

Oracle® GoldenGate
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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.

Overview of Oracle GoldenGate for DB2 on z/OS

On the IBM z/OS platform, Oracle GoldenGate for DB2 runs natively on UNIX System Services (USS), also known as Open MVS (OMVS). With Oracle GoldenGate, you can move data between similar or dissimilar supported DB2 for z/OS versions, or you can move data between a DB2 for z/OS database and a database of another type, such as Oracle or DB2 for LUW. Oracle GoldenGate for DB2 on the z/OS platform supports the filtering, mapping, and transformation of data, unless otherwise noted in this documentation.

You can install Oracle GoldenGate directly on the z/OS system, and the Oracle GoldenGate Extract and Replicat processes will use ODBC (Open Database Connectivity) to connect to the DB2 subsystem. For delivery, you can optionally install Oracle GoldenGate DB2Remote on a Linux, UNIX, or Windows system where DB2 LUW is installed, instead of installing directly on the z/OS target. The Replicat process will use the DB2 Connect driver from DB2 for LUW to deliver replicated data to the DB2 target on the z/OS system.

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

System services

- Activate Unix System Services (USS) in full function mode rather than in minimum mode. You can use the z/OS UNIX Configuration Wizard for this purpose. Refer to the IBM UNIX System Services Planning manual for more information. The UNIX customization includes the following:
 - Make the Language Environment run-time library (RTL) available to Oracle GoldenGate and other C programs by including it in the link list or Link Pack Area (LPA), or by adding it to the STEPLIB environment variable. RTL consists of data sets

SCEERUN and SCEERUN2. If you are using STEPLIB, define the SCEERUN data sets to LLA to make loading the run-time modules faster. See the UNIX System Services Planning documentation for more information.

- To support the Oracle GoldenGate edit and report commands under the TSO/E OMVS command, concatenate the following target libraries to the appropriate ISPF data definition names (ddnames):
 - ▶ Data set SYS1.SBPXPENU to ddname ISPLLIB
 - ▶ Data set SYS1.SBPXMENU to ddname ISPLLIB
 - ▶ Data set SYS1.SBPXTENU to ddname ISPTLIB
 - ▶ Data set SYS1.SBPXEXEC to ddname SYSEXEC or SYSPROC
- Install Recoverable Resource Manager Services (RRS) for the best performance. Depending on the attachment type, the user by which Oracle GoldenGate runs might need one of the following permissions on the DSNR resource class:
 - If using RRSF, assign RACF ACCESS(READ) to the RRSF resource. IBM recommends using RRSF because it has several advantages over CAF, including support for two-phase commit, thread reuse, and control over accounting intervals.
 - If using CAF (the default), assign RACF ACCESS(READ) to the BATCH environment. If using CAF, it is possible for Oracle GoldenGate to hold locks on the system catalog until it receives a transaction commit.
- Oracle GoldenGate supports Sysplex data sharing.

Memory requirements

- Allocate approximately 50-100 MB of virtual memory for each Oracle GoldenGate Extract process, depending upon the amount of uncommitted data per unit of work. Oracle GoldenGate stores transaction data on the source system until either a commit or rollback indicator is received. Alternately, you can use spill files to hold most of the data. You may need to monitor the usage of your z/OS page data sets that have extensive USS usage.
- The default size of the initial Extract memory heap might be too high for some z/OS systems, especially those running applications that primarily generate small transactions. To adjust the size, use the TRANSMEMORY parameter in the Extract parameter file.
- The GGSCI program uses the International Components for Unicode (ICU) libraries and thus requires a virtual memory allocation of 48 MB.
- When using TSO to access USS, give the TSO user enough memory allocation to start the Oracle GoldenGate GGSCI process. If you get the error message “*CEE3536S Not enough storage was available for the WSA,*” increase the TSO user memory or ask your TSO administrator to do it.

Disk requirements

Assign a Hierarchical File System (HFS) volume with the following free disk space:

- 50-150 MB, depending on the database and platform. This includes space for the compressed download file and space for the uncompressed files. You can delete the download file after the installation is complete.

- 40 MB for the working directories and binaries for each instance of Oracle GoldenGate that you are installing on the system. For example, to install two builds of Oracle GoldenGate into two separate directories, allocate 80 MB of space.
- To install Oracle GoldenGate into a cluster environment, install the Oracle GoldenGate binaries and files on a shared file system that is available to all cluster nodes.
 - DSN=[hfs dsn]
 - DISP=(NEW,CATLG,DELETE)
 - SPACE =
 - DCB=DSORG=PO,DSNTYPE=HFS

Automatically mount the new file at IPL with an update to the BPXPRM UNIX PARMLIB member. Make certain that the MOUNT FILESYSTEM parameter for HFS in the BPXPRM PARMLIB member is not set to NOSETUID. To mount the files:

```
MOUNT FILESYSTEM([hfs dsn] ') TYPE(HFS) MODE(RDWR)
MOUNTPOINT(' [/u/ggs] ')
```

- 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. You will specify the location of the trails when you configure Oracle GoldenGate.

For trails that are stored at the source location, there should be enough space to handle data accumulation should the network connection fail. In a typical configuration, a secondary Extract process (known as a data pump) sends data from a local trail over the network, and 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.

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.

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

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

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

Network

- Configure the system to use TCP/IP services, including DNS.
- Configure the network with the host names or IP addresses of all systems that will be hosting Oracle GoldenGate processes and to which Oracle GoldenGate will be connecting. Host names are easier to use.
- Oracle GoldenGate requires 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.

Other operating system requirements

- To use Oracle GoldenGate user exits, install the C/C++ Compiler, which creates the programs in the required shared object or DLL.
- For best results, have the following tools on the system:
 - Gzip to decompress the Oracle GoldenGate installation files. Otherwise, you must unzip the installation on a PC by using a Windows-based product, and then FTP it to the z/OS machine.
 - RACF command processor.
 - Time Sharing Option Extensions (TSO/E) command processor, including authorized TSO/E commands.
- For best results, apply HIPER maintenance on a regular basis, staying within one year of the current maintenance release, as recommended by IBM. The HIPER process identifies defects that could affect data availability or integrity. IBM provides Program Temporary Fixes (PTF) to correct defects found in DB2 and z/OS.

The following are the required operating system privileges for Oracle GoldenGate:

Table 1 Operating system privileges

User privilege	Manager	Extract	Replicat
Resource Access Control Facility (RACF) account (or equivalent) with OMVS segment ¹	X		

Table 1 Operating system privileges

User privilege	Manager	Extract	Replicat
CONNECT to the local DB2 subsystem ²		X	X
ACCESS(READ) to the bootstrap data set (BSDS)		X ³	
ACCESS(READ) to resource BPX.FILEATTR.APF in CLASS(FACILITY) ⁴		X	
chmod +rw on the subdirectories in the Oracle GoldenGate directory	X	X	X

¹ The user who starts the Manager process is typically the user by which other Oracle GoldenGate processes run.

² Requires access to either the CAF or the RRSAPF protected access profile in the DSNR RACF resource class, depending upon the MVSATTACHTYPE value in the ODBC initialization file.

³ Non-data sharing only.

⁴ Required for the user that installs the Extract program.

Database requirements

Database configuration

- Install a DB2 ODBC driver. The Oracle GoldenGate Extract and Replicat processes use ODBC (Open Database Connectivity) to connect to the DB2 subsystem. For information about ODBC, see the *DB2 for z/OS ODBC Guide and Reference* documentation.
- Install and configure the DB2 ODBC dynamic load library.
- Grant Oracle GoldenGate EXECUTE privilege on the plan that is specified in the ODBC initialization file (the default is DSNACL).
- You might need to insert the name of the local DB2 subsystem into the SYSIBM.LOCATIONS table, which contains the remote DB2 server locations. Use a statement similar to the following (the example uses the name DB2A).

```
INSERT INTO SYSIBM.LOCATIONS (LOCATION, PORT) VALUES ('DB2A', '446');
```

Database user for Oracle GoldenGate processes

- By default, the user who starts the Manager process becomes the default DB2 primary authorization ID for all of the Oracle GoldenGate processes that any users start in that Oracle GoldenGate instance. You can assign a different user to any process by means of JCL or UNIX variables.
- To monitor Oracle GoldenGate processing accurately, do not permit other applications or processes to operate as the Oracle GoldenGate user.
- Assign the DB2 privileges listed in Table 2 to the user by which Extract and Replicat will be running (default is the user who starts Manager). These are in addition to any permissions that DB2 ODBC requires. All Extract privileges apply to initial-load and log-based Extract processes, except where noted.

Table 2 Privileges needed by Oracle GoldenGate for DB2 on z/OS

User privilege	Extract	Replicat
MONITOR2 (does not apply to initial-load Extract)	X	
SELECT ON these SYSIBM tables: SYSTABLES SYSCOLUMNS SYSTABLEPART SYSKEYS SYSINDEXES SYSCOLAUTH SYSDATABASE SYSFOREIGNKEYS SYSPARMS SYSRELS SYSROUTINES SYSSYNONYMS SYSTABAUTH SYSAXRELS	X	X
SELECT, INSERT, DELETE on SYSIBM.SYSTRIGGERS	X	X
SELECT on source tables ¹	X	
INSERT, UPDATE, DELETE on target tables		X
CREATE TABLE ²		X
EXECUTE on ODBC plan (default is DSNACLI)	X	
Privileges required by SQLEXEC procedures or queries that you will be using. ³	X	X

¹ SELECT on source tables required only if tables contain LOB columns, or for an initial-load Extract, if used.

² Required if using ADD CHECKPOINTTABLE in GGSCI to use the database checkpoint feature.

³ SQLEXEC enables stored procedures and queries to be executed by an Oracle GoldenGate process.

Supported DB2 on z/OS data types

- ASCII or EBCDIC data format. Oracle GoldenGate will convert between ASCII and EBCDIC data automatically. Unicode is never converted.
- Most DB2 data types except those listed in “Non-supported DB2 on z/OS data types”.

Limitations of support

- Oracle GoldenGate does not perform character set conversion for columns that could contain multi-byte data. This includes GRAPHIC, VARGRAPHIC and DBCLOB data types, as well as CHAR, VARCHAR, and CLOB for tables defined with ENCODING_SCHEME of 'M' (multiple CCSID set or multiple encoding schemes) or 'U' (Unicode). Such data is only supported if the source and target systems are the same CCSID.
- The column conversion functions of Oracle GoldenGate only support tables with EBCDIC encoding.
- 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.
- 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.

Non-supported DB2 on z/OS data types

- DECFLOAT
- XML
- User-defined types
- Negative dates

Supported objects and operations for DB2 on z/OS

- Extraction and replication of DML operations on DB2 for z/OS tables that contain rows of up to 512KB in length. This size exceeds the maximum row size of DB2.
- 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.
- Extraction and replication of data that is stored using DB2 data compression (CREATE TABLESPACE COMPRESS YES).
- TRUNCATE TABLE is supported, but because this command issues row deletes to perform the truncate, they are shown in Oracle GoldenGate statistics as such, and not as a truncate operation. To replicate a TRUNCATE, Replicat uses a DELETE without a WHERE clause.
- TRUNCATES are always captured from a DB2 for z/OS source, but can be ignored by Replicat if the IGNORETRUNCATES parameter is used in the Replicat parameter file.

Non-supported objects and operations for DB2 on z/OS

- Extraction or replication of DDL operations
- Clone tables

- Data manipulation, including compression, that is performed within user-supplied DB2 exit routines, such as:
 - Date and time routines
 - Edit routines (CREATE TABLE EDITPROC)
 - Validation routines (CREATE TABLE VALIDPROC)

Supported and non-supported object names and case

The following will help you verify whether the name of a supported object qualifies or disqualifies it for inclusion in an Oracle GoldenGate configuration.

Object names and owners

Source and target object names must be fully qualified in Oracle GoldenGate parameter files, as in `fin.emp`. Oracle GoldenGate supports character case as follows.

Case sensitivity

The following are general guidelines for the case-sensitivity of object names as it relates to Oracle GoldenGate. These guidelines may or may not apply to your databases, depending on whether the database or the underlying operating system supports case-sensitivity. Keep in mind that case-sensitivity (or lack thereof) may apply to the source database but not the target, or to the target but not the source.

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

To preserve case-sensitivity in an Oracle GoldenGate configuration

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

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

For example:

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

Supported characters

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

Table 3 Supported non-alphanumeric characters in object names and non-key column names¹

Character	Description
~	Tilde
<>	Greater-than and less-than symbols
/	Forward slash
\	Backward slash
!	Exclamation point
@	At symbol
#	Pound symbol
\$	Dollar symbol
%	Percent symbol
^	Caret symbol
()	Open and close parentheses
_	Underscore
-	Dash
+	Plus sign
=	Equal symbol
	Pipe
[]	Begin and end brackets
{}	Begin and end curly brackets (braces)

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

Non-supported characters

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

Table 4 Non-supported characters in object and column names¹

Character	Description
&	Ampersand
*	Asterisk
?	Question mark
:	Colon
;	Semi-colon
,	Comma
'	Single quotes
“”	Double quotes
‘	Accent mark (Diacritical mark)
.	Period
	Space

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

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:

- Choosing an installation system for a DB2 target
- Downloading Oracle GoldenGate
- Setting library paths for dynamic builds
- Installing the Oracle GoldenGate software
- Configuring Manager and other processes

NOTE Before proceeding, make certain that you have reviewed the System Requirements in this guide.

Choosing an installation system for a DB2 target

Oracle GoldenGate for DB2 is installed directly on the source system. However, for delivery to a DB2 target, you can use either of the following configurations:

- Install Oracle GoldenGate directly on the DB2 target system. Go to “Installing Oracle GoldenGate in USS on z/OS” on page 11.
- Install Oracle GoldenGate DB2Remote on an “intermediary” Linux, UNIX, or Windows system for remote delivery to a DB2 target system. In this configuration, Replicat connects to the target DB2 database by using the ODBC API that is supplied in DB2 Connect (requires DB2 LUW). See the following instructions.

NOTE All of the Oracle GoldenGate functionality that is supported for DB2 for z/OS is supported in this configuration. In addition, ASCII character data is converted to EBCDIC automatically by DB2 Connect.

To use remote delivery via DB2Connect

1. For the intermediary system, select any Linux, UNIX, or Windows platform that Oracle GoldenGate supports for the DB2 for LUW database. This will be the system on which Oracle GoldenGate is installed.
 2. Install and run DB2 for LUW on the selected intermediary system so that the Replicat process can use the supplied DB2 Connect driver.
-

3. Catalog the DB2 target node in the DB2 for LUW database on the intermediary system by using the following DB2 command:

```
catalog tcpip node <db2-node-name> remote <DNS-name>  
server <DB2-port-number>
```

4. Add the target DB2 database to the DB2 for LUW catalog on the intermediary system by using the following DB2 command:

```
catalog db <database-name> as <database-alias> at node <db-node-name>
```

NOTE Refer to the IBM DB2 LUW documentation for more information about these commands.

5. Download and install the appropriate Oracle GoldenGate build for the selected intermediary platform. Make certain to select the build that is labeled for **DB2Remote**. Follow “Downloading Oracle GoldenGate” on page 9, and then follow the appropriate installation instructions:
 - “Installing Oracle GoldenGate on Linux and UNIX” on page 11
 - “Installing Oracle GoldenGate on Windows and Windows Cluster” on page 12
6. Specify the DB2 target database name with the Replicat parameter TARGETDB when you configure the Oracle GoldenGate processes.

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. *Note:* To install Oracle GoldenGate to connect to a DB2 target using DB2 Connect from a Windows or UNIX system, select the build that is labeled as **DB2Remote**; or to download Oracle GoldenGate to run on the DB2 target system, select the appropriate build for the database and platform. (See “Choosing an installation system for a DB2 target” on page 8.)
 - 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 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.
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 ¹	Environment variable
IBM AIX	LIBPATH
IBM z/OS	
HP-UX	SHLIB_PATH
Sun Solaris	LD_LIBRARY_PATH ²
HP Tru64 (OSF/1)	
LINUX	

¹ A specific platform may or may not be supported by Oracle GoldenGate for your database.

² 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.

Installing Oracle GoldenGate in USS on z/OS

Follow these instructions to install Oracle GoldenGate in UNIX System Services on a z/OS system.

1. Log on as a superuser or as a user who has z/OS authorization to add the "a" extended attribute. If you cannot log on as this kind of user, then someone with the proper authority will need to set the "a" attribute later. It is required for the Extract process, which uses a privileged API by the name of *IFI IFCID 306*¹ to perform certain work, and then it reverts to normal application privileges for other work. The work that requires elevated privileges is:
 - Call the API in Supervisor State with Storage Key 0.
 - Allocate a return area in Extended Common Storage Area (ECSA) memory subpool 241 (not fetch protected, pageable) with Storage Key 7. The size of the return area will be a minimum of the largest DB2 log record that is returned, plus the additional area that is defined in DB2 macro DSNDQW04.

¹ IFI is IBM's Instrumentation Facility Interface. IFCID is IBM's Instrumentation Facility Counter ID.

2. Extract the Oracle GoldenGate mediapack.zip file to the system and directory where you want Oracle GoldenGate to be installed.

3. In the Unix shell, verify that the DLL files have the write mode set.

```
ls -l *.dll
```

```
-rwxrwx--- a-s- 1 BSTPIER IPGROUP 6127616 Apr 25 14:56 lib.dll
```

4. If the write mode is not set, issue the following command.

```
chmod +w *.dll
```

5. In the UNIX shell, check for the "a" authorization for Extract and the DLL files by issuing the following command.

```
ls -E extract *.dll
```

In the output, look for the "a" attribute, indicating the authorization in Authorized Program Facility (APF) as shown in the following example.

```
-rwxrwx--- a-s- 1 BSTPIER IPGROUP 6127616 Apr 25 14:56 extract
```

6. If the "a" attribute is not set for both Extract and its DLL files (it may be built into one but not the other, depending on the build configuration), issue the following commands to add the authorization for Extract and the DLL files.

```
extattr +a extract
```

```
extattr +a *.dll
```

7. Run the command shell and change directories to the new Oracle GoldenGate directory.

8. Set the LIBPATH environment variable to include the path to the Oracle GoldenGate installation directory.

```
export LIBPATH=".:$(LIBPATH) "
```

The “.” indicates the current directory. This change must be performed before starting any Oracle GoldenGate processes and can be made in one of the following ways:

- system-wide
- for a specific user at login time
- manually each time that Oracle GoldenGate is executed

9. From the Oracle GoldenGate directory, run the GGSCI program.

```
GGSCI
```

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

```
CREATE SUBDIRS
```

11. Issue the following command to exit GGSCI.

```
EXIT
```

Installing Oracle GoldenGate on Linux and UNIX

Follow these instructions to install Oracle GoldenGate DB2Remote on a UNIX or Linux system (other than z/OS) to support remote delivery to a DB2 for z/OS target system. To install directly on a z/OS system, see “Installing Oracle GoldenGate in USS on z/OS” on page 11.

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 and Windows Cluster

Follow these instructions to install Oracle GoldenGate DB2Remote on a Windows system to support remote delivery to a DB2 for z/OS target system. To install directly on a z/OS system, see “Installing Oracle GoldenGate in USS on z/OS” on page 11.

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, such as one for the Oracle GoldenGate replication software and one for Oracle GoldenGate Veridata. Each Manager on a system must have a unique name. Before proceeding further, 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 3 INSTALL options

Option	Description
ADDEVENTS	Adds Oracle GoldenGate events to the Windows Event Manager. By default, Oracle GoldenGate errors are generic. To produce more specific error content, copy the following files from the Oracle GoldenGate installation directory to the SYSTEM32 directory. category.dll ggsmg.dll
ADDSERVICE	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. ¹ The service is installed to start at system boot time (see AUTOSTART). To start it after installation, either reboot the system or start the service manually from the Services applet of the Control Panel.
AUTOSTART	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>	Specifies a domain user account that executes Manager. For <name>, include the domain name, a backward slash, and the user name, for example HEADQT\GGSMGR. By default, the Manager service is installed to use the Local System account.
PASSWORD <password>	Specifies the password for the user that is specified with USER.

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

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

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

Adding Oracle GoldenGate as a Windows cluster resource

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

1. In the Cluster Administrator, select **File>New>Resource**.
2. In the New Resource dialog box, provide a descriptive name for the Oracle GoldenGate Manager (need not be its actual name). For Resource Type, select Generic Service. For Group, select the group that contains the database instance to which Oracle GoldenGate will connect.
3. Click **Next**.
4. In the Possible Owners dialog box, select the nodes on which Oracle GoldenGate will run.
5. Click **Next**.
6. In the GGS Manager Service Properties dialog box, click the Dependencies tab, and add the following to the Resource dependencies list:
 - The database resource
 - 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
7. Click **Apply**, then **OK**.
8. In the Generic Service Parameters dialog box, type either the default Manager service name of GGSMGR or the custom name, if one is specified with MGRSERVNAME in the GLOBALS file.
9. Click **Next**.
10. Click **Finish** to exit the wizard.
11. In the Cluster Administrator tree, right-click the Manager resource and then select Properties.
12. Click the Advanced tab, and then deselect Affect the Group. This is a recommendation, but you can configure it as needed for your environment.
13. Click **Apply**.
14. Bring the cluster resource online to verify that it was installed correctly.
15. Take the resource offline again.
16. Move the group to the next node in the cluster. When the group moves successfully to the second node, the Manager resource should still be offline.
17. Log onto the second node.
18. Install Oracle GoldenGate Manager as a service on this node by running the **install** program as you did on the previous node. If you created a custom name for Manager in the GLOBALS file, that name will be used.
19. Bring the resource online to verify that it is running correctly on this node.
20. Repeat from step 16 for each additional node in the cluster.

Configuring Manager and other processes

To configure Oracle GoldenGate to support your business requirements, see the Oracle GoldenGate *Windows and UNIX Administrator's Guide*. It contains instructions to:

- Configure the Manager process with a TCP/IP port and other optional parameters that control dynamic port assignments, trail file maintenance, automatic startup, and other properties.
- Configure Extract and Replicat processes to support reporting, high availability, disaster recovery, and other topologies.
- Configure security to control user access, file security, and data encryption.
- Configure integration, manipulation, and conversion features that enable you to customize Oracle GoldenGate and support the delivery of data across heterogeneous environments.
- Configure utilities and other tools that support Oracle GoldenGate.

CHAPTER 3

Preparing the system for Oracle GoldenGate

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Preparing tables for processing

The following table attributes must be addressed in an Oracle GoldenGate environment.

Disabling triggers and cascade constraints

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

1. A delete is issued for emp_src.
2. It cascades a delete to salary_src.
3. Oracle GoldenGate sends both deletes to the target.
4. The parent delete arrives first and is applied to emp_targ.
5. The parent delete cascades a delete to salary_targ.
6. The cascaded delete from salary_src is applied to salary_targ.
7. The row cannot be located because it was already deleted in step 5.

Assigning row identifiers

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

How Oracle GoldenGate determines the kind of row identifier to use

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

1. Primary key
2. First unique key alphanumerically that does not contain a timestamp or non-materialized computed column.
3. If none of the preceding key types exist (even though there might be other types of keys defined on the table) Oracle GoldenGate constructs a pseudo key of all columns that the database allows to be used in a unique key, excluding those that are not supported by Oracle GoldenGate in a key or those that are excluded from the Oracle GoldenGate configuration.

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

Handling ROWID columns

Any attempt to insert into a target table that includes a column with data type of ROWID GENERATED ALWAYS (the default) will fail with the following ODBC error:

```
ODBC error: SQLSTATE 428C9 native database error -798. {DB2 FOR
OS/390}{ODBC DRIVER}{DSN08015} DSNT408I SQLCODE = -798, ERROR: YOU CANNOT
INSERT A VALUE INTO A COLUMN THAT IS DEFINED WITH THE OPTION GENERATED
ALWAYS. COLUMN NAME ROWIDCOL.
```

You can do one of the following to prepare tables with ROWID columns to be processed by Oracle GoldenGate:

- Ensure that any ROWID columns in target tables are defined as GENERATED BY DEFAULT.
- If it is not possible to change the table definition, you can work around it with the following procedure.

To work around ROWID GENERATE ALWAYS

1. For the source table, create an Extract TABLE statement, and use a COLSEXCEPT clause in that statement that excludes the ROWID column. For example:

```
TABLE tab1, COLSEXCEPT (rowidcol);
```

The COLSEXCEPT clause excludes the ROWID column from being captured and replicated to the target table.

2. For the target table, ensure that Replicat does not attempt to use the ROWID column as the key. This can be done in one of the following ways:
 - Specify a primary key in the target table definition.
 - If a key cannot be created, create a Replicat MAP parameter for the table, and use a KEYCOLS clause in that statement that contains any unique columns except for the ROWID column. Replicat will use those columns as a key. For example:

```
MAP tab1, TARGET tab1, KEYCOLS (num, ckey);
```

For more information about KEYCOLS, see “Assigning row identifiers” on page 21.

Configuring character sets

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

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

Configuring database connections

The following guidelines assume that an appropriate ODBC driver is installed and configured.

Setting initialization parameters

The following DB2 for z/OS initialization parameters apply to Oracle GoldenGate and must be set correctly before starting Oracle GoldenGate processes.

- MVSDEFAULTSSID: set to the DB2 subsystem.
- LOCATION: set to the DB2 location name as stored in the DB2 Boot Strap Dataset.
- MVSATTACHTYPE: set to RRSF (Recoverable Resource Manager Services Attachment Facility) or CAF (Call Attachment Facility). IBM recommends using RRSF.
- MULTICONTEXT: set to 1 if using RRSF.
- PLANNAME: set to the DB2 plan. The default plan name is DSNACLI.

NOTE When using the CAF attachment type, you must use the Oracle GoldenGate DBOPTIONS parameter with the NOCATALOGCONNECT option in the parameter file of any Extract or Replicat process that connects to DB2. This parameter disables the usual attempt by Oracle GoldenGate to obtain a second thread for the DB2 catalog. Otherwise, you will receive error messages, such as "ODBC operation failed: Couldn't connect to <data source> for catalog queries."

Specifying the path to the initialization file

Specify the ODBC initialization file by setting the DSNAOINI environment variable in the z/OS UNIX profile, as in the following example:

```
export DSNAOINI="/etc/odbc810.ini"
```

Ensuring ODBC connection compatibility

To ensure that you configure the DB2 ODBC initialization file correctly, follow the guidelines in the *DB2 UDB for z/OS ODBC Guide and Reference* manual. One important consideration is the coding of the open and close square brackets: the [and] characters. The square bracket characters are "variant" characters that are encoded differently in different coded character set identifiers (CCSID), but must be of the IBM-1047 CCSID in the ODBC initialization file:

- The first (or open) bracket must use the hexadecimal characters X'AD' (0xAD).
- The second (or close) bracket must use the hexadecimal characters X'BD' (0xBD).

DB2 ODBC does not recognize brackets of any other CCSID.

To set the correct code for square brackets

Use any of the following methods.

- Use the “hex” command in OEDIT and change the hex code for each character appropriately.
- Use the iconv utility convert the ODBC initialization file. For example, to convert from CCSID IBM-037 to IBM-1047, use the following command:

```
iconv -f IBM-037 -t IBM-1047 ODBC.ini > ODBC-1047.ini  
mv ODBC-1047.ini ODBC.ini
```

- Change your terminal emulator or terminal configuration to use CCSID IBM-1047 when you create or alter the file.

Specifying the number of connection threads

Every Oracle GoldenGate process makes a database connection. Depending on the number of processes that you will be using and the number of other DB2 connections that you expect, you might need to adjust the following DB2 system parameters on the DSNTIPE DB2 Thread Management Panel:

- MAX USERS (macro DSN6SYSP CTHREAD)
- MAX TSO CONNECT (macro DSN6SYSP IDFORE)
- MAX BATCH CONNECT (macro DSN6SYSP IDBACK)

To determine the number of threads required

If using RRSAP, allow:

- Two DB2 threads per process for each of the following:
 - Extract
 - Replicat
 - The GGSCI command DBLOGIN (logs into the database)
 - DEFGEN (generates data definitions for column mapping)
- One extra DB2 thread for Extract for IFI calls.
- One extra DB2 thread for each SQLEXEC parameter statement that will be issued by each Extract and Replicat process. For more information about SQLEXEC, see the Oracle GoldenGate *Windows and UNIX Reference Guide*.

If using CAF, there can be only one thread per Oracle GoldenGate process.

Accessing load modules

Grant Oracle GoldenGate USS access to the SDSNLOAD system load library and to the DSNHDECP load module. You can include the libraries in one of the following places:

- the z/OS system search order.
- the USS profile of the Oracle GoldenGate user. Use a UNIX command similar to the following, where DSN810 is the user-assigned data set prefix from the DB2 installation.

```
export STEPLIB='DSN810.SDSNEXIT:DSN810.SDSNLOAD'
```

The preceding command will cause USS to allocate the equivalent of a STEPLIB DD statement whenever it executes a shell command or Oracle GoldenGate process. If using APF, all libraries in the STEPLIB concatenation must be APF-authorized.

Specifying job names and owners

By default, USS sets the job name and owner of all Oracle GoldenGate processes to that of the user who started them. You can change the job name or user by setting the `_BPX_JOBNAME` and `_BPX_USERID` environment variables, or you can create z/OS jobs or started-task procedures for the Oracle GoldenGate processes. For more details, see the *z/OS System Services Planning* document.

Assigning WLM velocity goals

The user who starts the Manager process is typically the user by which other Oracle GoldenGate processes run. Oracle GoldenGate work appears as forked child processes of WLM subsystem type OMVS. Assign the Oracle GoldenGate processes their Workload Manager (WLM) velocity goals based on the following guidelines.

- Assign the Extract process that reads the transaction logs a medium velocity goal, one that is below the velocity of the main DB2 address spaces, but above the velocity of most online transactions, TSO/E sessions, and z/OS batch work. The higher the velocity goal, the more processor power that Extract will receive, and the less lag that it will experience.
- You can assign an initial-load Extract process a velocity goal, or you can treat it as a typical DB2 batch job. For more information about the initial-load processes, see the *Oracle GoldenGate Windows and UNIX Administrator's Guide*.
- You might need to assign the Replicat process a higher velocity goal. Although Replicat is a typical DB2 batch application, it might require more processing power to prevent backlogs and latency.
- You probably will run Oracle GoldenGate utilities, such as DEFGEN and LOGDUMP, only occasionally, so you can let them perform like the other UNIX terminal-oriented work.
- If using SQLEXEC stored procedures, make certain that they do not become a bottleneck for Oracle GoldenGate. Their priority should be close to that of the calling Extract or Replicat process. WLM executes them with that priority, but the z/OS system executes them under the priority of a stored procedure as defined by the DB2 and z/OS system programmers.

If you run Oracle GoldenGate under the TSO/E OMVS command, the Oracle GoldenGate processes are subject to the system and WLM limits of the TSO/E user account, rather than those of the UNIX kernel. Very long TSO/E response times (up to 20 seconds), often with little service consumption, can be recorded for an OMVS user because of the way that OMVS polls for terminal input. This can affect those WLM goals that are based on response time.

Sample WLM Solution

You can use multiple WLM service classes for the Oracle GoldenGate processes. The following is an example of how to maintain relative priorities for Oracle GoldenGate and other work, from highest priority to the lowest:

1. z/OS system processes, including the UNIX kernel and IRLM.
2. DB2 for z/OS address spaces for the primary Extract group.
3. Primary Extract group configured for online or batch change synchronization, and any DB2 stored procedures that it calls.
4. z/OS transaction managers, such as CICS and IMS.
5. Collector (Server) for local Extract data pump, if used.
6. Local Extract data pump (reading from trail), if used.
7. Collector for remote trails (files received from a remote site). Such files include the QSAM file created with the Extract RMTBATCH parameter on a NonStop system.
8. Online Replicat groups and any DB2 stored procedures that they call.
9. Manager process (required only for startup of Oracle GoldenGate processes and trail cleanup).
10. GGSCI and other user UNIX and TSO/E terminal work.
11. Initial-load Extract and any DB2 stored procedures that it calls.
12. Initial-load Replicat and any DB2 stored procedures that it calls.
13. Other z/OS batch work.

Monitoring processes

The following provides information about monitoring Oracle GoldenGate with z/OS system facilities.

Viewing Oracle GoldenGate messages

If the system log process (syslog daemon syslogd) is running, USS routes Oracle GoldenGate messages to their configured destination by means of UNIX message priority. For more information about configuring syslogd, see the z/OS IP configuration documents and the *UNIX System Services Planning* document.

If syslogd is not running, Oracle GoldenGate writes its command output, status information, and error messages to the system console. You can redirect console messages to the Oracle GoldenGate USS session and to the Oracle GoldenGate report files by using the following UNIX command:

```
export _BPXK_JOBLOG=STDERR
```

Identifying processes

The system management facility (SMF) typically creates a separate accounting record for each UNIX process, including Oracle GoldenGate processes. However, if a user invokes the UNIX shell by using the OMVS command with the default SHAREAS option, or if a user sets

the environment variable `_BPX_SHAREAS` to YES, it could cause two or more processes to run in the same address space. SMF provides process identification only for the first process, but resource consumption is accumulated for all processes that are running. For Oracle GoldenGate, this means that the work probably will be recorded under the Manager process, which is named `mgr`.

If the DB2 accounting trace is also active to the SMF destination, DB2 will create an SMF accounting record for each of the following Oracle GoldenGate processes:

- Extract
- Replicat
- Manager, if performing maintenance on Oracle GoldenGate tables. Examples of Oracle GoldenGate tables are the marker table and the Replicat checkpoint table.
- GGSCI sessions that issue the Oracle GoldenGate `DBLOGIN` command to log into the database.

Interpreting statistics for update operations

The actual number of DML operations that are executed on the DB2 database might not match the number of extracted DML operations that are reported by Oracle GoldenGate. DB2 does not log update statements if they do not physically change a row, so Oracle GoldenGate cannot detect them or include them in statistics.

CHAPTER 4

Preparing the DB2 for z/OS transaction logs for Oracle GoldenGate

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Specifying a bootstrap data set

The Extract process uses the BSDS to find its initial position in the transaction log within a non-data-sharing environment. You specify the BSDS when you create your Extract groups. It must be the BSDS for the DB2 subsystem to which the Extract process will be connecting. Oracle GoldenGate does not perform any validations of the BSDS specification.

Making transaction data available

Oracle GoldenGate can extract DB2 transaction data from the active and archived logs. Follow these guidelines to configure the logs so that Extract can capture data.

Enabling change capture

Configure DB2 to log data changes in the expanded format that is supplied by the DATA CAPTURE CHANGES feature of the CREATE TABLE and ALTER TABLE commands. This format provides Oracle GoldenGate with the entire before and after images of rows that are changed with update statements. You can use GGSCI to issue the ALTER TABLE command.

To enable change capture from GGSCI

1. From the Oracle GoldenGate directory, run GGSCI.
2. Log on to DB2 from GGSCI as a user that has ALTER TABLE privileges.

```
DBLOGIN SOURCEDB <ODBC data source name>,  
USERID <user>[, PASSWORD <password>]
```
3. Issue the following command. where <table> is the fully qualified name of the table. You can use a wildcard to specify multiple table names but not owner names.

```
ADD TRANDATA <table>
```

By default, ADD TRANDATA issues the following command:

```
ALTER TABLE <name> DATA CAPTURE CHANGES;
```

Enabling access to log records

Activate DB2 Monitor Trace Class 1 ("TRACE(MONITOR) CLASS(1)") so that DB2 allows Extract to read the active log. The default destination of OPX is sufficient, because Oracle GoldenGate does not use a destination.

To start the trace manually

1. Log on to DB2 as a DB2 user who has the TRACE privilege or at least SYSOPR authority.
2. Issue the following command:

```
start trace(monitor) class(1) scope(group)
```

To start the trace automatically when DB2 is started

Do either of the following:

- Set MONITOR TRACE to 'YES' on the DSNTIPN installation tracing panel.
- Set 'DSN6SYSP MON=YES' in the DSNTIJUZ installation job, as described in the *DB2 UDB Installation Guide*.

NOTE The primary authorization ID, or one of the secondary authorization IDs, of the ODBC plan executor also must have the MONITOR2 privilege.

Sizing and retaining the logs

When tables are defined with DATA CAPTURE CHANGES, more data is logged than when they are defined with DATA CAPTURE NONE. If any of the following is true, you might need to increase the number and size of the active and archived logs.

- Your applications generate large amounts of DB2 data.
- Your applications have infrequent commits.
- You expect to stop Extract for long periods of time.
- Your network is unreliable or slow.

Retain enough log data so that Extract can start again from its checkpoints after you stop it or after an unplanned outage. Extract must have access to the log that contains the start of the oldest uncommitted unit of work, and all logs thereafter.

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 tables, and then start the Oracle GoldenGate environment over again.

To control log retention

Use the DSN6LOGP MAXARCH system parameter in the DSNTIJUZ installation job.

NOTE The IBM documentation makes recommendations for improving the performance of log reads. In particular, you can use large log output buffers, large active logs, and make archives to disk.

Using archive logs on tape

Oracle GoldenGate can read DB2 archive logs on tape, but it will degrade performance. For example, DB2 reserves taped archives for a single recovery task. Therefore, Extract would not be able to read an archive tape that is being used to recover a table until the recovery is finished. You could use DFHSM or equivalent tools to move the archive logs in a seamless

manner between online DASD storage and tape, but Extract will have to wait until the transfer is finished. Delays in Extract processing increase the latency between source and target data.

Controlling log flushes

When reading the transaction log, Extract does not process a transaction until it captures the commit record. If the commit record is on a data block that is not full, it cannot be captured until more log activity is generated to complete the block. The API that is used by Extract to read the logs only retrieves full physical data blocks.

A delay in receiving blocks that contain commits can cause latency between the source and target data. If the applications are not generating enough log records to fill a block, Extract generates its own log records by issuing SAVEPOINT and COMMIT statements, until the block fills up one way or the other and is released.

In a data sharing group, each API call causes DB2 to flush the data blocks of all active members, eliminating the need for Extract to perform flushes.

To prevent the flushes

Use the Extract parameter `TRANLOGOPTIONS` with the `NOFLUSH` option.

CHAPTER 4

Uninstalling Oracle GoldenGate

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

Uninstalling Oracle GoldenGate from UNIX (includes USS)

Follow these instructions to remove Oracle GoldenGate from an IBM z/OS source or target system, or from a Linux or UNIX system that is being used for remote delivery to DB2 on z/OS.

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. Log into the database with the DBLOGIN command, and then run the DELETE TRANDATA command to alter the tables to DATA CAPTURE NONE.

On any system where a Replicat checkpoint table is being used:

8. Log into the database with the DBLOGIN command, and then remove the Replicat checkpoint table by running the DELETE CHECKPOINTTABLE command.

On all systems:

9. Make certain all processes are stopped (including GGSCI).
10. Remove the Oracle GoldenGate files by removing the installation directory.

Removing Oracle GoldenGate from Windows Cluster

Follow these instructions to remove Oracle GoldenGate from a Windows cluster that is

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being used for remote delivery to DB2 on an IBM z/OS system.

1. Working from the node in the cluster that owns the cluster group that contains the Manager resource, run GGSCI and then stop any Extract and Replicat processes that are still running.
2. Use the Cluster Administrator tool to take the Manager resource offline.
3. Right click the resource and select **Delete** to remove it.
4. Click **Start > Run**, and type cmd in the **Run** dialog box to open the command console.
5. Change directories to the Oracle GoldenGate installation directory.
6. Run the install program using the following syntax.

```
install deleteevents deleteservice
```

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

7. Delete the CATEGORY.DLL and GGSMMSG.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)

Follow these instructions to remove Oracle GoldenGate from a Windows system that is being used for remote delivery to DB2 on an IBM z/OS system.

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 deleteevents 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 GGSMMSG.DLL files from the Windows SYSTEM32 folder.

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) and then remove the Oracle GoldenGate files by removing the installation directory.

APPENDIX 1

Oracle GoldenGate installed components

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

Oracle GoldenGate Programs and Utilities

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

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

Table 3 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.
emscnt	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 3 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 4 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.

Table 4 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 <group name><sequence number>.<ext> where <sequence number> is a sequential number appended to aged files and <ext> is either cpe for Extract checkpoint files or cpr for Replicat checkpoint files.</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 4 Subdirectories (continued)

Directory	Description
dirpcs	<p>Default location for status files. File name format is <group>.<extension> where <group> is the name of the group and <extension> is either pce (Extract), pcr (Replicat), or pcm (Manager).</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 <group name/user-defined name>.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	<p>Not used by Oracle GoldenGate.</p>
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 <group name><sequence number>.rpt where <sequence number> is a sequential number appended to aged files.</p> <p>Do not edit these files.</p> <p>Examples: fin2.rpt mgr4.rpt</p>
dirsql	<p>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.</p>
dirtmp	<p>The default location for storing large transactions when the size exceeds the allocated memory size. Do not edit these files.</p>
dirwlt	<p>Contains the Oracle Wallet that supports Oracle GoldenGate Monitor. This directory is not installed until the utility that creates the wallet is run.</p>
UserExitExamples	<p>Contains sample files to help with the creation of user exits.</p>

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 5 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 5 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 5 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.
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.
icudt38.dll icuin38.dll icuuc38.dll	Windows shared libraries for International Components for Unicode.

Table 5 Other files (continued)

Component	Description
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.
prvtclkm.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)
sqlldr.tpl	Template for use with Replicat when creating a control file for the Oracle SQL*Loader bulk-load utility.

Table 5 Other files (continued)

Component	Description
start.prm stop.prm	z/OS parmlib 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 6 Checkpoint table definitions

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

Table 6 Checkpoint table definitions

Column	Description
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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