Oracle® GoldenGate
MySQL Installation and Setup Guide
11*g* Release 1 (11.1.1)
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Oracle GoldenGate MySQL Installation and Setup Guide 11g Release 1 (11.1.1)

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CHAPTER 1

System requirements and preinstallation instructions

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Overview of Oracle GoldenGate for MySQL

Oracle GoldenGate for MySQL supports replication from a MySQL source database to a MySQL target database or to a supported database of another type to perform an initial load or change data replication.

Supported platforms

To find out which Oracle GoldenGate builds are available for a specific combination of database version and operating system, log onto http://support.oracle.com and select the **Certifications** tab. For assistance, click **Tips for Finding Certifications**.

An email and password are required to enter this site.

Operating system requirements

Disk requirements

Assign the following free disk space:

- 50-150 MB, depending on the database and platform. This includes space for the compressed download file and space for the uncompressed files. You can delete the download file after the installation is complete.
- 40 MB for the working directories and binaries for each instance of Oracle GoldenGate that you are installing on the system. For example, to install two builds of Oracle GoldenGate into two separate directories, allocate 80 MB of space.
- To install Oracle GoldenGate into a cluster environment, install the Oracle GoldenGate binaries and files on a shared file system that is available to all cluster nodes.
- Additional disk space on any system that hosts Oracle GoldenGate trails, which are files that contain the working data. The space that is consumed by the trails varies, depending on the volume of data that will be processed. A good starting point is 1 GB. See the following guidelines.

Storage for Oracle GoldenGate trails

To prevent trail activity from interfering with business applications, assign a separate disk or file system to contain the trail files. These files are created during processing to store all of the data that is captured by Oracle GoldenGate. The default size is 10 megabytes, but can be changed during the configuration process. Trail files accumulate but can be purged according to rules set with the PURGEOLDEXTRACTS parameter.

Trail files can reside on drives that are local to the Oracle GoldenGate installation, or they can reside on NAS or SAN devices. You will specify the location of the trails when you configure Oracle GoldenGate.

For trails that are stored at the source location, there should be enough space to handle data accumulation should the network connection fail. In a typical configuration, a secondary Extract process (known as a data pump) sends data from a local trail over the network, and will fail when the network does. However, the primary Extract that reads the transaction logs and writes to the local trail will continue to do so. This Extract should not be stopped during a failure; otherwise, transaction data might be missed if the transaction logs recycle or get off-loaded before the data is completely captured. There must be enough disk space to hold the data accumulation.

For trails at the target location, provide enough disk space to handle data accumulation according to the purge rules set with PURGEOLDEXTRACTS. Even with PURGEOLDEXTRACTS in use, data will always accumulate on the target because it is transferred across the network faster than it can be applied to the target database.

To estimate required trail space

1. Estimate the longest time that the network could be unavailable. Plan to store enough data to withstand the longest possible outage, because otherwise you will need to resynchronize the source and target data if the outage outlasts disk capacity.

2. Estimate how much transaction log volume your business applications generate in one hour.

3. Use the following formula to calculate the required disk space.

   [log volume in one hour] x [number of hours downtime] x .4 = trail disk space

   This equation uses a multiplier of 40 percent because only about 40 percent of the data in a transaction log is needed by Oracle GoldenGate.

   > **NOTE** This formula is a conservative estimate, and you should run tests once you have configured Oracle GoldenGate to determine exactly how much space you need.

TCP/IP

- Configure the system to use TCP/IP services, including DNS.
- Configure the network with the host names or IP addresses of all systems that will be hosting Oracle GoldenGate processes and to which Oracle GoldenGate will be connecting. Host names are easier to use.
- Oracle GoldenGate requires the following unreserved and unrestricted TCP/IP ports:
  - One port for communication between the Manager process and other Oracle GoldenGate processes.
  - A range of ports for local Oracle GoldenGate communications: can be the default range starting at port 7840 or a customized range of up to 256 other ports.

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●	Keep a record of the ports you assigned to Oracle GoldenGate. You will specify them with parameters when configuring the Manager process.

●	Configure your firewalls to accept connections through the Oracle GoldenGate ports.

Operating system requirements

●	To install on Windows, the user installing Oracle GoldenGate must log in as Administrator.

●	To install on UNIX, the user installing Oracle GoldenGate must have read and write privileges on the Oracle GoldenGate installation directory.

●	The Oracle GoldenGate processes require an operating system user that has privileges to read, write, and delete files and subdirectories in the Oracle GoldenGate directory. In addition, the user for the Manager process requires privileges to control Oracle GoldenGate processes.

●	Dedicate these operating system users to Oracle GoldenGate. Sensitive information might be available to anyone who runs an Oracle GoldenGate process.

Third-party programs

●	Before installing Oracle GoldenGate on a Windows system, install and configure the Microsoft Visual C ++ 2005 SP1 Redistributable Package. **Make certain it is the SP1 version of this package, and make certain to get the correct bit version for your server**. This package installs runtime components of Visual C++ Libraries. For more information, and to download this package, go to http://www.microsoft.com.

●	Oracle GoldenGate fully supports virtual machine environments created with any virtualization software on any platform. When installing Oracle GoldenGate into a virtual machine environment, select a build that matches the database and the operating system of the virtual machine, not the host system.

Database requirements

Database storage engine

●	Oracle GoldenGate supports InnoDB storage engine for a source MySQL database.

●	To preserve transaction boundaries for a MySQL target, create or alter the target tables to the InnoDB transactional database engine instead of the MyISAM engine. MyISAM will cause Replicat records to be applied as they are received, which does not guarantee transaction integrity even with auto-commit turned off. You cannot roll back a transaction with MyISAM.

●	On a target MySQL database, the Oracle GoldenGate Replicat process connects to the database through the MySQL native API.

Database user and permissions

●	Create a database user that is dedicated to Oracle GoldenGate. It can be the same user for all of the Oracle GoldenGate processes that must connect to a database:

❍	Extract (source database)

❍	Replicat (target database)

❍	DEFGEN (source or target database)

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- To preserve the security of your data, and to monitor Oracle GoldenGate processing accurately, do not permit other users, applications, or processes to log on as, or operate as, the Oracle GoldenGate database user.
- Specify the user and password with the USERID parameter in the Oracle GoldenGate parameter files.
- To capture binary log events, an Administrator must provide the following permissions to the Extract user:
  ○ Read and Execute permissions for the directory where the MySQL configuration file (my.cnf) is located
  ○ Read permission for the MySQL configuration file (my.cnf)
  ○ Read and Execute permissions for the directory where the binary logs are located
  ○ Read and Execute permission for the tmp directory

Supported data types

CHAR	TIMESTAMP
VARCHAR	BINARY
INT	VARBINARY
TINYINT	TEXT
SMALL INT	TINYTEXT
MEDIUM INT	MEDIUMTEXT
BIG INT	LONGTEXT
DECIMAL	BLOB
FLOAT	TINYBLOB
DOUBLE	MEDIUMBLOB
DATE	LONGBLOB
TIME	ENUM
YEAR	BIT(M)
DATETIME	

Limitations and clarifications

- Oracle GoldenGate does not support BLOB or TEXT types when used as a primary key.
- BLOB and TEXT types are not supported by the Oracle GoldenGate SQLEXEC feature.
- Oracle GoldenGate supports UTF8 and UCS2 character sets. UTF8 data is converted to UTF16 by Oracle GoldenGate before writing it to the trail.
- Oracle GoldenGate supports these data ranges for the following types:
- BIG INT: 0 to 8899999999999999999
- TIME: 00:00:00 to 24:59:59

Non-supported data types

- GEOMETRY
- SET

Supported objects and operations

- Oracle GoldenGate supports the extraction and replication of transactional tables.
- Oracle GoldenGate supports transactional tables up to the full row size and maximum number of columns that are supported by MySQL and the database storage engine that is being used. InnoDB supports up to 1000 columns.
- Oracle GoldenGate supports the AUTO_INCREMENT column attribute. The increment value is captured from the binary log by Extract and applied to the target table in a Replicat insert operation.
- Oracle GoldenGate supports the following DML operations on source and target database transactional tables:
  - ❍ Start Transaction
  - ❍ Commit Transaction
  - ❍ Rollback Transaction (Note: MySQL does not send rolled-back transactions to the binary logs, but it does log the transaction rollback operation itself if the transaction included InnoDB tables.)
  - ❍ Insert operation
  - ❍ Update operation (compressed included)
  - ❍ Delete operation (compressed included)
  - ❍ Truncate operation
- Oracle GoldenGate supports the following initial load methods from a source MySQL database to a MySQL or other target database:
  - ❍ Loading data with Replicat
  - ❍ Loading data with an Oracle GoldenGate direct load
- Oracle GoldenGate can operate concurrently with MySQL native replication.
- Oracle GoldenGate supports the DYNSQL feature for MySQL.

Non-supported objects and operations

- Extraction or replication of DDL (data definition language) operations
- The Oracle GoldenGate BATCHSQL feature
- Array fetching during initial load.

Supported and non-supported object names and case

The following will help you verify whether the name of a supported object type qualifies or disqualifies it for inclusion in an Oracle GoldenGate configuration. Oracle GoldenGate supports the full maximum name length of MySQL objects (database.table).

Object names and owners

MySQL maps the database name as a directory name and the table name as a file name. Source and target object names must be fully qualified in Oracle GoldenGate parameter files, as in fin.emp. Oracle GoldenGate supports character case as follows.

Case sensitivity

The following are general guidelines for the case-sensitivity of object names as it relates to Oracle GoldenGate. These guidelines may or may not apply to your databases, depending on whether the database or the underlying operating system supports case-sensitivity. Case sensitive table names in MySQL depend upon the underlying operating system in which MySQL runs. MySQL does not distinguish table names with mixed case on the Windows platform and is case-sensitive on most UNIX platforms. Keep in mind that case-sensitivity (or lack thereof) may apply to the source database but not the target, or to the target but not the source.

- If the system or database is case-sensitive, Oracle GoldenGate supports the case sensitivity of database names, owner and schema names, object names, column names, and user names.
- If the system or database is case-insensitive (or is configured for case-insensitivity), Oracle GoldenGate converts all names to upper case.

To preserve case-sensitivity in an Oracle GoldenGate configuration

In Oracle GoldenGate parameter files, specify case-sensitive names exactly as they appear in the database. In TABLE and MAP parameters, enclose case-sensitive names in double quotes if the other database (the source or target of the case-sensitive objects) is not case-sensitive.

If replicating from a case-insensitive source to a case-sensitive target, enter the source names in upper case in the Replicat MAP statements, to reflect the fact that Extract writes them to the trail as uppercase.

For example:

```
MAP SALES.CUSTOMER, TARGET "Sales.Account";
```

Supported characters

Oracle GoldenGate supports alphanumeric characters in object names and in the names of key columns and non-key columns. Oracle GoldenGate also supports the following non-alphanumeric characters in columns that are not being used by Oracle GoldenGate as a key.

Table 1   Supported non-alphanumeric characters in object names and non-key column names[1]

Character	Description
~	Tilde
< >	Greater-than and less-than symbols
/	Forward slash
\	Backward slash
!	Exclamation point
@	At symbol

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Table 1   Supported non-alphanumeric characters in object names and non-key column names[1]

Character	Description
#	Pound symbol
$	Dollar symbol
%	Percent symbol
^	Caret symbol
( )	Open and close parentheses
_	Underscore
-	Dash
+	Plus sign
=	Equal symbol
|	Pipe
[ ]	Begin and end brackets
{ }	Begin and end curly brackets (braces)

[1] The type of key that is being used by Oracle GoldenGate depends on the definition of a given table and whether there are any overrides by means of a KEYCOLS clause. Oracle GoldenGate will use a primary key, if available, or a unique key/index (selection is dependent on the database). In the absence of those definitions, all columns of the table are used, but a KEYCOLS clause overrides all existing key types. For columns that are being used by Oracle GoldenGate as a key, the characters in the names must be valid for inclusion in a WHERE clause. This list is all-inclusive; a given database platform may or may not support all listed characters.

Non-supported characters

Oracle GoldenGate does not support the following characters in object or column names.

Table 2   Non-supported characters in object and column names[1]

Character	Description
&	Ampersand
*	Asterisk
?	Question mark
:	Colon
;	Semi-colon
,	Comma

Table 2   Non-supported characters in object and column names[1]

Character	Description
' '	Single quotes
" "	Double quotes
'	Accent mark (Diacritical mark)
.	Period
	Space

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[1] This list is all-inclusive; a given database platform may or may not support all listed characters.

CHAPTER 2

Installing Oracle GoldenGate

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Installation overview

These instructions are for installing Oracle GoldenGate for the first time. Installing Oracle GoldenGate installs all of the components required to run and manage the processing (exclusive of any components required from other vendors, such as drivers or libraries) and it installs the Oracle GoldenGate utilities. The installation process takes a short amount of time.

Upgrades

To upgrade Oracle GoldenGate from one version to another, follow the instructions on http://www.oracle.com/technology/software/products/goldengate/index.html.

New installations

To install Oracle GoldenGate for the first time, the following steps are required:

- Downloading Oracle GoldenGate
- Setting library paths for dynamic builds
- Installing the Oracle GoldenGate software

> **NOTE** Before proceeding, make certain that you have reviewed the System Requirements.

Downloading Oracle GoldenGate

1. Navigate to http://edelivery.oracle.com.

2. On the **Welcome** page:
   - ❍ Select your language.
   - ❍ Click **Continue**.

3. On the **Export Validation** page:
   - ❍ Enter your identification information.
   - ❍ Accept the **Trial License Agreement** (even if you have a permanent license).
   - ❍ Accept the **Export Restrictions**.
   - ❍ Click **Continue**.

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4. On the **Media Pack Search** page:

   ❍ Select the **Oracle Fusion Middleware** Product Pack.

   ❍ Select the platform on which you will be installing the software.

   ❍ Click **Go**.

5. In the **Results List**:

   ❍ Select the Oracle GoldenGate Media Pack that you want.

   ❍ Click **Continue**.

6. On the **Download** page:

   ❍ Click **Download** for each component that you want. Follow the automatic download process to transfer the mediapack.zip file to your system.

   > **NOTE** Before installing the software, review the release notes for any new features, new requirements, or bug fixes that affect your current configuration.

Setting library paths for dynamic builds on UNIX systems

Oracle GoldenGate uses shared libraries. When you install Oracle GoldenGate on a UNIX system, the following must be true *before you run GGSCI or any other Oracle GoldenGate process*.

1. Make certain that the database libraries are added to the shared-library environment variables of the system. This procedure is usually performed at database installation time. Consult your Database Administrator if you have any questions.

2. If you will be running an Oracle GoldenGate program from outside the Oracle GoldenGate installation directory on a UNIX system:

   ❍ (Optional) Add the Oracle GoldenGate installation directory to the PATH environment variable.

   ❍ (Required) Add the Oracle GoldenGate installation directory to the shared-libraries environment variable.

   For example, given an Oracle GoldenGate installation directory of /ggs/10.0, the second command in the following table requires these variables to be set:

Command	Requires GG libraries in environment variable?
$ ggs/10.0 > ./ggsci	No
$ ggs > ./10.0/ggsci	Yes

To set the variables in Korn shell

```
PATH=<installation directory>:$PATH
export PATH
<shared libraries variable>=<absolute path of installation directory>:$<shared libraries variable>
export <shared libraries variable>
```

Configuring Manager and other processes

- To use Oracle GoldenGate, you must configure the Manager process. You must specify a TCP/IP port for Manager to use, and you can specify optional parameters that control dynamic port assignments, trail file maintenance, and other properties.
- To configure other required processes, Oracle GoldenGate security, and other features that enable you to customize Oracle GoldenGate, see the *Oracle GoldenGate Windows and UNIX Administrator's Guide*.

Installing Oracle GoldenGate on Windows and Windows Cluster

Installing Oracle GoldenGate into a Windows Cluster

1. Log into one of the nodes in the cluster.

2. For the Oracle GoldenGate installation location, choose a drive that is a resource within the same cluster group that contains the database instance.

3. Ensure that this group is owned by the cluster node that you are logging into.

4. Install Oracle GoldenGate according to the following instructions.

Installing the Oracle GoldenGate files

1. Unzip the downloaded file(s) by using WinZip or an equivalent compression product.

2. Move the files in binary mode to a folder on the drive where you want to install Oracle GoldenGate. *Do not* install Oracle GoldenGate into a folder that contains spaces in its name, even if the path is in quotes, for example C:\"Oracle GoldenGate".

3. From the Oracle GoldenGate folder, run the GGSCI program.

4. In GGSCI, issue the following command to create the Oracle GoldenGate working directories.

   ```
   CREATE SUBDIRS
   ```

5. Issue the following command to exit GGSCI.

   ```
   EXIT
   ```

Specifying a custom Manager name

You must specify a custom name for the Manager process if either of the following is true:

- you want to use a name for Manager other than the default of GGSMGR.
- there will be multiple Manager processes running as Windows services on this system, such as one for the Oracle GoldenGate replication software and one for Oracle GoldenGate Veridata. Each Manager on a system must have a unique name. Before proceeding further, verify the names of any local Manager services.

To specify a custom Manager name

1. From the directory that contains the Manager program, run GGSCI.

2. Issue the following command.

    ```
    EDIT PARAMS ./GLOBALS
    ```

3. In the file, add the following line, where <name> is a one-word name for the Manager service.

    ```
    MGRSERVNAME <name>
    ```

4. Save the file. The file is saved automatically with the name GLOBALS, *without a file extension.* Do not move this file. It is referenced during installation of the Windows service and during data processing.

Installing Manager as a Windows service

By default, Manager is not installed as a service and can be run by a local or domain account. However, when run this way, Manager will stop when the user logs out. When you install Manager as a service, you can operate it independently of user connections, and you can configure it to start manually or at system start-up. Installing Manager as a service is required on a Windows Cluster, but optional otherwise.

To install Manager as a Windows service

1. (Recommended) Log on as the system administrator.

2. Click **Start** > **Run**, and type **cmd** in the **Run** dialog box.

3. From the directory that contains the Manager program that you are installing as a service, run the **install** program with the following syntax:

    ```
    install <option> [...]
    ```

    Where: <option> is one of the following:

Table 3   INSTALL options

Option	Description
ADDEVENTS	Adds Oracle GoldenGate events to the Windows Event Manager. By default, Oracle GoldenGate errors are generic. To produce more specific error content, copy the following files from the Oracle GoldenGate installation directory to the SYSTEM32 directory. category.dll ggsmsg.dll

Table 3   INSTALL options (continued)

Option	Description
ADDSERVICE	Adds Manager as a service by the name specified in the GLOBALS file, if one exists, or by the default of GGSMGR. ADDSERVICE configures the service to run as the Local System account, the standard for most Windows applications because the service can be run independently of user logins and password changes. To run Manager as a specific account, use the USER and PASSWORD options.[1]
	The service is installed to start at system boot time (see AUTOSTART). To start it after installation, either reboot the system, or start the service manually from the Services applet of the Control Panel.
AUTOSTART	Specifies that the service created with ADDSERVICE is to be started at system boot time. This is the default unless MANUALSTART is used.
MANUALSTART	Specifies that the service created with ADDSERVICE is to be started manually through GGSCI, a script, or the Services applet of the Control Panel. The default is AUTOSTART.
USER <name>	Specifies a domain user account for executing Manager. For <name>, include the domain name, a backward slash, and the user name, for example HEADQT\GGSMGR.
	By default, the Manager service is installed to use the Local System account.
PASSWORD <password>	Specifies the password for the user specified with USER.

[1] A user account can be changed by selecting the Properties action from the Services applet of the Windows Control Panel.

4. (Windows Server 2008) If Windows User Account Control (UAC) is enabled, you are prompted to allow or deny the program access to the computer. Select **Allow** to enable the install program to run. This installs the Manager service with a local system account running with administrator privileges. No further UAC prompts will be encountered when running Manager if installed as a service.

> **NOTE**   If Manager is not installed as a service, Oracle GoldenGate users will receive a UAC prompt to confirm the elevation of privileges for Manager when it is started from the GGSCI command prompt. Running other Oracle GoldenGate programs also will trigger a prompt.

Adding Oracle GoldenGate as a Windows cluster resource

If you installed Oracle GoldenGate into a cluster, follow these instructions to establish Oracle GoldenGate as a cluster resource and configure the Manager service correctly on all nodes.

1. In the Cluster Administrator, select **File>New>Resource**.

2. In the New Resource dialog box, provide a descriptive name for the Oracle GoldenGate Manager (need not be its actual name). For Resource Type, select Generic Service. For Group, select the group that contains the database instance to which Oracle GoldenGate will connect.

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3. Click **Next**.

4. In the Possible Owners dialog box, select the nodes on which Oracle GoldenGate will run.

5. Click **Next**.

6. In the GGS Manager Service Properties dialog box, click the Dependencies tab, and add the following to the Resource dependencies list:

  ❍ The database resource group
  ❍ The disk resource containing the Oracle GoldenGate directory
  ❍ The disk resource containing the database transaction log files
  ❍ The disk resource containing the database transaction log backup files

7. Click **Apply**, then **OK**.

8. In the Generic Service Parameters dialog box, type either the default Manager service name of GGSMGR or, if applicable, the custom name specified in the GLOBALS file.

9. Click **Next**.

10. Click **Finish** to exit the wizard.

11. In the Cluster Administrator tree, right-click the Manager resource and select Properties.

12. Click the Advanced tab, and deselect Affect the Group. This is a recommendation, but you can configure it as needed for your environment.

13. Click **Apply**.

14. Bring the cluster resource online to verify that it was installed correctly.

15. Take the resource offline again.

16. Move the group to the next node in the cluster. When the group has been successfully moved to the second node, the Manager resource should still be offline.

17. Log onto the second node.

18. Install Oracle GoldenGate Manager as a service on this node by running the **install** program as you did on the previous node. If you created a custom name for Manager in the GLOBALS file, that name will be used.

19. Bring the resource online to verify that it is running correctly on this node.

20. Repeat from step 16 for each additional node in the cluster.

Configuring Manager and other processes

● To use Oracle GoldenGate, you must configure the Manager process. You must specify a TCP/IP port for Manager to use, and you can specify optional parameters that control dynamic port assignments, trail file maintenance, and other properties.

● To configure other required processes, Oracle GoldenGate security, and other features that enable you to customize Oracle GoldenGate, see the *Oracle GoldenGate Windows and UNIX Administrator's Guide*.

Preparing the system for Oracle GoldenGate

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Setting MYSQL_HOME

Make certain that the environment variable MYSQL_HOME points to the installation location of the MySQL database. The Oracle GoldenGate Extract process uses this variable to find the MySQL configuration file (my.ini on Windows or my.conf on other platforms). On Windows, remember to enclose the value in quotes if the directory name contains spaces.

Setting MySQL configuration parameters

The following parameters must be set in the MySQL server configuration file. On Windows, the file name is my.ini. On other platforms, it is my.conf.

- Set log-bin to a value that specifies a directory and name format for the log files, as shown in the following example.

  ```
  log-bin="C:/MySQL/MySQL Server 5.1/log/test.bin"
  ```

  In this example, name of the log files are created as test.00001, test.00002, and so forth and are stored in the directory named c:/MySQL/MySQL Server 5.1/log.

- Set max_binlog_size to specify the size, in bytes, of the binary log file. The minimum value should be 4096.

  ```
  max_binlog_size=4096
  ```

  > **NOTE**   The server will create a new binary log file automatically when the size of the current log reaches the max_binlog_size value, unless it must finish recording a transaction before rolling over to a new file.

- Set binlog_format to the value of ROW, as shown in the following example.

  ```
  binlog_format=row
  ```

  The value of ROW causes DML statements to be logged in binary format. Any other log format (mixed or statement) will cause Extract to abend.

  > **NOTE**   MySQL binary logging does not allow logging to be enabled or disabled for specific tables. It applies globally to all tables in the database.

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Ensuring data availability

Retain enough binary log data so that if you stop Extract or there is an unplanned outage, Extract can start again from its checkpoints. Extract must have access to the binary log that contains the start of the oldest uncommitted unit of work, and all binary logs thereafter. The recommended retention period is at least 24 hours worth of transaction data, including both active and archived information. You might need to do some testing to determine the best retention time given your data volume and business requirements.

If data that Extract needs during processing was not retained, either in active or backup logs, one of the following corrective actions might be required:

- alter Extract to capture from a later point in time for which binary log data is available (and accept possible data loss on the target).
- resynchronize the source and target tables, and then start the Oracle GoldenGate environment over again.

To determine where the Extract checkpoints are, use the INFO EXTRACT command. For more information, see the Oracle GoldenGate *Windows and UNIX Reference Guide*.

Configuring bi-directional replication

1. Configure Oracle GoldenGate for high availability or active-active replication according to the instructions in the Oracle GoldenGate *Windows and UNIX Administrator's Guide*.

2. To properly filter out Replicat operations in a bi-directional configuration, so that the applied operations are not captured and looped back to the source again, take the following steps on each MySQL database:

   ❍ Configure each Replicat process to use a checkpoint table. Replicat writes a checkpoint to this table at the end of each transaction. You can use one global checkpoint table or one per Replicat process. See the Oracle GoldenGate *Windows and UNIX Administrator's Guide*.

   ❍ Specify the name of the checkpoint table with the FILTERTABLE <table> option of the TRANLOGOPTIONS parameter in the Extract parameter file. The Extract process will ignore transactions that end with an operation to this table (Replicat operations).

      NOTE Although optional for other supported databases as a means of enhancing recovery, the use of a checkpoint table is required for MySQL when using bi-directional replication (and likewise, will enhance recovery).

3. Edit the MySQL server configuration file to set the auto_increment_increment and auto_increment_offset parameters to avoid discrepancies that could be caused by the bi-directional operations. The following illustrates these parameters, assuming two servers: ServerA and ServerB.

   ServerA:

   ```
   auto-increment-increment = 2
   auto-increment-offset = 1
   ```

   ServerB:

   ```
   auto-increment-increment = 2
   auto-increment-offset = 2
   ```

Oracle GoldenGate parameters for MySQL

The following parameters are available for MySQL installations, as needed. For more information, see the *Windows and UNIX Reference Guide.*

DBOPTIONS

When using multi-daemon MySQL, use the DBOPTIONS parameter with the HOST and CONNECTIONPORT options in the Oracle GoldenGate parameter files.

SQLEXEC

To bypass the MySQL connection timeout, configure the following command in a SQLEXEC statement in the Replicat parameter file.

```
SQLEXEC "select CURRENT_TIME();" EVERY <n> MINUTES
```

Where: <n> is the maximum interval after which you want Replicat to reconnect. The recommended connection timeouts are 2147483 seconds (25 days) for Windows and 31536000 seconds (365 days) for UNIX and Linux.

TRANLOGOPTIONS

Use the TRANLOGOPTIONS parameter with the ALTLOGDEST option to specify a location for the log index file, if you need to override the default location. Extract uses the log index file to find the binary log file that it needs to read.

How Oracle GoldenGate identifies transactions

Oracle GoldenGate keeps track of transaction identifiers as part of its method of ensuring data integrity. MySQL does not create a transaction ID as part of its event data, so Oracle GoldenGate considers a unique transaction identifier to be a *combination* of the following:

- the log file number of the log file that contains the START TRANSACTION record for the transaction that is being identified
- the record offset of that record

This unique combined value is known as a *Commit Sequence Number*, or *CSN,* in Oracle GoldenGate terms. The CSN guarantees the uniqueness of a transaction across multiple log files. Oracle GoldenGate associates the CSN value with all of the DML statements that belong to a given transaction.

Positioning Extract to a specific start point

You can position the ADD EXTRACT and ALTER EXTRACT commands to a specific start point in the transaction logs with the following command.

```
{ADD | ALTER EXTRACT} <group>, VAM, LOGNUM <log_num>, LOGPOS <log_pos>
```

- <group> is the name of the Oracle GoldenGate Extract group for which the start position is required.
- <log_num> is the log file number. For example, if the required log file name is test.000034, this value would be 34. Extract will search for this log file.
- <log_pos> is an *event offset value* within the log file that identifies a specific transaction record. Event offset values are stored in the header section of a log record.

In MySQL logs, an event offset value can be unique only within a given binary file. The combination of the position value and a log number will uniquely identify a transaction record. (See "How Oracle GoldenGate identifies transactions" preceding this topic.) Transactional records available after this position within the specified log will be captured by Extract.

Preparing tables for processing

Assigning row identifiers

Oracle GoldenGate requires some form of unique row identifier on the source and target tables to locate the correct target rows for replicated updates and deletes.

How Oracle GoldenGate determines the kind of row identifier to use

Unless a KEYCOLS clause is used in the TABLE or MAP statement, Oracle GoldenGate selects a row identifier to use in the following order of priority:

1. Primary key

2. First unique key alphanumerically that does not contain a timestamp or non-materialized computed column

3. If none of the preceding key types exist (even though there might be other types of keys defined on the table) Oracle GoldenGate constructs a pseudo key of all columns that the database allows to be used in a unique key, excluding those that are not supported by Oracle GoldenGate in a key or those that are excluded from the Oracle GoldenGate configuration.

> **NOTE**   If there are other, non-usable keys on a table or if there are no keys at all on the table, Oracle GoldenGate logs an appropriate message to the report file. Constructing a key from all of the columns impedes the performance of Oracle GoldenGate on the source system. On the target, this key causes Replicat to use a larger, less efficient WHERE clause.

Tables with a primary key derived from a unique index

In the absence of a primary key on a table, MySQL will promote a unique index to primary key if the indexed column is NOT NULL. If there are more than one of these not-null indexes, the first one that was created becomes the primary key. To avoid Replicat errors, create these indexes in the same order on the source and target tables.

For example, assume that source and target tables named ggvam.emp each have columns named first, middle, and last, and all are defined as NOT NULL. If you create unique indexes in the following order, Oracle GoldenGate will abend on the target because the table definitions do not match.

Source:

```
mysql> create unique index uq1 on ggvam.emp(first);
mysql> create unique index uq2 on ggvam.emp(middle);
mysql> create unique index uq3 on ggvam.emp(last);
```

Target:

```
mysql> create unique index uq1 on ggvam.emp(last);
mysql> create unique index uq2 on ggvam.emp(first);
mysql> create unique index uq3 on ggvam.emp(middle);
```

The result of this sequence is that MySQL promotes the index on the source "first" column to primary key, and it promotes the index on the target "last" column to primary key. Oracle GoldenGate will select the primary keys as identifiers when it builds its metadata record, and the metadata will not match. To avoid this error, decide which column you want to promote to primary key, and create that index first on the source and target.

How to specify your own key for Oracle GoldenGate to use

If a table does not have one of the preceding types of row identifiers, or if you prefer those identifiers not to be used, you can define a substitute key if the table has columns that always contain unique values. You define this substitute key by including a KEYCOLS clause within the Extract TABLE parameter and the Replicat MAP parameter. The specified key will override any existing primary or unique key that Oracle GoldenGate finds.

Disabling triggers and cascade constraints

Disable triggers, cascade delete constraints, and cascade update constraints on the target tables, or alter them to ignore changes made by the Oracle GoldenGate database user. Oracle GoldenGate replicates DML that results from a trigger or cascade constraint. If the same trigger or constraint gets activated on the target table, it becomes redundant because of the replicated version, and the database returns an error. Consider the following example, where the source tables are "emp_src" and "salary_src" and the target tables are "emp_targ" and "salary_targ."

1. A delete is issued for emp_src.

2. It cascades a delete to salary_src.

3. Oracle GoldenGate sends both deletes to the target.

4. The parent delete arrives first and is applied to emp_targ.

5. The parent delete cascades a delete to salary_targ.

6. The cascaded delete from salary_src is applied to salary_targ.

7. The row cannot be located because it was already deleted in step 5.

Configuring character sets

To ensure accurate character representation from one database to another, the following must be true:

●   The character set of the target database must be a superset of the character set of the source database.

●   If your client applications use different character sets, the database character set must be a superset of the character sets of the client applications. In this configuration, every character is represented when converting from a client character set to the database character set.

Uninstalling Oracle GoldenGate

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This procedure assumes that you no longer need the data in the Oracle GoldenGate trails, and that you no longer need to preserve the current Oracle GoldenGate environment. To preserve your current environment and data, make a backup of the Oracle GoldenGate directory and all subdirectories before starting this procedure.

Uninstalling Oracle GoldenGate from UNIX

1. Run the command shell.

2. (Suggested) Log on as the system administrator, or as a user with permission to issue Oracle GoldenGate commands, and to delete files and directories from the operating system.

3. Change directories to the Oracle GoldenGate installation directory.

4. Run GGSCI.

5. Stop all Oracle GoldenGate processes.

6. Stop the Manager process.

7. Exit GGSCI.

8. Remove the Oracle GoldenGate files by removing the installation directory.

9. Drop any Oracle GoldenGate-related objects from the database as needed.

Uninstalling Oracle GoldenGate from Windows (non-cluster)

1. (Suggested) Log on as the system administrator or as a user with permission to issue Oracle GoldenGate commands and to delete files and directories from the operating system.

2. From the Oracle GoldenGate installation folder, run GGSCI.

3. Stop all Oracle GoldenGate processes.

4. Stop the Manager program or service.

5. Exit GGSCI.

6. Click **Start** > **Run**, and type cmd in the **Run** dialog box to open the command console.

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7. Change directories to the Oracle GoldenGate installation directory.

8. Run the install program using the following syntax.

```
install deleteevents deleteservice
```

This command stops Oracle GoldenGate events from being reported to the Windows Event Manager and removes the Manager service.

9. Delete the CATEGORY.DLL and GGSMSG.DLL files from the Windows SYSTEM32 folder.

10. Delete the Oracle GoldenGate installation folder.

11. Drop any Oracle GoldenGate-related objects from the database as needed.

Uninstalling Oracle GoldenGate from Windows Cluster

1. Working from the node in the cluster that owns the cluster group that contains the Manager resource, run GGSCI and then stop any Extract and Replicat processes that are still running.

2. Use the Cluster Administrator tool to take the Manager resource offline.

3. Right click the resource and select **Delete** to remove it.

4. Click **Start** > **Run**, and type cmd in the **Run** dialog box to open the command console.

5. Change directories to the Oracle GoldenGate installation directory.

6. Run the install program using the following syntax.

```
install deleteevents deleteservice
```

This command stops Oracle GoldenGate events from being reported to the Windows Event Manager and removes the Manager service.

7. Delete the CATEGORY.DLL and GGSMSG.DLL files from the Windows SYSTEM32 folder.

8. Move the cluster group to the next node in the cluster, and repeat from step 4.

9. Delete the Oracle GoldenGate installation folder.

10. Drop any Oracle GoldenGate-related objects from the database as needed.

Oracle GoldenGate installed components

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This appendix describes the programs, directories, and other components created or used by the Oracle GoldenGate software in the Oracle GoldenGate installation directory. Additional files not listed here might be installed on certain platforms. Files listed here might not be installed on every platform.

Oracle GoldenGate Programs and Utilities

This section describes programs installed in the root Oracle GoldenGate installation directory.

> **NOTE** **Some programs may not exist in all installations.** For example, if only capture or delivery is supported by Oracle GoldenGate for your platform, the extract or replicat program will not be installed, respectively. Likewise, special files might be installed to support a specific database.

Table 4   Programs and utilities

Program	Description
cobgen	Generates source definitions based on COBOL layouts. Used for Oracle GoldenGate for Datawise on Stratus.
convchk	Converts checkpoint files to a newer version.
ddlcob	Generates target DDL table creation statements based on COBOL layouts. Used for Oracle GoldenGate for Datawise on Stratus.
defgen	Generates data definitions and is referenced by Oracle GoldenGate processes when source and target tables have dissimilar definitions.
emsclnt	Sends event messages created by Collector and Replicat on Windows or UNIX systems to EMS on NonStop systems.
extract	Performs capture from database tables or transaction logs or receives transaction data from a vendor access module.
ggmxinstall	Oracle GoldenGate installation script for the SQL/MX database.

Table 4   Programs and utilities (continued)

Program	Description
ggsci	User interface to Oracle GoldenGate for issuing commands and managing parameter files.
ggsmgr.jcl ggsmgr.proc ggsmgrst.jcl ggsmgrst.proc	Start the Oracle GoldenGate Manager process from a batch job or the operator console on a z/OS system. Installed to support DB2 z/OS databases.
install	Installs Oracle GoldenGate as a Windows service and provides other Windows-based service options.
keygen	Generates data-encryption keys.
logdump	A utility for viewing and saving information stored in extract trails or files.
mgr	(Manager) Control process for resource management, control and monitoring of Oracle GoldenGate processes, reporting, and routing of requests through the GGSCI interface.
replicat	Applies data to target database tables.
reverse	A utility that reverses the order of transactional operations, so that Replicat can be used to back out changes from target tables, restoring them to a previous state.
server	The Collector process, an Extract TCP/IP server collector that writes data to remote trails.
vamserv	Started by Extract to read the TMF audit trails generated by TMF-enabled applications. Installed to support the NonStop SQL/MX database.

Oracle GoldenGate subdirectories

This section describes the subdirectories of the Oracle GoldenGate installation directory and their contents.

NOTE   **Some directories may not exist in all installations.**

Table 5   Subdirectories

Directory	Description
dirchk	Contains the checkpoint files created by Extract and Replicat processes, which store current read and write positions to support data accuracy and fault tolerance. Written in internal Oracle GoldenGate format.
	File name format is <group name><sequence number>.<ext> where <sequence number> is a sequential number appended to aged files and <ext> is either cpe for Extract checkpoint files or cpr for Replicat checkpoint files.
	Do not edit these files.
	Examples:
	ext1.cpe
	rep1.cpr
dirdat	The default location for Oracle GoldenGate trail files and extract files that are created by Extract processes to store extracted data for further processing by the Replicat process or another application or utility. Written in internal Oracle GoldenGate format.
	File name format is a user-defined two-character prefix followed by either a six-digit sequence number (trail files) or the user-defined name of the associated Extract process group (extract files).
	Do not edit these files.
	Examples:
	rt000001
	finance
dirdef	The default location for data definitions files created by the DEFGEN utility to contain source or target data definitions used in a heterogeneous synchronization environment. Written in external ASCII. File name format is a user-defined name specified in the DEFGEN parameter file.
	These files may be edited to add definitions for newly created tables. If you are unsure of how to edit a definitions file, contact Oracle GoldenGate technical support.
	Example:
	defs.dat
dirout	This directory is not used any more.

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Table 5   Subdirectories (continued)

Directory	Description
dirpcs	Default location for status files. File name format is <group>.<extension> where <group> is the name of the group and <extension> is either pce (Extract), pcr (Replicat), or pcm (Manager). These files are only created while a process is running. The file shows the program name, the process name, the port number, and the process ID. Do not edit these files. Examples: mgr.pcm ext.pce
dirprm	The default location for Oracle GoldenGate parameter files created by Oracle GoldenGate users to store run-time parameters for Oracle GoldenGate process groups or utilities. Written in external ASCII format. File name format is <group name/user-defined name>.prm or mgr.prm. These files may be edited to change Oracle GoldenGate parameter values after stopping the process. They can be edited directly from a text editor or by using the EDIT PARAMS command in GGSCI. Examples: defgen.prm finance.prm
dirrec	Not used by Oracle GoldenGate.
dirrpt	The default location for process report files created by Extract, Replicat, and Manager processes to report statistical information relating to a processing run. Written in external ASCII format. File name format is <group name><sequence number>.rpt where <sequence number> is a sequential number appended to aged files. Do not edit these files. Examples: fin2.rpt mgr4.rpt
dirtmp	The default location for storing large transactions when the size exceeds the allocated memory size. Do not edit these files.
dirver	An Oracle GoldenGate Veridata directory. Not used unless this software is installed in the Oracle GoldenGate location.

Other Oracle GoldenGate files

This section describes other files, templates, and objects created or installed in the root Oracle GoldenGate installation directory.

NOTE Some files may not be installed in your environment, depending on the database and OS platform.

Table 6   Other files

Component	Description
bcpfmt.tpl	Template for use with Replicat when creating a run file for the Microsoft BCP/DTS bulk-load utility.
blowfish.txt	Blowfish encryption software license agreement.
category.dll	Windows dynamic link library used by the INSTALL program.
chkpt_<db>_create.sql	Script that creates a checkpoint table in the local database. A different script is installed for each database type.
db2cntl.tpl	Template for use with Replicat when creating a control file for the IBM LOADUTIL bulk-load utility.
ddl_cleartrace.sql	Script that removes the DDL trace file. (Oracle installations)
ddl_disable.sql	Script that disables the Oracle GoldenGate DDL trigger. (Oracle installations)
ddl_enable.sql	Script that enables the Oracle GoldenGate DDL trigger. (Oracle installations)
ddl_ora9.sql	A script that gets tablespace information from an Oracle 9 database.
ddl_ora10.sql	A script that disables the Oracle recyclebin and gets tablespace information from an Oracle 10 database.
ddl_pin.sql	Script that pins DDL tracing, the DDL package, and the DDL trigger for performance improvements. (Oracle installations)
ddl_remove.sql	Script that removes the DDL extraction trigger and package. (Oracle installations)
ddl_setup.sql	Script that installs the Oracle GoldenGate DDL extraction and replication objects. (Oracle installations)
ddl_status.sql	Script that verifies whether or not each object created by the Oracle GoldenGate DDL support feature exists and is functioning properly. (Oracle installations)

Table 6   Other files (continued)

Component	Description
ddl_tracelevel.sql	Script that sets the level of tracing for the DDL support feature. (Oracle installations)
debug files	Debug text files that may be present if tracing was turned on.
demo_<db>_create.sql	Script that creates demonstration tables in the database associated with the Oracle GoldenGate installation.
demo_<db>_insert.sql	Script that inserts initial test data into the demonstration tables.
demo_<db>_misc.sql	Script that simulates transaction activity on the demonstration tables.
ENCKEYS	User-created file that stores encryption keys. Written in external ASCII format.
exitdemo.c	User exit example.
ggmessage.dat	Data file that contains error, informational, and warning messages that are returned by the Oracle GoldenGate processes. The version of this file is checked upon process startup and must be identical to that of the process in order for the process to operate.
ggserr.logs	File that logs processing events, messages, errors, and warnings generated by Oracle GoldenGate.
ggsmsg.dll	Windows dynamic link library used by the INSTALL program.
GLOBALS	User-created file that stores parameters applying to the Oracle GoldenGate instance as a whole.
help.txt	Help file for the GGSCI command interface.
LGPL.txt	Lesser General Public License statement. Applies to free libraries from the Free Software Foundation.
libxml2.dll	Windows dynamic link library containing the XML library for the Oracle GoldenGate XML procedures.
libxml2.txt	License agreement for libxml2.dll.
marker.hist	File created by Replicat if markers were passed from a NonStop source system.
marker_remove.sql	Script that removes the DDL marker table. (Oracle installations)

Table 6   Other files (continued)

Component	Description
marker_setup.sql	Script that installs the Oracle GoldenGate DDL marker table. (Oracle installations)
marker_status.sql	Script that confirms successful installation of the DDL marker table. (Oracle installations)
params.sql	Script that contains configurable parameters for DDL support. (Oracle installations)
pthread-win32.txt	License agreement for pthread-VC.dll.
pthread-VC.dll	POSIX threads library for Microsoft Windows.
role_setup.sql	Script that creates the database role necessary for Oracle GoldenGate DDL support. (Oracle installations)
sqlldr.tpl	Template for use with Replicat when creating a control file for the Oracle SQL*Loader bulk-load utility.
start.prm stop.prm	z/OS paramlib members to start and stop the Manager process.
startmgr stopmgr	z/OS Unix System Services scripts to start the Manager process from GGSCI.
startmgrcom stopmgrcom	z/OS system input command for the Manager process.
tcperrs	File containing user-defined instructions for responding to TCP/IP errors.
usrdecs.h	Include file for user exit API.
zlib.txt	License agreement for zlib compression library.

Oracle GoldenGate checkpoint table

When database checkpoints are being used, Oracle GoldenGate creates a checkpoint table with a user-defined name in the database upon execution of the ADD CHECKPOINTTABLE command, or a user can create the table by using the chkpt_<db>_create.sql script, where <db> is the type of database.

Do not change the names or attributes of the columns in this table. You can change table storage attributes as needed.

Table 7   Checkpoint table definitions

Column	Description
GROUP_NAME (primary key)	The name of a Replicat group using this table for checkpoints. There can be multiple Replicat groups using the same table.
GROUP_KEY (primary key)	A unique identifier that, together with GROUPNAME, uniquely identifies a checkpoint regardless of how many Replicat groups are writing to the same table.
SEQNO	The sequence number of the checkpoint file.
RBA	The relative byte address of the checkpoint in the file.
AUDIT_TS	The timestamp of the checkpoint position in the checkpoint file.
CREATE_TS	The date and time when the checkpoint table was created.
LAST_UPDATE_TS	The date and time when the checkpoint table was last updated.
CURRENT_DIR	The current Oracle GoldenGate home directory or folder.

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