

**Oracle® GoldenGate**  
Oracle Installation and Setup Guide  
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## PREFACE

# About this guide

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## About Oracle GoldenGate for the Oracle database

Oracle GoldenGate delivers low-impact, real-time data acquisition, distribution, and delivery across heterogeneous systems. Oracle GoldenGate offers integration with Oracle technologies and applications, support for additional heterogeneous systems, and high performance.

Oracle GoldenGate moves committed transactions with transaction integrity and minimal overhead on your existing infrastructure. Its wide variety of use cases includes real-time business intelligence; query offloading; zero-downtime upgrades and migrations; disaster recovery; and active-active databases for data distribution, data synchronization and high availability.

With Oracle GoldenGate, you can:

- Replicate, filter, and transform transactional data changes between similar or dissimilar supported Oracle versions, or between an Oracle database and a database of another type.
- Replicate and filter Oracle DDL operations between heterogeneous Oracle databases.
- Perform initial loads to target tables to instantiate a synchronized replication environment.

## About the Oracle GoldenGate documentation

The complete Oracle GoldenGate documentation set contains the following components:

### *HP NonStop platforms*

- *Oracle GoldenGate HP NonStop Administrator's Guide*: Explains how to plan for, configure, and implement the Oracle GoldenGate replication solution on the NonStop platform.
- *Oracle GoldenGate HP NonStop Reference Guide*: Contains detailed information about Oracle GoldenGate parameters, commands, and functions for the NonStop platform.

### *Windows, UNIX, Linux platforms*

- *Installation and Setup guides*: There is one such guide for each database that is supported by Oracle GoldenGate. It contains system requirements, pre-installation and post-installation procedures, installation instructions, and other system-specific information for installing the Oracle GoldenGate replication solution.
- *Oracle GoldenGate Windows and UNIX Administrator's Guide*: Explains how to plan for, configure, and implement the Oracle GoldenGate replication solution on the Windows and UNIX platforms.

- *Oracle GoldenGate Windows and UNIX Reference Guide*: Contains detailed information about Oracle GoldenGate parameters, commands, and functions for the Windows and UNIX platforms.
- *Oracle GoldenGate Windows and UNIX Troubleshooting and Tuning Guide*: Contains suggestions for improving the performance of the Oracle GoldenGate replication solution and provides solutions to common problems.

**Other Oracle GoldenGate products**

- *Oracle GoldenGate Director Administrator's Guide*: Explains how to install, run, and administer Oracle GoldenGate Director for configuring, managing, monitoring, and reporting on the Oracle GoldenGate replication components.
- *Oracle GoldenGate Veridata Administrator's Guide*: Explains how to install, run, and administer the Oracle GoldenGate Veridata data comparison solution.
- *Oracle GoldenGate for Java Administrator's Guide*: Explains how to install, configure, and run Oracle GoldenGate for Java to capture JMS messages to Oracle GoldenGate trails or deliver captured data to messaging systems or custom APIs.
- *Oracle GoldenGate for Flat File Administrator's Guide*: Explains how to install, configure, and run Oracle GoldenGate for Flat File to format data captured by Oracle GoldenGate as batch input to ETL, proprietary or legacy applications.

## Typographic conventions used in this manual

This manual uses the following style conventions.

- Parameter and command arguments are shown in upper case, for example:  
`CHECKPARAMS`
- File names, table names, and other names are shown in lower case unless they are case-sensitive to the operating system or software application they are associated with, for example:  
`account_tab`  
`GLOBALS`
- Variables are shown within `< >` characters, for example:  
`<group name>`
- When one of multiple mutually-exclusive arguments must be selected, the selection is enclosed within braces and separated with pipe characters, for example:  
`VIEW PARAMS {MGR | <group> | <file name>}`
- Optional arguments are enclosed within brackets, for example:  
`CLEANUP EXTRACT <group name> [, SAVE <count>]`
- When there are numerous multiple optional arguments, a placeholder such as `[<option>]` may be used, and the options are listed and described separately, for example:  
`TRANLOGOPTIONS [<option>]`

- When an argument is accepted more than once, an ellipsis character (...) is used, for example:  
`PARAMS ([<requirement rule>] <param spec> [, <param spec>] [, ...])`
- The ampersand (&) is used as a continuation character in Oracle GoldenGate parameter files. It is required to be placed at the end of each line of a parameter statement that spans multiple lines. Most examples in this documentation show the ampersand in its proper place; however, some examples of multi-line statements may omit it to allow for space constraints of the publication format.

## Getting more help with Oracle GoldenGate

In addition to the Oracle GoldenGate documentation, you can get help for Oracle GoldenGate in the following ways.

### Getting help with the Oracle GoldenGate interface

Both GGSCI and the Oracle GoldenGate Director applications provide online help.

#### *GGSCI commands*

To get help for an Oracle GoldenGate command, use the `HELP` command in GGSCI. To get a summary of command categories, issue the `HELP` command without options. To get help for a specific command, issue the `HELP` command with the command name as input.

```
HELP <command name>
```

Example:

```
HELP ADD EXTRACT
```

The help file displays the syntax and description of the command.

#### *Oracle GoldenGate Director and Oracle GoldenGate Monitor*

To get help for the Oracle GoldenGate graphical client interfaces, use the `Help` menu within the application.

### Getting help with questions and problems

For troubleshooting assistance, see *Oracle GoldenGate Windows and UNIX Troubleshooting and Tuning Guide*. Additional information can be obtained from the Knowledge Base on <http://support.oracle.com>. If you cannot find an answer, you can open a service request from the support site.

CHAPTER 1

# System requirements and preinstallation instructions

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This chapter contains the requirements for the system and database resources that support Oracle GoldenGate.

## 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 e-mail and password are required to enter this site.

## Operating system requirements

### Memory requirements

The amount of memory that is required for Oracle GoldenGate depends on the number of concurrent processes that will be running. At minimum on the source system, there is a primary Extract process that captures source data and a secondary Extract data-pump process that transfers data across the network. At minimum on the target system is at least one Replicat process that applies the replicated data to the target database. In some cases, these processes might all operate on the same system, depending on the required configuration.

- The Oracle GoldenGate GGSCI command interface fully supports up to 5,000 concurrent Extract and Replicat processes per instance of Oracle GoldenGate. An instance of Oracle GoldenGate equates to one Manager process, which is the main controller process.
- Each Extract and Replicat process needs approximately 25-55 MB of memory, or more depending on the size of the transactions and the number of concurrent transactions.

The actual amount of physical memory that is used by any Oracle GoldenGate process is controlled by the operating system, not the Oracle GoldenGate program. The Oracle GoldenGate cache manager takes advantage of the memory management functions of the operating system to ensure that Oracle GoldenGate processes work in a sustained and efficient manner. Within its cache, it makes use of modern virtual memory techniques by:

- Allocating and managing active buffers efficiently.
- Recycling old buffers instead of paging to disk, when possible.
- Paging less-used information to disk, when necessary.

The cache manager keeps an Oracle GoldenGate process working within the soft limit of

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its global cache size, only allocating virtual memory (not physical memory) on demand. System calls to increase the cache size are made only as a last resort and, when used, are always followed by the release of virtual memory back to the system.

The system must have sufficient swap space for each Oracle GoldenGate Extract and Replicat process that will be running. To determine the required swap space:

1. Start up one Extract or Replicat.
2. Run GGSCI.
3. View the report file and find the line `PROCESS VM AVAIL FROM OS (min)`.
4. Round up the value to the next full gigabyte if needed. For example, round up 1.76GB to 2 GB.
5. Multiply that value by the number of Extract and Replicat processes that will be running. The result is the maximum amount of swap space that could be required. To determine the number of processes you will need, consult the configuration chapters in the *Oracle GoldenGate Windows and UNIX Administrator's Guide*.

## 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 as the Oracle user on a shared file system that is available to all cluster nodes. See “Preparing to install Oracle GoldenGate within a cluster” on page 28 for more information.
- An additional 1 GB of disk space on any system that hosts Oracle GoldenGate trails, which are files that contain the working data. You may need more or less than this amount, because the space that is consumed by the trails depends on the volume of data that will be processed. Start with 1 GB and adjust as needed. See also 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. In an Oracle cluster, they can reside on ASM or DBFS storage. You decide and 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 it 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 removed from the system before the data is completely captured. There must be enough disk space to hold the data accumulation, or Extract will abend.

For trails at the target location, provide enough disk space to handle data accumulation according to the purge rules set with the PURGEOLDEXTRACTS parameter. 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.

$$[\text{log volume in one hour}] \times [\text{number of hours downtime}] \times .4 = \text{trail disk space}$$

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.

### Temporary disk requirements

By default, Oracle GoldenGate maintains data that it swaps to disk in the dirtmp sub-directory of the Oracle GoldenGate installation directory. The cache manager assumes that all of the free space on the file system is available. This directory can fill up quickly if there is a large transaction volume with large transaction sizes. To prevent I/O contention and possible disk-related Extract failures, dedicate a disk to this directory. You can assign a name to this directory with the CACHEDIRECTORY option of the CACHEMGR parameter.

### Network

- For optimal performance and reliability, especially in maintaining low latency on the target, use the fastest network possible and install redundancies at all points of failure.
- Configure the system to use TCP/IP services, including DNS. Oracle GoldenGate supports IPv4 and IPv6 and can operate in a system that supports one or both of these protocols.
- 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 some unreserved and unrestricted TCP/IP ports, the number of which depends on the number and types of processes in your configuration. See the Oracle GoldenGate *Windows and UNIX Administrator's Guide* for details on how to configure the Manager process to handle the required ports.
- Keep a record of the ports that 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 privileges

- To install on Windows, the person who installs Oracle GoldenGate must log in as Administrator.
- To install on UNIX, the person who installs Oracle GoldenGate must have read and write privileges on the Oracle GoldenGate installation directory.
- The Oracle GoldenGate Extract, Replicat, and Manager processes must operate as an operating system user that has privileges to read, write, and delete files and subdirectories in the Oracle GoldenGate directory. In addition, the Manager process requires privileges to control the other Oracle GoldenGate processes.
- (Classic capture mode) In classic capture mode, the Extract process reads the redo logs directly and must operate as an operating system user that has read access to the log files, both online and archived. On UNIX systems, that user must be a member of the group that owns the Oracle instance. If you install the Manager process as a Windows service during the installation steps in this documentation, you must install as Administrator for the correct permissions to be assigned. If you cannot install Manager as a service, assign read access to the Extract process manually, and then always run Manager and Extract as Administrator.
- Dedicate the Extract, Replicat, and Manager operating system users to Oracle GoldenGate. Sensitive information might be available to anyone who runs an Oracle GoldenGate process, depending on how database authentication is configured.

## Itanium requirements

To install Oracle GoldenGate on a Microsoft Itanium system, the `vc redistrib_1A64.exe` runtime library package must be installed. You can download this package from the Microsoft website. This package includes VisualStudio DLLs necessary for Oracle GoldenGate to operate on the Itanium platform. If these libraries are not installed, Oracle GoldenGate generates the following error.

```
"The application failed to initialize properly (0xc0150002). Click on Ok to terminate the application.
```

## Other 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. For example, on a Windows system with a RHAS 4.0 virtual machine running Oracle11g, you would install the RHAS 4.0 build for Oracle 11g, just as you would on an actual Linux machine.

## Database configuration

- To run Oracle GoldenGate for multiple Oracle instances on a Windows system, you must install an instance of Oracle GoldenGate for each one
- On 64-bit Sun Solaris, HP Tru64 (OSF/1), and LINUX machines with 32-bit Oracle databases, Oracle GoldenGate requires LD\_LIBRARY\_PATH to include the 32-bit Oracle libraries. You will be instructed to set LD\_LIBRARY\_PATH in “Setting library paths for dynamic builds on UNIX” on page 27.
- If the database is configured to use a bequeath connection, the sqlnet.ora file must contain the bequeath\_detach=true setting.
- (Integrated capture mode) Oracle GoldenGate 11.2.1 introduced integrated capture support for Oracle 11.2.0.3 with the [11.2.0.3 Database specific bundle patch for Integrated Extract 11.2.x \(Doc ID 1411356.1\)](#). This mode makes use of a logmining server on the source system or in a downstream Oracle database. For more information, see “Deciding which capture method to use” on page 40.
- Additional database user privileges and configuration requirements are explained elsewhere in this manual.

## Database client

The full Oracle client must be used with Oracle GoldenGate so that the Oracle GoldenGate programs have access to the Oracle XDK libraries. Do not use Oracle Instant Client, which lacks those libraries. You can download the full client from the Oracle website.

## Oracle RAC requirements

To install Oracle GoldenGate in an Oracle Real Application Cluster (RAC) environment, install Oracle GoldenGate on the shared drive(s) that are accessed by the RAC nodes. For more information, see “Preparing to install Oracle GoldenGate within a cluster” on page 28.

## Summary of supported Oracle data types and objects per capture mode

This section contains summary and detail information about the way that Oracle GoldenGate supports the Oracle data types according to the capture mode that you choose. For more information about capture modes, see “Deciding which capture method to use” on page 40.

Detailed support information for Oracle data types, objects, and operations starts with “Details of support for Oracle data types” on page 11.

**Table 1 Supported data types per capture mode**

Data type	Classic capture	Integrated capture
Scalar columns including DATE and DATETIME columns	Captured from redo.	Captured from redo.
Basicfile LOB columns	<ul style="list-style-type: none"> <li>◆ LOB modifications done via DML (INSERT/UPDATE/DELETE) are captured from redo.</li> <li>◆ LOB modifications done via DBMS_LOB package are captured by fetching values from the base table.</li> </ul>	All LOB modifications (done via DML and those done via DBMS_LOB package) are captured from redo.
Securefile LOB	<ul style="list-style-type: none"> <li>◆ Securefile LOBs are only captured from redo if LOBs are not transformed (such as not compressed or encrypted) and stored out of row, and if the modification is done via DML statements.</li> <li>◆ LOBs are fetched from the base table for the following cases:                             <ul style="list-style-type: none"> <li>◆ LOB is encrypted</li> <li>◆ LOB is compressed</li> <li>◆ LOB is stored in-line</li> <li>◆ LOB is modified via DBMS_LOB package</li> <li>◆ LOB is deduplicated</li> <li>◆ LOB is modified via fragment operations</li> <li>◆ NOLOGGING LOBs</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>◆ Securefile LOBs are captured from redo except for the following cases:                             <ul style="list-style-type: none"> <li>◆ LOB is deduplicated</li> <li>◆ LOB is modified via fragment operations</li> <li>◆ NOLOGGING LOBs</li> </ul> </li> <li>◆ LOBs are fetched from the base table for the following cases:                             <ul style="list-style-type: none"> <li>◆ LOB is deduplicated</li> <li>◆ LOB is modified via fragment operations</li> <li>◆ NOLOGGING LOBs</li> </ul> </li> <li>◆ Requires source database COMPATIBLE setting to be 11.2.0.0.0 or higher.</li> </ul>
Index Organized Tables (IOT)	<p>Captured from redo with the following restrictions:</p> <ul style="list-style-type: none"> <li>◆ IOT with mapping table not supported.</li> <li>◆ Direct load inserts to IOT tables cannot have the SORTED clause.</li> </ul>	<ul style="list-style-type: none"> <li>◆ Captured from redo.</li> <li>◆ No restrictions.</li> </ul>
XML stored as CLOB	<ul style="list-style-type: none"> <li>◆ Captured from redo.</li> <li>◆ IOT with prefix compression as specified with COMPRESS clause is not supported.</li> </ul>	<ul style="list-style-type: none"> <li>◆ Captured from redo.</li> <li>◆ Requires source database compatibility to be set to 11.0.0.0.0 or higher.</li> </ul>

**Table 1 Supported data types per capture mode (continued)**

Data type	Classic capture	Integrated capture
XML stored as Binary	Fetches from base table.	<ul style="list-style-type: none"> <li>◆ Captured from redo.</li> <li>◆ Requires source database compatibility to be set to 11.2.0.3.0 or higher.</li> </ul>
XML stored as Object-Relational	Not supported.	<ul style="list-style-type: none"> <li>◆ Captured from redo.</li> <li>◆ Requires source database compatibility to be set to 11.2.0.3.0 or higher.</li> </ul>
XMLType Table	Not supported.	Captured from redo.
ADT (Abstract Data Type)	Fetches from source table.	<ul style="list-style-type: none"> <li>◆ Fetches from source table.</li> <li>◆ Requires source database compatibility to be set to 11.2.0.3.0 or higher.</li> </ul>
Collections (VARRAYs)	Fetches from source table.	<ul style="list-style-type: none"> <li>◆ Fetches from source table.</li> <li>◆ Requires source database compatibility to be set to 11.2.0.0.0 or higher.</li> </ul>
Collections (Nested Tables)	<ul style="list-style-type: none"> <li>◆ Fetches from source table with limitations.</li> <li>◆ See “Details of support for Oracle objects and operations in DML” on page 16</li> </ul>	<ul style="list-style-type: none"> <li>◆ Fetches from source table with limitations.</li> <li>◆ See “Details of support for Oracle objects and operations in DML” on page 16</li> </ul>
Object Table	Fetches from source table.	Fetches from source table.
Transparent Data Encryption (Column Encryption & Tablespace Encryption)	<ul style="list-style-type: none"> <li>◆ Captured from redo.</li> <li>◆ Requires additional setup: See “Capturing Oracle TDE-encrypted data in classic capture mode” on page 73.</li> </ul>	<ul style="list-style-type: none"> <li>◆ Captured from redo.</li> <li>◆ No additional setup is required.</li> <li>◆ Requires source database compatibility to be set to 11.0.0.0.0 or higher.</li> </ul>
Basic Compression	Not supported.	<ul style="list-style-type: none"> <li>◆ Captured from redo.</li> <li>◆ Requires source database compatibility to be set to 11.2.0.0.0 or higher.</li> </ul>

Table 1 Supported data types per capture mode (continued)

Data type	Classic capture	Integrated capture
OLTP-Compression	Not supported.	<ul style="list-style-type: none"> <li>◆ Captured from redo.</li> <li>◆ Requires source database compatibility to be set to 11.2.0.0.0 or higher.</li> </ul>
Exadata Hybrid Columnar Compression	Not supported.	<ul style="list-style-type: none"> <li>◆ Captured from redo.</li> <li>◆ Requires source database compatibility to be set to 11.2.0.0.0 or higher.</li> </ul>
XA on non-RAC database	Captured from redo.	Captured from redo.
XA on RAC database	<ul style="list-style-type: none"> <li>◆ Not supported.</li> <li>◆ To get support, must make sure all branches of XA goes to the same instance.</li> </ul>	<ul style="list-style-type: none"> <li>◆ Captured from redo.</li> <li>◆ Requires source database compatibility to be set to 11.2.0.0.0 or higher.</li> </ul>
PDML on non-RAC database	Captured from redo.	Captured from redo.
PDML on RAC database	<ul style="list-style-type: none"> <li>◆ Not supported.</li> <li>◆ To get support, must make sure child transactions spawned from a PDML transaction does not span multiple instances.</li> </ul>	Captured from redo.

## Details of support for Oracle data types

The following outlines details of Oracle data type support by Oracle GoldenGate. Unless otherwise noted, the support applies to both classic and integrated capture mode. For more information about these modes, see “Configuring Oracle GoldenGate on Oracle source and target databases” on page 38.

### Numeric data types

- NUMBER up to the maximum size permitted by Oracle
- BINARY FLOAT
- BINARY DOUBLE

### Limitations of support

The support of range and precision for floating-point numbers depends on the host machine. In general, the precision is accurate to 16 significant digits, but you should review the database documentation to determine the expected approximations. Oracle GoldenGate rounds or truncates values that exceed the supported precision.

## Character data types

- CHAR
- VARCHAR2
- LONG
- NCHAR
- NVARCHAR2

## Multi-byte character types

- NCHAR and NVARCHAR2 multi-byte character data types
- Multi-byte data stored in CHAR and VARCHAR2 columns

### *Limitations of support*

- For Oracle GoldenGate to support multi-byte character data, the source and target databases must be logically identical in terms of schema definition for the tables and sequences being replicated. Transformation, filtering, and other manipulation are not supported. The character sets between the two databases must be one of the following:
  - Identical, for example SHIFT-JIS on the source and on the target.
  - Equivalent, which is not the same character set but containing the same set of characters, for example SHIFT-JIS and EUC-JP.
  - Target is superset of the source: For example, UNICODE is a superset of all character types, and therefore of any other character set.
- Multi-byte data is supported whether the length semantics are in bytes or characters.

For additional configuration requirements, see “Handling special data types” on page 67.

## Binary data types

- RAW
- LONG RAW

## Date and timestamp data types

- DATE
- TIMESTAMP (see Limitations of support)

### *Limitations of support*

- Oracle GoldenGate does not support negative dates.
- INTERVAL DAY and INTERVAL YEAR are supported only if the size of the target column is equal to, or greater than, that of the source.
- Oracle GoldenGate supports the capture and replication of TIMESTAMP WITH TIME ZONE as a UTC offset (TIMESTAMP '2011-01-01 8:00:00 -8:00').
- TIMESTAMP WITH TIME ZONE as TZR (Region ID) is supported for the replication of data changes, but not for initial loads, for SQLEXEC, or for operations where the column must be fetched from the database. In these cases, the region ID is converted to a time offset by the database when the column is selected. Replicat replicates the timestamp as date and time data with a time offset value.

To support `TIMESTAMP WITH TIME ZONE` specified as `TZR` properly, and also to handle `TIMESTAMP WITH LOCAL TIMEZONE` properly, see the “Handling special data types” on page 67.

## Large object data types

- CLOB
- NCLOB
- BLOB

SECUREFILE and BASICFILE are both supported.

### *Limitations of support - integrated capture mode*

In integrated capture mode, Extract captures SECUREFILE LOBs from the redo logs only when the update is complete, and the LOB is not compressed, encrypted, or deduplicated, and the LOB is stored out-of-row. Extract fetches SECUREFILE LOBs from the database when LOB data is not in the redo log, which occurs when the LOB is created with the `deduplicate`, `no_logging`, or `filesystem_like_logging` options.

### *Limitations of support - classic capture mode*

- BASICFILE LOBs are captured from the redo log regardless of storage, but are fetched from the database in the following circumstances:
  - Extract determines the LOB is invalid.
  - The LOB data is not in the redo log, which occurs when the BASICFILE LOB is created with the `no_logging` option.
  - The LOB is created with the `CACHE` attribute.
  - The LOB is only partially updated. Oracle GoldenGate does not support partial column data. Extract assumes LOB data to be incomplete if the LOB does not start with a LOB reset record, or if the LOB does not start at the first byte and does not end at the last byte, according to the new LOB length. Partial updates can be generated by the following OCI calls: `OCILOBWrite()`, `OCILobAppend()`, `OCILobCopy()`, `OCILobLoadFromFile()`, `OCILobTrim()`, and by updates made through procedures in the `dbms_lob` package.
  - Extract detects an anomaly in the LOB data, such as a missing page number, missing `END MARKER`, or a mismatch between the size that was captured and the expected size.
- SECUREFILE LOBs are captured from the redo logs only when the update is complete and the LOB is not transformed (the column is not compressed or encrypted or deduplicated) and stored out-of-row. SECUREFILE LOBs are fetched from the database in the following circumstances:
  - The LOB is stored in-row.
  - The LOB is transformed either with compression or encryption.
  - The LOB is created with the `CACHE` attribute.
  - Extract determines that a LOB instance is invalid.
  - LOB data is missing from the redo log. This can occur if the LOB is created with any of following options: `deduplicate`, `no_logging`, `filesystem_like_logging`.
  - The LOB is updated using `OCILOBWrite()`, `OCILobAppend()`, `OCILobCopy()`, `OCILobLoadFromFile()`, `OCILobTrim()`, or through procedures in the `dbms_lob` package.

- Any other anomalies as detected by Extract in terms of a missing page number, a missing END MARKER, or a mismatch between the size that was captured and the expected size.
- When changing a SECUREFILE LOB from one storage to another (such as from ENCRYPT to DECRYPT), Oracle updates the whole table, and Extract captures those updates from the log. Therefore, it will appear as though Oracle updated all of the data blocks that are associated with the table. This also can happen when an ALTER TABLE command sets a DEFAULT value to a column that has null values.
- When the size of a large object exceeds 4K, Oracle GoldenGate stores the data in segments within the Oracle GoldenGate trail. The first 4K is stored in the base segment, and the rest is stored in a series of 2K segments. Oracle GoldenGate does not support the filtering, column mapping, or manipulation of large objects of this size. Full Oracle GoldenGate functionality can be used for objects that are 4K or smaller.

For additional setup requirements, see “Handling special data types” in Chapter 5.

### XML data types

- In integrated capture mode, Oracle GoldenGate supports XMLType columns and XMLType tables stored as XML CLOB, XML Object Relational, and XML Binary.
- In classic capture mode, Oracle GoldenGate supports XMLType columns and XMLType tables stored as XML CLOB and XML Binary.

#### *Limitations of support - integrated and classic capture modes*

- The source and target objects that contain the XML must be identical. Filtering and manipulation are not supported. You can map the XML representation of an object to a character column by means of a COLMAP clause in a TABLE or MAP statement.
- The following are not supported:
  - Hierarchy-enabled tables (these are managed by the Oracle XML database repository.)
  - XMLType tables created from a CTAS (CREATE TABLE AS SELECT) statement that populates the table. Assuming DDL support is enabled, Oracle GoldenGate replicates the CTAS statement and allows it to select the data from the underlying target table(s). The original inserts are not replicated. For XMLType tables, the row object IDs must match between source and target, which cannot be maintained when Replicat uses logical SQL statements. XMLType tables created by an empty CTAS statement (that does not insert data in the new table) can be maintained correctly.
  - XMLType tables with primary key-based object identifiers (OID)
  - Non-XMLType tables with a single XML column
  - SQL\*Loader direct-path insert for XML Binary and XML Object Relational
- XMLSchema-based XMLType tables and columns are supported, but changes made to XMLSchemas are not replicated and must be registered on both source and target databases with the dbms\_xml package.
- Supported tables must have at least one unique key constraint that is made up of scalar columns, or the combination of all scalar columns must guarantee uniqueness. Extract or Replicat cannot use unique or primary key constraints made up of XML attributes for row identification purposes.



**Limitations of support - integrated capture mode**

- The Oracle database must be release 11.2.0.3 or higher, and Extract must be configured in integrated capture mode.
- The maximum length for the entire SET value of an update to an XMLType is 32K, including the new content plus other operators and XQuery bind values.

**Limitations of support - classic capture mode**

- Oracle GoldenGate treats XMLType data as a LOB.
- For XML Binary, Oracle GoldenGate fetches additional row data from the source database because the redo log does not contain enough information. Because the fetched data is not part of the original transaction, it may lead to inconsistency.
- A table that contains XMLType columns must have one of the following: a primary key, column(s) with a unique constraint, or a unique index.

See “Handling special data types” on page 67 for additional information about replicating XML.

**User defined or abstract types**

Oracle GoldenGate supports user defined types (UDT) or abstract data types (ADT) when the source and target objects have the same structure. The schema names can be different.

**General limitations of support - integrated and classic capture modes**

- Because a UDT must be fetched, a table that contains one must have one of the following: a primary key, column(s) with a unique constraint, or a unique index.
- Oracle GoldenGate does not support UDTs with the following embedded scalar types: CLOB, CFILE, BFILE, or INTERVAL\_YM, INTERVAL\_DS, and OPAQUE (with the exception of XMLType, which is supported).
- Object or relational tables where the key contains a UDT, or where a UDT is the only column, are not supported.
- The RMTTASK parameter does not support user-defined types (UDT).
- CHAR and VARCHAR attributes that contain binary or unprintable characters are not supported.
- UDTs, including values inside object columns or rows, cannot be used within filtering criteria in TABLE or MAP statements, or as input or output for the Oracle GoldenGate column-conversion functions, SQLEXEC, or other built-in data-manipulation tools. Support is only provided for like-to-like Oracle source and targets.
- Oracle GoldenGate does not support REF types.

For additional setup requirements, see “Handling special data types” in Chapter 5.

**Limitations for collection types - integrated and classic capture modes**

- When data in a nested table is updated, the row that contains the nested table must be updated at the same time.
- When VARRAYS and nested tables are fetched, the entire contents of the column are fetched each time, not just the changes.

**Limitations for object tables- - integrated and classic capture modes**

- Oracle GoldenGate supports object tables in uni-directional and active-active configurations. Object tables are captured from the redo log, but certain data types that are fetched from the database when in regular relational tables, such as LOBs and collection types, are also fetched when in object tables. Similarly, current limitations that apply to collection types when in regular tables also apply to these types when in object tables.
- An Oracle object table can be mapped to a non-Oracle object table in a supported target database.
- A primary key must be defined on the root-level object attributes of the object table, and cannot include leaf-level attributes. If no key is defined, Oracle GoldenGate will use all viable columns as a pseudo-key.
- Oracle GoldenGate does not support the replication of DDL operations for an object table. This limitation includes the database object versioning that is associated with ALTERs of object tables.
- Synonyms are not supported for object tables or relational tables that contain object tables.

**Limitations for spatial types - integrated and classic capture modes**

- Oracle GoldenGate supports SDO\_GEOMETRY, SDO\_TOPO\_GEOMETRY, and SDO\_GEORASTER (raster tables).

See additional configuration information in “Handling special data types” on page 67.

**Non-supported Oracle data types**

- Abstract data types (ADT) with scalar, LOBs, VARRAYS, nested tables, and/or REFsANYDATA
- ANYDATASET
- ANYTYPE
- BFILE
- MLSLABEL
- ORDDICOM
- ROWID
- TIMEZONE\_ABBR
- URITYPE
- UROWID

See additional exclusions in the *Limitations of support* sections in “Summary of supported Oracle data types and objects per capture mode” on page 8.

## Details of support for Oracle objects and operations in DML

This section outlines the Oracle objects and operations that Oracle GoldenGate supports for the capture and replication of DML operations.

### Tables, views, and materialized views

Oracle GoldenGate supports the following DML operations made to regular tables, index-

organized tables, clustered tables, and materialized views.

- INSERT
- UPDATE
- DELETE
- Associated transaction control operations

#### **Limitations of support for regular tables**

These limitations apply to integrated and classic capture modes.

- Oracle GoldenGate supports tables that contain any number of rows up to 2 MB in length. Each character LOB/LONG column contributes up to 4 KB to this limit, and each binary LOB column contributes up to 8 KB. This row-size limitation mostly affects update operations on columns that are being used as a row identifier. This identifier can be a primary or unique key, a key defined within the Oracle GoldenGate parameter file, or all of the columns if no key is defined. If a row identifier is updated, the 2 MB length must include not only the after image, but also the full before image, which is required to find the correct key on the target for the update.
- Oracle GoldenGate supports the maximum number of columns per table that is supported by the database.
- Oracle GoldenGate supports the maximum column size that is supported by the database.
- Oracle GoldenGate supports tables that contain only one column, except when the column contains one of the following data types:
  - LOB
  - LONG
  - Nested table
  - User defined data type
  - VARRAY
  - XML
- Oracle GoldenGate supports tables with unused columns, but the support is disabled by default, and Extract abends on them. See “Handling other database properties” on page 70.
- Oracle GoldenGate supports tables with these partitioning attributes:
  - Range partitioning
  - Hash Partitioning
  - Interval Partitioning
  - System Partitioning
  - Composite Partitioning
  - Virtual Column-Based Partitioning
  - Reference Partitioning
  - List PartitioningSee “Handling other database properties” on page 70.
- Oracle GoldenGate supports tables with virtual columns, but does not capture change data for these columns or apply change data to them: The database does not write virtual columns to the transaction log, and the Oracle database does permit DML on

virtual columns. For the same reason, initial load data cannot be applied to a virtual column. You can map the data from virtual columns to non-virtual target columns. See “Handling other database properties” on page 70.

- Oracle GoldenGate ignores any virtual column that is part of a unique key or index. If a virtual column is the only unique identifier for a table, Oracle GoldenGate uses all of the remaining columns for row identification, so it is possible that the wrong target rows could be deleted or updated if the remaining columns do not enforce uniqueness.
- Oracle GoldenGate supports replication to and from Oracle Exadata. See “Using Oracle GoldenGate with Oracle Exadata” on page 71.
- Oracle GoldenGate supports Transparent Data Encryption (TDE). For integrated capture, the source database must be Oracle version 11.1.0 with compatibility setting of 11.0.0.0 or higher. Column-level encryption is supported for all versions of Oracle 10.2.0.5, 11.1, and 11.2. Tablespace-level encryption is supported for all versions of Oracle 10.2.0.5 and 11.2.0.1. TDE is supported without setup requirements in integrated capture mode. TDE in classic capture mode requires some setup. See page 73.
- Oracle GoldenGate supports TRUNCATE statements as part of its DDL replication support, or as standalone functionality that is independent of the DDL support. See “Handling other database properties” on page 70.
- Oracle GoldenGate supports the capture of direct-load INSERTs. Supplemental logging must be enabled, and the database must be in archive log mode. The following direct-load methods are supported.
  - /\*+ APPEND \*/ hint
  - /\*+ PARALLEL \*/ hint (Non-RAC only in classic capture mode)
  - SQLLDR with DIRECT=TRUE
- Oracle GoldenGate fully supports basic, advanced, and EHCC compressed tables in integrated capture mode. In classic capture mode, Oracle GoldenGate can deliver to, but not capture from, regular and EHCC compressed tables on Oracle Exadata. See “Handling other database properties” on page 70.
- Oracle GoldenGate supports XA and PDML distributed transactions in integrated capture mode.

#### ***Limitations of support for index-organized tables***

These limitations apply to classic capture mode.

- IOT with a mapping table is not supported in classic capture mode. The DDL for an IOT with mapping table will be replicated correctly, but subsequent DML on it will fail. This limitation applies to integrated and classic capture modes.
- IOT with key compression enabled (indicated by the COMPRESS keyword in the key\_compression clause) is not supported in classic capture mode, but is supported in integrated capture mode.

#### ***Limitations of support for views***

These limitations apply to integrated and classic capture modes.

- Oracle GoldenGate does not capture from a view, but it supports capture from the underlying tables of a view.

- Oracle GoldenGate can replicate to a view as long as the view is inherently updatable. The structures of the source tables and a target view must be identical.

See configuration requirements for views in “Handling other database properties” on page 70.

#### ***Limitations of support for materialized views***

These limitations apply to integrated and classic capture modes.

- Materialized views created WITH ROWID are not supported.
- The materialized view log can be created WITH ROWID.
- The source table must have a primary key.
- Truncates of materialized views are not supported. You can use a DELETE FROM statement.
- Some Oracle GoldenGate initial-load methods do not support LOBs in a materialized view.
- For Replicat, the materialized view must be updateable.
- DML (but not DDL) from a full refresh of a materialized view is supported. If DDL support for this feature is required, open an Oracle GoldenGate support case.

#### ***Limitations of support for clustered tables***

Indexed and hash clusters are both supported in both integrated and classic capture modes, but in classic capture mode the following limitations apply:

- Encrypted and compressed clustered tables are not supported in classic capture.
- Extract in classic capture mode captures DML changes made to index clustered tables if the cluster size remains the same. Any DDL that causes the cluster size to increase or decrease may cause Extract to capture subsequent DML on that table incorrectly.

## **Sequences**

These limitations apply to integrated and classic capture modes.

- Oracle GoldenGate supports the replication of sequence values in a uni-directional and active-passive high-availability configuration.
- Oracle GoldenGate does not support the replication of sequence values in an active-active bi-directional configuration.
- Oracle GoldenGate ensures that the target sequence values will always be higher than those of the source (or equal to them, if the cache is 0).

See configuration requirements in “Handling other database properties” on page 70.

#### ***Limitations of support for sequences***

These limitations apply to integrated and classic capture modes.

- The cache size and the increment interval of the source and target sequences must be identical. The cache can be any size, including 0 (NOCACHE).
- The sequence can be set to cycle or not cycle, but the source and target databases must be set the same way.

## Non-supported objects and operations in Oracle DML

Non-supported in both capture modes:

- REF
- Sequence values in an active-active bi-directional configuration
- Database Replay
- Tables created as EXTERNAL

Non-supported in classic capture mode only:

- Exadata Hybrid Columnar Compression
- Capture from tables with OLTP table compression
- Capture from tablespaces and tables created or altered with COMPRESS
- Capture from encrypted and compressed clustered tables
- Synonyms
- Distributed transactions
- XA and PDML distributed transactions
- Materialized views created WITH ROWID
- Truncates of materialized views

## Details of support for objects and operations in Oracle DDL

This section outlines the Oracle objects and operation types that Oracle GoldenGate supports for the capture and replication of DDL operations.

### Supported objects and operations in Oracle DDL

These statements apply to integrated and classic capture modes.

- All Oracle GoldenGate topology configurations are supported for Oracle DDL replication.
- Active-active (bi-directional) replication of Oracle DDL is supported between two (and only two) databases that contain identical metadata.
- Oracle GoldenGate supports DDL operations of up to 2 MB in size on the following objects:
  - clusters
  - functions
  - indexes
  - packages
  - procedure
  - tables
  - tablespaces
  - roles
  - sequences
  - synonyms
  - triggers

- types
- views
- materialized views
- users

The 2 MB size limitation includes packages, procedures, and functions.

**NOTE** The actual size limit of the DDL support is approximate, because the size will not only include the statement text but also Oracle GoldenGate maintenance overhead that depends on the length of the object name, the DDL type, and other characteristics of keeping a DDL record internally.

See the Oracle GoldenGate *Windows and UNIX Administrator's Guide* for specific support guidelines, support limitations, and configuration instructions.

## Non-supported objects and operations in Oracle DDL

These statements apply to integrated and classic capture modes.

### *Oracle-reserved schemas*

The following schema names are considered Oracle-reserved and must be excluded from the Oracle GoldenGate DDL configuration. Oracle GoldenGate will ignore these schemas.

- ANONYMOUS
- AURORA
- \$JIS
- \$UTILITY
- \$AURORA
- \$ORB
- \$UNAUTHENTICATED
- CTXSYS
- DBSNMP
- DMSYS
- DSSYS
- EXFSYS
- MDSYS
- ODM
- ODM\_MTR
- OLAPSYS
- ORDPLUGINS
- ORDSYS
- OSE\$HTTP\$ADMIN
- OUTLN
- PERFSTAT
- PUBLIC
- REPADMIN

- SYS
- SYSMAN
- SYSTEM
- TRACESVR
- WKPROXY
- WKSYS
- WMSYS
- XDB

**Other non-supported DDL**

Oracle GoldenGate does not support the following:

- ALTER TABLE ... MOVE TABLESPACE
- DDL on nested tables
- ALTER DATABASE and ALTER SYSTEM (these are not considered to be DDL)
- DDL on a standby database

In addition, classic capture mode does not support DDL that involves password-based column encryption, such as:

- CREATE TABLE t1 ( a number, b varchar2(32) ENCRYPT IDENTIFIED BY my\_password);
- ALTER TABLE t1 ADD COLUMN c varchar2(64) ENCRYPT IDENTIFIED BY my\_password;

## Supported and non-supported object names

For information about Oracle GoldenGate support for object names and case, see “Mapping and manipulating data” in the Oracle GoldenGate *Windows and UNIX Administrator's Guide*.



## CHAPTER 2

# Installing Oracle GoldenGate

.....

These instructions are for installing Oracle GoldenGate for the first time. To upgrade Oracle GoldenGate from one version to another, follow the instructions on:

<http://www.oracle.com/technology/software/products/goldengate/index.html>

Installing Oracle GoldenGate installs all of the components that are required to run and manage the processing (excluding 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.

## Installation overview

To install Oracle GoldenGate, the following steps are required:

[Downloading Oracle GoldenGate](#)

[Setting ORACLE\\_HOME and ORACLE\\_SID](#)

[Setting library paths for dynamic builds on UNIX](#)

[Preparing to install Oracle GoldenGate within a cluster](#)

[Installing Oracle GoldenGate on Linux and UNIX](#)

[Installing Oracle GoldenGate on Windows](#)

[Integrating Oracle GoldenGate into a cluster](#)

[Installing support for Oracle sequences](#)

## Downloading Oracle GoldenGate

Download the appropriate Oracle GoldenGate build to each system that will be part of the Oracle GoldenGate configuration.

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**.

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 Media Pack that you want to download.
  - 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. Review the readme file for known issues.

## Setting ORACLE\_HOME and ORACLE\_SID

Make certain that the ORACLE\_HOME and ORACLE\_SID system environment variables are set to the correct Oracle instance. The Oracle GoldenGate processes refer to them when connecting to the database.

### To specify Oracle variables on UNIX-based systems

- If there is one instance of Oracle on the system, set ORACLE\_HOME and ORACLE\_SID at the system level. If you cannot set them that way, use the following SETENV statements in the parameter file of every Extract and Replicat group that will be connecting to the instance.

```
SETENV (ORACLE_HOME = "<path to Oracle home location>")  
SETENV (ORACLE_SID = "<SID>")
```

The SETENV parameters override the system settings and allow the Oracle GoldenGate process to set the variables at the session level when it connects to the database.

- If there are multiple Oracle instances on the system with Extract and Replicat processes connecting to them, you will need to use a SETENV statement in the parameter file of each process group and point it to the correct instance. For example, the following shows parameter files for two Extract groups, each capturing from a different Oracle instance.

#### Group 1:

```
EXTRACT ora9a  
SETENV (ORACLE_HOME = "/home/oracle/ora9/product")  
SETENV (ORACLE_SID = "ora9a")  
USERID ggsa, PASSWORD ggsa  
RMTHOST sysb  
RMTTRAIL /home/ggs/dirdat/rt  
TABLE hr.emp;  
TABLE hr.salary;
```

**Group 2:**

```
EXTRACT ora9b
SETENV (ORACLE_HOME = "/home/oracle/ora9/product")
SETENV (ORACLE_SID = "ora9b")
USERID ggsb, PASSWORD ggsb
RMTHOST sysb
RMTTRAIL /home/ggs/dirdat/st
TABLE fin.sales;
TABLE fin.cust;
```

**To specify Oracle variables on Windows systems**

- If there is one instance of Oracle on the system, the Registry settings for ORACLE\_HOME and ORACLE\_SID should be sufficient for Oracle GoldenGate. If those settings are incorrect in the Registry and cannot be changed, you can set an override as follows.
  - On the desktop or Start menu (depending on the Windows version), right-click **My Computer**, and then select **Properties**.
  - In **Properties**, click the **Advanced** tab.
  - Click **Environment Variables**.
  - Under **System Variables**, click **New**.
  - For **Variable Name**, type ORACLE\_HOME.
  - For **Variable Value**, type the path to the Oracle binaries.
  - Click **OK**.
  - Click **New** again.
  - For **Variable Name**, type ORACLE\_SID.
  - For **Variable Value**, type the instance name.
  - Click **OK**.
- If there are multiple Oracle instances on the system with Extract and Replicat processes connecting to them, do the following.
  - Use the preceding procedure (single Oracle instance on system) to set the ORACLE\_HOME and ORACLE\_SID system variables to the first Oracle instance.
  - Start all of the Oracle GoldenGate processes that will connect to that instance.
  - Repeat the procedure for the next Oracle instance, but first **Edit** the existing ORACLE\_HOME and ORACLE\_SID variables to specify the new information.
  - Start the Oracle GoldenGate processes that will connect to that instance.
  - Repeat the **Edit** and startup procedure for the rest of the Oracle instances.

## Setting library paths for dynamic builds on UNIX

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.

When Oracle GoldenGate is running on the same server as the database, all of the following must have the same bit type, either all 32-bit, all 64-bit, or all IA64:

- Oracle library versions
- Oracle GoldenGate version
- Database versions

When Oracle GoldenGate connects remotely to the database server through SQL\*Net, the following are required:

- Replicat: The Oracle client library and the Oracle GoldenGate build must have the same Oracle version, bit type (32-bit, 64-bit, IA64), and operating system version.
- Extract: The Oracle client library and the Oracle GoldenGate build must have the same Oracle version, bit type (32-bit, 64-bit, IA64), and operating system version. In addition, both operating systems must be the same endian.

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 /users/ogg, the second command in the following example requires these variables to be set:

Command	Requires GG libraries in environment variable?
\$ users/ogg > ./ggsci	No
\$ users > ./ogg/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>
```

**To set the variables in Bourne shell**

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

**To set the variables in C shell**

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

**Where:** <shared libraries variable> is one of the following:

**UNIX/Linux library path variables per platform**

Platform	Environment variable
IBM AIX	LIBPATH
HP-UX	SHLIB_PATH
Sun Solaris	LD_LIBRARY_PATH <sup>1</sup>
HP Tru64 (OSF/1)	
LINUX	

<sup>1</sup> In 64-bit environments with 32-bit Oracle databases, Oracle GoldenGate requires the LD\_LIBRARY\_PATH to include the 32-bit Oracle libraries.

**Example**     `export LD_LIBRARY_PATH=/ggs/10.0:$LD_LIBRARY_PATH`

**NOTE**     To view the libraries that are required by an Oracle GoldenGate process, use the `ldd <process>` shell command before starting the process. This command also shows an error message for any that are missing.

## Preparing to install Oracle GoldenGate within a cluster

This topic covers the installation requirements that apply when Oracle GoldenGate will be installed in a cluster environment. Oracle GoldenGate can be used with any cluster-management solution that is Oracle-certified. The *Oracle Clusterware* solution provides the advantage of being able to be used with or without an Oracle RAC database, which enables you to include any non-database servers that are running Oracle GoldenGate.

### Installing as the Oracle user

To install into an Oracle cluster, install as the Oracle operating system user.

### Supported Oracle cluster storage

You will need to install at least some Oracle GoldenGate objects on shared storage. Select cluster-aware shared storage that is independent of, but available to, all nodes of the cluster. You can use any of the following:

- Oracle Cluster File System (OCFS). Instead of installing Oracle GoldenGate in a local directory, install it in a directory that is mounted to an OCFS volume. See the OCFS2 documentation for configuration information.
- Oracle Automatic Storage Management System (AFS). If using classic capture, see setup requirements in “Capturing from an Oracle ASM instance when in classic capture mode” on page 77.
- Oracle Automatic Storage Management Cluster File System (ACFS) in Oracle .
- Oracle Database Filesystem (DBFS). Do not install Oracle GoldenGate on DBFS, but you can store the subdirectories (that are created with `CREATE SUBDIRS` during installation) in a DBFS cluster that is only mounted to one server at a time. For requirements in high-availability, see “Preparing DBFS for active-active propagation with Oracle GoldenGate” on page 158.

## Deciding where to install Oracle GoldenGate binaries and files in the cluster

The best practice is to install Oracle GoldenGate entirely on shared storage. This allows you to start the Oracle GoldenGate processes from any of the nodes without having to make changes to the parameter files. If the active node fails, the processes can be started quickly on another node, using the processing checkpoints that are preserved in the installation directory.

If you decide to install the Oracle GoldenGate binaries and files on each node, rather than on shared storage, the following must be true:

- The Oracle GoldenGate installation must have the same location path on every node
- At minimum, install the following directories on the shared storage to support Oracle GoldenGate recovery requirements. On UNIX or Linux, you can create symbolic links to them from the installation directory on each node.
  - br
  - dirchk
  - dirdat
  - dirtmp

These directories are among those created when you issue `CREATE SUBDIRS` during installation.

- The parameter files in the `dirprm` directory, if not placed on the shared drive, must be identical on all nodes. To resolve environment settings that must be different from one node to the other, you can set environment settings so they are inherited from the local Manager process or reference a node-specific Oracle GoldenGate macro file. Because this scenario can be difficult to enforce, the inherent concerns can be avoided by storing the parameter files on the shared drive.

See also “Integrating Oracle GoldenGate into a cluster” on page 31 after you install Oracle GoldenGate.

## Installing Oracle GoldenGate on Linux and UNIX

Follow these steps to install Oracle GoldenGate for Oracle on a Linux or UNIX system or in the appropriate location in a cluster. See “Preparing to install Oracle GoldenGate within a cluster” on page 27 for more information.

### Installing the Oracle GoldenGate files

1. Extract the Oracle GoldenGate `mediapack.zip` file to the system and directory where you want Oracle GoldenGate to be installed.
2. Run the command shell.
3. Change directories to the new Oracle GoldenGate directory.
4. From the Oracle GoldenGate directory, run the GGSCI program.

```
GGSCI
```

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

```
CREATE SUBDIRS
```

6. Issue the following command to exit GGSCI.

```
EXIT
```

## Installing Oracle GoldenGate on Windows

Follow these steps to install Oracle GoldenGate for Oracle on a Windows system or in the appropriate location in a cluster. See “Preparing to install Oracle GoldenGate within a cluster” on page 27 for more information.

### Installing Oracle GoldenGate into a Windows Cluster

1. Log into one of the nodes in the cluster.
2. Choose a drive for the Oracle GoldenGate installation location. This drive must be a resource within the same cluster group that contains the database instance.
3. Ensure that this cluster 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” is not valid.
```

```
C:\Oracle_GoldenGate is valid.
```

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. Each Manager on a system must have a unique name. Before proceeding further, note 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
```

**NOTE** The ./ portion of this command must be used, because the GLOBALS file must reside at the root of the Oracle GoldenGate installation file.

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 used 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 2**    **INSTALL options**

Option	Description
ADDEVENTS	<p>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.</p> <pre>category.dll ggsmg.dll</pre>



**Table 2**    **INSTALL options (continued)**

Option	Description
ADDSERVICE	<p>Adds Manager as a service with the name that is specified with the MGRSERVNAME parameter 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.<sup>1</sup></p> <p>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.</p>
AUTOSTART	Sets the service that is created with ADDSERVICE to start at system boot time. This is the default unless MANUALSTART is used.
MANUALSTART	Sets the service that is created with ADDSERVICE to start manually through GGSCI, a script, or the Services applet of the Control Panel. The default is AUTOSTART.
USER <name>	<p>Specifies a domain user account that executes Manager. For &lt;name&gt;, include the domain name, a backward slash, and the user name, for example HEADQT\GGSMGR.</p> <p>By default, the Manager service is installed to use the Local System account.</p>
PASSWORD <password>	Specifies the password for the user that is specified with USER.

---

<sup>1</sup> 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 triggers a prompt.

## Integrating Oracle GoldenGate into a cluster

If you installed Oracle GoldenGate in a cluster, take the following steps to integrate Oracle GoldenGate within the cluster solution.

## General requirements in a cluster

1. Register the Oracle GoldenGate Manager process (and only Manager) as a cluster-managed resource as you would any other application. Manager must be the only Oracle GoldenGate process that the cluster-management software starts and stops, because it is the parent process that manages all other processes.
2. If the cluster uses a virtual IP address (such as Oracle Clusterware), you may need to obtain an available fixed IP address for the Manager process. The VIP must be an available IP address on the public subnet and cannot be determined through DHCP. In the parameter files of the Extract data pumps, specify the VIP of the remote Manager as the input value of the RMTHOST parameter. Other Oracle GoldenGate products that access Manager also should use the VIP.
3. (Oracle databases earlier than version 10.2) Make certain that all nodes in the cluster have synchronized system clocks. The clocks must be synchronized with the clock on the system where Extract is executed. Oracle GoldenGate compares the time of the local system to the commit timestamps to make critical decisions. For information about synchronizing system clocks, consult [www.ntp.org](http://www.ntp.org) or your systems administrator. See also the IOLATENCY option of the THREADOPTIONS parameter in the *Oracle GoldenGate Windows and UNIX Reference Guide*. This is not a requirement for integrated capture.
4. Make certain that all nodes in the cluster have the same COMPATIBLE parameter setting.
5. When you configure Manager, add the AUTOSTART and AUTORESTART parameters so that Manager starts the replication processes automatically (see “Creating the Oracle GoldenGate instance” on page 46). You can, when needed, control Extract, Replicat, and other Oracle GoldenGate processes from within the Oracle GoldenGate user interfaces.
6. Mount the shared drive on one node only. This prevents processes from being started on another node. Use the same mount point on all nodes.
7. Configure Oracle GoldenGate as directed in this documentation.

## Adding Oracle GoldenGate as a Windows cluster resource

When installing Oracle GoldenGate in a Windows cluster, follow these instructions to establish Oracle GoldenGate as a cluster resource and configure the Manager service correctly on all nodes.

- In the cluster administrator, add the Manager process to the group that contains the database instance to which Oracle GoldenGate will connect.
- Make sure all nodes on which Oracle GoldenGate will run are selected as possible owners of the resource.
- Make certain the Manager Windows service has the following dependencies (configurable from the Services control panel):
  - The database resource
  - The disk resource that contains the Oracle GoldenGate directory
  - The disk resource that contains the database transaction log files
  - The disk resource that contains the database transaction log backup files

## Installing support for Oracle sequences

To support Oracle sequences, you must install some database procedures. These procedures support the Oracle GoldenGate `FLUSH SEQUENCE` command, which you issue immediately after you start the Oracle GoldenGate processes for the first time (typically when you perform the initial data synchronization procedure).

You will perform steps on the **source** and **target** systems.

### To install Oracle sequence objects

1. In SQL\*Plus, connect to the source and target Oracle systems as SYSDBA.
2. If you already assigned a database user to support the Oracle GoldenGate DDL replication feature, you can skip this step. Otherwise, in SQL\*Plus on both systems create a database user that can also be the DDL user.

```
CREATE USER DDLuser IDENTIFIED BY password;  
GRANT CONNECT,RESOURCE,DBA TO DDLuser;
```
3. From the Oracle GoldenGate installation directory on each system, run GGSCI.
4. In GGSCI, issue the following command on each system.

```
EDIT PARAMS ./GLOBALS
```
5. In each GLOBALS file, enter the GGSHEMA parameter and specify the schema of the DDL user that you created earlier in this procedure.

```
GGSHEMA <schema>
```
6. Save and close the files.
7. In SQL\*Plus on both systems, run the `sequence.sql` script from the root of the Oracle GoldenGate installation directory. This script creates some procedures for use by Oracle GoldenGate processes. (Do not run them yourself.) You are prompted for the user information that you created in the first step.

```
@sequence.sql
```
8. In SQL\*Plus on the source system, grant EXECUTE privilege on the `updateSequence` procedure to a database user that can be used to issue the `DBLOGIN` command. Remember or record this user. You use `DBLOGIN` to log into the database prior to issuing the `FLUSH SEQUENCE` command, which calls the procedure.

```
GRANT EXECUTE on DDLuser.updateSequence TO DBLOGINuser;
```
9. In SQL\*Plus on the target system, grant EXECUTE privilege on the `replicateSequence` procedure to the Replicat database user.

```
GRANT EXECUTE on DDLuser.replicateSequence TO Replicatuser;
```
10. In SQL\*Plus on the source system, issue the following statement in SQL\*Plus.

```
alter table sys.seq$ add supplemental log data (primary key) columns;
```

CHAPTER 3

# Installing Oracle GoldenGate DDL support for an Oracle database

.....

This chapter contains instructions for installing the objects that support DDL replication. To configure Oracle GoldenGate to capture and replicate DDL, see Chapter 7 on page 85.

**NOTE** DDL support for sequences (CREATE, ALTER, DROP, RENAME) is compatible with, but not required for, replicating the sequence values themselves. To replicate just sequence values, you *do not* need to install the Oracle GoldenGate DDL support environment. You can just use the SEQUENCE parameter.

## Overview of the DDL objects

To install the Oracle GoldenGate DDL environment, you will be installing the database objects shown in Table 3.

Table 3 DDL synchronization objects

Object	Purpose	Default name
DDL marker table	Stores DDL information. This table only receives inserts.	GG_MARKER
Sequence on marker table	Used for a column in the marker table.	GG_DDL_SEQ
DDL history table	Stores object metadata history. This table receives inserts, updates, deletes.	GG_DDL_HIST
Object ID history table	Contains object IDs of configured objects.	GG_DDL_HIST_ALT
DDL trigger	Fires on DDL operations. Writes information about the operation to the marker and history tables. Installed with the trigger are some packages.	GG_DDL_TRIGGER_BEFORE
DDL schema	Contains the DDL synchronization objects.	None; must be specified during installation and in the GLOBALS file.

**Table 3 DDL synchronization objects (continued)**

Object	Purpose	Default name
User role	Establishes the role needed to execute DDL operations.	GGG_GGSUSER_ROLE
Internal setup table	Database table for internal use only.	GGG_SETUP
ddl_pin	Pins DDL tracing, the DDL package, and the DDL trigger for performance improvements.	ddl_pin
ddl_cleartrace.sql	Removes the DDL trace file.	ddl_cleartrace.sql
ddl_status.sql	Verifies that the Oracle GoldenGate DDL objects are installed	ddl_status.sql
marker_status.sql	Verifies that the marker table is installed.	marker_status.sql
ddl_tracelevel.sql	Sets the level for DDL tracing.	ddl_tracelevel.sql

## Installing the DDL objects

1. Choose an Oracle GoldenGate schema or another schema for the DDL objects. This schema cannot be case-sensitive.
2. Grant the following permission on the Oracle GoldenGate schema.  

```
GRANT EXECUTE ON utl_file TO <schema>;
```
3. Choose a tablespace for the DDL objects that can accommodate the growth of the GGS\_DDL\_HIST and GGS\_MARKER tables. The GGS\_DDL\_HIST table, in particular, will grow in proportion to overall DDL activity. If the tablespace that contains these objects fills up, no DDL operations can be issued on the database, and the business applications will pause.
4. Open the GLOBALS file in the home directory of this instance of Oracle GoldenGate. If a GLOBALS file does not exist, create one. For information on creating or editing a GLOBALS file, see the Oracle GoldenGate *Windows and UNIX Administrator's Guide*.
5. Specify the name of the DDL schema by adding the following parameter to the GLOBALS file.  

```
GGSCHEMA <schema_name>
```
6. (Optional) To change the names of other objects listed in Table 3, *the changes must be made now, before proceeding with the rest of the installation. Otherwise, you will need to stop Oracle GoldenGate DDL processing and reinstall the DDL objects.* It is recommended that you accept the default names of the database objects. To change any name in Table 3 (except the schema), do one or both of the following:

- Record all name changes in the params.sql script. Edit this script and change the appropriate parameters. Do not run this script.
- List the names shown in Table 4 in the GLOBALS file. The correct parameters to use are listed in the Parameter column of the table.

**Table 4** GLOBALS parameters for changing DDL object names

Object	Parameter
Marker table	MARKERTABLE <new_table_name> <sup>1</sup>
History table	DDLTABLE <new_table_name>

<sup>1</sup> Do not qualify the name of any of these tables. The schema name for these table must be either the one that is specified with GGSCHEMA or the schema of the current user, if GGSCHEMA is not specified in GLOBALS.

7. Change directories to the Oracle GoldenGate installation directory.
8. Exit all Oracle sessions, including those of SQL\*Plus, those of business applications, those of the Oracle GoldenGate processes, and those of any other software that uses Oracle. Prevent the start of any new sessions.
9. Run SQL\*Plus and log in as a user that has SYSDBA privilege. This privilege is required to install the DDL trigger in the SYS schema, which is required by Oracle. All other DDL objects are installed in the schema that you created in step 1.

10. Run the marker\_setup.sql script.

```
@marker_setup.sql
```

- Supply the name of the Oracle GoldenGate schema when prompted, and then press **Enter** to execute the script.
- This script installs support for the Oracle GoldenGate DDL marker system.

Run the ddl\_setup.sql script. You are prompted to specify the name of the DDL schema from step 1.

```
@ddl_setup.sql
```

11. Run the role\_setup.sql script.

```
@role_setup.sql
```

- At the prompt, supply the DDL schema name.
- The script drops and creates the role that is needed for DDL synchronization, and it grants DML permissions on the Oracle GoldenGate DDL objects.

12. Grant the role that was created (default name is GGS\_GGSUSER\_ROLE to all Oracle GoldenGate Extract users. You may need to make multiple grants if the processes have different user names.

```
GRANT <role> TO <user>;
```

13. Run the ddl\_enable.sql script to enable the DDL trigger.

```
@ddl_enable.sql
```

**To install and use the optional performance tool**

To improve the performance of the DDL trigger, make the `ddl_pin` script part of the database startup. It must be invoked with the Oracle GoldenGate DDL user name, as in:

```
@ddl_pin <DDL_user>
```

This script pins the PL/SQL package that is used by the trigger into memory. If executing this script from SQL\*Plus, connect as SYSDBA from the Oracle GoldenGate installation directory. This script relies on the Oracle `dmbs_shared_pool` system package, so install that package before using `ddl_pin`.

## CHAPTER 4

# Configuring Oracle GoldenGate on Oracle source and target databases

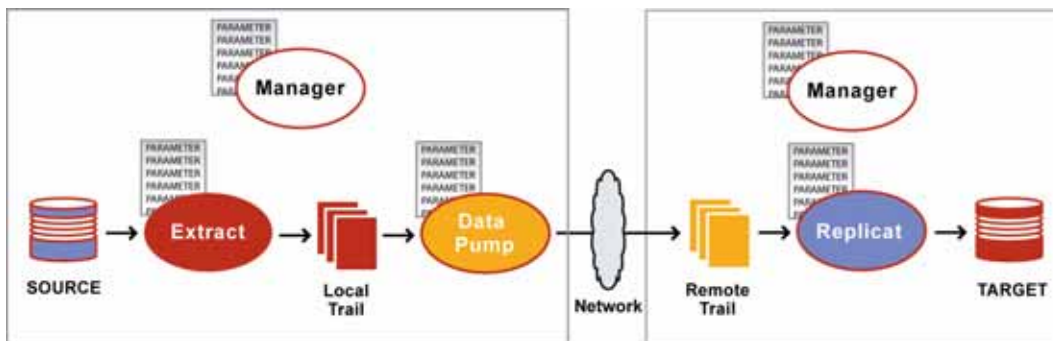
.....

This chapter contains instructions for configuring Oracle GoldenGate to capture source Oracle data and apply it to a target Oracle database.

## What to expect from this procedure

These instructions show you how to configure a *basic* set of Oracle GoldenGate parameter (configuration) files, one for each process that replicates transactional data changes from an Oracle source to an identical Oracle target. Your business requirements probably will require a more complex topology, but this procedure forms a basis for the rest of your configuration steps.

Figure 1 The basic configuration



By performing these steps, you can:

- get the basic configuration files established.
- build upon them later by adding more parameters as you make decisions about features or requirements that apply to your environment.
- use copies of them to make additional parameter files faster than starting from scratch.

## Creating and editing parameter files

You will be working with Oracle GoldenGate parameter files throughout the deployment process. To create and edit a parameter file, use the EDIT PARAMS command in GGSCI at any time after you start Manager.

```
EDIT PARAMS <name>
```

.....



**Where:** <name> is the name of the parameter file.

For more information about ways to work with Oracle GoldenGate parameter files, see the Oracle GoldenGate *Windows and UNIX Administrator's Guide*.

## Overview of basic steps to configure Oracle GoldenGate

You will make some decisions:

- [Choosing names for processes and files](#)
- [Deciding which capture method to use](#)
- [Assigning a database user for Oracle GoldenGate](#)

You will create the following basic set of objects.

**On both systems:**

- [Creating the Oracle GoldenGate instance](#)

**On the source system:**

- [Configuring Extract for change capture](#)

**On the target system:**

- [Configuring Replicat for change delivery](#)

This chapter also includes recommendations for:

- [Configuring additional process groups for best performance](#)
- [Next steps in the deployment](#)
- [When to start replicating transactional changes](#)
- [Testing your configuration](#)

## Choosing names for processes and files

It is helpful to develop some naming conventions for the Oracle GoldenGate processes and files before you start configuration steps. Choosing meaningful names helps you differentiate among multiple processes and files in displays, error logs, and external monitoring programs. In addition, it accommodates the naming of additional processes and files later, as your environment changes or expands.

This section contains instructions for:

[Choosing group names](#)

[Choosing file names](#)

### Choosing group names

You specify the names of Oracle GoldenGate processes in the parameter files and when you create them during the instantiation of the Oracle GoldenGate environment (Chapter 8). , At minimum, you must choose names for the following processing components:

- **Primary Extract:** The primary Extract process captures data and DDL from the database source.
- **Data pump:** The data pump is a secondary Extract process that reads captured data from a local trail on the source system and sends it over the network to the target. The data pump adds storage flexibility and isolates the primary Extract process from TCP/IP activity. For an illustration of how a data pump fits into the capture configuration, see Figure 1 on page 38.
- **Replicat:** The Replicat process reads a remote trail and applies the transactional changes to the target database.

Realistically, however, you probably will be creating more than one Replicat group and possibly more than one primary Extract group and data pump, depending on such decisions as capture method, performance tuning, or load balancing. For process naming conventions, see the ADD EXTRACT and ADD REPLICAT commands for adding processes in the Oracle GoldenGate *Windows and UNIX Reference Guide*.

### Choosing file names

Captured data must be processed into a series of files called a *trail*, where it is stored for processing by the next Oracle GoldenGate process downstream. The basic configuration is:

- a local trail on the source system
- a remote trail on the target system.

The name can be a relative or fully qualified path name. The actual trail name can contain only two characters, such as *.dirdat/tr*. Oracle GoldenGate appends this name with a six-digit sequence number whenever a new file is created, such as *.dirdat/aa000002*.

For more information about trail files, how they are stored, and how they are managed, see “Overview of trails” in the Oracle GoldenGate *Windows and UNIX Administrator’s Guide*.

## Deciding which capture method to use

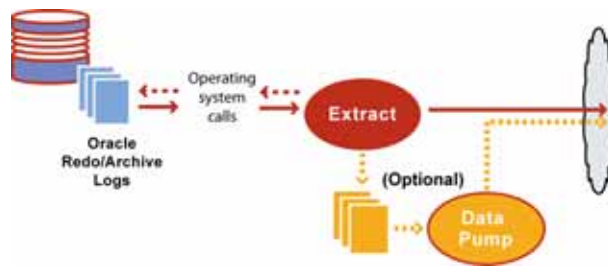
For an Oracle source database, you can use either *classic capture* or *integrated capture* mode.

- Integrated capture can be used for Oracle versions of 11.2.0.3 that have the patch for bug 13560925. You can also use classic capture for these databases.
- For earlier databases, you must use classic capture.

### About classic capture

In classic capture mode, the Oracle GoldenGate Extract process captures data changes from the Oracle redo or archive log files on the source system or from shipped archive logs on a standby system.

Figure 2 Classic capture



Classic capture supports most Oracle data types fully, with restricted support for the complex data types. Classic capture is the original, fast, and time-proven Oracle GoldenGate capture method that supports a broad array of the most commonly used Oracle data types and features.

You can use classic capture to support the following:

- ADTs, VARRAYs, NOLOGGING LOBs with source database compatibility set below 11.2.0.0.0.
- Transparent Data Encryption support with source database compatibility set below 11.0.0.0.0.
- Securefile support with source database compatibility set below 11.2.0.0.0.
- NOLOGGING LOB support with source database compatibility set below 11.2.0.0.0.

For more information, see “Summary of supported Oracle data types and objects per capture mode” on page 8.

If using classic capture, some additional setup is required after you complete the configuration steps to produce a basic set of Oracle GoldenGate parameter files. See “Additional requirements for classic capture” on page 73.

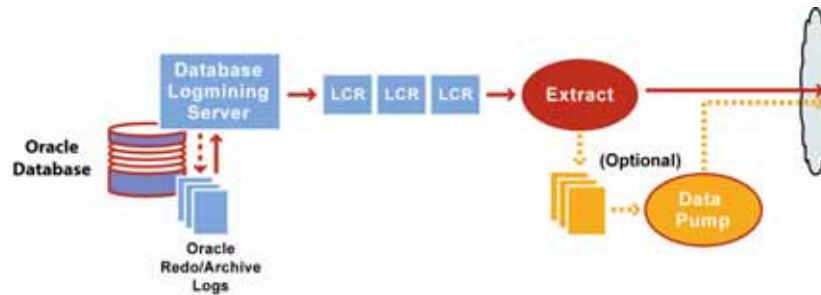
### About integrated capture

Integrated capture can be used to capture changes from Oracle RDBMS versions starting with 11.2.0.3 with the 11.2.0.3 Database specific bundle patch for Integrated Extract 11.2.x (Doc ID 1411356.1). To get this patch from Oracle support, go to:

<https://support.us.oracle.com/oip/faces/secure/km/DocumentDisplay.jspx?id=1411356.1>

Integrated capture can also be used to capture changes from Oracle RDBMS versions starting with 10.2.0.4 in a downstream mining deployment (see “Integrated capture deployment options” on page 42). In integrated capture mode, the Oracle GoldenGate Extract process interacts directly with a database logmining server to receive data changes in the form of logical change records (LCR).

Figure 3 Integrated capture



Integrated capture supports more data and storage types as compared to classic capture, and the support is more transparent. For more information, see “Summary of supported Oracle data types and objects per capture mode” on page 8.

The following are some additional benefits of integrated capture:

- Because integrated capture is fully integrated with the database, no additional setup is required to work with Oracle RAC, ASM, and TDE.
- Integrated capture uses the database logmining server to access the Oracle redo stream, with the benefit of being able to automatically switch between different copies of archive logs or different mirrored versions of the online logs. Thus integrated capture can transparently handle the inavailability of a log file caused by disk corruption, hardware failure, or operator error, assuming that additional copies of the archived and online logs are available
- Integrated capture enables faster filtering of tables.
- Integrated capture handles point-in-time recovery and RAC integration more efficiently.
- Integrated capture features integrated log management. The Oracle Recovery Manager (RMAN) automatically retains the archive logs that are needed by Extract.

#### ***Integrated capture deployment options***

There are two deployment options for integrated capture, depending on where the *mining database* is deployed. The mining database database is the one where the logmining server is deployed.

- *Local deployment:* For local deployment, the source database and the mining database are the same. The source database is the database for which you want to mine the redo stream to capture changes, and also where you deploy the logmining server. Because integrated capture is fully integrated with the database, this mode does not require any special database setup.
- *Downstream deployment:* In downstream deployment, the source and mining databases are different databases of the same platform. You create the logmining server at the downstream database. You configure redo transport at the source database to ship the redo logs to the downstream mining database for capture at that location. Using a downstream mining server for capture may be desirable to offload the capture overhead and any other overhead from transformation or other processing

from the production server, but requires log shipping and other configuration. To configure a downstream mining database, see “Configuring a downstream mining database for integrated capture” on page 147.

### Checking database compatibility settings

To use integrated capture, confirm that the source database is running with a compatibility of 10.2.0.0.0 or higher. However, to get full data type support, compatibility must be 11.2.0.3.0 or higher. See “Summary of supported Oracle data types and objects per capture mode” on page 8.

In the following example, the source database compatibility setting is 11.2.0.3.0, indicating that integrated capture is running in full support mode (all data and storage types are captured).

```
SQL> select name, value from v$parameter where name = 'compatibility';
```

NAME	VALUE
compatibility	11.2.0.3.0

In the next example, the source database compatibility setting is 10.2.0.0.0, indicating that integrated capture is running in limited support mode. In this mode, Securefile LOBs, XML columns, Transparent Data Encryption, and UDTs are not supported.

```
SQL> select name, value from v$parameter where name = 'compatible';
```

NAME	VALUE
compatible	10.2.0.0.0

### Combining capture modes

For Oracle RDBMS 11.2.0.3 with the patch for bug 13560925, you can use either integrated capture, classic capture, or a combination of the two modes. You can divide your tables between two or more Extracts in different capture modes depending on the attributes and data types of the tables. The Oracle GoldenGate parameter files, trails, conversion capabilities, mapping options, and replication mechanisms are fundamentally the same in both modes.

## Assigning a database user for Oracle GoldenGate

This procedure creates a database user for each Oracle GoldenGate process and assigns the correct database privileges.

1. Create a source database user and a target database user, each one dedicated to Oracle GoldenGate on the source and target systems. It can be the same user for all of the Oracle GoldenGate processes that must connect to a source or target Oracle database:
  - Extract (source database): This user performs metadata queries on the source database, and to fetch data from the source tables for data types that are not directly supported from the redo stream. For a list of these data types, see “Summary of supported Oracle data types and objects per capture mode” on page 8. In a local mining deployment of integrated capture, this user also creates, alters, and connects to the logmining server and receives logical change records (LCR) from it.

- Replicat (target database): This user is used to create the Replicat checkpoint table and to apply DML, DDL, and initial load operations.
  - Manager (source database, if using DDL support): This user performs maintenance on the Oracle GoldenGate database objects if DDL support is being used.
  - DEFGEN (source or target database): This user performs local metadata queries to build a data-definitions file that supplies the metadata to remote Oracle GoldenGate instances.
2. If you are using Extract in integrated capture mode, *and* you will be using a downstream mining database, create a *mining user* in the downstream database. This user creates, alters, and connects to the logmining server on the mining database, and it receives logical change records (LCR) from it. If using the source database as the mining database, this user can be the same as the source Extract user.

**NOTE** Choose the name of the mining user carefully. Once created by this user, the database logmining server cannot be altered or used by another user.

3. To assign the correct privileges to the Oracle GoldenGate users, see Table 5.

**Table 5 Database privileges by Oracle GoldenGate process**

User privilege	Extract (Classic Capture)	Extract (Integrated Capture)	Replicat	Manager	Purpose
CREATE SESSION, ALTER SESSION	X	X	X		
RESOURCE	X	X	X*		* If RESOURCE cannot be granted to Replicat, use ALTER USER <user> QUOTA (<size>   UNLIMITED) ON <tablespace>, where <tablespace> represents all tablespaces that contain target objects.
CONNECT	X	X	X*		* Required only if Replicat owns target objects or any PL/SQL procedures. If Replicat cannot have CONNECT, grant CREATE <object> for any object that Replicat needs to create.
SELECT ANY DICTIONARY	X	X	X		
FLASHBACK ANY TABLE or FLASHBACK ON <owner.table>	X	X			
SELECT ANY TABLE or SELECT ON <owner.table>	X	X	X		

**Table 5 Database privileges by Oracle GoldenGate process (continued)**

User privilege	Extract (Classic Capture)	Extract (Integrated Capture)	Replicat	Manager	Purpose
SELECT on dba_clusters	X	X			
INSERT, UPDATE, DELETE ON <target tables>			X		
CREATE TABLE			X		Required to use ADD CHECKPOINTTABLE to enable the database checkpoint feature.
Privileges required to issue DDL operations to target tables (DDL support only).			X		
EXECUTE on DBMS_FLASHBACK package	X	X			Oracle GoldenGate makes a call to DBMS_FLASHBACK.GET_SYSTEM_CHANGE_NUMBER.
GGG_GGSUSER_ROLE	X	X			Role for DML privileges on Oracle GoldenGate-owned DDL objects, if DDL support is used. Role is created during installation of DDL objects. User that installs this role must have SYSDBA privileges.
DELETE ON Oracle GoldenGate DDL objects				X	Required only if using parameters that maintain the Oracle GoldenGate DDL database objects.
LOCK ANY TABLE			X		Required only to use the Oracle GoldenGate initial load method that inserts data by means of a direct bulk load to SQL*Loader.
sys.dbms_internal_clkm	X				Required to replicate Oracle Transparent Data Encryption (TDE) in classic capture mode.

Table 5 Database privileges by Oracle GoldenGate process (continued)

User privilege	Extract (Classic Capture)	Extract (Integrated Capture)	Replicat	Manager	Purpose
SELECT ANY TRANSACTION	X				Required for Extract to use a newer Oracle ASM API. For more information, see the DBLOGREADER option of TRANLOGOPTIONS in the Oracle GoldenGate reference documentation.
Permissions granted through dbms_goldengate_auth.grant_admin_privilege		X			Required to interact with a database logmining server in integrated capture mode. See "Deciding which capture method to use" on page 40.

4. Keep a record of the database users. They must be specified in the Oracle GoldenGate parameter files.
5. 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.
6. Additional users or privileges may be required to use the following features, if Extract will run in classic capture mode:
  - RMAN log retention (page 80)
  - TDE support (page 73)
  - ASM (page 77)

## Creating the Oracle GoldenGate instance

Each Oracle GoldenGate installation is rooted in the Manager process. This is the controller process that instantiates the Oracle GoldenGate processes, allocates port numbers, and performs file maintenance. Together, the Manager process and its child processes, and their related programs and files comprise an Oracle GoldenGate *instance*.

To run Oracle GoldenGate, a Manager process must be running on all systems that will be part of the Oracle GoldenGate environment. To run Manager, you first create a parameter file for it.

To create the Manager parameter file

1. From the Oracle GoldenGate directory, run the ggsci program to open the Oracle GoldenGate Software Command Interface (GGSCI).
2. In GGSCI, edit the Manager parameter file.
 

```
EDIT PARAMS MGR
```
3. Add the Manager parameters, each on one line. If a parameter statement must span multiple lines, use an ampersand (&) before each line break.



- The only required Manager parameter is PORT, but DYNAMICPORTLIST is strongly recommended.
- In a cluster environment, configure Manager with the AUTOSTART and AUTORESTART parameters, so that the Oracle GoldenGate processes start or restart automatically when Manager is started or fails over.
- Use PURGEOLDEXTRACTS to manage the accumulation of trail files.
- For more information about Manager parameters, see the Oracle GoldenGate *Windows and UNIX Reference Guide*.

For more details on configuring Manager and its network connections, see the Oracle GoldenGate *Windows and UNIX Administrator's Guide*.

4. Save, then close the file.

**Example** The following sample Manager parameter file is on a UNIX system using required and recommended parameters.

```
PORT 7809
DYNAMICPORTLIST 7810-7820, 7830
AUTOSTART ER t*
AUTORESTART ER t*, RETRIES 4, WAITMINUTES 4
STARTUPVALIDATIONDELAY 5
PURGEOLDEXTRACTS /ogg/dirdat/tt*, USECHECKPOINTS, MINKEEPHOURS 2
```

## Configuring Extract for change capture

Perform these steps on the source system to configure the processes that support change capture.

### Configure the primary Extract (classic or integrated mode)

1. In GGSCI on the source system, create the Extract parameter file.

```
EDIT PARAMS <name>
```

**Where:** <name> is the name of the primary Extract.

2. Enter the Extract parameters in the order shown, starting a new line for each parameter statement. Your input variables will be different. See Table 6 for descriptions.

Basic parameters for the primary Extract group in *classic capture* mode:

```
EXTRACT finance
USERID ogg, PASSWORD AACAAAAAAAAAAAAJAUEUGODSCVGVJEEIUGKJDJTFNDKEJFFFTC &
    AES128, ENCRYPTKEY securekey1
ENCRYPTTRAIL AES192, KEYNAME mykey1
EXTTRAIL /ggs/dirdat/lt
SEQUENCE hr.employees_seq;
TABLE hr.*;
```

Basic parameters for the primary Extract group in *integrated capture* mode where the source database is the mining database:

```
EXTRACT financep
USERID ogg, PASSWORD AACAAAAAAAAAAAAJAUEUGODSCVJEEIUGKJDJTFNDKEJFFFTC &
  AES128, ENCRYPTKEY securekey1
[TRANLOGOPTIONS [MININGUSER oggm, &
  MININGPASSWORD AACAAAAAAAAAAAAJAUEUGODSCVJEEIUGKJDJTFNDKEJFFFTC &
  AES128, ENCRYPTKEY securekey1]
TRANLOGOPTIONS INTEGRATEDPARAMS (MAX_SGA_SIZE=164, &
  DOWNSTREAM_REAL_TIME_MINE=y)
ENCRYPTTRAIL AES192, KEYNAME mykey1
EXTTRAIL /ggs/dirdat/lt
SEQUENCE hr.employees_seq;
TABLE hr.*;
```

Basic parameters for the primary Extract group in *integrated capture* mode where the mining database is a downstream database:

```
EXTRACT financep
USERID ogg, PASSWORD AACAAAAAAAAAAAAJAUEUGODSCVJEEIUGKJDJTFNDKEJFFFTC &
  AES128, ENCRYPTKEY securekey1
[TRANLOGOPTIONS [MININGUSER oggm, &
  MININGPASSWORD AACAAAAAAAAAAAAJAUEUGODSCVJEEIUGKJDJTFNDKEJFFFTC &
  AES128, ENCRYPTKEY securekey1]
TRANLOGOPTIONS INTEGRATEDPARAMS (MAX_SGA_SIZE=164, &
  DOWNSTREAM_REAL_TIME_MINE=y)
ENCRYPTTRAIL AES192, KEYNAME mykey1
EXTTRAIL /ggs/dirdat/lt
SEQUENCE hr.employees_seq;
TABLE hr.*;
```

**Table 6 Basic parameters for primary Extract (classic or integrated mode)**

Parameter	Description
EXTRACT <group name>	<group name> is the name of the Extract group.

**Table 6 Basic parameters for primary Extract (classic or integrated mode) (continued)**

Parameter	Description
<pre>USERID &lt;user id&gt;, PASSWORD &lt;pw&gt; [&lt;encryption options&gt;]]</pre>	<p>Specifies database connection information for the database user that was created in “Assigning a database user for Oracle GoldenGate” on page 43.</p> <ul style="list-style-type: none"> <li>◆ USERID specifies the Extract database user.</li> <li>◆ PASSWORD specifies the user’s password.</li> <li>◆ &lt;encryption options&gt; specifies one of several ways to encrypt the password.</li> </ul> <p>For additional login options and encryption details, see the Oracle GoldenGate <i>Windows and UNIX Reference Guide</i>. Make certain this user has the permissions that are required for the Oracle GoldenGate capture mode that you are using:</p> <ul style="list-style-type: none"> <li>◆ Required source database login (page 43)</li> <li>◆ RMAN log retention (page 80)</li> <li>◆ TDE support (page 73)</li> <li>◆ ASM (page 77)</li> </ul>
<pre>TRANLOGOPTIONS MININGUSER &lt;user id&gt;, MININGPASSWORD &lt;pw&gt; [, &lt;encryption options&gt;]</pre>	<p>(Integrated capture mode) Specifies connection information for the logmining server at the downstream mining database, if being used.</p> <ul style="list-style-type: none"> <li>◆ MININGUSER specifies the Extract user for the downstream mining database. This is the user that you created in “Creating a mining user account” on page 149.</li> <li>◆ MININGPASSWORD specifies the user’s password.</li> <li>◆ &lt;encryption options&gt; specifies one of several ways to encrypt the password.</li> </ul> <p>Use only if the database logmining server is in a different database from the source database; otherwise use USERID. When using MININGUSER, use it <i>in addition to</i> USERID, because logins are required for both databases. For additional login options and encryption details, see the Oracle GoldenGate <i>Windows and UNIX Reference Guide</i>.</p>
<pre>TRANLOGOPTIONS [INTEGRATEDPARAMS (&lt;parameter&gt;[, ...]]]</pre>	<p>(Integrated capture mode) Passes parameters to the Oracle database that contains the database logmining server. Use to specify the amount of SGA memory used by the logmining server, the number of processes supporting the logmining server, and whether integrated capture operates in real-time or archived-log mode if a downstream mining database is being used. See “Tuning recommendations for integrated capture” on page 56.</p>
<pre>ENCRYPTTRAIL &lt;encryption options&gt;</pre>	<p>Encrypts the local trail. For encryption options, see the <i>Windows and UNIX Reference Guide</i>.</p>

**Table 6 Basic parameters for primary Extract (classic or integrated mode) (continued)**

Parameter	Description
<code>EXTRAIL &lt;pathname&gt;</code>	Specifies the path name of the local trail to which the primary Extract writes captured data.
<code>SEQUENCE &lt;owner&gt;.&lt;sequence&gt;;</code>	Specifies an Oracle sequence to capture. <ul style="list-style-type: none"> <li>◆ &lt;owner&gt; is the schema name.</li> <li>◆ &lt;sequence&gt; is the name of the sequence.</li> </ul> Terminate the statement with a semi-colon.
<code>TABLE &lt;owner&gt;.&lt;table&gt;;</code>	Specifies a table or tables for which to extract data changes. <ul style="list-style-type: none"> <li>◆ &lt;owner&gt; is the schema name.</li> <li>◆ &lt;table&gt; is the name of the table or a group of tables defined with wildcards.</li> </ul> Schema names cannot be wildcarded. To extract data from tables in multiple schemas, use a separate TABLE statement for each schema. For example: <pre>TABLE fin.*; TABLE hr.*;</pre> Terminate the TABLE statement with a semi-colon.                     To exclude tables from a wildcard specification, use the TABLEEXCLUDE <owner>.<table> parameter after the TABLE statement.                     For more information and for additional options that control data filtering, mapping, and manipulation, see TABLE in the Oracle GoldenGate <i>Windows and UNIX Reference Guide</i> .

3. Enter any optional Extract parameters that are recommended elsewhere in this manual and any others shown in the Oracle GoldenGate *Windows and UNIX Reference Guide*.
4. Save and close the file.

## Configuring the data pump

Perform these steps on the source system to configure the data pump that interacts with the primary Extract.

1. In GGSCI on the source system, create the data-pump parameter file.

```
EDIT PARAMS <name>
```

**Where:** <name> is the name of the data pump Extract.

2. Enter the data-pump parameters in the order shown, starting a new line for each parameter statement. Your input variables will be different. See Table 6 for descriptions.

**Basic parameters for the data-pump Extract group:**

```
EXTRACT extpump
USERID ogg, PASSWORD AACAAAAAAAAAAAAJAUEUGODSCVJGJEEIUGKJDJTFNDKEJFFFTC &
    AES128, ENCRYPTKEY securekey1
DECRYPTTRAIL AES192, KEYNAME mykey1
RMTHOST fin1, MGRPORT 7809 ENCRYPT AES192, KEYNAME securekey2
ENCRYPTTRAIL AES192, KEYNAME mykey1
RMTTRAIL /ggs/dirdat/rt
SEQUENCE hr.employees_seq;
TABLE hr.*;
```

**Table 7 Basic parameters for primary Extract or data-pump Extract**

Parameter	Description
EXTRACT <group name>	<group name> is the name of the data pump Extract.
USERID <user id>, PASSWORD <pw> [<encryption options>]]	Specifies database connection information. <ul style="list-style-type: none"> <li>◆ USERID specifies the Extract database user.</li> <li>◆ PASSWORD specifies the user's password.</li> <li>◆ &lt;encryption options&gt; specifies one of several ways to encrypt the password.</li> </ul>
RMTHOST <hostname>, MGRPORT <portnumber>, [, ENCRYPT <algorithm> KEYNAME <keyname>]	<ul style="list-style-type: none"> <li>◆ RMTHOST specifies the name or IP address of the target system.</li> <li>◆ MGRPORT specifies the port number where Manager is running on the target.</li> <li>◆ ENCRYPT specifies optional encryption of data across TCP/IP.</li> </ul> <p>For additional options and encryption details, see the Oracle GoldenGate <i>Windows and UNIX Reference Guide</i>.</p>
ENCRYPTTRAIL <encryption options>	Encrypts the remote trail on the target to which this data pump writes. For encryption options, see the <i>Windows and UNIX Reference Guide</i> .
DECRYPTTRAIL <encryption options>	Decrypts the local input trail that the data pump reads. The <encryption options> must match those of the ENCRYPTTRAIL statement that is used for the primary Extract group.
RMTTRAIL <pathname>	Specifies the path name of the remote trail.

**Table 7 Basic parameters for primary Extract or data-pump Extract (continued)**

Parameter	Description
<pre>SEQUENCE &lt;owner&gt;.&lt;sequence&gt;;</pre>	<p>Specifies an Oracle sequence. In most cases, this listing will be the same as that in the primary Extract parameter file.</p> <ul style="list-style-type: none"> <li>◆ &lt;owner&gt; is the schema name.</li> <li>◆ &lt;sequence&gt; is the name of the sequence.</li> </ul> <p>Terminate the statement with a semi-colon.</p>
<pre>TABLE &lt;owner&gt;.&lt;table&gt;;</pre>	<p>Specifies a table or tables. In most cases, this listing will be the same as that in the primary Extract parameter file.</p> <ul style="list-style-type: none"> <li>◆ &lt;owner&gt; is the schema name.</li> <li>◆ &lt;table&gt; is the name of the table or a group of tables defined with wildcards.</li> </ul> <p>Schema names cannot be wildcarded. To extract data from tables in multiple schemas, use a separate TABLE statement for each schema. For example:</p> <pre>TABLE fin.*; TABLE hr.*;</pre> <p>Terminate the TABLE statement with a semi-colon.</p> <p>To exclude tables from a wildcard specification, use the TABLEEXCLUDE &lt;owner&gt;.&lt;table&gt; parameter after the TABLE statement.</p> <p>For more information and for additional options that control data filtering, mapping, and manipulation, see TABLE in the Oracle GoldenGate <i>Windows and UNIX Reference Guide</i>.</p>

3. Enter any optional Extract parameters that are recommended elsewhere in this manual and any others shown in the Oracle GoldenGate *Windows and UNIX Reference Guide*.
4. Save and close the file.

## Configuring Replicat for change delivery

Perform these steps on the target system to configure the objects that support change delivery to the target database.

### Create a checkpoint table

Replicat maintains its checkpoints in a checkpoint table in the target database. Each checkpoint is written to the checkpoint table within the Replicat transaction. Because a checkpoint either succeeds or fails with the transaction, Replicat ensures that a transaction is only applied once, even if there is a failure of the process or the database. The checkpoint table must be created in the target database prior to creating Replicat groups.

**NOTE** This procedure installs a default checkpoint table, which is sufficient in most cases. More than one checkpoint table can be used, such as to use a different one for each Replicat group. To use a non-default checkpoint table, which overrides the default table, use the CHECKPOINTTABLE option of ADD REPLICAT when you create the Replicat processes. For details, see the Oracle GoldenGate *Windows and UNIX Reference Guide*.

**To add a checkpoint table to the target database**

1. From the Oracle GoldenGate directory on the target, run GGSCI and issue the DBLOGIN command to log into the target database.

```
DBLOGIN, USERID <db_user>[, PASSWORD <pw>[<encryption options>]]
```

**Where:**

- USERID <db\_user>, PASSWORD <pw>, and <encryption options> supply database credentials of a user with CREATE TABLE permissions, and optional password encryption. See the Oracle GoldenGate *Windows and UNIX Reference Guide* for more information about command options.
2. In GGSCI, create the checkpoint table in a schema of your choice (ideally dedicated to Oracle GoldenGate).

```
ADD CHECKPOINTTABLE <owner>.<table>
```

**To specify the checkpoint table in the Oracle GoldenGate configuration**

1. Create a GLOBALS file (or edit the existing one).

```
EDIT PARAMS ./GLOBALS
```

**NOTE** GLOBALS must be in upper case, without a file extension. The file must remain in the root Oracle GoldenGate directory.

2. In the GLOBALS file, enter the CHECKPOINTTABLE parameter.

```
CHECKPOINTTABLE <owner>.<table>
```

**Where:** <owner>.<table> is the owner and a name that is supported by the database.

3. Save and close the GLOBALS file.

When Replicat uses a checkpoint table, it takes advantage of the asynchronous COMMIT feature that was introduced in Oracle 10gR2. Replicat includes the NOWAIT option in its COMMIT statement to improve performance. Replicat is able to continue processing immediately after applying the COMMIT, while the database logs the transaction in the background. You can disable the default asynchronous COMMIT by using the DBOPTIONS parameter with the DISABLECOMMITNOWAIT option in the Replicat parameter file.

If a checkpoint table is not used for a Replicat group, the checkpoints are maintained in a file on disk. In this case, Replicat uses COMMIT with WAIT to prevent inconsistencies in the event of a database failure that causes the state of the transaction, as in the checkpoint file, to be different than its state after the recovery.

## Configure Replicat

1. In GGSCI on the target system, create the Replicat parameter file.

```
EDIT PARAMS <name>
```

**Where:** <name> is the name of the Replicat group.

2. Enter the Replicat parameters in the order shown, starting a new line for each parameter statement. See Table 8 for descriptions.

```
REPLICAT financer
USERID ogg, PASSWORD AACAAAAAAAAAAAAJAUEUGODSCVGJEEIUGKJDJTFNDKEJFFFTC &
  AES128, ENCRYPTKEY securekey1
-- SUPPRESSTRIGGERS is for Oracle 10.2.0.5 & later patches, and
-- for Oracle 11.2.0.2 and later 11gR2 versions
DBOPTIONS SUPPRESSTRIGGERS
DECRYPTTRAIL AES192, KEYNAME mykey1
ASSUMETARGETDEFS
DISCARDFILE /users/ogg/disc
MAP hr.*, TARGET hr2.*;
```

**Table 8 Basic parameters for Replicat**

Parameter	Description
REPLICAT <group name>	<group name> is the name of the Replicat group.
USERID <user id>, PASSWORD <pw> [<encryption options>]	<p>Specifies database connection information.</p> <ul style="list-style-type: none"> <li>◆ USERID specifies the Replicat database user.</li> <li>◆ PASSWORD specifies the user's password.</li> <li>◆ &lt;encryption options&gt; specifies one of several ways to encrypt the password.</li> </ul> <p>For additional login options and encryption details, see the Oracle GoldenGate <i>Windows and UNIX Reference Guide</i>.</p>
DBOPTIONS SUPPRESSTRIGGERS, DEFERREFCONST	<p>SUPPRESSTRIGGERS prevents triggers from firing on target objects that are configured for replication with Oracle GoldenGate.</p> <p>DEFERREFCONST sets constraints to DEFERRABLE to delay the enforcement of cascade constraints by the target database until the Replicat transaction is committed.</p> <p>See the Oracle GoldenGate <i>Windows and UNIX Reference Guide</i> for additional important information about these DBOPTIONS parameters.</p>



**Table 8 Basic parameters for Replicat**

Parameter	Description
ASSUMETARGETDEFS	<p>Specifies how to interpret data definitions. ASSUMETARGETDEFS assumes the source and target tables have identical definitions, including semantics. (This procedure assume identical definitions.)</p> <p>Use the alternative SOURCEDEFS if the source and target tables have different definitions, and create a source data-definitions file with DEFGEN. See Chapter 13 in the Oracle GoldenGate <i>Windows and UNIX Administrator's Guide</i> for more information.</p>
DISCARDFILE <full_pathname>	<p>Specifies the full path name of a file to which Replicat writes rejected record data, for example records that generated database errors. A discard file is optional but recommended. See the Oracle GoldenGate <i>Windows and UNIX Reference Guide</i> for additional options.</p>
DECRYPTTRAIL <encryption options>	<p>Decrypts the input trail that this Replicat reads. The &lt;encryption options&gt; must match those of the ENCRYPTTRAIL statement for this input trail.</p>
MAP <owner>.<table>, TARGET <owner>.<table>;	<p>Specifies a relationship between a source and target table or tables.</p> <ul style="list-style-type: none"> <li>◆ &lt;owner&gt; is the schema name.</li> <li>◆ &lt;table&gt; is the name of a table or a wildcard definition for multiple tables.</li> </ul> <p>Schema names cannot be wildcarded. To map tables in multiple schemas, use a separate MAP statement for each schema. For example:</p> <pre>MAP fin.*, TARGET fin.*; MAP hr.*, TARGET hr.*;</pre> <p>Terminate the MAP statement with a semi-colon.</p> <p>To exclude tables from a wildcard specification, use the MAPEXCLUDE parameter.</p> <p>For more information and for additional options that control data filtering, mapping, and manipulation, see MAP in the Oracle GoldenGate <i>Windows and UNIX Reference Guide</i>.</p>

3. Enter any optional Extract parameters that are recommended elsewhere in this manual and any others shown in the Oracle GoldenGate *Windows and UNIX Reference Guide*.
4. Save and close the file.

## Tuning recommendations for integrated capture

Integrated capture uses a database logmining server in the mining database to mine the redo stream of the source database. The logmining server consumes two types of database resources: a given number of processes and a given amount of shared memory. You can control these resources by specifying the following parameters in the INTEGRATEDPARAMS list of the Extract TRANLOGOPTIONS parameter:

- To control the amount of shared memory used by the logmining server, specify the `max_sga_size` parameter with a value in megabytes.
- To control the number of processes used by the logmining server, specify the parallelism parameter.

For example, you can specify that the logmining server uses 200 MB of memory with a parallelism of 3 by specifying the following:

```
TRANLOGOPTIONS INTEGRATEDPARAMS (max_sga_size 200, parallelism 3)
```

The shared memory that is used by the logmining server comes from the Streams pool portion of the System Global Area (SGA) in the database. Therefore, you must set `streams_pool_size` high enough to keep enough memory available for the number of Extract processes that you expect to run in integrated capture mode against a given database instance. Note that Streams pool is also used by other components of the database (like AQ), so make certain to take them into account while sizing the Streams pool for Oracle GoldenGate.

By default, one integrated capture Extract requests the logmining server to run with `max_sga_size` of 1GB and a parallelism of 2. Thus, if you are running three Extracts in integrated capture mode in the same database instance, you need at least 3 GB of memory allocated to the Streams pool. As best practice, keep 25 percent of the Streams pool available. For example, if there are three Extracts in integrated capture mode, set `stream_pool_size` to the following:

```
3 GB + (3 GB * 0.25) = 3.75 GB
```

## Configuring additional process groups for best performance

Develop business rules that specify the acceptable amount of lag between the time when transactions are generated by your source applications and when those changes are applied to the target database. These rules determine the number of parallel Extract and Replicat processes that are required to enable Oracle GoldenGate to perform at its best.

Gather the size and activity rates of all of the tables that you intend to replicate with Oracle GoldenGate, and then:

- Assign one Extract group to the tables with low activity rates.
- Assign a dedicated Extract group to tables with high activity rates.

Configure these Extract groups to work with dedicated data pumps and Replicat groups. Once you have a basic set of parameter files for one Extract and Replicat process, you can:

- copy them to the names of the new process groups.
- edit the copies to produce the parameter files for your additional process groups.

For more information about configuring Oracle GoldenGate for best performance, see the Oracle GoldenGate *Windows and UNIX Troubleshooting and Tuning Guide*.

## Next steps in the deployment

Because of its flexibility, Oracle GoldenGate offers numerous features and options that must be considered before you start any processes. To further configure Oracle GoldenGate to suit your business needs, see the following:

- To prepare the database and the redo logs, and to learn about additional parameters that may be required, see the remaining chapters in this manual.
- To configure Oracle GoldenGate to capture and apply DDL operations, see [Chapter 7](#).
- If either the source or target database is non-Oracle, follow the installation and configuration instructions in the Oracle GoldenGate installation and setup guide for that database, and then refer to the Oracle GoldenGate administration and reference documentation for further information.
- For additional configuration guidelines to achieve specific replication topologies, see the Oracle GoldenGate *Windows and UNIX Administrator's Guide*. This guide includes instructions for the following configurations:
  - [Using Oracle GoldenGate for live reporting](#)
  - [Using Oracle GoldenGate for real-time data distribution](#)
  - [Configuring Oracle GoldenGate for real-time data warehousing](#)
  - [Using Oracle GoldenGate to maintain a live standby database](#)
  - [Using Oracle GoldenGate for active-active high availability](#)

That guide also contains information about:

- Oracle GoldenGate architecture
  - Oracle GoldenGate commands
  - Oracle GoldenGate initial load methods
  - Configuring security
  - Using customization features
  - Configuring data filtering and manipulation
- For syntax options and descriptions of Oracle GoldenGate GGSCI commands and Oracle GoldenGate parameters shown in this guide, see the Oracle GoldenGate *Windows and UNIX Reference Guide*.

## When to start replicating transactional changes

You must start replication when the source and target data is in a synchronized state, where the corresponding rows in the source and target tables contain identical data values. Unless you are starting with brand new source and target databases with no current user activity, you will need to activate change synchronization to capture ongoing transactional changes while an initial load is being applied to the target. The initial load captures a point-in-time snapshot of the source data and applies it to the target, while Oracle GoldenGate maintains any changes that are made after that point.

After you satisfy the requirements for configuring the database and the Oracle GoldenGate processes (including DDL support if required), see “Instantiating and starting Oracle GoldenGate replication” on page 118 to perform an initial load, start replicating changes, and handle post-load collisions.

## **Testing your configuration**

It is important to test your configuration in a test environment before deploying it live on your production machines. This is especially important in an active-active or high availability configuration, where trusted source data may be touched by the replication processes. Testing enables you to find and resolve any configuration mistakes or data issues without the need to interrupt user activity for re-loads on the target or other troubleshooting activities.

## CHAPTER 5

# Preparing the database for Oracle GoldenGate

.....

This chapter contains steps to take so that the source and target Oracle databases with which Oracle GoldenGate interacts is configured properly to support capture and replication. Some steps apply to just a source system, some just to a target, and some to both. You will be adding new parameters to the basic parameter file that you created in “Configuring Oracle GoldenGate on Oracle source and target databases” on page 38.

The procedures to prepare the database are:

[Preparing integrity constraints in source and target tables](#)

[Configuring the source database to log key values](#)

[Limiting row changes in tables that do not have a unique row identifier](#)

[Supporting the conversion of character sets](#)

[Setting fetch options](#)

[Handling special data types](#)

[Handling other database properties](#)

[Using Oracle GoldenGate with Oracle Exadata](#)

## Preparing integrity constraints in source and target tables

Triggers, cascade constraints, and unique identifiers must be properly configured in an Oracle GoldenGate environment. Review the following guidelines and implement the ones that are relative to your configuration, before you start Extract or Replicat to process data.

### Disabling triggers and referential cascade constraints on target tables

Triggers and cascade constraints must be disabled on Oracle target tables. Oracle GoldenGate provides some options to handle triggers or cascade constraints automatically, depending on the Oracle version:

- **DBOPTIONS with SUPPRESSTRIGGERS:** Supported for Oracle 10.2.0.5 and later patches to 10.2.0.5, and for Oracle 11.2.0.2 and later 11gR2 versions. This parameter causes Replicat to disable the triggers during its session.
- **DBOPTIONS with DEFERREFCONST:** Delays the checking and enforcement of cascade update and cascade delete constraints until the Replicat transaction commits.
- For other Oracle versions, you must disable triggers and integrity constraints or alter them manually to ignore the Replicat database user.

Constraints must be disabled because Oracle GoldenGate replicates DML that results from a trigger or a 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.

## Deferring constraint checking on target tables

You may need to defer constraint checking on the target.

1. If constraints are DEFERRABLE on the source, the constraints on the target must also be DEFERRABLE. You can use one of the following parameter statements to defer constraint checking until a Replicat transaction commits:
  - Use SQLEXEC at the root level of the Replicat parameter file to defer the constraints for an entire Replicat session.  
`SQLEXEC ("alter session set constraint deferred")`
  - Use the Replicat parameter DBOPTIONS with the DEFERREFCONST option to delay constraint checking for each Replicat transaction.
2. You might need to configure Replicat to overcome integrity errors caused by transient primary-key duplicates. Transient primary-key duplicates are duplicates that occur temporarily during the execution of a transaction, but are resolved by transaction commit time. This kind of operation typically uses a “SET x = x+n” formula or some other manipulation that shifts values so that a new value equals an existing one.

The following illustrates a sequence of value changes that can cause a transient primary-key duplicate if constraints are not deferred. The example assumes the primary key column is “CODE” and the current key values (before the updates) are 1, 2, and 3.

```
update item set code = 2 where code = 1;  
update item set code = 3 where code = 2;  
update item set code = 4 where code = 3;
```

In this example, when Replicat applies the first update to the target, there is an ORA-00001 (unique constraint) error because the key value of 2 already exists in the table. The Replicat transaction returns constraint violation errors. By default, Replicat does not handle these violations and abends.

### To handle transient primary-key duplicates in versions earlier than 11.2.0.2

To handle transient primary-key duplicates in versions earlier than 11.2.0.2, use the Replicat parameter HANDLETPKUPDATE. In this configuration, Replicat handles transient primary-key updates by temporarily deferring constraints. To support this functionality, you must create or alter the constraints as DEFERRABLE INITIALLY IMMEDIATE on the target tables. If the constraints are not DEFERRABLE, Replicat handles the errors according to rules

that are specified with the `HANDLECOLLISIONS` and `REPERROR` parameters, if they exist, or else it abends.

#### To handle transient primary-key duplicates in version 11.2.0.2 or later

For versions later than 11.2.0.2, Replicat by default tries to resolve transient primary-key duplicates automatically by using a workspace in Oracle Workspace Manager. In this configuration, Replicat can defer the constraint checking until commit time without requiring the constraints to be explicitly defined as deferrable.

The requirements for automatic handling of transient primary-key duplicates are:

- Grant the Replicat database user access to the following Oracle Streams function:  
`DBMS_XSTREAM_GG.ENABLE_TDUP_WORKSPACE()`
- The target tables cannot have deferrable constraints; otherwise Replicat returns an error and abends.

To handle tables with deferrable constraints, make certain the constraints are `DEFERRABLE INITIALLY IMMEDIATE`, and use the `HANDLETPKUPDATE` parameter in the `MAP` statement that maps that table. The `HANDLETPKUPDATE` parameter overrides the default of handling the duplicates automatically.

The use of a workspace affects the following Oracle GoldenGate error handling parameters:

- `HANDLECOLLISIONS`
- `REPERROR`

When Replicat enables a workspace in Oracle Workspace Manager, it ignores the error handling that is specified by Oracle GoldenGate parameters such as `HANDLECOLLISIONS` and `REPERROR`. Instead, Replicat aborts its grouped transaction (if `BATCHSQL` is enabled), and then retries the update in normal mode by using the active workspace. If `ORA-00001` occurs again, Replicat rolls back the transaction and then retries the transaction with error-handling rules in effect again.

**NOTE** If Replicat encounters `ORA-00001` for a non-update record, the error-handling parameters such as `HANDLECOLLISIONS` and `REPERROR` handle it.

A workspace cannot be used if the operation that contains a transient primary-key duplicate also has updates to any out-of-line columns, such as `LOB` and `XMLType`. Therefore, these cases are not supported, and any such cases can result in undetected data corruption on the target. An example of this is:

```
update T set PK = PK + 1, C_LOB = "ABC";
```

## Ensuring row uniqueness in source and target tables

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. You will issue a command to direct Oracle to log key values when you begin configuring Oracle GoldenGate to capture transactional changes.

### *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 automatically selects a row identifier to use in the following order of priority:

1. Primary key
2. First unique key alphanumerically with no virtual columns, no UDTs, no function-based columns, and no nullable columns. A key cannot contain a column that is part of an invisible index.
3. First unique key alphanumerically with no virtual columns, no UDTs, and no function-based columns, but can include nullable columns. A key cannot contain a column that is part of an invisible index.
4. 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 virtual columns, UDTs, function-based columns, and any columns that are explicitly 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.

#### *Using KEYCOLS to specify a custom key*

If a table does not have an appropriate key, or if you prefer the existing key(s) 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. For more information, see the Oracle GoldenGate *Windows and UNIX Reference Guide*.

## Configuring the source database to log key values

GGSCI provides commands to configure the source database to log the appropriate key values whenever it logs a row change, so that they are available to Oracle GoldenGate in the redo record. By default, the Oracle database only logs column values that are changed. The appropriate command must be issued before you start Oracle GoldenGate processing.

Because redo volume is increased as the result of logging key values, you might want to wait until just before you start Oracle GoldenGate processing to enable the logging. Otherwise, you can issue them any time before processing starts.

You will enable some or all of the following supplemental logging types:

[Enabling database-level supplemental logging](#)

[Enabling schema-level supplemental logging](#)

[Enabling table-level supplemental logging](#)



## Enabling database-level supplemental logging

Oracle GoldenGate requires enabling database-level supplemental logging.

1. Log in to SQL\*Plus as a user with ALTER SYSTEM privilege, and then issue the following command to enable minimal supplemental logging at the database level. This logging is required to process updates to primary keys and chained rows.

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

2. To start the supplemental logging, switch the log files.

```
ALTER SYSTEM SWITCH LOGFILE;
```

3. Verify that supplemental logging is enabled at the database level with this command:

```
SELECT SUPPLEMENTAL_LOG_DATA_MIN FROM V$DATABASE;
```

The output must be YES or IMPLICIT.

## Enabling schema-level supplemental logging

Use ADD SCHEMATRANDATA to enable schema-level supplemental logging of the source tables if you will be using the Oracle GoldenGate DDL replication feature. ADD SCHEMATRANDATA logs key values atomically when each DDL operation occurs.

ADD SCHEMATRANDATA logs all valid keys to the redo log, and it affects all of the current and future tables of a given schema. See the ADD SCHEMATRANDATA command in the Oracle GoldenGate *Windows and UNIX Reference Guide* for additional usage considerations.

To issue ADD SCHEMATRANDATA

1. Apply Oracle Patch 10423000 to the source Oracle database if the version is earlier than 11.2.0.2.
2. Run GGSCI on the source system.
3. Issue the DBLOGIN command as a user that has privilege to enable schema-level supplemental logging.

```
DBLOGIN USERID <user>, PASSWORD <password> [<encryption options>]
```

See the Oracle GoldenGate Windows and UNIX Reference Guide for password encryption options for DBLOGIN.

4. Issue the following command for each schema for which you want to capture data changes.

```
ADD SCHEMATRANDATA <schema>
```

As an example, the following commands enable supplemental logging for the FINANCE and HR schemas.

```
ADD SCHEMATRANDATA FINANCE  
ADD SCHEMATRANDATA HR
```

## Enabling table-level supplemental logging

The ADD TRANDATA command is required to enable table-level supplemental logging of key values for use by Oracle GoldenGate. You can also use the COLS option of this command to log non-key columns for use in a KEYCOLS clause or for filtering or manipulation.

To issue ADD TRANDATA

1. Run GGSCI on the source system.
2. Issue the DBLOGIN command as a user that has privilege to enable table-level supplemental logging.

```
DBLOGIN USERID <user>, PASSWORD <password> [<encryption options>]
```

See the Oracle GoldenGate Windows and UNIX Reference Guide for password encryption options for DBLOGIN.

3. Issue the following command.

```
ADD TRANDATA <table> [, COLS <columns>] [, NOKEY]
```

Where:

- <table> is the owner and name of the table. You can use a wildcard for the table name, but not the owner name.
  - COLS <columns> logs non-key columns that are required for a KEYCOLS clause or for filtering and manipulation.
  - NOKEY prevents the logging of the primary key or unique key. Requires a KEYCOLS clause in the TABLE and MAP parameters and a COLS clause in the ADD TRANDATA command to log the KEYCOLS columns.
4. If using ADD TRANDATA with the COLS option, create a unique index for those columns on the target to optimize row retrieval. If you are logging those columns as a substitute key for a KEYCOLS clause, make a note to add the KEYCOLS clause to the TABLE and MAP statements when you configure the Oracle GoldenGate processes.

See the ADD TRANDATA command in the Oracle GoldenGate *Windows and UNIX Reference Guide* for additional usage considerations.

## Limiting row changes in tables that do not have a unique row identifier

If a target Oracle table does not have a primary key or a unique key, duplicate rows can exist. In this case, Oracle GoldenGate could update or delete too many target rows, causing the source and target data to go out of synchronization without error messages to alert you.

To limit the number of rows that are updated, use the DBOPTIONS parameter with the LIMITROWS option in the Replicat parameter file. LIMITROWS can increase the performance of Oracle GoldenGate on the target system because only one row is processed.

## Supporting the conversion of character sets

When replicating from a source Windows-based or UNIX-based database to a target Oracle database that has another character set, Replicat allows Oracle to perform the character-

set conversion. When replicating from a z/OS system, Replicat performs the conversion.

To support the conversion of character sets by an Oracle target database, the NLS\_LANG environment variable must be set to the character set of the *source* database on the target system. You can use the Replicat parameter SETENV to set NLS\_LANG for the Replicat client session, instead of setting it at the system level. When set from the parameter file, it is less likely to be changed than at the system level. (*Note:* Oracle GoldenGate programmatically sets NLS\_LANG to the source database character set on the source.)

#### To set NLS\_LANG with SETEN

1. Use the following syntax to set NLS\_LANG.

```
SETENV (NLS_LANG = <NLS_LANGUAGE>_<NLS_TERRITORY>.<NLS_CHARACTERSET>)
```

The following is an example from the UNIX platform:

```
SETENV (NLS_LANG = "AMERICAN_AMERICA.AL32UTF8")
```

2. Stop and then start the Oracle GoldenGate Manager process so that the processes recognize the new variable.

#### To view globalization settings

To determine the globalization settings of the database and whether it is using byte or character semantics, use the following commands in SQL\*Plus:

```
SHOW PARAMETER NLS_LANGUAGE  
SHOW PARAMETER NLS_TERRITORY  
SELECT name, value$ from SYS.PROPS$ WHERE name = 'NLS_CHARACTERSET';  
SHOW PARAMETER NLS_LENGTH_SEMANTICS
```

#### To view globalization settings from GGSCI

The VIEW REPORT <group> command in GGSCI shows the current database language and character settings and indicates whether or not NLS\_LANG is set.

#### To get more information on character set support

For more information about support for character sets by Oracle GoldenGate, see “Mapping and manipulating data” in the Oracle GoldenGate *Windows and UNIX Administrator's Guide*.

## Setting fetch options

To process certain update records, Extract fetches additional row data from the source database. Oracle GoldenGate fetches data for the following:

- User-defined types
- Nested tables
- XMLType objects

By default, Oracle GoldenGate uses Flashback Query to fetch the values from the undo (rollback) tablespaces. That way, Oracle GoldenGate can reconstruct a read-consistent row image as of a specific time or SCN to match the redo record.

**To configure the database for best fetch results**

For best fetch results, configure the source database as follows:

1. Set a sufficient amount of redo retention by setting the Oracle initialization parameters UNDO\_MANAGEMENT and UNDO\_RETENTION as follows (in seconds).

```
UNDO_MANAGEMENT=AUTO
UNDO_RETENTION=86400
```

UNDO\_RETENTION can be adjusted upward in high-volume environments.

2. Calculate the space that is required in the undo tablespace by using the following formula.

$$\text{<undo space>} = \text{<UNDO\_RETENTION>} * \text{<UPS>} + \text{<overhead>}$$

Where:

- <undo space> is the number of undo blocks.
- <UNDO\_RETENTION> is the value of the UNDO\_RETENTION parameter (in seconds).
- <UPS> is the number of undo blocks for each second.
- <overhead> is the minimal overhead for metadata (transaction tables, etc.).

Use the system view V\$UNDOSTAT to estimate <UPS> and <overhead>.

3. For tables that contain LOBs, do one of the following:
  - Set the LOB storage clause to RETENTION. This is the default for tables that are created when UNDO\_MANAGEMENT is set to AUTO.
  - If using PCTVERSION instead of RETENTION, set PCTVERSION to an initial value of 25. You can adjust it based on the fetch statistics that are reported with the STATS EXTRACT command (see Table 9). If the value of the STAT\_OPER\_ROWFETCH\_CURRENTBYROWID or STAT\_OPER\_ROWFETCH\_CURRENTBYKEY field in these statistics is high, increase PCTVERSION in increments of 10 until the statistics show low values.

4. Grant the following privileges to the Oracle GoldenGate Extract user:

```
GRANT FLASHBACK ANY TABLE TO <db_user>
```

Or ...

```
GRANT FLASHBACK ON <owner.table> TO <db_user>
```

Oracle GoldenGate provides the following parameters to manage fetching.

**Table 9 Oracle GoldenGate parameters and commands to manage fetching**

Parameter or Command	Description
STATS EXTRACT command with REPORTFETCH option	Shows Extract fetch statistics on demand.
STATOPTIONS parameter with REPORTFETCH option	Sets the STATS EXTRACT command so that it always shows fetch statistics.

Table 9 Oracle GoldenGate parameters and commands to manage fetching (continued)

Parameter or Command	Description
MAXFETCHSTATEMENTS parameter	Controls the number of open cursors for prepared queries that Extract maintains in the source database, and also for SOLEXEC operations.
FETCHOPTIONS parameter with USESNAPSHOT or NOUSESNAPSHOT option	Controls the default fetch behavior of Extract: whether Extract performs a flashback query or fetches the current image from the table.
FETCHOPTIONS parameter with the USELATESTVERSION or NOUSELATESTVERSION option	Handles the failure of an Extract flashback query, such as if the undo retention expired or the structure of a table changed. Extract can fetch the current image from the table or ignore the failure.
REPFETCHEDCOLOPTIONS parameter	Controls the response by Replicat when it processes trail records that include fetched data or column-missing conditions.

## Handling special data types

This section applies whether Extract operates in classic or integrated capture mode, unless otherwise noted. It addresses special configuration requirements for the following Oracle data types:

- [Multibyte character types](#)
- [Oracle Spatial objects](#)
- [TIMESTAMP](#)
- [Large Objects \(LOB\)](#)
- [XML](#)
- [User defined types](#)

### Multibyte character types

Multi-byte characters are supported as part of a supported character set. If the semantics setting of an Oracle source database is BYTE and the setting of an Oracle target is CHAR, use the Replicat parameter SOURCEDEFS in your configuration, and place a DEFGEN-generated definitions file on the target. These steps are required to support the difference in semantics, whether or not the source and target data definitions are identical. Replicat refers to the definitions file to determine the upper size limit for fixed-size character columns.

For more information about character-set support, see “Mapping and manipulating data” in the Oracle GoldenGate *Windows and UNIX Administrator’s Guide*.

For information about SOURCEDEFS and DEFGEN, see the Oracle GoldenGate *Windows and UNIX Administrator’s Guide*.

## Oracle Spatial objects

To replicate georaster tables (tables that contain one or more columns of SDO\_GEOCASTER object type) from an Oracle source to an Oracle target, follow these instructions to configure Oracle GoldenGate to process them correctly.

1. Create a TABLE statement and a MAP statement for the georaster tables *and also for* the related raster data tables.
2. If the METADATA attribute of the SDO\_GEOCASTER data type in any of the values exceeds 1 MB, use the DBOPTIONS parameter with the XMLBUFSIZE option to increase the size of the memory buffer that stores the embedded SYS.XMLTYPE attribute of the SDO\_GEOCASTER data type. If the buffer is too small, Extract abends. For more information about XMLBUFSIZE, see DBOPTIONS in the Oracle GoldenGate *Windows and UNIX Reference Guide*.
3. To ensure the integrity of the target georaster tables and the spatial data, keep the trigger enabled on both source and target.
4. Use the REPERROR option of the MAP parameter to handle the “ORA-01403 No data found” error that occurs as a result of keeping the trigger enabled on the target. It occurs when a row in the source georaster table is deleted, and the trigger cascades the delete to the raster data table. Both deletes are replicated. The replicated parent delete triggers the cascaded (child) delete on the target. When the replicated child delete arrives, it is redundant and generates the error. To use REPERROR, do the following:
  - Use a REPERROR statement in each MAP statement that contains a raster data table.
  - Use Oracle error 1403 as the SQL error.
  - Use any of the response options as the error handling.

A sufficient way to handle the errors on raster tables caused by active triggers on target georaster tables is to use REPERROR with DISCARD to discard the cascaded delete that triggers them. The trigger on the target georaster table performs the delete to the raster data table, so the replicated one is not needed.

```
MAP geo.st_rdt, TARGET geo.st_rdt, REPERROR (-1403, DISCARD);
```

If you need to keep an audit trail of the error handling, use REPERROR with EXCEPTION to invoke exceptions handling. For this, you create an exceptions table and map the source raster data table twice:

- once to the actual target raster data table (with REPERROR handling the 1403 errors).
- again to the exceptions table, which captures the 1403 error and other relevant information by means of a COLMAP clause.

For more information about using an exceptions table, see the Oracle GoldenGate *Windows and UNIX Administrator's Guide*.

For more information about REPERROR options, see the Oracle GoldenGate *Windows and UNIX Reference Guide*.

## TIMESTAMP

To replicate timestamps, follow these guidelines.

1. To prevent Oracle GoldenGate from abending on `TIMESTAMP WITH TIME ZONE` as TZR, use the `Extract` parameter `TRANLOGOPTIONS` with one of the following:
  - `INCLUDEREGIONID` to replicate `TIMESTAMP WITH TIME ZONE` as TZR from an Oracle source to an Oracle target of the same version or later.
  - `INCLUDEREGIONIDWITHOFFSET` to replicate `TIMESTAMP WITH TIMEZONE` as TZR from an Oracle source that is at least v10g to an earlier Oracle target, or from an Oracle source to a non-Oracle target.

These options allow replication to Oracle versions that do not support `TIMESTAMP WITH TIME ZONE` as TZR and to database systems that only support time zone as a UTC offset. For more information, see `TRANLOGOPTIONS` in the *Windows and UNIX Reference Guide*.

2. Because the Oracle database normalizes `TIMESTAMP WITH LOCAL TIME ZONE` data to the local time zone of the database that receives it, the timestamps do not transfer correctly between databases that are in different time zones. For example, data that reflects 5:00 a.m. EST on a source server in New York City becomes 5:00 a.m. PST on a target server in San Francisco, when it should be 2:00 a.m. in San Francisco time to reflect the three-hour difference in time zones.

To adjust the timestamp to the target time zone for all of the records that are applied by Replicat, place the following parameter statement after the `USERID` parameter, but before the first `MAP` statement, in the Replicat parameter file:

```
SQLEXEC "ALTER SESSION SET TIME_ZONE = '<value of source_timezone>'"
```

**Where:** `<value of source_timezone>` is the offset from the source timezone. For example, using the previous example, the value would be `'-03:00.'` Use a `+` or `-` sign, depending on whether the target is ahead of, or behind, the source time.

## Large Objects (LOB)

The following are some configuration guidelines for LOBs in both classic capture and integrated capture mode.

1. Store large objects out of row if possible.
2. Replicat writes LOB data to a target database in fragments. To minimize the effect of this I/O on the system, Replicat enables Oracle's LOB caching mechanism, caches the fragments in a buffer, and performs a write only when the buffer is full. For example, if the buffer is 25,000 bytes in size, Replicat only performs I/O four times given a LOB of 100,000 bytes.
  - To optimize the buffer size to the size of your LOB data, use the `DBOPTIONS` parameter with the `LOBWRITESIZE <size>` option. The higher the value, the fewer the I/O calls made by Replicat to write one LOB.
  - To disable Oracle's LOB caching, use the `DBOPTIONS` parameter with the `DISABLELOBCACHING` option. When LOB caching is disabled, whatever is sent by Replicat to Oracle in one I/O call is written directly to the database media.
3. If CLOB columns can store binary data, set the `NLS_LANG` system environment variable and the `NLS_LANGUAGE` database parameter to the same value.

## XML

The following are tools for working with XML within Oracle GoldenGate constraints.

- Although both classic and integrated capture modes do not support the capture of changes made to an XML schema, you may be able to evolve the schemas and then resume replication of them without the need for a resynchronization. See “Supporting changes to XML schemas” on page 157.
- (Applies only to integrated capture) Integrated capture captures XML from the redo log. For UPDATE operations on an XML document, only the changed portion of the XML is logged if it is stored as OBJECT RELATIONAL or BINARY. To force whole XML documents to be written to the trail when only the changed portion is logged, use the TRANLOGOPTIONS parameter with the FETCHPARTIALXML option in the Extract parameter file. When Extract receives partial XML content from the logmining server, it fetches the full XML document instead of processing the partial XML. For more information, see the Oracle GoldenGate *Windows and UNIX Reference Guide*.

## User defined types

Extract fetches UDTs (except for object tables) from the database. For more information, see “Setting fetch options” on page 65.

## Handling other database properties

The following table shows database properties that may affect Oracle GoldenGate and the parameters that you can use to resolve or work around the condition.

Table 10 Handling other database properties

Database property	Concern/Resolution
Table with unused columns	By default, unused columns are not supported. To support them, use the DBOPTIONS parameter with the ALLOWUNUSEDCOLUMN option to force Extract to generate a warning and continue processing. The same unused column must exist in the target table, or a source definitions file must be created for Replicat with the DEFGEN utility. You can include the appropriate ALTER TABLE...SET UNUSED statements in a DDL replication configuration.
Table with interval partitioning	To support tables with interval partitioning, make certain that the WILDCARDRESOLVE parameter remains at its default of DYNAMIC.
Table with virtual columns	Virtual columns are not logged, and Oracle does not permit DML on virtual columns. You can, however, capture this data and map it to a target column that is not a virtual column by doing the following: <ul style="list-style-type: none"> <li>◆ Include the table in the Extract TABLE statement and use the FETCHCOLS option of TABLE to fetch the value from the virtual column in the database.</li> <li>◆ In the Replicat MAP statement, map the source virtual column to the non-virtual target column.</li> </ul>



Table 10 Handling other database properties

Database property	Concern/Resolution
Table with inherently updateable view	To replicate to an inherently updateable view, define a key on the unique columns in the updateable view by using a KEYCOLS clause in the same MAP statement in which the associated source and target tables are mapped.
Redo logs or archives in different locations	The TRANLOGOPTIONS parameter contains options to handle environments where the redo logs or archives are stored in a different location than the database default or on a different platform from that on which Extract is running.
TRUNCATE operations	To replicate TRUNCATE operations, choose one of two options: <ul style="list-style-type: none"> <li>◆ Standalone TRUNCATE support by means of the GETTRUNCATES parameter replicates TRUNCATE TABLE, but no other TRUNCATE options.</li> <li>◆ The full DDL support replicates TRUNCATE TABLE, ALTER TABLE TRUNCATE PARTITION, and other DDL. To install this support, see “Installing Oracle GoldenGate DDL support for an Oracle database” on page 34.</li> </ul>
Sequences	To replicate DDL for sequences (CREATE, ALTER, DROP, RENAME), use Oracle GoldenGate DDL support.  To replicate just sequence values, use the SEQUENCE parameter in the Extract parameter file. This does <i>not</i> require the Oracle GoldenGate DDL support environment. See SEQUENCE in the Oracle GoldenGate Windows and UNIX Reference Guide for additional requirements.

## Using Oracle GoldenGate with Oracle Exadata

Oracle GoldenGate supports Oracle Exadata Database Machine as follows:

- Oracle GoldenGate can capture from Exadata in either classic capture or integrated capture mode, but to capture from Exadata with EHCC compression enabled, Extract must be in integrated capture mode.
- Oracle GoldenGate can replicate data from any supported database to Exadata.

In general, the configuration of Oracle GoldenGate to operate with Exadata is the same as any other Oracle GoldenGate configuration. These instructions highlight configuration requirements that are different from the standard Oracle GoldenGate installation.

### Migrating to Oracle Exadata

Oracle GoldenGate supports the logical migration of data to Exadata with unload and reload performed through SQL. To migrate from other databases to Exadata Database Machine, you can do one of the following:

- [Migrate to Exadata by using an initial load](#)
- [Migrate to Exadata by using an active-passive configuration](#)

### ***Migrate to Exadata by using an initial load***

One way to migrate from your original database to Exadata is to perform a simple initial load from one system to the other. This is a uni-directional initial synchronization of the source and target tables, while Oracle GoldenGate captures any ongoing transactions that must remain active. Install Oracle GoldenGate on both systems, and follow the configuration, database setup, and initial load instructions in this guide. For additional initial load options, see the Oracle GoldenGate *Windows and UNIX Administrator's Guide*.

### ***Migrate to Exadata by using an active-passive configuration***

You can use an active-passive bi-directional configuration to migrate to Exadata. The active database is the “primary” database from which the data is being migrated, and the “passive” database is the Exadata machine. In this configuration, the Exadata machine can work in tandem with the original system until testing is completed and you switch operations over to the Exadata machine.

No special setup is needed if using integrated capture to deploy this configuration. However, to use classic capture mode, include the following TRANLOGOPTIONS statements in the Extract parameter file on the Exadata machine:

- TRANLOGOPTIONS with DBLOGREADER: Uses the Oracle database server to access the log files, instead of connecting to the Oracle ASM instance, for improved read performance. This option is supported for Oracle 10.2.0.5, and for Oracle 11.1.0.7 and later 11g R2 versions (but not Oracle 11g R1 versions).
- TRANLOGOPTIONS with ASMUSER: Logs into ASM to access the log files. This option provides a backup in the event that the source database becomes unavailable, so that Extract can continue to read the log files directly in ASM.

Each of these should be a separate TRANLOGOPTIONS parameter statement: comment out the ASMUSER one until it is needed in a database server failure. For syntax for these parameters and other options for tuning ASM interactivity, see TRANLOGOPTIONS in the Oracle GoldenGate *Windows and UNIX Reference Guide*.

To deploy a migration to Exadata using an active-passive configuration:

- Install Oracle GoldenGate on both systems, and follow the configuration, database setup, and initial load instructions in this guide.
- For the specifics of configuring the active-passive topology, see “Using Oracle GoldenGate to maintain a live standby database” of the Oracle GoldenGate *Windows and UNIX Administrator's Guide*.

### **Replicating to Exadata with EHCC enabled**

To ensure successful delivery of insert operations to Oracle Exadata with Hybrid Columnar Compression (EHCC), use the INSERTAPPEND parameter in the Replicat parameter file. INSERTAPPEND causes Replicat to use an APPEND hint for inserts so they remain compressed. Without this hint, the record will be inserted uncompressed. For more information about INSERTAPPEND, see the Oracle GoldenGate *Windows and UNIX Reference Guide*.

## CHAPTER 6

# Additional requirements for classic capture

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This chapter contains preparation requirements for Extract in classic capture mode. For more information about classic capture, see “Deciding which capture method to use” on page 40.

## Capturing Oracle TDE-encrypted data in classic capture mode

The following special configuration steps are required to support TDE when Extract is in classic capture mode.

### Required database patches

To support TDE, download and apply Oracle Patch 10395645 to the source database. If you cannot find this patch on the My Oracle Support website (<https://support.oracle.com>), submit a service request (SR) and request a backport.

### Overview of TDE support in classic capture

TDE support when Extract is in classic capture mode requires the exchange of two kinds of keys:

- The *encrypted key* can be a table key (column-level encryption), an encrypted redo log key (tablespace-level encryption), or both. A key is shared between the Oracle server and Extract.
- The *decryption key* is a password known as the *shared secret* that is stored securely in the Oracle and Oracle GoldenGate domains. Only a party that has possession of the shared secret can decrypt the table and redo log keys.

The encrypted keys are delivered to the Extract process by means of built-in PL/SQL code. Extract uses the shared secret to decrypt the data. Extract never handles the wallet Master Key itself, nor is it aware of the Master Key password. Those remain within the Oracle server security framework.

Extract never writes the decrypted data to any file other than a trail file, not even a discard file (specified with the DISCARDFILE parameter). The word “ENCRYPTED” will be written to any discard file that is in use.

The impact of this feature on Oracle GoldenGate performance should mirror that of the impact of decryption on database performance. Other than a slight increase in Extract startup time, there should be a minimal affect on performance from replicating TDE data.

### Requirements for capturing TDE in classic capture mode

- To maintain high security standards, the Oracle GoldenGate Extract process should run as part of the Oracle User (the user that runs the Oracle Server). That way, the keys are protected in memory by the same privileges as the Oracle User.

- The Extract process must run on the same machine as the database installation.

### Configuring TDE support

The following outlines the steps that the Oracle Security Officer and the Oracle GoldenGate Administrator take to establish communication between the Oracle server and the Extract process.

**Table 11** Steps to configure Oracle TDE support

Person	Responsibility
Oracle Security Officer <i>and</i> Oracle GoldenGate Administrator	Agree on a shared secret (password) that meets or exceeds Oracle password standards. This password must not be known by anyone else. For more information, see the <i>Oracle Database Security Guide</i> .
Oracle Security Officer	<ol style="list-style-type: none"> <li>1. Issue the following MKSTORE command to create an "ORACLEGG" entry in the Oracle wallet. ORACLEGG must be the name of the key. Do not supply the shared secret on the command line; instead, supply it when prompted. <pre> mkstore -wrl ./ -createEntry ORACLE.SECURITY.CL.ENCRYPTION.ORACLEGG  Enter &lt;secret&gt; </pre> </li> <li>2. Copy the wallet that contains the shared secret to each node, and then reopen the wallets. <b>Note:</b> With Oracle 11gR2, there is one wallet in a shared location, with synchronized access among all nodes.</li> <li>3. Run the <code>prvtckm.plb</code> file that is installed in the Oracle GoldenGate installation directory.</li> </ol>

**Table 11 Steps to configure Oracle TDE support**

Person	Responsibility
Oracle GoldenGate Administrator	<ol style="list-style-type: none"> <li>1. Grant EXEC privilege on the dbms_internal_cklm.get_key procedure to the Extract database user. This procedure facilitates sharing of the encrypted keys between the Oracle Server and Extract.</li> <li>2. Run GGSCI and issue the ENCRYPT PASSWORD command to encrypt the shared secret so that it is obfuscated within the Extract parameter file. <i>This is a security requirement.</i> ENCRYPT PASSWORD takes the clear-text string as input and provides options for encrypting it with an Oracle GoldenGate-generated default key or a user-defined key that is stored in a secure local ENCKEYS file. For instructions, see the security chapter of the Oracle GoldenGate <i>Windows and UNIX Administrator's Guide</i>.</li> <li>3. In the Extract parameter file, use the DBOPTIONS parameter with the DECRYPTPASSWORD option. As input, supply the encrypted shared secret and the Oracle GoldenGate-generated or user-defined decryption key. For syntax options, see the Oracle GoldenGate <i>Windows and UNIX Reference Guide</i>.</li> <li>4. Close, and then open, the Oracle wallet before you start Extract. This step works around issues with caching that can cause an ORA-28360 (security module) error.</li> </ol> <p>Note: Close and then open the wallet whenever a shared secret is created or changed.</p>

### Recommendations for maintaining data security after decryption

Extract decrypts the TDE data and writes it to the trail as clear text. To maintain data security throughout the path to the target tables, it is recommended that you also deploy Oracle GoldenGate security features to:

- encrypt the data in the trails
- encrypt the data in transit across TCP/IP

For more information, see the security chapter in the *GoldenGate for Windows and UNIX Administrator Guide*.

### Performing DDL while TDE capture is active

If DDL will ever be performed on a table that has column-level encryption, or if table keys will ever be re-keyed, you must either quiesce the table while the DDL is performed or enable Oracle GoldenGate DDL support. It is more practical to have the DDL environment active so that it is ready, because a re-key usually is a response to a security violation and must be performed immediately. To install the Oracle GoldenGate DDL environment, see the instructions in this guide. To configure Oracle GoldenGate DDL support, see the *GoldenGate for Windows and UNIX Administrator Guide*. For tablespace-level encryption, the Oracle GoldenGate DDL support is not required.

## Changing the Oracle shared secret

Use this procedure to change the shared secret that supports Oracle Transparent Data Encryption. You can change the shared secret when needed, but "ORACLEGG" must remain the name of the key.

1. Stop the Extract process.

```
STOP EXTRACT <group>
```

2. Issue the following MKSTORE command to modify the "ORACLEGG" entry in the Oracle wallet. Do not supply the new shared secret on the command line; instead, supply it when prompted.

```
mkstore -wrl ./ -modifyEntry ORACLE.SECURITY.CL.ENCRYPTION.ORACLEGG  
Enter <secret>
```

**NOTE** To change the shared secret, the parameter 'modifyEntry' is used instead of "createEntry," because you are modifying an existing wallet entry.

3. Use the ENCRYPT PASSWORD command in GGSCI to encrypt the new shared secret. For instructions, see the security chapter of the Oracle GoldenGate *Windows and UNIX Administrator's Guide*.
4. Replace the old encrypted shared secret and decryption key with the new ones in the Extract parameter file by modifying the DECRYPTPASSWORD option of DBOPTIONS. For syntax options, see the Oracle GoldenGate *Windows and UNIX Reference Guide*.
5. Close, and then open, the Oracle wallet before you start Extract. This process works around issues with caching that can cause an ORA-28360 error.
6. Start Extract.

```
START EXTRACT <group>
```

## Using Oracle GoldenGate in an Oracle RAC environment

These guidelines apply to Oracle RAC when Extract is operating in classic capture mode.

### General requirements for operating within Oracle RAC

- During operations, if the primary database instance against which Oracle GoldenGate is running stops or fails for any reason, Extract abends. To resume processing, you can restart the instance or mount the Oracle GoldenGate binaries to another node where the database is running and then restart the Oracle GoldenGate processes. Stop the Manager process on the original node before starting Oracle GoldenGate processes from another node.
- Whenever the number of redo threads changes, the Extract group must be dropped and re-created. For the recommended procedure, see the Oracle GoldenGate *Windows and UNIX Administrator's Guide*.
- Extract ensures that transactions are written to the trail file in commit order, regardless of the RAC instance where the transaction originated. When Extract is capturing in archived-log-only (ALO) mode, where one or more RAC instances may be idle, you may need to perform archive log switching on the idle nodes to ensure that operations from the active instances are recorded in the trail file in a timely manner.

You can instruct the Oracle RDBMS to do this log archiving automatically at a preset interval by setting the `archive_lag_target` parameter. For example, to ensure that logs are archived every fifteen minutes, regardless of activity, you can issue the following command in all instances of the RAC system:

```
SQL> alter system set archive_lag_target 900
```

- To process the last transaction in a RAC cluster before shutting down Extract, insert a dummy record into a source table that Oracle GoldenGate is replicating, and then switch log files on all nodes. This updates the Extract checkpoint and confirms that all available archive logs can be read. It also confirms that all transactions in those archive logs are captured and written to the trail in the correct order.

### Special Oracle GoldenGate parameters for Oracle RAC

The following table shows some Oracle GoldenGate parameters that are of specific benefit in Oracle RAC.

**Table 12 Oracle GoldenGate parameters for Oracle RAC**

Parameter	Description
THREADOPTIONS parameter with the INQUEUESIZE and OUTQUEUESIZE options	Sets the amount of data that Extract queues in memory before sending it to the target system. Tuning these parameters might increase Extract performance on Oracle RAC.
TRANLOGOPTIONS parameter with the PURGEORPHANEDTRANSACTIONS   NOPURGEORPHANEDTRANSACTIONS and TRANCLEANUPFREQUENCY options	Controls how Extract handles orphaned transactions, which can occur when a node fails during a transaction and Extract cannot capture the rollback. Although the database performs the rollback on the failover node, the transaction would otherwise remain in the Extract transaction list indefinitely and prevent further checkpointing for the Extract thread that was processing the transaction. By default, Oracle GoldenGate purges these transactions from its list after they are confirmed as orphaned. This functionality can also be controlled on demand with the SEND EXTRACT command in GGSCI.

## Capturing from an Oracle ASM instance when in classic capture mode

This topic covers additional configuration requirements that apply when Oracle GoldenGate operates against transaction logs that are stored in Oracle Automatic Storage Management (ASM). Oracle GoldenGate requires a connection to the ASM instance to be able to read the logs.

### Accessing the transaction logs in ASM

Extract must be configured to read logs that are stored in ASM. Depending on the ASM version, the following options are available:

#### *Optimal ASM connection from the database server*

Use the TRANLOGOPTIONS parameter with the DBLOGREADER option in the Extract parameter

file if the ASM instance is one of the following versions:

- Oracle 10.2.0.5 or later 10g R2 versions
- Oracle 11.2.0.2 or later 11g R2 versions

A newer ASM API is available in those releases (but not in Oracle 11g R1 versions) that uses the database server to access the redo and archive logs. When used, this API enables Extract to use a read buffer size of up to 4 MB in size. A larger buffer may improve the performance of Extract when redo rate is high. You can use the `DBLOGREADERBUFSIZE` option of `TRANLOGOPTIONS` to specify a buffer size.

**ASM direct connection**

If the ASM version is not one of those listed in “Optimal ASM connection from the database server”, do the following:

1. Create a user for the Extract process to access the ASM instance directly. Assign this user `SYS` or `SYSDBA` privileges in the ASM instance. Oracle GoldenGate does not support using operating-system authentication for the ASM user. See Table 13 for additional details.

**Table 13** Extract database privileges — ASM instance

ASM password configuration <sup>1</sup>	Permitted user
ASM instance and the database share a password file	You can use the Oracle GoldenGate source database user if you grant that user <code>SYSDBA</code> , or you can use any other database user that has <code>SYSDBA</code> privileges.
ASM instance and the source database have separate password files	You can overwrite the ASM password file with the source database password file, understanding that this procedure changes the <code>SYS</code> password in the ASM instance to the value that is contained in the database password file, and it also grants ASM access to the other users in the database password file. Save a copy of the ASM file before overwriting it.

<sup>1</sup> To view how the current ASM password file is configured, log on to the ASM instance and issue the following command in SQL\*Plus:

```
SQL> SELECT name, value FROM v$parameter
WHERE name = 'remote_login_passwordfile';
```

2. Specify the ASM user with the `TRANLOGOPTIONS` parameter with the `ASMUSER` option.

For syntax, additional information, and related parameters, see `TRANLOGOPTIONS` in the Oracle GoldenGate *Windows and UNIX Reference Guide*.

**Ensuring ASM connectivity**

To ensure that the Oracle GoldenGate Extract process can connect to an ASM instance, list the ASM instance in the `tnsnames.ora` file. The recommended method for connecting to an ASM instance when Oracle GoldenGate is running on the database host machine is to use



a bequeath (BEQ) protocol. The BEQ protocol does not require a listener. If you prefer to use the TCP/IP protocol, verify that the Oracle listener is listening for new connections to the ASM instance. The listener.ora file must contain an entry similar to the following.

```
SID_LIST_LISTENER_ASM =  
  (SID_LIST =  
    (SID_DESC =  
      (GLOBAL_DBNAME = ASM)  
      (ORACLE_HOME = /u01/app/grid)  
      (SID_NAME = +ASM1)  
    )  
  )  
)
```

**NOTE** A BEQ connection does not work when using a remote Extract configuration, so in that case, configure TNSNAMES with the TCP/IP protocol.

## Ensuring data availability

To ensure the continuity and integrity of capture processing when Extract operates in classic capture mode, enable archive logging. The archive logs provide a secondary data source should the online logs recycle before Extract is finished with them. The archive logs for open transactions must be retained on the system in case Extract needs to recapture data from them to perform a recovery.

**WARNING** If you cannot enable archive logging, there is a high risk that you will need to completely resynchronize the source and target objects and reinitiate replication should there be a failure that causes an Extract outage while transactions are still active. If you must operate this way, configure the online logs according to the following guidelines to retain enough data for Extract to capture what it needs before the online logs recycle. Allow for Extract backlogs caused by network outages and other external factors, as well as long-running transactions.

In a RAC configuration, Extract must have access to the online and archived logs for all nodes in the cluster, including the one where Oracle GoldenGate is installed.

## Log retention requirements per Extract recovery mode

The following summarizes the different recovery modes that Extract might use and their log-retention requirements:

- By default, the Bounded Recovery mode is in effect, and Extract requires access to the logs only as far back as twice the Bounded Recovery interval that is set with the BR parameter. This interval is an integral multiple of the standard Extract checkpoint interval, as controlled by the CHECKPOINTSECS parameter. These two parameters control the Oracle GoldenGate Bounded Recovery feature, which ensures that Extract can recover in-memory captured data after a failure, no matter how old the oldest open transaction was at the time of failure. For more information about this requirement, see the BR parameter documentation in the Oracle GoldenGate *Windows and UNIX Reference Guide*.

- In the unlikely event that the Bounded Recovery mechanism fails when Extract attempts a recovery, Extract reverts to normal recovery mode and must have access to the archived log that contains the beginning of the oldest open transaction in memory at the time of failure and all logs thereafter.

## Log retention options

Depending on the version of Oracle, there are different options for ensuring that the required logs are retained on the system.

### *Oracle Enterprise Edition 10.2 and later*

For these versions, Extract can be configured to work with Oracle Recovery Manager (RMAN) to retain the logs that Extract needs for recovery. You enable this feature when you issue the REGISTER EXTRACT command before creating your Extract processes (see “Configuring Extract for change capture” on page 47).

To use this feature, the Extract database user must have the following privileges, in addition to the basic privileges listed on page 43.

**Table 14** Extract database privileges —Log retention in Oracle EE 10.2 and later

Oracle EE version	Privileges
10.2	<ol style="list-style-type: none"> <li>1. Run package to grant Oracle Streams admin privilege. <code>exec dbms_streams_auth.grant_admin_privilege('&lt;user&gt;')</code></li> <li>2. Grant INSERT into logmnr_restart_ckpt\$. <code>grant insert on system.logmnr_restart_ckpt\$ to &lt;user&gt;;</code></li> <li>3. Grant UPDATE on streams\$_capture_process. <code>grant update on sys.streams\$_capture_process to &lt;user&gt;;</code></li> <li>4. Grant the 'become user' privilege. <code>grant become user to &lt;user&gt;;</code></li> </ol>
11.1 and 11.2.0.1	<ol style="list-style-type: none"> <li>1. Run package to grant Oracle Streams admin privilege. <code>exec dbms_streams_auth.grant_admin_privilege('&lt;user&gt;')</code></li> <li>2. Grant the 'become user' privilege. <code>grant become user to &lt;user&gt;;</code></li> </ol>
11.2.0.2 and later	<p>Run package to grant Oracle Streams admin privilege. <code>exec dbms_goldengate_auth.grant_admin_privilege('&lt;user&gt;')</code></p>

When log retention is enabled, Extract retains enough logs to perform a Bounded Recovery, but you can configure Extract to retain enough logs through RMAN for a normal recovery by using the TRANLOGOPTIONS parameter with the LOGRETENTION option set to SR. There also is an option to disable the use of RMAN log retention. Review the options of LOGRETENTION in the Oracle GoldenGate *Windows and UNIX Reference Guide* before you configure Extract. If you set LOGRETENTION to DISABLED, see “Determining how much data to retain”.

**NOTE** To support RMAN log retention on Oracle RAC, you must download and install the database patch that is provided in BUGFIX 11879974 before you add the Extract groups.

The RMAN log retention feature creates an underlying (but non-functioning) Oracle Streams Capture process for each Extract group. The name of the Capture is based on the name of the associated Extract group. The log retention feature can operate concurrently with other local Oracle Streams installations. When you create an Extract group, the logs are retained from the current database SCN.

**NOTE** If the Oracle Flashback storage area is full, RMAN purges the archive logs even when needed by Extract. This limitation exists so that the requirements of Extract (and other Oracle replication components) do not interfere with the availability of redo to the database.

To have even more integration of Oracle GoldenGate capture with the Oracle database engine, you can use integrated capture if the source database is Oracle 11.2.0.2 or later. In integrated capture mode, log retention is enabled automatically, and Extract receives data changes directly from a database logmining server instead of reading the redo logs directly. See “About integrated capture” on page 41.

#### **All other Oracle versions**

For versions of Oracle other than Enterprise Edition 10.2 and later, you must manage the log retention process with your preferred administrative tools. Follow the directions in “Determining how much data to retain”.

### **Determining how much data to retain**

When managing log retention, try to ensure rapid access to the logs that Extract would require to perform a normal recovery (not a Bounded Recovery). See “Log retention requirements per Extract recovery mode”. If you must move the archives off the database system, the `TRANLOGOPTIONS` parameter provides a way to specify an alternate location. See “Specifying the archive location”.

The recommended retention period is at least 24 hours worth of transaction data, including both online and archived logs. To determine the oldest log that Extract might need at any given point, issue the `SEND EXTRACT` command with the `SHOWTRANS` option. 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 online or archived logs, one of the following corrective actions might be required:

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

### **Purging log archives**

Make certain not to use backup or archive options that cause old archive files to be overwritten by new backups. Ideally, new backups should be separate files with different names from older ones. This ensures that if Extract looks for a particular log, it will still exist, and it also ensures that the data is available in case it is needed for a support case.

## Specifying the archive location

If the archived logs reside somewhere other than the Oracle default directory, specify that directory with the `ALTARCHIVELOGDEST` option of the `TRANLOGOPTIONS` parameter in the Extract parameter file.

You might also need to use the `ALTARCHIVEDLOGFORMAT` option of `TRANLOGOPTIONS` if the format that is specified with the Oracle parameter `LOG_ARCHIVE_FORMAT` contains sub-directories. `ALTARCHIVEDLOGFORMAT` specifies an alternate format that removes the sub-directory from the path. For example, `%T/log_%t_%s_%r.arc` would be changed to `log_%t_%s_%r.arc`. As an alternative to using `ALTARCHIVEDLOGFORMAT`, you can create the sub-directory manually, and then move the log files to it.

## Mounting logs that are stored on other platforms

If the online and archived redo logs are stored on a different platform from the one that Extract is built for, do the following:

- NFS-mount the archive files.
- Map the file structure to the structure of the source system by using the `LOGSOURCE` and `PATHMAP` options of the Extract parameter `TRANLOGOPTIONS`. For more information, see the Oracle GoldenGate *Windows and UNIX Reference Guide*.

## Configuring Oracle GoldenGate to read only the archived logs

You can configure Extract to read exclusively from the archived logs. This is known as *Archived Log Only (ALO)* mode. In this mode, Extract reads exclusively from archived logs that are stored in a specified location. ALO mode enables Extract to use production logs that are shipped to a secondary database (such as a standby) as the data source. The online logs are not used at all. Oracle GoldenGate connects to the secondary database to get metadata and other required data as needed. As an alternative, ALO mode is supported on the production system.

**NOTE** ALO mode is not compatible with Extract operating in integrated capture mode.

### Limitations and requirements of ALO mode

- Log resets (`RESETLOG`) cannot be done on the source database after the standby database is created.
- ALO cannot be used on a standby database if the production system is Oracle RAC and the standby database is non-RAC. In addition to both systems being Oracle RAC, the number of nodes on each system must be identical.
- ALO on Oracle RAC requires a dedicated connection to the source server. If that connection is lost, Oracle GoldenGate processing will stop.
- On Oracle RAC, the directories that contain the archive logs must have unique names across all nodes; otherwise, Extract may return “out of order SCN” errors.
- ALO mode does not support archive log files in ASM mode. The archive log files must be outside the ASM environment for Extract to read them.
- The `LOGRETENTION` parameter defaults to `DISABLED` when Extract is in ALO mode. You can override this with a specific `LOGRETENTION` setting, if needed.

## Configuring Extract for ALO mode

1. Enable supplemental logging at the table level and the database level for the tables in the source database. (See “Configuring the source database to log key values” on page 62.)
2. When Oracle GoldenGate is running on a different server from the source database, make certain that SQL\*Net is configured properly to connect to a remote server, such as providing the correct entries in a TNSNAMES file. Extract must have permission to maintain a SQL\*Net connection to the source database.
3. Use a SQL\*Net connect string in:
  - The USERID parameter in the parameter file of every Oracle GoldenGate process that connects to that database.
  - The DBLOGIN command in GGSCI.

Example USERID statement:

```
USERID ggext@ora01, PASSWORD ggs123
```

**NOTE** If you have a standby server that is local to the server that Oracle GoldenGate is running on, you do not need to use a connect string in USERID. You can just supply the user login name.

4. Use the Extract parameter **TRANLOGOPTIONS** with the **ARCHIVEDLOGONLY** option. This option forces Extract to operate in ALO mode against a primary or logical standby database, as determined by a value of PRIMARY or LOGICAL STANDBY in the `db_role` column of the `v$database` view. The default is to read the online logs. **TRANLOGOPTIONS** with **ARCHIVEDLOGONLY** is not needed if using ALO mode against a physical standby database, as determined by a value of PHYSICAL STANDBY in the `db_role` column of `v$database`. Extract automatically operates in ALO mode if it detects that the database is a physical standby.
5. Other **TRANLOGOPTIONS** options might be required for your environment. For example, depending on the copy program that you use, you might need to use the **COMPLETEARCHIVEDLOGONLY** option to prevent Extract errors.
6. Use the **MAP** parameter for Extract to map the table names to the source object IDs. For more information, see the Oracle GoldenGate *Windows and UNIX Reference Guide*.
7. Add the Extract group by issuing the **ADD EXTRACT** command with a timestamp as the **BEGIN** option, or by using **ADD EXTRACT** with the **SEQNO** and **RBA** options. It is best to give Extract a known start point at which to begin extracting data, rather than by using the **NOW** argument. The start time of “NOW” corresponds to the time of the current *online* redo log, but an ALO Extract cannot read the online logs, so it must wait for that log to be archived when Oracle switches logs. The timing of the switch depends on the size of the redo logs and the volume of database activity, so there might be a lag between when you start Extract and when data starts being captured. This can happen in both regular and RAC database configurations.

**NOTE** If Extract appears to stall while operating in ALO mode, see the Oracle GoldenGate *Windows and UNIX Troubleshooting and Tuning Guide* for help with diagnosing the problem.

## Avoiding log-read bottlenecks

When Oracle GoldenGate captures data from the redo logs, I/O bottlenecks can occur because Extract is reading the same files that are being written by the database logging mechanism. Performance degradation increases with the number of Extract processes that read the same logs. You can:

- Try using faster drives and a faster controller. Both Extract and the database logging mechanism will be faster on a faster I/O system.
- Store the logs on RAID 0+1. Avoid RAID 5, which performs checksums on every block written and is not a good choice for high levels of continuous I/O. For more information, see the Oracle documentation or search related web sites.

CHAPTER 7

# Configuring DDL synchronization for an Oracle database

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This chapter contains information to help you understand and configure DDL support in Oracle GoldenGate.

## Overview of DDL synchronization

Oracle GoldenGate supports the synchronization of DDL operations from one database to another. DDL synchronization can be active when:

- business applications are actively accessing and updating the source and target objects.
- Oracle GoldenGate transactional data synchronization is active.

The components that support the replication of DDL and the replication of transactional data changes (DML) are independent of each other. Therefore, you can synchronize:

- just DDL changes
- just DML changes
- both DDL and DML

For a list of supported objects and operations for DDL support for Oracle, see the Oracle GoldenGate *Oracle Installation and Setup Guide*.

## Limitations of Oracle GoldenGate DDL support

This topic contains some limitations of the DDL feature. For any additional limitations that were found after this documentation was published, see the Oracle GoldenGate release notes or the readme file that comes with the software.

### DDL statement length

Oracle GoldenGate measures the length of a DDL statement in bytes, not in characters. The supported length is approximately 2 MB, allowing for some internal overhead that can vary in size depending on the name of the affected object and its DDL type, among other characteristics. If the DDL is longer than the supported size, Extract will issue a warning and ignore the DDL operation.

The ignored DDL is saved in the marker table. You can capture Oracle DDL statements that are ignored, as well as any other Oracle DDL statement, by using the `ddl_ddl2file.sql` script, which saves the DDL operation to a text file in the `USER_DUMP_DEST` directory of Oracle. The script prompts for the following input:

- The name of the schema that contains the Oracle GoldenGate DDL objects, which is specified in the GLOBALS file
- The Oracle GoldenGate marker sequence number, which is recorded in the Extract report file when DDLOPTIONS with the REPORT option is used in the Extract parameter file
- A name for the output file

## Supported topologies

Oracle GoldenGate supports DDL synchronization only in a like-to-like configuration. The source and target object definitions must be identical.

Oracle GoldenGate does not support DDL on a standby database.

Oracle GoldenGate supports DDL replication in all supported uni-directional configurations, and in bi-directional configurations between two, and only two, systems. For special considerations in an Oracle active-active configuration, see “Propagating DDL in an active-active (bi-directional) configurations” on page 109.

## Filtering, mapping, and transformation

DDL operations cannot be transformed by any Oracle GoldenGate process. However, source DDL can be mapped and filtered to a different target object by a primary Extract or a Replicat process. Mapping or filtering of DDL by a data-pump Extract is not permitted, and the DDL is passed as it was received from the primary Extract. This is known as PASSTHRU mode.

For example, ALTER TABLE TableA is processed by a data pump as ALTER TABLE TableA. It cannot be mapped by that process as ALTER TABLE TableB, regardless of any TABLE statements that specify otherwise.

## Renames

- RENAME operations on tables are converted to the equivalent ALTER TABLE RENAME. For example RENAME tab1 TO tab2 would be changed to ALTER TABLE tab1 RENAME TO tab2. The reason for this conversion is that RENAME does not support the use of a schema name, but ALTER TABLE RENAME does. Oracle GoldenGate makes the conversion so that a schema name can be included in the target DDL statement. The conversion is reported in the Replicat process report file.
- An ALTER TABLE RENAME will fail if the old or new table name is longer than 18 characters (16 for the name and two for the quotation marks). Oracle only allows 18 characters for a rename because of the ANSI limit for identifiers.
- RENAME operations on sequences and views cannot be converted to an ALTER statement, because there is no such statement in Oracle for sequences and views. Consequently, sequence renames are always replicated on the target with the same owner and object name as in the source DDL and cannot be mapped to something different.

## Interactions between fetches from a table and DDL

Oracle GoldenGate supports some data types by identifying the modified row from the redo stream and then querying the underlying table to fetch the changed columns. For instance, in classic capture, partial updates on LOBs (modifications done via dbms\_lob package) are supported by identifying the modified row and the LOB column from the redo log, and then



querying for the LOB column value for the row from the base table. A similar technique is employed to support User Defined Types (both in classic and integrated capture).

Such fetch-based support is implemented by issuing a flashback query to the database based on the SCN (System Change Number) at which the transaction committed. The flashback query feature has certain limitations. Certain DDL operations act as barriers such that flashback queries to get data prior to these DDLs do not succeed. Examples of such DDL are "ALTER TABLE MODIFY COLUMN" and "ALTER TABLE DROP COLUMN".

Thus, in cases where there is Extract capture lag, an intervening DDL may cause fetch requests for data prior to the DDL to fail. In such cases, Extract falls back and fetches the current snapshot of the data for the modified column. There are two limitations to this approach: First, the DDL could have modified the column that Extract needs to fetch (for example, suppose the intervening DDL added a new attribute to the UDT that is being captured). Second, the DDL could have modified one of the columns that Extract uses as a logical row identifier.

To prevent fetch-related inconsistencies such as these, take the following precautions while modifying columns.

1. Pause all DML to the table.
2. Wait for Extract to finish capturing all remaining redo, and wait for Replicat to finish processing the captured data from trail. To determine whether Replicat is finished, issue the following command in GGSCI until you see a message that there is no more data to process.

```
INFO REPLICAT <group>
```

3. Execute the DDL on the source.
4. Resume source DML operations.

## Comments in SQL

If a source DDL statement contains a comment in the middle of an object name, that comment will appear at the end of the object name in the target DDL statement. For example:

Source	Target
CREATE TABLE hr./*comment*/emp ...	CREATE TABLE hr.emp /*comment*/ ...

This does not affect the integrity of DDL synchronization. Comments in any other area of a DDL statement remain in place when replicated.

## Compilation errors

If a CREATE operation on a trigger, procedure, function, or package results in compilation errors, Oracle GoldenGate executes the DDL operation on the target anyway. Technically, the DDL operations themselves completed successfully and should be propagated to allow dependencies to be executed on the target, for example in recursive procedures.

## Interval partitioning

DDL replication is unaffected by interval partitioning, because the DDL is implicit.

## Configuration guidelines for DDL support

The following are guidelines to take into account when configuring Oracle GoldenGate processes to support DDL replication.

### Database privileges

See the Oracle GoldenGate *Oracle Installation and Setup Guide* for database privileges that are required for Oracle GoldenGate to support DDL capture and replication.

### Parallel processing

If using parallel Extract and/or Replicat processes, keep related DDL and DML together in the same process stream to ensure data integrity. Configure the processes so that:

- all DDL and DML for any given object are processed by the same Extract group and by the same Replicat group.
- all objects that are relational to one another are processed by the same process group.

For example, if ReplicatA processes DML for Table1, then it should also process the DDL for Table1. If Table2 has a foreign key to Table1, then its DML and DDL operations also should be processed by ReplicatA.

If an Extract group writes to multiple trails that are read by different Replicat groups, Extract sends all of the DDL to all of the trails. Use each Replicat group to filter the DDL by using the filter options of the DDL parameter in the Replicat parameter file.

### DDL and DML in data pumps

If using a data pump, configure DML for PASSTHRU mode if the objects are using DDL support. DDL is passed through a data pump in PASSTHRU mode, so the same must be true of the DML. Any filtering, mapping, or transformation of the DML must be done by the primary Extract or by Replicat. However, tables that do not use DDL support can be configured in NOPASSTHRU mode to allow data filtering, and manipulation by a data pump.

To configure tables for PASSTHRU, NOPASSTHRU, or both

1. In the parameter file of the data pump, place the PASSTHRU parameter before all of the TABLE statements that contain tables that use DDL support.
2. In the same parameter file, you can place the NOPASSTHRU parameter before any TABLE statements that contain tables that do not use DDL support, if you want data filtering, mapping, or transformation to be performed for them.
3. Do not use any of the DDL configuration parameters for a data pump: DDL, DDLOPTIONS, DDLSUBST, PURGEDDLHISTORY, PURGEMARKERHISTORY, DDLERROR, or any of the Oracle GoldenGate tracing parameters with DDL options.

For more information about PASSTHRU and NOPASSTHRU, see the Oracle GoldenGate *Windows and UNIX Reference Guide*.

## Object names

Oracle GoldenGate preserves the database-defined object name, case, and character set. This support preserves single-byte and multibyte names, symbols, and accent characters at all levels of the database hierarchy. For more information about support for object names, see “Mapping and manipulating data” in the Oracle GoldenGate *Windows and UNIX Administrator's Guide*.

You can use the question mark (?) and asterisk (\*) wildcards to specify object names in configuration parameters that support DDL synchronization. For more information about support for wildcards, see “Mapping and manipulating data” in the Oracle GoldenGate *Windows and UNIX Administrator's Guide*. To process wildcards correctly, the WILDCARDRESOLVE parameter is set to DYNAMIC by default. If WILDCARDRESOLVE is set to anything else, the Oracle GoldenGate process that is processing DDL operations will abend and write the error to the process report.

## Data definitions

Because DDL support requires a like-to-like configuration, the ASSUMETARGETDEFS parameter must be used in the Replicat parameter file. Replicat will abend if objects are configured for DDL support and the SOURCEDEFS parameter is being used. For more information about ASSUMETARGETDEFS, see the Oracle GoldenGate *Windows and UNIX Reference Guide*.

## Truncates

TRUNCATE statements can be supported as follows:

- As part of the Oracle GoldenGate full DDL support, which supports TRUNCATE TABLE, ALTER TABLE TRUNCATE PARTITION, and other DDL. This is controlled by the DDL parameter (see “Enabling DDL support” on page 94).
- As standalone TRUNCATE support. This support enables you to replicate TRUNCATE TABLE, but no other DDL. The GETTRUNCATES parameter controls the standalone TRUNCATE feature. For more information, see the Oracle GoldenGate *Windows and UNIX Reference Guide*.

To avoid errors from duplicate operations, only one of these features can be active at the same time.

## Initial synchronization

To configure DDL replication, start with a target database that is synchronized with the source database. DDL support is compatible with the Replicat initial load method.

Before executing an initial load, disable DDL extraction and replication. DDL processing is controlled by the DDL parameter in the Extract and Replicat parameter files.

After initial synchronization of the source and target data, use all of the source sequence values at least once with NEXTVAL before you run the source applications. You can use a script that selects NEXTVAL from every sequence in the system. This must be done while Extract is running.

## Data continuity after CREATE or RENAME

To replicate DML operations on new Oracle tables resulting from a CREATE or RENAME operation, the names of the new tables must be specified in TABLE and MAP statements in the parameter files. You can use wildcards to make certain that they are included.

To create a new user with CREATE USER and then move new or renamed tables into that schema, the new user name must be specified in TABLE and MAP statements. To create a new user “fin2” and move new or renamed tables into that schema, the parameter statements could look as follows, depending on whether you want the “fin2” objects mapped to the same, or different, schema on the target:

Extract:

```
TABLE fin2.*;
```

Replicat:

```
MAP fin2*, TARGET <different_schema>*;
```

## Understanding DDL scopes

Database objects are classified into *scopes*. A scope is a category that defines how DDL operations on an object are handled by Oracle GoldenGate. The scopes are:

- MAPPED
- UNMAPPED
- OTHER

The use of scopes enables granular control over the filtering of DDL operations, string substitutions, and error handling.

### Mapped scope

Objects that are specified in TABLE and MAP statements are of *MAPPED scope*. Extraction and replication instructions in those statements apply to both data (DML) and DDL on the specified objects, unless override rules are applied.

For objects in TABLE and MAP statements, the DDL operations listed in the following table are supported.

**Table 15 Objects that can be mapped in MAP and TABLE statements**

Operations	Object <sup>1</sup>
CREATE	TABLE (includes AS SELECT)
ALTER	INDEX
DROP	TRIGGER
RENAME	SEQUENCE
COMMENT ON <sup>2</sup>	MATERIALIZED VIEW VIEW FUNCTION PACKAGE PROCEDURE  SYNONYM PUBLIC SYNONYM <sup>3</sup>
GRANT	TABLE
REVOKE	SEQUENCE MATERIALIZED VIEW
ANALYZE	TABLE INDEX CLUSTER

<sup>1</sup> TABLE and MAP do not support some special characters that could be used in an object name affected by these operations. For a list of those characters, see the MAP and TABLE parameter descriptions in the Oracle GoldenGate *Windows and UNIX Reference Guide*. Objects with non-supported special characters are supported by the scopes of UN-MAPPED and OTHER.

<sup>2</sup> Applies to COMMENT ON TABLE, COMMENT ON COLUMN.

<sup>3</sup> Table name must be qualified with schema name.

For Extract, MAPPED scope marks an object for DDL capture according to the instructions in the TABLE statement. For Replicat, MAPPED scope marks DDL for replication and maps it to the object specified by the schema and name in the TARGET clause of the MAP statement. To perform this mapping, Replicat issues ALTER SESSION to set the schema of the Replicat session to the schema that is specified in the TARGET clause. If the DDL contains unqualified objects, the schema that is assigned on the target depends on circumstances described in “Correctly identifying unqualified object names in DDL” on page 93.

Assume the following TABLE and MAP statements:

Extract (source)	Replicat (target)
TABLE fin.expen;	MAP fin.expen, TARGET fin2.expen2;
TABLE hr.tab*;	MAP hr.tab*, TARGET hrBackup.bak_*;

Also assume a source DDL statement of:

```
ALTER TABLE fin.expen ADD notes varchar2(100);
```

In this example, because the source table “fin.expen” is in a MAP statement with a TARGET

clause that maps to a different owner and table name, the target DDL statement becomes:

```
ALTER TABLE fin2.expen2 ADD notes varchar2(100);
```

Likewise, the following source and target DDL statements are possible for the second set of TABLE and MAP statements in the example:

```
Source:      CREATE TABLE hr.tabPayables ... ;
Target:      CREATE TABLE hrBackup.bak_tabPayables ... ;
```

When objects are of MAPPED scope, you can omit their names from the DDL configuration parameters, unless you want to refine their DDL support further. If you ever need to change the object names in TABLE and MAP statements, the changes will apply automatically to the DDL on those objects.

If you include an object in a TABLE statement, but not in a MAP statement, the DDL for that object is MAPPED in scope on the source but UNMAPPED in scope on the target.

### **Mapping Oracle cluster tables and UDTs**

An Oracle clustered table or Oracle user defined type (UDT) cannot be mapped to a different target name, but it can be mapped to a different target owner. Because these special kinds of objects can consist of underlying tables that, themselves, could be a mix of both MAPPED and UNMAPPED scope, name mapping cannot be used.

### **Mapping ALTER INDEX**

An ALTER INDEX...RENAME command cannot be mapped to a different target index name, but it can be mapped to a different target owner.

**Valid example:**

```
ALTER INDEX src.ind RENAME TO indnew;
```

This DDL can be mapped with wildcards as:

```
MAP src.* TARGET tgt.*;
```

Alternatively, it can be mapped explicitly as the following, making sure to use the original index name in the source and target specifications:

```
MAP src.ind TARGET tgt.ind;
```

In either of the preceding cases, the target DDL will be:

```
ALTER INDEX tgt.ind RENAME TO indnew;
```

**Invalid example:**

A MAP statement such as the following is not valid:

```
MAP src.ind TARGET tgt.indnew;
```

That statement maps the old name to the new name, and the target DDL will become:

```
ALTER INDEX tgt.indnew RENAME TO indnew;
```

## Unmapped scope

If a DDL operation is supported for use in a TABLE or MAP statement, but its base object name is not included in one of those parameters, it is of *UNMAPPED scope*.

An object name can be of UNMAPPED scope on the source (not in an Extract TABLE statement), but of MAPPED scope on the target (in a Replicat MAP statement), or the other way around. When Oracle DDL is of UNMAPPED scope in the Replicat configuration, Replicat will by default do the following:

1. Set the current owner of the Replicat session to the owner of the source DDL object.
2. Execute the DDL as that owner.
3. Restore Replicat as the current owner of the Replicat session.

See also “Correctly identifying unqualified object names in DDL” on page 93.

## Other scope

DDL operations that cannot be mapped are of *OTHER scope*. When DDL is of OTHER scope in the Replicat configuration, it is applied to the target with the same owner and object name as in the source DDL.

An example of OTHER scope is a DDL operation that makes a system-specific reference, such as DDL that operates on data file names.

Some other examples of OTHER scope:

```
CREATE USER joe IDENTIFIED by joe;
CREATE ROLE ggs_gguser_role IDENTIFIED GLOBALLY;
ALTER TABLESPACE gg_user TABLESPACE GROUP gg_grp_user;
```

See also “Correctly identifying unqualified object names in DDL” on page 93.

## Correctly identifying unqualified object names in DDL

Extract captures the current schema (also called session schema) that is in effect when a DDL operation is executed. This schema is used to resolve unqualified object names in the DDL.

Consider the following example:

```
CONNECT SCOTT/TIGER
CREATE TABLE TAB1 (X NUMBER);
CREATE TABLE SRC1.TAB2(X NUMBER) AS SELECT * FROM TAB1;
```

In both of those DDL statements, the unqualified table TAB1 is resolved as SCOTT.TAB1 based on the current schema SCOTT that is in effect during the DDL execution.

There is another way of setting the current schema, which is to set the current\_schema for the session, as in the following example:

```
CONNECT SCOTT/TIGER
ALTER SESSION SET CURRENT_SCHEMA=SRC;
CREATE TABLE TAB1 (X NUMBER);
CREATE TABLE SRC1.TAB2(X NUMBER) AS SELECT * FROM TAB1;
```

In both of those DDL statements, the unqualified table `TAB1` is resolved as `SRC.TAB1` based on the current schema `SRC` that is in effect during the DDL execution.

In both classic and integrated capture modes, Extract captures the current schema that is in effect during DDL execution, and it resolves the unqualified object names (if any) by using the current schema. As a result, `MAP` statements specified for Replicat work correctly for DDL with unqualified object names.

You can also map a source session schema to a different target session schema. Session schema mapping is required for some DDL to succeed on the target in the presence of mapping, such as `CREATE TABLE AS SELECT` and in `CREATE TABLE` operations with the `REFERENCES` clause. This mapping is global and overrides any other mappings that involve the same schema names. To map session schemas, use the `DDLOPTIONS` parameter with the `MAPSESSIONSCHEMA` option. For more information, see the Oracle GoldenGate *Windows and UNIX Reference Guide*.

You can prevent explicit schema mapping with the `NOEXPLICITSCHEMAMAPPING` option of the `DDLOPTIONS` parameter. See the `DDLOPTIONS` parameter documentation in the *Windows and UNIX Reference Guide*.

## Enabling DDL support

By default, the status of DDL replication support is as follows:

- On the source, Oracle GoldenGate DDL support is disabled by default. You must configure Extract to capture DDL by using the `DDL` parameter.
- On the target, DDL support is enabled by default, to maintain the integrity of transactional data that is replicated. By default, Replicat will process all DDL operations that the trail contains. If needed, you can use the `DDL` parameter to configure Replicat to ignore or filter DDL operations.

## Filtering DDL replication

For Oracle databases, you can use the following methods to filter DDL operations so that specific (or all) DDL is applied to the target database according to your requirements.

- *Filter with the DDL trigger on the source system.* This method makes use of an Oracle function that is called at run-time by the trigger when a DDL operation occurs. Information about the DDL is passed to this function, and you can use it to compute whether the DDL will be passed to Extract or not. (By default, all DDL is passed to Extract.) By sending fewer DDL operations to Extract, this method can improve capture performance and can also be used for any other purpose that requires filtering at an early stage of processing.
- *Filter with the DDL parameter on the source, the target, or both.* This method is performed within Oracle GoldenGate, and both Extract and Replicat can execute filter criteria. Extract can perform filtering, or it can send all of the DDL to a trail, and then Replicat can perform the filtering. Alternatively, you can filter in a combination of different locations. The `DDL` parameter gives you control over where the filtering is performed, and it also offers more filtering options than the trigger method, including the ability to filter collectively based on the DDL scope (for example, include all `MAPPED` scope).



- *Combine trigger and DDL parameter filtering.* Any DDL that is passed to Extract after it is filtered by the DDL trigger can be filtered further with the DDL parameter to meet specific needs.

## Filtering at the trigger level

To filter DDL at the level of the DDL trigger, perform the following steps.

1. Copy the `ddl_filter.sql` file that is in the Oracle GoldenGate installation directory to a test machine where you can test the code that you will be writing.
2. Open the file for editing. It contains a PL/SQL function named `filterDDL`, which you can modify to specify “if/then” filter criteria. The information that is passed to this function includes:
  - `ora_owner`: the owner of the DDL object
  - `ora_name`: the defined name of the object
  - `ora_objtype`: the type of object, such as `TABLE` or `INDEX`
  - `ora_optype`: the operation type, such as `CREATE` or `ALTER`
  - `ora_login_user`: The user that executed the DDL
  - `retVal`: can be either `INCLUDE` to include the DDL, or `EXCLUDE` to exclude the DDL from Extract processing.

In the location after the `'compute retVal here'` comment, write filter code for each type of DDL that you want to be filtered. The following is an example:

```
if ora_owner='SYS' then
retVal:='EXCLUDE';
end if;
if ora_objtype='USER' and ora_optype='DROP' then
retVal:='EXCLUDE';
end if;
if ora_owner='JOE' and ora_name like 'TEMP%' then
retVal:='EXCLUDE';
end if;
```

In this example, the following DDL is excluded from being processed by the DDL trigger:

- DDL for objects owned by `SYS`
  - any `DROP USER`
  - any DDL on `JOE.TEMP%`
3. (Optional) To trace the filtering, you can add the following syntax to each if/then statement in the PL/SQL:

```
if ora_owner='JOE' and ora_name like 'TEMP%' then
retVal:='EXCLUDE';
if "&gg_user" .DDLReplication.trace_level >= 1 then
"&gg_user" .trace_put_line ('DDLFILTER', 'excluded JOE.TEMP%');
end if;
```

**Where:**

- “&gg\_user” is the schema of the Oracle GoldenGate DDL support objects
- .DDLReplication.trace\_level is the level of DDL tracing. To use trigger tracing, the TRACE or TRACE2 parameter must be used with the DDL or DDLONLY option in the Extract parameter file. .DDLReplication.trace\_level must be set to >=1.
- trace\_put\_line is a user-defined text string that Extract writes to the trace file that represents the type of DDL that was filtered.

4. Save the code.
5. Stop DDL activity on the test system.
6. In SQL\*Plus, compile the ddl\_filter.sql file as follows, where schema\_name is the schema where the Oracle GoldenGate DDL objects are installed.

```
@ddl_filter schema_name
```

**NOTE** See the Oracle GoldenGate *Oracle Installation and Setup Guide* for information on these objects.

7. Test in the test environment to make certain that the filtering works. It is important to perform this testing, because any errors in the code could cause source and target DDL to become out of synchronization.
8. After a successful test, copy the file to the Oracle GoldenGate installation directory on the source production system.
9. Stop DDL activity on the source system.
10. Compile the ddl\_filter.sql file as you did before.  

```
@ddl_filter schema_name
```
11. Resume DDL activity on the source system.

## Filtering with the DDL parameter

The DDL parameter is the main Oracle GoldenGate parameter for filtering DDL within the Extract and Replicat processes.

When used without options, the DDL parameter performs no filtering, and it causes all DDL operations to be propagated as follows:

- As an Extract parameter, it captures all supported DDL operations that are generated on all supported database objects and sends them to the trail.
- As a Replicat parameter, it replicates all DDL operations from the Oracle GoldenGate trail and applies them to the target. This is the same as the default behavior without this parameter.

When used with options, the DDL parameter acts as a filtering agent to include or exclude DDL operations based on:

- scope
- object type
- operation type

- object name
- strings in the DDL command syntax or comments, or both

Only one DDL parameter can be used in a parameter file, but you can combine multiple inclusion and exclusion options to filter the DDL to the required level.

- DDL filtering options are valid for a primary Extract that captures from the transaction source, but not for a data-pump Extract.
- When combined, multiple filter option specifications are linked logically as “AND” statements.
- All filter criteria specified with multiple options must be satisfied for a DDL statement to be replicated.
- When using complex DDL filtering criteria, it is recommended that you test your configuration in a test environment before using it in production.

**WARNING** Do not include any Oracle GoldenGate-installed DDL objects in a DDL parameter, in a TABLE parameter, or in a MAP parameter, nor in a TABLEEXCLUDE or MAPEXCLUDE parameter. Make certain that wildcard specifications in those parameters do not include Oracle GoldenGate-installed DDL objects. These objects must not be part of the Oracle GoldenGate configuration, but the Extract process must be aware of operations on them, and that is why you must not explicitly exclude them from the configuration with an EXCLUDE, TABLEEXCLUDE, or MAPEXCLUDE parameter statement.

**NOTE** Before you create a DDL parameter statement, it might help to review “How DDL is evaluated for processing” in this chapter.

**Syntax**

```
DDL [  
  {INCLUDE | EXCLUDE}  
  [, MAPPED | UNMAPPED | OTHER | ALL]  
  [, OPTYPE <type>]  
  [, OBJTYPE '<type>'  
  [, OBJNAME <name>]  
  [, INSTR '<string>'  
  [, INSTRCOMMENTS '<comment_string>'  
  [, STAYMETADATA]  
  [, EVENTACTIONS (<action specification>)  
]  
[...]  
,
```

Table 16 DDL inclusion and exclusion options

Option	Description
INCLUDE   EXCLUDE	<p>Use INCLUDE and EXCLUDE to identify the beginning of an inclusion or exclusion clause.</p> <ul style="list-style-type: none"> <li>◆ An inclusion clause contains filtering criteria that identifies the DDL that this parameter will affect.</li> <li>◆ An exclusion clause contains filtering criteria that excludes specific DDL from this parameter.</li> </ul> <p>The inclusion or exclusion clause must consist of the INCLUDE or EXCLUDE keyword followed by any valid combination of other options of the parameter that is being applied.</p> <p>If you use EXCLUDE, you must create a corresponding INCLUDE clause. For example, the following is invalid:</p> <pre>DDL EXCLUDE OBJNAME "hr.*"</pre> <p>However, you can use either of the following:</p> <pre>DDL INCLUDE ALL, EXCLUDE OBJNAME "hr.*" DDL INCLUDE OBJNAME "fin.*" EXCLUDE "fin.ss"</pre> <p>An EXCLUDE takes priority over any INCLUDEs that contain the same criteria. You can use multiple inclusion and exclusion clauses.</p>
MAPPED   UNMAPPED   OTHER   ALL	<p>Use MAPPED, UNMAPPED, OTHER, and ALL to apply INCLUDE or EXCLUDE based on the DDL operation scope.</p> <ul style="list-style-type: none"> <li>◆ MAPPED applies INCLUDE or EXCLUDE to DDL operations that are of MAPPED scope. MAPPED filtering is performed before filtering that is specified with other DDL parameter options.</li> <li>◆ UNMAPPED applies INCLUDE or EXCLUDE to DDL operations that are of UNMAPPED scope.</li> <li>◆ OTHER applies INCLUDE or EXCLUDE to DDL operations that are of OTHER scope.</li> <li>◆ ALL applies INCLUDE or EXCLUDE to DDL operations of all scopes.</li> </ul>
OPTYPE <type>	<p>Use OPTYPE to apply INCLUDE or EXCLUDE to a specific type of DDL operation, such as CREATE, ALTER, and RENAME. For &lt;type&gt;, use any DDL command that is valid for the database. For example, to include ALTER operations, the correct syntax is:</p> <pre>DDL INCLUDE OPTYPE ALTER</pre>

**Table 16 DDL inclusion and exclusion options**

Option	Description
OBJTYPE '<type>'	<p>Use OBJTYPE to apply INCLUDE or EXCLUDE to a specific type of database object. For &lt;type&gt;, use any object type that is valid for the database, such as TABLE, INDEX, and TRIGGER. For an Oracle materialized view and materialized views log, the correct types are snapshot and snapshot log, respectively. Enclose the name of the object type within single quotes. For example:</p> <pre>DDL INCLUDE OBJTYPE 'INDEX' DDL INCLUDE OBJTYPE 'SNAPSHOT'</pre> <p>For Oracle object type USER, do not use the OBJNAME option, because OBJNAME expects "owner.object" whereas USER only has a schema.</p>
OBJNAME <name>	<p>Use OBJNAME to apply INCLUDE or EXCLUDE to the fully qualified name of an object, for example owner.table_name. You can use a wildcard only for the object name.</p> <p>Example:</p> <pre>DDL INCLUDE OBJNAME accounts.*</pre> <p>Do not use OBJNAME for the Oracle USER object, because OBJNAME expects owner.object, whereas USER only has a schema.</p> <p>When using OBJNAME with MAPPED in a Replicat parameter file, the value for OBJNAME must refer to the name specified with the TARGET clause of the MAP statement. For example, given the following MAP statement, the correct value is OBJNAME fin2.*.</p> <pre>MAP fin.exp_*, TARGET fin2.*;</pre> <p>In the following example, a CREATE TABLE statement executes like this on the source:</p> <pre>CREATE TABLE fin.exp_phone;</pre> <p>And like this on the target:</p> <pre>CREATE TABLE fin2.exp_phone;</pre> <p>If a target owner is not specified in the MAP statement, Replicat maps it to the database user that is specified with the USERID parameter.</p> <p>For DDL that creates derived objects, such as a trigger, the value for OBJNAME must be the name of the base object, not the name of the derived object.</p> <p>For example, to include the following DDL statement, the correct value is "hr.accounts," not "hr.insert_trig."</p> <pre>CREATE TRIGGER hr.insert_trig ON hr.accounts;</pre> <p>For RENAME operations, the value for OBJNAME must be the new table name. For example, to include the following DDL statement, the correct value is "hr.acct."</p> <pre>ALTER TABLE hr.accounts RENAME TO acct;</pre>

Table 16 DDL inclusion and exclusion options

Option	Description
INSTR '<string>'	<p>Use INSTR to apply INCLUDE or EXCLUDE to DDL statements that contain a specific character string within the command syntax itself, but not within comments. For example, the following excludes DDL that creates an index.</p> <pre data-bbox="625 478 1252 506">DDL INCLUDE ALL EXCLUDE INSTR 'CREATE INDEX'</pre> <p>Enclose the string within single quotes. The string search is not case sensitive.</p> <p>INSTR does not support single quotation marks ( ' ') that are within the string, nor does it support NULL values.</p>
INSTRCOMMENTS '<comment_string>'	<p>Use INSTRCOMMENTS to apply INCLUDE or EXCLUDE to DDL statements that contain a specific character string within a comment, but not within the DDL command itself. By using INSTRCOMMENTS, you can use comments as a filtering agent.</p> <p>For example, the following excludes DDL statements that include "source" in the comments.</p> <pre data-bbox="625 894 1354 921">DDL INCLUDE ALL EXCLUDE INSTRCOMMENTS 'SOURCE ONLY'</pre> <p>In this example, DDL statements such as the following are not replicated.</p> <pre data-bbox="625 1003 1370 1031">CREATE USER john IDENTIFIED BY john /*source only*/;</pre> <p>Enclose the string within single quotes. The string search is not case sensitive. You can combine INSTR and INSTRCOMMENTS to filter on a string in the command syntax and in the comments of the same DDL statement.</p> <p>INSTRCOMMENTS does not support single quotation marks ( ' ') that are within the string, nor does it support NULL values.</p>
INSTRWORDS '<word list>'	<p>Use INSTRWORDS to apply INCLUDE or EXCLUDE to DDL statements that contain the specified words.</p> <p>For &lt;word list&gt;, supply the words in any order, within single quotes. To include spaces, put the space (and the word, if applicable) in double quotes. Double quotes also can be used to enclose sentences.</p> <p>All specified words must be present in the DDL for INSTRWORDS to take effect.</p> <p><b>Example:</b></p> <pre data-bbox="625 1562 1414 1589">ALTER TABLE INCLUDE INSTRWORDS 'ALTER CONSTRAINT " xyz"'</pre> <p><b>This example will match</b></p> <pre data-bbox="625 1640 1146 1667">ALTER TABLE ADD CONSTRAINT xyz CHECK</pre> <p><b>and</b></p> <pre data-bbox="625 1717 1073 1745">ALTER TABLE DROP CONSTRAINT xyz</pre> <p>INSTRWORDS does not support single quotation marks ( ' ') that are within the string, nor does it support NULL values.</p>

Table 16 DDL inclusion and exclusion options

Option	Description
INSTRCOMMENTSWORDS '<word list>'	<p>Works the same way as INSTRWORDS, but only applies to comments within a DDL statement, not the DDL syntax itself. By using INSTRCOMMENTS, you can use comments as a filtering agent.</p> <p>INSTRCOMMENTSWORDS does not support single quotation marks ( ' ') that are within the string, nor does it support NULL values.</p> <p>You can combine INSTRWORDS and INSTRCOMMENTSWORDS to filter on a string in the command syntax and in the comments of the same DDL statement.</p>
STAYMETADATA	<p>Valid for Extract and Replicat. Prevents metadata from being replicated.</p> <p>When Extract first encounters DML on a table, it retrieves the metadata for that table. When DDL is encountered on that table, the old metadata is invalidated. The next DML on that table is matched to the new metadata so that the target table structure always is up-to-date with that of the source.</p> <p>However, if you know that a particular DDL operation will not affect the table's metadata, you can use STAYMETADATA so that the current metadata is not retrieved or replicated. This is a performance improvement that has benefit for such operations as imports and exports, where such DDL as truncates and the disabling of constraints are often performed. These operations do not affect table structure, as it relates to the integrity of subsequent data replication, so they can be ignored in such cases. For example ALTER TABLE ADD FOREIGN KEY does not affect table metadata.</p> <p>An example of how this can be applied selectively is as follows:</p> <pre>DDL INCLUDE ALL INCLUDE STAYMETADATA OBJNAME xyz</pre> <p>This example states that all DDL is to be included for replication, but only DDL that operates on object "xyz" will be subject to STAYMETADATA. STAYMETADATA also can be used the same way in an EXCLUDE clause. STAYMETADATA must be used the same way on the source and target to ensure metadata integrity.</p>

Table 16 DDL inclusion and exclusion options

Option	Description
	<p>When STAYMETADATA is in use, a message is added to the report file. DDL reporting is controlled by the DDLOPTIONS parameter with the REPORT option.</p> <p>This same functionality can be applied globally to all DDL that occurs on the source by using the @ddl_staymetadata scripts:</p> <ul style="list-style-type: none"> <li>◆ @ddl_staymetadata_on globally turns off metadata versioning.</li> <li>◆ @ddl_staymetadata_off globally enables metadata versioning again.</li> </ul> <p>This option should be used with the assistance of Oracle GoldenGate technical support staff, because it might not always be apparent which DDL affects object metadata. If improperly used, it can break the integrity of the replication environment.</p>
<p>EVENTACTIONS (&lt;action specification&gt;)</p>	<p>Causes the Extract or Replicat process take a defined action based on a DDL record in the transaction log or trail, which is known as the <i>event record</i>. The DDL event is triggered if the DDL record is eligible to be written to the trail by Extract or a data pump, or to be executed by Replicat, as determined by the other filtering options of the DDL parameter. You can use this system to customize processing based on database events.</p> <p>For &lt;action specification&gt; see EVENTACTIONS under the MAP and TABLE parameters.</p> <p>Guidelines for using EVENTACTIONS on DDL records:</p> <ul style="list-style-type: none"> <li>◆ CHECKPOINTBEFORE: Since each DDL record is autonomous, the DDL record is guaranteed to be the start of a transaction; therefore, the CHECKPOINT BEFORE event action is implied for a DDL record.</li> <li>◆ IGNORE: This option is not valid for DDL records. Because DDL operations are autonomous, ignoring a record is equivalent to ignoring the entire transaction.</li> </ul> <p>EVENTACTIONS does not support the following DDL objects because they are derived objects:</p> <ul style="list-style-type: none"> <li>◆ indexes</li> <li>◆ triggers</li> <li>◆ synonyms</li> <li>◆ RENAME on a table and ALTER TABLE RENAME</li> </ul>

### Combining DDL parameter options

The following is an example of how to combine DDL parameter options.



```
DDL &  
INCLUDE UNMAPPED &  
  OPTYPE alter &  
  OBJTYPE 'table' &  
  OBJNAME users.tab* &  
INCLUDE MAPPED OBJNAME * &  
EXCLUDE MAPPED OBJNAME temporary.tab"
```

The combined filter criteria in this statement specify the following:

- INCLUDE all ALTER TABLE statements for tables that are not mapped with a TABLE or MAP statement (UNMAPPED scope),
  - only if those tables are owned by “users” and their names start with “tab,”
- and INCLUDE all DDL operation types for all tables that are mapped with a TABLE or MAP statement (MAPPED scope).
- and EXCLUDE all DDL operation types for all tables that are MAPPED in scope,
  - only if those tables are owned by “temporary.”
  - and only if their names begin with “tab.”

## Special filter cases

The following are special cases that you should be aware of when creating your filter conditions.

### DDL EXCLUDE ALL

DDL EXCLUDE ALL is a special processing option that maintains up-to-date object metadata for Oracle GoldenGate, while blocking the replication of the DDL operations themselves. You can use DDL EXCLUDE ALL when using a method other than Oracle GoldenGate to apply DDL to the target, but you want Oracle GoldenGate to replicate data changes to the target objects. It provides the current metadata to Oracle GoldenGate as objects change, thus preventing the need to stop and start the Oracle GoldenGate processes. The following special conditions apply to DDL EXCLUDE ALL:

- DDL EXCLUDE ALL does not require the use of an INCLUDE clause.
- When using DDL EXCLUDE ALL, you may set the WILDCARDRESOLVE parameter to IMMEDIATE to allow immediate DML resolution if required.

To prevent all DDL metadata and operations from being replicated, omit the DDL parameter entirely. The DDL trigger will continue to record the DDL operations to the history table, unless disabled manually.

### Implicit DDL

User-generated DDL operations can generate implicit DDL operations. For example, the following statement causes the Oracle DDL trigger to process two distinct DDL operations.

```
CREATE TABLE customers (custID number, name varchar2(50), address  
varchar2(75), address2 varchar2(75), city varchar2(50), state (varchar2(2),  
zip number, contact varchar2(50), areacode number(3), phone number(7), primary  
key (custID));
```

- The first (explicit) DDL operation is the CREATE TABLE statement itself.
- The second DDL operation is an implicit CREATE UNIQUE INDEX statement that creates the index for the primary key. This operation is generated by the database engine, not a user application.

#### Guidelines for filtering implicit DDL

When the *DDL parameter* is used to filter DDL operations, Oracle GoldenGate filters out any implicit DDL by default, because the explicit DDL will generate the implicit DDL on the target. For example, the target database will create the appropriate index when the CREATE TABLE statement in the preceding example is applied by Replicat.

However, when the *DDL trigger* is used to filter DDL operations, you must handle the implicit DDL in your filter rules based on the following:

- If your filtering rules exclude the explicit DDL from being propagated, you must also create a rule to exclude the implicit DDL. For example, if you exclude the CREATE TABLE statement in the preceding example, but do not exclude the CREATE UNIQUE INDEX statement, the target database will try to create the index on a non-existent table.
- If your filtering rules permit the propagation of the explicit DDL, you do not need to exclude the implicit DDL. It will be handled correctly by Oracle GoldenGate and the target database.

## How Oracle GoldenGate handles derived object names

DDL operations can contain a *base object* name and also a *derived object* name. A base object is an object that contains data. A derived object is an object that inherits some attributes of the base object to perform a function related to that object. DDL statements that have both base and derived objects are:

- RENAME and ALTER RENAME
- CREATE and DROP on an index, synonym, or trigger

Consider the following DDL statement:

```
CREATE INDEX hr.indexPayrollDate ON TABLE hr.tabPayroll (payDate);
```

In this case, the table is the base object. Its name (hr.tabPayroll) is the *base name* and is subject to mapping with TABLE or MAP under the MAPPED scope. The derived object is the index, and its name (hr.indexPayrollDate) is the *derived name*.

You can map a derived name in its own TABLE or MAP statement, separately from that of the base object. Or, you can use one MAP statement to handle both. In the case of MAP, the conversion of derived object names on the target works as follows.

### MAP exists for base object, but not derived object

If there is a MAP statement for the base object, but not for the derived object, the result is an *implicit mapping* of the derived object. Assuming the DDL statement includes MAPPED, Replicat gives the derived object the same target owner as that of the base object. The name of the derived object stays the same as in the source statement. For example, assume the following:

Extract (source)	Replicat (target)
TABLE hr.tab*;	MAP hr.tab*, TARGET hrBackup.*;

Assume the following source DDL statement:

```
CREATE INDEX hr.indexPayrollDate ON TABLE hr.tabPayroll (payDate);
```

The CREATE INDEX statement is executed by Replicat on the target as:

```
CREATE INDEX hrBackup.indexPayrollDate ON TABLE hrBackup.tabPayroll  
(payDate);
```

The rule for the implicit mapping is based the typical industry practice of giving derived objects the same owner as the base object. It ensures the correct name conversion even if the name of the derived object is not fully qualified in the source statement. Also, when indexes are owned by the same target owner as the base object, an implicit mapping eliminates the need to map derived object names explicitly.

## MAP exists for base and derived objects

If there is a MAP statement for the base object and also one for the derived object, the result is an *explicit mapping*. Assuming the DDL statement includes MAPPED, Replicat converts the owner and name of each object according to its own TARGET clause. For example, assume the following:

Extract (source)	Replicat (target)
TABLE hr.tab*;	MAP hr.tab*, TARGET hrBackup.*;
TABLE hr.index*;	MAP hr.index*, TARGET hrIndex.*;

Assume the following source DDL statement:

```
CREATE INDEX hr.indexPayrollDate ON TABLE hr.tabPayroll (payDate);
```

The CREATE INDEX statement is executed by Replicat on the target as:

```
CREATE INDEX hrIndex.indexPayrollDate ON TABLE hrBackup.tabPayroll  
(payDate);
```

Use an explicit mapping when the index on the target must be owned by a different owner from that of the base object, or when the name on the target must be different from that of the source.

## MAP exists for derived object, but not base object

If there is a MAP statement for the derived object, but not for the base object, Replicat does not perform any name conversion for either object. The target DDL statement is the same as that of the source. To map a derived object, the choices are:

- Use an explicit MAP statement for the base object.
- If names permit, map both base and derived objects in the same MAP statement by means of a wildcard.

- Create a MAP statement for each object, depending on how you want the names converted.

## New tables as derived objects

The following explains how Oracle GoldenGate handles new tables that are created from:

- RENAME and ALTER RENAME
- CREATE TABLE AS SELECT

### **RENAME and ALTER TABLE RENAME**

In RENAME and ALTER TABLE RENAME operations, the base object is always the new table name. In the following example, the base object name is considered to be “index\_paydate.”

```
ALTER TABLE hr.indexPayrollDate RENAME TO index_paydate;
```

or...

```
RENAME hr.indexPayrollDate TO index_paydate;
```

The derived object name is “hr.indexPayrollDate.”

### **CREATE TABLE AS SELECT**

CREATE TABLE AS SELECT statements include SELECT statements and INSERT statements that affect any number of underlying objects. On the target, Oracle GoldenGate obtains the data for the AS SELECT clause from the target database.

**NOTE** For this reason, Oracle XMLType tables created from a CTAS (CREATE TABLE AS SELECT) statement cannot be supported. For XMLType tables, the row object IDs must match between source and target, which cannot be maintained in this scenario. XMLType tables created by an empty CTAS statement (that does not insert data in the new table) can be maintained correctly.

The objects in the AS SELECT clause must exist in the target database, and their names must be identical to the ones on the source.

In a MAP statement, Oracle GoldenGate only maps the name of the new table (CREATE TABLE <name>) to the TARGET specification, but does not map the names of the underlying objects from the AS SELECT clause. There could be dependencies on those objects that could cause data inconsistencies if the names were converted to the TARGET specification.

The following shows an example of a CREATE TABLE AS SELECT statement on the source and how it would be replicated to the target by Oracle GoldenGate.

```
CREATE TABLE a.tab1 AS SELECT * FROM a.tab2;
```

The MAP statement for Replicat is:

```
MAP a.tab*, TARGET a.x*;
```

The target DDL statement that is applied by Replicat is this:

```
CREATE TABLE a.xtab1 AS SELECT * FROM a.tab2;
```

not this:

```
CREATE TABLE a.xtab1 AS SELECT * FROM a.xtab2;
```

The name of the table in the AS SELECT \* FROM clause remains as it was on the source: tab2.

To keep the data in the underlying objects consistent on source and target, you can configure them for data replication by Oracle GoldenGate. In the preceding example, you could use the following statements to accommodate this requirement:

Source	Target
TABLE a.tab*;	MAPEXCLUDE a.tab2
	MAP a.tab*, TARGET a.x*;
	MAP a.tab2, TARGET a.tab2;

See also “Correctly identifying unqualified object names in DDL” on page 93.

### Disabling the mapping of derived objects

Use the DDLOPTIONS parameter with the NOMAPDERIVED option to prevent the conversion of the name of a derived object according to a TARGET clause of a MAP statement that includes it. NOMAPDERIVED overrides any explicit MAP statements that contain the name of the base or derived object. Source DDL that contains derived objects is replicated to the target with the same owner and object names as on the source.

The following table shows the results of MAPDERIVED compared to NOMAPDERIVED, based on whether there is a MAP statement just for the base object, just for the derived object, or for both.

Table 17 [NO]MAPDERIVED results on target based on mapping configuration

Base Object	Derived Object	MAP/NOMAP DERIVED?	Derived object converted per a MAP?	Derived object gets owner of base object?
mapped <sup>1</sup>	mapped	MAPDERIVED	yes	no
mapped	not mapped	MAPDERIVED	no	yes
not mapped	mapped	MAPDERIVED	no	no
not mapped	not mapped	MAPDERIVED	no	no
mapped	mapped	NOMAPDERIVED	no	no
mapped	not mapped	NOMAPDERIVED	no	no
not mapped	mapped	NOMAPDERIVED	no	no
not mapped	not mapped	NOMAPDERIVED	no	no

<sup>1</sup> Mapped means included in a MAP statement.

The following examples illustrate the results of MAPDERIVED as compared to NOMAPDERIVED. In the following table, both trigger and table are owned by “rpt” on the target because both base and derived names are converted by means of MAPDERIVED.

**Table 18** Default mapping of derived object names (MAPDERIVED)

MAP statement	Source DDL statement captured by Extract	Target DDL statement applied by Replicat
MAP fin.*, TARGET rpt.*;	CREATE TRIGGER fin.act_trig ON fin.acct;	CREATE TRIGGER rpt.act_trig ON rpt.acct;

In the following table, the trigger is owned by “fin,” because conversion is prevented by means of NOMAPDERIVED.

**Table 19** Mapping of derived object names when using NOMAPDERIVED

MAP statement	Source DDL statement captured by Extract	Target DDL statement applied by Replicat
MAP fin.*, TARGET rpt.*;	CREATE TRIGGER fin.act_trig ON fin.acct;	CREATE TRIGGER fin.act_trig ON rpt.acct;

**NOTE** In the case of a RENAME statement, the new table name is considered to be the base table name, and the old table name is considered to be the derived table name.

## Using DDL string substitution

You can substitute strings within a DDL operation while it is being processed by Oracle GoldenGate. This feature provides a convenience for changing and mapping directory names, comments, and other things that are not directly related to data structures. For example, you could substitute one tablespace name for another, or substitute a string within comments. String substitution is controlled by the DDLSUBST parameter.

For more information, see the Oracle GoldenGate *Windows and UNIX Reference Guide*.

**NOTE** Before you create a DDLSUBST parameter statement, it might help to review “How DDL is evaluated for processing” in this chapter.

## Controlling the propagation of DDL that is executed by Replicat

Extract and Replicat both issue DDL operations.

- Extract issues ALTER TABLE statements to create log groups,
- Replicat applies replicated DDL statements to the target.

To identify Oracle GoldenGate DDL operations, the following comment is part of each

Extract and Replicat DDL statement:

```
/* GOLDENGATE_DDL_REPLICATION */
```

The DDLOPTIONS parameter controls whether or not Replicat's DDL is propagated.

- The GETREPLICATES and IGNOREREPLICATES options control whether *Replicat's* DDL operations are captured by Extract or ignored. The default is IGNOREREPLICATES.
- The GETAPPLOPS and IGNOREAPPLOPS options control whether DDL from *applications other than Replicat* (the business applications) are captured or ignored.

By default, Extract ignores DDL that is applied to the local database by a local Replicat, so that the DDL is not sent back to its source, but Extract captures all other DDL that is configured for replication. The following is the default DDLOPTIONS configuration.

```
DDLOPTIONS GETAPPLOPS, IGNOREREPLICATES
```

This behavior can be modified. See the following topics:

- "Propagating DDL in an active-active (bi-directional) configurations"
- "Propagating DDL in a cascading configuration"

### Propagating DDL in an active-active (bi-directional) configurations

Oracle GoldenGate supports active-active DDL replication between two systems. For an active-active bi-directional replication, the following must be configured in the Oracle GoldenGate processes:

1. DDL that is performed by a business application on one system must be replicated to the other system to maintain synchronization. To satisfy this requirement, include the GETAPPLOPS option in the DDLOPTIONS statement in the Extract parameter files on both systems.
2. DDL that is applied by Replicat on one system must be captured by the local Extract and sent back to the other system. To satisfy this requirement, use the GETREPLICATES option in the DDLOPTIONS statement in the Extract parameter files on both systems.

**NOTE** An internal Oracle GoldenGate token will cause the actual Replicat DDL statement itself to be ignored to prevent loopback. The purpose of propagating Replicat DDL back to the original system is so that the Replicat on that system can update its object metadata cache, in preparation to receive incoming DML, which will have the new metadata. See the illustration in this topic.

3. Each Replicat must be configured to update its object metadata cache whenever the remote Extract sends over a captured Replicat DDL statement. To satisfy this requirement, use the UPDATEMETADATA option in the DDLOPTIONS statement in the Replicat parameter files on both systems.

The resultant DDLOPTIONS statements should look as follows:

Extract (primary and secondary)

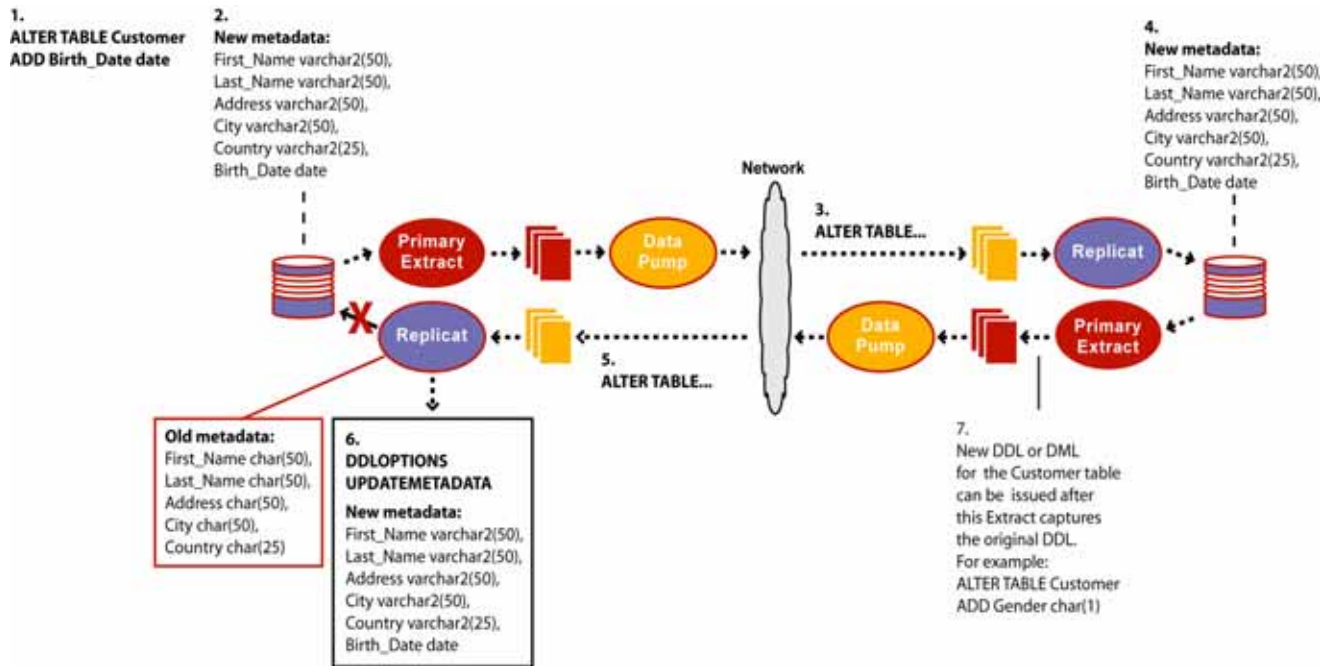
```
DDLOPTIONS GETREPLICATES, GETAPPLOPS
```

Replicat (primary and secondary)

```
DDLOPTIONS UPDATEMETADATA
```

**WARNING** Before you allow new DDL or DML to be issued for the same object(s) as the original DDL, allow time for the original DDL to be replicated to the remote system and then captured again by the Extract on that system. This will ensure that the operations arrive in correct order to the Replicat on the original system, to prevent DML errors caused by metadata inconsistencies. See the diagram for more information.

Figure 4 Path of DDL in round trip to update Replicat object metadata cache



## Propagating DDL in a cascading configuration

In a cascading configuration, use the following setting for DDLOPTIONS in the Extract parameter file on each intermediary system. This configuration forces Extract to capture the DDL from Replicat on an intermediary system and cascade it to the next system downstream.

```
DDLOPTIONS GETREPLICATES, IGNOREAPPLOPS
```

## Adding supplemental log groups automatically

You can use the DDLOPTIONS parameter with the ADDTRANDATA option to:

- enable Oracle's supplemental logging automatically for new tables created with a CREATE TABLE.
- update Oracle's supplemental logging for tables affected by an ALTER TABLE to add or drop columns.
- update Oracle's supplemental logging for tables that are renamed.



- update Oracle's supplemental logging for tables where unique or primary keys are added or dropped.

By default, the ALTER TABLE that adds the supplemental logging is not replicated to the target unless the GETREPLICATES parameter is in use.

For more information about this option, see the Oracle GoldenGate *Windows and UNIX Reference Guide*.

## Removing comments from replicated DDL

You can use the DDLOPTIONS parameter with the REMOVECOMMENTS BEFORE and REMOVECOMMENTS AFTER options to prevent comments that were used in the source DDL from being included in the target DDL. By default, comments are not removed, so that they can be used for string substitution.

For more information about this option, see the Oracle GoldenGate *Windows and UNIX Reference Guide*.

## Replicating an IDENTIFIED BY password

Use the DDLOPTIONS parameter with the DEFAULTUSERPASSWORD and REPLICATEPASSWORD | NOREPLICATEPASSWORD options to control how the password of a replicated {CREATE | ALTER} USER <name> IDENTIFIED BY <password> statement is handled. These options must be used together.

For more information about these options, see the Oracle GoldenGate *Windows and UNIX Reference Guide*.

## How DDL is evaluated for processing

The following explains how Oracle GoldenGate processes DDL statements on the source and target systems. It shows the order in which different criteria in the Oracle GoldenGate parameters are processed, and it explains the differences between how Extract and Replicat each process the DDL.

### *Extract*

1. Extract captures a DDL operation.
2. Extract separates comments, if any, from the main statement.
3. Extract searches for the DDL parameter. (This example assumes it exists.)
4. Extract searches for the IGNOREREPLICATES parameter. If it is present, and if Replicat produced this DDL operation on this system, Extract ignores the DDL statement. (This example assumes no Replicat operations on this system.)
5. Extract determines whether the statement is a RENAME. If so, the rename is flagged internally.
6. Extract gets the base object name and, if present, the derived object name.
7. If the statement is a RENAME, Extract changes it to ALTER TABLE RENAME.

8. Extract searches for the DDLOPTIONS REMOVECOMMENTS BEFORE parameter. If it is present, Extract removes the comments from the DDL statement, but stores them in case there is a DDL INCLUDE or DDL EXCLUDE clause that uses INSTR or INSTRCOMMENTS.
9. Extract determines the DDL scope: MAPPED, UNMAPPED or OTHER. It is MAPPED if:
  - the operation and object types are supported for mapping.  
and...
  - the base object name and/or derived object name (if RENAME) is in a TABLE parameter.

It is UNMAPPED if:

- the operation and object types are not supported for mapping.  
and...
- the base object name and/or derived object name (if RENAME) is not in a TABLE parameter.

Otherwise the operation is identified as OTHER.

10. Extract checks the DDL parameter for INCLUDE and EXCLUDE clauses, and it evaluates the DDL parameter criteria in those clauses. All options must evaluate to TRUE in order for the INCLUDE or EXCLUDE to evaluate to TRUE. The following occurs:
  - If an EXCLUDE clause evaluates to TRUE, Extract discards the DDL operation and evaluates another DDL operation. In this case, the processing steps start over.
  - If an INCLUDE clause evaluates to TRUE, or if the DDL parameter does not have any INCLUDE or EXCLUDE clauses, Extract includes the DDL operation, and the processing logic continues.
11. Extract searches for a DDLSUBST parameter and evaluates the INCLUDE and EXCLUDE clauses. If the criteria in those clauses add up to TRUE, Extract performs string substitution. Extract evaluates the DDL operation against each DDLSUBST statement in the parameter file. For all true DDLSUBST statements, Extract performs string substitution in the order that the DDLSUBST parameters are listed in the file.
12. Now that DDLSUBT has been processed, Extract searches for the REMOVECOMMENTS AFTER parameter. If it is present, Extract removes the comments from the DDL statement.
13. Extract searches for DDLOPTIONS ADDTRANDATA. If it is present, and if the operation is CREATE TABLE, Extract issues the ALTER TABLE <name> ADD SUPPLEMENTAL LOG GROUP command on the table.
14. Extract writes the DDL statement to the trail.

### **Replicat**

1. Replicat reads the DDL operation from the trail.
2. Replicat separates comments, if any, from the main statement.
3. Replicat searches for DDLOPTIONS REMOVECOMMENTS BEFORE. If it is present, Replicat removes the comments from the DDL statement.
4. Replicat evaluates the DDL synchronization scope to determine if the DDL qualifies for name mapping. Anything else is of OTHER scope.

5. Replicat evaluates the MAP statements in the parameter file. If the source base object name for this DDL (as read from the trail) appears in any of the MAP statements, the operation is marked as MAPPED in scope. Otherwise it is marked as UNMAPPED in scope.
6. Replicat replaces the source base object name with the base object name that is specified in the TARGET clause of the MAP statement.
7. If there is a derived object, Replicat searches for DDLOPTIONS MAPDERIVED. If it is present, Replicat replaces the source derived name with the target derived name from the MAP statement.
8. Replicat checks the DDL parameter for INCLUDE and EXCLUDE clauses, and it evaluates the DDL parameter criteria contained in them. All options must evaluate to TRUE in order for the INCLUDE or EXCLUDE to evaluate to TRUE. The following occurs:
  - If any EXCLUDE clause evaluates to TRUE, Replicat discards the DDL operation and starts evaluating another DDL operation. In this case, the processing steps start over.
  - If any INCLUDE clause evaluates to TRUE, or if the DDL parameter does not have any INCLUDE or EXCLUDE clauses, Replicat includes the DDL operation, and the processing logic continues.
9. Replicat searches for the DDLSUBST parameter and evaluates the INCLUDE and EXCLUDE clauses. If the options in those clauses add up to TRUE, Replicat performs string substitution. Replicat evaluates the DDL operation against each DDLSUBST statement in the parameter file. For all true DDLSUBST statements, Replicat performs string substitution in the order that the DDLSUBST parameters are listed in the file.
10. Now that DDLSUBT has been processed, Replicat searches for the REMOVECOMMENTS AFTER parameter. If it is present, Replicat removes the comments from the DDL statement.
11. Replicat executes the DDL operation on the target database.
12. If there are no errors, Replicat processes the next DDL statement. If there are errors, Replicat performs the following steps.
13. Replicat analyzes the INCLUDE and EXCLUDE rules in the Replicat DDLERROR parameter statements in the order that they appear in the parameter file. If Replicat finds a rule for the error code, it applies the specified error handling; otherwise, it applies DEFAULT handling.
14. If the error handling does not enable the DDL operation to succeed, Replicat does one of the following: abends, ignores the operation, or discards it as specified in the rules.

**NOTE** If there are multiple targets for the same source in a MAP statement, the processing logic executes for each one.

## Handling DDL processing errors

Use the DDLERROR parameter to handle errors on objects found by Extract for which metadata cannot be found, and for Replicat errors that occur when DDL is applied to the target database. With DDLERROR options, you can handle most errors in a default manner, for example to stop processing, and also handle other errors in a specific manner. You can use multiple instances of DDLERROR in the same parameter file to handle all errors that are anticipated.

For options and usage, see the Oracle GoldenGate *Windows and UNIX Reference Guide*.

## Handling DDL trigger errors

Use the following parameters in the `params.sql` non-executable script to handle failures of the Oracle GoldenGate DDL trigger in relation to whether the source DDL fails or succeeds.

- **ddl\_fire\_error\_in\_trigger**: If set to `TRUE`, failures of the Oracle GoldenGate DDL trigger are raised with a Oracle GoldenGate error message and a database error message to the source end-user application. The source operations fails.  
If set to `FALSE`, no errors are raised, and a message is written to the trigger trace file in the Oracle GoldenGate directory. The source operation succeeds, but no DDL is replicated. The target application will eventually fail if subsequent data changes do not match the old target object structure. The default is `FALSE`.
- **\_ddl\_cause\_error**: If set to `TRUE`, tests the error response of the trigger by deliberately causing an error. To generate the error, Oracle GoldenGate attempts to `SELECT` zero rows without exception handling. Revert this flag to the default of `FALSE` after testing is done.

The `params.sql` script is in the root Oracle GoldenGate directory.

## Viewing DDL report information

By default, Oracle GoldenGate shows basic statistics about DDL operations at the end of the Extract and Replicat reports. To enable expanded DDL reporting, use the `DDLOPTIONS` parameter with the `REPORT` option. Expanded reporting includes the following information about DDL processing:

- A step-by-step history of the DDL operations that were processed by Oracle GoldenGate.
- The DDL filtering and processing parameters that are being used.

Expanded DDL report information increases the size of the report file, but it might be useful in certain situations, such as for troubleshooting or to determine when an `ADDTRANDATA` to add supplemental logging was applied.

### To view a process report

To view a report, use the `VIEW REPORT` command in `GGSCI`.

```
VIEW REPORT <group>
```

## Extract DDL reporting

The Extract report lists the following:

- The entire syntax of each captured DDL operation, the start and end SCN, the Oracle instance, the DDL sequence number (from the `SEQNO` column of the history table), and the size of the operation in bytes.
- A subsequent entry that shows how processing criteria was applied to the operation, for example string substitution or `INCLUDE` and `EXCLUDE` filtering.
- Another entry showing whether the operation was written to the trail or excluded.

The following, taken from an Extract report, shows an included operation and an excluded operation. There is a report message for the included operation, but not for the excluded one.

```
2011-01-20 15:11:41 GGS INFO      2100 DDL found, operation [create table
myTable (
  myId number (10) not null,
  myNumber number,
  myString varchar2(100),
  myDate date,
  primary key (myId)
) ], start SCN [1186754], commit SCN [1186772] instance [test11g (1)], DDL
seqno [4134].

2011-01-20 15:11:41 GGS INFO      2100 DDL operation included [INCLUDE OBJNAME
myTable*], optype [CREATE], objtype [TABLE], objname [QATEST1.MYTABLE].

2011-01-20 15:11:41 GGS INFO      2100 DDL operation written to extract trail
file.

2011-01-20 15:11:42 GGS INFO      2100 Successfully added TRAN DATA for table
with the key, table [QATEST1.MYTABLE], operation [ALTER TABLE
"QATEST1"."MYTABLE" ADD SUPPLEMENTAL LOG GROUP "GGS_MYTABLE_53475" (MYID)
ALWAYS /* GOLDENGATE_DDL_REPLICATION */ ].

2011-01-20 15:11:43 GGS INFO      2100 DDL found, operation [create table
myTableTemp (
  vid varchar2(100),
  someDate date,
  primary key (vid)
) ], start SCN [1186777], commit SCN [1186795] instance [test11g (1)], DDL
seqno [4137].

2011-01-20 15:11:43 GGS INFO      2100 DDL operation excluded [EXCLUDE OBJNAME
myTableTemp OPTYPE CREATE], optype [CREATE], objtype [TABLE], objname
[QATEST1.MYTABLETEMP].
```

## Replicat DDL reporting

The Replicat report lists:

- The entire syntax and source Oracle GoldenGate SCN of each DDL operation that Replicat processed from the trail. You can use the source SCN for tracking purposes, especially when there are restores from backup and Replicat is positioned backward in the trail.
- A subsequent entry that shows the scope of the operation (MAPPED, UNMAPPED, OTHER) and how object names were mapped in the target DDL statement, if applicable.
- Another entry that shows how processing criteria was applied.
- Additional entries that show whether the operation succeeded or failed, and whether or not Replicat applied error handling rules.

The following excerpt from a Replicat report illustrates a sequence of steps, including error

**handling:**

```
2011-01-20 15:11:45 GGS INFO      2104 DDL found, operation [drop table
myTableTemp ], Source SCN [1186713.0].

2011-01-20 15:11:45 GGS INFO      2100 DDL is of mapped scope, after mapping
new operation [drop table "QATEST2"."MYTABLETEMP" ].

2011-01-20 15:11:45 GGS INFO      2100 DDL operation included [include objname
myTable*], optype [DROP], objtype [TABLE], objname [QATEST2.MYTABLETEMP].

2011-01-20 15:11:45 GGS INFO      2100 Executing DDL operation.

2011-01-20 15:11:48 GGS INFO      2105 DDL error ignored for next retry: error
code [942], filter [include objname myTableTemp], error text [ORA-00942: table
or view does not exist], retry [1].

2011-01-20 15:11:48 GGS INFO      2100 Executing DDL operation , trying again
due to RETRYOP parameter.

2011-01-20 15:11:51 GGS INFO      2105 DDL error ignored for next retry: error
code [942], filter [include objname myTableTemp], error text [ORA-00942: table
or view does not exist], retry [2].

2011-01-20 15:11:51 GGS INFO      2100 Executing DDL operation, trying again
due to RETRYOP parameter.

2011-01-20 15:11:54 GGS INFO      2105 DDL error ignored for next retry: error
code [942], filter [include objname myTableTemp], error text [ORA-00942: table
or view does not exist], retry [3].

2011-01-20 15:11:54 GGS INFO      2100 Executing DDL operation, trying again
due to RETRYOP parameter.

2011-01-20 15:11:54 GGS INFO      2105 DDL error ignored: error code [942],
filter [include objname myTableTemp], error text [ORA-00942: table or view does
not exist].
```

**Statistics in the process reports**

You can send current statistics for DDL processing to the Extract and Replicat reports by using the SEND command in GGSCI.

```
SEND {EXTRACT | REPLICAT} <group> REPORT
```

The statistics show totals for:

- All DDL operations
- Operations that are MAPPED in scope
- Operations that are UNMAPPED in scope
- Operations that are OTHER in scope
- Operations that were excluded (number of operations minus included ones)
- Errors (Replicat only)

- Retried errors (Replicat only)
- Discarded errors (Replicat only)
- Ignored operations (Replicat only)

## Viewing metadata in the DDL history table

Use the DUMPDDL command in GGSCI to view the information that is contained in the DDL history table. This information is stored in proprietary format, but you can export it in human-readable form to the screen or to a series of SQL tables that you can query. The information in the DDL history table is the same as that used by the Extract process. For more information, see the Oracle GoldenGate *Windows and UNIX Reference Guide*.

## Tracing DDL processing

If you open a support case with Oracle GoldenGate Technical Support, you might be asked to turn on tracing. The following parameters control DDL tracing.

- TLTRACE controls Extract tracing
- TRACE and TRACE2 control Replicat tracing.

These parameters have options to isolate the tracing of DDL from the tracing of DML. For more information, see the Oracle GoldenGate *Windows and UNIX Reference Guide*.

## Tracing the DDL trigger

To trace the activity of the Oracle GoldenGate DDL trigger, use the following tools.

- ggs\_ddl\_trace.log trace file: Oracle GoldenGate creates a trace file in the USER\_DUMP\_DEST directory of Oracle. On RAC, each node has its own trace file that captures DDL tracing for that node. You can query the trace file as follows:  

```
select value from sys.v_$parameter where name = 'user_dump_dest';
```
- ddl\_tracelevel script: Edit and run this script to set the trace level. A value of None generates no DDL tracing, except for fatal errors and installation logging. The default value of 0 generates minimal tracing information. A value of 1 or 2 generates a much larger amount of information in the trace file. Do not use 1 or 2 unless requested to do so by a Oracle GoldenGate Technical Support analyst as part of a support case.
- ddl\_cleartrace script: Run this script on a regular schedule to prevent the trace file from consuming excessive disk space as it expands. It deletes the file, but Oracle GoldenGate will create another one. The DDL trigger stops writing to the trace file when the Oracle directory gets low on space, and then resumes writing when space is available again. This script is in the Oracle GoldenGate directory. Back up the trace file before running the script.

## CHAPTER 8

# Instantiating and starting Oracle GoldenGate replication

.....

This chapter contains instructions for configuring an initial load of target data, adding the required processes to instantiate replication, and perform the instantiation. The expected outcome of these steps is that source-target data is made consistent (known as the *initial synchronization*), and that Oracle GoldenGate captures and delivers ongoing transactional changes so that consistency is maintained going forward.

## Overview of basic Oracle GoldenGate instantiation steps

These instructions show you how to instantiate the basic replication environment that you configured in Chapter 4. These steps are:

- [Satisfying prerequisites for instantiation](#)
- [Making the instantiation procedure more efficient](#)
- [Configuring the initial load](#)
- [Registering Extract with the mining database](#)
- [Adding change-capture and change-delivery processes](#)
- [Performing the target instantiation](#)
- [Monitoring processing after the instantiation](#)
- [Backing up the Oracle GoldenGate environment](#)

## Satisfying prerequisites for instantiation

These steps must be taken before starting any Oracle GoldenGate processes or native database load processes.

### Configure change capture and delivery

By the time you are ready to instantiate the replication environment, all of your Extract and Replicat process groups must be configured with completed parameter files as directed in Chapter 4 on page 38.

In addition, all of the other setup requirements in this manual must be satisfied.

### Add collision handling

If the source database will remain active during the initial load, collision-handling logic must be added to the Replicat parameter file. This logic handles conflicts that occur because static data is being loaded to the target tables while Oracle GoldenGate replicates transactional changes to those tables.



To handle collisions, add the `HANDLECOLLISIONS` parameter to the Replicat parameter file to resolve:

- INSERT operations for which the row already exists/
- UPDATE and DELETE operations for which the row does not exist.

For more information about this parameter, see the Oracle GoldenGate *Windows and UNIX Reference Guide*.

## Disable DDL processing

Before executing an initial load, disable DDL extraction and replication. DDL processing is controlled by the `DDL` parameter in the Extract and Replicat parameter files. See “Configuring DDL synchronization for an Oracle database” on page 150 for more information about DDL support.

## Prepare the target tables

The following are suggestions that can make the load go faster and help you to avoid errors.

- **Data:** Make certain that the target tables are empty. Otherwise, there may be duplicate-row errors or conflicts between existing rows and rows that are being loaded.
- **Constraints:** If you have not done so already, disable foreign-key constraints and check constraints. Foreign-key constraints can cause errors, and check constraints can slow down the loading process. See also “Preparing integrity constraints in source and target tables” on page 59 for additional requirements.
- **Indexes:** Remove indexes from the target tables. Indexes are not necessary for the inserts performed by the initial load process and will slow it down significantly. You can add back the indexes after the load is finished.
- **Keys:** To use the `HANDLECOLLISIONS` function to reconcile incremental data changes with the load, each target table must have a primary or unique key. If you cannot create a key through your application, use the `KEYCOLS` option of the `TABLE` and `MAP` parameters to specify columns as a substitute key for Oracle GoldenGate’s purposes. *If you cannot create keys, the affected source table must be quiesced for the load.*

## Making the instantiation procedure more efficient

The following are some suggestions for making the instantiation process move more efficiently.

### Share parameters between process groups

Some of the parameters that you use in a change-synchronization parameter file also are required in an initial-load Extract and initial-load Replicat parameter file. To take advantage of the commonalities, you can use any of the following methods:

- Copy common parameters from one parameter file to another.
- Store the common parameters in a central file and use the `OBEY` parameter in each parameter file to retrieve them.

- Create an Oracle GoldenGate macro for the common parameters and then call the macro from each parameter file with the MACRO parameter.

## Use parallel processes

You can configure parallel initial-load processes to perform the initial load more quickly. It is important to keep tables with foreign-key relationships within the same set of processes. You can isolate large tables from smaller ones by using different sets of processes, or simply apportion the load across any number of process sets. To configure parallel processes correctly, see “Tuning the Performance of Oracle GoldenGate” on page 20 of the Oracle GoldenGate *Windows and UNIX Troubleshooting and Tuning Guide*.

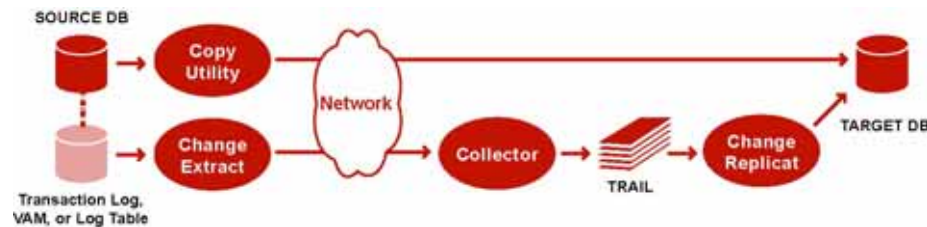
## Configuring the initial load

Oracle GoldenGate supports the following load methods specifically for Oracle:

- [To load with a database utility](#)
- [To direct bulk load to SQL\\*Loader](#)
- [To load from an input file to SQL\\*Loader](#)

Select a method and follow its configuration steps to create the load processes and parameter files.

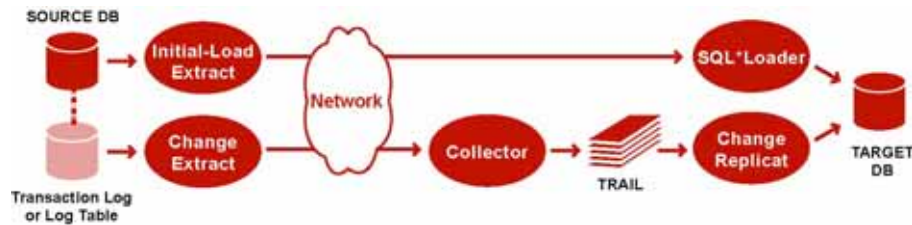
### To load with a database utility



This method uses a database copy utility to establish the target data. You start a change-synchronization Extract group to extract ongoing data changes while the database utility makes and applies a static copy of the data. When the copy is finished, you start the change-synchronization Replicat group to re-synchronize rows that were changed while the copy was being applied. From that point forward, both Extract and Replicat continue running to maintain data synchronization.

No special configuration of any initial-load processes is needed for this method. You just use the change-synchronization process groups that you configured in Chapter 4.

## To direct bulk load to SQL\*Loader



With this method, you configure and run an Oracle GoldenGate initial-load Extract to extract complete source records and send them directly to an initial-load Replicat task. The initial-load Replicat task communicates with SQL\*Loader to load data as a direct-path bulk load. Data mapping and transformation can be done by either the initial-load Extract or initial-load Replicat, or both. During the load, the change-synchronization groups that you configured in Chapter 4 replicated incremental changes, which are then reconciled with the results of the load.

### Limitations:

- This method does not support extraction of LOB or LONG data. As an alternative, see [“To load from an input file to SQL\\*Loader” on page 124](#).
- This method does not support materialized views that contain LOBs, regardless of their size. It also does not support data encryption.

### To configure a direct bulk load to SQL\*Loader

1. Grant LOCK ANY TABLE to the Replicat database user on the target Oracle database.
2. On the source and target systems, run GGSCI and start Manager.

```
START MANAGER
```

3. On the source system, create the initial-load Extract.

```
ADD EXTRACT <initial-load Extract name>, SOURCEISTABLE
```

#### Where:

- <initial-load Extract name> is the name of the initial-load Extract, up to eight characters.
  - SOURCEISTABLE directs Extract to read complete records directly from the source tables.
4. On the source system, create the initial-load Extract parameter file.

```
EDIT PARAMS <initial-load Extract name>
```

5. Enter the initial-load Extract parameters in the order shown, starting a new line for each parameter statement. Your input will be different. Refer to Table 20 for descriptions.

```
EXTRACT initext
USERID ogg, PASSWORD AACAAAAAAAAAAAAJAUEUGODSCVJEEIUGKJDJTFNDKEJFFFTC &
  AES128, ENCRYPTKEY securekey1
RMTHOST fin1, MGRPORT 7809 ENCRYPT AES192, KEYNAME securekey2
RMTTASK replicat, GROUP initrep
TABLE hr.*;
```

**Table 20 Initial-load Extract parameters to direct bulk load to SQL\*Loader**

Parameter	Description
EXTRACT <initial-load Extract name>	Specifies the name of the initial-load Extract, as stated with ADD EXTRACT.
USERID <user id>, PASSWORD <pw> [<encryption options>]	Specifies database credentials and encryption information, if required. You can use the same user that you created for the change-synchronization processes.
RMTHOST <hostname>, MGRPORT <portnumber> [, ENCRYPT <algorithm> KEYNAME <keyname>]	Specifies the target system, the port where Manager is running, and optional encryption of data across TCP/IP.
RMTTASK replicat, GROUP <initial-load Replicat name>	Specifies the process type (Replicat) and the name of the initial-load Replicat. Directs Manager on the target system to dynamically start the initial-load Replicat as a one-time task.
TABLE <owner>.<table>;	Specifies the owner and a table or multiple tables specified with a wildcard for initial data extraction. To exclude tables from a wildcard specification, use the TABLEEXCLUDE parameter.

6. Save and close the file.
7. On the target system, create the initial-load Replicat.

```
ADD REPLICAT <initial-load Replicat name>, SPECIALRUN
```

**Where:**

- <initial-load Replicat name> is the name of the initial-load Replicat task.
- SPECIALRUN identifies the initial-load Replicat as a one-time task, not a continuous process.

8. On the target system, create the initial-load Replicat parameter file.

```
EDIT PARAMS <initial-load Replicat name>
```

9. Enter the initial-load Replicat parameters in the order shown, starting a new line for each parameter statement. See Table 21 for descriptions.

```

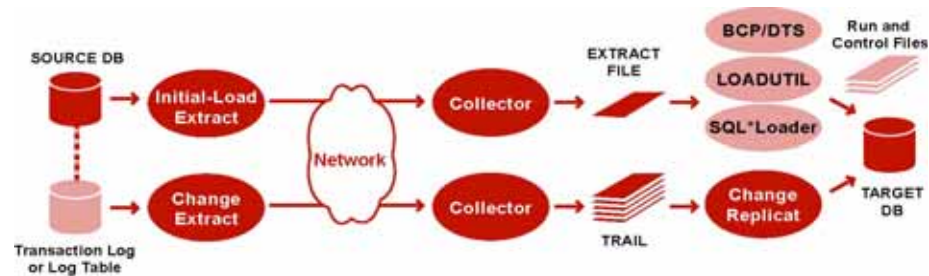
REPLICAT initrep
USERID ogg, PASSWORD AACAAAAAAAAAAAAJAUEUGODSCVJEEIUGKJDJTFNDKEJFFFTC &
    AES128, ENCRYPTKEY securekey1
BULKLOAD
ASSUMETARGETDEFS
MAP hr.*, TARGET hr2.*;
    
```

**Table 21 Initial-load Replicat parameters to direct bulk load to SQL\*Loader**

Parameter	Description
REPLICAT <initial-load Replicat name>	Specifies the name of the initial-load Replicat task, as stated with ADD REPLICAT.
USERID <user id>, PASSWORD <pw> [<encryption options>]	Specifies database credentials and encryption information, if required. You can use the same user that you created for the change-synchronization processes.
BULKLOAD	Directs Replicat to interface directly with the Oracle SQL*Loader interface.
ASSUMETARGETDEFS	Assumes the source and target tables are identical, including semantics.  If source and target definitions are different, you must create and specify a source-definitions file that both the change-synchronization and initial-load processes will use. For more information, see Chapter 13 of the Oracle GoldenGate <i>Windows and UNIX Administrator's Guide</i> .
MAP <owner>.<table>, TARGET <owner>.<table>;	Specifies a relationship between a source and target table or tables. <ul style="list-style-type: none"> <li>◆ &lt;owner&gt; is the schema name.</li> <li>◆ &lt;table&gt; is the name of a table or a wildcard definition for multiple tables. To exclude tables from a wildcard specification, use the MAPEXCLUDE parameter.</li> </ul>

10. Save and close the parameter file.
11. Proceed to “Registering Extract with the mining database” on page 126.

## To load from an input file to SQL\*Loader



With this method, an initial-load Extract extracts source records from the source tables and writes them to an extract file in external ASCII format. The files are read by SQL\*Loader. During the load, the change-synchronization groups that you configured in Chapter 4 replicate incremental changes, which are then reconciled with the results of the load. As part of the load procedure, Oracle GoldenGate uses the initial-load Replicat to create run and control files required by the database utility. Any data transformation must be performed by the initial-load Extract on the source system because the control files are generated dynamically and cannot be pre-configured with transformation rules.

### To configure a load from file to SQL\*Loader

1. On the source and target systems, run GGSCI and start Manager.

```
START MANAGER
```

2. On the source system, create the initial-load Extract parameter file.

```
EDIT PARAMS <initial-load Extract name>
```

3. Enter the initial-load Extract parameters in the order shown, starting a new line for each parameter statement. Your input will be different. Refer to Table 22 for descriptions.

```
SOURCEISTABLE
USERID ogg, PASSWORD AACAAAAAAAAAAAAJAUEUGODSCVGVJEEIUGKJDTFNDKEJFFFTC &
  AES128, ENCRYPTKEY securekey1
RMTHOST fin1, MGRPORT 7809 ENCRYPT AES192, KEYNAME securekey2
ENCRYPTTRAIL AES192, KEYNAME mykey1
RMTFILE /ggs/dirdat/ie
FORMATASCII, SQLLOADER
TABLE hr.*;
```

Table 22 Initial-load Extract parameters to load from file to SQL\*Loader

Parameter	Description
SOURCEISTABLE	Designates Extract as an initial load process that extracts records directly from the source tables.
USERID <user id>, PASSWORD <pw> [<encryption options>]	Specifies database credentials and encryption information, if required. You can use the same user that you created for the change-synchronization processes.

**Table 22 Initial-load Extract parameters to load from file to SQL\*Loader (continued)**

Parameter	Description
RMTHOST <hostname>, MGRPORT <portnumber> [, ENCRYPT <algorithm> KEYNAME <keyname>]	Specifies the target system, the port where Manager is running, and optional encryption of data across TCP/IP.
ENCRYPTTRAIL <encryption options>	Encrypts the data in the remote file. For encryption options, see the Oracle GoldenGate <i>Windows and UNIX Reference Guide</i> .
RMTFILE <path name>,	Specifies the absolute or full path name of an extract file that Extract creates and to which it writes the load data.
FORMATASCII, SQLLOADER	Produces a fixed-length, ASCII-formatted remote file that is compatible with SQL*Loader. For information about limitations and options of FORMATASCII, see the Oracle GoldenGate <i>Windows and UNIX Reference Guide</i> .
TABLE <owner>.<table>;	Specifies the owner and a table or multiple tables specified with a wildcard for initial data extraction. To exclude tables from a wildcard specification, use the TABLEEXCLUDE parameter.

4. Save and close the parameter file.
5. On the target system, create the initial-load Replicat parameter file.  

```
EDIT PARAMS <initial-load Replicat name>
```
6. Enter the initial-load Replicat parameters in the order shown, starting a new line for each parameter statement. See Table 23 for descriptions.  

```
GENLOADFILES sqlldr.tpl
USERID ogg, PASSWORD AACAAAAAAAAAAAAJAUEUGODSCVJGJEEIUGKJJDJTFNDKEJFFFTC &
  AES128, ENCRYPTKEY securekey1
DECRYPTTRAIL AES192, KEYNAME mykey1
EXTFILE /ggs/dirdat/ie
ASSUMETARGETDEFS
MAP hr.*, TARGET hr2.*;
```
- 7.

**Table 23 Initial-load Replicat parameters to load from file to SQL\*Loader**

Parameter	Description
GENLOADFILES <template file>	Generates run and control files for the database utility. For instructions on using this parameter, see the Oracle GoldenGate <i>Windows and UNIX Reference Guide</i> .

**Table 23 Initial-load Replicat parameters to load from file to SQL\*Loader (continued)**

Parameter	Description
USERID <user id>, PASSWORD <pw> [<encryption options>]	USERID specifies database credentials and encryption information, if required. You can use the same user that you created for the change-synchronization processes.
DECRYPTTRAIL <encryption options>	Decrypts the data in the input extract file. For encryption options, see the Oracle GoldenGate <i>Windows and UNIX Reference Guide</i> .
EXTFILE <path name>   EXTTRAIL <path name>	Specifies the extract file that you specified with the Extract parameter RMTFILE.
ASSUMETARGETDEFS	Assumes the source and target tables are identical, including semantics.  If source and target definitions are different, you must create and specify a source-definitions file that both the change-synchronization and initial-load processes will use. For more information, see Chapter 13 of the Oracle GoldenGate <i>Windows and UNIX Administrator's Guide</i> .
MAP <owner>.<table>, TARGET <owner>.<table>;	Specifies a relationship between a source and target table or tables.  <ul style="list-style-type: none"> <li>◆ &lt;owner&gt; is the schema name.</li> <li>◆ &lt;table&gt; is the name of a table or a wildcard definition for multiple tables. To exclude tables from a wildcard specification, use the MAPEXCLUDE parameter.</li> </ul>

8. Save and close the parameter file.
9. Proceed to “Registering Extract with the mining database”.

## Registering Extract with the mining database

To create the database logmining server, you register each Extract process with the mining database. The creation of the logmining server extracts a snapshot of the source database in the redo stream of the source database. To avoid unnecessary logmining activity on the source, perform this procedure close in time to when you instantiate replication.

1. Log into the mining database. The command to use differs, depending on whether the database logmining server is to be created at a source mining database or a downstream mining database.

Command for source deployment:

```
DBLOGIN USERID <user>, PASSWORD <password>, [<encryption options>]
```



Command for downstream deployment:

```
MININGDBLOGIN USERID <user>, PASSWORD <password>, [<encryption options>]
```

**Where:** <encryption options> specifies optional encryption options for the password. For more information, see DBLOGIN in the Oracle GoldenGate *Windows and UNIX Reference Guide*.

2. Register the Extract process with the mining database. To register multiple Extracts with a downstream database, issue the command for each one.

```
GGSCI> REGISTER EXTRACT <group> DATABASE
```

The register process may take a few to several minutes to complete, even though the REGISTER command returns immediately.

## Adding change-capture and change-delivery processes

**NOTE** Perform these steps at or close to the time that you are ready to start the initial load and change capture.

These steps establish the Oracle GoldenGate Extract, data pump, and Replicat processes that you configured in Chapter 4 on page 38. Collectively known as the “change-synchronization” processes, these are the processes that:

- capture and apply ongoing source changes while the load is being performed on the target
- reconcile any collisions that occur.

**NOTE** Perform these steps as close as possible to the time that you plan to start the initial load processes. You will start these processes during the initial load steps.

### Set the RMAN archive log deletion policy

Set the RMAN archivelog deletion policy to a value of "TO APPLIED ON [ALL] STANDBY".

```
CONFIGURE ARCHIVELOG DELETION POLICY TO APPLIED ON ALL STANDBY
```

This must be done before you add the primary Extract.

### Add the primary Extract

These steps add the primary Extract that captures change data.

1. Run GGSCI.
2. Issue the ADD EXTRACT command to add the primary Extract group.

```
ADD EXTRACT <group name>  
{, TRANLOG | , INTEGRATED TRANLOG}  
{, BEGIN {NOW | yyyy-mm-dd [:hh:mi:[ss[.cccccc]]}] |  
  {, EXTSEQNO <seqno>, EXTRBA <relative byte address>}  
[, THREADS <n>]
```

**Where:**

- <group name> is the name of the Extract group.
- TRANLOG specifies the transaction log as the data source; for *classic capture only*.
- INTEGRATED TRANLOG specifies that Extract receives logical change records through a database logmining server; for *integrated capture only*.
- BEGIN <start point> specifies to begin capturing data as of a specific *time*:
  - ▶ NOW starts at the first record that is timestamped at the same time that ADD EXTRACT is issued.
  - ▶ <YYYY-MM-DD HH:MM[:SS[.CCCCCC]]> starts at an explicit timestamp. Logs from this timestamp must be available.
- EXTSEQNO <seqno>, EXTRBA <relative byte address> specifies to begin capturing data at a specific *location* (log sequence number and RBA) in the redo stream.
- THREADS <n> is required in classic capture mode for Oracle Real Application Cluster (RAC), to specify the number of redo log threads being used by the cluster. Extract reads and coordinates each thread to maintain transactional consistency. Not required for integrated capture.

**NOTE** This is the minimum required syntax. Additional options are available. See the Oracle GoldenGate *Windows and UNIX Reference Guide*.

**Example 1 Classic capture with timestamp start point**

```
ADD EXTRACT finance, TRANLOG, BEGIN 2011-01-01 12:00:00.000000
```

**Example 2 Integrated capture with ADD EXTRACT timestamp start point**

```
ADD EXTRACT finance, INTEGRATED TRANLOG, BEGIN NOW
```

**Example 3 Integrated capture with log sequence/RBA start point**

```
ADD EXTRACT finance, INTEGRATED TRANLOG, EXTSEQNO 2952, EXTRBA 7598080
```

## Add the local trail

These steps add the local trail to which the primary Extract writes captured data.

In GGSCI on the source system, issue the ADD EXTTRAIL command:

```
ADD EXTTRAIL <pathname>, EXTRACT <group name>
```

**Where:**

- EXTTRAIL specifies that the trail is to be created on the local system.
- <pathname> is the relative or fully qualified name of the trail, including the two-character name.
- EXTRACT <group name> is the name of the primary Extract group.

**Example**

```
ADD EXTTRAIL /ggs/dirdat/lt, EXTRACT finance
```

## Add the data pump Extract group

These steps add the data pump that reads the local trail and sends the data to the target.

In GGSCI on the source system, issue the ADD EXTRACT command.

```
ADD EXTRACT <group name>, EXTTRAILSOURCE <trail name>
```

**Where:**

- <group name> is the name of the Extract group.
- EXTTRAILSOURCE <trail name> is the relative or fully qualified name of the local trail.

**Example**     ADD EXTRACT financep, EXTTRAILSOURCE c:\ggs\dirdat\lt

## Add the remote trail

These steps add the remote trail. Although it is read by Replicat, this trail must be associated with the data pump, so it must be added on the source system, not the target.

In GGSCI on the source system, issue the following command:

```
ADD RMTTRAIL <pathname>, EXTRACT <group name>
```

**Where:**

- RMTTRAIL specifies that the trail is to be created on the target system.
- <pathname> is the relative or fully qualified name of the trail, including the two-character name.
- EXTRACT <group name> is the name of the data-pump Extract group.

**Example**     ADD RMTTRAIL /ggs/dirdat/rt, EXTRACT financep

## Add the Replicat group

These steps add the Replicat group that reads the remote trail (which gets created automatically on the target) and applies the data changes to the target Oracle database.

1. Run GGSCI on the target system.
2. Issue the ADD REPLICAT command.

```
ADD REPLICAT <group name>, EXTTRAIL <pathname>
```

**Where:**

- <group name> is the name of the Replicat group.
- EXTTRAIL <pathname> is the relative or fully qualified name of the remote trail, including the two-character name.

**Example**     ADD REPLICAT financer, EXTTRAIL c:\ggs\dirdat\rt

## Performing the target instantiation

This procedure instantiates the target tables while Oracle GoldenGate captures ongoing transactional changes on the source and stores them until they can be applied on the target. By the time you perform the instantiation of the target tables, the entire Oracle GoldenGate environment should be configured for change capture and delivery, as should the initial-load processes if using Oracle GoldenGate as an initial-load utility.

## To perform instantiation with a database utility

1. On the source and target systems, run GGSCI and start the Manager process.

```
START MANAGER
```

**NOTE** In a Windows cluster, start the Manager resource from the Cluster Administrator.

2. Start the primary change-capture Extract group.

```
START EXTRACT <Extract group name>
```

3. Start the data-pump Extract group.

```
START EXTRACT <data pump name>
```

**NOTE** The first time that Extract starts in a new Oracle GoldenGate configuration, any open transactions will be skipped. Only transactions that begin after Extract starts are captured.

4. If replicating sequence values:

- Issue the DBLOGIN command as a user who has EXECUTE privilege on update.Sequence.  
`DBLOGIN USERID DBLOGINuser, PASSWORD password [<encryption options>]`

- Issue the following command to update each source sequence and generate redo. From the redo, Replicat performs initial synchronization of the sequences on the target. You can use an asterisk wildcard for any or all characters for the sequence name but not owner.

```
FLUSH SEQUENCE <owner.sequence>
```

5. Start making the copy with the database utility.

6. Wait until the copy is finished and record the time of completion.

7. On the target system, view the Replicat parameter file to make certain that the HANDLECOLLISIONS parameter is listed. If not, add the parameter with the EDIT PARAMS command.

```
VIEW PARAMS <group name>  
EDIT PARAMS <group name>
```

8. Start Replicat.

```
START REPLICAT <group name>
```

9. Issue the INFO REPLICAT command, and continue to issue it until it shows that Replicat posted all of the change data that was generated during the initial load. For example, if the initial-load Extract stopped at 12:05, make sure Replicat posted data up to that time.

```
INFO REPLICAT <Replicat group name>
```

10. Turn off HANDLECOLLISIONS for the change-delivery Replicat to disable initial-load error handling.

```
SEND REPLICAT <Replicat group name>, NOHANDLECOLLISIONS
```

11. Edit the change-delivery Replicat parameter file to remove the HANDLECOLLISIONS parameter.

```
EDIT PARAMS <Replicat group name>
```

12. Save and close the parameter file.

From this point forward, Oracle GoldenGate continues to synchronize data changes.

## To perform instantiation with direct bulk load to SQL\*Loader

1. On the source system, run GGSCI.
2. Start the primary change-capture Extract group.  

```
START EXTRACT <Extract group name>
```
3. Start the data-pump Extract group.  

```
START EXTRACT <data pump name>
```
4. If replicating sequence values:
  - Issue the DBLOGIN command as a user who has EXECUTE privilege on update.Sequence.  

```
DBLOGIN USERID DBLOGINuser, PASSWORD password [<encryption options>]
```
  - Issue the following command to update each source sequence and generate redo. From the redo, Replicat performs initial synchronization of the sequences on the target. You can use an asterisk wildcard for any or all characters for the sequence name but not owner.  

```
FLUSH SEQUENCE <owner.sequence>
```
5. Start the initial-load Extract.  

```
START EXTRACT <initial-load Extract name>
```

**WARNING** Do not start the initial-load Replicat. The Manager process starts it automatically and terminates it when the load is finished.
6. On the target system, run GGSCI.
7. Issue the VIEW REPORT command to determine when the initial load to SQL\*Loader is finished.  

```
VIEW REPORT <initial-load Extract name>
```
8. When the load is finished, start the change-data Replicat group.  

```
START REPLICAT <Replicat group name>
```
9. Issue the INFO REPLICAT command, and continue to issue it until it shows that Replicat posted all of the change data that was generated during the initial load. For example, if the initial-load Extract stopped at 12:05, make sure Replicat posted data up to that time.  

```
INFO REPLICAT <Replicat group name>
```

10. Turn off HANDLECOLLISIONS for the change-delivery Replicat to disable initial-load error handling.

```
SEND REPLICAT <Replicat group name>, NOHANDLECOLLISIONS
```

11. Edit the change-delivery Replicat parameter file to remove the HANDLECOLLISIONS parameter.

```
EDIT PARAMS <Replicat group name>
```

12. Save and close the parameter file.

From this point forward, Oracle GoldenGate continues to synchronize data changes.

## To perform instantiation from an input file to SQL\*Loader

1. On the source system, run GGSCI.
2. Start the primary change-capture Extract group.  

```
START EXTRACT <Extract group name>
```
3. Start the data-pump Extract group.  

```
START EXTRACT <data pump name>
```
4. If replicating sequence values:

- Issue the DBLOGIN command as a user who has EXECUTE privilege on update.Sequence.  

```
DBLOGIN USERID DBLOGINuser, PASSWORD password [<encryption options>]
```

- Issue the following command to update each source sequence and generate redo. From the redo, Replicat performs initial synchronization of the sequences on the target. You can use an asterisk wildcard for any or all characters for the sequence name but not owner.  

```
FLUSH SEQUENCE <owner.sequence>
```

5. From the Oracle GoldenGate installation directory on the source system, start the initial-load Extract from the command line of the operating system (not GGSCI).

### *UNIX and Linux:*

```
$ /<GGS directory>/extract paramfile dirprm/<initial-load Extract name>.prm reportfile <path name>
```

### *Windows:*

```
C:\> <GGS directory>\extract paramfile dirprm\<initial-load Extract name>.prm reportfile <path name>
```

**Where:** <initial-load Extract name> is the name of the initial-load Extract and <path name> is the relative or fully qualified path where you want the Extract report file to be created.

6. Wait until the initial extraction from the source is finished. Verify its progress and results by viewing the Extract report file from the command line.
7. On the target system, start the initial-load Replicat.

*UNIX and Linux:*

```
$ /<GGS directory>/replicat paramfile dirprm/<initial-load Replicat  
name>.prm reportfile <path name>
```

*Windows:*

```
C:\> <GGS directory>\replicat paramfile dirprm\<initial-load Replicat  
name>.prm reportfile <path name>
```

**Where:** <initial-load Replicat name> is the name of the initial-load Replicat and <path name> is the relative or fully qualified path where you want the Replicat report file to be created.

8. When the initial-load Replicat stops, verify its results by viewing the Replicat report file from the command line.
9. Using the ASCII-formatted file and the run and control files that the initial-load Replicat created, load the data with SQL\*Loader.
10. When the load is finished, start the change-delivery Replicat group.

```
START REPLICAT <Replicat group name>
```

11. Issue the INFO REPLICAT command, and continue to issue it until it shows that Replicat posted all of the change data that was generated during the initial load. For example, if the initial-load Extract stopped at 12:05, make sure Replicat posted data up to that time.

```
INFO REPLICAT <group name>
```

12. Turn off HANDLECOLLISIONS for the change-delivery Replicat to disable initial-load error handling.

```
SEND REPLICAT <Replicat group name>, NOHANDLECOLLISIONS
```

13. Edit the change-delivery Replicat parameter file to remove the HANDLECOLLISIONS parameter.

```
EDIT PARAMS <Replicat group name>
```

14. Save and close the parameter file.

From this point forward, Oracle GoldenGate continues to synchronize data changes.

## Monitoring processing after the instantiation

After the target is instantiated and replication is in effect, you can, and should, view the status, lag, and overall health of the replication environment to ensure that processes are running properly, that there are no warnings in the Oracle GoldenGate error log, and that lag is at an acceptable level. You can view Oracle GoldenGate processes from:

- *GGSCI:* See Chapter 17 of the Oracle GoldenGate *Windows and UNIX Administrator's Guide*.
- *Oracle GoldenGate Monitor:* See the administration documentation and online help for that product.

You also should verify that capture and delivery is being performed for all of the appropriate tables, and that the data remains synchronized. You can use the Oracle GoldenGate Veridata product for this purpose.

## **Backing up the Oracle GoldenGate environment**

After you start Oracle GoldenGate processing, an effective backup routine is critical to preserving the state of processing in the event of a failure. Unless the Oracle GoldenGate working files can be restored, the entire replication environment must be re-instantiated, complete with new initial loads.

As a best practice, include the entire Oracle GoldenGate home installation in your backup routines. There are too many critical sub-directories, as well as files and programs at the root of the directory, to keep track of separately. In any event, the most critical files are those that consume the vast majority of backup space, and therefore it makes sense just to back up the entire installation directory for fast, simple recovery.



## CHAPTER 9

# Controlling processes

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The standard way to control online processes is through GGSCI. For alternate methods, see the Oracle GoldenGate *Windows and UNIX Administrator's Guide*.

### When to start processes

Typically, the first time that Oracle GoldenGate processes are started in a production setting is during the initial synchronization process, assuming source user applications must remain active. While the target is loaded with the source data, Oracle GoldenGate captures ongoing user changes and then reconciles them with the results of the load.

**NOTE** The first time that Extract starts in a new Oracle GoldenGate configuration, any open transactions will be skipped. Only transactions that begin after Extract starts are captured.

### Starting processes after instantiation is complete

These instructions are for starting the processes on a daily basis, as needed. They show basic syntax. Additional syntax may be available and is documented in the Oracle GoldenGate *Windows and UNIX Reference Guide*.

#### To start Manager

1. From the Oracle GoldenGate directory, run GGSCI.
2. In GGSCI, issue the following command.

```
START MANAGER
```

**NOTE** When starting Manager from the command line or GGSCI on Windows Server 2008 with User Account Control enabled, you will receive a UAC prompt requesting you to allow or deny the program to run.

#### To start Extract or Replicat

```
START {EXTRACT | REPLICAT} <group_name>
```

#### Where:

<group\_name> is the name of the Extract or Replicat group or a wildcard set of groups (for example, \* or fin\*).

#### To stop Extract or Replicat gracefully

```
STOP {EXTRACT | REPLICAT} <group_name>
```

**Where:**

<group\_name> is the name of the Extract or Replicat group or a wildcard set of groups (for example, \* or fin\*).

**To stop Replicat forcefully**

```
STOP REPLICAT <group name> !
```

The current transaction is aborted and the process stops immediately. You cannot stop Extract forcefully.

**To kill a process that STOP cannot stop**

```
KILL {EXTRACT | REPLICAT} <group name>
```

Killing a process does not shut it down gracefully, and checkpoint information can be lost.

**To control multiple processes at once**

```
<command> ER <wildcard specification>
```

**Where:**

- <command> is: KILL, START, or STOP
- <wildcard specification> is a wildcard specification for the names of the process groups that you want to affect with the command. The command affects every Extract and Replicat group that satisfies the wildcard. Oracle GoldenGate supports up to 100,000 wildcard entries.

**To delete an Extract group**

1. Run GGSCI.
2. Stop the process.

```
STOP EXTRACT <group_name>
```

3. Issue the following command.

```
DELETE EXTRACT <group> [!]
```

The ! argument deletes all Extract groups that satisfy a wildcard without prompting.

**To delete a Replicat group**

1. Stop the process.

```
STOP EXTRACT <group_name>
```

2. If using a checkpoint table for this group, issue the following command from GGSCI to log into the database.

```
DBLOGIN USERID <user>[, PASSWORD <password>[ <encryption options>]]
```

**Where:**

- USERID <user>, PASSWORD <password>, and <encryption options> supply database credentials and encryption information, if required.

3. Issue the following command to delete the group.

```
DELETE REPLICAT <group>
```

**NOTE** For additional commands and options, see the Oracle GoldenGate *Windows and UNIX Reference Guide*.

Deleting a process group preserves the parameter file. You can create the same group again, using the same parameter file, or you can delete the parameter file to remove the group's configuration permanently.

## CHAPTER 10

# Managing the Oracle DDL replication environment

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This chapter contains instructions for making changes to the database environment or the Oracle GoldenGate environment when the Oracle GoldenGate DDL objects still exist on the system.

For instructions on configuring Oracle GoldenGate DDL support, see the Oracle GoldenGate *Windows and UNIX Administrator's Guide*.

## Enabling and disabling the DDL trigger

You can enable and disable the trigger that captures DDL operations without making any configuration changes within Oracle GoldenGate. The following scripts control the DDL trigger.

- `ddl_disable`: Disables the trigger. No further DDL operations are captured or replicated after you disable the trigger.
- `ddl_enable`: Enables the trigger. When you enable the trigger, Oracle GoldenGate starts capturing current DDL changes, but does not capture DDL that was generated while the trigger was disabled.

Before running these scripts, disable all sessions that ever issued DDL, including those of the Oracle GoldenGate processes, SQL\*Plus, business applications, and any other software that uses Oracle. Otherwise the database might generate an ORA-04021 error. Do not use these scripts if you intend to maintain consistent DDL on the source and target systems.

## Maintaining the DDL marker table

You can purge rows from the marker table at any time. It does not keep DDL history. To purge the marker table, use the Manager parameter `PURGEMARKERHISTORY`. Manager gets the name of the marker table from one of the following:

1. The name given with the `MARKERTABLE <table>` parameter in the `GLOBALS` file, if specified.
2. The default name of `GGS_MARKER`.

`PURGEMARKERHISTORY` provides options to specify maximum and minimum lengths of time to keep a row, based on the last modification date. For more information, see the Oracle GoldenGate *Windows and UNIX Reference Guide*.

## Deleting the DDL marker table

Do not delete the DDL marker table unless you want to discontinue synchronizing DDL. The marker table and the DDL trigger are interdependent. An attempt to drop the marker

.....

table fails if the DDL trigger is enabled. This is a safety measure to prevent the trigger from becoming invalid and missing DDL operations. If you remove the marker table, the following error is generated:

```
"ORA-04098: trigger 'SYS.GGS_DDL_TRIGGER_BEFORE' is invalid and failed re-validation"
```

The proper way to remove an Oracle GoldenGate DDL object depends on your plans for the rest of the DDL environment. To choose the correct procedure, see one of the following:

- “Restoring an existing DDL environment to a clean state” on page 141
- “Removing the DDL objects from the system” on page 142

## Maintaining the DDL history table

You can purge the DDL history table to control its size, but do so carefully. The DDL history table maintains the integrity of the DDL synchronization environment. Purges to this table cannot be recovered through the Oracle GoldenGate interface.

### To maintain the DDL history table

1. To prevent any possibility of DDL history loss, make regular full backups of the history table.
2. To ensure the recoverability of purged DDL, enable Oracle Flashback for the history table. Set the flashback retention time well past the point where it could be needed. For example, if your full backups are at most one week old, retain two weeks of flashback. Oracle GoldenGate can be positioned backward into the flashback for reprocessing.
3. If possible, purge the DDL history table manually to ensure that essential rows are not purged accidentally. If you require an automated purging mechanism, use the `PURGEDDLHISTORY` parameter in the Manager parameter file. You can specify maximum and minimum lengths of time to keep a row. For more information, see the Oracle GoldenGate *Windows and UNIX Reference Guide*.

**NOTE** Temporary tables created by Oracle GoldenGate to increase performance might be purged at the same time as the DDL history table, according to the same rules. The names of these tables are derived from the name of the history table, and their purging is reported in the Manager report file. This is normal behavior.

## Deleting the DDL history table

Do not delete the DDL history table unless you want to discontinue synchronizing DDL. The history table contains a record of DDL operations that were issued.

The history table and the DDL trigger are interdependent. An attempt to drop the history table fails if the DDL trigger is enabled. This is a safety measure to prevent the trigger from becoming invalid and missing DDL operations. If you remove the history table, the following error is generated:

```
"ORA-04098: trigger 'SYS.GGS_DDL_TRIGGER_BEFORE' is invalid and failed re-validation"
```

The proper way to remove an Oracle GoldenGate DDL object depends on your plans for the

rest of the DDL environment. To choose the correct procedure, see one of the following:

- “Restoring an existing DDL environment to a clean state” on page 141
- “Removing the DDL objects from the system” on page 142

## Purging the DDL trace file

To prevent the DDL trace file from consuming excessive disk space, run the `ddl_cleartrace` script on a regular basis. This script deletes the trace file, but Oracle GoldenGate will create it again.

The default name of the DDL trace file is `ggs_ddl_trace.log`. It is in the `USER_DUMP_DEST` directory of Oracle. The `ddl_cleartrace` script is in the Oracle GoldenGate directory.

## Applying database patches and upgrades when DDL support is enabled

Database patches and upgrades usually invalidate the Oracle GoldenGate DDL trigger and other Oracle GoldenGate DDL objects. Before applying a database patch, do the following.

1. Disable the Oracle GoldenGate DDL trigger by running the following script.

```
@ddl_disable
```

2. Apply the patch.

3. Enable the DDL trigger by running the following script.

```
@ddl_enable
```

**NOTE** Database upgrades and patches generally operate on Oracle objects. Because Oracle GoldenGate filters out those objects automatically, DDL from those procedures is not replicated when replication starts again.

To avoid recompile errors after the patch or upgrade, which are caused if the trigger is not disabled before the procedure, consider adding calls to `@ddl_disable` and `@ddl_enable` at the appropriate locations within your scripts.

## Applying Oracle GoldenGate patches and upgrades when DDL support is enabled

**NOTE** If there are instructions like these in the release notes or upgrade instructions that accompany a release, follow those instead of these. Do not use this procedure for an upgrade from an Oracle GoldenGate version that does not support DDL statements that are larger than 30K (pre-version 10.4). To upgrade in that case, follow the instructions in “Restoring an existing DDL environment to a clean state” on page 141.

Follow these steps to apply a patch or upgrade to the DDL objects. This procedure may or may not preserve the current DDL synchronization configuration, depending on whether the new build requires a clean installation.

1. Run GGSCI. Keep the session open for the duration of this procedure.

2. Stop Extract to stop DDL capture.  
`STOP EXTRACT <group>`
3. Stop Replicat to stop DDL replication.  
`STOP REPLICAT <group>`
4. Download or extract the patch or upgrade files according to the instructions provided by Oracle GoldenGate.
5. Change directories to the Oracle GoldenGate installation directory.
6. Run SQL\*Plus and log in as a user that has SYSDBA privileges.
7. Disconnect all sessions that ever issued DDL, including those of Oracle GoldenGate processes, SQL\*Plus, business applications, and any other software that uses Oracle. Otherwise the database might generate an ORA-04021 error.
8. Run the `ddl_disable` script to disable the DDL trigger.
9. Run the `ddl_setup` script. You are prompted for the name of the Oracle GoldenGate DDL schema. If you changed the schema name, use the new one.
10. Run the `ddl_enable.sql` script to enable the DDL trigger.
11. In GGSCI, start Extract to resume DDL capture.  
`START EXTRACT <group>`
12. Start Replicat to start DDL replication.  
`START REPLICAT <group>`

## Restoring an existing DDL environment to a clean state

Follow these steps to completely remove, and then reinstall, the Oracle GoldenGate DDL objects. This procedure creates a new DDL environment, but removes DDL history.

**NOTE** Due to object interdependencies, all objects must be removed and reinstalled in this procedure.

1. If you are performing this procedure in conjunction with the installation of a new Oracle GoldenGate version, download and install the Oracle GoldenGate files, and create or update process groups and parameter files as necessary.
2. (Optional) To preserve the continuity of source and target structures, stop DDL activities and then make certain that Replicat finished processing all of the DDL and DML data in the trail. To determine when Replicat is finished, issue the following command until you see a message that there is no more data to process.

```
INFO REPLICAT <group>
```

**NOTE** Instead of using `INFO Replicat`, you can use the `EVENTACTIONS` option of `TABLE` and `MAP` to stop the Extract and Replicat processes after the DDL and DML has been processed.

3. Run GGSCI.

4. Stop Extract to stop DDL capture.  
`STOP EXTRACT <group>`
5. Stop Replicat to stop DDL replication.  
`STOP REPLICAT <group>`
6. Change directories to the Oracle GoldenGate installation directory.
7. Run SQL\*Plus and log in as a user that has SYSDBA privileges.
8. Disconnect all sessions that ever issued DDL, including those of Oracle GoldenGate processes, SQL\*Plus, business applications, and any other software that uses Oracle. Otherwise the database might generate an ORA-04021 error.
9. Run the `ddl_disable` script to disable the DDL trigger.
10. Run the `ddl_remove` script to remove the Oracle GoldenGate DDL trigger, the DDL history and marker tables, and other associated objects. This script produces a `ddl_remove_spool.txt` file that logs the script output and a `ddl_remove_set.txt` file that logs environment settings in case they are needed for debugging.
11. Run the `marker_remove` script to remove the Oracle GoldenGate marker support system. This script produces a `marker_remove_spool.txt` file that logs the script output and a `marker_remove_set.txt` file that logs environment settings in case they are needed for debugging.
12. Run the `marker_setup` script to reinstall the Oracle GoldenGate marker support system. You are prompted for the name of the Oracle GoldenGate schema.
13. Run the `ddl_setup` script. You are prompted for the name of the Oracle GoldenGate DDL schema.
14. Run the `role_setup` script to recreate the Oracle GoldenGate DDL role.
15. Grant the role to all Oracle GoldenGate users under which the following Oracle GoldenGate processes run: Extract, Replicat, GGSCI, and Manager. You might need to make multiple grants if the processes have different user names.
16. Run the `ddl_enable.sql` script to enable the DDL trigger.

## Removing the DDL objects from the system

This procedure removes the DDL environment and removes the history that maintains continuity between source and target DDL operations.

**NOTE** Due to object interdependencies, all objects must be removed.

1. Run GGSCI.
2. Stop Extract to stop DDL capture.  
`STOP EXTRACT <group>`



3. Stop Replicat to stop DDL replication.

```
STOP REPLICAT <group>
```

4. Change directories to the Oracle GoldenGate installation directory.
5. Run SQL\*Plus and log in as a user that has SYSDBA privileges.
6. Disconnect all sessions that ever issued DDL, including those of Oracle GoldenGate processes, SQL\*Plus, business applications, and any other software that uses Oracle. Otherwise the database might generate an ORA-04021 error.
7. Run the `ddl_disable` script to disable the DDL trigger.
8. Run the `ddl_remove` script to remove the Oracle GoldenGate DDL trigger, the DDL history and marker tables, and the associated objects. This script produces a `ddl_remove_spool.txt` file that logs the script output and a `ddl_remove_set.txt` file that logs current user environment settings in case they are needed for debugging.
9. Run the `marker_remove` script to remove the Oracle GoldenGate marker support system. This script produces a `marker_remove_spool.txt` file that logs the script output and a `marker_remove_set.txt` file that logs environment settings in case they are needed for debugging.

## CHAPTER 11

# Uninstalling Oracle GoldenGate

.....

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 Linux or UNIX

On all systems:

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 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.

On a source system:

7. If DDL is enabled, run the `ddl_remove` script to remove the Oracle GoldenGate DDL objects from the database.
8. Log into the database with the `DBLOGIN` command and then run any or all of the following commands, depending on your configuration:
  - Run the `DELETE SCHEMATRANDATA` command to disable schema-level supplemental logging.
  - Run the `DELETE TRANDATA` command to disable table-level supplemental logging.
  - Run the `DELETE TRACETABLE` command to remove the Oracle trace table if bi-directional replication was being used.

On any system where a Replicat checkpoint table is being used:

9. Log into the database with the `DBLOGIN` command, and then remove the Replicat checkpoint table by running the `DELETE CHECKPOINTTABLE` command.

On all systems:

10. Make certain all processes are stopped (including GGSCI).
11. Remove the Oracle GoldenGate files by removing the installation directory.

## Removing 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 deletevents 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. Follow the instructions in “Uninstalling Oracle GoldenGate from Windows (non-cluster)”.

## Uninstalling Oracle GoldenGate from Windows (non-cluster)

On all systems:

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.

**NOTE** Skip step 5 through step 8 if you already performed them when removing Oracle GoldenGate from a Windows cluster.

5. Click **Start > Run**, and type `cmd` in the Run dialog box to open the command console.
6. Change directories to the Oracle GoldenGate installation directory.
7. Run the install program using the following syntax.

```
install deletevents deleteservice
```

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

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

**On a source system:**

9. If DDL is enabled, run the `ddl_remove` script to remove the Oracle GoldenGate DDL objects from the database.
10. Log into the database with the `DBLOGIN` command and then run any or all of the following commands, depending on your configuration:
  - Run the `DELETE SCHEMATRANDATA` command to disable schema-level supplemental logging.
  - Run the `DELETE TRANDATA` command to disable table-level supplemental logging.
  - Run the `DELETE TRACETABLE` command to remove the Oracle trace table if bi-directional replication was being used.

**On any system where a Replicat checkpoint table is being used:**

11. Log into the database with the `DBLOGIN` command, and then remove the Replicat checkpoint table by running the `DELETE CHECKPOINTTABLE` command.

**On all systems:**

12. Make certain all processes are stopped (including GGSCI) and then remove the Oracle GoldenGate files by removing the installation directory.

## APPENDIX 1

# Configuring a downstream mining database for integrated capture

.....

This chapter contains instructions for preparing a downstream Oracle mining database to support Extract in integrated capture mode.

### [Evaluating capture options for a downstream deployment](#)

For more information about the parameters used in this procedure, see the [Oracle® Database Reference 11g Release 2 \(11.2\)](#) and [Oracle Data Guard Concepts and Administration 11g Release 2 \(11.2\)](#).

### [Creating a mining user account](#)

### [Preparing a downstream mining database for real-time capture](#)

For more information about integrated capture, see “Deciding which capture method to use” on page 40.

For examples of the downstream mining configuration, see “Example configuration of downstream mining database for integrated capture” on page 152.

## Evaluating capture options for a downstream deployment

When deploying integrated capture in a downstream mining database you can choose between two options.

- To employ real-time mining, you can use the downstream mining database to capture changes only from a single source database. You need to create standby redo logs so that the source database can use Oracle Data Guard redo transport to send redo to the downstream mining database as it is written to the online redo log at the source.
- To use the downstream mining database to capture changes from multiple source databases, you must make sure that no standby redo logs are present in the downstream mining database. All Extract sessions that operate in integrated capture mode will capture changes from the archived logs sent over from the various source databases to the downstream mining database.

For more information about the parameters used in this procedure, see the [Oracle® Database Reference 11g Release 2 \(11.2\)](#) and [Oracle Data Guard Concepts and Administration 11g Release 2 \(11.2\)](#).

## Configuring redo transport from a source to the downstream mining database

Complete the following steps to set up the transfer of redo log files from a source database to the downstream mining database, and to prepare the downstream mining database to accept these redo log files. These instructions take into account the requirements to ship

redo from multiple sources, if required. You configure an Extract process for each of those sources.

**To configure redo transport**

1. Configure Oracle Net so that each source database can communicate with the mining database. For instructions, see [Oracle® Database Net Services Administrator's Guide 11g Release 2 \(11.2\)](#).
2. Configure authentication at each source database and the downstream mining database to support the transfer of redo data. Redo transport sessions are authenticated using either the Secure Sockets Layer (SSL) protocol or a remote login password file. If a source database has a remote login password file, copy it to the appropriate directory of the mining database system. The password file must be the same at all source databases as well as the mining database. For more information about authentication requirements for redo transport, see [Preparing the Primary Database for Standby Database Creation in Oracle® Data Guard Concepts and Administration 11g Release 2 \(11.2\)](#).
3. At each source database, configure at least one LOG\_ARCHIVE\_DEST\_n initialization parameter to transmit redo data to the downstream mining database. Set the attributes of this parameter as shown in one of the following examples, depending on whether real-time or archive-log capture mode is to be used.

Example for a real-time downstream logmining server:

```
ALTER SYSTEM
SET LOG_ARCHIVE_DEST_2='SERVICE=DBMS2.EXAMPLE.COM ASYNC NOREGISTER
VALID_FOR=(ONLINE_LOGFILES,PRIMARY_ROLE)DB_UNIQUE_NAME=dbms2'
```

Example for an archived-log-only downstream logmining server.

```
ALTER SYSTEM SET
LOG_ARCHIVE_DEST_2='SERVICE=DMBS2.EXAMPLE.COM ASYNC NOREGISTER
VALID_FOR=(ONLINE_LOGFILES,PRIMARY_ROLE)
TEMPLATE=/usr/oracle/log_for_dbms1/dbms1_arch_%t_%s_%r.log
DB_UNIQUE_NAME=dbms2'
```

**NOTE** When using an archived-log-only downstream mining database, specify a value for TEMPLATE attribute that keeps log files from all remote source databases separated from the local database log files, and from each other.

4. At the source database, set a value of ENABLE for the LOG\_ARCHIVE\_DEST\_STATE\_n initialization parameter that corresponds with the LOG\_ARCHIVE\_DEST\_n parameter on the downstream mining database, as shown in the following example.

```
ALTER SYSTEM SET LOG_ARCHIVE_DEST_STATE_2=ENABLE
```

5. At both the source database and the downstream mining database, set the DG\_CONFIG attribute of the LOG\_ARCHIVE\_CONFIG initialization parameter to include the DB\_UNIQUE\_NAME of the source database and the downstream database, as shown in the following example.

```
ALTER SYSTEM SET LOG_ARCHIVE_CONFIG='DG_CONFIG=(dbms1,dbms2)'
```

## Creating a mining user account

To grant the downstream mining user the required privileges on the mining database, see “Assigning a database user for Oracle GoldenGate” on page 43.

## Preparing a downstream mining database for real-time capture

This procedure is required only if you want to use real-time capture at a downstream mining database. It is not required to use archived-log-only mode.

**NOTE** Real-time capture can be used when there is only one source database.

This procedure has the following parts:

[Configure the database to archive the standby redo data](#)

[Configure the database to receive and write shipped redo data locally](#)

[Create the standby redo log files](#)

### Configure the database to archive the standby redo data

This procedure sets the archive location for the redo data that is generated by the downstream mining database.

1. Complete the steps in “For more information about the parameters used in this procedure, see the Oracle® Database Reference 11g Release 2 (11.2) and Oracle Data Guard Concepts and Administration 11g Release 2 (11.2).” on page 147.
2. At the downstream mining database, set at least one archive log destination in the LOG\_ARCHIVE\_DEST\_n initialization parameter as shown in the following example:

```
ALTER SYSTEM SET  
LOG_ARCHIVE_DEST_2='LOCATION=/home/arc_dest/local_rl_dbms2  
VALID_FOR=(ONLINE_LOGFILE,PRIMARY_ROLE) '
```

**NOTE** Log files from all remote source databases must be kept separate from local mining database log files. For information about configuring a fast recovery area, see [Oracle® Database Backup and Recovery User's Guide 11g Release 2 \(11.2\)](#).

3. Set the LOG\_ARCHIVE\_DEST\_STATE\_n initialization parameter that corresponds with the LOG\_ARCHIVE\_DEST\_n parameter to ENABLE, as shown in the following example.

```
ALTER SYSTEM SET  
LOG_ARCHIVE_DEST_STATE_2=ENABLE
```

### Configure the database to receive and write shipped redo data locally

This procedure configures the downstream mining database to receive redo data from the source database and to write the redo to the local standby redo log.

1. At the downstream mining database, set at least one archive log destination in the LOG\_ARCHIVE\_DEST\_n initialization parameter as shown in the following example.

```
ALTER SYSTEM SET  
LOG_ARCHIVE_DEST_2='LOCATION=/home/arc_dest/srl_dbms1  
VALID_FOR=(STANDBY_LOGFILE,PRIMARY_ROLE) '
```

**NOTE** Log files from all remote source databases must be kept separate from local mining database log files, and from each other. For information about configuring a fast recovery area, see [Oracle® Database Backup and Recovery User's Guide 11g Release 2 \(11.2\)](#).

2. Set the LOG\_ARCHIVE\_DEST\_STATE\_n initialization parameter that corresponds with the LOG\_ARCHIVE\_DEST\_n parameter to ENABLE as shown in the following example.

```
ALTER SYSTEM SET LOG_ARCHIVE_DEST_STATE_2=ENABLE
```

For more information about these initialization parameters, see [Oracle Data Guard Concepts and Administration 11g Release 2 \(11.2\)](#).

## Create the standby redo log files

The following steps outline the procedure for adding standby redo log files to the downstream mining database. The specific steps and SQL statements that are required to add standby redo log files depend on your environment. See [Oracle Data Guard Concepts and Administration 11g Release 2 \(11.2\)](#) for detailed instructions about adding standby redo log files to a database.

1. In SQL\*Plus, connect to the source database as an administrative user.
2. Determine the size of the source log file. Make note of the results.

```
SELECT BYTES FROM V$LOG;
```

3. Determine the number of online log file groups that are configured on the source database. Make note of the results.

```
SELECT COUNT(GROUP#) FROM V$LOG;
```

4. Connect to the downstream mining database as an administrative user.
5. Add the standby log file groups to the mining database. The standby log file size must be at least the size of the source log file size. The number of standby log file groups must be at least one more than the number of source online log file groups. The following example shows three standby log groups.

```
ALTER DATABASE ADD STANDBY LOGFILE GROUP 3  
( '/oracle/dbs/slog3a.rdo', '/oracle/dbs/slog3b.rdo' ) SIZE 500M;
```

```
ALTER DATABASE ADD STANDBY LOGFILE GROUP 4  
( '/oracle/dbs/slog4.rdo', '/oracle/dbs/slog4b.rdo' ) SIZE 500M;
```

```
ALTER DATABASE ADD STANDBY LOGFILE GROUP 5  
( '/oracle/dbs/slog5.rdo', '/oracle/dbs/slog5b.rdo' ) SIZE 500M;
```

6. Confirm that the standby log file groups were added successfully.

```
SELECT GROUP#, THREAD#, SEQUENCE#, ARCHIVED, STATUS  
FROM V$STANDBY_LOG;
```



The output should be similar to the following:

GROUP#	THREAD#	SEQUENCE#	ARC	STATUS
3	0	0	YES	UNASSIGNED
4	0	0	YES	UNASSIGNED
5	0	0	YES	UNASSIGNED

7. Ensure that log files from the source database are appearing in the location that is specified in the LOCATION attribute of the local LOG\_ARCHIVE\_DEST\_n that you set. You might need to switch the log file at the source database to see files in the directory.

## APPENDIX 2

# Example configuration of downstream mining database for integrated capture

.....

This appendix contains examples for preparing a downstream Oracle mining database to support Extract in integrated capture mode. For more information about configuring a downstream mining database, see “Configuring a downstream mining database for integrated capture” on page 147.

## Example 1: Capturing from one source in real-time mode

This example captures changes from source database DBMS1 by deploying an integrated capture session at a downstream mining database DBMSCAP. This assumes that the following users exist:

- User GGADM1 in DBMS1 whose credentials Extract will use to fetch data and metadata from DBMS1.
- User GGADMCAP in DBMSCAP whose credentials Extract will use to retrieve logical change records from the logmining server at the downstream mining database DBMSCAP. It is assumed that the DBMS\_GOLDENGATE\_AUTH.GRANT\_ADMIN\_PRIVILEGE() procedure was called to grant appropriate privileges to this user.

### Prepare the mining database to accept redo from the source database

1. Add the standby log file groups to the downstream mining database. The standby log file size must be at least the size of the source log file size. The number of standby log file groups must be at least one more than the number of source online log file groups. The following example shows three standby log groups.

```
ALTER DATABASE ADD STANDBY LOGFILE GROUP 3
('/oracle/dbs/slog3a.rdo', '/oracle/dbs/slog3b.rdo') SIZE 500M;
ALTER DATABASE ADD STANDBY LOGFILE GROUP 4
('/oracle/dbs/slog4.rdo', '/oracle/dbs/slog4b.rdo') SIZE 500M;
ALTER DATABASE ADD STANDBY LOGFILE GROUP 5
('/oracle/dbs/slog5.rdo', '/oracle/dbs/slog5b.rdo') SIZE 500M;
```

2. Confirm that the standby log file groups were added successfully.

```
SELECT GROUP#, THREAD#, SEQUENCE#, ARCHIVED, STATUS FROM V$STANDBY_LOG;
```

The output should be similar to the following:

GROUP#	THREAD#	SEQUENCE#	ARC	STATUS
3	0	0	YES	UNASSIGNED
4	0	0	YES	UNASSIGNED
5	0	0	YES	UNASSIGNED

.....

3. Set DG\_CONFIG at the downstream mining database.

```
ALTER SYSTEM SET LOG_ARCHIVE_CONFIG='DG_CONFIG=(dbms1,dbmscap)'
```

### Prepare the source database to send redo to the mining database

1. Make sure that the source database is running with the required compatibility.

```
select name, value from v$parameter where name = 'compatible';
NAME                VALUE
-----
compatible          11.1.0.7.0
```

The minimum compatibility setting required from integrated capture is 10.2.0.3.0

2. Set DG\_CONFIG at the source database.

```
ALTER SYSTEM SET LOG_ARCHIVE_CONFIG='DG_CONFIG=(dbms1,dbmscap)';
```

3. Set up redo transport at the source database.

```
ALTER SYSTEM
SET LOG_ARCHIVE_DEST_2='SERVICE=DBMSCAP.EXAMPLE.COM ASYNC OPTIONAL
NOREGISTER
TEMPLATE='/usr/orcl/arc_dest/dbms1/dbms1_arch_%t_%s_%r.log
VALID_FOR=(ONLINE_LOGFILES,PRIMARY_ROLE)DB_UNIQUE_NAME=dbmscap';
```

4. Enable the downstream destination.

```
ALTER SYSTEM SET LOG_ARCHIVE_DEST_STATE_2=ENABLE;
```

### Set up integrated capture on DBMSCAP

1. Register Extract with the downstream mining database.

```
GGSCI> DBLOGIN userid ggadm1@dbms1 password ggs123
GGSCI> MININGDBLOGIN userid ggadmcap@dbmscap password ggs123
GGSCI> REGISTER EXTRACT ext1 DATABASE
```

2. Create Extract at the downstream mining database.

```
GGSCI> ADD EXTRACT ext1 INTEGRATED TRANLOG BEGIN NOW
```

3. Edit Extract parameter file ext1.prm. The following lines must be present to take advantage of real-time capture.

```
USER ggadm1@dbms1 password
MININGUSER ggadm2@dbmscap password
TRANLOGOPTIONS INTEGRATEDPARAMS (downsream_real_time_mine Y)
```

4. Start Extract.

```
START EXTRACT ext1
```

## Example 2: Capturing from multiple sources in archive-log mode

The following example captures changes from database DBMS1 and DBMS2 by deploying

an integrated capture session at a downstream mining database DBMSCAP. It assumes the following users:

- User GGADM1 in DBMS1 whose credentials Extract will use to fetch data and meta data from DBMS1.
- User GGADM2 in DBMS2 whose credentials Extract will use to fetch data and metadata from DBMS2.
- User GGADMCAP in DBMSCAP whose credentials Extract will use to retrieve logical change records from the logmining server at the downstream mining database. It is assumed that the DBMS\_GOLDENGATE\_AUTH.GRANT\_ADMIN\_PRIVILEGE() procedure was called to grant appropriate privileges to this user.

### Prepare the mining database to accept redo from the source database

1. Make sure no standby redo logs are configured at the downstream mining database.

```
SELECT GROUP#, THREAD#, SEQUENCE#, ARCHIVED, STATUS FROM V$STANDBY_LOG;
```

GROUP#	THREAD#	SEQUENCE#	ARC	STATUS
3	0	0	YES	UNASSIGNED
4	0	0	YES	UNASSIGNED
5	0	0	YES	UNASSIGNED

2. For each group number, drop the standby redo log.

```
ALTER DATABASE DROP STANDBY LOGFILE GROUP 3;
ALTER DATABASE DROP STANDBY LOGFILE GROUP 4;
ALTER DATABASE DROP STANDBY LOGFILE GROUP 5;
```

Make sure that the query to v\$standby\_log returns no rows.

3. Set DG\_CONFIG on the downstream mining database.

```
ALTER SYSTEM SET LOG_ARCHIVE_CONFIG='DG_CONFIG=(dbms1, dbms2, dbmscap)'
```

**NOTE** Oracle does not allow real time mining of the redo logs when you configure multiple source databases to send their redo to a single downstream mining database.

### Prepare the first source database to send redo to the mining database

1. Make certain that DBMS1 source database is running with the required compatibility.

```
select name, value from v$parameter where name = 'compatible';
NAME          VALUE
-----
compatible    11.1.0.7.0
```

The minimum compatibility setting required from integrated capture is 10.2.0.3.0.

2. Set DG\_CONFIG at DBMS1 source database.

```
ALTER SYSTEM SET LOG_ARCHIVE_CONFIG='DG_CONFIG=(dbms1, dbms2, dbmscap)';
```

3. Set up redo transport at DBMS1 source database.

```
ALTER SYSTEM
SET LOG_ARCHIVE_DEST_2='SERVICE=DBMSCAP.EXAMPLE.COM ASYNC OPTIONAL
NOREGISTER
TEMPLATE='/usr/orcl/arc_dest/dbms1/dbms1_arch_%t_%s_%r.log
VALID_FOR=(ONLINE_LOGFILES,PRIMARY_ROLE)DB_UNIQUE_NAME=dbmscap';
```

4. Enable the downstream destination.

```
ALTER SYSTEM SET LOG_ARCHIVE_DEST_STATE_2=ENABLE;
```

**Prepare the second source database to send redo to the mining database**

1. Make sure that DBMS2 source database is running with the required compatibility.

```
select name, value from v$parameter where name = 'compatible';
NAME                                VALUE
-----                                -
compatible                            11.1.0.7.0
```

The minimum compatibility setting required from integrated capture is 10.2.0.3.0.

2. Set DG\_CONFIG at DBMS2 source database.

```
ALTER SYSTEM SET LOG_ARCHIVE_CONFIG='DG_CONFIG=(dbms1, dbms2, dbmscap)';
```

3. Set up redo transport at DBMS2 source database.

```
ALTER SYSTEM
SET LOG_ARCHIVE_DEST_2='SERVICE=DBMSCAP.EXAMPLE.COM ASYNC OPTIONAL
NOREGISTER
TEMPLATE='/usr/orcl/arc_dest/dbms2/dbms2_arch_%t_%s_%r.log
VALID_FOR=(ONLINE_LOGFILES,PRIMARY_ROLE)DB_UNIQUE_NAME=dbmscap';
```

4. Enable the downstream destination.

```
ALTER SYSTEM SET LOG_ARCHIVE_DEST_STATE_2=ENABLE;
```

**Set up Extract1 to capture changes from archived logs sent by DBMS1**

The following steps are all done on the DBMSCAP downstream mining database.

1. Register Extract with DBMSCAP for the DBMS1 source database.

```
GGSCI> DBLOGIN userid ggadm1@dbms1 password ggadm1pw
GGSCI> MININGDBLOGIN userid ggadmcap@dbmscap password ggadmcappw
GGSCI> REGISTER EXTRACT ext1 DATABASE
```

2. Add Extract at the mining database DBMSCAP.

```
GGSCI> ADD EXTRACT ext1 INTEGRATED TRANLOG BEGIN NOW
```

3. Edit the Extract parameter file ext1.prm. The following lines must be present to take advantage of real-time capture.

```
USER ggadm1@dbms1 password ggadm1pw
TRANLOGOPTIONS MININGUSER ggadmcap@dbmscap, miningpassword ggadmcappw
```

4. Start Extract.

```
START EXTRACT ext1
```

**Set up Extract2 to capture changes from archived logs sent by DBMS2**

The following steps are all done on the downstream DBMSCAP mining database.

1. Register Extract with the mining database for source database DBMS2.

```
GGSCI> DBLOGIN userid ggadm2@dbms2, password ggadm2pw  
GGSCI> MININGDBLOGIN userid ggadmcap@dbmscap, password ggadmcappw  
GGSCI> REGISTER EXTRACT ext2 DATABASE
```

2. Create Extract at the mining database.

```
GGSCI> ADD EXTRACT ext2 INTEGRATED TRANLOG, BEGIN NOW
```

3. Edit the Extract parameter file ext2.prm. The following lines must be present to take advantage of real-time capture.

```
USERID ggadm2@dbms1, password ggadm2pwd  
TRANLOGOPTIONS MININGUSER ggadmcap@dbmscap, miningpassword ggadmcappw
```

4. Start Extract.

```
GGSCI> START EXTRACT ext2
```

## APPENDIX 3

# Supporting changes to XML schemas

.....

This topic contains instructions for supporting changes to an XML schema. Both classic and integrated capture modes do not support the capture of changes made to an XML schema.

## Supporting RegisterSchema

RegisterSchema can be handled by registering the schema definition on both source and target databases before any table is created that references the XML schema.

## Supporting DeleteSchema:

Issue DeleteSchema on the source database first. Once Replicat is caught up with the changes made to the source database, issue the DeleteSchema call on the target database.

## Supporting CopyEvolve

The CopyEvolve procedure evolves, or changes, a schema and can modify tables by adding or removing columns. It can also be used to change whether or not XML documents are valid. Handling CopyEvolve requires more coordination. Use the following procedure if you are issuing CopyEvolve on the source database.

1. Quiesce changes to dependent tables on the source database.
2. Execute the CopyEvolve on the primary or source database.
3. Wait for Replicat to finish applying all of the data from those tables to the target database.
4. Stop Replicat.
5. Apply the CopyEvolve on the target database.
6. Restart Replicat.

## APPENDIX 4

# Preparing DBFS for active-active propagation with Oracle GoldenGate

.....

This chapter contains steps to configure Oracle GoldenGate to function within an active-active bi-directional or multi-directional environment where Oracle Database File System (DBFS) is in use on both (or all) systems.

## Supported operations and prerequisites

Oracle GoldenGate for DBFS supports the following:

- Supported DDL (like TRUNCATE or ALTER) on DBFS objects except for CREATE statements on the DBFS objects. CREATE on DBFS must be excluded from the configuration, as must any schemas that will hold the created DBFS objects. The reason to exclude CREATES is that the metadata for DBFS must be properly populated in the SYS dictionary tables (which itself is excluded from Oracle GoldenGate capture by default).
- Capture and replication of DML on the tables that underlie the DBFS filesystem.

The procedures that follow assume that Oracle GoldenGate is configured properly to support active-active configuration. This means that it must be:

- Installed according to the instructions in this guide.
- Configured according to the instructions in the Oracle GoldenGate *Windows and UNIX Administrator's Guide*.

## Applying the required patch

Apply the Oracle DBFS patch for bug-9651229 on both databases. To determine if the patch is installed, run the following query:

```
connect / as sysdba
select procedure_name
from dba_procedures
where object_name = 'DBMS_DBFS_SFS_ADMIN'
and procedure_name = 'PARTITION_SEQUENCE';
```

The query should return a single row. Anything else indicates that the proper patched version of DBFS is not available on your database.

## Examples used in these procedures

The following procedures assume two systems and configure the environment so that DBFS users on both systems see the same DBFS files, directories, and contents that are



kept in synchronization with Oracle GoldenGate. It is possible to extend these concepts to support three or more peer systems.

## Partitioning the DBFS sequence numbers

DBFS uses an internal sequence-number generator to construct unique names and unique IDs. These steps partition the sequences into distinct ranges to ensure that there are no conflicts across the databases. After this is done, further DBFS operations (both creation of new filesystems and subsequent filesystem operations) can be performed without conflicts of names, primary keys, or IDs during DML propagation.

1. Connect to each database as sysdba.
2. Issue the following query on each database.

```
select last_number
from dba_sequences
where sequence_owner = 'SYS'
and sequence_name = 'DBFS_SFS_$FSSEQ'
```
3. From this query, choose the maximum value of LAST\_NUMBER across both systems, or pick a high value that is significantly larger than the current value of the sequence on either system.
4. Substitute this value (“maxval” is used here as a placeholder) in both of the following procedures. These procedures logically index each system as myid=0 and myid=1.

### Node1

```
declare
begin
    dbms_dbfs_sfs_admin.partition_sequence(nodes => 2, myid => 0,
    newstart => :maxval);
commit;
end;
/
```

### Node 2

```
declare
begin
    dbms_dbfs_sfs_admin.partition_sequence( nodes => 2, myid => 1,
    newstart => :maxval);
commit;
end;
/
```

**NOTE** Notice the difference in the value specified for the myid parameter. These are the different index values.

For a multi-way configuration among three or more databases, you could make the following alterations:

- Adjust the maximum value that is set for “maxval” upward appropriately, and use that value on all nodes.

- Vary the value of “myid” in the procedure from 0 for the first node, 1 for the second node, 2 for the third one, and so on.
5. (Recommended) After (and only after) the DBFS sequence generator is partitioned, create a new DBFS filesystem on each system, and use only these filesystems for DML propagation with Oracle GoldenGate. See “Configuring the DBFS filesystem”

**NOTE** DBFS filesystems that were created before the patch for bug-9651229 was applied or before the DBFS sequence number was adjusted can be configured for propagation, but that requires additional steps not described in this document. If you must retain old filesystems, open a service request with Oracle Support.

## Configuring the DBFS filesystem

To replicate DBFS filesystem operations, use a configuration that is similar to the standard bi-directional configuration for DML.

- Use matched pairs of identically structured tables.
- Allow each database to have write privileges to opposite tables in a set, and set the other one in the set to read-only. For example:
  - Node1 writes to local table “t1” and these changes are replicated to t1 on Node2.
  - Node2 writes to local table “t2” and these changes are replicated to t2 on Node1.
  - On Node1, t2 is read-only. On Node2, t1 is read-only.

DBFS filesystems make this kind of table pairing simple because:

- The tables that underlie the DBFS filesystems have the same structure.
- These tables are modified by simple, conventional DML during higher-level filesystem operations.
- The DBFS ContentAPI provides a way of unifying the namespace of the individual DBFS stores by means of mount points that can be qualified as read-write or read-only.

The following steps create two DBFS filesystems (in this case named FS1 and FS2) and set them to be read-write or read, as appropriate.

1. Run the following procedure to create the two filesystems. (Substitute your store names for “FS1” and “FS2.”)

**Example**

```
declare
  dbms_dbfs_sfs.createFilesystem('FS1');
  dbms_dbfs_sfs.createFilesystem('FS2');

  dbms_dbfs_content.registerStore('FS1',
    'posix', 'DBMS_DBFS_SFS');
  dbms_dbfs_content.registerStore('FS2',
    'posix', 'DBMS_DBFS_SFS');
  commit;
end;
/
```

2. Run the following procedure to give each filesystem the appropriate access rights. (Substitute your store names for “FS1” and “FS2.”)

**Example Node 1**

```
declare
  dbms_dbfs_content.mountStore('FS1', 'local');
  dbms_dbfs_content.mountStore('FS2', 'remote',
    read_only => true);
  commit;
end;
/
```

**Example Node 2**

```
declare
  dbms_dbfs_content.mountStore('FS1', 'remote',
    read_only => true);
  dbms_dbfs_content.mountStore('FS2', 'local');
  commit;
end;
/
```

In this example, note that on Node 1, store "FS1" is read-write and store "FS2" is read-only, while on Node 2 the converse is true: store "FS1" is read-only and store "FS2" is read-write.

Note also that the read-write store is mounted as "local" and the read-only store is mounted as "remote". This provides users on each system with an identical namespace and identical semantics for read and write operations. Local path names can be modified, but remote path names cannot.

## Mapping local and remote peers correctly

The names of the tables that underlie the DBFS filesystems are generated internally and dynamically. Continuing with the preceding example, there are:

- Two nodes (Node 1 and Node 2 in the example).
- Four stores: two on each node (FS1 and FS2 in the example).
- Eight underlying tables: two for each store (a table and a ptable). These tables must be identified, specified in Extract TABLE statements, and mapped in Replicat MAP statements.

1. To identify the table names that back each filesystem, issue the following query. (Substitute your store names for "FS1" and "FS2.")

**Example**

```
select fs.store_name, tb.table_name, tb.ptable_name
from table(dbms_dbfs_sfs.listTables) tb,
     table(dbms_dbfs_sfs.listFilesystems) fs
where  fs.schema_name = tb.schema_name
      and fs.table_name = tb.table_name
      and fs.store_name in ('FS1', 'FS2')
;
```

The output looks like the following examples.

**Example output: Node 1 (Your table names will be different.)**

STORE_NAME	TABLE_NAME	PTABLE_NAME
FS1	SFS\$_FST_100	SFS\$_FSTP_100
FS2	SFS\$_FST_118	SFS\$_FSTP_118

**Example output: Node 2 (Your table names will be different.)**

STORE_NAME	TABLE_NAME	PTABLE_NAME
FS1	SFS\$_FST_101	SFS\$_FSTP_101
FS2	SFS\$_FST_119	SFS\$_FSTP_119

- Identify the tables that are *locally read-write* to Extract by creating the following TABLE statements in the Extract parameter files. (Substitute your owner and table names.)

**Example: Node 1**

```
TABLE owner.SFS$_FST_100;
TABLE owner.SFS$_FSTP_100;
```

**Example: Node 2**

```
TABLE owner.SFS$_FST_119;
TABLE owner.SFS$_FSTP_119;
```

- Link changes on each remote filesystem to the corresponding local filesystem by creating the following MAP statements in the Replicat parameter files. (Substitute your owner and table names.)

**Example: Node 1**

```
MAP owner.SFS$_FST_119,
   TARGET owner.SFS$_FST_118;
MAP owner.SFS$_FSTP_119,
   TARGET owner.SFS$_FSTP_118;
```

**Example: Node 2**

```
MAP owner.SFS$_FST_100,
   TARGET owner.SFS$_FST_101;
MAP owner.SFS$_FSTP_100,
   TARGET owner.SFS$_FSTP_101;
```

This mapping captures and replicates local read-write “source” tables to remote read-only peer tables:

- Filesystem changes made to FS1 on Node 1 propagate to FS1 on Node 2.
- Filesystem changes made to FS2 on Node 2 propagate to FS2 on Node1.

Changes to the filesystems can be made through the DBFS ContentAPI (package DBMS\_DBFS\_CONTENT) of the database or through dbfs\_client mounts and conventional filesystems tools.

All changes are propagated in both directions.

- A user at the virtual root of the DBFS namespace on each system sees identical content.
- For mutable operations, users use the "/local" sub-directory on each system.
- For read operations, users can use either of the "/local" or "/remote" sub-directories, depending on whether they want to see local or remote content.

## APPENDIX 5

# Oracle GoldenGate installed components

.....

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 24 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.
ddlgen	Generates target database table definitions based on source database DDL. Used primarily on the NonStop platform.
defgen	Generates data definitions and is referenced by Oracle GoldenGate processes when source and target tables have dissimilar definitions.
emscInt	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.
ggmxcinstall	Oracle GoldenGate installation script for the SQL/MX database.
ggsci	User interface to Oracle GoldenGate for issuing commands and managing parameter files.

.....

**Table 24 Programs and utilities (continued)**

Program	Description
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 25 Subdirectories**

Directory	Description
br	Contains the checkpoint files for the bounded recover feature.
cfg	Contains the property and xml files that are used to configure Oracle GoldenGate Monitor.
dirdb	Contains the datastore that is used to persist information that is gathered from an Oracle GoldenGate instance for use by the Oracle GoldenGate Monitor application or within Oracle Enterprise Manager.

Table 25 Subdirectories (continued)

Directory	Description
dirchk	<p>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.</p> <p>File name format is &lt;group name&gt;&lt;sequence number&gt;.&lt;ext&gt; where &lt;sequence number&gt; is a sequential number appended to aged files and &lt;ext&gt; is either cpe for Extract checkpoint files or cpr for Replicat checkpoint files.</p> <p>Do not edit these files.</p> <p>Examples: ext1.cpe rep1.cpr</p>
dirdat	<p>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.</p> <p>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).</p> <p>Do not edit these files.</p> <p>Examples: rt000001 finance</p>
dirdef	<p>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.</p> <p>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.</p> <p>Example: defs.dat</p>
dirjar	<p>Contains the Java executable files that support Oracle GoldenGate Monitor.</p>
dirout	<p>This directory is not used any more.</p>

Table 25 Subdirectories (continued)

Directory	Description
dirpcs	<p>Default location for status files. File name format is &lt;group&gt;.&lt;extension&gt; where &lt;group&gt; is the name of the group and &lt;extension&gt; is either pce (Extract), pcr (Replicat), or pcm (Manager).</p> <p>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.</p> <p>Do not edit these files.</p> <p>Examples: mgr.pcm ext.pce</p>
dirprm	<p>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 &lt;group name/user-defined name&gt;.prm or mgr.prm.</p> <p>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.</p> <p>Examples: defgen.prm finance.prm</p>
dirrec	Not used by Oracle GoldenGate.
dirrpt	<p>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.</p> <p>File name format is &lt;group name&gt;&lt;sequence number&gt;.rpt where &lt;sequence number&gt; is a sequential number appended to aged files.</p> <p>Do not edit these files.</p> <p>Examples: fin2.rpt mgr4.rpt</p>
dirsql	Used by the TRIGGEN utility to store SQL scripts before TRIGGEN was deprecated. Currently used to store training scripts and any user-created SQL scripts that support Oracle GoldenGate.
dirtmp	The default location for storing transaction data when the size exceeds the memory size that is allocated for the cache manager. Do not edit these files.
dirwlt	Contains the Oracle Wallet that supports Oracle GoldenGate Monitor. This directory is not installed until the utility that creates the wallet is run.
UserExitExamples	Contains sample files to help with the creation of user exits.



## 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 26 Other files**

Component	Description
bcpfmt.tpl	Template for use with Replicat when creating a run file for the Microsoft BCP/DTS bulk-load utility.
bcrypt.txt	Blowfish encryption software license agreement.
cagent.dll	Contains the Windows dynamic link library for the Oracle GoldenGate Monitor C sub-agent.
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_access.tpl	Template used by the DDLGEN utility to convert source DDL to Microsoft Access DDL.
ddl_cleartrace.sql	Script that removes the DDL trace file. (Oracle installations)
ddl_db2.tpl	Template used by the DDLGEN utility to convert source DDL to DB2 DDL (Linux, UNIX, Windows).
ddl_db2_os390.tpl	Template used by the DDLGEN utility to convert source DDL to DB2 DDL (z/OS systems).
ddl_ddl2file.sql	Script that saves DDL from the marker table to a file.
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_filter.sql	Script that supports filtering of DDL by Oracle GoldenGate. This script runs programmatically; do not run it manually.
ddl_informix.tpl	Template used by the DDLGEN utility to convert source DDL to Informix DDL.

**Table 26 Other files (continued)**

Component	Description
ddl_mss.tpl	Template used by the DDLGEN utility to convert source DDL to SQL Server DDL.
ddl_mysql.tpl	Template used by the DDLGEN utility to convert source DDL to MySQL DDL.
ddl_nopurgeRecyclebin.sql	Empty script file for use by Oracle GoldenGate support staff.
ddl_nssql.tpl	Template used by the DDLGEN utility to convert source DDL to NonStop SQL DDL.
ddl_ora9.sql ddl_ora10.sql ddl_ora11.sql ddl_ora10upCommon.sql	Scripts that run programmatically as part of Oracle GoldenGate DDL support; do not run these scripts.
ddl_oracle.tpl	Template used by the DDLGEN utility to convert source DDL to Oracle DDL.
ddl_pin.sql	Script that pins DDL tracing, the DDL package, and the DDL trigger for performance improvements. (Oracle installations)
ddl_purgeRecyclebin.sql	Script that purges the Oracle recyclebin in support of the DDL replication feature.
ddl_remove.sql	Script that removes the DDL extraction trigger and package. (Oracle installations)
ddl_session.sql ddl_session1.sql	Supports the installation of the Oracle DDL objects. This script runs programmatically; do not run it manually.
ddl_setup.sql	Script that installs the Oracle GoldenGate DDL extraction and replication objects. (Oracle installations)
ddl_sqlmx.tpl	Template used by the DDLGEN utility to convert Tandem Enscribe DDL to NonStop SQL/MX DDL.
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)
ddl_staymetadata_off.sql ddl_staymetadata_on.sql	Scripts that control whether the Oracle DDL trigger collects metadata. This script runs programmatically; do not run it manually.
ddl_sybase.tpl	Template used by the DDLGEN utility to convert source DDL to Sybase DDL.

**Table 26 Other files (continued)**

Component	Description
ddl_tandem.tpl	Template used by the DDLGEN utility to convert source DDL to NonStop SQL DDL.
ddl_trace_off.sql ddl_trace_on.sql	Scripts that control whether DDL tracing is on or off.
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 demo_more_<db>_create.sql demo_<db>_insert.sql demo_more_<db>_insert.sql demo_<db>_lob_create.sql demo_<db>_misc.sql	Scripts that create and populate demonstration tables for use with tutorials and basic testing.
.dmp files	Dump files created by Oracle GoldenGate processes for tracing purposes.
ENCKEYS	User-created file that stores encryption keys. Written in external ASCII format.
exitdemo.c	User exit example.
exitdemo_utf16.c	User exit example that demonstrates how to use UTF16 encoded data in the callback structures for information exchanged between the user exit and the process.
freeBSD.txt	License agreement for FreeBSD.
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.log	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.

**Table 26 Other files (continued)**

Component	Description
icudt38.dll icuin38.dll icuuc38.dll	Windows shared libraries for International Components for Unicode.
jagent.bat	Windows batch file for the Java Agent for Oracle GoldenGate Monitor.
jagent.log jagentjni.log	Log files for the Oracle GoldenGate Monitor Agent.
jagent.sh	UNIX shell script for the Java Agent for Oracle GoldenGate Monitor
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)
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)
notices.txt	Third-party software license file.
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.
prvtckm.plb	Supports the replication of Oracle encrypted data.
pw_agent_util.bat pw_agent_util.sh	Script files that support the Oracle GoldenGate Monitor Agent.
role_setup.sql	Script that creates the database role necessary for Oracle GoldenGate DDL support. (Oracle installations)

**Table 26 Other files (continued)**

Component	Description
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.
xerces-c_2_8.dll	Apache XML parser library.
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 27 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.

**Table 27 Checkpoint table definitions**

Column	Description
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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