Oracle® GoldenGate
DB2 z/OS Installation and Setup Guide
11*g* Release 1 (11.1.1)
E17796-01

August 2010

ORACLE®

Oracle GoldenGate DB2 z/OS Installation and Setup Guide 11g Release 1 (11.1.1)

E17796-01

Contents

· · · · · · · · · · · · · ·

· ·

. . . .

. . . .

System requirements and preinstallation instructions

・・・・・・・・・・・・・・

Overview of Oracle GoldenGate for DB2 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.

Standard configuration

On the z/OS platform, the standard configuration is to install Oracle GoldenGate directly on the z/OS system. The Oracle GoldenGate Extract and Replicat processes use ODBC (Open Database Connectivity) to connect to the DB2 subsystem.

Remote delivery option

As an alternative to installing Oracle GoldenGate directly on a target z/OS system, you can install it on a Linux, UNIX, or Windows system that hosts a DB2 for LUW instance. The Replicat process uses the DB2 Connect driver from DB2 for LUW to deliver replicated data to the DB2 target on the z/OS system. For more information, see Appendix 1 on page 30.

Supported platforms

● DB2 Universal Database (UDB) for OS/390 and z/OS 7.1 (until IBM end of service date)
● DB2 Universal Database (UDB) for z/OS Version 8.1 and 9.1
● Oracle GoldenGate supplies Generally Available (GA) software only for versions of z/OS that are officially supported by IBM Corporation. For assistance with running Oracle GoldenGate on other z/OS operating systems, open a service request with Oracle Support.

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 ISPPLIB

    ▸ Data set SYS1.SBPXMENU to ddname ISPMLIB

    ▸ 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 RRSAF, assign RACF ACCESS(READ) to the RRSAF resource. IBM recommends using RRSAF 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. For more information, see page page 23.

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.

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]')
  ```

- Additional disk space on any system that hosts Oracle GoldenGate trails, which are files that contain the working data. The space that is consumed by the trails varies, depending on the volume of data that will be processed. A good starting point is 1 GB. See the following guidelines.

Storage for Oracle GoldenGate trails

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

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

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

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

To estimate required trail space

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

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

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

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

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

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

TCP/IP

● Configure the system to use TCP/IP services, including DNS.

● Configure the network with the host names or IP addresses of all systems that will be hosting Oracle GoldenGate processes and to which Oracle GoldenGate will be connecting. Host names are easier to use.

● Oracle GoldenGate requires the following unreserved and unrestricted TCP/IP ports:

  ❍ One port for communication between the Manager process and other Oracle GoldenGate processes.

  ❍ A range of ports for local Oracle GoldenGate communications: can be the default range starting at port 7840 or a customized range of up to 256 other ports.

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

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

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.

● 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.

● 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.

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		
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 RRSAF 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 DSNACLI).

● 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

- 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 SYSAUXRELS	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	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 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 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.
- 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 data types

- DECFLOAT
- XML
- User-defined types

Supported objects and operations

- 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). For more information, see page 24.
- 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.

Non-supported objects and operations

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

Table 3   Supported non-alphanumeric characters in object names and non-key column names[1]

Character	Description
~	Tilde
< >	Greater-than and less-than symbols
/	Forward slash
\	Backward slash
!	Exclamation point
@	At symbol
#	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 names[1]

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.

Installing Oracle GoldenGate on a z/OS system

● ● ● ● ● ● ● ● ● ● ● ● ● ●

These instructions guide you through the process of installing Oracle GoldenGate on a z/OS system. As an option, you can install Oracle GoldenGate on a Linux, UNIX, or Windows system for remote delivery to a DB2 for z/OS target. See Appendix 1 on page 30.

Installation overview

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

Upgrades

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

New installations

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

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

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

Downloading Oracle GoldenGate

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

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

. . . .

Oracle GoldenGate *DB2 z/OS Installation and Setup Guide*   14

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 Oracle GoldenGate Media Pack that you want.

❍ Click **Continue**.

6. On the **Download** page:

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

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

Setting library paths for dynamic builds

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

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

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

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

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

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

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

To set the variables in Korn shell

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

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
◆ HP Tru64 (OSF/1)	
◆ LINUX	

[1] A specific platform may or may not be supported by Oracle GoldenGate for your database. See the Systems Requirements for supported platforms.

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

Installing the Oracle GoldenGate files

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.

---

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

❍ 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.

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
```

Configuring Manager and other processes

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

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

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.

To uninstall Oracle GoldenGate

1. Run the command shell.

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

3. Change directories to the Oracle GoldenGate installation directory.

4. Run GGSCI.

5. Stop all Oracle GoldenGate processes.

6. Stop the Manager process.

7. Exit GGSCI.

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

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

CHAPTER 3

Preparing the DB2 for z/OS system for Oracle GoldenGate

. . . .

Configuring database connections

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

Setting initialization parameters

The following DB2 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 RRSAF (Recoverable Resource Manager Services Attachment Facility) or CAF (Call Attachment Facility). IBM recommends using RRSAF.
- MULTICONTEXT: set to 1 if using RRSAF.
- 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 RRSAF, 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.

Using Oracle GoldenGate in a data sharing environment

In a data-sharing environment, use a distributed byte-range locking manager (BRLM) if possible. In this configuration, each system in the group runs a separate BRLM that is dedicated to the file systems that are mounted on that system.

If using a central BRLM to handle byte-range locking for all members of a group, use the AUTORESTART parameter in the Manager parameter file. AUTORESTART restarts any Oracle GoldenGate processes in the group that fail if the member that hosts the BRLM fails. Oracle GoldenGate does not handle I/O errors caused by lock failures.

Using data compression

To prevent problems with dictionary mismatches, always use the KEEPDICTIONARY option with LOAD and REORG utility statements. Recovering or loading data with a compression dictionary that is different from the current one might cause the data to become unreadable by Oracle GoldenGate. Before starting LOAD or REORG activities, allow the Oracle GoldenGate extraction and replication processes to finish their work, and then stop

. . . .

them. One symptom of mismatched compression dictionaries is an Extract failure that returns DB2 reason codes 00C90063 and 00C90064.

Preparing tables to be processed

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.

> **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.

How to specify your own key for Oracle GoldenGate to use

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

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 24.

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.

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

. . . .

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 <dsn>, 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.

Installing Oracle GoldenGate for remote delivery to a DB2 for z/OS target

• • • • • • • • • • • • • •

Instead of installing Oracle GoldenGate directly on a target z/OS system, you can install it on a remote Linux, UNIX, or Windows system.

● Replicat will connect to the target DB2 database by using the ODBC API that is supplied in DB2 Connect.

● All of the Oracle GoldenGate functionality that is supported for DB2 for z/OS is supported in this configuration.

● ASCII character data is converted to EBCDIC automatically by DB2 Connect.

Choosing and configuring a system for remote delivery

1. Select any Linux, UNIX, or Windows platform that Oracle GoldenGate supports for DB2 for LUW.

2. Install and run DB2 for LUW on the remote system so that the Replicat process can use the supplied DB2 Connect driver.

3. Catalog the z/OS node in the DB2 for LUW database by using the following DB2 command:

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

4. Add the target DB2 for z/OS database to the DB2 for LUW catalog 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. Specify the DB2 for z/OS database name with the Replicat parameter TARGETDB.

Downloading Oracle GoldenGate

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

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

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

4. On the **Media Pack Search** page:
    ❍ Select the **Oracle Fusion Middleware** Product Pack.
    ❍ Select the platform on which you will be installing the software.
    ❍ Click **Go**.

5. In the **Results List**:
    ❍ Select the Oracle GoldenGate Media Pack that you want.
    ❍ Click **Continue**.

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

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

Setting library paths for dynamic builds

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

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

2. If you will be running an Oracle GoldenGate program from outside the Oracle GoldenGate installation directory on a UNIX system:
    ❍ (Optional) Add the Oracle GoldenGate installation directory to the PATH environment variable.
    ❍ (Required) Add the Oracle GoldenGate installation directory to the shared-libraries environment variable.

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

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

To set the variables in Korn shell

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

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 ◆ IBM z/OS	LIBPATH
HP-UX	SHLIB_PATH
◆ Sun Solaris ◆ HP Tru64 (OSF/1) ◆ LINUX	LD_LIBRARY_PATH

[1] A specific platform may or may not be supported by Oracle GoldenGate for your database. See the Systems Requirements for supported platforms.

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 on Linux and UNIX

### Installing the Oracle GoldenGate files

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*[2] 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.

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.

[2.] IFI is IBM's Instrumentation Facility Interface. IFCID is IBM's Instrumentation Facility Counter ID.

• •

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 Windows and Windows Cluster

Installing Oracle GoldenGate into a Windows Cluster

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

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

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

4. Install Oracle GoldenGate according to the following instructions.

Installing the Oracle GoldenGate files

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

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

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

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

```
CREATE SUBDIRS
```

• •

5.   Issue the following command to exit GGSCI.

```
EXIT
```

Specifying a custom Manager name

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

● you want to use a name for Manager other than the default of GGSMGR.

● there will be multiple Manager processes running as Windows services on this system, such as one for the Oracle GoldenGate replication software and one for Oracle GoldenGate Veridata. Each Manager on a system must have a unique name. Before proceeding further, verify the names of any local Manager services.

To specify a custom Manager name

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

2.   Issue the following command.

```
EDIT PARAMS ./GLOBALS
```

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

```
MGRSERVNAME <name>
```

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

Installing Manager as a Windows service

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

To install Manager as a Windows service

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

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

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

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

Where: <option> is one of the following:

Table 5   INSTALL options

Option	Description
ADDEVENTS	Adds Oracle GoldenGate events to the Windows Event Manager. By default, Oracle GoldenGate errors are generic. To produce more specific error content, copy the following files from the Oracle GoldenGate installation directory to the SYSTEM32 directory. category.dll ggsmsg.dll
ADDSERVICE	Adds Manager as a service by the name specified in the GLOBALS file, if one exists, or by the default of GGSMGR. ADDSERVICE configures the service to run as the Local System account, the standard for most Windows applications because the service can be run independently of user logins and password changes. To run Manager as a specific account, use the USER and PASSWORD options.[1] The service is installed to start at system boot time (see AUTOSTART). To start it after installation, either reboot the system, or start the service manually from the Services applet of the Control Panel.
AUTOSTART	Specifies that the service created with ADDSERVICE is to be started at system boot time. This is the default unless MANUALSTART is used.
MANUALSTART	Specifies that the service created with ADDSERVICE is to be started manually through GGSCI, a script, or the Services applet of the Control Panel. The default is AUTOSTART.
USER <name>	Specifies a domain user account for executing Manager. For <name>, include the domain name, a backward slash, and the user name, for example HEADQT\GGSMGR. By default, the Manager service is installed to use the Local System account.
PASSWORD <password>	Specifies the password for the user specified with USER.

---

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

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

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

Adding Oracle GoldenGate as a Windows cluster resource

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

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

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

3. Click **Next**.

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

5. Click **Next**.

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

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

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

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

9. Click **Next**.

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

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

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

13. Click **Apply**.

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

15. Take the resource offline again.

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

17. Log onto the second node.

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

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

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

• •

Configuring Oracle GoldenGate processes on this system

On the remote Linux, UNIX, or Windows system where you will be running Oracle GoldenGate for remote delivery, set up Oracle GoldenGate as follows:

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

● Create and configure at least one Replicat group for delivery to the DB2 for z/OS target.

● Use required Replicat parameters, and optional parameters as needed, that support the DB2 for z/OS target platform.

● If you are replicating data from a source database that is not DB2 for z/OS, create a source-definitions file and transfer it to the Linux, UNIX, or Windows system that you have chosen as the remote delivery system.

To configure these processes, to add security, and to customize Oracle GoldenGate, see the *Oracle GoldenGate Windows and UNIX Administrator's Guide*.

APPENDIX 2
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 6   Programs and utilities

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

Table 6   Programs and utilities (continued)

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

Oracle GoldenGate subdirectories

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

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

Table 7 **Subdirectories**

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

• •

Table 7   Subdirectories (continued)

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

Other Oracle GoldenGate files

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

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

Table 8   Other files

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

Table 8   Other files (continued)

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

Table 8   Other files (continued)

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

Oracle GoldenGate checkpoint table

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

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

Table 9   Checkpoint table definitions

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

Index

Symbols

$LD_LIBRARY_PATH variable 16, 32
$PATH variable 16, 32

A

accounting record for Oracle GoldenGate 23
ADDEVENTS Windows service option 36
ADDSERVICE Windows service option 36
API privileges for Oracle GoldenGate 16, 33
archive logs
    on tape 28
    retaining 28
ASCII, converting to EBCDIC 10
attachment type 5
AUTORESTART parameter 23
AUTOSTART Windows service option 36

B

bootstrap data set, specifying 27
BPX_JOBNAME environment variable 21
BPX_SHAREAS environment variable 23
BPX_USERID environment variable 21
byte range locking, managing 23

C

C Compiler 7
CAF attachment type 5
cascade deletes, disabling 24
cascade updates, disabling 24
case, supported 11
category.dll 36
change capture, enabling 27
character sets, configuring 26

characters
    ASCII, EBCDIC conversion 10
    supported in object names 11
cluster, installing on 6, 34, 37
columns
    number and size supported 10
    supported data types 10
compression, data 10, 23
connection threads, number of 20
connection, database 9, 19, 20
constraints, integrity 24
CREATE SUBDIRS command 17, 34

D

DATA CAPTURE CHANGES 27
data compression 23
data sharing, and Oracle GoldenGate 23
data types, supported 10
database
    character sets 26
    connections 19
    logs, preparing 27
    requirements 9
    tables, preparing to be processed 24
DBOPTIONS parameter 19
DDL operations 10
DECFLOAT data type 10
deletes, cascaded 24
disk requirements 6
DSN6LOGP MAXARCH system parameter 28
DSN6SYSP MON 28
DSNACLI plan name 19
DSNAOINI environment variable 19
DSNHDECP load module, access to 21
DSNTIJUZ installation job 28