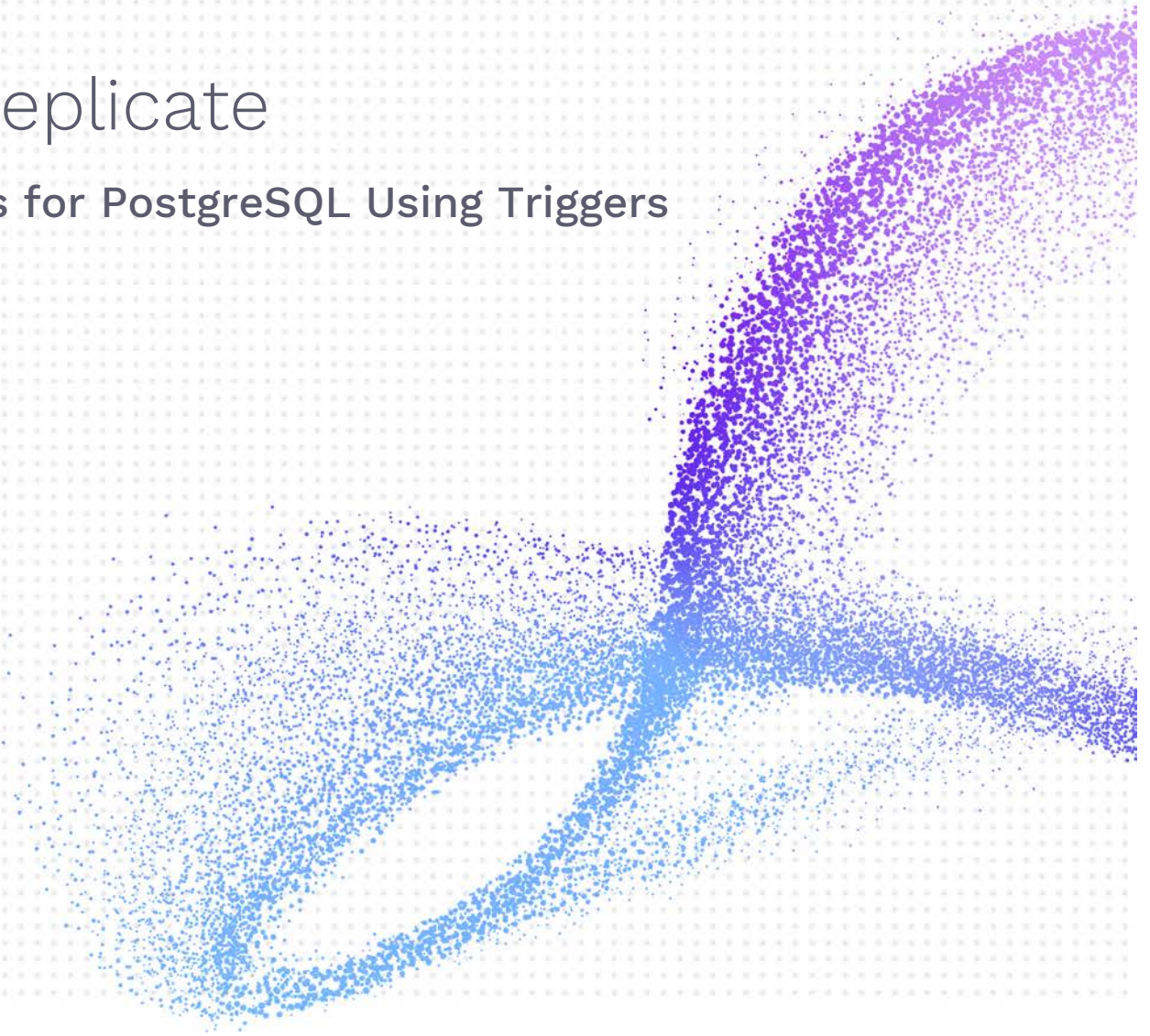
Syniti

Syniti Replicate

Setup Notes for PostgreSQL Using Triggers

Version 10.2



Syniti

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Syniti Replicate

These notes provide essential information for setting up replications using **PostgreSQL** as a source database for one-way mirroring and synchronization.

This guide describes the setup process using the Triggers options for one-way mirroring and synchronization when replicating data from a PostgreSQL database. For mirroring and synchronization replications using PostgreSQL as a source, Syniti Replicate offers two approaches:

- **Log Server Agent**: Uses a Windows service and a Log Server component to query the PostgreSQL log for increased performance when dealing with large amounts of data. This approach is described in the document *Setup Notes for PostgreSQL Transactional Replications* available in the Help Center.
- **Triggers**: Uses triggers installed on the PostgreSQL database to log changes. This approach is required if implementing synchronization using PostgreSQL.

For complete details on the setup process, check the *Syniti Replicate User Guide* available from the Management Center **Help** menu or the *Syniti Replicate Setup Guide*, available for download in the Help Center.

Connection Type

PostgreSQL .NET Data Provider recommended by PostgreSQL

Assembly: Npgsql (file name: Npgsql.dll)

Sample path: C:\Npgsql-2.2.3-net40\Npgsql.dll

To use the bulkinsert feature for increased performance:

1. The driver DLL has to be installed using the Microsoft Global Assembly Cache Tool (GAC). If the provider is not registered, you will receive the following error when attempting to use the provider:

   ```
   Error creating the command for writing to the target (Replication: 'EMP1' - Target
   table: 'public.test1')

   System.IO.FileNotFoundException: Could not load file or assembly 'Npgsql,
   Version=2.2.3.0, Culture=neutral, PublicKeyToken=5d8b90d52f46fda7' or one of its
   dependencies. The system cannot find the file specified.

   File name: 'Npgsql, Version=2.2.3.0, Culture=neutral,
   PublicKeyToken=5d8b90d52f46fda7'

   at ....
   ```

   The commands for installing the PostgreSQL DLLs are as follows when running from the location where the GAC tool is installed:

   gacutil.exe -i C:\Npgsql-2.2.3-net40\Npgsql.dll

   gacutil.exe -i C:\Npgsql-2.2.3-net40\Mono.Security.dll

2. The provider version number stored in the DBReplicator.exe.config file (in the Syniti Replicate install folder) should match the provider version that you are using. To change the version of the provider, specify the "newVersion" in the DBReplicator.exe.config file as follows:

   ```
   <dependentAssembly>
     <assemblyIdentity name="Npgsql" publicKeyToken="5d8b90d52f46fda7"
   culture="neutral"></assemblyIdentity>
   ```

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```
  <bindingRedirect oldVersion="2.2.3.0" newVersion="2.2.3.0"></bindingRedirect>
</dependentAssembly>
```

Trigger-Based Replication Overview

A database trigger is code that is automatically executed in response to certain events on a database table. To define a trigger-based replication (mirroring or synchronization), you need to provide information in the Source and/or Target Connection wizards so that triggers can be created to log table changes for replication.

For each table involved in the replication, Syniti Replicate creates 3 triggers in the source table that fire when a specific event occurs on a record:

- INSERT trigger which fires when a new record is being inserted in the table
- UPDATE trigger which fires when a record is modified
- DELETE trigger which fires when a record is deleted

If the replication is later deleted, the triggers are removed by Syniti Replicate. However, note that if you change a replication from mirroring to refresh, the triggers on the source table are not deleted. All transactions will continue to be recorded in the log tables. If you are not planning to reset the replication to mirroring, it is better to delete the replication, so that the triggers are removed, and create a new refresh replication.

Data retrieved using the triggers is stored in log tables that are specified in your Source/Target connection. The master log table can be an existing table or one created specifically to hold Syniti Replicate information. It contains general information about the transactions, like user name, timestamp, table name. A log table (_DBM__LOG_x) is also created for each source table in the replication, and contains the data changes identified by the triggers, as well as trigger objects _DBM__TRG_OBJS.

Note that Syniti Replicate does not create a tablespace. If you want to have a table space named SYNITIDR, you must create it beforehand using a SQL tool. Run the appropriate SQL statement for your environment. For example:

CREATE TABLESPACE SYNITIDR

When creating a connection, it is important to set the retention time to keep the log table size under control. The higher the value, the more data is kept in the log tables. Try to estimate the number of transactions occurring in all the source tables during a retention period and be sure that the database and table space have enough storage capacity for all those transactions. The Replication Agent cleans up the log tables periodically, based on the retention setting in the connection dialog. If the engine is not running, the log tables are not cleaned up. This might create space problems in the database as the logs grow in size. If you stop the engine and you are not planning to run it again, be sure to remove all the mirroring synchronization replications.

In addition, if you have many table replications in a single group, using a single connection, all the replications share a master log table. Access to the log table for each source table can become a bottleneck if there are many transactions using the same master log and log tables. Syniti Replicate may report errors about locked tables during replication. Although Syniti Replicate is able to recover from these errors and continue replicating, a better approach is to prevent the errors by splitting the replications into multiple groups with multiple connections and multiple master log tables. First, create multiple source connections to the database. Use the Transaction Log Type field in the Connection Properties of each connection to open the Setup Info dialog and create a new master log table for each connection.

During replication:

- When a record is inserted in the source table, the INSERT trigger fires and inserts one record in the master table and one record in the log table associated with the source table. The record inserted in the log table contains all the original values of the INSERT statement.

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- When a record is deleted from a table, the DELETE trigger fires and inserts one record in the master table and one record in the log table associated with the source table. The record inserted in the log table contains the key values of the deleted record.
- When a record is updated, the UPDATE trigger fires and inserts one record in the master table and two records in the log table associated with the source table. The two records inserted in the log table contain all the record values before and all the records after the update.

A transaction ID is saved both on the master records and log record to maintain a link between the transaction and the data changes for that transaction. See “Syniti Replicate Log Tables” for more details on the structure of the Master and Log tables.

Your system administrator needs to create and define appropriate table spaces and databases to hold the log tables. They should be large enough to handle the expected amount of replication data.

Syniti Replicate Log Tables

Log tables are used to record all data changes made to the source tables. They are populated by triggers that are fired when source tables are modified. Currently, log tables must reside in the replication source database. Note that log tables are created only if they do not already exist in the database.

There are two log tables associated with each replication: a master table, common to all replications using that connection, and a log table, one for each replication. The master table keeps track of all the transactions affecting the source tables and it records general transactional information.

Master table structure

- `TID DECIMAL(31,0) GENERATED BY DEFAULT AS IDENTITY`:
  Transaction ID number associated with each record data change (transaction)

- `SNAME VARCHAR(128)`:
  Name of the schema the transaction was applied to.

- `TNAME VARCHAR(128)`:
  Name of the table the transaction was applied to.

- `TTS TIMESTAMP`:
  Transaction timestamp indicating when the transaction was submitted to the system

- `TUSER VARCHAR(128)`:
  Name of the user who executed the transaction

Log Table Structure

The Log table contains the actual data changes for a specific source table. Its structure depends on the structure of the source table.

- `__TID DECIMAL(31,0)`:

  Transaction ID, link to the corresponding record in the master table

- `__OP CHAR`:

  Indicates the type of operation:

  ‘I’ INSERT

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‘D’ DELETE
‘B’ UPDATE: values before the update
‘A’ UPDATE: values after the update

- <Field list>:

  All the columns of the source table with their original data type. For example if the source table was created as:

```
CREATE TABLE SOURCET
(ID INTEGER,
 FNAME VARCHAR(30),
 LNAME VARCHAR(50))
```

  The log table will have the following structure:

```
CREATE TABLE _DBM__SOURCET
(__TID DECIMAL(31,0),
 __OP  CHAR,
 ID    INTEGER,
 FNAME VARCHAR(30),
 LNAME VARCHAR(50))
```

Reading From/Managing Log Table

Syniti Replicate reads the log tables using the SELECT SQL statement. First, it queries the master table to see if new transactions came in since the last processed __TID. If transactions are found, Syniti Replicate queries the corresponding log table to collect the data changes and apply them to the target table.

The SELECTs on the master and log tables are sorted by the unique column __TID which ensures that all records will be read in the order that they were written. Syniti Replicate also uses the unique __TID column to keep track of the point where the last record was read and processed from the log tables.

Syniti Replicate provides options to manage log records that have been read and replicated. They can be deleted from the log table as soon as they are processed or a retention time can be set to leave this record in the log tables for the specified number of hours.

PostgreSQL User Permissions for Trigger-based Replications

When setting up replications that use PostgreSQL as either a source or target database, you need to be sure that the user ID used for making connections to the database has sufficient privileges to complete all the operations required for Syniti Replicate to perform a replication.

This section is organized by the type of replication you want to perform. It describes in detail all the user authorities that will be required during the setup and execution of replications.

Refresh with PostgreSQL as Either Source or Target Database

1. AUTHORITY TO CONNECT TO DATABASE.

2. AUTHORITY TO SELECT CATALOG
   To display a list of tables and show fields in the table in the Management Center (for selecting a source or target table and for setting which fields to replicate), Syniti Replicate runs a SELECT_CATALOG command. If

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the user ID has insufficient privileges, an error is generated on the server.

3. AUTHORITY TO SELECT TABLES
   Syniti Replicate runs a SELECT statement to identify records to replicate. Therefore, the user ID used to make a connection must have adequate authority to run a SELECT statement for tables involved in replication.

4. AUTHORITY TO CREATE TABLES IN A TABLESPACE OR DATABASE (Optional)
   To create a target table in the Management Center (as part of the Create Table Wizard), Syniti Replicate uses the following commands.

   ```
   GRANT { CREATE | ALL [ PRIVILEGES ] }     ON TABLESPACE tablespace_name [, ...]     TO { [ GROUP ] role_name | PUBLIC }
   ```

   Example:
   ```
   grant create on tablespace ABC to sdruser;
   ```

   Alternatively, if a tablespace is not required, grant table creation on a specific database:
   ```
   GRANT { { CREATE | CONNECT | TEMPORARY | TEMP } [,...] | ALL [ PRIVILEGES ] }     ON DATABASE database_name [, ...]     TO { [ GROUP ] role_name | PUBLIC } [, ...] [ WITH GRANT OPTION ]
   ```

   Example:
   ```
   grant create on database DBTEST to sdruser;
   ```

5. AUTHORITY TO DROP TABLES, ALTER TABLES (Optional)
   The use of these commands from within Syniti Replicate is entirely optional (i.e. not necessary for running a refresh replication.) They are used if you choose to remove a table or change the table via the Management Center SQL Query tab.

Transactional Replications/Initial Refresh with PostgreSQL as Either Source or Target Database

This section includes information for mirroring where PostgreSQL is the data source, and synchronization where PostgreSQL can be either the “source” or “target” data source.

1. (OPTIONAL) CREATION OF TABLESPACE
   The recommended approach is to assign a tablespace for the Master table and Log Tables so that it is easier to control log table sizes. Note that Syniti Replicate does not create a tablespace, but the user can specify access to a tablespace. If you want to have a table space named SYNITIDR, you must create it beforehand
2. CREATE USER FOR SYNITI REPLICATE OPERATIONS AND TABLESPACE PERMISSIONS
   The DBA should create a user for Syniti Replicate operations on the machine, then grant privileges to a specific tablespace with the command below. The user ID you are planning to use should have sufficient permissions to complete all operations in Syniti Replicate: permissions to connect, select tables, insert/update/delete records and so on.

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3. AUTHORITY TO CONNECT TO DATABASE
   To open a connection to a PostgreSQL database, you need specific authority for a user.

4. AUTHORITY TO SELECT A CATALOG
   To display a list of tables and show fields in the table in the Management Center (for selecting a source or target table and for setting which fields to replicate), Syniti Replicate runs a SELECT_CATALOG command. If the user ID has insufficient privileges, an error is generated on the PostgreSQL server.

5. AUTHORITY TO SELECT TABLES
   Syniti Replicate runs a SELECT statement to identify records to replicate. Therefore, the user ID used to make a connection must have adequate authority to run a SELECT statement for tables involved in replication.

6. AUTHORITY TO UPDATE TABLES, CREATE TABLES
   To create a target table in the Management Center (as part of the Create Table Wizard), Syniti Replicate uses the following commands.
   Grant create and update permissions (insert, update and delete) using:

```
GRANT { { SELECT | INSERT | UPDATE | DELETE | TRUNCATE | REFERENCES | TRIGGER }     [, ...] | ALL [ PRIVILEGES ] }     ON { [ TABLE ] table_name [, ...]          | ALL TABLES IN SCHEMA schema_name [, ...] }     TO { [ GROUP ] role_name | PUBLIC } [, ...] [ WITH GRANT OPTION ]
```

7. AUTHORITY TO DROP TABLES, ALTER TABLES (Optional)
   The use of these commands from within Syniti Replicate is entirely optional. They are used if you choose to remove a table or change the table via the Management Center SQL Query tab.

8. SET UP TRANSACTIONS
   To set up transactional replications, you need permission to create and drop triggers in the schema where the _DBM__TRG_OBJS table resides: To create a trigger on a table, you must have the TRIGGER privilege on the table and EXECUTE privilege on the trigger function. Use the following statement:

```
GRANT { { SELECT | INSERT | UPDATE | DELETE | TRUNCATE | REFERENCES | TRIGGER }     [, ...] | ALL [ PRIVILEGES ] }     ON { [ TABLE ] table_name [, ...]          | ALL TABLES IN SCHEMA schema_name [, ...] }     TO { [ GROUP ] role_name | PUBLIC } [, ...] [ WITH GRANT OPTION ]
```

9. ACCESS TRANSACTION LOG
   You need to access the transaction log information stored in the table _DBM__TRG_OBJS. Note that if you revoke read access, the replication works but it is unable to read the last ID.

```
grant select on <DEFAULT_SCHEMA>."_DBM__TRG_OBJS" to <UID>;
```

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Add a Source Connection Wizard

Select Provider Screen

Database

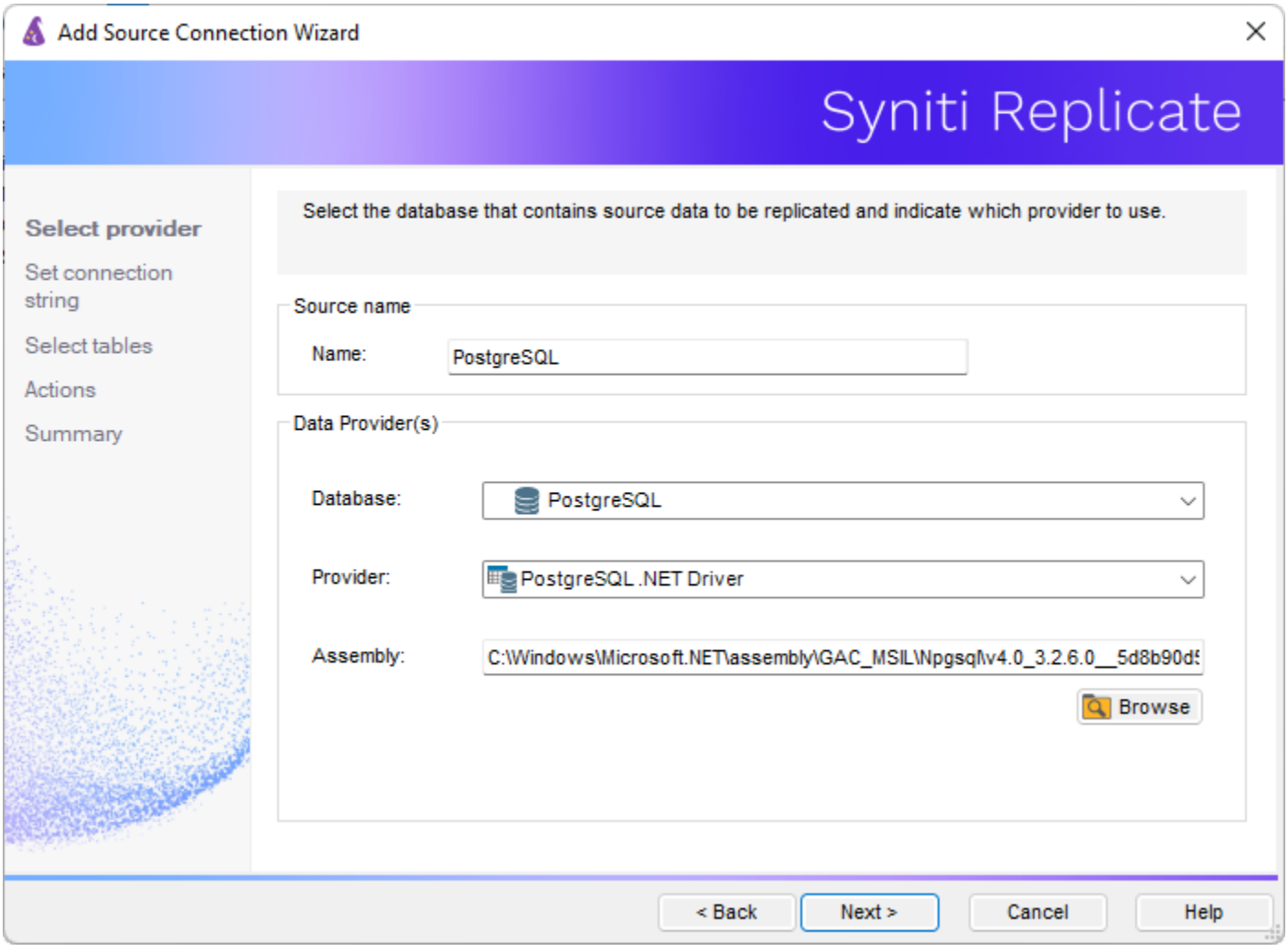
Select PostgreSQL from the drop-down list.

Provider

PostgreSQL .NET Driver

Assembly

Locate the file Npgsql.dll, typically in the installation folder for the PostgreSQL .NET Provider.



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Set Connection String Screen

User ID

Enter a user ID which will be exclusively used by Syniti Replicate and has the authority to read the database transaction log (redo log.) See a detailed list of authorities needed.

For Synchronization Replications:
The login/user ID that you provide must be unique to Syniti Replicate. It should not be used for any transactions occurring in either database involved in the synchronization. Syniti Replicate does not replicate transactions by the user you specify in this connection. This user ID is used by Syniti Replicate during synchronization to read the database logs and perform the synchronization operations. Therefore, any transactions found in the logs with this user ID are not replicated as part of the synchronization data.

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Enable Transactional Replication Wizard

For transactional replications (mirroring and synchronization), use the Enable Transactional Replication wizard after setting up a source connection. The following field(s) require specific information for PostgreSQL.

Log Type Screen

Select the Triggers option.

Trigger Settings Screen

Master Table

Either specify an existing qualified table name, or click **Change** to create a new table to hold general information about replication transactions including user name, timestamp, table name for each transaction.

There are two tables associated with each replication: a Master table, common to all replications using that connection, and a Log table for each replication source table. The Master table keeps track of all the transactions affecting the source tables and it records general transactional information.

Master and Log tables are created in the schema specified when you set the Master table name. You can choose a Master table name, or use the default _DBM__MASTERLOG. Log tables are automatically generated by Syniti Replicate and the names are _DBM__LOG_#, where # is a number. The selected schema for the Master and Log tables must not contain other non-Syniti tables with names _DBM__LOG_#. The recommended approach is to create a new schema to use specifically for the Syniti Master and Log tables.

Tablespace

The recommended approach is to assign a tablespace for the Master table and Log Tables so that it is easier to control log table sizes. If you leave this field blank, the default tablespace value for your login ID will be used. Your system administrator should be able to provide you with the appropriate value for this field.

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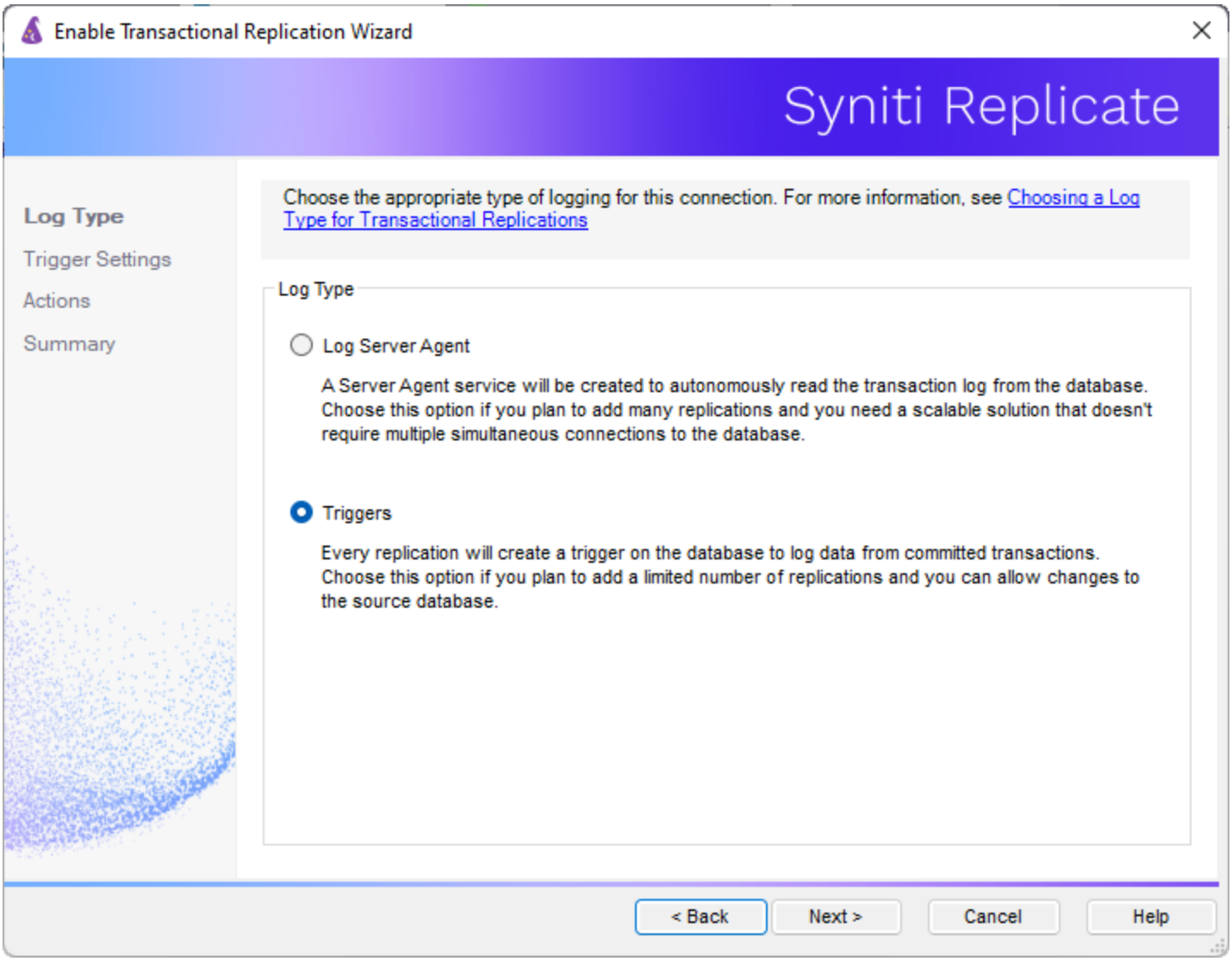

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Retention Time

The amount of time in hours that a transaction is kept in the log tables. The default value is 72 hours. When the amount of time a transaction resides in the log exceeds the retention time, the transaction is permanently removed from the log tables. Tuning the retention time provides control over the size of the log tables. It is also possible to instruct Syniti Replicate to remove all the processed transactions at the end of each mirroring interval. Tuning the retention time provides control over the size of the log tables.

Delete Block Size

Based on the retention time, Syniti Replicate deletes items from the log. This field specifies the maximum number of records to delete from the Syniti Replicate log tables with a single SQL statement. The default value is 10,000 records. You do not typically need to edit this value.

Lower-case Trigger Identifiers

Check this option if your database installation uses lower-case trigger identifiers.

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