

Implement Enterprise Real-Time Change Data Capture & Transformations For In-Memory Analytics Applications

The Enterprise Data Warehouse (EDW)

Developed by
Fawzi A Alswaimil
An Oracle GoldenGate Expert
Oracle Systems Ltd
Saudi Arabia

fawzi.alswaimil@oracle.com

ORACLE®
GoldenGate 12c

Real-Time, In-Memory BI Applications

Overview

An Enterprise Data Warehouse (EDW) is an essential component to drive a fast-base business model. Business outlook need be projected on real-time for better decision-making. This pilot delivers the implementation's phases for deploying a real-time analytical application as part of Enterprise Data Warehouse repository powered by Oracle GoldenGate 12c 12.3 and Oracle Database 12c 12.2.

Figure 1 illustrates the architecture of an Enterprise Data Warehouse. The building infrastructure layers of an EDW are:

- A transactional *Oracle Database 11g*
- An *Oracle GoldenGate 12c R1 Downstream* for real-time change data capture
- The *Enterprise Data Warehouse Repository on Oracle Database 12c R2*

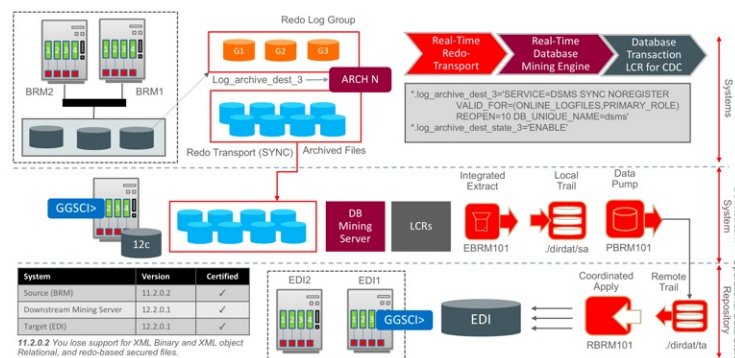


Figure 1: An Enterprise Data Warehouse Architecture

The OLTP transactions logs are shipped to its associated Oracle GoldenGate 12c downstream system, the database mining engine build the stream of Logical Change Records (LCR), the integrated Extract perform change data capture, create the local extract trails. A secondary extract, the data pump, send the extract trail to the EDW system as remote trails. The high-performance coordinated parallel apply the transactions in real-time to the EDW database.

Environment Configuration

Table 1, 2 and 3 show the details for the systems depicted on Figure 1. The source OLTP database running Transactional applications, EDI Running EDW System.

S Transactional Source System

Hostname	oltp01.mobily.com.sa
OS root password	oracle
OS oracle password	oracle
Global Name	BRM.mobily.com.sa
SYS	oracle_4U
SYSTEM	oracle_4U
Database Version	11.2.0.3.0
Operating Mode	Archive Log

Table 1: Transactional System details

D Downstream GoldenGate Database Mining System

Hostname	dss01.oracle.com
OS root password	oracle
OS oracle password	oracle
Global Name	DSDB.mobily.com.sa
SYS	oracle_4U
SYSTEM	oracle_4U
Database Version	12.1.0.2.0
Operating Mode	Archive Log

Table 2: Oracle GoldenGate 12c Downstream System details

T EDI System

Hostname	edw01.mobily.com.sa
OS root password	oracle
OS oracle password	oracle
Global Name	EDI.mobily.com.sa
SYS	oracle_4U
SYSTEM	oracle_4U
Database Version	12.2.0.1.0
Operating Mode	No Archive Log

Table 3: EDI System details

The Workload Simulator

A workload simulator developed using PL/SQL, the database procedure TRANS_LOAD is invoked, passing the workload parameters as explained below. Use the default parameters, unless otherwise instructed to use different values.

Parameter	Description
N	The workload level, default value 500, which inserts 5000 rows
S	The wait second between two transactions, default value is 5 seconds.

```
BRM> desc trans_load
PROCEDURE trans_load
Argument Name                                Type In/Out  Default?
-----
PLOAD_LEVEL                                NUMBER      IN          DEFAULT
PSTARTFROM                                NUMBER      IN          DEFAULT
```

```
BRM> desc call_trans_load
PROCEDURE call_trans_load
Argument Name                                Type In/Out  Default?
-----
N                                             NUMBER      IN          DEFAULT
S                                             NUMBER      IN          DEFAULT
```

SQL>

Run the work load simulator using the default values. The actual parameters use the default values; N=500 and S=5 seconds.

```
SQL> exec call_trans_load;
```

Run the workload simulator using N=2000, this will sustain transactions load of approximately 4hrs.

```
SQL> exec call_trans_load(2000);
```

The following call is an extreme level, use this parameter setting when performing the workshop on 8-20 cores system.

```
SQL> exec call_trans_load(300000, 1);
```

The Database Design

The database schema OSM_REPAPI owns the tables manipulated by the workload simulator. Figure 2 shows the database tables of the source database.

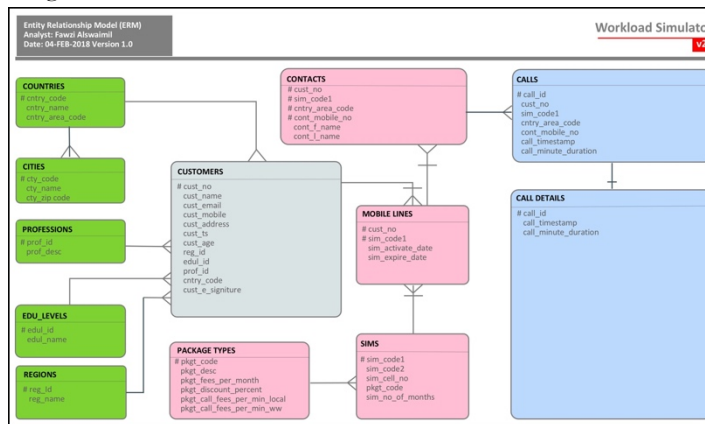


Figure 2: OLTP Source Database Tables

Figure 3 shows the database tables of the target Database (EDI). Because it's a data warehouse design, specific volatile tables are de-normalized to enable faster application runtime. In our case, the CALL_DETAILS table has been largely de-normalized by adding columns from unrelated tables, which are normally obtained by coding several SQL join operations, which negatively impact the SQL applications performance. Several transformations are done; on the called number by splitting the area code and the called number, concatenating the contact first and last names.

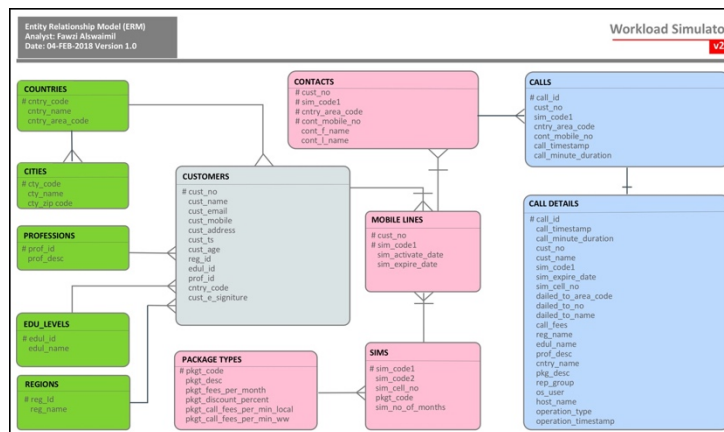


Figure 3: EDW Target Database Design

Database Tables

The source and target database tables are structurally identical with the exception of the CALL_DETAILS tables. On the source database, it's designed for OLTP, however; on the target database, it's largely de-normalized as described below.

SOURCE (BRM): CALL_DETAILS

```
BRM> desc call_details
```

Name	Null?	Type
CALL_ID	NOT NULL	VARCHAR2 (64)
CALL_TIMESTAMP	NOT NULL	TIMESTAMP (6)
CALL_MINUTE_DURATION	NOT NULL	NUMBER (5,2)

```
BRM>
```

TARGET (EDI): CALL_DETAILS

```
EDI> desc call_details
```

Name	Null?	Type
CALL_ID	NOT NULL	VARCHAR2 (64)
CALL_TIMESTAMP	NOT NULL	TIMESTAMP (6)
CALL_MINUTE_DURATION	NOT NULL	NUMBER (5,2)
CUST_NO		NUMBER
CUST_NAME		VARCHAR2 (128)
SIM_CODE1		VARCHAR2 (32)
SIM_EXPIRE_DATE		DATE
SIM_CELL_NO		VARCHAR2 (16)
DAILED_TO_AREA_CODE		VARCHAR2 (8)
DAILED_TO_NO		VARCHAR2 (16)
DAILED_TO_NAME		VARCHAR2 (128)
CALL_FEES		NUMBER (6,2)
REG_NAME		VARCHAR2 (128)
EDUL_NAME		VARCHAR2 (128)
PROF_DESC		VARCHAR2 (128)
CNTRY_NAME		VARCHAR2 (128)
PKGT_DESC		VARCHAR2 (128)
REP_GROUP		VARCHAR2 (8)
OS_USER		VARCHAR2 (32)
HOST_NAME		VARCHAR2 (32)
OPERATION_TYPE		VARCHAR2 (16)
OPERATION_TIMESTAMP		TIMESTAMP (6)

```
EDI>
```

To list the tables owned by the schema OSM_REPAPI, run the query:

```
BRM> select table_name  
2 from user_tables;
```

Database Sizing for Very Large Database

In order to support highly intensive OLTP operations on a very large database (VLDB), there are several essential elements that must be configured and sized correctly:

- Oracle Memory (SGA) Management
- Online Redo Log Groups
- Fast Recovery Area
- Automatic Database Files Extension
- Enable Archive Log Files Purge
- DNS and SQLNET configuration

Oracle Memory Management

Unless you have special requirements, Oracle recommends configuring the System Global Area (SGA) using the Automatic Memory Management (AMM). Setting the memory target to a large value supported by the operating system. Size the SGA by setting the Database parameters `MEMORY_MAX_TARGET` and `MEMORY_TARGET`. Restart the database to activate the parameters. Figure 4 depicts the allocated physical memory of 40GB.

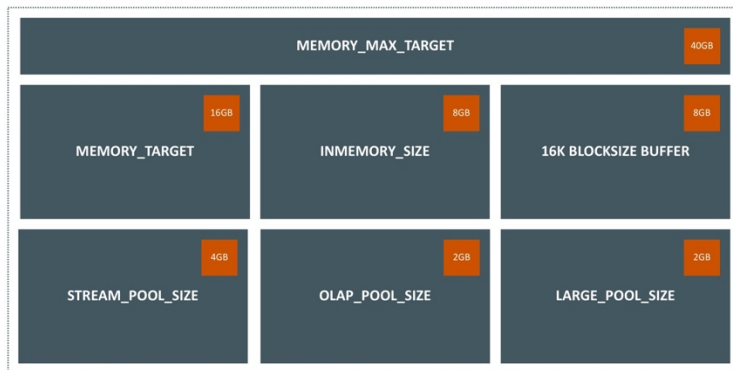


Figure 4: Memory Structure for System Global Area (SGA)

Create a backup of the server parameter file (SPFILE) by creating the parameter file (PFILE), which may be needed in case the database must be restarted with explicit parameters.

```
T D S BRM> create pfile='/tmp/initBRM.ora' from spfile;  
File created.
```

```

DSDB> alter system set memory_max_target=40G scope=spfile;

System altered.

DSDB> alter system set memory_target=16G scope=spfile;

System altered.

BRM> startup force
ORACLE instance started.

Total System Global Area          3.9863E+10 bytes
Fixed Size                        . 12169848 bytes
Variable Size                     2.9931E+10 bytes
Database Buffers                  9797894144 bytes
Redo Buffers                      122044416 bytes
Database mounted.
Database opened.
BRM>

```

Online Redo Log Groups

The default database has 3 redo log groups, each of size 50M, when running the workload load simulator archival may wait for free redo log group. The solution is to increase the number and size of the online redo log groups. Figure 5 shows a symmetrical configuration of the redo log groups and members.



Figure 5: Configure the source and target Database Redo Log Groups

While connected as SYSDBA, execute the following SQL commands to create the configuration shown in Figure 5.



```

BRM> select group#||' - '||member from v$logfile
2 order by 1;

GROUP# || ' - ' || MEMBER

```

```
-----
1 - /u01/app/oracle/oradata/BRM/redo01.log
2 - /u01/app/oracle/oradata/BRM/redo02.log
3 - /u01/app/oracle/oradata/BRM/redo03.log
```

BRM>

```
BRM> select name from v$controlfile;
```

NAME

```
-----
/u01/app/oracle/oradata/BRM/control01.ctl
/u01/app/oracle/fast_recovery_area/BRM/control02.ctl
```

BRM>

```
BRM> alter database add logfile group 4
      2 ('/u01/app/oracle/oradata/BRM/redo04a.log',
        '/u01/app/oracle/fast_recovery_area/BRM/redo04b.log') size 200M;
```

Database altered.

```
BRM> alter database add logfile group 5
      2 ('/u01/app/oracle/oradata/BRM/redo05a.log',
        '/u01/app/oracle/fast_recovery_area/BRM/redo05b.log') size 200M;
```

Database altered.

```
BRM> alter database add logfile group 6
      2 ('/u01/app/oracle/oradata/BRM/redo06a.log',
        '/u01/app/oracle/fast_recovery_area/BRM/redo06a.log') size 200M;
```

Database altered.

```
BRM> select group#, status from v$log;
```

GROUP# STATUS

```
-----
1 INACTIVE
2 UNUSED
3 CURRENT
4 UNUSED
5 UNUSED
6 INACTIVE
```

6 rows selected.

```
BRM> alter database drop logfile group 1;
```

Database altered.

Repeat for Group 2 and 3

```
BRM> alter database add logfile group 1
      2 ('/u01/app/oracle/oradata/BRM/redo01a.log',
        '/u01/app/oracle/fast_recovery_area/BRM/redo01b.log') size 200M;
```

```

Database altered.

BRM> alter database add logfile group 2
      2 ('/u01/app/oracle/oradata/BRM/redo02a.log',
        '/u01/app/oracle/fast_recovery_area/BRM/redo02b.log') size 200M;

Database altered.

BRM> alter database add logfile group 3
      2 ('/u01/app/oracle/oradata/BRM/redo03a.log',
        '/u01/app/oracle/fast_recovery_area/BRM/redo03b.log') size 200M;

Database altered.

BRM> select member from v$logfile
      2 order by group#;

MEMBER
-----
/u01/app/oracle/fast_recovery_area/BRM/redo01b.log
/u01/app/oracle/oradata/BRM/redo01a.log
/u01/app/oracle/fast_recovery_area/BRM/redo02b.log
/u01/app/oracle/oradata/BRM/redo02a.log
/u01/app/oracle/fast_recovery_area/BRM/redo03b.log
/u01/app/oracle/oradata/BRM/redo03a.log
/u01/app/oracle/oradata/BRM/redo04a.log
/u01/app/oracle/fast_recovery_area/BRM/redo04b.log
/u01/app/oracle/fast_recovery_area/BRM/redo05b.log
/u01/app/oracle/oradata/BRM/redo05a.log
/u01/app/oracle/oradata/BRM/redo06a.log

MEMBER
-----
/u01/app/oracle/fast_recovery_area/BRM/redo06a.log

12 rows selected.

BRM>

```

Fast Recovery Area

Configure the Fast Recovery Area (FRA) to support extensive workload as shown below.

```

TDS BRM> alter system set db_recovery_file_dest_size=100G scope=both;

System altered.

BRM>

```

Automatic Database Files Extension

Ensure the database files are automatically extended to support extensive workload as shown below.

```
T S BRM> select default_tablespace
2   from   dba_users
3   where  username='OSM_REPAPI';

DEFAULT_TABLESPACE
-----
OSM_DAT

BRM> alter database datafile
2   '/u01/app/oracle/oradata/BRM/osm_dat01.dbf' autoextend on;

Database altered.

BRM>
```

Enable Archive Log Files Purge

Use RMAN to delete archive log files by executing the shell script:
\$HOME/ClearArch.sh. *Do not follow this purge technique in production environments, rather use the Recovery Manager (RMAN) ARCHIVE LOG retention policy.*

```
S #!/bin/sh
export ORACLE_SID=BRM
export ORACLE_HOME=/u01/app/oracle/product/11.2.0/dbhome_1
export HOME=/home/oracle
$ORACLE_HOME/bin/rman target / @$HOME/ClearArch.rcv log=$HOME/ClearArch.log
append
```

Which invoke the recovery manager script: \$HOME/ClearArch.rcv

```
S delete noprompt archivelog all;
```

The RMAN delete command is scheduled as a database job: CLEARARCH, which runs every 15 minutes.

```
S begin
  dbms_scheduler.create_job(
    job_name=>'ClearArch',
    job_type=>'EXECUTABLE',
    job_action=>'/home/oracle/ClearArch.sh',
    repeat_interval=>'FREQ=MINUTELY; interval=15; bysecond=0;',
    enabled=>TRUE
  );
end;
```

Monitor the log files ClearArch.log to verify archive files are successfully deleted.

```

S Recovery Manager: Release 11.2.0.3.0 - Production on Sat Feb 3 15:53:55 2018

Copyright (c) 1982, 2011, Oracle and/or its affiliates. All rights
reserved.

connected to target database: BRM (DBID=3929558603)

RMAN> delete noprompt archivelog all;
2>
using target database control file instead of recovery catalog
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=91 device type=DISK
specification does not match any archived log in the repository

Recovery Manager complete.

```

DNS and SQLNET configuration

Verify the local DNS and SQLNET clients configured.

T	D	S
192.168.1.40	dhdb01.oracle.com	dhdb01
192.168.1.30	dxdb01.oracle.com	dxdb01
192.168.1.50	edw01.oracle.com	edw01

```

[oracle@dxdb01 admin]$ tnsping dhdb

TNS Ping Utility for Linux: Version 12.1.0.2.0 - Production on 16-FEB-2018
11:58:01

Copyright (c) 1997, 2014, Oracle. All rights reserved.

Used parameter files:

Used TNSNAMES adapter to resolve the alias
Attempting to contact (DESCRIPTION = (ADDRESS_LIST = (ADDRESS = (PROTOCOL =
TCP)(HOST = dhdb01.oracle.com)(PORT = 1521))) (CONNECT_DATA = (SERVICE_NAME
= DHDB.oracle.com)))
OK (0 msec)
[oracle@dxdb01 admin]$

```

```

[oracle@dxdb01 admin]$ tnsping edw

TNS Ping Utility for Linux: Version 12.1.0.2.0 - Production on 16-FEB-2018
11:58:47

Copyright (c) 1997, 2014, Oracle. All rights reserved.

Used parameter files:

```

```
Used TNSNAMES adapter to resolve the alias
Attempting to contact (DESCRIPTION = (ADDRESS_LIST = (ADDRESS = (PROTOCOL =
TCP) (HOST = edw01.oracle.com) (PORT = 1521))) (CONNECT_DATA = (SERVICE_NAME =
EDW.oracle.com)))
OK (0 msec)
[oracle@dxdb01 admin]$
```

Repeat the steps for Downstream (DSDB) and Target (EDI) instances as indicated by the sign.

Conventions

There are three symbolic conversion used throughout the workshops:



Designate the Source Database System



Designate the Downstream Database System



Designate the Enterprise Data Warehouse System

The workshop commands are executed interactively or via a Linux shell scripts. For interactive mode, execute the command in bold only.

☐ Completed

```
[oracle@dss01 gghome_1]$ ./ggsci

Oracle GoldenGate Command Interpreter for Oracle
Version 12.3.0.1.0 OGGCORE 12.3.0.1.0 PLATFORMS 170721.0154_FBO
Linux, x64, 64bit (optimized), Oracle 12c on Jul 21 2017 23:31:13
Operating system character set identified as UTF-8.

Copyright (C) 1995, 2017, Oracle and/or its affiliates. All rights reserved.

GGSCI (dss01.mobily.com.sa) 2> miningdblogin userid ogg_admin@edsdb, password
oracle
Successfully logged into mining database.

GGSCI (dss01.mobily.com.sa) 3> dblogin userid ogg_admin@BRM, password oracle
Successfully logged into database.

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 4>
```

☐ Completed

Successful command indicator

The interactive utilities used throughout the workshop:

SQL>	SQL*Plus
LSNRCTL>	Oracle Listener Command Interface
GGSCI>	GoldenGate Software Command Interface
vi	Linux Editor
#	Root prompt
\$	Oracle prompt

EDW Deployment Roadmap

The deployment roadmap follows a top-down approach as described in Figure 5. Phase I begins by certifying the production environment with Oracle GoldenGate 12c for installing Oracle GoldenGate 12.3 in a downstream system and the target system.

Phase II, accurately preparation of the production (source), the downstream and the target database is essential by settings database parameters (SGA Sizing) and enabling the database supplemental logging.

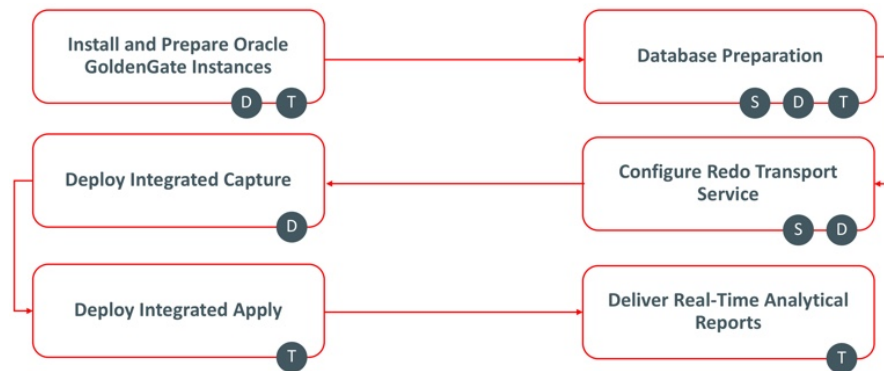


Figure 5: Deploying an EDW using Oracle GoldenGate 12c

Phase III, configure Oracle GoldenGate 12c for downstream deployment by configuring Oracle Redo-Transport Service. Phase IV Deploys Integrated Extract (IE) for change data capture, Phase V deploys Integrated coordinated parallel apply. Phase VI delivers Real-Time Analytical Reports. It empowers Oracle Database 12c 12.2 options such as OLAP, compression, in-memory, partitioning etc. to deploy high-performance Enterprise Data Warehouse Repository.

Phase I: Install Oracle GoldenGate 12c

Install Oracle GoldenGate 12c and prepare the GoldenGate instance for Phase II.

Task No	Description
1	Install Oracle GoldenGate 12c on Downstream System
2	Verify Oracle GoldenGate 12c instance on Downstream System
3	Optimize the Manager process parameters on Downstream System
4	Install Oracle GoldenGate 12c on Target System
5	Verify Oracle GoldenGate 12c instance on Target System
6	Optimize the Manager process parameters on Target System

Phase II: Source, Downstream and Target Database Preparation

Prepare the source, the downstream and the target Oracle GoldenGate 12c and Oracle Database 12c.

Task No	Description
1	Verify the source Database operating mode
2	Enable Database Supplemental Logging on Source Database
3	Create GoldenGate Database Administration Schema on Source
4	Activate Archive Log Mode on Downstream
5	Enable Database Supplemental Logging on Downstream Database
6	Create GoldenGate Database Administration Schema on Downstream
7	Database parameters setting on Downstream
8	Verify GoldenGate Database Login for Downstream
9	Create GoldenGate Administration Schema on Target
10	Verify GoldenGate Database Login for Target
11	Database parameters setting on Target
12	Enable GoldenGate table-level supplemental logging

Phase III: Configure Redo-Transport Service

The redo transport service ships the database transaction logs from the source database to the downstream Oracle GoldenGate 12c instance, which in turn has a database mining engine to perform logical change record (LCR) for the integrated extract to perform high-performance change data capture (CDC).

Task No	Description
1	Run the workload simulator
2	Configure and test the password file
3	Configure SQLNET listener and client (DONE)
4	Configure the source database parameters
5	Configure the downstream database parameters
6	Create the standby online redo log files
7	Create the directory structure
8	Verify Redo-Transport Service

Phase IV: Configure Integrated Capture

Begin by registering the Integrated Extract, then configure and defined the integrated extract, its trail and the data pump for data streaming.

Task No	Description
1	Register the Integrated Extract
2	Configure the Integrated Extract
3	Define the Integrated Extract
4	Configure the Secondary Extract (data pump)
5	Define the Secondary Extract (data pump)

Phase V: Configure Integrated Apply

Configure coordinated, parallel and integrated Replicat.

Task No	Description
1	Configure the checkpoint table
2	Create the checkpoint table
3	Configure the coordinated parallel Replicat
4	Define the coordinated Replicat
5	Start Extracts
6	Start Replicat
7	Verify Data Synchronization

Phase VI: Develop Data Transformations for BI Applications

The transformation empowers Oracle GoldenGate 12c capabilities to call-out user-defined PL/SQL procedure for performing basic-to-advanced data transformation on heavily de-normalized database table – CALL_DETAILS.

Task No	Description
1	Develop the PL/SQL Transformation Procedure
2	Grant Database Privileges to Execute the Procedure
3	Re-Configure the coordinated parallel Replicat
4	Start the Workload Simulator
5	Verify Data Synchronization
6	Verify Data Transformation

Phase VII: Delivering Real-Time BI Applications

Empowers Oracle Database 12c features and options to deliver high-performance real-time Enterprise Data Warehouse Repository, capable to deliver real-time analytical reports engine.

Task No	Description
1	Setting Optimizer Parameters for Data Warehouse Queries
2	Implement 16K-32K block I/O
3	Implement Temporary Groups
4	Online Database Structure Partitioning
5	Deploy Materialized View for Query Re-Write
6	Implement In-Memory Database Options
7	Implement Advanced Compression for DSS
8	Implement Parallel queries outlines
9	Run the Analytical Applications on production
10	Run the Analytical Applications on EDW
11	Compare the runtime execution plan

Phase I: Install Oracle GoldenGate 12c

There are two installation options for Oracle GoldenGate 12c:

- Interactive GUI installation
- Silent mode installation

The silent mode installation will be used to install Oracle GoldenGate 12c.

Table 4 lists the tasks for Phase I: install Oracle GoldenGate 12c.

Task No	Description
1	Install Oracle GoldenGate 12c on Downstream System
2	Verify Oracle GoldenGate 12c instance on Downstream System is Running
3	Optimize the Manager process parameters on Downstream System
4	Install Oracle GoldenGate 12c on Target System
5	Verify Oracle GoldenGate 12c instance on Target System is Running
6	Optimize the Manager process parameters on Target System

Table 4: Install Oracle GoldenGate 12c on Downstream and Target Systems

Because Oracle GoldenGate 12c is deployed in a downstream configuration, figure 6 shows where Oracle GoldenGate 12c is installed.

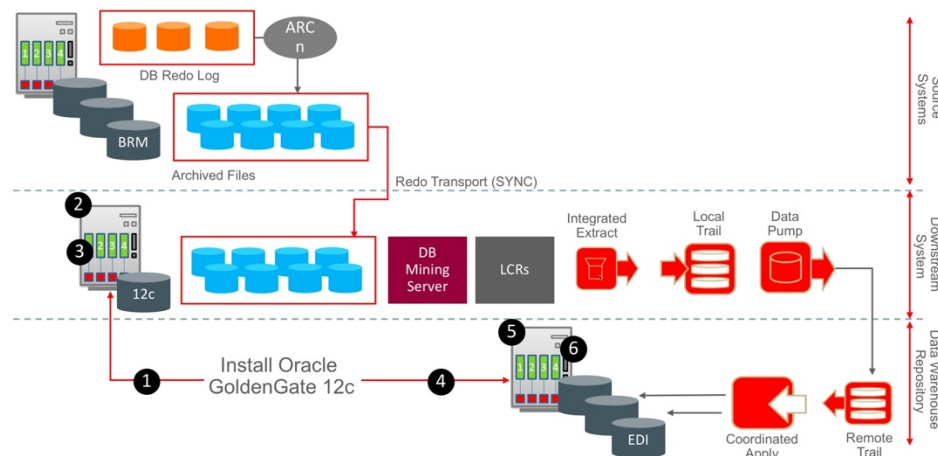


Figure 6: Oracle GoldenGate 12c install locations

Oracle GoldenGate 12c will be installed on the Downstream system and the Target (EDI) system. In the case Oracle GoldenGate 12c is locally deployed, then it's also required to install on the production environment (Source).

Task 1: Install Oracle GoldenGate 12c on Downstream System

The installation is performed using the silent mode option. It requires preparation of the installer Oracle GoldenGate 12c response file, then run the Oracle Universal Installer on silent mode using the shell script provided version – runInstaller.sh located at oracle \$HOME. Upon successfully installing Oracle GoldenGate, the installer starts the manager process on the port specified.

```
D [oracle@dss01 ~]$ cd
[oracle@dss01 ~]$ cat oggcore1.rsp

oracle.install.responseFileVersion=rspfmt_ogginstall_response_schema_v12_3_0
INSTALL_OPTION=ORA12c
SOFTWARE_LOCATION=/u01/app/oracle/product/12.3.0/gghome_1
START_MANAGER=true
MANAGER_PORT=7840
DATABASE_LOCATION=/u01/app/oracle/product/12.1.0/dbhome_1
INVENTORY_LOCATION=/u01/app/oraInventory
UNIX_GROUP_NAME=oinstall
```

Make sure the DATABASE_LOCATION is matching the ORACLE_HOME.

```
D [oracle@dss01 ~]$ echo $ORACLE_HOME
/u01/app/oracle/product/12.1.0/dbhome_1
[oracle@dss01 ~]$
```

```
D [oracle@dss01 ~]$ ./runInstall.sh
```

DISPLAY turned off Successfully

The Silent install option...

```
oracle.install.responseFileVersion=rspfmt_ogginstall_response_schema_v12_3_0
INSTALL_OPTION=ORA12c
SOFTWARE_LOCATION=/u01/app/oracle/product/12.3.0/gghome_1
START_MANAGER=true
MANAGER_PORT=7840
DATABASE_LOCATION=/u01/app/oracle/product/12.1.0/dbhome_1
INVENTORY_LOCATION=/u01/app/oraInventory
UNIX_GROUP_NAME=oinstall

/stage/ogg1230/fbo_ggs_Linux_x64_shiphome/Disk1/runInstaller -silent -
responsefile /home/oracle/oggcore1.rsp -nowelcome -showProgress -force -
waitforcompletion
```

```
Press Enter to Begin Oracle GoldenGate Silent Install.....
Do not interrupt the installation while in-progress.....
It will take approximately 5-10 minutes. Press Enter to begin....
Starting Oracle Universal Installer...
```

```

Checking Temp space: must be greater than 120 MB.    Actual 438253
MB    Passed
Checking swap space: must be greater than 150 MB.    Actual 11999
MB    Passed
Preparing to launch Oracle Universal Installer from /tmp/OraInstall2018-01-
27_12-42-10AM. Please wait ...You can find the log of this install session
at:
  /u01/app/oraInventory/logs/installActions2018-01-27_12-42-10AM.log

Prepare in progress.
..... 9% Done.

Prepare successful.

Copy files in progress.
..... 31% Done.
..... 44% Done.
..... 65% Done.
..... 70% Done.
..... 89% Done.
.....
Copy files successful.

Link binaries in progress.

Link binaries successful.

Setup files in progress.

Setup files successful.

Setup Inventory in progress.

Setup Inventory successful.

Finish Setup successful.
The installation of Oracle GoldenGate Core was successful.
Please check '/u01/app/oraInventory/logs/silentInstall2018-01-27_12-42-
10AM.log' for more details.

Running Configuration Assistants in progress.

Configuring and starting manager... in progress.
..... 100% Done.

Configuring and starting manager... successful.
Successfully Setup Software.
[oracle@dss01 ~]$

```

Task 2: Verify Oracle GoldenGate 12c Instance on Downstream System is Running

Verify Oracle GoldenGate 12c instance directory structure and the manager process is running on the port specified.

```
D [oracle@dss01 ~]$ cd $OGG_HOME
[oracle@dss01 gghome_1]$ ./ggsci

Oracle GoldenGate Command Interpreter for Oracle
Version 12.3.0.1.0 OGGCORE_12.3.0.1.0_PLATFORMS_170721.0154_FBO
Linux, x64, 64bit (optimized), Oracle 12c on Jul 21 2017 23:31:13
Operating system character set identified as UTF-8.

Copyright (C) 1995, 2017, Oracle and/or its affiliates. All rights reserved.

GGSCI (dss01.mobily.com.sa) 1>
```

Show the manager current runtime.

```
D GGSCI (dss01.mobily.com.sa) 1> info mgr

Manager is running (IP port dss01.mobily.com.sa.7840, Process ID 11693).

GGSCI (dss01.mobily.com.sa) 2>
```

Show the Oracle GoldenGate instance directory structure

```
D GGSCI (dss01.mobily.com.sa) 2> show

Parameter settings:

SET DEBUG      OFF

Current directory: /u01/app/oracle/product/12.3.0/gghome_1

Editor: vi

Reports (.rpt)           /u01/app/oracle/product/12.3.0/gghome_1/dirprt
Parameters (.prm)        /u01/app/oracle/product/12.3.0/gghome_1/dirprm
Replicat Checkpoints (.cpr) /u01/app/oracle/product/12.3.0/gghome_1/dirchk
Extract Checkpoints (.cpe) /u01/app/oracle/product/12.3.0/gghome_1/dirchk
Process Status (.pcs)    /u01/app/oracle/product/12.3.0/gghome_1/dirpcs
SQL Scripts (.sql)       /u01/app/oracle/product/12.3.0/gghome_1/dirsq
Database Definitions (.def) /u01/app/oracle/product/12.3.0/gghome_1/dirdef
Dump files (.dmp)        /u01/app/oracle/product/12.3.0/gghome_1/dirdmp
Masterkey wallet files (.wlt) /u01/app/oracle/product/12.3.0/gghome_1/dirwlt
Credential store files (.crd) /u01/app/oracle/product/12.3.0/gghome_1/dircrd
```

```
GGSCI (dss01.mobily.com.sa) 3>
```

Task 3: Optimize the Manager Process Parameters on Downstream System

Enable trails purge and automatic restart features to the manager parameter files. Stopping and restarting the manger process is required to re-activate the new parameters.

D

```
GGSCI (dss01.mobily.com.sa) 3> edit params mgr
```

```
PORT 7840
PURGEOLDEXTRACTS ./dirdat/*, USECHECKPOINTS, MINKEEPHOURS 1
AUTORESTART ER *, RETRIES 10, WAITMINUTES 1
```

D

```
GGSCI (dss01.mobily.com.sa) 4> stop mgr!
```

```
Sending STOP request to MANAGER ...
Request processed.
Manager stopped.
```

```
GGSCI (dss01.mobily.com.sa) 5> start mgr
Manager started.
```

```
GGSCI (dss01.mobily.com.sa) 6> info mgr
```

```
Manager is running (IP port dss01.mobily.com.sa.7840, Process ID 13048).
```

```
GGSCI (dss01.mobily.com.sa) 7> view params mgr
```

```
PORT 7840
PURGEOLDEXTRACTS ./dirdat/*, USECHECKPOINTS, MINKEEPHOURS 1
AUTORESTART ER *, RETRIES 10, WAITMINUTES 1
```

```
GGSCI (dss01.mobily.com.sa) 8> exit
```

Task 4: Install Oracle GoldenGate 12c on Target System

The installation is performed using the silent mode option. It requires preparation of the installer response file, then run the Oracle Universal Installer on silent mode using the shell script provided version – runInstaller.sh located at oracle \$HOME. Upon successfully installing Oracle GoldenGate, the installer starts the manager process on the port specified.

```
T [oracle@edw01 ~]$ cd
[oracle@edw01 ~]$ cat oggcore1.rsp
```

```
oracle.install.responseFileVersion=rsfmt_ogginstall_response_schema_v12_3_0
INSTALL_OPTION=ORA12c
SOFTWARE_LOCATION=/u01/app/oracle/product/12.3.0/gghome_1
START_MANAGER=true
MANAGER_PORT=7850
DATABASE_LOCATION=/u01/app/oracle/product/12.2.0/dbhome_1
INVENTORY_LOCATION=/u01/app/oraInventory
UNIX_GROUP_NAME=oinstall
```

Make sure the DATABASE_LOCATION is matching the ORACLE_HOME.

```
T [oracle@edw01 ~]$ echo $ORACLE_HOME
/u01/app/oracle/product/12.2.0/dbhome_1
[oracle@edw01 ~]$
```

```
T [oracle@edw01 ~]$ ./runInstall.sh
```

DISPLAY turned off Successfully

The Silent install option...

```
oracle.install.responseFileVersion=rsfmt_ogginstall_response_schema_v12_3_0
INSTALL_OPTION=ORA12c
SOFTWARE_LOCATION=/u01/app/oracle/product/12.3.0/gghome_1
START_MANAGER=true
MANAGER_PORT=7850
DATABASE_LOCATION=/u01/app/oracle/product/12.2.0/dbhome_1
INVENTORY_LOCATION=/u01/app/oraInventory
UNIX_GROUP_NAME=oinstall
```

```
/stage/ogg1230/fbo_ggs_Linux_x64_shiphome/Disk1/runInstaller -silent -
responsefile /home/oracle/oggcore1.rsp -nowelcome -showProgress -force -
waitforcompletion
```

```
Press Enter to Begin Oracle GoldenGate Silent Install.....
Do not interrupt the installation while in-progress.....
It will take approximately 5-10 minutes. Press Enter to begin....
Starting Oracle Universal Installer...
```

```
Checking Temp space: must be greater than 120 MB.   Actual 1076303
MB      Passed
```

```

Checking swap space: must be greater than 150 MB.   Actual 11999
MB      Passed
Preparing to launch Oracle Universal Installer from /tmp/OraInstall2018-01-
27_12-56-26AM. Please wait ...You can find the log of this install session
at:
  /u01/app/oraInventory/logs/installActions2018-01-27_12-56-26AM.log

Prepare in progress.
..... 9% Done.

Prepare successful.

Copy files in progress.
..... 31% Done.
..... 44% Done.
..... 65% Done.
..... 70% Done.
..... 89% Done.
.....
Copy files successful.

Link binaries in progress.

Link binaries successful.

Setup files in progress.

Setup files successful.

Setup Inventory in progress.

Setup Inventory successful.

Finish Setup successful.
The installation of Oracle GoldenGate Core was successful.
Please check '/u01/app/oraInventory/logs/silentInstall2018-01-27_12-56-
26AM.log' for more details.

Running Configuration Assistants in progress.

Configuring and starting manager... in progress.
..... 100% Done.

Configuring and starting manager... successful.
Successfully Setup Software.
[oracle@edw01 ~]$

```

Task 5: Verify Oracle GoldenGate 12c Instance on Target System is Running

Verify Oracle GoldenGate 12c instance directory structure and the manager process is running on the port specified.

```
T [oracle@edw01 ~]$ cd $OGG_HOME
[oracle@edw01 gghome_1]$ ./ggsci

Oracle GoldenGate Command Interpreter for Oracle
Version 12.3.0.1.0 OGGCORE_12.3.0.1.0_PLATFORMS_170721.0154_FBO
Linux, x64, 64bit (optimized), Oracle 12c on Jul 21 2017 23:31:13
Operating system character set identified as UTF-8.

Copyright (C) 1995, 2017, Oracle and/or its affiliates. All rights reserved.

GGSCI (edw01.mobily.com.sa) 1>
```

Show the manager current runtime.

```
T GGSCI (edw01.mobily.com.sa) 1> info mgr

Manager is running (IP port edw01.mobily.com.sa.7850, Process ID 12506).

GGSCI (edw01.mobily.com.sa) 2>
```

Verify the Oracle GoldenGate 12c instance directory structure

```
T GGSCI (edw01.mobily.com.sa) 2> show

Parameter settings:

SET DEBUG      OFF

Current directory: /u01/app/oracle/product/12.3.0/gghome_1

Editor: vi

Reports (.rpt)           /u01/app/oracle/product/12.3.0/gghome_1/dirrpt
Parameters (.prm)        /u01/app/oracle/product/12.3.0/gghome_1/dirprm
Replicat Checkpoints (.cpr) /u01/app/oracle/product/12.3.0/gghome_1/dirchk
Extract Checkpoints (.cpe) /u01/app/oracle/product/12.3.0/gghome_1/dirchk
Process Status (.pcs)     /u01/app/oracle/product/12.3.0/gghome_1/dirpcs
SQL Scripts (.sql)        /u01/app/oracle/product/12.3.0/gghome_1/dirsq
Database Definitions (.def) /u01/app/oracle/product/12.3.0/gghome_1/dirdef
Dump files (.dmp)         /u01/app/oracle/product/12.3.0/gghome_1/dirdmp
Masterkey wallet files (.wlt) /u01/app/oracle/product/12.3.0/gghome_1/dirwlt
Credential store files (.crd) /u01/app/oracle/product/12.3.0/gghome_1/dircrd
```

```
GGSCI (edw01.mobily.com.sa) 3>
```

Task 6: Optimize the Manager Process Parameters on Target System

Enable trails purge and automatic restart features to the manager parameter files. Stop and restart the manager process is required to re-activate the added parameters.



```
GGSCI (edw01.mobily.com.sa) 3> edit params mgr
```

```
PORT 7850
PURGEOLDEXTRACTS ./dirdat/*, USECHECKPOINTS, MINKEEPHOURS 1
AUTORESTART ER *, RETRIES 10, WAITMINUTES 1
```



```
GGSCI (edw01.mobily.com.sa) 11> stop mgr!
```

```
Sending STOP request to MANAGER ...
Request processed.
Manager stopped.
```

```
GGSCI (edw01.mobily.com.sa) 12> start mgr
Manager started.
```

```
GGSCI (edw01.mobily.com.sa) 13> info mgr
```

```
Manager is running (IP port edw01.mobily.com.sa.7850, Process ID 13360).
```

```
GGSCI (edw01.mobily.com.sa) 14> view params mgr
```

```
PORT 7850
PURGEOLDEXTRACTS ./dirdat/*, USECHECKPOINTS, MINKEEPHOURS 1
AUTORESTART ER *, RETRIES 10, WAITMINUTES 1
```

```
GGSCI (edw01.mobily.com.sa) 15> exit
```

Phase II: Source, Downstream and Target Database Preparation

Oracle GoldenGate 12c requires database pre-requisites. This section verifies and perform the database pre-requisites.

Table 5 lists the tasks for Phase II: Source, Downstream and Target Database Preparation.

Task No	Description
1	Verify the Source Database is Running on ARCHIVELOG mode
2	Enable Database Supplemental Logging on Source Database
3	Create GoldenGate Database Administration Schema on Source
4	Create GoldenGate Database Administration Schema on Downstream
5	Database Parameters Setting on Downstream System
6	Verify GoldenGate Database Login for Downstream System
7	Create GoldenGate Administration Schema on Target
8	Verify GoldenGate Database Login for Target
9	Database Parameters Setting on Target
10	Enable GoldenGate Table-Level Supplemental Logging

Table 5: Prepare the source, downstream and target Database

Figure 6 shows the database preparation; these tasks are Oracle GoldenGate 12c perquisites running on Oracle GoldenGate 12c downstream configuration.

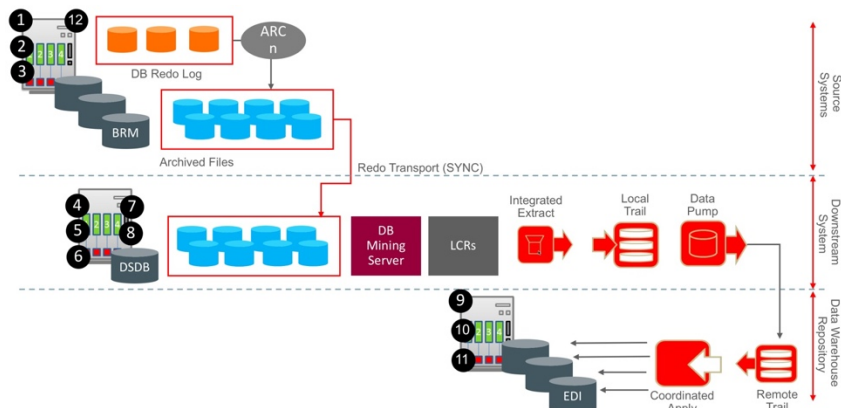


Figure 6: Database Pre-requisites

It's essential Phase II tasks are completed successfully, otherwise the following phases may not proceed as documented. Hence, do not proceed if you have encountered errors or misleading result of the commands.

Task 1: Verify the Source Database running on ARCHIVELOG Mode

The source database must operate in archive log mode. Query the database archive mode and enable if necessary.



```
[oracle@oltp01 ~]$ sqlplus /nolog

SQL*Plus: Release 11.2.0.3.0 Production on Sat Jan 27 08:02:55 2018

Copyright (c) 1982, 2011, Oracle. All rights reserved.

BRM> conn / as sysdba
Connected.
BRM> select log_mode
       2 from v$database;

LOG_MODE
-----
ARCHIVELOG

BRM>
```

TASK 2: Enable Database Supplemental Logging on Source Database

The database supplemental logging must be enabled. This is required by Oracle GoldenGate to perform database transactions logs capture. Query the current supplemental state and enable if necessary.



```
BRM> select supplemental_log_data_min
       2 from v$database;

SUPPLEME
-----
NO

BRM> alter database add supplemental log data;

Database altered.

BRM> select supplemental_log_data_min
       2 from v$database;

SUPPLEME
-----
YES

BRM>
```

Now, perform switch log file. This enable the database supplemental logging.

```
S BRM> alter system switch logfile;

System altered.

BRM>
```

Task 3: Create GoldenGate Database Administration Schema on Source

Create Oracle GoldenGate, grant the privileges and test connection to the source database instance using the connect string (BRM). Because this a test instance, the DBA privilege is granted. In a production, this must be avoided and explicitly grant the privileges required for the capture.

```
S BRM> create tablespace ogg_dat
2 datafile '/u01/app/oracle/oradata/BRM/ogg_dat01.dbf'
3 size 50M autoextend on;

Tablespace created.

BRM> grant dba to ogg_admin identified by oracle;

Grant succeeded.

BRM> alter user ogg_admin default tablespace ogg_dat;

User altered.

BRM>
```

Verify create database session

```
S BRM> conn ogg_admin/oracle@BRM

Connected.

BRM>
```

In the event of unable to connect, please do not continue, the connection (TNS error) must be resolved before continuing further.

Task 4: Create GoldenGate Database Administration Schema on Downstream

Create Oracle GoldenGate schema, grant the privileges and test connection to the source database instance using the connect string (EDI). Because this a test instance,

the DBA privilege is granted. In a production, this must be avoided and explicitly grant the privileges required for the capture.

```
D
DSDB>create tablespace ogg_dat;

Tablespace created.

DSDB>grant dba to ogg_admin identified by oracle;

Grant succeeded.

DSDB>alter user ogg_admin default tablespace ogg_dat;

User altered.

DSDB>
```

Test connection using DSD connect string

```
D
DSDB>conn ogg_admin/oracle@DSDB
Connected.
DSDB>
```

Task 5: Database Parameters Setting on Downstream

Settings parameters required by Oracle GoldenGate Replication

```
D
DSDB>alter system set enable_goldengate_replication=true scope=both;

System altered.

DSDB>alter system set stream_pool_size=5000M scope=both;

System altered.

DSDB>
```

Verify Database parameters settings

```
D
DSDB>show parameters enable_goldengate_replication

NAME                                TYPE                                VALUE
-----                                -
enable_goldengate_replication        boolean                             TRUE
                                     big integer                         5G
DSDB>show parameters stream_pool_size

NAME                                TYPE                                VALUE
-----                                -
stream_pool_size                     big integer                         5G
```

```

DSDB> exit
Disconnected from Oracle Database 12c Enterprise Edition Release 12.1.0.2.0
- 64bit Production
With the Partitioning, OLAP, Advanced Analytics and Real Application Testing
options
[oracle@dss01 admin]$

```

Task 6: Verify GoldenGate Database Login for Downstream

Login to the database using Oracle GoldenGate 12c command line – GGSCI.



```

[oracle@dss01 admin]$ cd $OGG_HOME
[oracle@dss01 gghome_1]$ ./ggsci

Oracle GoldenGate Command Interpreter for Oracle
Version 12.3.0.1.0 OGGCORE_12.3.0.1.0_PLATFORMS_170721.0154_FBO
Linux, x64, 64bit (optimized), Oracle 12c on Jul 21 2017 23:31:13
Operating system character set identified as UTF-8.

Copyright (C) 1995, 2017, Oracle and/or its affiliates. All rights reserved.

GGSCI (dss01.mobily.com.sa) 2> miningdblogin userid ogg_admin@dsdb, password
oracle
Successfully logged into mining database.

GGSCI (dss01.mobily.com.sa) 3> dblogin userid ogg_admin@BRM, password oracle
Successfully logged into database.

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 4>

```

Task 7: Create GoldenGate Administration Schema on Target

Create Oracle GoldenGate schema, grant the privileges and test connection to the source database instance using the connect string (EDI). Because this a test instance, the DBA privilege is granted. In a production, this must be avoided and explicitly grant the privileges required for the capture.



```

[oracle@edw01 ~]$ sqlplus /nolog

SQL*Plus: Release 12.2.0.1.0 Production on Sat Jan 27 12:51:17 2018

Copyright (c) 1982, 2016, Oracle. All rights reserved.

EDI> conn / as sysdba
Connected.
EDI> create tablespace ogg_dat;

Tablespace created.

```



```
EDI> grant dba to ogg_admin identified by oracle;

Grant succeeded.

EDI> alter user ogg_admin default tablespace ogg_dat;

User altered.

EDI>
```

Verify connection is successful



```
EDI> conn ogg_admin/oracle@EDI
Connected.
EDI> exit
Disconnected from Oracle Database 12c Enterprise Edition Release 12.2.0.1.0
- 64bit Production
[oracle@edw01 ~]$
```

Task 8: Verify GoldenGate Database Login for Target

Login to the database using Oracle GoldenGate Software Command Interface (GGSCI).



```
[oracle@edw01 ~]$ cd $OGG_HOME
[oracle@edw01 gghome_1]$ ./ggsci

Oracle GoldenGate Command Interpreter for Oracle
Version 12.3.0.1.0 OGGCORE_12.3.0.1.0_PLATFORMS_170721.0154_FBO
Linux, x64, 64bit (optimized), Oracle 12c on Jul 21 2017 23:31:13
Operating system character set identified as UTF-8.

Copyright (C) 1995, 2017, Oracle and/or its affiliates. All rights reserved.

GGSCI (edw01.mobily.com.sa) 1> dblogin userid ogg_admin@EDI, password oracle
Successfully logged into database.

GGSCI (edw01.mobily.com.sa as ogg_admin@EDI) 2> exit
[oracle@edw01 gghome_1]$
```

Task 9: Database Parameters Setting on Target

ENABLE_GOLDENGATE_REPLICATION is the only required parameter to enable is the target. However; there are additional database performance-parameter to size more accurately, these parameters are related to the System Global Area (SGA).



```
[oracle@edw01 gghome_1]$ sqlplus /nolog

SQL*Plus: Release 12.2.0.1.0 Production on Sat Jan 27 12:58:43 2018

Copyright (c) 1982, 2016, Oracle. All rights reserved.

EDI> conn / as sysdba
Connected.

EDI> alter system set enable_goldengate_replication=true scope=both;

System altered.

EDI>
```

Task 10: Enable GoldenGate Table-Level Supplemental Logging

The last step is to enable table-level supplemental logging by:

1. Start GGSCI
2. Login to the database
3. Run the command ADD TRANDATA



```
GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 24> add trandata
osm_repapi.REGIONS

2018-02-03 18:20:21 INFO      OGG-15132  Logging of supplemental redo data
enabled for table OSM_REPAPI.REGIONS.

2018-02-03 18:20:21 INFO      OGG-15133  TRANDATA for scheduling columns has
been added on table OSM_REPAPI.REGIONS.

2018-02-03 18:20:21 INFO      OGG-15135  TRANDATA for instantiation CSN has
been added on table OSM_REPAPI.REGIONS.

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 25> add trandata
osm_repapi.PROFESSIONS

2018-02-03 18:20:32 INFO      OGG-15132  Logging of supplemental redo data
enabled for table OSM_REPAPI.PROFESSIONS.

2018-02-03 18:20:32 INFO      OGG-15133  TRANDATA for scheduling columns has
been added on table OSM_REPAPI.PROFESSIONS.

2018-02-03 18:20:32 INFO      OGG-15135  TRANDATA for instantiation CSN has
been added on table OSM_REPAPI.PROFESSIONS.

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 26> add trandata
osm_repapi.EDU_LEVELS
```

```

2018-02-03 18:20:43 INFO OGG-15132 Logging of supplemental redo data
enabled for table OSM_REPAPI.EDU_LEVELS.

2018-02-03 18:20:43 INFO OGG-15133 TRANDATA for scheduling columns has
been added on table OSM_REPAPI.EDU_LEVELS.

2018-02-03 18:20:43 INFO OGG-15135 TRANDATA for instantiation CSN has
been added on table OSM_REPAPI.EDU_LEVELS.

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 27> add trandata
osm_repapi.NATIONALITIES

2018-02-03 18:20:54 INFO OGG-15132 Logging of supplemental redo data
enabled for table OSM_REPAPI.NATIONALITIES.

2018-02-03 18:20:54 INFO OGG-15133 TRANDATA for scheduling columns has
been added on table OSM_REPAPI.NATIONALITIES.

2018-02-03 18:20:54 INFO OGG-15135 TRANDATA for instantiation CSN has
been added on table OSM_REPAPI.NATIONALITIES.

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 28> add trandata
osm_repapi.PACKAGES

2018-02-03 18:21:09 INFO OGG-15132 Logging of supplemental redo data
enabled for table OSM_REPAPI.PACKAGES.

2018-02-03 18:21:09 INFO OGG-15133 TRANDATA for scheduling columns has
been added on table OSM_REPAPI.PACKAGES.

2018-02-03 18:21:09 INFO OGG-15135 TRANDATA for instantiation CSN has
been added on table OSM_REPAPI.PACKAGES.

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 29> add trandata
osm_repapi.PACKAGE_TYPES

2018-02-03 18:21:26 INFO OGG-15132 Logging of supplemental redo data
enabled for table OSM_REPAPI.PACKAGE_TYPES.

2018-02-03 18:21:26 INFO OGG-15133 TRANDATA for scheduling columns has
been added on table OSM_REPAPI.PACKAGE_TYPES.

2018-02-03 18:21:26 INFO OGG-15135 TRANDATA for instantiation CSN has
been added on table OSM_REPAPI.PACKAGE_TYPES.

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 30> add trandata
osm_repapi.SIMS

2018-02-03 18:21:37 INFO OGG-15132 Logging of supplemental redo data
enabled for table OSM_REPAPI.SIMS.

2018-02-03 18:21:37 INFO OGG-15133 TRANDATA for scheduling columns has
been added on table OSM_REPAPI.SIMS.

2018-02-03 18:21:37 INFO OGG-15135 TRANDATA for instantiation CSN has
been added on table OSM_REPAPI.SIMS.

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 31> add trandata
osm_repapi.CUSTOMERS

```

```

2018-02-03 18:21:53 INFO OGG-15132 Logging of supplemental redo data
enabled for table OSM_REPAPI.CUSTOMERS.

2018-02-03 18:21:53 INFO OGG-15133 TRANDATA for scheduling columns has
been added on table OSM_REPAPI.CUSTOMERS.

2018-02-03 18:21:53 INFO OGG-15135 TRANDATA for instantiation CSN has
been added on table OSM_REPAPI.CUSTOMERS.

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 32> add trandata
osm_repapi.MOBILE_LINES

2018-02-03 18:22:15 INFO OGG-15132 Logging of supplemental redo data
enabled for table OSM_REPAPI.MOBILE_LINES.

2018-02-03 18:22:15 INFO OGG-15133 TRANDATA for scheduling columns has
been added on table OSM_REPAPI.MOBILE_LINES.

2018-02-03 18:22:15 INFO OGG-15135 TRANDATA for instantiation CSN has
been added on table OSM_REPAPI.MOBILE_LINES.

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 33> add trandata
osm_repapi.CONTACTS

2018-02-03 18:22:26 INFO OGG-15132 Logging of supplemental redo data
enabled for table OSM_REPAPI.CONTACTS.

2018-02-03 18:22:26 INFO OGG-15133 TRANDATA for scheduling columns has
been added on table OSM_REPAPI.CONTACTS.

2018-02-03 18:22:26 INFO OGG-15135 TRANDATA for instantiation CSN has
been added on table OSM_REPAPI.CONTACTS.

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 34> add trandata
osm_repapi.calls

2018-02-03 18:22:36 INFO OGG-15132 Logging of supplemental redo data
enabled for table OSM_REPAPI.CALLS.

2018-02-03 18:22:36 INFO OGG-15133 TRANDATA for scheduling columns has
been added on table OSM_REPAPI.CALLS.

2018-02-03 18:22:36 INFO OGG-15135 TRANDATA for instantiation CSN has
been added on table OSM_REPAPI.CALLS.

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 35> add trandata
osm_repapi.call_details

2018-02-03 18:22:41 INFO OGG-15132 Logging of supplemental redo data
enabled for table OSM_REPAPI.CALL_DETAILS.

2018-02-03 18:22:41 INFO OGG-15133 TRANDATA for scheduling columns has
been added on table OSM_REPAPI.CALL_DETAILS.

2018-02-03 18:22:41 INFO OGG-15135 TRANDATA for instantiation CSN has
been added on table OSM_REPAPI.CALL_DETAILS.

```

```
GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 36> exit
```

Phase III: Configure Redo-Transport Service

The following tasks configure the redo-transport service to implement Oracle GoldenGate 12c deployed for downstream configuration, shipping the production transaction to the downstream system for producing the Logical Change Record (LCRs) in preparation for high-performance non-intrusive change data capture (CDC).

Table 6 lists the tasks of the Redo-Transport Service.

Task No	Description
1	Configure and test the password file
2	Configure the source database parameters
3	Configure the downstream database parameters
4	Create the standby online redo log files
5	Create the directory structure
6	Verify Redo-Transport Service

Table 6: Redo-Transport Service Tasks

Figure 7 shows the roadmap for configuring the Redo-Transport Service.

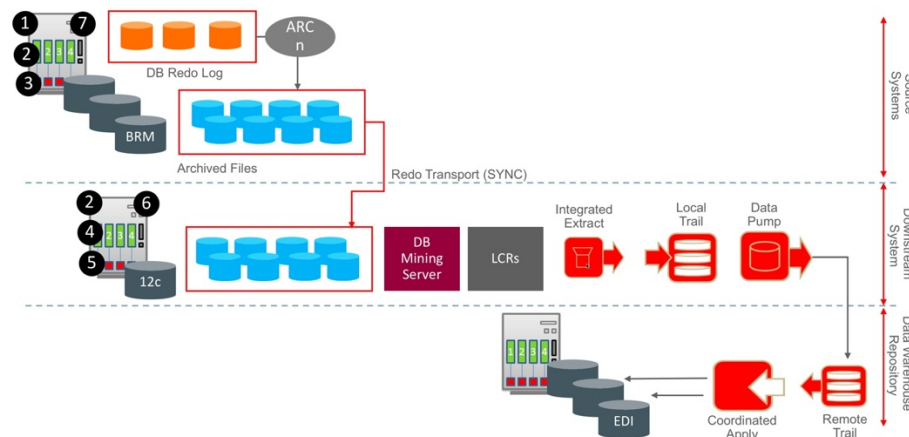


Figure 7: Redo-Transport Configuration

Optimizing the redo-transport is done by enabling the compression at the configuration parameter LOG_ARCHIVE_DEST_2 of the source, which require Oracle Advanced Compression option to be licensed. However; stream data from the downstream system to the target is compressed and encrypted using Oracle GoldenGate 12c built-in features.

Task 1: Configure and Test the Password File

The redo-transport requires the database password is identical for the source and downstream system.

Login to the primary node and downstream system as `_oracle` user and remove the current password files. Notice the password file is operating system specific, for Linux/UNIX the password file format is: `orapw<SID>`.

Use the Oracle password file utility `orapwd` to re-create the password file on the primary node only. *Do not re-create the password on the downstream system.* The utility uses the following options:

`IGNORECASE` : Non-Case sensitive password
`ENTRIES` : The maximum number of SYSDBA entries to be granted
`FORCE` : Override if password file exist



```
[oracle@oltp01 ~]$ cd $ORACLE_HOME/dbs
[oracle@oltp01 dbs]$ ls -al *pw*
-rw-r----- 1 oracle oinstall 1536 Jan 26 13:57 orapwBRM
[oracle@oltp01 dbs]$ orapwd file=orapwBRM password=oracle ignorecase=Y
entries=30 force=Y
[oracle@oltp01 dbs]$ ls -al *pw*
-rw-r----- 1 oracle oinstall 5120 Jan 28 07:11 orapwBRM
[oracle@oltp01 dbs]$ pwd
/u01/app/oracle/product/11.2.0/dbhome_1/dbs
[oracle@oltp01 dbs]$ scp orapwBRM
root@dss01:/u01/app/oracle/product/12.1.0/dbhome_1/dbs/orapwDSDB
root@dss01's password:
orapwBRM                               100%
5120      5.0KB/s   00:00
[oracle@oltp01 dbs]$
```



```
[oracle@dss01 ~]$ cd $ORACLE_HOME/dbs
[oracle@dss01 dbs]$ ls -al *pw*
-rw-r----- 1 oracle oinstall 5120 Jan 28 07:20 orapwDSDB
[oracle@dss01 dbs]$ su
Password:
[root@dss01 dbs]# chown oracle:oinstall orapwDSDB

[root@dss01 dbs]# exit
exit
[oracle@dss01 dbs]$ ls -al *pw*
-rw-r----- 1 oracle oinstall 5120 Jan 28 07:20 orapwDSDB
[oracle@dss01 dbs]$
```

Restart the primary node and downstream system database. The reason because the `IGNORECASE` was specified when re-creating the password file. `STARTUP FORCE` is used to quickly shutdown-restart the database instance.



```
[oracle@oltp01 dbs]$ sqlplus /nolog

SQL*Plus: Release 11.2.0.3.0 Production on Sun Jan 28 07:21:07 2018

Copyright (c) 1982, 2011, Oracle. All rights reserved.

BRM> conn / as sysdba
Connected.
BRM> startup force
ORACLE instance started.

Total System Global Area          1.2226E+10 bytes
Fixed Size                        2239616 bytes
Variable Size                     1811940224 bytes
Database Buffers                  1.0402E+10 bytes
Redo Buffers                       10031104 bytes
Database mounted.
Database opened.
BRM> exit
```

Restart the downstream database



```
[oracle@dss01 dbs]$ sqlplus /nolog

SQL*Plus: Release 12.2.0.1.0 Production on Sun Jan 28 07:25:54 2018

Copyright (c) 1982, 2016, Oracle. All rights reserved.

DSDB>conn / as sysdba
Connected.
DSDB>startup force
ORACLE instance started.

Total System Global Area          3.9863E+10 bytes
Fixed Size                        12169848 bytes
Variable Size                     3.3554E+10 bytes
Database Buffers                  6174015488 bytes
Redo Buffers                       122044416 bytes
Database mounted.
Database opened.
DSDB>
```

Verify TNS is reachable from the primary node to downstream system. *Please do not continue if the command tnsping result failed.*



```
[oracle@oltp01 dbs]$ tnsping DSDB

TNS Ping Utility for Linux: Version 11.2.0.3.0 - Production on 28-JAN-2018
07:24:36

Copyright (c) 1997, 2011, Oracle. All rights reserved.
```

Used parameter files:

```
Used TNSNAMES adapter to resolve the alias
Attempting to contact (DESCRIPTION = (ADDRESS_LIST = (ADDRESS = (PROTOCOL =
TCP)(HOST = dss01.mobily.com.sa)(PORT = 1521))) (CONNECT_DATA =
(SERVICE_NAME = DSDB.mobily.com.sa)))
OK (0 msec)
[oracle@oltp01 dbs]$
```

Configure LOG_ARCHIVE_DEST_2 to transmit the Redo log files to the downstream system mining database.

S

```
[oracle@oltp01 dbs]$ sqlplus /nolog

SQL*Plus: Release 11.2.0.3.0 Production on Sat Jan 27 09:50:30 2018

Copyright (c) 1982, 2011, Oracle. All rights reserved.

BRM> conn / as sysdba
Connected.
BRM> alter system set log_archive_dest_2='SERVICE=DSDB SYNC NOREGISTER
VALID_FOR=(ONLINE_LOGFILES,PRIMARY_ROLE) REOPEN=10 DB_UNIQUE_NAME=DSDB'
scope=both;

System altered.

BRM>
```

LOG_ARCHIVE_DEST_2 must be explicitly enabled

S

```
BRM> ALTER SYSTEM SET LOG_ARCHIVE_DEST_STATE_2=ENABLE scope=both;

System altered.

BRM>
```

Set the data guard configuration, using the database unique names. Specifying the unique name for the primary node and the extended node 1.

S

```
BRM> ALTER SYSTEM SET
2 LOG_ARCHIVE_CONFIG='DG_CONFIG=(BRM, DSDB) ' scope=both;

System altered.

BRM>
```

Review the size and number of members of the primary node, in preparation to create the standby Redo log files on the downstream system database.

```

S BRM> select group#, bytes/1024/1024 MB from v$log
2 order by 1;

  GROUP#      MB
  -----
1         200
2         200
3         200
4         200
5         200
6         200

6 rows selected.

BRM> exit

```

Configure the standby redo log groups. The number of the standby Redo log groups, should be one greater than the primary node, i.e. 7.

```

D SQL> select file_name from dba_data_files
2 where rownum < 2;

FILE_NAME
-----
/u01/app/oracle/oradata/DSDB/datafile/o1_mf_users_f6w9cmd9_.dbf

SQL>

```

Use the output of the above query to create the directory locations for the Redo logs, the archived logs and the standby Redo logs for the downstream system mining instance.

```

D SQL> host mkdir -p /u01/app/oracle/oradata/DSDB/arch

SQL> host mkdir -p /u01/app/oracle/oradata/DSDB/redo

SQL> host mkdir -p /u01/app/oracle/oradata/DSDB/standby

SQL>

```

Configure the downstream system mining database to receive and write shipped redo data locally, and to create the standby redo log files.

```

D SQL> alter system set
2 log_archive_dest_1='LOCATION=/u01/app/oracle/oradata/DSDB/arch
3 VALID_FOR=(ONLINE_LOGFILE,PRIMARY_ROLE) ' scope=both;

System altered.

SQL>

```

D

```
SQL> alter system set
2 log_archive_dest_2='LOCATION=/u01/app/oracle/oradata/DSDB/standby
3 VALID_FOR=(STANDBY_LOGFILE,ALL_ROLES)' scope=both;

System altered.

SQL>
```

D

```
SQL> ALTER SYSTEM SET
2 LOG_ARCHIVE_CONFIG='DG_CONFIG=(BRM, DSDB)' scope=both;

System altered.

SQL>
```

Enable both destinations.

D

```
SQL> alter system set log_archive_dest_state_1='ENABLE' scope=both;

System altered.

SQL> alter system set log_archive_dest_state_2='ENABLE' scope=both;

System altered.

SQL>
```

Show the location of the current online Redo groups (members)

D

```
DSDB> select member from v$logfile;

MEMBER
-----
/u01/app/oracle/oradata/DSDB/onlinelog/redo03a.log
/u01/app/oracle/fast_recovery_area/DSDB/onlinelog/redo03b.log
/u01/app/oracle/oradata/DSDB/onlinelog/redo02a.log
/u01/app/oracle/fast_recovery_area/DSDB/onlinelog/redo02b.log
/u01/app/oracle/oradata/DSDB/onlinelog/redo01a.log
/u01/app/oracle/fast_recovery_area/DSDB/onlinelog/redo01b.log
/u01/app/oracle/oradata/DSDB/onlinelog/redo04a.log
/u01/app/oracle/fast_recovery_area/DSDB/onlinelog/redo04b.log
/u01/app/oracle/oradata/DSDB/onlinelog/redo05a.log
/u01/app/oracle/fast_recovery_area/DSDB/onlinelog/redo05b.log
/u01/app/oracle/oradata/DSDB/onlinelog/redo06a.log

MEMBER
-----
/u01/app/oracle/fast_recovery_area/DSDB/onlinelog/redo06b.log

12 rows selected.

DSDB>
```

Create four standby Redo log groups: 4, 5, 6, 7, 8, 9, 10, 11, 12 and 13. The size should be greater than the current online Redo log groups of the primary node. Notice, two members of each group are defined.

```
D
DSDB> alter database add standby logfile group 7
      2 ('/u01/app/oracle/oradata/DSDB/onlineolog/sredo07a.log',
        '/u01/app/oracle/fast_recovery_area/DSDB/onlineolog/sredo07b.log') size 210M;

Database altered.

DSDB> alter database add standby logfile group 8
      2 ('/u01/app/oracle/oradata/DSDB/onlineolog/sredo08a.log',
        '/u01/app/oracle/fast_recovery_area/DSDB/onlineolog/sredo08b.log') size 210M;

Database altered.

DSDB> alter database add standby logfile group 9
      2 ('/u01/app/oracle/oradata/DSDB/onlineolog/sredo09a.log',
        '/u01/app/oracle/fast_recovery_area/DSDB/onlineolog/sredo09b.log') size 210M;

Database altered.

DSDB> alter database add standby logfile group 10
      2 ('/u01/app/oracle/oradata/DSDB/onlineolog/sredo10a.log',
        '/u01/app/oracle/fast_recovery_area/DSDB/onlineolog/sredo10b.log') size 210M;

Database altered.

DSDB> alter database add standby logfile group 11
      2 ('/u01/app/oracle/oradata/DSDB/onlineolog/sredo11a.log',
        '/u01/app/oracle/fast_recovery_area/DSDB/onlineolog/sredo11b.log') size 210M;

Database altered.

DSDB> alter database add standby logfile group 12
      2 ('/u01/app/oracle/oradata/DSDB/onlineolog/sredo12a.log',
        '/u01/app/oracle/fast_recovery_area/DSDB/onlineolog/sredo12b.log') size 210M;

Database altered.

DSDB> alter database add standby logfile group 13
      2 ('/u01/app/oracle/oradata/DSDB/onlineolog/sredo13a.log',
        '/u01/app/oracle/fast_recovery_area/DSDB/onlineolog/sredo13b.log') size 210M;

Database altered.

DSDB> exit
```

Verify redo-transport from the primary node to the downstream is successful.

```
S
[[oracle@oltp01 ~]$ cd $ORACLE_DIAG
[oracle@oltp01 trace]$ pwd
/u01/app/oracle/diag/rdbms/brm/BRM/trace
[oracle@oltp01 trace]$ tail -f alert_BRM.log
Sun Jan 28 22:44:53 2018
Archived Log entry 20 added for thread 1 sequence 25 ID 0xea385b4b dest 1:
```

```

Sun Jan 28 22:45:03 2018
*****
LGWR: Setting 'active' archival for destination LOG_ARCHIVE_DEST_2
*****
Thread 1 advanced to log sequence 27 (LGWR switch)
  Current log# 3 seq# 27 mem# 0: /u01/app/oracle/oradata/BRM/redo03.log
Sun Jan 28 22:45:03 2018
Archived Log entry 23 added for thread 1 sequence 26 ID 0xea385b4b dest 1:

```



```

[oracle@oltp01 trace]$ sqlplus /nolog

SQL*Plus: Release 11.2.0.3.0 Production on Sat Feb 3 18:47:36 2018

Copyright (c) 1982, 2011, Oracle. All rights reserved.

BRM> conn / as sysdba
Connected.

BRM> alter system switch logfile;

System altered.

BRM> alter system switch logfile;

System altered.

BRM>

```

```

[oracle@oltp01 trace]$ tail -f alert_BRM.log
Sun Jan 28 22:44:53 2018
Archived Log entry 20 added for thread 1 sequence 25 ID 0xea385b4b dest 1:
Sun Jan 28 22:45:03 2018
*****
LGWR: Setting 'active' archival for destination LOG_ARCHIVE_DEST_2
*****
Thread 1 advanced to log sequence 27 (LGWR switch)
  Current log# 3 seq# 27 mem# 0: /u01/app/oracle/oradata/BRM/redo03.log
Sun Jan 28 22:45:03 2018
Archived Log entry 23 added for thread 1 sequence 26 ID 0xea385b4b dest 1:
Sun Jan 28 23:00:44 2018
*****
LGWR: Setting 'active' archival for destination LOG_ARCHIVE_DEST_2
*****
Thread 1 advanced to log sequence 28 (LGWR switch)
  Current log# 1 seq# 28 mem# 0: /u01/app/oracle/oradata/BRM/redo01.log
Sun Jan 28 23:00:44 2018
Archived Log entry 25 added for thread 1 sequence 27 ID 0xea385b4b dest 1:

```

Phase V: Configure Integrated Capture

Begin by registering the Integrated Extract, then configure and defined the integrated extract, its trail and the data pump for data streaming.

Table 7 lists the tasks for configuring Oracle GoldenGate Integrated Capture

Task No	Description
1	Register the Integrated Extract (EBRM01)
2	Verify Successful Registration
3	Configure the Integrated Extract
4	Define the Integrated Extract
5	Configure the Secondary Extract (data pump PBRM01)
6	Define the Secondary Extract (data pump)
7	Verify Extracts Status

Table 7: Configure Integrated Capture

Figure 8 shows the components configured for Integrated Capture.

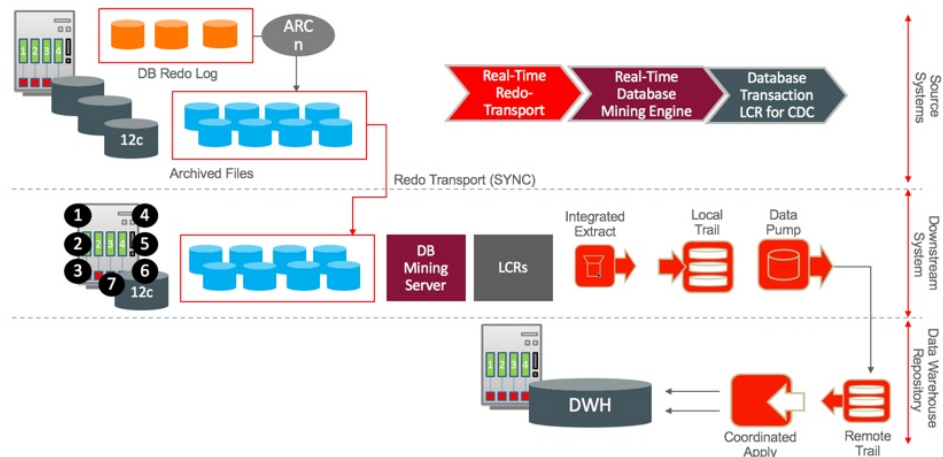


Figure 8: Integrated Capture Configuration

Task 1: Register the Integrated Extract (EBRM01)

Login to the downstream system and the source database to register the integrated extract.

```
D [oracle@dss01 ~]$ cd $OGG_HOME
[oracle@dss01 gghome_1]$ ./ggsci

Oracle GoldenGate Command Interpreter for Oracle
Version 12.3.0.1.0 OGGCORE_12.3.0.1.0_PLATFORMS_170721.0154_FBO
Linux, x64, 64bit (optimized), Oracle 12c on Jul 21 2017 23:31:13
Operating system character set identified as UTF-8.

Copyright (C) 1995, 2017, Oracle and/or its affiliates. All rights reserved.

GGSCI (dss01.mobily.com.sa) 1> miningdblogin userid ogg_admin@dsdb, password
oracle
Successfully logged into mining database.

GGSCI (dss01.mobily.com.sa) 2> dblogin userid ogg_admin@BRM, password oracle
Successfully logged into database.

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 4> register extract EBRM01,
DATABASE

2018-01-27 20:07:37 WARNING OGG-02064 Oracle compatibility version
11.2.0.0.0 has limited datatype support for integrated capture. Version
11.2.0.3 required for full support.

2018-01-27 20:07:51 INFO OGG-02003 Extract EBRM01 successfully
registered with database at SCN 1191381.

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 5> exit
```

Task 2: Verify Successful Registration

Verify it's successful by querying DBA_CAPTURE view.

```
D [oracle@dss01 gghome_1]$ sqlplus /nolog

SQL*Plus: Release 12.1.0.2.0 Production on Sat Feb 3 18:59:10 2018

Copyright (c) 1982, 2014, Oracle. All rights reserved.

DSDB> conn / as sysdba
Connected.
DSDB> select capture_name, captured_scn
2 from dba_capture;

CAPTURE_NAME CAPTURED SCN
```

```
OGG$CAP_EBRM01
```

```
1191381
```

```
DSDB> exit
```

Task 3: Configure the Integrated Extract

Prepare the configuration parameter for the primary extract.

D

```
[oracle@dss01 gghome_1]$ ./ggsci
```

```
Oracle GoldenGate Command Interpreter for Oracle  
Version 12.3.0.1.0 OGGCORE_12.3.0.1.0_PLATFORMS_170721.0154_FBO  
Linux, x64, 64bit (optimized), Oracle 12c on Jul 21 2017 23:31:13  
Operating system character set identified as UTF-8.  
  
Copyright (C) 1995, 2017, Oracle and/or its affiliates. All rights reserved.
```

```
GGSCI (dss01.mobily.com.sa) 1>
```

```
GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 5> edit params EBRM01
```

D

```
EXTRACT EBRM01  
SETENV (ORACLE_SID = DSDB)  
SETENV (ORACLE_HOME = "/u01/app/oracle/product/12.1.0/dbhome_1")  
SETENV (NLS_LANG = AMERICAN_AMERICA.AL32UTF8)  
SETENV (TNS_ADMIN =  
"/u01/app/oracle/product/12.1.0/dbhome_1/network/admin")  
USERID ogg_admin@BRM, PASSWORD oracle  
tranlogoptions mininguser ogg_admin@DSDB, miningpassword oracle  
tranlogoptions integratedparams (max_sga_size 128, downstream_real_time_mine  
Y)  
EXTTRAIL ./dirdat/sa  
TABLE osm_repapi.REGIONS;  
TABLE osm_repapi.PROFESSIONS;  
TABLE osm_repapi.EDU_LEVELS;  
TABLE osm_repapi.NATIONALITIES;  
TABLE osm_repapi.PACKAGES;  
TABLE osm_repapi.PACKAGE_TYPES;  
TABLE osm_repapi.SIMS;  
TABLE osm_repapi.CUSTOMERS;  
TABLE osm_repapi.MOBILE_LINES;  
TABLE osm_repapi.CONTACTS;  
TABLE osm_repapi.CALLS;  
TABLE osm_repapi.CALL_DETAILS;
```

```
GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 6> view params EBRM01
```

D

```
EXTRACT EBRM01  
SETENV (ORACLE_SID = DSDB)
```

```

SETENV (ORACLE_HOME = "/u01/app/oracle/product/12.1.0/dbhome_1")
SETENV (NLS_LANG = AMERICAN_AMERICA.AL32UTF8)
SETENV (TNS_ADMIN =
"/u01/app/oracle/product/12.1.0/dbhome_1/network/admin")
USERID ogg_admin@BRM, PASSWORD oracle
tranlogoptions mininguser ogg_admin@DSDB, miningpassword oracle
tranlogoptions integratedparams (max_sga_size 128, downstream_real_time_mine
Y)
TRANLOGOPTIONS EXCLUDEUSER ogg_admin
EXTTRAIL ./dirdat/sa
TABLE osm_repapi.REGIONS;
TABLE osm_repapi.PROFESSIONS;
TABLE osm_repapi.EDU_LEVELS;
TABLE osm_repapi.NATIONALITIES;
TABLE osm_repapi.PACKAGES;
TABLE osm_repapi.PACKAGE_TYPES;
TABLE osm_repapi.SIMS;
TABLE osm_repapi.CUSTOMERS;
TABLE osm_repapi.MOBILE_LINES;
TABLE osm_repapi.CONTACTS;
TABLE osm_repapi.CALLS;
TABLE osm_repapi.CALL_DETAILS;

GGSCI (dss01.mobily.com.sa) 3>

```

Task 4: Define the Integrated Extract

Run the command to define the Extract: ADD EXTRACT and ADD EXTTRAIL.



```

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 7> add extract EBRM01,
integrated tranlog, begin now
EXTRACT (Integrated) added.

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 8> add exttrail ./dirdat/sa,
extract EBRM01, megabytes 100
EXTTRAIL added.

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 9>

```

Task 5: Configure the Secondary Extract (data pump PBRM01)

Prepare the configuration parameter for the secondary extract (data pump)



```

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 9> edit params PBRM01

EXTRACT PBRM01
SETENV (ORACLE_SID = DSDB)
SETENV (ORACLE_HOME = "/u01/app/oracle/product/12.1.0/dbhome_1")

```

```

SETENV (NLS_LANG = AMERICAN_AMERICA.AL32UTF8)
USERID ogg_admin@DSDB, PASSWORD oracle
RMTHOST edw01.mobily.com.sa, MGRPORT 7850
RMTRAIL ./dirdat/ta
TABLE osm_repapi.*;

```

```

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 10> view params PBRM01

```

```

EXTRACT PBRM01
SETENV (ORACLE_SID = DSDB)
SETENV (ORACLE_HOME = "/u01/app/oracle/product/12.1.0/dbhome_1")
SETENV (NLS_LANG = AMERICAN_AMERICA.AL32UTF8)
USERID ogg_admin@DSDB, PASSWORD oracle
RMTHOST edw01.mobily.com.sa, MGRPORT 7850
RMTRAIL ./dirdat/ta
TABLE osm_repapi.*;

```

```

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 11>

```

Task 6: Define the Secondary Extract (data pump)

Define the secondary extract (data pump) by running the commands ADD EXTRACT and ADD RMTRAIL.



```

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 11> add extract PBRM01,
exttrailsource ./dirdat/ta
EXTRACT added.

```

```

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 13> add rmtrail ./dirdat/ta,
extract PBRM01, megabytes 100
RMTRAIL added.

```

```

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 14>

```

Task 7: Verify Extracts Status

Verify status of the extracts

```

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 14> info all

```

Program	Status	Group	Lag at Chkpt	Time Since Chkpt
MANAGER	RUNNING			
EXTRACT	STOPPED	EBRM01	00:00:00	00:11:42
EXTRACT	STOPPED	PBRM01	00:00:00	00:02:01

```
GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 15>
```

INFO extract EBRM01

```
GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 15> info extract EBRM01

EXTRACT      EBRM01      Initialized    2018-01-27 20:19      Status STOPPED
Checkpoint Lag      00:00:00 (updated 00:12:12 ago)
Log Read Checkpoint      Oracle Integrated Redo Logs
                        2018-01-27 20:19:58
                        SCN 0.0 (0)

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 16>
```

INFO extract PBRM01

```
GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 16> info extract PBRM01

EXTRACT      PBRM01      Initialized    2018-01-27 20:29      Status STOPPED
Checkpoint Lag      00:00:00 (updated 00:03:04 ago)
Log Read Checkpoint      File ./dirdat/sa0000000000
                        First Record RBA 0

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 17>
```

START all

```
GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 17> start *

Sending START request to MANAGER ...
EXTRACT EBRM01 starting

Sending START request to MANAGER ...
EXTRACT PBRM01 starting

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 18> info all

Program      Status      Group      Lag at Chkpt  Time Since Chkpt
MANAGER      RUNNING
EXTRACT      RUNNING      EBRM01      00:00:00      00:13:22
EXTRACT      RUNNING      PBRM01      00:00:00      00:03:40

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 19> stop *

Sending STOP request to EXTRACT EBRM01 ...
Request processed.

Sending STOP request to EXTRACT PBRM01 ...
Request processed.
```

```
GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 20> info all
```

Program	Status	Group	Lag at Chkpt	Time Since Chkpt
MANAGER	RUNNING			
EXTRACT	STOPPED	EBRM01	00:03:22	00:00:06
EXTRACT	STOPPED	PBRM01	00:00:00	00:00:06

```
GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 21>
```

Phase IV: Configure Integrated Coordinated Parallel Apply

Configure coordinated, parallel and integrated Replicat.

Table 8 lists the tasks associated with configuring integrated apply (Replicat)

Task No	Description
1	Configure and Create Oracle GoldenGate Database Checkpoint Table
2	Configure the Coordinated Parallel Replicat
3	Define the Coordinated Parallel Replicat
4	Start Extracts and Verify Status
5	Start the Replicat and Verify Status
6	Start the Workload Simulator
7	Verify Data Synchronization

Table 8: Configure Integrated apply

Figure 9 shows the components for configuring integrated apply

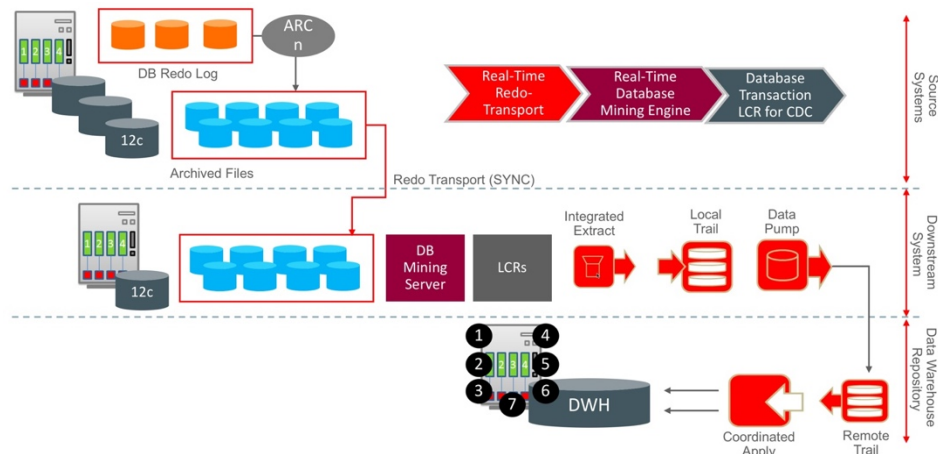


Figure 9: Integrated Apply Components

Task 1: Configure the Database Checkpoint table

Create the checkpoint table as it's the default checkpoint for the Replicat.

```
[oracle@edw01 ~]$ cd $OGG_HOME
[oracle@edw01 gghome_1]$ pwd
/u01/app/oracle/product/12.3.0/gghome_1
[oracle@edw01 gghome_1]$ vi GLOBALS
```

```
checkpointtable ogg_admin.chkpttab
```

```
[oracle@edw01 gghome_1]$ ./ggsci

Oracle GoldenGate Command Interpreter for Oracle
Version 12.3.0.1.0 OGGCORE_12.3.0.1.0_PLATFORMS_170721.0154_FBO
Linux, x64, 64bit (optimized), Oracle 12c on Jul 21 2017 23:31:13
Operating system character set identified as UTF-8.

Copyright (C) 1995, 2017, Oracle and/or its affiliates. All rights reserved.

GGSCI (edw01.mobily.com.sa) 1> dblogin userid ogg_admin@EDI, password oracle
Successfully logged into database.

GGSCI (edw01.mobily.com.sa as ogg_admin@EDI) 2> add checkpointtable

No checkpoint table specified. Using GLOBALS specification
ogg_admin.chkpttab...

Successfully created checkpoint table ogg_admin.chkpttab.

GGSCI (edw01.mobily.com.sa as ogg_admin@EDI) 3>
```

Task 2: Configure the Coordinated Replicat

Prepare the parameter file for the Replicat.

```
GGSCI (edw01.mobily.com.sa as ogg_admin@EDI) 3> edit params RBRM
```

```
REPLICAT RBRM
SETENV (ORACLE_SID = EDI)
SETENV (NLS_LANG = AMERICAN_AMERICA.AL32UTF8)
USERID ogg_admin@EDI, PASSWORD oracle
REPERERROR (DEFAULT, DISCARD)
DISCARDFILE /u01/app/oracle/product/12.3.0/gghome_1/dirrpt/RBRM.dsc, PURGE
MAP osm_repapi.REGIONS, TARGET osm_repapi.REGIONS;
MAP osm_repapi.PROFESSIONS, TARGET osm_repapi.PROFESSIONS;
MAP osm_repapi.EDU_LEVELS, TARGET osm_repapi.EDU_LEVELS;
MAP osm_repapi.NATIONALITIES, TARGET osm_repapi.COUNTRIES;
MAP osm_repapi.PACKAGES, TARGET osm_repapi.PACKAGES;
MAP osm_repapi.PACKAGE_TYPES, TARGET osm_repapi.PACKAGE_TYPES;
```

```

MAP osm_repapi.SIMS, TARGET osm_repapi.SIMS;
MAP osm_repapi.CUSTOMERS, TARGET osm_repapi.CUSTOMERS;
MAP osm_repapi.MOBILE_LINES, TARGET osm_repapi.MOBILE_LINES;
MAP osm_repapi.CONTACTS, TARGET osm_repapi.CONTACTS;
MAP osm_repapi.CALLS, TARGET osm_repapi.CALLS;
MAP osm_repapi.CALL_DETAILS, TARGET osm_repapi.CALL_DETAILS;

```

```

GGSCI (edw01.mobily.com.sa as ogg_admin@EDI) 4> view params RBRM

```

```

REPLICAT RBRM
SETENV (ORACLE_SID = EDI)
SETENV (NLS_LANG = AMERICAN_AMERICA.AL32UTF8)
USERID ogg_admin@EDI, PASSWORD oracle
REPEROR (DEFAULT, DISCARD)
DISCARDFILE /u01/app/oracle/product/12.3.0/gghome_1/dirrpt/RBRM.dsc, PURGE
MAP osm_repapi.REGIONS, TARGET osm_repapi.REGIONS;
MAP osm_repapi.PROFESSIONS, TARGET osm_repapi.PROFESSIONS;
MAP osm_repapi.EDU_LEVELS, TARGET osm_repapi.EDU_LEVELS;
MAP osm_repapi.NATIONALITIES, TARGET osm_repapi.COUNTRIES;
MAP osm_repapi.PACKAGES, TARGET osm_repapi.PACKAGES;
MAP osm_repapi.PACKAGE_TYPES, TARGET osm_repapi.PACKAGE_TYPES;
MAP osm_repapi.SIMS, TARGET osm_repapi.SIMS;
MAP osm_repapi.CUSTOMERS, TARGET osm_repapi.CUSTOMERS;
MAP osm_repapi.MOBILE_LINES, TARGET osm_repapi.MOBILE_LINES;
MAP osm_repapi.CONTACTS, TARGET osm_repapi.CONTACTS;
MAP osm_repapi.CALLS, TARGET osm_repapi.CALLS;
MAP osm_repapi.CALL_DETAILS, TARGET osm_repapi.CALL_DETAILS;

```

```

GGSCI (edw01.mobily.com.sa as ogg_admin@EDI) 5>

```

Task 3: Define the Coordinated Replicat

Define the integrated Replicat using the options: INTEGRATED and PARALLEL.

```

GGSCI (edw01.mobily.com.sa as ogg_admin@EDI) 6> ADD REPLICAT RBRM ,
integrated, parallel, EXTRAIL ./dirdat/ta
REPLICAT (Parallel) added.

```

```

GGSCI (edw01.mobily.com.sa as ogg_admin@EDI) 7>

```

Task 4: Start Extracts and Verify Status

Check status of the Extracts...

```

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 22> start *

Sending START request to MANAGER ...
EXTRACT EBRM01 starting

```

```

Sending START request to MANAGER ...
EXTRACT PBRM01 starting

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 23> info all

Program      Status      Group      Lag at Chkpt  Time Since Chkpt
-----
MANAGER      RUNNING
EXTRACT      RUNNING     EBRM01     00:03:22      00:16:32
EXTRACT      RUNNING     PBRM01     00:00:00      00:16:32

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 24>

```

```

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 25> info EBRM01

EXTRACT      EBRM01      Last Started 2018-01-27 20:50   Status RUNNING
Checkpoint Lag      00:03:20 (updated 00:00:08 ago)
Process ID        12045
Log Read Checkpoint Oracle Integrated Redo Logs
                  2018-01-27 20:47:26
                  SCN 0.1195774 (1195774)

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 26>

```

```

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 26> info PBRM01

EXTRACT      PBRM01      Last Started 2018-01-27 20:50   Status RUNNING
Checkpoint Lag      00:00:00 (updated 00:00:05 ago)
Process ID        12046
Log Read Checkpoint File
/u01/app/oracle/product/12.3.0/gghome_1/dirdat/sa000000001
                  2018-01-27 20:50:06.124821 RBA 1495

GGSCI (dss01.mobily.com.sa as ogg_admin@BRM) 27>

```

Task 5: Start Replicat and Verify Status

Start and check status of the Replicat...

```

GGSCI (edw01.mobily.com.sa) 3> start *

Sending START request to MANAGER ...
REPLICAT RBRM starting

GGSCI (edw01.mobily.com.sa) 4> info all

Program      Status      Group      Lag at Chkpt  Time Since Chkpt
-----

```

```
MANAGER      RUNNING
REPLICAT     RUNNING      RBRM      00:00:00      00:05:02

GGSCI (edw01.mobily.com.sa) 5>
```

```
GGSCI (edw01.mobily.com.sa) 5> info RBRM

REPLICAT  RBRM      Last Started 2018-01-27 20:50      Status RUNNING
INTEGRATED
Parallel
Checkpoint Lag      00:00:00 (updated 00:00:04 ago)
Process ID          5889
Log Read Checkpoint File
/u01/app/oracle/product/12.3.0/gghome_1/dirdat/ta000000000
2018-01-27 20:50:38.250835 RBA 1575

GGSCI (edw01.mobily.com.sa) 6> exit
```

Task 6: Start Workload Simulator

Starting the workload simulator generate transaction on the source database according to the level of specified. Use the default which is recommended at the stage.

```
[oracle@oltp01 ~]$ sqlplus /nolog

SQL*Plus: Release 11.2.0.3.0 Production on Sat Feb 3 19:18:27 2018

Copyright (c) 1982, 2011, Oracle. All rights reserved.

BRM> conn osm_repapi/oracle
Connected.
BRM> exec call_trans_load;
```

Task 7: Verify Data Synchronization

Verify data is synchronized from source (BRM) to target (EDI) system database.

```
[oracle@oltp01 ~]$ sqlplus /nolog

SQL*Plus: Release 11.2.0.3.0 Production on Sat Jan 27 20:57:37 2018

Copyright (c) 1982, 2011, Oracle. All rights reserved.

BRM> conn osm_repapi/oracle
Connected.
BRM> exec call_trans_load;
```

On Downstream

```
[oracle@dss01 gghome_1]$ cd dirdat
[oracle@dss01 dirdat]$ ls -al
total 84
drwxr-x--- 2 oracle oinstall 4096 Jan 27 20:50 .
drwxr-xr-x 29 oracle oinstall 4096 Jan 27 20:33 ..
-rw-r----- 1 oracle oinstall 1434 Jan 27 20:50 sa000000000
-rw-r----- 1 oracle oinstall 65811 Jan 27 21:02 sa000000001
[oracle@dss01 dirdat]$ ls -al
total 84
drwxr-x--- 2 oracle oinstall 4096 Jan 27 20:50 .
drwxr-xr-x 29 oracle oinstall 4096 Jan 27 20:33 ..
-rw-r----- 1 oracle oinstall 1434 Jan 27 20:50 sa000000000
-rw-r----- 1 oracle oinstall 66099 Jan 27 21:02 sa000000001
[oracle@dss01 dirdat]$
```

On target

```
[oracle@edw01 gghome_1]$ cd dirdat
[oracle@edw01 dirdat]$ ls -al
total 124
drwxr-x--- 2 oracle oinstall 4096 Jan 27 20:29 .
drwxr-xr-x 28 oracle oinstall 4096 Jan 27 20:34 ..
-rw-r----- 1 oracle oinstall 115530 Jan 27 20:59 ta000000000
[oracle@edw01 dirdat]$ ls -al
total 124
drwxr-x--- 2 oracle oinstall 4096 Jan 27 20:29 .
drwxr-xr-x 28 oracle oinstall 4096 Jan 27 20:34 ..
-rw-r----- 1 oracle oinstall 117059 Jan 27 20:59 ta000000000
[oracle@edw01 dirdat]$
```

Use SQLPlus to verify row count is incrementing

```
[oracle@edw01 ~]$ sqlplus osm_repapi/oracle

SQL*Plus: Release 12.2.0.1.0 Production on Sat Feb 3 19:51:31 2018

Copyright (c) 1982, 2016, Oracle. All rights reserved.

Last Successful login time: Sat Feb 03 2018 19:22:28 +03:00

Connected to:
Oracle Database 12c Enterprise Edition Release 12.2.0.1.0 - 64bit Production

EDT> select count(*) from customers;

COUNT(*)
-----
236494

EDT> /

COUNT(*)
-----
236497

EDT> select count(*) from sims;
```

```

COUNT (*)
-----
27324

EDI> /

COUNT (*)
-----
27337

EDI> select count(*) from contacts;

COUNT (*)
-----
2504150

EDI> /

COUNT (*)
-----
2504150

EDI> /

COUNT (*)
-----
2505487

EDI> select count(*) from calls;

COUNT (*)
-----
4998980

EDI> /

COUNT (*)
-----
5017366

EDI>
```

Phase VII: Develop Data Transformations for BI Applications

The transformation empowers Oracle GoldenGate 12c capabilities to call-out user-defined PL/SQL procedure for performing basic-to-advanced data transformation on heavily de-normalized database table – CALL_DETAILS as shown in Figure 10.

Tale 9 lists the tasks associated with Phase VII.

Task No	Description
1	Develop the PL/SQL Transformation Procedure
2	Grant Database Privileges to Execute the Procedure
3	Re-Configure the coordinated parallel Replicat
4	Start the Workload Simulator
5	Verify Data Synchronization
6	Verify Data Transformation
7	Generate Replicat Statistics

Table 9: Data Transformation Tasks

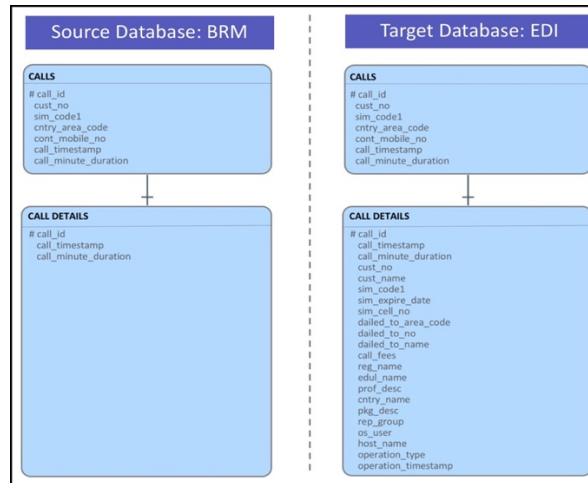


Figure 10: Source (BRM) and Target (EDI) database tables

The data transformations developed as follow:

1. Create the transformation database procedure
2. Modify the Replicat to call-out the database procedure to perform transformation
3. Start the workload simulator

Task 1: Develop Transformation on CALL_DETAILS

The database procedure TRANSFORM_CALL_DETAILS is invoked from within the Replicat RBRM, it takes the call ID (pCall_id) as input, then perform all fetches and data manipulations to transform the data. The TRANSFORM_CALL_DETAILS procedure has the following structure.

```
EDI> desc call_details
Name                                         Null?      Type
-----
CALL_ID                                    NOT NULL   VARCHAR2 (64)
CALL_TIMESTAMP                             NOT NULL   TIMESTAMP (6)
CALL_MINUTE_DURATION                       NOT NULL   NUMBER (5,2)
CUST_NO                                     NUMBER
CUST_NAME                                  VARCHAR2 (128)
SIM_CODE1                                  VARCHAR2 (32)
SIM_EXPIRE_DATE                           DATE
SIM_CELL_NO                               VARCHAR2 (16)
DAILED_TO_AREA_CODE                       VARCHAR2 (8)
DAILED_TO_NO                              VARCHAR2 (16)
DAILED_TO_NAME                            VARCHAR2 (128)
CALL_FEES                                  NUMBER (6,2)
REG_NAME                                   VARCHAR2 (128)
EDUL_NAME                                  VARCHAR2 (128)
PROF_DESC                                  VARCHAR2 (128)
CNTRY_NAME                                 VARCHAR2 (128)
PKGT_DESC                                  VARCHAR2 (128)
REP_GROUP                                  VARCHAR2 (8)
OS_USER                                    VARCHAR2 (32)
HOST_NAME                                  VARCHAR2 (32)
OPERATION_TYPE                             VARCHAR2 (16)
OPERATION_TIMESTAMP                       TIMESTAMP (6)

EDI>
```

Create the user-defined data transformation procedure -
TRANSFORM_CALL_DETAILS

```
Create Or Replace Procedure Transform_Call_Details (
    Pcall_Id In Varchar2,
    Pcust_No Out Number,
    Pcust_Name Out Varchar2,
    Psim_Code1 Out Varchar2,
    Psim_Expire_Date Out Date,
    Psim_Cell_No Out Varchar2,
    Pdailed_To_Area_Code Out Varchar2,
    Pdailed_To_No Out Varchar2,
    Pdailed_To_Name Out Varchar2,
    Pcall_Fees Out Number,
    Preg_Name Out Varchar2,
    Pedul_Name Out Varchar2,
    Pprof_Name Out Varchar2,
    Pcntry_Name Out Varchar2,
    Ppkg Desc Out Varchar2) Is
```

```

--
Vcust_No                Number;
Vcust_Name              Varchar2(128);
Vsim_Code1              Varchar2(64);
Vsim_Expire_Date        Date;
Vsim_Cell_No            Varchar2(32);
Vcntry_Area_Code        Varchar2(8);
Vcont_Mobile_No         Varchar2(16);
Vdailed_To_Name         Varchar2(128);
Vreg_Name               Varchar2(128);
Vedul_Name              Varchar2(128);
Vprof_Name              Varchar2(128);
Vcntry_Name              Varchar2(128);
Vpkggt_Desc             Varchar2(132);
Vcall_Min               Number(5,2);
Vpkggt_Call_Fees_Min_Local Number(4,2);
Verr                    Varchar2(2000);
Vline                   Number:=0;

Begin
  Vline := 1;
  Select C.Cust_No, C.Sim_Code1, C.Cntry_Area_Code, C.Cont_Mobile_No,
c.Call_Minute_Duration
  Into Vcust_No, Vsim_Code1, Vcntry_Area_Code, Vcont_Mobile_No, Vcall_Min
  From   Calls C
  Where  C.Call_Id = Pcall_Id;
  Pcust_No := Vcust_No;
  Psim_Code1 := Vsim_Code1;
  Pdailed_To_Area_Code := Vcntry_Area_Code;
  Pdailed_To_No := Vcont_Mobile_No;
  --
  Vline := 2;
  Select Cust_Name Into Vcust_Name
  From   Customers
  Where  Cust_No = Vcust_No;
  Pcust_Name := Vcust_Name;
  --
  Vline := 3;
  Select Sim_Code1 Into Vsim_Code1
  From   Calls
  Where  Call_Id = Pcall_Id;
  Psim_Code1 := Vsim_Code1;
  --
  Vline := 4;
  Select Sim_Expire_Date Into Vsim_Expire_Date
  From   Mobile_Lines
  Where  Sim_Code1 = Vsim_Code1 And
        Cust_No = Vcust_No;
  Psim_Expire_Date:=Vsim_Expire_Date;
  --
  Vline := 5;
  Select Cont_F_Name||' '||Cont_L_Name
  Into   Vdailed_To_Name
  From   Contacts
  Where  Cust_No          = Vcust_No And
        Sim_Code1        = Vsim_Code1 And
        Cntry_Area_Code = Vcntry_Area_Code And
        Cont_Mobile_No   = Vcont_Mobile_No;
  Pdailed_To_Name := Vdailed_To_Name;
  --

```

```

Vline := 6;
Select R.Reg_Name
Into   Vreg_Name
From   Customers C, Regions R
Where  C.Cust_No = Vcust_No And
       C.Reg_Id = R.Reg_Id;
Preg_Name := Vreg_Name;
--
Vline := 7;
Select L.Edul_Name Into Vedul_Name
From   Customers C, Edu_Levels L
Where  C.Cust_No = Vcust_No And
       C.Edul_Id = L.Edul_Id;
Pedul_Name := Vedul_Name;
--
Vline := 8;
Select P.Prof_Name Into Vprof_Name
From   Customers C, Professions P
Where  C.Cust_No = Vcust_No And
       C.Prof_Id = P.Prof_Id;
Pprof_Name := Vprof_Name;
--
Vline := 9;
Select Ct.Cntry_Name Into Vcntry_Name
From   Customers C, Countries Ct
Where  C.Cust_No = Vcust_No And
       C.Cntry_Code = Ct.Cntry_Code;
Pcntry_Name := Vcntry_Name;
--
Vline := 10;
Select P.Pkgt_Desc, P.Pkgt_Call_Fees_Per_Min_Local, s.sim_cell_no Into
Vpkggt_Desc, Vpkggt_Call_Fees_Min_Local, vsim_cell_no
From   Package_Types P, Sims S
Where  P.Pkgt_Code = S.Pkgt_Code And
       S.Sim_Code1 = Vsim_Code1;
Ppkggt_Desc := Vpkggt_Desc;
Pcall_Fees := Round(Vpkggt_Call_Fees_Min_Local * Vcall_Min, 2);
Psim_Cell_No := vsim_cell_no;
Exception
When Others Then
    Verr:= Sqlerrm;
    Insert Into Trans_Log Values ('LINE='||Vline||' -
    '||'CALL_ID='||Pcall_Id||' --> '||Verr);
    Commit;
End

```

Task 2: Grant Database Privileges to Execute the Procedure

Grant execute on the data transformation procedure -
TRANSFORM_CALL_DETAILS, to OGG_ADMIN.

```

EDI> conn osm_repapi/oracle
Connected.

```

```

EDI> grant execute on Transform_call_details to ogg_admin;

Grant succeeded.

EDI>

```

Task 3: Re-Configure the Coordinated Parallel Replicat

Reconfigure the integrated Replicat to call-out the stored procedure and assigning value to the table CALL_DETAILS additional columns.

```

[oracle@edw01 ~]$ cd $OGG_HOME
[oracle@edw01 gghome_1]$ ./ggsci

Oracle GoldenGate Command Interpreter for Oracle
Version 12.3.0.1.0 OGGCORE_12.3.0.1.0_PLATFORMS_170721.0154_FBO
Linux, x64, 64bit (optimized), Oracle 12c on Jul 21 2017 23:31:13
Operating system character set identified as UTF-8.

Copyright (C) 1995, 2017, Oracle and/or its affiliates. All rights reserved.

GGSCI (edw01.mobily.com.sa) 1> info all

Program      Status      Group      Lag at Chkpt  Time Since Chkpt
-----
MANAGER      RUNNING
REPLICAT     RUNNING     RBRM       00:00:00      00:00:03

GGSCI (edw01.mobily.com.sa) 2>

```

```

GGSCI (edw01.mobily.com.sa) 2> edit params RBRM

```

```

REPLICAT RBRM
SETENV (ORACLE_SID = EDI)
SETENV (NLS_LANG = AMERICAN AMERICA.AL32UTF8)
USERID ogg_admin@EDI, PASSWORD oracle
REPERERROR (DEFAULT, DISCARD)
DISCARDFILE /u01/app/oracle/product/12.3.0/gghome_1/dirrpt/RBRM.dsc, PURGE,
megabytes 1000
MAP osm_repapi.REGION, TARGET osm_repapi.REGION;
MAP osm_repapi.PROFESSIONS, TARGET osm_repapi.PROFESSIONS;
MAP osm_repapi.EDU_LEVELS, TARGET osm_repapi.EDU_LEVELS;
MAP osm_repapi.COUNTRIES, TARGET osm_repapi.COUNTRIES;
MAP osm_repapi.PACKAGE_TYPES, TARGET osm_repapi.PACKAGE_TYPES;
MAP osm_repapi.SIMS, TARGET osm_repapi.SIMS;
MAP osm_repapi.CUSTOMERS, TARGET osm_repapi.CUSTOMERS;
MAP osm_repapi.MOBILE_LINES, TARGET osm_repapi.MOBILE_LINES;
MAP osm_repapi.CONTACTS, TARGET osm_repapi.CONTACTS;
MAP osm_repapi.CALLS, TARGET osm_repapi.CALLS;
MAP osm_repapi.CALL_DETAILS, TARGET osm_repapi.CALL_DETAILS, &
  SQLEXEC (SPNAME osm_repapi.Transform_call_details, &

```

```

ID      TCD, &
PARAMS (pCall_id = CALL_ID), &
COLMAP (USEDEFAULTS, &
        CUST_NO = @GETVAL(TCD.pCust_no), &
        CUST_NAME = @GETVAL(TCD.pCust_name), &
        SIM_CODE1 = @GETVAL(TCD.pSim_code1), &
        SIM_EXPIRE_DATE = @GETVAL(TCD.PSIM_EXPIRE_DATE), &
        SIM_CELL_NO = @GETVAL(TCD.PSIM_CELL_NO), &
        DAILED_TO_AREA_CODE =
        @GETVAL(TCD.PDAILED_TO_AREA_CODE), &
        DAILED_TO_NO = @GETVAL(TCD.PDAILED_TO_NO), &
        DAILED_TO_NAME = @GETVAL(TCD.PDAILED_TO_NAME), &
        CALL_FEES = @GETVAL(TCD.PCALL_FEES), &
        REG_NAME = @GETVAL(TCD.PREG_NAME), &
        EDUL_NAME = @GETVAL(TCD.PEDUL_NAME), &
        PROF_DESC = @GETVAL(TCD.PPROF_NAME), &
        CNTRY_NAME = @GETVAL(TCD.PCNTRY_NAME), &
        PKGT_DESC = @GETVAL(TCD.PPKGT_DESC), &
        REP_GROUP= @GETENV('GGENVIRONMENT', 'GROUPNAME'), &
        OS_USER=@GETENV('GGENVIRONMENT', 'OSUSERNAME'), &
        HOST_NAME=@GETENV('GGENVIRONMENT', 'HOSTNAME'), &
        OPERATION_TYPE=@GETENV('GGHEADER', 'OPTYPE'), &
        OPERATION_TIMESTAMP=@GETENV('GGHEADER',
        'COMMITTIMESTAMP'));

```

To activate the data transformation configuration, stop and restart the Replicat.

```

GGSCI (edw01.mobily.com.sa) 10> stop *

Sending STOP request to REPLICAT RBRM ...
Request processed.

GGSCI (edw01.mobily.com.sa) 21> info all

Program      Status      Group      Lag at Chkpt  Time Since Chkpt
MANAGER      RUNNING
REPLICAT     STOPPED    RBRM       00:00:00     00:00:10

GGSCI (edw01.mobily.com.sa) 22> start *

Sending START request to MANAGER ...
REPLICAT RBRM starting

GGSCI (edw01.mobily.com.sa) 24> info all

Program      Status      Group      Lag at Chkpt  Time Since Chkpt
MANAGER      RUNNING
REPLICAT     RUNNING    RBRM       00:00:00     00:00:02

GGSCI (edw01.mobily.com.sa) 25>

```

Task 4: Start the Workload Simulator

Start the workload simulator using the default parameters

```
BRM> conn osm_repapi/oracle
Connected.
BRM> exec call trans load;
```

Task 5: Verify Data Synchronization

Verify data synchronization using SQLPlus or GGSCI report. SQLPlus is used here to verify row incrementing while the workload simulator is running on source (BRM) database.

```
[oracle@dss01 ~]$ cd $OGG_HOME
[oracle@dss01 gghome_1]$ ./ggsci

Oracle GoldenGate Command Interpreter for Oracle
Version 12.3.0.1.0 OGGCORE_12.3.0.1.0_PLATFORMS_170721.0154_FBO
Linux, x64, 64bit (optimized), Oracle 12c on Jul 21 2017 23:31:13
Operating system character set identified as UTF-8.

Copyright (C) 1995, 2017, Oracle and/or its affiliates. All rights reserved.

GGSCI (dss01.mobily.com.sa) 1> info all

Program      Status      Group      Lag at Chkpt  Time Since Chkpt
-----
MANAGER      RUNNING
EXTRACT      RUNNING     EBRM01     00:01:28     00:00:00
EXTRACT      RUNNING     PBRM01     00:00:00     00:00:06

GGSCI (dss01.mobily.com.sa) 2>
```

The target instance...

```
[oracle@edw01 ~]$ cd $OGG_HOME
[oracle@edw01 gghome_1]$ ./ggsci

Oracle GoldenGate Command Interpreter for Oracle
Version 12.3.0.1.0 OGGCORE_12.3.0.1.0_PLATFORMS_170721.0154_FBO
Linux, x64, 64bit (optimized), Oracle 12c on Jul 21 2017 23:31:13
Operating system character set identified as UTF-8.

Copyright (C) 1995, 2017, Oracle and/or its affiliates. All rights reserved.

GGSCI (edw01.mobily.com.sa) 1> info all
```

Program	Status	Group	Lag at Chkpt	Time Since Chkpt
MANAGER	RUNNING			
REPLICAT	RUNNING	RBRM	00:00:00	00:00:01

GGSCI (edw01.mobily.com.sa) 2>

```

EDI> conn osm_repapi/oracle
Connected.
EDI>

```

```

EDI> select count(*) from mobile_lines;

```

```

COUNT (*)
-----
2207

```

```

EDI> /

```

```

COUNT (*)
-----
2213

```

```

EDI> select count(*) from contacts;

```

```

COUNT (*)
-----
1135108

```

```

EDI> /

```

```

COUNT (*)
-----
1139192

```

```

EDI> select count(*) from calls;

```

```

COUNT (*)
-----
402332

```

```

EDI> /

```

```

COUNT (*)
-----
403991

```

```

EDI> select count(*) from call_details;

```

```

COUNT (*)
-----
408793

```

```

EDI> /

```

```

COUNT(*)
-----
410462

EDI>

```

Task 6: Verify Data Transformation

Query data from CALL_DETAILS table.

```

EDI> column CUST_NAME format A20
EDI> column DAILED_TO_NAME format A30
EDI> select count(*) CALLS, CUST_NO, CUST_NAME, DAILED_TO_NAME
2   from   call_details
3   where  rownum < 21
4   group by CUST_NO, CUST_NAME, DAILED_TO_NAME;

```

	CALLS	CUST_NO	CUST_NAME	DAILED_TO_NAME
	1	1001818	Fawzi Q. Alawami	Mohammed Alawami
	1	1001818	Fawzi Q. Alawami	Mohammed Alibrahim
	1	1001818	Fawzi Q. Alawami	Saeed Alswaimil
	1	1001818	Fawzi Q. Alawami	Hassan Alshikhs
	1	1001818	Fawzi Q. Alawami	Nour Alawami
	1	1001818	Fawzi Q. Alawami	Saeed Alamodi
	1	1001818	Fawzi Q. Alawami	Philip Alshammari
	1	1001818	Fawzi Q. Alawami	Saeed Al-Qahtani
	1	1001818	Fawzi Q. Alawami	Abudllah Al-Qahtani
	1	1001818	Fawzi Q. Alawami	Osmah Al-Ghamdi
	1	1001818	Fawzi Q. Alawami	Saeed Alsaihati
	2	1001818	Fawzi Q. Alawami	Osmah Alsaihati
	1	1001818	Fawzi Q. Alawami	Deema Al-Qahtani
	1	1001818	Fawzi Q. Alawami	Deema Alsalem
	1	1001819	Abudllah L. Alawami	Talat Alsuwaidi
	1	1001818	Fawzi Q. Alawami	Hassan Alibrahim
	1	1001818	Fawzi Q. Alawami	Mohammed Alamodi
	1	1001818	Fawzi Q. Alawami	Ali Alshammari
	1	1001818	Fawzi Q. Alawami	Hassan Alsaihati

```

19 rows selected.

EDI>

```

Task 7: Generate Replicat Statistic Report

The following are optional parameters, however; adding them to the Replicat enhances the apply performance.

```

GGSCI (edw01.mobily.com.sa) 2> stats replicat RBRM

```

Sending STATS request to REPLICAT RBRM ...

Parallel Replicat Statistics:

Total transactions	3601268.00
Large transactions	0.00
Total metadata changes	0.00
DDL operations	0.00
Replicated procedures	0.00
Event Actions	0.00
Datatype functionality	0.00
Store Procedures	755415.00
Checkpoint errors	0.00
Transactions retried	0.00

Start of Statistics at 2018-02-05 15:25:55.

Replicating from OSM_REPAPI.CUSTOMERS to OSM_REPAPI.CUSTOMERS:

*** Total statistics since 2018-02-05 14:57:38 ***

Total inserts	754.00
Total updates	0.00
Total deletes	0.00
Total discards	0.00
Total operations	754.00

*** Daily statistics since 2018-02-05 14:57:38 ***

Total inserts	754.00
Total updates	0.00
Total deletes	0.00
Total discards	0.00
Total operations	754.00

*** Hourly statistics since 2018-02-05 15:00:00 ***

Total inserts	694.00
Total updates	0.00
Total deletes	0.00
Total discards	0.00
Total operations	694.00

*** Latest statistics since 2018-02-05 14:57:38 ***

Total inserts	754.00
Total updates	0.00
Total deletes	0.00
Total discards	0.00
Total operations	754.00

Replicating from OSM_REPAPI.SIMS to OSM_REPAPI.SIMS:

*** Total statistics since 2018-02-05 14:57:38 ***

Total inserts	4138.00
Total updates	0.00
Total deletes	0.00
Total discards	0.00
Total operations	4138.00

*** Daily statistics since 2018-02-05 14:57:38 ***

```

Total inserts          4138.00
Total updates          0.00
Total deletes          0.00
Total discards         0.00
Total operations       4138.00

*** Hourly statistics since 2018-02-05 15:00:00 ***
Total inserts          3813.00
Total updates          0.00
Total deletes          0.00
Total discards         0.00
Total operations       3813.00

*** Latest statistics since 2018-02-05 14:57:38 ***
Total inserts          4138.00
Total updates          0.00
Total deletes          0.00
Total discards         0.00
Total operations       4138.00

Replicating from OSM_REPAPI.MOBILE_LINES to OSM_REPAPI.MOBILE_LINES:

*** Total statistics since 2018-02-05 14:57:38 ***
Total inserts          4138.00
Total updates          0.00
Total deletes          0.00
Total discards         0.00
Total operations       4138.00

*** Daily statistics since 2018-02-05 14:57:38 ***
Total inserts          4138.00
Total updates          0.00
Total deletes          0.00
Total discards         0.00
Total operations       4138.00

*** Hourly statistics since 2018-02-05 15:00:00 ***
Total inserts          3813.00
Total updates          0.00
Total deletes          0.00
Total discards         0.00
Total operations       3813.00

*** Latest statistics since 2018-02-05 14:57:38 ***
Total inserts          4138.00
Total updates          0.00
Total deletes          0.00
Total discards         0.00
Total operations       4138.00

Replicating from OSM_REPAPI.CONTACTS to OSM_REPAPI.CONTACTS:

*** Total statistics since 2018-02-05 14:57:38 ***
Total inserts          2077042.00
Total updates          0.00
Total deletes          0.00
Total discards         0.00
Total operations       2077042.00

```

```

*** Daily statistics since 2018-02-05 14:57:38 ***
Total inserts                2077042.00
Total updates                 0.00
Total deletes                 0.00
Total discards                0.00
Total operations              2077042.00

*** Hourly statistics since 2018-02-05 15:00:00 ***
Total inserts                1912524.00
Total updates                 0.00
Total deletes                 0.00
Total discards                0.00
Total operations              1912524.00

*** Latest statistics since 2018-02-05 14:57:38 ***
Total inserts                2077042.00
Total updates                 0.00
Total deletes                 0.00
Total discards                0.00
Total operations              2077042.00

```

Replicating from OSM_REPAPI.CALLS to OSM_REPAPI.CALLS:

```

*** Total statistics since 2018-02-05 14:57:38 ***
Total inserts                754764.00
Total updates                 0.00
Total deletes                 0.00
Total discards                0.00
Total operations              754764.00

*** Daily statistics since 2018-02-05 14:57:38 ***
Total inserts                754764.00
Total updates                 0.00
Total deletes                 0.00
Total discards                0.00
Total operations              754764.00

*** Hourly statistics since 2018-02-05 15:00:00 ***
Total inserts                690390.00
Total updates                 0.00
Total deletes                 0.00
Total discards                0.00
Total operations              690390.00

*** Latest statistics since 2018-02-05 14:57:38 ***
Total inserts                754764.00
Total updates                 0.00
Total deletes                 0.00
Total discards                0.00
Total operations              754764.00

```

Replicating from OSM_REPAPI.CALL_DETAILS to OSM_REPAPI.CALL_DETAILS:

```

*** Total statistics since 2018-02-05 14:57:38 ***
Total inserts                754765.00
Total updates                 0.00
Total deletes                 0.00
Total discards                0.00
Total operations              754765.00

```

```

*** Daily statistics since 2018-02-05 14:57:38 ***
Total inserts          754765.00
Total updates          0.00
Total deletes          0.00
Total discards         0.00
Total operations       754765.00

*** Hourly statistics since 2018-02-05 15:00:00 ***
Total inserts          690392.00
Total updates          0.00
Total deletes          0.00
Total discards         0.00
Total operations       690392.00

*** Latest statistics since 2018-02-05 14:57:38 ***
Total inserts          754765.00
Total updates          0.00
Total deletes          0.00
Total discards         0.00
Total operations       754765.00

```

End of Statistics.

GGSCI (edw01.mobily.com.sa) 3>

Part VIII: Delivering Real-Time BI Applications

Empowers Oracle Database 12c features and options to deliver high-performance real-time Enterprise Data Warehouse Repository, capable to deliver real-time analytical reports engine.

Table 10 lists the tasks associated with Part VIII: Delivering Real-Time BI Applications.

Task No	Description
1	Setting Optimizer Parameters for Data Warehouse Queries
2	Implement 16K block I/O BIGFILE Tablespace
3	Implement Temporary Groups
4	Online Database Structure Partitioning
5	Implement In-Memory Database Option
6	Implement Advanced Compression for DSS
7	Deploy Materialized View for Query Re-Write
8	Deploy In-Memory Materialized View for Query Re-Write
9	Implement Parallel Queries Execution
10	Run the Analytical Applications on BRM
11	Run the Analytical Applications on EDI
12	Compare the Runtime Results

Table 10: Tasks for deploying Real-Time BI Applications

Figure 11 shows the essentials tasks execution.

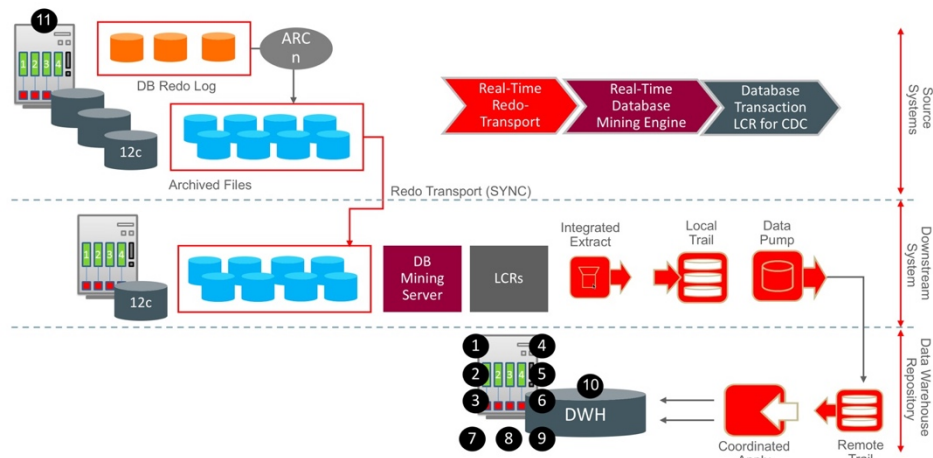


Figure 11: Delivering Real-Time BI Applications

Task 1: Setting Optimizer Parameters for Data Warehouse Queries

Sizing the following essential database parameters enhances query intensive database applications. Perform SPFILE backup, which is handy to use in case you're trapped to start the instance due to parameters set incorrectly.

```
T EDI> conn / as sysdba
Connected.
EDI>
```

```
T EDI> create pfile='/tmp/initEDI.ora' from spfile;

File created.

EDI>
```

In Linux, set large temporary file system that appear as a mounted file system, but one which uses virtual memory instead of a persistent storage device. Update /etc/fstab to make tmpfs size permanent on next reboot.

```
/dev/mapper/vg_edw01-lv_root
/          ext4      defaults        1 1
UUID=8dd2f934-6b7a-43c6-afa5-af4a7a9a971b
/boot      ext4      defaults        1 2
/dev/mapper/vg_edw01-lv_home
/home      ext4      defaults        1 2
/dev/mapper/vg_edw01-lv_swap
swap       swap      defaults        0 0
tmpfs     /dev/shm  tmpfs  size=40g    0 0
devpts     /dev/pts  devpts  gid=5,mode=620 0 0
sysfs      /sys      sysfs   defaults       0 0
proc       /proc     proc    defaults       0 0
```

```
T [oracle@edw01 ~]$ su
Password:
[root@edw01 oracle]# mount -t tmpfs shmfs -o size=40g /dev/shm
[root@edw01 oracle]# exit
```

Set the following Database Parameters, other parameters may be applied to influence the optimizer performance for specific queries.

Parameter	Description
memory_max_target	Specifies the maximum value to which a DBA can set the MEMORY_TARGET initialization parameter.

memory_target	specifies the Oracle system-wide usable memory. The database tunes memory to the MEMORY_TARGET value, reducing or enlarging the SGA and PGA as needed.
db_file_multiblock_read_count	It specifies the maximum number of blocks read in one I/O operation during a sequential scan. The total number of I/Os needed to perform a full table scan depends on such factors as the size of the table, the multiblock read count, and whether parallel execution is being utilized for the operation.
olap_page_pool_size	Specifies (in bytes) the size of the OLAP pool.
star_transformation_enabled	Determines whether a cost-based query transformation will be applied to star queries.

```

EDI> alter system set MEMORY_MAX_TARGET=40G scope=spfile;

System altered.

EDI> alter system set MEMORY_TARGET=16000M scope=spfile;

System altered.

EDI> alter system set db_file_multiblock_read_count=512 scope=spfile;

System altered.

EDI> alter system set olap_page_pool_size=2000M scope=spfile;

System altered.

EDI> alter system set star_transformation_enabled=true scope=spfile;

System altered.

EDI>

```

Restart the database to activate static parameters.

```

EDI> startup force
ORACLE instance started.

Total System Global Area      1.6777E+10 bytes
Fixed Size                    12179616 bytes
Variable Size                  6509561696 bytes
Database Buffers               1.0234E+10 bytes
Redo Buffers                   21372928 bytes
Database mounted.
Database opened.
EDI>

```

Task 2: Implement 16K Block I/O for BIGFILE Tablespace

Enlarging I/O by implementing a large block size. Oracle Database 12c supports up to five block sizes: 2K, 4K, 8K, 16K and 32K. Due to limitation on Linux, a 16K I/O block size is implemented.

```
EDI> alter system set db_16k_cache_size=10G scope=spfile;

System altered.

EDI> startup force
ORACLE instance started.

Total System Global Area          1.6777E+10 bytes
Fixed Size                        12179616 bytes
Variable Size                     5234493280 bytes
Database Buffers                  1.1509E+10 bytes
Redo Buffers                       21372928 bytes
Database mounted.
Database opened.
EDI>
```

Create tablespace dedicated for 16K block size. Notice the tablespace is BIGFILE tablespace, which means the tablespace created using one-and-one data file. The Auto extend option enable the data file extended automatically when it's under space pressure.

```
EDI> create bigfile tablespace OSM_DAT_16K
  2  blocksize 16K
  3  datafile '/u01/app/oracle/oradata/EDI/datafile/OSM_DAT_16K_01.dbf' size
200G
  4  autoextend on;

Tablespace created.

EDI>
```

Make the tablespace OSM_DAT_16K is the default for schema OSM_REPAPI, migrate the relevant BI applications tables to this tablespace.

```
EDI> alter user osm_repapi default tablespace OSM_DAT_16K;

User altered.

EDI> alter user osm_repapi quota unlimited on OSM_DAT_16K;

User altered.

EDI> alter table osm_repapi.call_details move tablespace OSM_DAT_16K;

Table altered.
```

```

EDI> alter table osm_repapi.calls move tablespace OSM_DAT_16K;
Table altered.

EDI> alter table osm_repapi.contacts move tablespace OSM_DAT_16K;
Table altered.

EDI> alter table osm_repapi.mobile_lines move tablespace OSM_DAT_16K;
Table altered.

EDI> alter table osm_repapi.sims move tablespace OSM_DAT_16K;
Table altered.

EDI> alter table osm_repapi.customers move tablespace OSM_DAT_16K;
Table altered.

EDI> alter table osm_repapi.package_types move tablespace OSM_DAT_16K;
Table altered.

EDI>

```

Task 3: Implement Temporary Groups

Temporary group enables temporary space allocation for long running queries demanding temporary sort area.

```

EDI> select file_name from dba_temp_files;

FILE_NAME
-----
/u01/app/oracle/oradata/EDI/datafile/o1_mf_temp_f6p2ppoy_.tmp

EDI> create temporary tablespace temp01
2 tempfile '/u01/app/oracle/oradata/EDI/datafile/temp01_01.dbf' size 500M
3 autoextend on
4 tablespace group temp_ts_group;

Tablespace created.

EDI> alter tablespace temp tablespace group temp_ts_group;

Tablespace altered.

EDI> select * from dba_tablespace_groups;

GROUP_NAME                                TABLESPACE_NAME
-----
TEMP_TS_GROUP                             TEMP
TEMP_TS_GROUP                             TEMP01

```

```

EDI>

EDI> alter user OSM_REPAPI temporary tablespace temp_ts_group;

User altered.

EDI>

```

Task 4: Online Database Structure Partitioning

The following applies table partitioning to the CALL_DETAILS table. Partitioned table delivers better performance, in addition provides a management window for volatile tables. The partitioning key is based on the column CALL_TIMESTAMP year.

```

EDI> desc call_details

```

Name	Null?	Type
CALL_ID	NOT NULL	VARCHAR2 (64)
CALL_TIMESTAMP	NOT NULL	TIMESTAMP (6)
CALL_MINUTE_DURATION		NUMBER (5,2)
CUST_NO		NUMBER
CUST_NAME		VARCHAR2 (128)
SIM_CODE1		VARCHAR2 (32)
SIM_EXPIRE_DATE		DATE
SIM_CELL_NO		VARCHAR2 (16)
DAILED_TO_AREA_CODE		VARCHAR2 (8)
DAILED_TO_NO		VARCHAR2 (16)
DAILED_TO_NAME		VARCHAR2 (128)
CALL_FEES		NUMBER (6,2)
REG_NAME		VARCHAR2 (128)
EDUL_NAME		VARCHAR2 (128)
PROF_DESC		VARCHAR2 (128)
CNTRY_NAME		VARCHAR2 (128)
PKGT_DESC		VARCHAR2 (128)
REP_GROUP		VARCHAR2 (8)
OS_USER		VARCHAR2 (32)
HOST_NAME		VARCHAR2 (32)
OPERATION_TYPE		VARCHAR2 (16)
OPERATION_TIMESTAMP		TIMESTAMP (6)

```

EDI>

```

DBMS_REDEFINITION PL/SQL API enables online table re-organization, such as migration of non-partitioned table to partitioned table as illustrated below.

- Check the table CALL_DETAILS can be re-defined, if the call successfully completed, then the table is re-definable.

```

EDI> begin
2   dbms_redefinition.can_redef_table (
3       'OSM_REPAPI', 'CALL_DETAILS');

```

```

4  end;
5  /

PL/SQL procedure successfully completed.

EDI>

```

- Create the interim table – CALL_DETAILS2, which has the new structure to enable partitioned table.

```

EDI> create table call_details2 (
2      CALL_ID          varchar2(64) primary key,
3      CALL_TIMESTAMP    timestamp not null,
4      CALL_MINUTE_DURATION number(5,2) not null,
5      CUST_NO           number,
6      CUST_NAME          varchar2(128),
7      SIM_CODE1          varchar2(32),
8      SIM_EXPIRE_DATE    date,
9      SIM_CELL_NO        varchar2(16),
10     DAILED_TO_AREA_CODE varchar2(8),
11     DAILED_TO_NO        varchar2(16),
12     DAILED_TO_NAME      varchar2(128),
13     CALL_FEES           number(6,2),
14     REG_NAME            varchar2(128),
15     EDUL_NAME           varchar2(128),
16     PROF_DESC           varchar2(128),
17     CNTRY_NAME          varchar2(128),
18     PKGT_DESC           varchar2(128),
19     REP_GROUP           varchar2(8),
20     OS_USER             varchar2(32),
21     HOST_NAME           varchar2(32),
22     OPERATION_TYPE      varchar2(16),
23     OPERATION_TIMESTAMP timestamp)
24 partition by range(CALL_TIMESTAMP)
25 (partition p2010 values less than (to_date('01-1-2011', 'DD-MM-YYYY')),
26  partition p2011 values less than (to_date('01-1-2012', 'DD-MM-YYYY')),
27  partition p2012 values less than (to_date('01-1-2013', 'DD-MM-YYYY')),
28  partition p2013 values less than (to_date('01-1-2014', 'DD-MM-YYYY')),
29  partition p2014 values less than (to_date('01-1-2015', 'DD-MM-YYYY')),
30  partition p2015 values less than (to_date('01-1-2016', 'DD-MM-YYYY')),
31  partition p2016 values less than (to_date('01-1-2017', 'DD-MM-YYYY')),
32  partition p2017 values less than (to_date('01-1-2018', 'DD-MM-YYYY')),
33  partition p2018 values less than (to_date('01-1-2019', 'DD-MM-YYYY')),
34  partition p2019 values less than (MAXVALUE));

Table created.

EDI>

```

- Start the redefinition process

```

EDI> begin
2      dbms_redefinition.start_redef_table (
3      'OSM_REPAPI', 'CALL_DETAILS', 'CALL_DETAILS2');
4  end;
5  /

```

```
PL/SQL procedure successfully completed.
```

```
EDI>
```

- Synchronized the new table with data. This may take time when the table has large number of rows.

```
EDI> begin
2   dbms_redefinition.sync_interim_table(
3       'OSM_REPAPI', 'CALL_DETAILS', 'CALL_DETAILS2');
4 end;
5 /
```

```
PL/SQL procedure successfully completed.
```

```
EDI>
```

```
EDI> select count(*) from call_details2;
```

```
COUNT(*)
-----
4523156
```

```
EDI>
```

- Copy dependent objects.

```
EDI> declare
2   x binary_integer;
3 begin
4   dbms_redefinition.copy_table_dependents(
5       uname=>'OSM_REPAPI',
6       orig_table=>'CALL_DETAILS',
7       int_table=>'CALL_DETAILS2',
8       copy_indexes=>1,
9       num_errors=>x);
10 end;
11 /
declare
*
ERROR at line 1:
ORA-01442: column to be modified to NOT NULL is already NOT NULL
ORA-06512: at "SYS.DBMS_REDEFINITION", line 2074
ORA-06512: at "SYS.DBMS_REDEFINITION", line 2074
ORA-06512: at "SYS.DBMS_REDEFINITION", line 1608
ORA-06512: at "SYS.DBMS_REDEFINITION", line 1487
ORA-06512: at "SYS.DBMS_REDEFINITION", line 408
ORA-06512: at "SYS.DBMS_REDEFINITION", line 1480
ORA-06512: at "SYS.DBMS_REDEFINITION", line 2056
ORA-06512: at "SYS.DBMS_REDEFINITION", line 3115
ORA-06512: at "SYS.DBMS_REDEFINITION", line 5578
ORA-06512: at line 4
```

```
EDI>
```

- Complete the redefinition

```
EDI> begin
2   dbms_redefinition.finish_redef_table(
3       'OSM_REPAPI', 'CALL_DETAILS', 'CALL_DETAILS2');
4   end;
5   /
```

PL/SQL procedure successfully completed.

```
EDI>
```

- Verify table is partitioned

```
EDI> select PARTITIONED
2   from user_tables
3  where table_name='CALL_DETAILS';
```

PAR

YES

```
EDI>
```

- Drop the interim table

```
EDI> drop table call_details2;
```

Table dropped.

```
EDI>
```

Task 5: Implement In-Memory Database Option

The implementation of the database in-memory option enables BI application to run from the memory.

```
EDI> alter system set inmemory_size=8G scope=spfile;
```

System altered.

```
EDI> startup force
```

ORACLE instance started.

Total System Global Area	1.7180E+10 bytes
Fixed Size	8641256 bytes
Variable Size	5570037016 bytes
Database Buffers	838860800 bytes
Redo Buffers	24911872 bytes

```
In-Memory Area          1.0737E+10 bytes
Database mounted.
Database opened.
EDI>
```

Task 6: Implement Advanced Compression for DSS

Advanced compression compress space and enhances the query performance. Enable compression on table CALLS_DETAILS.

```
EDI> alter table osm_repapi.call_details
2   compress;

Table altered.

EDI>
```

Task 7: Deploy Materialized View for Query Re-Write

By deploying materialized views, query performance drastically enhanced. Instead of retrieving data from a relational table, the data is retrieved from the result of the query stored on disk or memory.

The original query shows TABLE ACCESS FULL, after deploying the materialized view, the result of the query is retrieved from the materialized view, which reduce the execution steps, hence better performance achieved.

```
EDI> alter system flush shared_pool;

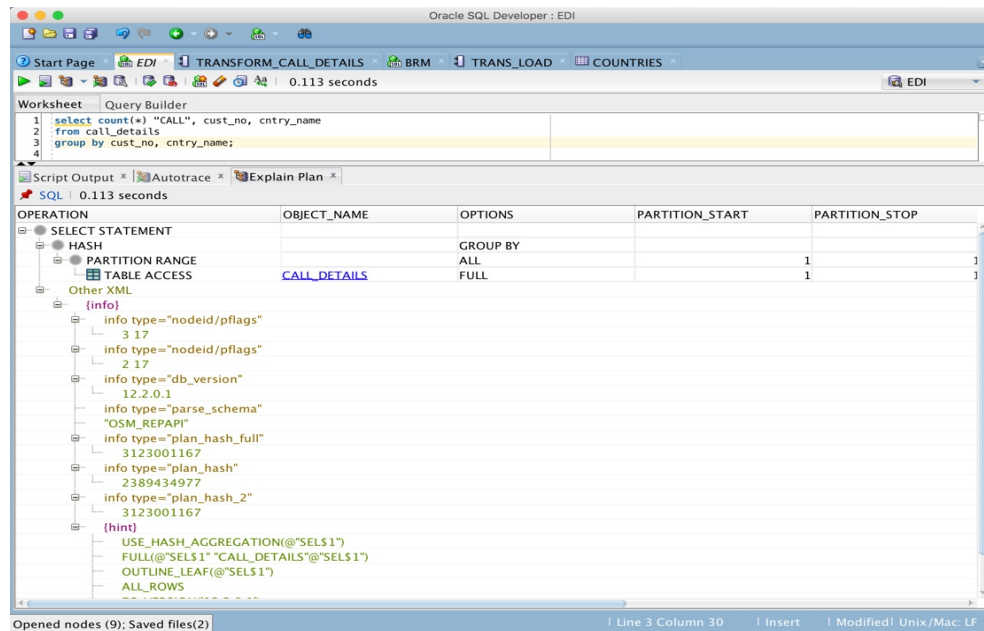
System altered.

EDI> alter system flush buffer_cache;

System altered.

EDI>
```

```
EDI> select count(*) "CALL", cust_no, cntry_name
2   from   call_details
3  group by cust_no, cntry_name
4  /
```



The execution plan shows a TABLE ACCESS operation on PARTITION RANGE.

Create the materialized view Log on tables referenced by
CALL_DETAILS_BY_CUST_CNTRY.

```
EDI> create materialized view log on call_details
2 with rowid, sequence (cust_no, cntry_name)
3 including new values;
```

Materialized view log created.

```
EDI>
```

Create the materialized view CALL_DETAILS_BY_CUST_CNTRY.

```
EDI> create materialized view call_details_by_cust_cntry
2 REFRESH FAST ON DEMAND
3 ENABLE QUERY REWRITE
4 ENABLE ON QUERY COMPUTATION
5 AS
6 select count(*) "CALL", cust_no, cntry_name
7 from call_details
8 group by cust_no, cntry_name
9 /
```

Materialized view created.

```
EDI>
```

Gather data dictionary statistics

```
EDI> begin
2    dbms_stats.gather_table_stats(
3        ownname=>'OSM_REPAPI',
4        tabname=>'call_details_by_cust_cntry');
5    end;
6    /
```

PL/SQL procedure successfully completed.

EDI>

```
EDI> alter system flush shared_pool;
```

System altered.

```
EDI> alter system flush buffer_cache;
```

System altered.

EDI>

Execute the query and observe the execution plan.

The screenshot shows the Oracle SQL Developer interface. The top pane displays a query: `select count(*) "CALL", cust_no, cntry_name from call_details group by cust_no, cntry_name;`. The bottom pane shows the execution plan for this query. The plan is a full table scan of the `CALL_DETAILS_BY_CUST_CNTRY` table. The plan details are as follows:

OPERATION	OBJECT_NAME	OPTIONS	CARDINALITY	COST
SELECT STATEMENT				9
MAT_VIEW REWRITE ACCESS	CALL_DETAILS_BY_CUST_CNTRY	FULL	6246	9

The plan also includes a tree view of the execution steps, showing the full table scan and the resulting cardinality and cost. The plan is labeled as `SQL` and took `0.062 seconds` to execute. The bottom status bar indicates `Opened nodes (9); Saved files(2)`.

Task 8: Deploy In-Memory Materialized View for Query Re-Write

This further enhances the queries performance, enabling Real-Time BI Applications.

```
EDI> alter materialized view osm_repapi.call_details_by_cust_cntry
2   inmemory
3   memcompress for capacity high priority high;

Materialized view altered.

EDI> exec dbms_mview.refresh('osm_repapi.call_details_by_cust_cntry');

PL/SQL procedure successfully completed.

EDI>
```

Re-run the query and observe the execution plan. Notice the Query elapsed execution time is 0 seconds.

Oracle SQL Developer : EDI

Start Page | EDI | TRANSFORM_CALL_DETAILS | BRM | TRANS_LOAD | COUNTRIES | 0 seconds

Worksheet | Query Builder

```
1 select count(*) "CALL", cust_no, cntry_name
2 from call_details
3 group by cust_no, cntry_name;
```

Script Output | Autotrace | Explain Plan | SQL | 0 seconds

OPERATION	OBJECT_NAME	OPTIONS	CARDINALITY	COST
SELECT STATEMENT				6246
MAT_VIEW REWRITE ACCESS	CALL_DETAILS_BY_CUST_C...	INMEMORY FULL	6246	1

Other XML

info type="db_version"

12.2.0.1

info type="parse_schema"

"OSM_REPAPI"

info type="plan_hash_full"

653830240

info type="plan_hash"

info type="plan_hash_2"

653830240

cost=1

(hint)

FULL(@SEL\$117BF4B3 "CALL_DETAILS_BY_CUST_CNTRY"@SEL\$F99C6F56)

OUTLINE(@SEL\$1)

REWRITE(@SEL\$1 "CALL_DETAILS_BY_CUST_CNTRY")

OUTLINE(@SEL\$DDD2B3FC)

REWRITE(@SEL\$DDD2B3FC "CALL_DETAILS_BY_CUST_CNTRY")

OUTLINE_LEAF(@SEL\$117BF4B3)

ALL_ROWS

DB_VERSION('12.2.0.1')

OPTIMIZER_FEATURES_ENABLE('12.2.0.1')

IGNORE_OPTIM_EMBEDDED_HINTS

Opened nodes (9); Saved files(2) | Line 3 Column 30 | Insert | Modified | Unix/Mac: LF

Task 9: Implement Parallel Queries Execution

For specific load process, parallel execution speed up the execution of long-running queries.

```
EDI> commit;

Commit complete.

EDI> alter session force parallel DML
2 parallel 8;

Session altered.

EDI> alter session force parallel query
2 parallel 8;

Session altered.

EDI>
```

Task 10: Run the Analytical Applications on BRM

Run the query, evaluate the execution plan.

```
BRM> select count(*), cust_no, cont_mobile_no
2   from   contacts
3   group by cust_no, cont_mobile_no;
```

```
BRM> alter system flush shared_pool;
```

System altered.

```
BRM> alter system flush buffer_cache;
```

System altered.

```
BRM>
```

The screenshot shows the Oracle SQL Developer interface. The top toolbar includes icons for file operations, editing, and execution. The main window is titled 'Oracle SQL Developer : BRM'. Below the toolbar, there's a 'Worksheet' tab with a query editor containing the following SQL:

```
1 select count(*), cust_no, cont_mobile_no
2   from   contacts
3   group by cust_no, cont_mobile_no;
```

The 'Query Builder' tab is also visible. Below the query editor, the 'Explain Plan' tab is active, showing the execution plan for the query. The plan is displayed in a table with columns: OPERATION, OBJECT_NAME, OPTIONS, CARDINALITY, and COST.

OPERATION	OBJECT_NAME	OPTIONS	CARDINALITY	COST
SELECT STATEMENT				97294
HASH		GROUP BY		726
TABLE ACCESS	CONTACTS	FULL	97294	205

Below the table, there's a tree view showing the execution plan details. The tree includes information about the database version (11.2.0.3), the schema (OSM_REPAI), the plan hash (2505073297), and the plan hash 2 (528648520). A hint is also shown: `USE_HASH_AGGREGATION(@"SEL$1")`. The cost of the plan is highlighted as `COST=205`.

Task 11: Run the Analytical Applications on EDI

Run the query, evaluate the execution plan. Notice the execution plan indicates the query performed using the following features:

- Parallel Query Execution
- In-Memory Materialized view
- Advanced Compression

Let's begin without advanced configuration

Oracle SQL Developer : EDI

Start Page | EDI | TRANSFORM_CALL_DETAILS | BRM | TRANS_LOAD | COUNTRIES

0.115 seconds

Worksheet | Query Builder

```

1 select count(*), cust_no, cont_mobile_no
2 from contacts
3 group by cust_no, cont_mobile_no;
4

```

Script Output x | Autotrace x | Explain Plan x

SQL | 0.115 seconds

OPERATION	OBJECT_NAME	OPTIONS	CARDINALITY	COST
SELECT STATEMENT				1976882
HASH		GROUP BY		13368
TABLE ACCESS	CONTACTS	COST=2864		1976882

Other XML

```

{info}
  info type="db_version"
    12.2.0.1
  info type="parse_schema"
    "OSM_REPAI"
  info type="plan_hash_full"
    528648520
  info type="plan_hash"
    2505073297
  info type="plan_hash_2"
    528648520
{hint}
  USE_HASH_AGGREGATION(@"SEL$1")
  FULL(@"SEL$1" "CONTACTS"@"SEL$1")
  OUTLINE_LEAF(@"SEL$1")
  ALL_ROWS
  DB_VERSION("12.2.0.1")
  OPTIMIZER_FEATURES_ENABLE("12.2.0.1")
  IGNORE_OPTIM_EMBEDDED_HINTS

```

Opened nodes (9); Saved files(2)

Line 3 Column 34 | Insert | Modified | Unix/Mac: LF

Now, enable advanced configuration

Create the materialized view

```

EDI> create materialized view log on contacts
2 with rowid, sequence (cust_no, cont_mobile_no)
3 including new values;

```

Materialized view log created.

EDI>

```

EDI> create materialized view CountContactMV
2 REFRESH FAST ON DEMAND
3 ENABLE QUERY REWRITE

```

```

4  ENABLE ON QUERY COMPUTATION
5  AS
6  select count(*), cust_no, cont_mobile_no
7  from    contacts
8  group by cust_no, cont_mobile_no;

```

Materialized view created.

EDI>

Gather data dictionary statistics

```

EDI> begin
2    dbms_stats.gather_table_stats(
3        ownname=>'OSM_REPAPI',
4        tabname=>'CountContactMV');
5  end;
6  /

```

PL/SQL procedure successfully completed.

EDI>

Enable in-memory feature

```

EDI> alter materialized view osm_repapi.CountContactMV
2  inmemory
3  memcompress for capacity high priority high;

```

Materialized view altered.

EDI>

Refresh the materialized view, this may take time.

```

EDI> exec dbms_mview.refresh('osm_repapi.CountContactMV');

```

PL/SQL procedure successfully completed.

EDI>

```

EDI> alter system flush shared_pool;

```

System altered.

```

EDI> alter system flush buffer_cache;

```

System altered.

EDI>

Re-run the query

Oracle SQL Developer : EDI

Start Page | EDI | TRANSFORM_CALL_DETAILS | BRM | TRANS_LOAD | COUNTRIES

0 seconds

Worksheet | Query Builder

```

1 select count(*), cust_no, cont_mobile_no
2 from contacts
3 group by cust_no, cont_mobile_no;
4

```

Script Output | Autotrace | Explain Plan

SQL | 0 seconds

OPERATION	OBJECT_NAME	OPTIONS	CARDINALITY	COST
SELECT STATEMENT			17213477	730
MAT_VIEW REWRITE ACCESS	COUNTCONTACTMV	INMEMORY FULL	17213477	730

Other XML

```

{info}
  info type="db_version"
    12.2.0.1
  info type="parse_schema"
    "OSM_REPAPI"
  info type="plan_hash_full"
    2126189475
  info type="plan_hash"
    652088532
  info type="plan_hash_2"
    2126189475
{hint}
  FULL(@SEL$B067469B "COUNTCONTACTMV"@SEL$324F16CD)
  OUTLINE(@SEL$1)
  REWRITE(@SEL$1 "COUNTCONTACTMV")
  OUTLINE(@SEL$FAE885B7)
  REWRITE(@SEL$FAE885B7 "COUNTCONTACTMV")
  OUTLINE_LEAF(@SEL$B067469B)
  ALL_ROWS
  DB_VERSION('12.2.0.1')
  OPTIMIZER_FEATURES_ENABLE('12.2.0.1')
  IGNORE_OPTIM_EMBEDDED_HINTS

```

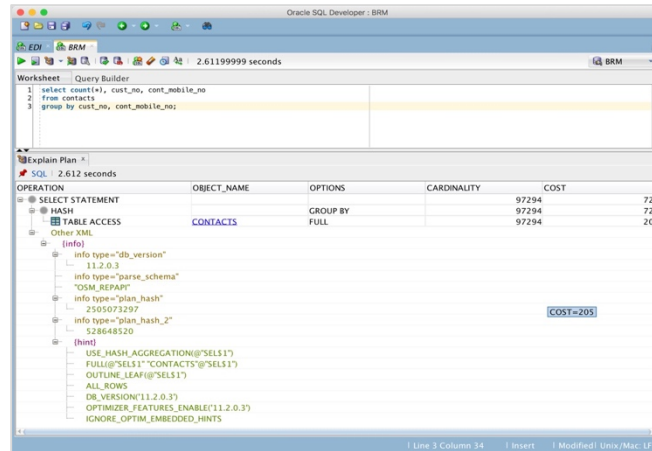
Opened nodes (9); Saved files(2)

Line 3 Column 34 | Insert | Modified | Unix/Mac: LF

Task 12: Compare the Runtime Results

The result is amazing, the execution ratio is by far faster on the EDI instance than on the BRM instance.

The BRM instance execution plan shows execution time of:
2.612 Seconds.



Oracle SQL Developer : BRM

Worksheet : Query Builder

```
1 select count(*), cust_no, cont_mobile_no
2 from contacts
3 group by cust_no, cont_mobile_no
```

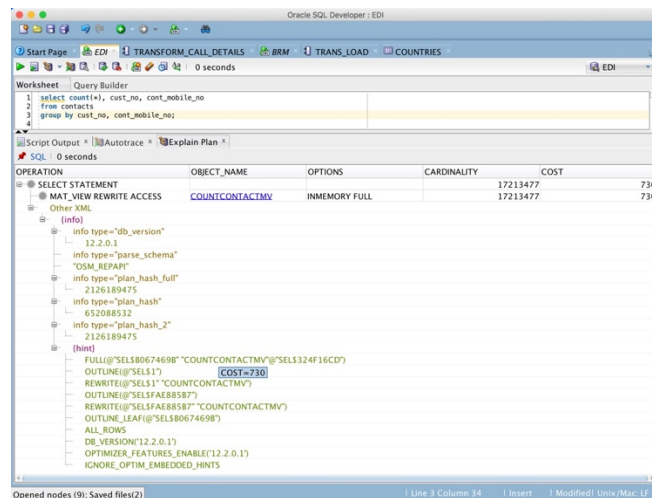
SQL : 2.612 seconds

OPERATION	OBJECT_NAME	OPTIONS	CARDINALITY	COST
SELECT STATEMENT				97294
HASH GROUP BY		GROUP BY		97294
TABLE ACCESS	CONTACTS	FULL		205

Other XML

- info type="db_version"11.2.0.3
- info type="parse_schema"OSM.REPAP
- info type="plan_hash"2505073297
- info type="plan_hash_2"528648520
- info type="plan_hash_3"528648520
- hintUSE_HASH_AGGREGATION(@"SEL\$1")FULL(@"SEL\$1" "CONTACTS"@"SEL\$1")OUTLINE_LEAF(@"SEL\$1")ALL_ROWSDB_VERSION("11.2.0.3")OPTIMIZER_FEATURES_ENABLE("11.2.0.3")IGNORE_OPTIM_EMBEDDED_HINTS

The EDI instance execution plan shows execution time of:
0 Seconds.



Oracle SQL Developer : EDI

Worksheet : Query Builder

```
1 select count(*), cust_no, cont_mobile_no
2 from contacts
3 group by cust_no, cont_mobile_no
```

SQL : 0 seconds

OPERATION	OBJECT_NAME	OPTIONS	CARDINALITY	COST
SELECT STATEMENT				730
MAT_VIEW REWRITE ACCESS	COUNTCONTACTMV	INMEMORY FULL	17213477	730

Other XML

- info type="db_version"12.2.0.1
- info type="parse_schema"OSM.REPAP
- info type="plan_hash"2126189475
- info type="plan_hash_2"65208532
- info type="plan_hash_3"2126189475
- hintFULL(@"SEL\$B067469B" "COUNTCONTACTMV"@"SEL\$324F16CD")OUTLINE(@"SEL\$1")REWRITE(@"SEL\$1" "COUNTCONTACTMV")OUTLINE(@"SEL\$FAE885B7")REWRITE(@"SEL\$FAE885B7" "COUNTCONTACTMV")OUTLINE_LEAF(@"SEL\$B067469B")ALL_ROWSDB_VERSION("12.2.0.1")OPTIMIZER_FEATURES_ENABLE("12.2.0.1")IGNORE_OPTIM_EMBEDDED_HINTS

Summary

The development of an Enterprise Data Warehouse (EDW) project empowers several major Oracle products. Figure 12 depicts the EDW building block of highly interconnected Oracle software, some of which are vital to EDW while others are highly recommended.

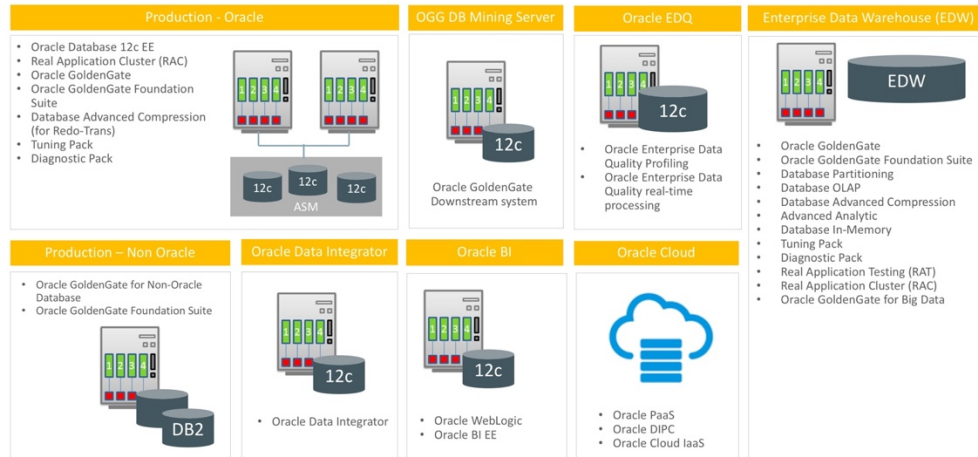


Figure 12: List of EDW Software

Table 11 lists Oracle software used to develop this Pilot.

Software	Comments
Oracle Linux 6 update 9	Operating System
Oracle Database 11g	Source Database
Oracle Database 12c	Downstream and target Systems
Oracle GoldenGate 12c	Downstream and target Systems
Oracle Database Partitioning	Target System
Oracle Database In-Memory option	Target System
Oracle Database 12c OLAP	Target System
Oracle Database 12c Advanced Compression	Target System
Oracle SQL Developer	Source and Target Systems

Table 11: List of Oracle Software

Oracle Linux

Oracle Linux Oracle Linux provides an innovative and secure open cloud IT infrastructure with support for major hardware platforms and applications. Ksplice

provides security with continuous patches to your kernel and user space without downtime.

Oracle Database 11g

Oracle Database 11g Enterprise Edition provides comprehensive features to manage the most demanding transaction processing, big data, and data warehouse workloads.

Oracle Database 12c

Oracle Database 12c Release 2 was built to transform the access and value of enterprise data of your business. Designed for the cloud, Oracle Database 12c allows you to lower IT costs, increase agility in provisioning database services, and elastically scale up, scale out, and scale down IT resources as needed.

Oracle GoldenGate 12c

Oracle GoldenGate 12c Low-impact, real-time change data capture, distribution, and delivery for transactional data across heterogeneous systems for continuous availability, zero downtime migration, and business intelligence.

Oracle Database Partitioning

Oracle Partitioning enhances database manageability, performance, and availability for a wide variety of applications. Oracle Partitioning allows tables, indexes, and index-organized tables to be subdivided into smaller pieces and managed cost-effectively on different disk storage tiers with a finer level of granularity to improve access performance.

Oracle Database 12c In-Memory

Oracle Database In-Memory delivers leading-edge in-memory performance without the need to restrict functionality or accept compromises, complexity and risk. Deploying Oracle Database In-Memory with virtually any existing Oracle Database compatible application is as easy as flipping a switch making it the most enterprise-strength offering in the industry.

Oracle Database 12c OLAP

Oracle OLAP delivers advanced multidimensional analytic capabilities within Oracle Database 12c. It's designed to provide excellent query performance, fast incremental updates of data sets, efficient management of summary data, and rich analytic content.

Oracle Database 12c Advanced Compression

Oracle Advanced Compression helps businesses manage data growth more cost-effectively by automating data management processes that maximize resource utilization with compression rates of 2 to 4x across all types of data and applications, saving disk space and improving query performance. Oracle Database 12c Advanced Row Compression reduces storage footprint, saving disk space and costs while improving query performance.

Oracle SQL Developer

An Oracle Database GUI interface, it allows you to manipulate the database, browse database objects and develop SQL application. One of the major developer tools provided by SQL Developer is the execution plan generation. It allows the developers to deliver high-performance applications by comparing the execution plan performance by viewing an in-depth execution plan.



Oracle Corporation, World Headquarters
Oracle Parkway 500
Redwood Shores, CA 94065, USA
www.oracle.com

Worldwide Inquiries

Phone: +1.650.506.7000
Fax: +1.650.506.7200



Copyright © 2014, Oracle and/or its affiliates. All rights reserved. This document is provided for information purposes only, and the contents hereof are subject to change without notice. This document is not warranted to be error-free, nor subject to any other warranties or conditions, whether expressed orally or implied in law, including implied warranties and conditions of merchantability or fitness for a particular purpose. We specifically disclaim any liability with respect to this document, and no contractual obligations are formed either directly or indirectly by this document. This document may not be reproduced or transmitted in any form or by any means, electronic or mechanical, for any purpose, without our prior written permission.

Oracle and Java are registered trademarks of Oracle and/or its affiliates. Other names may be trademarks of their respective owners.

Intel and Intel Xeon are trademarks or registered trademarks of Intel Corporation. All SPARC trademarks are used under license and are trademarks or registered trademarks of SPARC International, Inc. AMD, Opteron, the AMD logo, and the AMD Opteron logo are trademarks or registered trademarks of Advanced Micro Devices. UNIX is a registered trademark of The Open Group. 0315

Connect with us

- facebook.com/oracledataintegration
- twitter.com/orclgoldengate
- blogs.oracle.com/dataintegration
- oracle.com/goto/oraclegoldengate