Oracle GoldenGate Technical Deep Dive

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Oracle ACE
Oracle Certified Master (OCM)
Oracle ACE Spotlight – June 2016

New York Oracle User Group (NYOUG) 7th Dec 2016
Y V RAVI KUMAR

- **Oracle Certified Master (OCM)** – May 2009
- **Oracle ACE** – May 2015
- **Oracle ACE Spotlight for the month** - Jun 2016
- “Community Expert” in DELL’s Toad World
- “Expert” in Oracle Technology Network (OTN) community

**Oracle Speaker @**
- Oracle Technology Network (OTN)
- New York Oracle User Group (NYOUG)
- Independent Oracle User Group (IOUG)
- Sangam (Largest Oracle Event in India)
- All India Oracle User Group (AIOUG)

**Author of 70+ articles**
- Oracle Technology Network (OTN)
- Toad World - Connected-Driven Innovation
- OTech Magazine
- All things ORACLE from Redgate
- UKOUG Library

**ORACLE CERTIFICATIONS**
- Oracle Database 10g: Certified Master (10g OCM)
- Oracle Database 10g & 11g: Administering RAC Certified Expert
- Oracle Database 11g: Performance Tuning Certified Expert
- Oracle Exadata 11g Essentials
- Oracle Golden Gate 10 Essentials
- Oracle Database 11g: SQL Tuning Certified Expert
- Oracle 9i & 10g: Managing Oracle on Linux Certified Expert
- Oracle Certified Professional (OCP) – Oracle 12c, 11g, 10g, 9i and 8i
- SUN Certified – Solaris System Administrator in SUN Solaris 9
ORACLE GOLDENGATE 11g/12c

Introduction
Quick History in Replication

Change Data Capture (CDC)
  • Synchronous
  • Asynchronous

Oracle Advance Replication
  • Multi-Master Replication
  • MV Replication

Oracle Streams
  • Capture Messages
  • Staging Messages
  • Consumption

Oracle GoldenGate
  • Heterogeneous
  • Multiple Architectures
  • Multiple Use Cases
Database Replication Options

- ORACLE®
  - Data Guard
  - Active Data Guard

- IBM
  - InfoSphere Change Data Capture for Oracle Replication

- Dbvisit

- ORACLE®
  - Fusion Middleware 12c
  - GoldenGate

- Dell Software
  - SharePlex

- continuant
  - Storage Replication Software
  - HP XP Continuous Access Software
Oracle Golden Gate provides **low-impact capture, routing, transformation**, and delivery of database transactions across heterogeneous environments in near-real time.

Oracle Golden Gate enables the exchange and manipulation of data at the transaction level among multiple, **heterogeneous platforms** across the enterprise.

Oracle Golden Gate moves **committed transactions from redo logs** and maintains transaction integrity with sub-second latency.
Oracle GoldenGate – Supported Platforms

Choice can be made from 2 types of Oracle GoldenGate (OGG):

**Supported Databases**
- Oracle
- IBM DB2
- MySQL
- Sybase
- Teradata
- Microsoft SQL Server

**Supported Operating Systems**
- AIX
- z/OS
- iSeries
- z/Linux
- Solaris
- IBM
- HP UX
- Windows
- red hat Linux
- SUSE

Always check the latest Certification Matrix
Topologies
ORACLE GOLDENGATE TOPOLOGIES

Patterns
ORACLE GOLDEN GATE TOPOLOGIES

- Broadcast Data Distribution
- Cascading Datamarts
- Integration / Consolidation Data Warehouse
ORACLE GOLDEN GATE TOPOLOGIES

Patterns

<table>
<thead>
<tr>
<th>UNIDIRECTIONAL QUERY OFFLOADING</th>
<th>BIDIRECTIONAL STANDBY DB OR ACTIVE-ACTIVE FOR HIGH-AVAILABILITY</th>
<th>PEER-TO-PEER LOAD BALANCING, MULTIMASTER</th>
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<tbody>
<tr>
<td><img src="image1.png" alt="Diagram" /></td>
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Patterns
Benefits Of Oracle GoldenGate

- **High Availability (Standby Database)**
  - Load balancing
  - Application Specific HA

- **Zero Down-Time Upgrades and Migrations**
  - Consolidations
  - Database Migrations / Upgrades
    - Platform Migrations (e.g. HP-UX to Linux)
    - Database Upgrades
    - Homogeneous & Heterogeneous
  - Application Upgrades (e.g. Siebel 7 -> Siebel 8)
  - Application Releases (special use cases)

- **Live Reporting (Reporting Database)**
  - Off load reports to a separate system

- **Operational Business Intelligence**

- **Transactional Data Integration**
Oracle GG is a middleware product designed to work in a heterogeneous environment with different databases.

Oracle GG moves only committed data across platforms where as Oracle database, which writes committed and uncommitted changes to the redo logs.

Moves across a TCP/IP network and does not require Oracle Net.

Oracle GG will not provide automatic failover like Oracle DG.

Oracle GG uses its own Commit Sequence Number (CSN) to identify a transaction which based on the Oracle Database SCN (System Change Number).

Complete data recoverability via trail files.
Oracle Golden Gate Solutions for Oracle Database

- Migrate from non-Oracle databases to Oracle 12c
- Upgrade Oracle Database versions 8i, 9i, 10g or 11g to 12c
- Upgrade or migrate the database server or operating system
- Perform database maintenance
Oracle GoldenGate Solutions for Oracle Database

- Eliminate Down-Time During Oracle Database Upgrades
- Eliminate Unplanned Down-Time With Active Data Guard
- Improve Production System Performance
- Real-Time Reporting from a Lower-Cost System
- Increase ROI On Existing Servers and Synchronize Global Data
- Capture can be offloaded from the source DB to an intermediate host by copying the redo logs
ORACLE GOLDEN GATE LOGICAL ARCHITECTURE

DATA SOURCE FOR INITIAL LOAD: SOURCE TABLES

DATA SOURCE CHANGE SYNCHRONIZATION: TRANSACTION LOG

EXTRACT → MANAGER

INITIAL LOAD → REPLICAT

REPLICAT → COLLECTOR

COLLECTOR → DATA PUMP

DATA PUMP → MANAGER

MANAGER → NETWORK

NETWORK → MANAGER

TRANSACTION LOG (OPTIONAL)

CHANGE SYNCHRONIZATION

TRAIL OR FILE
Oracle GoldenGate 12c – Source and Target

SERVER: Golden Gate 1 (Source)

DATABASE: ORACLE

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LGWR Process

Writes database

Changes to redo log files

Online Redo

Log Files

GoldenGate extract process (HREXT)
only reads redo for HR schema

Extract

Writes

HR schema changes to

GoldenGate Trail Files

File grows until records are processed

Reads Trail Files

Reads

Trail Files

GoldenGate data pump process

Reads

Trail Files

Extracts

Writes to collectors

(database)

SERVER: Golden Gate 2 (Target)

DATABASE: ORACLE

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Changes written to HR Schema

GoldenGate Replicat (RPHR01) process

GoldenGate Collector process

Reads Trail Files

Trail files grow until data processed

Writes to Trail Files

GoldenGate Data Pump writes

Internet
Oracle GoldenGate 12c – Source and Target

SERVER: GoldenGate 1 (Source)

DATABASE: ORACLE

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Changes to redo log files

Online Redo Log Files

Reads redo log files

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Reads Trail Files

File grows until records are processed

GoldenGate data pump process

SERVER: GoldenGate 2 (Target)

DATABASE: ORACLE

SCHEMAS

| SYS |
| HR |

Changes written to HR Schema

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Trail files grow until data processed

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- Changes to redo log files

Log Files

Online Redo

GoldenGate extract process (HREXT)

- only reads redo for HR schema

Extract Trail Files

File grows until changes to HR schema are processed

**SERVER: Golden Gate 2 (Target)**

**DATABASE: ORACLE**

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Changes written to HR Schema

GoldenGate Replicat (RPHR01) process

GoldenGate Collector process

Trail files grow until data processed

Reads Trail Files

Writes to Trail Files

GoldenGate Data Pump writes
Checkpoints
CHECKPOINTS - CAPTURE

SOURCE DATABASE

- BEGIN : TX1
- INSERT : TX1
- BEGIN : TX2
- UPDATE : TX1
- INSERT : TX2
- COMMIT : TX2
- BEGIN : TX3
- INSERT : TX3
- BEGIN : TX4
- COMMIT : TX3
- DELETE : TX3
- DELETE : TX4

CAPTURE CHECKPOINT

Start of Oldest Open (Uncommited) Transaction

CURRENT READ POSITION

CURRENT WRITE POSITION

CAPTURE

COMMIT ORDERED SOURCE TRAIL

Patterns
CHECKPOINTS - CAPTURE - PUMP

SOURCE DATABASE

BEGIN : TX1
INSERT : TX1
BEGIN : TX2
UPDATE : TX1
INSERT : TX2
COMMIT : TX2
BEGIN : TX3
INSERT : TX3
BEGIN : TX4
COMMIT : TX3
DELETE : TX4

Start of Oldest Open (Uncommitted) Transaction

CURRENT READ POSITION
CAPTURE CHECKPOINT

CAPTURE

CURRENT WRITE POSITION

BEGIN : TX2
INSERT : TX2
COMMIT : TX2
BEGIN : TX3
INSERT : TX3
COMMIT : TX3

COMMIT ORDERED SOURCE TRAIL
CHECKPOINTS - CAPTURE - PUMP - DELIVERY

Patterns
ELIMINATE DOWN-TIME DURING ORACLE DATABASE UPGRADES

ZERO DOWN-TIME DATABASE UPGRADES

APPLICATION

REAL-TIME UPDATES

SWITCH OVER

DATA FLOW

Route (LAN/WAN/Web/IP)

COMPARE & VERIFY

POST-SWITCHOVER
ELIMINATE UNPLANNED DOWN-TIME WITH ACTIVE DATA GUARD

REAL-TIME UPDATES

Route (LAN/WAN/Web/IP)

POST-SWITCHOVER DATA FLOW

APPLICATION

SOURCE

DELIVERY

CAPTURE

STANDBY

STANDBY SERVER COULD BE USED FOR REPORTING, QUERING, TESTING....

DELIVERY

CAPTURE

SWITCH OVER

DISASTER RECOVERY & DATA PROTECTION

Patterns
PRODUCE PRODUCTION SYSTEM PERFORMANCE & LOWER COSTS

IMPROVE PRODUCTION SYSTEM PERFORMANCE & LOWER COSTS

QUERY OFFLOADING

APPLICATION

READ-ONLY ACTIVITY

REAL-TIME UPDATES

Route (LAN/WAN/Web/IP)

LEGACY PRODUCTION OLTP

ORACLE REPLICA

TRANSACTION PROCESSING ACTIVITY

CAPTURE

DELIVERY

APPLICATION

QUERY OFFLOADING
INCREASE ROI ON EXISTING SERVERS & SYNCHRONIZE GLOBAL DATA

APPLICATION

REAL-TIME UPDATES

Route (LAN/WAN/Web/IP)

APPLICATION

ACTIVE - ACTIVE

SOURCE & TARGET DB

CAPTURE

DELIVERY

CAPTURE

DELIVERY

APPLICATION
Extract
Committed transactions are captured (and can be filtered) as they occur by reading the transaction logs.

Trail Stages and Queues Data for Routing

Pump Distributes Data for Routing to Target(s)

Route Data is Compressed, Encrypted for Routing to Target(s)

Replicat applies data with transaction integrity

Patterns
OPTIMIZED FOR ORACLE 12c

SOURCE ORACLE 12C MULTITENANT CONTAINER DATABASE

TARGET ORACLE 12C MULTITENANT CONTAINER DATABASE

TRAIL FILES

Patterns
UPDATE DISASTER RECOVERY SITE – IN ONE OPERATION
MANAGE MANY DATABASES AS ONE

ONE STANDBY DATABASE COVERS ALL PLUGABLE DATABASES

PRODUCTION CONTAINER DATABASE

STANDBY CONTAINER DATABASE

12.1 ERP
12.1 CRM
12.1 DW
12.1 HCM

12.1 ERP
12.1 CRM
12.1 DW
12.1 HCM
ORACLE GOLDENGATE

Performance Tuning
Extract Flavours

Integrated Extract

✓ Is an Oracle GoldenGate Extract for Oracle databases (Database Release 11.2.0.3 and later)
✓ Is multithreaded & Supports more data types
✓ Relies on Oracle’s internal log parsing and processing implementation
✓ Supports downstream topologies
✓ Is new with version 11.2.1.0.0
✓ Works with Logminer

Register Extract (capture) with database/logminer required

Example: GGSCI> register extract [ name ] database container [ (PDB) ]

Classic Extract

✓ Is traditional REDO log-based extract for Oracle
✓ Works for all DB platforms and versions
Classic Extract

- Oracle Database 11.2.0.3.0 or earlier, or are running classic mode then the scripts need to be run from SQL *Plus as `sysdba`
- Scripts to be executed
  - `@marker_setup.sql`
  - `@ddl_setup.sql`
  - `@role_setup.sql`
  - Grant role to user
  - `@ddl_enable.sql`
- DDL Trigger must be enabled

Integrated Extract

- No need to run the scripts
- Requires Oracle Database 11.2.0.4.0 or later
- DDL Trigger must be disabled for Integrated mode DDL replication
**Patterns**

**Identify Extract – Classic OR Integrated**

GGSCI (ggnode1.oracle.com) 17> info extract eorcl

**ERROR**: Extract EORCL is not ready to be upgraded because recovery SCN 1755571 has not reached SCN 1755605.

GGSCI (ggnode1.oracle.com) 28> info extract eorcl

**ERROR**: Extract EORCL is not ready to be upgraded because recovery SCN 1755571 has not reached SCN 1755605.
Oracle GoldenGate Performance Areas

**Source Database**

- **Capture**
- **Trail Files**
- **Pump**

GoldenGate
GG tools: LAG, REPORTCOUNT

**DATABASE** - AWR, ASH, UTL_SPADV, TRACE

**HOST** - MPSTAT, VMSTAT, IOSTAT, STRACE, TOP

**Target Database**

GoldenGate

**Database**

**HOST**

Patterns
To install the UTL_SPADV Package (Integrated Extract and Integrated Replicat):

a. Grant the following privileges to a designated Oracle GoldenGate administrator database user:
   SQL> exec DBMS_GOLDENGATE_AUTH.GRANT_ADMIN_PRIVILEGE('db user name');

b. Connect to the database with the user name that was granted permissions in Step a.

c. Run the utlspadv.sql script. For example:
   SQL> @$ORACLE_HOME/rdbms/admin/utlspadv.sql

The UTL_SPADV PL/SQL package provides subprograms to collect and analyze statistics for the LogMiner server processes. The statistics help identify any current areas of contention such as CPU or I/O.

Oracle Streams Performance Advisor (SPADV) enables monitoring of the integrated GoldenGate server processes which are used by integrated Extract and integrated Replicat, and provides information about how these processes are performing.

SPADV statistics are collected and analyzed using the UTL_SPADV package.

UTL_SPADV package, as the Oracle GoldenGate administrator user on the source database.
Gather Statistics using the UTL_SPADV Package

Oracle recommends that you gather statistics for a 30-60 minute time period during which you are troubleshooting performance.

It is also recommended to gather statistics during a 30-60 minute time period where performance is good, serving as a baseline comparison.

To gather statistics every 15 seconds, run the following SQL*Plus command as the Oracle GoldenGate administrator:

```sql
SQL> exec UTL_SPADV.START_MONITORING(interval=>15);
```

To stop statistics gathering, run the following command:

```sql
SQL> exec UTL_SPADV.STOP_MONITORING;
```

Run the following commands to determine if the monitoring job is currently running:

```sql
SET SERVEROUTPUT ON
DECLARE
is_mon BOOLEAN;
BEGIN
is_mon := UTL_SPADV.IS_MONITORING(
job_name => 'STREAMS$MONITORING_JOB',
client_name => NULL);
IF is_mon=TRUE THEN
DBMS_OUTPUT.PUT_LINE('The monitoring job is running.');
ELSE
DBMS_OUTPUT.PUT_LINE('No monitoring job was found.');
END IF;
END;
/
```
Generating Report - UTL_SPADV Package

✓ It is also possible to create a static report of SPADV statistics after monitoring for a period of time. The report can be generated in text form much like the display of real-time statistics.

✓ To generate a text report, from SQL*Plus as the Oracle GoldenGate administrator, execute the following:

```sql
spool /tmp/spadv.txt

begin
  utl_spadv.show_stats(path_stat_table=>'STREAMS$_PA_SHOW_PATH_STAT',
                       bgn_run_id=> 1,
                       end_run_id=> 9999,
                       show_legend=> TRUE);
end;
```

After the reports have been generated, Oracle recommends purging the SPADV statistics using the following command:

```sql
SQL> exec UTL_SPADV.STOP_MONITORING(PURGE=>TRUE);```
Identifying the Bottlenecks

If the lag in EXTRACT, check for Lag in EXTRACT.

If the lag in PUMP, check for Lag in PUMP.

If the lag in REPLICAT, check for Lag in PUMP.

Monitoring Lag – Working from the Target back to the Source.

If the (latency) in REPLICAT is acceptable then All is Well.

Throughput Statistics are also useful in identifying potential bottlenecks.
Q & A

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