Replicate and a Pivotal Greenplum database.

- » [Windows Pivotal Greenplum Required Software](#)
- » [Linux Pivotal Greenplum Required Software](#)

## Windows Pivotal Greenplum Required Software

You must install the following on the same computer where the Attunity Replicate Server is installed:

- » Greenplum Client Tools 4.2.x
- » Greenplum Connectivity Tools 4.2.x
- » Greenplum Loaders 4.2.x (This will install the gpfdist program)
- » Greenplum DataDirect ODBC Drivers Version 7.x (only)

You can download the ODBC drivers from [emc.subscribenet.com](http://emc.subscribenet.com).

## Linux Pivotal Greenplum Required Software

You must make sure to configure the Linux computer as follows:

- » Greenplum Connectivity Tools 4.2.1.0. Unzip and install all of the components.
- » Install and configure **UnixODBC**.
- » Ensure that the following Pivotal Greenplum environment scripts are executed when

logging to the account where Attunity Replicate is run:

- » greenplum\_connectivity\_path.sh
- » greenplum\_clients\_path.sh
- » greenplum\_loaders\_path.sh
- » Make sure that port 8080 is open.

## Required Pivotal Greenplum Configuration and Environment

Attunity Replicate relies on the proper functioning of Pivotal Greenplum's gpfldist program on the computer with Attunity Replicate (the local computer). gpfldist is a simple Web server program with special performance customizing for concurrent access from Pivotal Greenplum database segment nodes to data files on the local computer.

Because gpfldist is a Web server program and because it needs to be accessible from the Pivotal Greenplum database segment nodes, there are some networking configuration settings that must be in place to allow for this access. This is documented in the *EMC Greenplum database Administration Guide*.

The following sections provide a simple test that verifies the proper configuration of the Pivotal Greenplum database and the local software installation. You can run this test before installing any Attunity software on your local computer. This test must be completed successfully to ensure that Attunity Replicate can work with a Pivotal Greenplum database.

- » [Collect Connection Information](#)
- » [Create a Test Input File](#)
- » [Create an SQL Script File](#)
- » [Start gpfldist](#)
- » [Run the SQL Script](#)

### Collect Connection Information

The following is the information required for this test. You should write down the information for your system to use later in this test.

- » <<Pivotal Greenplum-host>>: The Pivotal Greenplum database host name (master).
- » <<Pivotal Greenplum-port>>: The Pivotal Greenplum database port number (master). In many cases the port number is 5432
- » <<Pivotal Greenplum-user>>: The username that is used to connect to the Pivotal Greenplum database. This user must have permission to create an external table.
- » <<Pivotal Greenplum-password>>: The password of the selected Pivotal Greenplum user.
- » <<Pivotal Greenplum-database>>: The Pivotal Greenplum database name where the test is created.

- » <<Pivotal Greenplum-host>>: The local computer name as seen from the Pivotal Greenplum segment nodes.
- » <<gpfdist-port>>: The port number where the gpfdist program is listening.

## Create a Test Input File

Create a text file called `greenplum_test123.txt` with the following content:

```
Scott,Greenplum
Tiger,Woods
```

## Create an SQL Script File

Create a text file called `greenplum_test123.sql` with the following content, replacing the <<.fgf.>> tokens with the information for your system that you wrote down in step 1:

```
CREATE EXTERNAL TABLE greenplum_test123 ( name text, descr text )
LOCATION ('gpfdist://<<gpfdist-host>>:<<gpfdist-port>>/greenplum_
test123.txt')
FORMAT 'TEXT' (DELIMITER ',');
SELECT * FROM greenplum_test123;
DROP EXTERNAL TABLE greenplum_test123;
```

## Start gpfdist

Open a command shell and change the current directory to the directory where you created the Test Input File and the SQL Script File. Then start the gpfdist program with the following command:

```
$ gpfdist -v -p <<gpfdist-port>> -d .
```

## Run the SQL Script

Run the SQL script that you created with the following command:

```
$ psql -d <<Pivotal Greenplum-database>> -h <<Pivotal Greenplum-host>> -p
<<Pivotal Greenplum-port>> -U <<Pivotal Greenplum-user>> -f greenplum_
test123.sql
```

If the script runs successfully, the following is displayed:

```
CREATE EXTERNAL TABLE
name | descr
-----+-----
Scott | Pivotal Greenplum
Tiger | Woods
(2 rows)
```

```
DROP EXTERNAL TABLE
```

If the script is not successful, you will get an output that is similar to the following example:

```
CREATE EXTERNAL TABLE
```

```
psql:greenplum_test123.sql:4: ERROR: connection with gpfdist failed for
gpfdist://atturepl:18080/greenplum_test123.txt. effective url:
http://192.168.165.12:
18080/greenplum_test123.txt. error code = 110 (Connection timed out) (seg0
slice1 greenplum421.acme.local:40000 pid=31364)
```

```
DROP EXTERNAL TABLE
```

In the example above, the problem was that a firewall on the local computer prevented the Pivotal Greenplum database segment from reaching the local gpfdist instance.

Any error that occurs must be resolved before using Attunity Replicate with EMC Pivotal Greenplum. Once you resolve the error, you should run this test again to ensure that you can work with the Pivotal Greenplum database.

For information about what to do if this test fails, see [Troubleshooting gpfdist Issues](#).

## Troubleshooting gpfdist Issues

If the test described in [Required Pivotal Greenplum Configuration and Environment](#) fails, you should carry out the following checks:

- » [Did gpfdist start on the correct port or protocol?](#)
- » [Can Pivotal Greenplum reach gpfdist?](#)

### Did gpfdist start on the correct port or protocol?

To check whether gpfdist is listening on the correct port or protocol, enter the following command:

For Windows:

```
$ netstat -a -n | find "<<gpfdist-port>>"
```

For Linux:

```
$ netstat -a -n | grep "<<gpfdist-port>>"
```

The following is the output that you should get if gpfdist started on port 8080 on Windows:

```
$ netstat -a -n | find "8080"
TCP 0.0.0.0:8080 0.0.0.0:0 LISTENING
TCP [::]:8080 [::]:0 LISTENING
```

This indicates that gpfdist is listening on any network interface on both IPv4 (0.0.0.0:8080) and IPv6 ([::]:8080).

If only the IPv6 line is shown in most cases there is a local networking configuration problem. Pivotal Greenplum's recommendation in this case is to disable IPv6 on the local

computer (see the Microsoft knowledge base article on how to carry this out at <http://support.microsoft.com/kb/929852>).

## Can Pivotal Greenplum reach gpfdist?

For gpfdist to work, all Pivotal Greenplum database segments must be able to communicate with the local machine (the **ETL machine** as described by Pivotal Greenplum) using the HTTP protocol.

While gpfdist is running, run the following command from each one of the Pivotal Greenplum database segment nodes to ensure that all segments can access gpfdist:

```
$ wget http://<<Pivotal Greenplum-host>>?<<Pivotal Greenplum-port>>/gpfdist/status
```

This should return a status page with the following or similar content:

```
read_bytes 0  
total_bytes 0  
total_sessions 0
```

When carrying out the network checks from the Pivotal Greenplum internal master node, there is usually a file called `seg_host` that contains a list of the Pivotal Greenplum database segment node names. If this file exists, you can check access from all segment nodes using a single Pivotal Greenplum `gpssh` command:

```
$ gpssh -f seg_host  
=> wget http://<<Pivotal Greenplum-host>>?<<Pivotal Greenplum-port>>/gpfdist/status
```

If this check fails, a network or system manager must change the network or system configuration so that the check succeeds.

# E | Setting up Attunity Replicate in a Cluster Environment

This section describes how to set up Attunity Replicate in Windows and Linux clustering environments.

## In this appendix:

[Setting up Attunity Replicate in a Windows Server Cluster \(HA\)](#)

[Setting up Attunity Replicate in a Linux Cluster](#)

## Setting up Attunity Replicate in a Windows Server Cluster (HA)

This section describes how to set up Attunity Replicate in a Windows Server cluster environment. For instructions on setting up a Windows clustering environment, refer to the Microsoft Help.

The steps should be performed in the order they appear below:

[Step 1: Install Attunity Replicate in the Cluster](#)

[Step 2: Add the Attunity Replicate Services](#)

[Step 3: Define the Dependencies for Each Service](#)

[Step 4: Enable Different Console Configurations in a High Availability Environment](#)

## Step 1: Install Attunity Replicate in the Cluster

To install Attunity Replicate in your cluster environment, perform steps 1-3 on each of the cluster nodes:

1. Run the Attunity Replicate setup wizard on the first node that is part of your cluster. Install Attunity Replicate to a local folder. The default is:

C:\Program Files\Attunity\Replicate.

In the setup wizard, specify a shared storage location for the "data" folder; for example, F:\Replicate\data.

For more information, see [Attunity Replicate on Windows: Installing, Upgrading and Uninstalling](#).

2. Open a command prompt as an administrator and change the working directory to the Replicate **bin** directory. Then run the following two commands, where **Command 1**

should only be run on the *first* cluster node:

**Command 1:**

```
repctl -d "replicate_data_folder" setmasterkey new_master_key master_key_scope=1
```

**Command 2:**

```
RepUiCtl -d "replicate_data_folder" masterukey set -p new_master_user_key
```

**Important:** The *new\_master\_user\_key* must be identical on all participating cluster nodes.

For more information on the role played by the master user key in Replicate, see [Encrypting the User Permissions File](#).

where:

*replicate\_data\_folder* is the shared storage location of the Replicate **data** folder defined earlier (e.g. F:\Replicate\data), *new\_master\_key* is the new master key, and *new\_master\_user\_key* is the new master user key.

**Important:** The `setmasterkey` command overrides the **mk.dat** file, rendering all stored secrets invalid (as they were encrypted using the old key). Therefore, after changing the master key, you need to reenter the passwords in all of the relevant places. For more information, see [Changing and Protecting the Master Key](#).

Additionally, because the Replicate server password is also stored in the **mk.dat** file, you need to reset it as described in [Changing the Server Password](#).

3. Stop the Replicate services.
4. Now move your cluster to the next cluster node and install Attunity Replicate as described in Steps 1-3 above, making sure only to run the second command in Step 2.
5. After Replicate is installed on all nodes, edit the **ServiceConfiguration.xml** file in the "**data**" folder and change the `Https://` and `Http://` entries to use the Client Access Point name.

## Step 2: Add the Attunity Replicate Services

The two Attunity Replicate services must be added as resources to the service (Windows Server 2008 Cluster) or role (Windows Server 2012\2016 Cluster).

The Attunity Replicate services are called Attunity Replicate UI Server and Attunity Replicate Server.

### To add the Attunity Replicate services:

1. Do one of the following (according to your Windows Server version):
  - » **Windows Server 2008 Cluster:** Right-click the service you are working with and point to **Add a resource**. Then select **Generic Service**.
  - » **Windows Server 2012\2016 Cluster:** In the left pane of the Failover Cluster Manager, select **Roles**. The available roles will be listed in the right pane of the console. Right-click the role you are working with and point to **Add a resource**. Then select **Generic Service**.
2. In the **Select Service** screen of the New Resource wizard, select **Attunity Replicate UI Server** from the List.
3. Click **Next** and follow the directions in the wizard to create the resource. For information on how to use this wizard, see the Microsoft online help.
4. Repeat the same steps for the **Attunity Replicate Server**.

**Note** Attunity Replicate must be installed on the computers where you defined the service for the Attunity Replicate services to be available in the list.

## Step 3: Define the Dependencies for Each Service

You should define dependencies for the Attunity Replicate services. This allows the Storage and the Network names to start before the Attunity Replicate services. If these resources do not start up before the services, Attunity Replicate will not start because it will continue to search for the data location.

### To define the dependencies:

1. Do one of the following (according to your Windows Server version):
  - » **Windows Server 2008 Cluster:** In the left pane of the Failover Cluster Manager, select the **Attunity Replicate UI Server** service. The properties for this service are displayed in the center pane.
  - » **Windows Server 2012\2016 Cluster:** In the left pane of the Failover Cluster Manager console, select **Roles**. The available roles will be listed in the right pane of the console. Select the role you are working with and then, in the bottom right pane, select the **Resource** tab. From the list of the available roles, select **Attunity Replicate UI Server**.
2. Do one of the following (according to your Windows Server version):
  - » **Windows Server 2008 Cluster:** In the **Other Resources** section, double-click the **Attunity Replicate UI Server** service.
  - » **Windows Server 2012\2016 Cluster:** Right-click the **Attunity Replicate UI Server** role and select **Properties**.

The **Attunity Replicate UI Server Properties** dialog box opens.

3. In the **Attunity Replicate UI Server Properties** dialog box, select the **Dependencies** tab.
4. Click **Insert**. A new line is added to the Resource list.
5. In the Resource column, click the arrow and select the Replicate Data storage resource from the list.
6. Click **Insert** and add the Network Name resource (its name should be the same as the cluster name).
7. Repeat the steps for the Attunity Replicate Server service.
8. Start the Services using the Failover Cluster Manager and access the console using the Network name.
9. Register the license. The license should contain all host names of the cluster.

**Note** To open Attunity Replicate Console, it is recommended to use an address that includes the name or IP address of the cluster machine (as opposed to the specific node name).

**Example:**

[http://cluster\\_name\\_ip/attunityreplicate/5.5.118/#](http://cluster_name_ip/attunityreplicate/5.5.118/#)

## Step 4: Enable Different Console Configurations in a High Availability Environment

In a High Availability active-passive scenario, it is recommended to install the Attunity Replicate data folder on a shared storage device. The data folder contains various configuration files in XML format (e.g. ServiceConfiguration.xml). In a standard installation, you do not need to change the names of these files. However, in a High Availability environment in which Attunity Replicate Console is installed on two different machines, you may want each machine to have its own unique settings. In such a situation, changing the name of these files to include the hostname of the Attunity Replicate Console machine (as it appears in the output of the Windows hostname command) will allow you to store a different configuration for each machine.

The file name should be formatted as follows: [Name]Configuration-[hostname].xml

For example, let's assume that one Attunity Replicate Console is installed on a machine called `replicate-main` and the other Attunity Replicate Console is installed on a machine called `replicate-failover`. To set up a different configuration for each machine, simply create two copies of the `ServiceConfiguration.xml` file and then rename them to `ServiceConfiguration-replicate-main.xml` and `ServiceConfiguration-replicate-failover.xml` accordingly. After renaming the files, edit each of them with your desired settings.

## Setting up Attunity Replicate in a Linux Cluster

This section describes how to set up Attunity Replicate in a Linux Cluster Environment. There are several commercially available clustering solutions for Linux including Veritas Cluster Server, Red Hat Cluster Suite and IBM HACMP for Linux.

When one of the available clustering solutions is already in place, Attunity Replicate can be set up like any other cluster application while adhering to the following guidelines:

- » Replicate should be installed on the participating cluster nodes.  
For more information, see [Installing Attunity Replicate on Linux](#).
- » Replicate only supports the failover cluster configuration (active-passive).
- » Attunity Replicate data (the data folder, tasks folder, file channel, etc.) should be stored in a SAN for shared access between the cluster nodes. To change the default location of the Attunity Replicate data folder, run the following command on the primary cluster node when the installation completes:  
`./repctl-d <shared_storage_path> service start`
- » Only one instance of Replicate can be active at a given data location. The cluster software should be set so that during failover, one Replicate instance is stopped and the other is started.

# F | Control Tables

This section describes the Attunity Replicate Control Tables that are created on the target endpoint when the corresponding table is selected in the **Control Tables** tab.

## Notes

- » All Control Table timestamps are in UTC format.
- » Control tables are not created in Full Load only replication tasks.
- » Setting Replicate to **DROP** and **CREATE the table** if the target table already exists will not affect Control Tables.

## In this appendix:

- [Apply Exceptions](#)
- [Replication Status](#)
- [Suspended Tables](#)
- [Replication History](#)
- [Change Data Partitions](#)
- [DDL History](#)

## Apply Exceptions

Change Processing errors are recorded in the `attrep_apply_exceptions` table, which is described below.

The data in this table is never deleted.

**Table F.1 | attrep\_apply\_exceptions Table**

| Column      | Type      | Description                                                    |
|-------------|-----------|----------------------------------------------------------------|
| TASK_NAME   | nvchar    | The name of the Attunity Replicate task.                       |
| TABLE_OWNER | nvchar    | The table owner.                                               |
| TABLE_NAME  | nvchar    | The table name.                                                |
| ERROR_TIME  | timestamp | The time the exception (error) occurred.                       |
| STATEMENT   | nvchar    | The statement that was being executed when the error occurred. |
| ERROR       | nvchar    | The actual error.                                              |

## Replication Status

The `attrep_status` table contains the current status of each replication task and the target data. Although updates for the tasks in the `attrep_status` table are generated every few seconds, Replicate will only apply the updates *after* it has applied changes to the target tables. In some cases, this may take a few minutes.

**Table F.2 | `attrep_status` Table**

| Column                   | Type      | Description                                                                                                                                                                                                                          |
|--------------------------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SERVER_NAME              | nvchar    | The name of the machine on which Attunity Replicate is installed.                                                                                                                                                                    |
| TASK_NAME                | nvchar    | The name of the Attunity Replicate task.                                                                                                                                                                                             |
| TASK_STATUS              | varchar   | One of the following:<br>» FULL LOAD<br>» CHANGE PROCESSING<br>Task status is FULL LOAD as long as there is at least one table in full load. After <i>all</i> tables have been loaded, the task status changes to CHANGE PROCESSING. |
| STATUS_TIME              | timestamp | When the status was last updated.                                                                                                                                                                                                    |
| PENDING_CHANGES          | int       | The number of change records that were not yet applied to the target.                                                                                                                                                                |
| DISK_SWAP_SIZE           | int       | The amount of disk space that is occupied by old or offloaded transactions.                                                                                                                                                          |
| TASK_MEMORY              | int       | Current memory consumption in MB.                                                                                                                                                                                                    |
| SOURCE_CURRENT_POSITION  | varchar   | The POSITION in the source endpoint that Attunity Replicate is currently reading from.                                                                                                                                               |
| SOURCE_CURRENT_TIMESTAMP | timestamp | The TIMESTAMP in the source from which Attunity Replicate is currently reading.                                                                                                                                                      |
| SOURCE_TAIL_POSITION     | varchar   | The POSITION of the oldest start transaction that is still not committed. This represents the newest position that you can revert to, without losing any changes. There may, of course, be duplicates.                               |
| SOURCE_TAIL_TIMESTAMP    | timestamp | The TIMESTAMP of the oldest start transaction that is still not committed. This represents the newest TIMESTAMP that you can revert to, without losing any changes. There may, of                                                    |

**Table F.2 | attrep\_status Table (Cont.)**

| Column                   | Type      | Description                                                                                                                                                                                                                     |
|--------------------------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                          |           | course, be duplicates.                                                                                                                                                                                                          |
| SOURCE_TIMESTAMP_APPLIED | timestamp | This is the timestamp of the last transaction committed. In a bulk apply this will be the timestamp for the commit of the last transaction in that batch. It will only be changed as part of the last transaction in the batch. |

## Suspended Tables

When a table is suspended, information about the table including the reason for its suspension is recorded in the `attrep_suspended_tables` table. If a table is suspended and then unsuspended while the task is running, the entries for that table will be deleted from the `attrep_suspended_tables` table.

When a task with suspended tables stops, records for that task will remain in the `attrep_suspended_tables` table. In the event that the tables are still suspended when the task is restarted, the data is deleted and then recorded again.

**Table F.3 | attrep\_suspended\_tables Table**

| Column            | Type      | Description                                                       |
|-------------------|-----------|-------------------------------------------------------------------|
| SERVER_NAME       | nvchar    | The name of the machine on which Attunity Replicate is installed. |
| TASK_NAME         | nvchar    | The name of the Attunity Replicate task.                          |
| TABLE_OWNER       | nvchar    | The owner of the suspended table.                                 |
| TABLE_NAME        | nvchar    | The name of the suspended table.                                  |
| SUSPEND_REASON    | varchar   | The reason why the table was suspended.                           |
| SUSPEND_TIMESTAMP | timestamp | The date and time the table was suspended.                        |

## Replication History

The `attrep_history` table provides statistics about each task, such as the number and volume of records processed during a particular timeslot.

A new record is appended to the table at the end of each `TIMESLOT_DURATION`. In other words, the data in this table is never deleted.

**Table F.4 | attrep\_history Table**

| <b>Column</b>     | <b>Type</b> | <b>Description</b>                                                                                                                                                                                                             |
|-------------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SERVER_NAME       | nvchar      | The name of the machine on which Attunity Replicate is installed.                                                                                                                                                              |
| TASK_NAME         | nvchar      | The name of the Attunity Replicate task.                                                                                                                                                                                       |
| TIMESLOT_TYPE     | varchar     | One of the following:<br>» FULL LOAD<br>» CHANGE PROCESSING (CDC)<br>When FULL LOAD and CHANGE PROCESSING are running in parallel (some tables in full load, some in CDC), two history records will occupy the same time slot. |
| TIMESLOT          | timestamp   | The end timestamp of the time slot.                                                                                                                                                                                            |
| TIMESLOT_DURATION | int         | The duration of each history record in minutes.                                                                                                                                                                                |
| TIMESLOT_LATENCY  | int         | The latency at the end of the time slot. This is only applicable to CDC time slots. Note that this value contains the value of the target latency only.                                                                        |
| TIMESLOT_RECORDS  | int         | The number of records processed during the time slot.                                                                                                                                                                          |
| TIMESLOT_VOLUME   | int         | The volume of data processed in MB.                                                                                                                                                                                            |

## Change Data Partitions

The **attrep\_cdc\_partitions** table contains records of partitions created on the target database when [Change Data Partitioning](#) is enabled for a Replicate task. You can use this information to identify partitioned data that needs to be further processed.

**Table F.5 | attrep\_cdc\_partitions Table**

| <b>Column</b>   | <b>Type</b> | <b>Description</b>                                                |
|-----------------|-------------|-------------------------------------------------------------------|
| SERVER_NAME     | STRING      | The name of the machine on which Attunity Replicate is installed. |
| TASK_NAME       | STRING      | The name of the Attunity Replicate task.                          |
| PARTITION_NAME  | STRING      | The partition name consists of the partition start and end time.  |
| <b>Example:</b> |             |                                                                   |

**Table F.5 | attrep\_cdc\_partitions Table (Cont.)**

| Column               | Type      | Description                                                                  |
|----------------------|-----------|------------------------------------------------------------------------------|
|                      |           | 20170313T123000_20170313T170000                                              |
| PARTITION_START_TIME | TIMESTAMP | When the partition was opened:<br><b>Example:</b><br>2017-03-13 12:30:00.000 |
| PARTITION_END_TIME   | TIMESTAMP | When the partition was closed:<br><b>Example:</b><br>2017-03-13 17:00:00.000 |
| TABLE_OWNER          | STRING    | The table schema or owner.                                                   |
| TABLE_NAME           | STRING    | The table name.                                                              |

## DDL History

The **attrep\_ddl\_history** table contains a history of DDL changes that occurred in the source during replication to the target.

**Note** Currently, the DDL History table is only supported with the Hadoop target endpoint.

A new record is inserted into the table whenever a supported DDL change occurs in the source. Multiple ALTER TABLE statements that occur during a task may be represented as a single row in the control table. The JSON buffer (see below) describes all the changes that occurred (e.g. ADD COLUMN A, DROP COLUMN B, ALTER COLUMN C).

For information on enabling the DDL History Control Table as well as its limitations, see [Control Tables](#).

**Note** When the **Apply Changes** task option is enabled, an entry is created for the base table (e.g. tbIT1). If the **Store Changes** task option is also enabled, an additional entry is created for the CT table (e.g. tbIT1\_\_CT).

**Table F.6 | attrep\_ddl\_history**

| Column      | Type   | Description                                                       |
|-------------|--------|-------------------------------------------------------------------|
| SERVER_NAME | STRING | The name of the machine on which Attunity Replicate is installed. |
| TASK_NAME   | STRING | The name of the Attunity Replicate task.                          |

**Table F.6 | attrrep\_ddl\_history (Cont.)**

| <b>Column</b> | <b>Type</b> | <b>Description</b>                                                                                                                        |
|---------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| TABLE_OWNER   | STRING      | The source table schema or owner.                                                                                                         |
| TABLE_NAME    | STRING      | The source table name. If the table was renamed, this will be the table name before the change.                                           |
| CHANGE_SEQ    | STRING      | See <a href="#">Change_Seq</a> in <a href="#">Using Change Tables</a> .                                                                   |
| TIMESTAMP     | TIMESTAMP   | When the change occurred.                                                                                                                 |
| TABLE_VERSION | INTEGER     | Replicate assigns an internal version number to the table. The version number increases whenever a DDL change occurs in the source table. |
| DDL_TYPE      | STRING      | CREATE_TABLE, DROP_TABLE, ALTER_TABLE, TRUNCATE_TABLE                                                                                     |
| DETAILS       | CLOB        | JSON document describing the change(s)                                                                                                    |

**Example:**

```
{
    "owner": "string",
    "table": "string",
    "tableNewName": "string",
    "version": number,
    "columns": [
        {
            "col1": [
                {
                    "columnNewName": "string",
                    "action": "string",
                    "type": "string",
                    "length": number,
                    "precision": number,
                    "scale": number,
                    "primaryKeyPosition": number,
                    "nullable": boolean,
                    "ordinal": number
                },
                "col2": [
                    ...
                ]
            }
        }
    ]
}
```

**Table F.6 | attrep\_ddl\_history (Cont.)**

| Column | Type | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|--------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| where: |      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|        |      | <ul style="list-style-type: none"> <li>» <code>tableNewName</code> is NULL if the table was not renamed</li> <li>» <code>col1</code> and <code>col2</code> are the original column names (or the <i>only</i> column names if the columns were not renamed)</li> <li>» <code>columnNewName</code> is the new column name or NULL if the column was not renamed</li> <li>» <code>action</code> is ADD (also for CREATE TABLE), DROP, or ALTER</li> <li>» <code>type</code> is the Replicate data type</li> <li>» <code>primaryKeyPosition</code> is ZERO if the column is not part of the primary key</li> </ul> |

# G | Using HP NonStop SQL/MP as an ODBC Target

HP NonStop SQL/MP can be used as an ODBC target in a Replicate task. However, to ensure that Replicate and non-HP NonStop SQL/MP sources comply with HP NonStop SQL/MP conventions, several additional steps need to be performed. In addition, when defining the task settings, certain options will be unavailable or limited in their availability.

Note that when replicating to an HP NonStop SQL/MP target, you must select **SQLMP (ARC)** as the provider type. For information on how to select a provider type as well as a detailed explanation of how to define HP NonStop SQL/MP as an ODBC target in a Replicate task, see [Using ODBC to Connect to a Target](#).

## In this appendix:

[Prerequisites](#)

[Table Settings](#)

[Task Setting Limitations](#)

## Prerequisites

Before designing a task with HP NonStop SQL/MP as an ODBC Target, the following prerequisites must be met:

- » All source tables and their indexes must already exist on the target database.
- » The default name for the Replicate Apply Exceptions table (`atrep_apply_exceptions`) is not compliant with HP NonStop SQL/MP table naming conventions which dictate that table names cannot exceed 8 characters or contain non-alphanumeric characters. To resolve this conflict, you need to add the following entry to your NAVMAP file or create a new NAVMAP file (The NAVMAP file is located in the subvolume where ARC is installed):

Syntax:

[SQLMP]

```
atrep_apply_exceptions= \machine_name.$volume_name.subvolume_
name.atreapex
```

You also need to manually create the Apply Exceptions table on the HP NonStop SQL/MP target *before starting the task*. The table should be named `atreapex` and should contain the following columns:

| Column Name | Data Type                 |
|-------------|---------------------------|
| TASK_NAME   | Varchar(128)              |
| TABLE_OWNER | Varchar(128)              |
| TABLE_NAME  | Varchar(128)              |
| ERRORTIME   | Datetime year to fraction |
| STATEMENT   | Varchar(1000)             |
| ERROR       | Varchar(1000)             |

- » If you intend to enable the Replicate Store Changes option, you need to manually create the audit table on the HP NonStop SQL/MP target *before starting the task*.

**Note** This also requires you make the following changes in the [Store Changes Settings](#) tab:

- » Select **Audit table** from the **Store changes** drop-down list.
- » Change the default audit table name from `attrep_audit_table` to `atreauta`.

Create a table named `atreauta` with the following parameters:

| Column Name      | Data Type     |
|------------------|---------------|
| *task_name       | Varchar(110)  |
| *stream_position | Varchar(128)  |
| change_seq       | Varchar(35)   |
| change_oper      | Varchar(1)    |
| schema_name      | Varchar(128)  |
| table_name       | Varchar(128)  |
| operation        | Varchar(12)   |
| transaction_id   | Varchar(32)   |
| timestamp        | Timestamp     |
| change_record    | Varchar(1000) |
| bu_change_record | Varchar(1000) |

**Note** : You also need to create a Unique Index consisting of the **task\_name** and **stream\_position** columns (marked with an asterisk above).

## Table Settings

When the source database in a Replicate task is not HP NonStop SQL/MP, you must make sure that the selected source tables comply with HP NonStop SQL/MP conventions and limitations. This section describes how to apply transformations to source tables that are not HP NonStop SQL/MP-compliant.

- » The maximum size of a Unique Index in HP NonStop SQL/MP cannot exceed 240 bytes. In the Transform tab of the **<Table\_Name> Table Settings** dialog box, you can check which columns comprise the Unique Index and change them if necessary (i.e. if their combined **Type** value exceeds 240 bytes). For an explanation of how to do this, see [Using the Transform Tab](#).
- » HP NonStop SQL/MP does not support UPDATE operations on Primary Key columns. Therefore, if your application updates source tables columns that are part of a Primary Key, you will need to create the target table with a Unique Index on those columns instead of a Primary Key. For an explanation of how to do this, see [Using the Transform Tab](#).
- » Valid HP NonStop SQL/MP table names cannot exceed 8 characters or contain non-alphanumeric characters. If any of the source table names are not HP NonStop SQL/MP-compliant, you will need to map them to a valid name.

### To do this:

- » Open the **<Table\_Name> Table Settings** dialog box as described in [Table Settings](#).
- » In the **General** tab's **Table Name** field, enter the new table name.

## Task Setting Limitations

When defining your task settings, the following limitations apply:

- » **Metadata:**
  - » **Target Metadata:** As HP NonStop SQL/MP does not support LOB data types, the setting in this tab are not relevant.
  - » **Control Tables:** None of the optional tables are supported. The Apply Exceptions table, which is required, should be configured as described in [Prerequisites](#) above.
- » **Full Load:**
  - » **Full Load Settings:** As the source tables need to be created manually on the target, the **DROP and CREATE table** option is not supported.
  - » **Full Load Tuning:** No limitations.
- » **Change Processing:**
  - » **Apply Changes Settings:** No limitations
  - » **Store Changes Settings:** Change tables are not supported. If you want Replicate to store captured changes on HP NonStop SQL/MP, choose **Audit table**

from the **Store changes in** drop-down list. This also requires you to manually create the Audit Table on HP NonStop SQL/MP *before starting the task*, as described in [Prerequisites](#) above.

After creating the Audit table, specify its name in the **Audit table name** field (instead of the default name).

**Audit table creation options:**

As the Audit Table is created manually, the **DROP and CREATE audit table** option is not supported.

- » **Change Processing Tuning:** Only "Transactional apply" **Change processing mode** is supported.
- » **Error Handling:** No limitations.
- » **Logging:** No limitations.

For a detailed description of Task Settings, see [Task Settings](#).

# H | Impact of DST Change on Attunity Replicate

This section describes how Attunity Replicate is affected by Daylight Saving Time (DST) and provides guidelines for handling changes brought about by DST.

There are two types of DST changes:

- » **DST On** - Occurs approximately when Summer starts (actual date is country specific). Its impact on local time is that local time is moved one hour forward (so, for example, 01:00 AM becomes 02:00 AM). This DST change does not impact Attunity Replicate because it does not result in time overlap.
- » **DST Off** - Occurs approximately when Winter starts (actual date is country specific). Its impact on local time is that local time is moved back one hour (so, for example, 02:00 AM becomes 01:00 AM). This DST change results in time overlap where local time travels over the same hour twice in a row.

The comments below assume that the customer has not changed the time but rather the timezone or the DST setting. Changing the actual time (not for minor time adjustments) is a sensitive operation and is best done when Attunity Replicate is stopped.

Running Attunity Replicate tasks do not depend on the timezone or DST for correctly scanning and processing the transaction logs. Internally, Attunity Replicate timers use UTC.

Still, there are several places where DST may have an effect:

1. Timestamps in logs and audit messages are in local time. As a result, when Winter time starts, the logs will show the time going back an hour; conversely, when Summer time starts, the logs may appear to be missing one hour.
2. Scheduled jobs as well as the global and table manipulation variables `timestamp` and `commit_timestamp` use local time so these will also be affected. The impact of this depends on the manipulation done and on the intended use of the timestamp based data.

**Important:** To prevent timestamp and scheduling anomalies resulting from DST starting or ending, the following best practices should be observed:

- » **DST Off (summer to winter):** Do not schedule a task to start from the time the clock changes until the following hour. For example, if DST ends at 02:00 am, do not schedule a task to run between 02:00 and 02:59, as the task will run twice.
- » **DST On (winter to summer):** Do not schedule a task to start from the time the clock changes until the following hour. For example, if DST starts at 02:00 am, do not schedule a task to run between 02:00 and 02:59 as this hour does not exist.

If you have existing jobs scheduled to start at the overlap time and you do not want to modify them, then you need to stop the Attunity Replicate Server. Going in to Winter time, for example, if at 02:00 AM the clock is to be set back to 01:00 AM then when the time is 00:55 AM the Attunity Replicate Server should be stopped and, after an hour and ten minutes (at 01:05 AM), should be started again.

If you forget to do this, all scheduled jobs will run an hour earlier than intended. You can rectify this by setting the desired scheduling time and then restarting the Attunity Replicate Server service.

3. Statistics shown on the console are also sensitive to local time and thus may also show confusing/inaccurate data in the overlap period (going in to Winter time) or for the skipped period (going into Summer time).
4. If the clock on Attunity Replicate Server machine is one hour behind the clock on the Attunity Replicate Console (UI) machine, the following issues are known to occur:
  - » The [Applied Changes](#) circle graph will be updated as the changes are applied, but the information in the [Recent Activity](#) tab will not be updated.
  - » Scheduled jobs will start according to the Attunity Replicate Server time (as expected), but will remain in the **Active Jobs** list after execution instead of moving to the **Expired Jobs** tab.

For more information on scheduling jobs, see [Scheduling Jobs](#).

In general, it is recommended to avoid non-critical task design changes during the first overlap period (going in to Winter time) so as to prevent confusion about when the changes took place.

In addition to Attunity Replicate, other components are also involved including:

- » The source endpoint system
- » The target endpoint system
- » The local operating system
- » The task design (specifically using timestamp based variables)

Given the complexity of the topic and the involvement of many independent components and settings, Attunity generally recommends that customers first verify the impact of DST changes in their test environment.

# I | Metadata File Description

When the [Create metadata files in the target folder](#) option in the File target endpoint or Amazon S3 target endpoint is selected, for each CSV/JSON file Replicate creates a corresponding metadata file under the specified target folder.

The metadata file offers several benefits such as enabling custom batch processes to perform better validation, supporting deeper automation, offering lineage information and improving processing reliability.

The metadata files (which are in standard JSON format) are described in the table below.

**Note** All timestamps are in ISO-8601 format, for example 2016-08-02T10:05:04.802.

| Field                     | Description                                                                                                    |
|---------------------------|----------------------------------------------------------------------------------------------------------------|
| <b>Task Information</b>   |                                                                                                                |
| name                      | The name of the Replicate task.                                                                                |
| sourceEndpoint            | The name defined in the source endpoint settings.                                                              |
| sourceEndpointType        | The endpoint type defined in the source endpoint settings (e.g. Oracle, MySQL, etc.).                          |
| sourceEndpointUser        | The user defined in the source endpoint settings.                                                              |
| replicationServer         | The hostname of the machine on which Attunity Replicate is installed.                                          |
| operation                 | If a target data file has been created, this field will contain the following value: <code>dataProduced</code> |
| <b>File Information</b>   |                                                                                                                |
| name                      | The name of the data file without the extension.                                                               |
| extension                 | The extension of the data file (.csv or .json according to the selected target file format).                   |
| location                  | The location of the data file.                                                                                 |
| startWriteTimestamp       | UTC timestamp indicating when writing to the file started.                                                     |
| endWriteTimestamp         | UTC timestamp indicating when writing to the file ended.                                                       |
| firstTransactionTimestamp | UTC timestamp of the first record in the file.                                                                 |
| p                         |                                                                                                                |
| lastTransactionTimestamp  | UTC timestamp of the last record in the file.                                                                  |
| p                         |                                                                                                                |

| Field                     | Description                                                                                                                                                                                                                                                                                                                                |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| content                   | The values can either be data (i.e. Full Load replication) or changes (i.e Change Processing replication) according to the data in the corresponding CSV file.                                                                                                                                                                             |
| recordCount               | The number of records in the file.                                                                                                                                                                                                                                                                                                         |
| errorCount                | The number of data errors encountered during file creation.                                                                                                                                                                                                                                                                                |
| <b>Format Information</b> |                                                                                                                                                                                                                                                                                                                                            |
| format                    | delimited or json according to the selected target file format.                                                                                                                                                                                                                                                                            |
| options                   | The options for delimited file format. These options will not be shown for json format as they are not relevant.                                                                                                                                                                                                                           |
| recordDelimiter           | The delimiter used to separate records (rows) in the target files. The default is newline (\n).                                                                                                                                                                                                                                            |
| fieldDelimiter            | The delimiter used to separate fields (columns) in the target files. The default is a comma.                                                                                                                                                                                                                                               |
| nullValue                 | The string used to indicate a null value in the target file.                                                                                                                                                                                                                                                                               |
| quoteChar                 | The character used at the beginning and end of a column. The default is the double-quote character (").                                                                                                                                                                                                                                    |
| escapeChar                | The character used to escape a string when both the string and the column containing the string are enclosed in double quotes. Note that the string's quotation marks will be removed unless they are escaped.<br><b>Example (where " is the quote character and \ is the escape character):</b><br>1955,"old, \"rare\", Chevrolet",\$1000 |

### Custom Information

|                                                     |                                                                                                                                                                                                                    |
|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| customInfo                                          | This section contains any custom parameters that were set using the <b>dfmCustomProperties</b> internal parameter.<br>The <b>dfmCustomProperties</b> internal parameter must be specified in the following format: |
| Parameter1=Value1;Parameter2=Value2;Parameter3=Valu |                                                                                                                                                                                                                    |

| Field                                                                                                 | Description                                                                                                                                                                                                          |
|-------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| e3                                                                                                    |                                                                                                                                                                                                                      |
| <b>Example:</b>                                                                                       |                                                                                                                                                                                                                      |
| Color=Blue;Size=Large;Season=Spring                                                                   |                                                                                                                                                                                                                      |
| <p>For an explanation of how to set internal parameters, see <a href="#">Internal Parameters</a>.</p> |                                                                                                                                                                                                                      |
| Data Information                                                                                      |                                                                                                                                                                                                                      |
| sourceSchema                                                                                          | The schema containing the source table.                                                                                                                                                                              |
| sourceTable                                                                                           | The name of the source table.                                                                                                                                                                                        |
| targetSchema                                                                                          | <p>The name of the target table schema (if the source schema name was changed).</p> <p>For information on changing the source schema name, see <a href="#">Performing General Tasks for a Single Table/View</a>.</p> |
| targetTable                                                                                           | <p>The name of the target table (if the source table name was changed).</p> <p>For information on changing the source table name, see <a href="#">Performing General Tasks for a Single Table/View</a>.</p>          |
| tableVersion                                                                                          | Replicate assigns an internal version number to the table. The version number increases whenever a DDL change occurs in the source table.                                                                            |
| columns                                                                                               | Information about the table columns.                                                                                                                                                                                 |
| ordinal                                                                                               | The position of the column in the record (1, 2, 3, etc.).                                                                                                                                                            |
| name                                                                                                  | The column name.                                                                                                                                                                                                     |
| type                                                                                                  | The column data type. See <a href="#">File Target Data Types</a> or <a href="#">Amazon S3 Target Data Types</a> for more information.                                                                                |
| width                                                                                                 | The maximum size of the data (in bytes) permitted for the column.                                                                                                                                                    |
| scale                                                                                                 | The maximum number of digits to the right of the decimal point permitted for a number.                                                                                                                               |
| primaryKeyPos                                                                                         | The position of the column in the table's Primary Key or Unique Index. The value is zero if the column is not part of the table's Primary Key.                                                                       |

# J | Supported Platforms and Endpoints

In addition to listing the platforms on which Attunity Replicate can be installed, this appendix specifies which source and target endpoint versions can be used in an Attunity Replicate task.

## **In this appendix:**

- [Supported Platforms](#)
- [Supported Source Endpoints](#)
- [Supported Target Endpoints](#)
- [Endpoints Supported in Bidirectional Replication](#)
- [Supported Browsers](#)
- [The Attunity Preview Program](#)

## Supported Platforms

### Supported Windows Platforms

Attunity Replicate can be installed on any of the following Windows platforms:

- » Windows Server 2008 R2 (64-bit)
- » Windows Server 2012 (64-bit)
- » Windows Server 2012 R2 (64-bit)
- » Windows Server 2016 (64-bit)

### Supported Linux Platforms

Attunity Replicate can be installed on the following Linux platforms:

- » Red Hat Enterprise Linux 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 7.0, 7.1, 7.2, and 7.3 (64-bit)
- » SUSE Linux 11.4 or 12.0 (64-bit)

## Supported Source Endpoints

The table below lists the source endpoint versions supported by Attunity Replicate.

| Endpoint                                                                            | Version                                                           | Windows | Red Hat Linux | SUSE Linux |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------|---------|---------------|------------|
| <b>Cloud-Based</b>                                                                  |                                                                   |         |               |            |
| Amazon Aurora<br>Supported via the <a href="#">MySQL source endpoint</a> .          | Compatible with MySQL 5.6                                         | ✓       | ✓             | ✓          |
| Amazon RDS for MySQL<br>Supported via the <a href="#">MySQL source endpoint</a> .   | 5.6 and 5.7                                                       | ✓       | ✓             | ✓          |
| Amazon RDS for Oracle<br>Supported via the <a href="#">Oracle source endpoint</a> . | 11.2.0.2.v7                                                       | ✓       | ✓             | ✓          |
| <b>ARC-Based</b>                                                                    |                                                                   |         |               |            |
| HP Nonstop SQL/MP (AIS)<br>HP Nonstop Enscribe (AIS)                                | <b>Himalaya:</b><br>G06.32<br><b>Itanium:</b><br>H06.22/J06.14    | ✓       | ✓             | ✓          |
| OpenVMS RMS (AIS)                                                                   | <b>Alpha:</b><br>8.3<br><b>Itanium:</b><br>8.3                    | ✓       | ✓             | ✓          |
| IBM IMS (ARC)                                                                       | <b>IBM z/OS:</b><br>2.1, 2.2, and 2.3<br><b>IMS:</b><br>13 and 14 | ✓       | ✓             | ✓          |
| IBM VSAM Batch (ARC)                                                                | <b>IBM z/OS:</b><br>2.1, 2.2, and 2.3                             | ✓       | ✓             | ✓          |
| <b>File</b>                                                                         |                                                                   |         |               |            |
| File                                                                                | N/A                                                               | ✓       | ✓             | ✓          |

| Endpoint                                                         | Version                                                               | Windows | Red Hat Linux | SUSE Linux |
|------------------------------------------------------------------|-----------------------------------------------------------------------|---------|---------------|------------|
| File Channel                                                     | N/A                                                                   | ✓       | ✓             | ✓          |
| <b>Hadoop</b>                                                    |                                                                       |         |               |            |
| Hadoop - Cloudera                                                | 5.5, 5.6, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12, 5.13, and 5.14             | ✓       | ✓             | ✓          |
| Hadoop - Hortonworks                                             | 2.2.x, 2.3.x, 2.4.x, 2.5.x, and 2.6.x                                 | ✓       | ✓             | ✓          |
| Hadoop - MapR                                                    | 4.0, 4.1, 5.0, 5.1, 5.2, and 6.0                                      | ✓       | ✓             | ✓          |
| <b>Relational Databases</b>                                      |                                                                       |         |               |            |
| IBM DB2 for LUW                                                  | 9.7 Fix Pack 1, 10.1, 10.5, and 11.1                                  | ✓       | ✓             | ✓          |
| <p><b>Note</b> 10.5 with fix pack 5 is <i>not</i> supported.</p> |                                                                       |         |               |            |
| IBM DB2 for z/OS                                                 | <b>IBM z/OS:</b><br>2.1, 2.2, and 2.3<br><b>DB2:</b><br>10, 11 and 12 | ✓       | ✓             | ✓          |
| IBM DB2 for iSeries                                              | 7.1, 7.2 and 7.3                                                      | ✓       | ✓             | ✓          |
| IBM Informix                                                     | 11.5, 11.70, 12, 12.10                                                | ✓       |               |            |
| Microsoft SQL Server                                             | 2005, 2008, 2008 R2, 2012, 2014, 2016, and 2017                       | ✓       | ✓             | ✓          |
| MySQL                                                            | 5.5, 5.6, and 5.7                                                     | ✓       | ✓             | ✓          |
| MariaDB                                                          | 10.0.24 to 10.0.28                                                    | ✓       |               |            |
| Supported via the <a href="#">MySQL source endpoint</a> .        |                                                                       |         |               |            |
| Percona                                                          | 5.6.28                                                                | ✓       | ✓             |            |

| Endpoint                                                  | Version                                                                                                                                                                          | Windows | Red Hat Linux | SUSE Linux |
|-----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|---------------|------------|
| <hr/>                                                     |                                                                                                                                                                                  |         |               |            |
| Supported via the <a href="#">MySQL source endpoint</a> . |                                                                                                                                                                                  |         |               |            |
| Oracle                                                    | 10.x, 11.x, 12.1 and 12.2.0.1                                                                                                                                                    | ✓       | ✓             | ✓          |
| PostgreSQL                                                | 9.4.2 and 9.4.5, 9.5, 9.6, 10.1, 10.2 and 10.3                                                                                                                                   | ✓       | ✓             | ✓          |
| SAP Sybase ASE                                            | 12.5, 15, 15.5, 15.7, 16                                                                                                                                                         | ✓       |               |            |
| SAP HANA                                                  | 1.0 and 2.0                                                                                                                                                                      | ✓       | ✓             | ✓          |
| <b>Data Warehouses</b>                                    |                                                                                                                                                                                  |         |               |            |
| Teradata Database                                         | 13, 14, 14.10, 15, 15.10, and 16.1                                                                                                                                               | ✓       | ✓             | ✓          |
| IBM Netezza                                               | 7.2.x                                                                                                                                                                            | ✓       |               |            |
| <b>ODBC</b>                                               |                                                                                                                                                                                  |         |               |            |
| ODBC                                                      | 3.0, 3.5                                                                                                                                                                         | ✓       | ✓             | ✓          |
| ODBC with CDC                                             | 3.0, 3.5                                                                                                                                                                         | ✓       | ✓             | ✓          |
| <b>Other</b>                                              |                                                                                                                                                                                  |         |               |            |
| SAP Application                                           | Supported endpoints:<br>Oracle, Microsoft SQL Server, IBM DB2 for LUW, and SAP HANA.<br><br>See <a href="#">Relational Databases</a> above for version and platform information. |         |               |            |

## Supported Target Endpoints

The table below lists the target endpoint versions supported by Attunity Replicate.

| Endpoint                                                                                                    | Version                                  | Windows | Red Hat Linux | SUSE Linux |
|-------------------------------------------------------------------------------------------------------------|------------------------------------------|---------|---------------|------------|
| <b>Cloud-Based</b>                                                                                          |                                          |         |               |            |
| Amazon Aurora                                                                                               | Compatible with MySQL 5.6 and PostgreSQL | ✓       | ✓             | ✓          |
| Replication to Amazon Aurora (MySQL) is supported via the <a href="#">MySQL target endpoint</a> .           |                                          |         |               |            |
| Replication to Amazon Aurora (PostgreSQL) is supported via the <a href="#">PostgreSQL target endpoint</a> . |                                          |         |               |            |
| Amazon RDS for MariaDB                                                                                      | N/A                                      | ✓       | ✓             | ✓          |
| Supported via the <a href="#">MySQL target endpoint</a> .                                                   |                                          |         |               |            |
| Amazon RDS for MySQL                                                                                        | 5.6 and 5.7                              | ✓       | ✓             | ✓          |
| Supported via the <a href="#">MySQL target endpoint</a> .                                                   |                                          |         |               |            |
| Amazon RDS for Microsoft SQL Server                                                                         | 2008 R2 and 2012                         | ✓       |               |            |
| Supported via the <a href="#">Microsoft SQL Server target endpoint</a> .                                    |                                          |         |               |            |
| Amazon RDS for Oracle                                                                                       | 11.2.0.2.v7                              | ✓       | ✓             | ✓          |
| Supported via the <a href="#">Oracle target endpoint</a> .                                                  |                                          |         |               |            |
| Amazon RDS for PostgreSQL                                                                                   | 9.4.1                                    | ✓       | ✓             | ✓          |
| Supported via the <a href="#">PostgreSQL target endpoint</a> .                                              |                                          |         |               |            |
| Amazon Redshift                                                                                             | N/A                                      | ✓       | ✓             | ✓          |
| Amazon S3                                                                                                   | N/A                                      | ✓       | ✓             | ✓          |
| Amazon EMR                                                                                                  | N/A                                      | ✓       | ✓             | ✓          |
| Google Cloud for MySQL                                                                                      | N/A                                      | ✓       | ✓             | ✓          |
| Microsoft Azure SQL Data Warehouse                                                                          | N/A                                      | ✓       |               |            |

| Endpoint                                | Version                                                   | Windows | Red Hat Linux | SUSE Linux |
|-----------------------------------------|-----------------------------------------------------------|---------|---------------|------------|
| Microsoft Azure SQL Database            | N/A                                                       | ✓       | ✓             | ✓          |
| Microsoft Azure Database for MySQL      | N/A                                                       | ✓       | ✓             | ✓          |
| Microsoft Azure Database for PostgreSQL | N/A                                                       | ✓       | ✓             | ✓          |
| Microsoft Azure ADLS                    | N/A                                                       | ✓       | ✓             | ✓          |
| Microsoft Azure HDInsight               | N/A                                                       | ✓       | ✓             | ✓          |
| <b>Streaming</b>                        |                                                           |         |               |            |
| Kafka                                   | 0.8.x, 0.9.x, 0.10.x, 0.11.x, 1.0, and 1.1.               | ✓       | ✓             | ✓          |
| Microsoft Azure Event Hubs              | N/A                                                       | ✓       | ✓             | ✓          |
| Amazon Kinesis Data Streams             | N/A                                                       | ✓       | ✓             | ✓          |
| MapR Streams                            | 5.2                                                       |         | ✓             | ✓          |
| MemSQL                                  | 6.0.18                                                    | ✓       | ✓             | ✓          |
| <b>File-Based</b>                       |                                                           |         |               |            |
| File                                    | N/A                                                       | ✓       | ✓             | ✓          |
| File Channel                            | N/A                                                       | ✓       | ✓             | ✓          |
| <b>Hadoop</b>                           |                                                           |         |               |            |
| Hadoop - Cloudera                       | 5.5, 5.6, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12, 5.13, and 5.14 | ✓       | ✓             | ✓          |
| Hadoop - Hortonworks                    | 2.2.x, 2.3.x, 2.4.x, 2.5.x, and 2.6.x                     | ✓       | ✓             | ✓          |
| Hadoop - MapR                           | 4.0, 4.1, 5.0, 5.1, 5.2, and 6.0                          | ✓       | ✓             | ✓          |
| Hadoop - Amazon EMR                     | 5.2 - 5.11.x.                                             | ✓       | ✓             | ✓          |
| <b>Data Warehouses</b>                  |                                                           |         |               |            |
| Actian Vector                           | 3.0, 3.5                                                  | ✓       | ✓             | ✓          |
| HP Vertica                              | 6, 7, and 8.0.                                            | ✓       | ✓             | ✓          |

| Endpoint                                                  | Version                                            | Windows | Red Hat Linux | SUSE Linux |
|-----------------------------------------------------------|----------------------------------------------------|---------|---------------|------------|
| IBM Netezza                                               | 6.x and 7.x                                        | ✓       |               |            |
| Microsoft APS PDW                                         | AU2                                                | ✓       |               |            |
| Pivotal Greenplum                                         | 4.2, 4.3                                           | ✓       | ✓             | ✓          |
| SAP Sybase IQ                                             | 15.x and 16                                        | ✓       |               |            |
| Teradata Database                                         | 13, 14, 14.10, 15, 15.10, and 16.10                | ✓       | ✓             | ✓          |
| <b>Relational Databases</b>                               |                                                    |         |               |            |
| Microsoft SQL Server                                      | 2005, 2008, 2008R2, 2012, 2014, 2016, and 2017     | ✓       | ✓             | ✓          |
| MySQL                                                     | 5.5 and 5.6                                        | ✓       | ✓             | ✓          |
| MariaDB                                                   | 10.0.24 to 10.0.28                                 | ✓       |               |            |
| Supported via the <a href="#">MySQL target endpoint</a> . |                                                    |         |               |            |
| Oracle                                                    | 10.x, 11.x, 12.x                                   | ✓       | ✓             | ✓          |
| PostgreSQL                                                | 9.0, 9.3.x, 9.4.x, 9.5.x, 9.6, 10.1, 10.2 and 10.3 | ✓       | ✓             | ✓          |
| SAP Sybase ASE                                            | 15, 15.5, 15.7, 16                                 | ✓       |               |            |
| SAP HANA                                                  | 2.0                                                | ✓       | ✓             | ✓          |
| <b>ODBC</b>                                               |                                                    |         |               |            |
| ODBC                                                      | 3.0 and 3.5                                        | ✓       | ✓             | ✓          |

## Endpoints Supported in Bidirectional Replication

Bidirectional tasks support the following endpoints:

### Source Endpoints:

- » Oracle
- » Microsoft SQL Server
- » MySQL
- » PostgreSQL
- » All AIS sources
- » File Channel
- » SAP Sybase ASE
- » IBM DB2 for iSeries

### Target Endpoints:

- » Oracle
- » Microsoft SQL Server
- » MySQL
- » PostgreSQL
- » ODBC
- » File Channel
- » SAP Sybase ASE

## Supported Browsers

The following browsers are supported:

- » Microsoft Internet Explorer version 11 or above
- » Mozilla Firefox
- » Google Chrome

**Note** Displaying the console in a window that spans multiple vertical windows is not supported.

## The Attunity Preview Program

The Attunity Preview program is designed to provide early access to new functionality or integrations with third-party technologies (e.g. new endpoints). Selected customers will work closely with Attunity product management and provide feedback as the new capabilities progress through our development lifecycle.

# K | Best Practices when Working with Oracle ASM

This appendix provides detailed guidelines for configuring Attunity Replicate to work with the Oracle source endpoint when the redo logs are stored in Oracle ASM.

When the redo logs are stored in Oracle ASM, it is recommended to use the **Copy redo logs to temporary folder** option available in the **Advanced** tab. This option is only available when the **Attunity Log Reader** redo log access method is selected.

Attunity Log Reader is Attunity's proprietary high speed redo log parser for parsing the Oracle redo logs. Attunity Log Reader provides greatly improved performance and reduces the load on the Oracle server when compared with other methods such as Oracle LogMiner.

## In this appendix:

[The "Copy redo logs to temporary folder" Method](#)

[Oracle Permissions Required for the Attunity Log Reader and the "Copy redo logs to temporary folder" Options](#)

[Permissions for Deleting the Processed Redo logs from the Temporary Folder](#)

[Oracle ASM Access Permissions](#)

[Setting up the File Share if the "Direct Access" option was chosen](#)

[Configuring the "Copy to Temp Folder" Option in Replicate](#)

[Additional Considerations](#)

## The "Copy redo logs to temporary folder" Method

When the **Copy redo logs to temporary folder** option is enabled, Replicate instructs Oracle to copy the full redo log or chunks of the redo log to a local folder residing on the Oracle Server machine or to a shared network folder that can be accessed by Oracle Server.

Chunks of redo logs are copied from the ASM online redo logs using the Oracle **DBMS\_DISKGROUP** package whereas archived redo logs are copied in their entirety using the **COPY\_FILE** method of the **Oracle DBMS\_TRANSFER** package. In addition, Replicate uses Oracle directory objects to denote the source and target folder in this transfer (ASM is the source and the temporary folder is the target)

After the redo logs have been copied to the temporary folder, Replicate reads them using one of the following methods:

- » **Method 1:** Using Oracle BFILE to read from files or partial files from Oracle directory objects.

- » **Method 2:** Directly from the temporary folder after providing Replicate with access to the temporary folder. Using this method, Replicate reads the physical files directly from the folder.

Both options are significantly faster than accessing the redo logs directly from Oracle ASM. However, the "Direct Access" option using a shared network folder is the fastest and has the least impact on Oracle Server resources. This is because Replicate reads the files directly from the shared folder, thereby eliminating the need for Oracle to send Replicate the file content. However, using the "Direct Access" option requires some additional configuration (as described below).

To prevent old redo logs from accumulating in the temporary folder, Replicate should be configured to delete the redo log files from the temporary folder once they have been processed. The delete operation is performed using Oracle file groups and the Oracle DBMS\_FILE\_GROUP package.

## Oracle Permissions Required for the Attunity Log Reader and the "Copy redo logs to temporary folder" Options

Certain Oracle permissions are required, regardless of which access method is selected. These permissions are fully documented in [Using Oracle as a Target](#).

This section describes only those permissions required for the Attunity Log Reader and Copy redo logs to temporary folder options.

The following permissions are required:

- » CREATE SESSION
- » SELECT ON v\_\$transportable\_platform
- » EXECUTE ON DBMS\_FILE\_TRANSFER - Enables the archived redo logs to be copied to the temporary folder (using the COPY\_FILE method)
- » As mentioned above, Replicate needs to use directory objects for copying redo logs to the temporary folder and deleting them from the temporary folder. If you want Replicate to create and manage the Oracle directories, you need to grant the CREATE ANY DIRECTORY privilege. Replicate will then create the Oracle directories with the "attrep\_" prefix. If you do not grant this privilege, you will need to create the corresponding directories manually. The directories should point to the archived redo logs and temporary folder paths. Do not append the 'attrep\_' prefix to the directory names as Replicate ignores such object directories.
- » If you create the directories manually and the Oracle user specified in the Oracle Source endpoint is not the user that created the Oracle directories, grant the READ ON DIRECTORY privilege as well.
- » If the Oracle user specified in the Oracle source endpoint is not the user that created the Oracle directories, the following additional permissions are required:

- » READ on the Oracle directory object specified as the source directory (i.e. the ASM archived redo logs path and the temporary folder in the event that the BFILE method is used to read from the temporary folder)
- » WRITE on the directory object specified as the destination directory in the copy process (i.e. the temporary folder).

## Permissions for Deleting the Processed Redo logs from the Temporary Folder

The following permissions are required:

- » GRANT SELECT ON DBA\_FILE\_GROUPS

**Example:**

```
GRANT SELECT ON DBA_FILE_GROUPS to attu_user;
```

- » GRANT EXECUTE on SYS.DBMS\_FILE\_GROUP

**Example:**

```
GRANT EXECUTE ON SYS.DBMS_FILE_GROUP to attu_user;
```

- » EXECUTE DBMS\_FILE\_GROUP.GRANT\_SYSTEM\_PRIVILEGE with the system privilege 'MANAGE\_ANY\_FILE\_GROUP' for the Replicate user.

**Example:**

```
execute DBMS_FILE_GROUP.GRANT_SYSTEM_PRIVILEGE (DBMS_FILE_
GROUP.MANAGE_ANY_FILE_GROUP, 'attu_user', FALSE);
```

## Oracle ASM Access Permissions

Replicate requires ASM access permissions in order to read the online redo logs from ASM (SYSASM or SYSADM privilege). This is because reading the online redo logs from ASM is performed using a function from the Oracle DBMS\_DISKGROUP package, which requires the SYSASM or SYSADM privileges.

From Oracle 11g Release 2 (11.2.0.2), Attunity Replicate must be granted the SYSASM privilege in order to access the ASM account. For older supported versions, granting Attunity Replicate the SYSDBA privilege should be sufficient.

You can also validate ASM account access by opening a command prompt and issuing the following statements:

```
sqlplus asmuser/asmpassword@+asmserver as sysdba
```

-OR-

```
sqlplus asmuser/asmpassword@+asmserver as sysasm
```

## Setting up the File Share if the "Direct Access" option was chosen

If you use the Replicate has file level access to temporary folder option, you will need to set up a shared network folder (using NFS or SAMBA for example) that can be accessed from all Oracle nodes.

The shared folder must allow write access and grant delete permission to the user and group on which the Oracle database is running. In addition, it must allow read access to Replicate Server. Make sure you are able to read the contents of the share when logging in to the Replicate Server machine with the user under which the Attunity Replicate Server service runs ('Attunity' user).

This configuration should be done by the customer's IT team, but Replicate Support is always available to assist.

## Configuring the "Copy to Temp Folder" Option in Replicate

In the **Advanced** tab of the Oracle source endpoint:

1. Select **Attunity Log Reader** as the **Access redo logs via** method.
2. Provide the following information in the ASM parameters fields:
  - » A connection string to ASM
  - » A user and password for an Oracle user that has access to ASM (SYSASM or SYSADM - see privileges section above)
3. To access the temporary folder using BFILE, select the **Copy redo log files to temporary folder** check box and then specify the full path of the temporary folder path in the designated field (e.g. **/mnt/share**).
4. To access the temporary folder directly (using a shared network folder):
  - a. Select the **Copy redo log files to temporary folder** check box and then specify the full path of the temporary folder path in the designated field (e.g. **/mnt/share**).
  - b. Select the **Replicate has file level access to temporary folder** check box.
  - c. Select the **Access Archived Redo logs in folder** check box and the specify the share pointing to the temporary folder in the designated field. For example, if the temporary folder **/mnt/share** is shared with the Replicate Linux machine as **/storage/ora\_share**, enter **/storage/ora\_share**.
5. Select the **Delete processed archived redo log files** check box.

## Additional Considerations

This section describes additional factors that should be taken into consideration when working with Oracle ASM.

## Security and Folder Location

Oracle database must be able to write to the temporary folder and delete from it.

If the Oracle source database is part of a RAC cluster, the temporary folder must be located on a file share that is accessible to all of the nodes in the Oracle Server RAC.

If you chose the "BFILE" method for accessing the temporary folder, the folder does not need to be a shared network folder. In such as case, only authorized Oracle users can access it and only through Oracle.

If you choose the "Direct Access" option, only the Oracle user and the "Remote" Replicate user (NFS or Simba user) that will read the redo log should be granted permission to access the folder.

Also, as the archived redo logs are deleted from the temporary folder after processing, the risk of unauthorized access to the redo logs is greatly diminished.

## Multiple Tasks Using the Same Temporary Folder

If multiple tasks use the same temporary folder, conflicts may arise such as one task needing to access a redo log that another task has already deleted. To prevent such conflicts, only one Replicate task should access the same temporary folder at any given time. You can, however, create a different subfolder under the same root folder for each task. Then, for example, instead of specifying **/mnt/share** as the temporary folder for both tasks, you can specify **/mnt/share/task1** for one task, and **/mnt/share/task2** for the other.

## Temporary Folder Disk Usage

When working with the temporary folder, you should enable the Delete processed archived redo log files option described in [Configuring the "Copy to Temp Folder" Option in Replicate](#). This ensures that the redo logs will not accumulate in the temporary folder.

As Replicate needs to copy the redo logs from all your RAC nodes, you will need to allocate enough space in the temporary folder for (at least) the maximum size of your redo logs multiplied by the number of RAC nodes in your Oracle source. Also, for each temporary folder, allocate up to 50 MB multiplied by the number of RAC nodes. This is for small files which are copies of the chunk that Replicate is currently reading from the ASM online redo log. Although these files are not deleted, there will only be one such small file per RAC in each temporary folder at any given time.

In the event that multiple tasks are running, disk space calculation should also be multiplied by the number of tasks as each task has its own temporary folder.

# L | Replicate Loggers

This appendix provides a description of the following Replicate loggers:

- » [ADDONS](#)
- » [ASSERTION](#)
- » [COMMON](#)
- » [COMMUNICATION](#)
- » [DATA\\_RECORD](#)
- » [DATA\\_STRUCTURE](#)
- » [FILE\\_FACTORY](#)
- » [FILE\\_TRANSFER \(AKA CIFTA\)](#)
- » [INFRASTRUCTURE](#)
- » [IO](#)
- » [METADATA\\_CHANGES](#)
- » [METADATA\\_MANAGER](#)
- » [PERFORMANCE](#)
- » [REST\\_SERVER](#)
- » [SERVER](#)
- » [SORTER](#)
- » [SORTER\\_STORAGE](#)
- » [SOURCE\\_CAPTURE](#)
- » [SOURCE\\_LOG\\_DUMP](#)
- » [SOURCE\\_UNLOAD](#)
- » [STREAM](#)
- » [STREAM\\_COMPONENT](#)
- » [TABLES\\_MANAGER](#)
- » [TARGET\\_APPLY](#)
- » [TARGET\\_LOAD](#)
- » [TASK\\_MANAGER](#)
- » [TRANSFORMATION](#)
- » [UTILITIES](#)

## ADDONS

Only relevant when working with a Replicate add-on. Currently, the only add-ons are user-defined transformations.

## ASSERTION

Not implemented at present.

## COMMON

Writes low level messages such as network activity.

**Note** Not recommended to set to "Trace" as it will write a huge amount of data to the log.

## COMMUNICATION

Provides additional information about the communication between Replicate and the Source and Target components. For example, when using Hadoop, it will print the CURL debug messages and the "Apply" of the actual files (Mainly CURL and HTTP Client).

## DATA\_RECORD

Only available for some endpoints and may be implemented differently for each endpoint. It writes information about each change that occurs. While in Oracle it writes only the header fields, for some endpoints, such as Sybase ASE and IBM DB2 for LUW sources, it will also include the changed data. It records when a specific event was captured as well as the event context.

The content will not be presented; all events will be logged, even when a record is not in the task scope. (This is not relevant for Oracle LogMiner, as the list of objects are propagated to the LogMiner session).

### ***Example 15 - Example***

```
Produce INSERT event: object id 93685 context
'0000000003A46493010000100005190000821F001000010000000003A46427' xid
[00000000f9abd46] timestamp '2017-06-07 09:01:58' thread 1 (oracdc_
reader.c:2178)
```

## DATA\_STRUCTURE

Used for internal Replicate data structures and is related to how the code deals with the data and stores it in memory. In general, data structure is a way of organizing data in a computer so that it can be used efficiently.

**Note** Do not set to "Trace" unless specifically requested by Attunity.

## FILE\_FACTORY

Relevant to Hadoop Target, Amazon Redshift and Microsoft Azure SQL Data Warehouse. This component is responsible for moving the files from Replicate to the target which, in the case of Hadoop, is the HDFS stage of the task.

## FILE\_TRANSFER (AKA CIFTA)

Writes to the log when the File Transfer component is used to push files to a specific location.

## INFRASTRUCTURE

Records infrastructure information related to the infrastructure layers of Replicate code: ODBC infrastructure, logger infrastructure, PROTO\_BUF, REPOSITORY, FILES USE, opening a new thread, closing a thread, saving the task state, and so on.

## IO

Logs all IO operations (i.e. file operations), such as checking directory size, creating directories, deleting directories, and so on.

### **Example 16 - Example:**

```
[IO ]T: scanning 'E:\Program Files\Attunity\Replicate\data\tasks\Task_name\data_files' directory size (at_dir.c:827)
```

## METADATA\_CHANGES

Will show the actual DDL changes which are included in the scope (available for specific endpoints).

## METADATA\_MANAGER

Writes information whenever Replicate reads metadata from the source or target, or stores it. Manage tables metadata, metadata store, and dynamic metadata.

## PERFORMANCE

Currently used for latency only. Logs latency values for source and target endpoints every 30 seconds.

## REST\_SERVER

Handles all REST requests (API and UI). Also shows the interaction between Replicate and Attunity Enterprise Manager.

## SERVER

The server thread in the task that communicates with the Replicate Server service on task start, stop, etc. Includes `init` functions for the task and the task definition.

## SORTER

The main component in CDC that routes the changes captured from the source to the target.

Responsible for:

- » Synchronizing Full Load and CDC changes
- » Deciding which events to apply as cached changes
- » Storing the transactions that arrive from the source database until they are committed, and sending them to the target database in the correct order (i.e. by commit time).

Whenever there is a CDC issue such as missing events, events not applied, or unacceptable CDC latency, it is recommended to enable "Verbose" for this logger.

## SORTER\_STORAGE

SORTER\_STORAGE is the storage component of the Sorter which stores transactions (i.e. Changes) in memory and offloads them to disk when the transactions are too large, or unreasonably long. As this logger records a large amount of information, it should only be set to "Trace" if you encounter storage issues such as corrupt swap files, poor performance when offloading changes on disk, and so on.

## SOURCE\_CAPTURE

This is main CDC component on the source side. As such, it should be used to troubleshoot any CDC source issue. Note that setting to "Verbose" is not recommended unless absolutely necessary as it will record an enormous amount of data to the log.

Some target side components that use the source (e.g. LOB lookup) also use this logger. Setting the logger to "Trace" may be useful for troubleshooting performance issues and other source CDC issues such as bad data read from the source CDC.

## SOURCE\_LOG\_DUMP

When using Attunity Log Reader, this component creates additional files with dumps of the read changes. The logger will write the actual record as it's being captured from the source.

Note that the data will be stored in a separate file and not in the log itself.

## SOURCE\_UNLOAD

Records source activity related to Full load operations and includes the SELECT statement executed against the source tables prior to Full Load.

## STREAM

The Stream is the buffer in memory where data and control commands are kept. There are two types of stream: Data streams and Control streams. In the Data stream, source data is passed to the target or to the Sorter using this memory buffer. In the Control stream, Commands such as Start Full Load and Stop Full Load are passed to components.

As it records a large amount of data, this logger should only be set to "Trace" when a specific stream issue is encountered. Examples of stream issues include poor performance, issues with Control commands (e.g. commands not being performed), issues when loading many tables that may overload the control stream with Control commands, and so on.

## STREAM\_COMPONENT

Used by the Source, Sorter and Target to interact and communicate with the Stream component.

### ***Example 17 - Example***

Force switch to Transactional Apply mode for Hadoop target  
(endpointshell.c:1340)

## TABLES\_MANAGER

Manage the table status including whether they were loaded into the target, the number of events, how the tables are partitioned, and so on.

## TARGET\_APPLY

Determines which changes are applied to the target during CDC and is relevant to both the Batch Optimized Apply and Transactional Apply methods. It provides information about all Apply issues including missing events, bad data, and so on. As it usually does not record a lot of data, it can be safely set to "Verbose" in order to troubleshoot issues.

The logged messages will differ according to the target database.

## TARGET\_LOAD

Provides information about Full Load operations on the target side. Depending on the target, it may also print the metadata of the target table.

## TASK\_MANAGER

This is the parent task component that manages the other components in the task. It is responsible for issuing commands to start loading or finish loading a table, create the different components threads, start or stop tasks, and so on. It is useful for troubleshooting situations such as tables not loading, tables stuck in loading, one of the components not stopping or starting properly, and so on.

## TRANSFORMATION

Logs information related to transformations. When set to "Trace", it will log the actual transformations being used by the task.

### ***Example 18 - Example:***

In the example below, a new column named "C" was added to the table. The expression is \$AR\_H\_STREAM\_POSITION.

```
[TRANSFORMATION ]T: Transformation on table USER3.TEST1 exists  
(manipulation_manager.c:511) [TRANSFORMATION ]T: Set transformation for  
table 'USER3.TEST1' (manipulator.c:596) [TRANSFORMATION ]T: New column 'C',  
type: 'KAR_DATA_TYPE_STR' (manipulator.c:828) [TRANSFORMATION ]T:  
Transformation expression is '$AR_H_STREAM_POSITION' (manipulator.c:551)  
[TRANSFORMATION ]T: Final expression is '$AR_H_STREAM_POSITION'  
(expression_calc.c:822)
```

## UTILITIES

In most cases, UTILITIES logs issues related to notifications.

# Glossary

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## C

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### Change Data Capture (CDC)

Captures changes in the source data or metadata as they occur and applies them to the target endpoint as soon as possible, in near-real-time. The changes are captured and applied as units of single committed transactions and several different target tables may be updated as the result of a single source Commit. This guarantees transactional integrity in the target endpoint. The CDC process for any file or table starts as soon as the data Load operation for the file or table begins.

## F

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### Full Load

Creates all defined files or tables at the target endpoint, automatically defines the metadata that is required at the target, and populates the tables with data from the source.

## L

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### Latency

Latency can be understood as follows:  
- Source Latency: The gap in seconds between the original change in the source endpoint and capturing it.  
- Target Latency: The gap in seconds between the original change in the source endpoint and applying it to the target endpoint.  
- Apply Latency: The gap in seconds between capturing the change in the source endpoint and applying it to the target endpoint.

## S

---

### Source Endpoint

A collection of files or tables managed by an endpoint management system (such as, Oracle, SQL Server) that is part of the main computing service of the IT organization of an enterprise. This source continuously updated, may need to provide a high throughput rate, may have strict 24/7 up-time requirements, and may reference or update a number of tables in the course of a single logical transaction while providing transactional consistency and integrity for the data.

## T

---

### Target Endpoint

A collection of files or tables managed by an Endpoint Management System (DBMS), which may be different from the DBMS managing the source endpoint. It contains data that is derived from the source. It may contain only a subset of the tables, columns, or rows that appear in the source. Its tables may contain columns that do not appear in the source but are transformations or computations based on the source data.

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