Oracle Golden Gate and Oracle Data Guard: Working Together Seamlessly

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Oracle
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Program Agenda

- Overview of Oracle GoldenGate
- Overview of Oracle Data Guard
- Technical Challenges in Capturing Data in Presence of Data Guard Role Transitions
- Overview of Integrated Capture
- Different Deployment Options for Integrated Capture in the context of Data Guard FSFO
- Summary
Oracle GoldenGate
Low-Impact, Real-Time Data Integration & Transactional Replication

Legacy Systems

Oracle & Non-Oracle Database(s)

Message Bus

Log-based Changed Data

Oracle & Non-Oracle Database(s)

Message Bus

Zero Downtime Upgrade & Migration

Full Active Distributed DB

High Availability/Disaster Recovery

Reporting Database

Query & Report Offloading

Data Warehouse

Real-time BI, Operational Reporting, MDM

Global Data Centers

Data Synchronization within the Enterprise

Message Bus

Event Driven Architecture, SOA

New DB/ HW/OS/APP
Oracle GoldenGate
Differentiators

<table>
<thead>
<tr>
<th>Performance</th>
<th>Flexible</th>
<th>Reliable</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Low latency for data movement</td>
<td>• Modern, open, modular architecture</td>
<td>• Maintains transactional integrity</td>
</tr>
<tr>
<td>• Low-impact capture, routing, transformation,</td>
<td>• Supports heterogeneous sources and targets</td>
<td>• Resilient against interruptions and failures</td>
</tr>
<tr>
<td>and delivery of transactional data</td>
<td>• Agile and adaptable to modern data integration architectures</td>
<td>• Fast Recovery after process interruptions.</td>
</tr>
</tbody>
</table>
How Oracle GoldenGate Works

Capture: committed transactions are captured (and can be filtered) as they occur by reading the transaction logs. **New with V.11.2.1,** GoldenGate offers two options for capture for Oracle; Classic & Integrated Capture 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).

Delivery: applies data with transaction integrity, transforming the data as required.
How Oracle GoldenGate Works

Capture: committed transactions are captured (and can be filtered) as they occur by reading the transaction logs. **New** with V.11.2.1, GoldenGate offers two options for capture for Oracle; Classic & Integrated Capture.

- **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).
- **Delivery**: applies data with transaction integrity, transforming the data as required.

Capture

Delivery

Trail Files

Pump

LAN / WAN / Internet Over TCP/IP

Delivery

Target Oracle & Non-Oracle Database(s)

Source Oracle & Non-Oracle Database(s)

Bi-directional
Program Agenda

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Oracle Data Guard

- Easy to setup
- Supports everything
- Automatic failover based on declarative conditions
Oracle Data Guard Concepts

- **Switchover**: Planned role transition from a primary database to one of its standby database.
  - DGMGRL> SWITCHOVER TO CHICAGO

- **Failover**: Unplanned role transition based on primary failure
  - DGMGRL> FAILOVER TO CHICAGO
# Oracle Data Guard

## Robust
- Low-impact on primary
- Uses media recovery engine

## Turn-Key
- Easy to setup
- Supports everything
- Automatic gap resolution
- **Automatic failover** based on declarative conditions

## Data Protection (Disaster Recovery)
- Zero-Data-Loss Mode
- Resilient against interruptions and failures
- Fast Recovery after process interruptions.
Oracle Data Guard Fast Start Failover (FSFO)

Observer

Primary (BOSTON) -> Standby (CHICAGO)

Redo Transport

OCI Connection
Data Guard FSFO

- Observer Process communicates with both Primary and Standby
- Will initiate failover to standby if certain triggering events happen
  - Connectivity loss between the Primary and Standby or Primary and Observer AND user specified threshold timeout has expired
  - Database health check detects any of the failures at the Primary Database
    - Datafile has gone offline because of an I/O error
    - Control file is deemed to be corrupt
    - Log Writer (LGWR) process gets an I/O error and cannot write to any log file
    - ARCHIVER cannot write because of I/O error
    - Dictionary corruption is detected
Data Guard FSFO

• Zero Data Loss Mode
  – Redo transport set to SYNC with MAXIMUM AVAILABILITY

• User-specified Data Loss Mode
  – User can specify maximum amount of data loss
  – Redo transport set to ASYNC with MAXIMUM PERFORMANCE

• Reinstatement of the Failed Primary Database
  – Following the failover, Data Guard Broker will automatically try to reinstate the failed primary as a new standby database
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Technical Challenges in Capturing Data in Presence of Data Guard Role Transitions
Challenge 1: Thread count Mismatch

• Active Data Guard widely used for offloading read-intensive applications
  – A large percentage of deployments are RAC
  – Number of threads *often* do not match between Primary and Standby database

• Post Role Transition
  – Thread counts likely different
  – *Need capability to handle such mismatches transparently*
Challenge 2: Resetlogs Change on Failover

- Fast Start Failover (FSFO) widely used
  - Failover ALWAYS results in creation of a new database incarnation
  - Depending on situation, multiple fast start failovers can happen in a short period of time
  - Need to handle resetlogs operation transparently
Challenge 3: Fuzziness in Redo Data

• Zero Data Loss Guarantee
  – SYNC Transport
  – Redo is written in parallel to standby and online redo logs
  – Commits are not acknowledged to the user until an ACK is received from Standby
  – Redo state is fuzzy until ACK is received
    • Commit in both ORL and SRL (Good case)
    • Commit in ORL but not in SRL
    • Commit in SRL but not in ORL
    • Commit in neither ORL nor SRL (Good Case)
  – Need a way to avoid redo fuzziness during Capture
Challenge 4: Standbys may Not be Co-located

• GoldenGate Files May Need to be Replicated
  – Checkpoint file
  – Bounded Recovery file
  – Trail file
  – Parameter file
  – *Use shared storage or DBFS*
Program Agenda

✓ Overview of Oracle GoldenGate
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✓ Technical Challenges in Capturing Data in Presence of Data Guard Role Transitions
  ▪ Overview of Integrated Capture
  ▪ Different Deployment Options for Integrated Capture in the context of Data Guard FSFO
✓ Summary
Integrated Capture: What is it?
Oracle GoldenGate: Classic Capture

- GoldenGate Parameter File
- Database Archive/Redo Logs
- Messaging Subsystem
- Checkpoint Manager
- Memory Manager
- Redo Parsing
- Formatting
- Filtering
- Transformation and Mapping
- Trail File Generation
- Transformation Engine
- SQL Interface
- Metadata Manager
- Database Access
- Classic Capture
Oracle GoldenGate: Integrated Capture

GoldenGate Parameter File

Database LogMining Server

Parser

Checkpoint Manager

Memory Manager

Messaging Subsystem

LCR Processor

Formatting

Filtering

Transformation and Mapping

Trail File Generation

Transformation Engine

SQL Interface

Metadata Manager

Integrated Capture

Database Access

GoldenGate Event Log

GoldenGate Checkpoint File

GoldenGate Trail Files

GoldenGate Parameter File

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Integrated Capture: Overview

• Supports multiple deployment configuration
  – On-Source: Source database and Integrated Capture are on the same machine
  – Downstream: Integrated Capture runs on different database – typically on different machines

• Easy transitions for existing GoldenGate customers
  – Customers may choose which option they prefer based on their requirements.
Integrated Capture: Engineered for Data Guard

- **RAC instance addition/removal**
  - Thread count change based on DG role transition handled without user intervention
  - Transparent support for RAC-One

- **Resetlogs**
  - Will automatically detect resetlogs operation in redo logs and take the correct branch of redo
  - Transparent handling of repositioning in presence of resetlogs operation

- **Redo fuzziness around failover**
  - In local mode, knows to avoid fuzziness (stays behind unacknowledged commit)
  - In downstream mode, can be configured to avoid redo fuzziness
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Integrated Capture: Deploying On-Source For Data Guard
Integrated Capture (Shared Storage): On-Source

Observer

Primary Database

Standby Database

Redo Transport

OCI Connection

File I/O

Integrated Capture

LogMining Server

Trail and other OGG Files In Shared Storage

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Integrated Capture (Shared Storage): On-Source (Post-Failover)

(OLD) Primary Database

Observer

(NEW) Primary Database

Integrated Capture

Redo Transport

LogMining Server

OCI Connection

File I/O

Trail/Checkpoint/BR Files In Shared Storage
Integrated Capture (DBFS): On-Source Deployment

- Observer
- Primary Database
- Standby Database
- Integrated Capture
- LogMining Server
- Trail and other OGG Files In DBFS
- Redo Transport
- OCI Connection
- File I/O
Integrated Capture (DBFS): On-Source Post-Failover

(OLD) Primary Database

Observer

(NEW) Primary Database

Redo Transport

LogMining Server

OCI Connection

File I/O

Integrated Capture

Trail/Checkpoint/BR Files In DBFS
Integrated Capture: On-Source Deployment for Data Guard

• Connect to Database using Role-Based Services
  – Declarative way to specify a service should be published only when the database has a specific role
  – Publish a service only when database has the PRIMARY role
  – Make all OGG components connect to the database using role-based service

• Use Server-Side TAF and AQ-HA notifications
  – OCI client automatically inherits TAF attributes
  – AQ HA Notifications

• Role Change Trigger
  – Fires when database role changes (Standby to Primary, Primary to Standby)
  – Write a role change trigger that will restart the GoldenGate processes
On-Database Deployment for DG: Configure Services

• Configure role-based service
  – `srvctl add service -d BOSTON -s oggserv -l PRIMARY -e SESSION -m BASIC -w 60 -z 20 -P BASIC -r t1,t2,t3`
  – `srvctl add service -d CHICAGO -s oggserv -l PRIMARY -e SESSION -m BASIC -w 60 -z 20 -P BASIC -r t4,t5`
  • `-d` Unique name of the database
  • `-s` Service Name
  • `-l` Service Role
  • `-e` Type of failover (Session/Select/None)
  • `-m` Setting for fast failover from Primary to Standby
  • `-w` Wait time between connect attempts
  • `-z` Number of times to attempt connect after failover
  • `-P` TAF policy specification
  • `-r` List of participating instances
On-Database Deployment for DG: Net Alias

- Net Alias in tnsnames.ora at Primary
  - ggconn = (DESCRIPTION=(ADDRESS=(PROTOCOL=tcp)
    (HOST=BOSTON-SCAN) (PORT=2140)) (FAILOVER=on)(LOAD_BALANCE=off)
    (CONNECT_DATA= (SERVICE_NAME=oggserv.development.oracle.com)
    (FAILOVER_MODE=(TYPE=SESSION)(METHOD=BASIC)(RETRIES=20)(DELAY=60))))

- Net Alias in tnsnames.ora at Standby
  - ggconn = (DESCRIPTION=(ADDRESS=(PROTOCOL=tcp)
    (HOST=CHICAGO-SCAN) (PORT=2140)) (FAILOVER=on)(LOAD_BALANCE=off)
    (CONNECT_DATA= (SERVICE_NAME=oggserv.development.oracle.com)
    (FAILOVER_MODE = (TYPE=SESSION) (METHOD=BASIC) (RETRIES=20) (DELAY=60))))
On-Database Deployment: Param Files

• mgr.prm
  – USERID ggadm@ggcon PASSWORD ggadmpassword
  – AUTOSTART EXTRACT *
  – AUTOSTART REPLICAT *
  – AUTORESTART EXTRACT *, RETRIES 3, WAITMINUTES 1, RESETMINUTES 60
  – AUTORESTART REPLICAT *, RETRIES 3, WAITMINUTES 1, RESETMINUTES 60

• ext1.prm
  – USERID ggadm@ggcon PASSWORD ggadmpassword
On-Database Deployment for Data Guard: Role Change Trigger

- Create Role Change Trigger at the Primary Database
- Will Get Replicated at the Physical Standby
- Trigger should submit a job that runs a shell script
- Shell script must be accessible in both databases
Role Change Trigger

create or replace trigger ogg_failover_actions
after db_role_change on database
declare
    role varchar(30) ;
begin
    select database_role into role from v$database ;
    if role = 'PRIMARY' then
        dbms_scheduler.create_job(  
            job_name => 'failover_script',  
            job_type => 'EXECUTABLE',  
            job_action => '/ade/b/5568817/oracle/work/failover_action.sh',  
            enabled => TRUE) ;
    end if ;
end ;
end;  
/
Shell Script

#!/bin/sh
#Set environment variables

# if DBFS, need to mount the file system at the standby

#Stop Manager/Replicat/Extract

# Start Manager
Integrated Capture: Deploying Downstream For Data Guard
Integrated Capture: Downstream Deployment for Data Guard

- Observer
- Primary Database
- Standby Database
- Redo Transport (SYNC)
- LogMining Server
- Integrated Capture
- OCI Connection
- File I/O
- Redo Transport
Integrated Capture: Downstream Deployment Post-Failover

Observer

(Old) Primary Database

Redo Transport (SYNC)

(ASYN)

LogMining Server

Integrated Capture

(NEW) Primary Database

Redo Transport

OCI Connection

File I/O
Integrated Capture:
Downstream Deployment for Data Guard

• Connect to Database using Role-Based Services
  – Declarative way to specify a service should be published only when the database has a specific role
  – Publish a service only when database has the PRIMARY role
  – DBLOGIN uses role-based services to connect to the database
    • Used for meta data query and fetch

• Use Server-Side TAF
  – OCI client automatically inherits TAF attributes
Downstream Deployment for Data Guard: Configure Role Based Services

- `srvctl add service -d BOSTON -s oggserv -l PRIMARY -e SELECT -m BASIC -w 60 -z 20 -P BASIC -r t1,t2,t3`
- `srvctl add service -d CHICAGO -s oggserv -l PRIMARY -e SELECT -m BASIC -w 60 -z 20 -P BASIC -r t4,t5`

- `-d` Unique name of the database
- `-s` Service Name
- `-l` Service Role
- `-e` Type of failover (Session/Select/None)
- `-m` Setting for fast failover from Primary to Standby
- `-w` Wait time between connect attempts
- `-z` Number of times to attempt connect after failover
- `-P` TAF policy specification
- `-r` List of participating instances
Downstream Deployment for Data Guard: Net Alias Set up

tenames.ora:

```
  ggcon =
  (DESCRIPTION =
    (CONNECT_TIMEOUT=10)(RETRY_COUNT=3)
    (ADDRESS_LIST =
      (ADDRESS = (PROTOCOL = TCP)(HOST = BOSTON-SCAN)(PORT = 2140))
      (ADDRESS = (PROTOCOL = TCP)(HOST = CHICAGO-SCAN)(PORT = 2140))
    (LOAD_BALANCE = off) (FAILOVER = on) )
  (CONNECT_DATA=
    (SERVICE_NAME=oggserv.development.oracle.com)
    (FAILOVER_MODE =
      (TYPE = SELECT)(METHOD = BASIC) (RETRIES = 20) (DELAY = 60)))
```
Downstream Deployment for Data Guard: Parameter Files

• mgr.prm
  – USERID ggadm@ggcon PASSWORD ggadmpasswd
  – AUTOSTART EXTRACT *
  – AUTOSTART REPLICAT *
  – AUTORESTART EXTRACT *, RETRIES 3, WAITMINUTES 1, RESETMINUTES 60
  – AUTORESTART REPLICAT *, RETRIES 3, WAITMINUTES 1, RESETMINUTES 60

• ext1.prm
  – USERID ggadm@ggcon PASSWORD ggadmpasswd
Downstream Deployment for Data Guard: Setting Up Redo Transport

- Downstream deployment of Integrated Capture
  - Set up MININGUSER and give privileges
  - Set up the downstream mining database to accept redo logs
  - Set up redo transport at the source (PRIMARY) database to send redo logs
  - Set up redo transport at the standby database to send redo logs
    - Standby will not send any redo to downstream database unless it becomes the Primary
  - Set up Integrated Capture at downstream mining database
Downstream Deployment for Data Guard: Real Time Capture (Primary Database)

- Prepare Primary Database to Send Redo
  - Set DG_CONFIG
    - SQL> ALTER SYSTEM SET LOG_ARCHIVE_CONFIG = 'DG_CONFIG=(BOSTON, CHICAGO, dbmscap)'
  - Set up redo transport
    - SQL> ALTER SYSTEM SET LOG_ARCHIVE_DEST_2 = 'SERVICE = DBMSCP.EXAMPLE.COM  ASYNC  NOREGISTER REOPEN=30 VALID_FOR=(ONLINE_LOGFILES, PRIMARY_ROLE) DB_UNIQUE_NAME=dbmscap';
Downstream Deployment for Data Guard: Real Time Capture (Standby Database)

• Prepare Standby Database to Send Redo (when it becomes Primary)
  – Set DG_CONFIG
    – `SQL> ALTER SYSTEM SET LOG_ARCHIVE_CONFIG = 'DG_CONFIG=(BOSTON, CHICAGO, dbmscap)'`
  – Set up redo transport
    – `SQL> ALTER SYSTEM SET LOG_ARCHIVE_DEST_2 = 'SERVICE = DBMSCAP.EXAMPLE.COM ASYNC NOREGISTER REOPEN=30 VALID_FOR=(ONLINE_LOGFILES, PRIMARY_ROLE) DB_UNIQUE_NAME=dbmscap';`
Integrated Capture: Deployment Options

- **On-Database Deployment**
  - No need for another database
  - No additional configuration (like redo transport)
  - Needs database trigger
  - Needs shared storage or use of DBFS
  - GoldenGate processes see an outage as they have to be restarted

- **Downstream Deployment**
  - Offloads processing from the primary
  - TAF failover happens transparently. GoldenGate processes do not see any outage
  - GoldenGate files (trail/checkpoint/BR) can remain in local storage
  - Needs another database
Program Agenda

✓ Overview of Oracle GoldenGate
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✓ Technical Challenges in Capturing Data in Presence of Data Guard Role Transitions
✓ Overview of Integrated Capture
✓ Different Deployment Options for Integrated Capture in the context of Data Guard FSFO

- Summary
Summary

- Integrated Capture can be deployed in Zero Data Loss FSFO configuration
- Once configured via role-based services and role change triggers, no additional user intervention is required.
- Try it out!

Important MOS Notes/White Papers

- ID#1322547.1----OGG Best Practice - GoldenGate Classic Capture and Oracle Data Guard
- ID#1436913.1----OGG Best Practice – GoldenGate Integrated Capture and Oracle Data Guard
Join the Data Integration Community

Twitter
twitter.com/ORCLGoldenGate

LinkedIn
“Oracle Data Integration”

Facebook
facebook.com/OracleDataIntegration

Oracle’s Data Integration blog
blogs.oracle.com/dataintegration

Oracle’s Data GoldenGate YouTube channel
youtube.com/oraclegoldengate

Oracle.com/goto/dataintegration
Key Oracle GoldenGate Sessions at OOW

**Monday – October 1st**
- Real World Zero Downtime Operations Customer Panel 1:45pm Moscone West – 3005
- Oracle GoldenGate 11gR2 New Features 3:15pm Moscone West – 3005

**Tuesday – October 2nd**
- Oracle GoldenGate and Oracle Data Guard: Working Together Seamlessly 10:15am Moscone South – 305
- Real World Operational Reporting Customer Panel 11:45am Moscone West – 3005
- High-Volume OLTP with Oracle GoldenGate: Best Practices from Comcast 1:15pm Moscone West – 3022
- Everything You Need to Know about Monitoring Oracle GoldenGate 5pm Moscone West – 3005

**Wednesday – October 3rd**
- Best Practices for High Availability with GoldenGate on Oracle Exadata 11:45am Moscone South – 102
- Oracle GoldenGate Case Study: Real-Time Operational Reporting Deployment 1:15pm Moscone West – 2003
- Oracle GoldenGate Best Practices for Conflict Detection and Resolution 3:30pm Moscone West – 3005
- Tuning and Troubleshooting Oracle GoldenGate on Oracle Database 5pm Moscone South – 102
# Oracle GoldenGate Hands-On-Labs

**Wednesday – October 3rd**

<table>
<thead>
<tr>
<th>Event</th>
<th>Time</th>
<th>Location</th>
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<tbody>
<tr>
<td>Introduction to Oracle GoldenGate Veridata</td>
<td>10:15am</td>
<td>Marriott Marquis - Salon 1/2</td>
</tr>
</tbody>
</table>

**Thursday – October 4th**

<table>
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<tr>
<th>Event</th>
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<th>Location</th>
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<tbody>
<tr>
<td>Deep Dive into Oracle GoldenGate</td>
<td>11:15am</td>
<td>Marriott Marquis - Salon 1/2</td>
</tr>
</tbody>
</table>
Oracle Clusterware

RAC Failover Configuration for GoldenGate

- Configure Oracle Clusterware to start GoldenGate on surviving node during a failure
- Trail files, checkpoint files MUST be on shared storage (DBFS)
  - DBFS needs to be running on each RAC node
  - Mount DBFS from active node to prevent running Extract/Replicat file corruption
- Use Agent script to stop and restart GoldenGate automatically
- Refer to Oracle GoldenGate on Oracle Exadata Database Machine Configuration white paper (MOS note 1371489.1)
Oracle Grid Infrastructure Bundled Agents
For GoldenGate

• Released for 11.2.0.3 Grid Infrastructure
• Replaces user created agent scripts with Bundled Agent to;
  – Manage GoldenGate application failover
  – Start and stop GoldenGate processes (manager, Extract, Replicat)
  – Monitor GoldenGate processes
  – Relocate and clean the GoldenGate instance and relevant dependencies
• Intuitive command line utility (AGCTL) manages bundled agents
• Deploys in new or existing application environments
Oracle Grid Infrastructure Bundled Agents

Version Matrix / Further Information

<table>
<thead>
<tr>
<th>Grid Infrastructure</th>
<th>GoldenGate</th>
<th>Database</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.2.0.3.+ / 12.1</td>
<td>11.2.1.0.0 / 11.1.1.+</td>
<td>10.2.0.5.0.0, 11.1.+, 11.2.+</td>
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</table>

- Bundled with Oracle Grid Infrastructure – 12c


- Porting to other platforms planned for future release
Hardware and Software Engineered to Work Together
Oracle Database File System (DBFS)

- DBFS Client for Linux allows mounting DBFS file systems on Linux hosts
  - Similar to NFS mount
  - Application makes normal file calls
  - Linux FUSE module forwards file calls to DBFS_client executable
  - DBFS_client makes remote calls to DBFS Stores in the database

- DBFS Stores in Database implement a File Server
  - PL/SQL package implements file calls
    - File create, open, read, list, etc.
  - Directories and files stored in tables

- DBFS supported on all major platforms
DBFS Configuration for GoldenGate

Source – Extract/OGG Datapump

- DBFS database run in ARCHIVELOG mode
- Single DBFS file system
  - Create with nopartition and noencryption options
  - Set LOB segment to NOCACHE LOGGING (default)
  - Include mount option: -o direct_io
- Only mount on node running GoldenGate processes
DBFS Configuration for GoldenGate

Target – Collection server/Replicat

- DBFS database run in ARCHIVELOG mode
- Two separate DBFS file systems
  - Create with nopartition and noencryption options
  - Include mount option: -o direct_io
  - Trails: Set LOB segment to NOCACHE LOGGING (default)
  - Checkpoint files: Set LOB segment to CACHE LOGGING
- Only mount on node running GoldenGate processes