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Oracle GoldenGate 11g Advanced Features and Best Practices for Oracle Database
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>2</td>
</tr>
<tr>
<td>Oracle GoldenGate for Oracle Database Key Features</td>
<td>2</td>
</tr>
<tr>
<td>Extract (Capture)</td>
<td>3</td>
</tr>
<tr>
<td>Routing (Data Pump)</td>
<td>4</td>
</tr>
<tr>
<td>Delivery (Replicat)</td>
<td>4</td>
</tr>
<tr>
<td>Transformation</td>
<td>5</td>
</tr>
<tr>
<td>Oracle GoldenGate for Oracle Best Practices and Special Considerations</td>
<td>5</td>
</tr>
<tr>
<td>Database</td>
<td>5</td>
</tr>
<tr>
<td>RAC</td>
<td>6</td>
</tr>
<tr>
<td>ASM</td>
<td>6</td>
</tr>
<tr>
<td>LOGRETENTION</td>
<td>7</td>
</tr>
<tr>
<td>GoldenGate Environment</td>
<td>7</td>
</tr>
<tr>
<td>Summary</td>
<td>7</td>
</tr>
</tbody>
</table>
Introduction

Oracle GoldenGate 11g offers a real-time, log-based replication software platform to meet the needs of today’s transaction-driven applications. The software provides capture, routing, transformation, and delivery of transactional data across heterogeneous databases in real time. Using this technology, customers can achieve continuous availability for critical systems and real-time data integration for fast, easy access to current and accurate data. This document describes key features of the Oracle GoldenGate for Oracle Database architecture, as well as suggested best practices. To learn more about Oracle GoldenGate in general, including other new features available in the current release, please refer to the Real-Time Access to Real-Time Information Technical Whitepaper.

Oracle GoldenGate for Oracle Database Key Features

The Oracle GoldenGate 11g architecture consists of decoupled modules that can be combined across the enterprise to provide maximum flexibility, availability, and performance. This architecture facilitates the movement of transactional data in four simple, yet powerful steps: capture, route, transform, and deliver.

For the Oracle Database, Oracle GoldenGate can perform near real-time capture, transformation, routing, and apply of committed database DML transactions written to redo and/or archive logs. Advanced options of the product provide for the capture, routing, and apply of Oracle-to-Oracle DDL operations, and the capture of DML transactions from Archive logs only.

Oracle GoldenGate can efficiently operate on any platform running the database; including Oracle Real Application Clusters (RAC), Oracle Exadata, and databases managed by Automatic Storage Management (ASM). The following sections describe GoldenGate functionality, while highlighting capabilities that are specific to Oracle GoldenGate for the Oracle Database.
Extract (Capture)

During Extract, the Oracle GoldenGate Capture process continually scans the redo logs looking for qualified transactions. GoldenGate runs as a database user and must have the appropriate database privileges to access the redo and archive logs. The Oracle Recovery Manager (RMAN) automatically retains the archive logs that are needed by Extract. In addition to supporting replication of DML in an active-active Oracle environment, GoldenGate can also capture and apply DDL changes, including CREATE, ALTER and DROP operations on nearly all database objects, PL/SQL, and user privileges.

When a qualified transaction starts, the Capture process begins queuing the transaction details to memory. If the transaction details exceed the allocated process memory, the transaction details are written to temporary disk storage. This Capture mechanism enables GoldenGate to track and capture multiple transactions simultaneously. Additionally, the Capture module can track and capture transactions that span multiple redo or archive logs. When the transaction is committed to the database, the Capture process flushes all of the transaction details to a trail file for routing to the target database server(s). The data in this trail file is in commit order sequence.

Integrated Capture

Beginning with Oracle GoldenGate 11g Release 2, customers running Capture on an Oracle Database can choose to take advantage of the Integrated Capture capabilities. This multi-threaded Capture mechanism enables a variety of enhancements for customers extracting data from an Oracle Database. When operating in Integrated Capture mode, Extract integrates with an Oracle log mining server to receive change data from the server in the form of Logical Change Records (LCRs), which are a logical representation of the changed data.

When using Integrated Capture, customers can choose to locate the Capture mechanism at either the source database or an alternate location that is of the same platform type as the source. Performing the capture downstream is useful when it is necessary to minimize overhead at the source database. For example, when replicating changes from a mission-critical OLTP system to a reporting or test environment, it may be preferable to offload the capture process to the target location. Downstream capture can also be used to enable mining of earlier versions of the database in either real-time or archive log mode. The database where the downstream capture is being performed must be Oracle Database 11g Release 11.2.0.3 or higher; however, the logs may be from an Oracle Database 10g Release 2 or higher database.

Because it is fully integrated with the database, no additional setup is necessary to support Oracle Real Application Clusters (RAC), Automated Storage Management (ASM) or Transparent Data Encryption (TDE). Integrated capture handles point-in-time recovery and RAC integration more efficiently, automatically handling node outages.

Oracle GoldenGate with Integrated Capture is designed to interoperate with Oracle Data Guard, to provide the highest levels of database scalability and availability. Should the primary site become unavailable, it is possible for Oracle GoldenGate to switch to using the physical standby
or Active Data Guard standby database as the primary site. Users can restart the Oracle GoldenGate environment at the new primary site.

Additionally, with integrated capture, Oracle GoldenGate provides support for compression, including Basic Compression, OLTP-compression, and Exadata Hybrid Columnar Compression (EHCC) as well as distributed transaction support for XA and PDML transactions on Oracle RAC. XML Object Relational (OR) and XML Binary data types support has also been added along with LOB full and partial read (selective update) from the redo log.

Classic Capture

Oracle GoldenGate continues to support the existing Capture module, now referred to as Classic Capture, which directly accesses the database redo logs looking for DML changes to capture for distribution. It is possible to capture from redo logs stored inside of ASM. Adjusting the read size can improve Extract performance. In this mode, Extract can be integrated with Oracle RMAN to manage log retention.

To minimize overhead on the source database, customers can choose to use Oracle GoldenGate Archive Log Only (ALO) capture, which supports parsing the archive logs on a remote system. This system does not need to be identical to the target, for example, it is possible to parse Linux x86 redo logs on a Windows x86 server, or HP-UX PA-RISC logs on a Solaris SPARC system. When using ALO in connected mode, there are no data type or feature limitations. Using disconnected mode eliminates overhead on the source system.

Routing (Data Pump)

A separate Extract process continually scans the staging trail file, awaiting new data. When new data is detected in the staging trail file, it is packaged for routing via TCP/IP to specific target locations. The target location can be a single server disk location, multiple disk locations, or multiple servers and disk locations.

Oracle GoldenGate uses TCP/IP, including IPV6, for sending data, so no geographical distance constraints are imposed between the source and target systems. Advanced options provide for encryption (using FIPS or Blowfish) and compression of the data within the TCP/IP packet. At the target locations, a communications process receives the incoming transmission from TCP/IP, decrypts and decompresses the data packet, and writes the transaction information to a local trail file. An acknowledgement is returned to the Data Pump that the data was received and written to the trail file successfully.

Delivery (Replicat)

At the target database locations, Oracle GoldenGate also runs as a database user. Database privileges provide access that allows the Replicat process to execute DML and DDL on designated schemas and tables. The Replicat process continually scans the trail file for incoming
data. When new data is detected, the source database transaction DML or DDL statement is recreated and executed.

In an active-active configuration, conflicting updates can be detected using Oracle GoldenGate’s built-in conflict detection mechanism. Once detected, these conflicts can be automatically resolved using one or more of the supplied conflict resolution methods or by a custom method, as needed to meet business requirements.

Transformation

Data transformation can occur within any step of the capture, route, and delivery process; however, it is performed most commonly during the data delivery phase. Oracle GoldenGate transformation supports capture and delivery between dissimilar databases, between schemas and tables with different names, between source and target columns with different names or data types, as well as row-level transformations, where data can be modified based upon user requirements.

Oracle GoldenGate for Oracle Best Practices and Special Considerations

Oracle GoldenGate provides a variety of tools and resources that help companies build robust replication solutions. Numerous “best practices” white papers are available for download via My Oracle Support (MOS). Oracle GoldenGate customers are encouraged to review the available documents for considerations explicit to their operating environments. For example, the following papers are especially useful when deploying Oracle GoldenGate in an Oracle Database environment:

- Database specific bundle patch for Integrated Extract 11.2.x (Doc ID 1411356.1).
- Oracle GoldenGate Best Practices: Instantiation from an Oracle Source Database (Doc ID 1276058.1)
- Oracle GoldenGate Best Practice: NFS Mount options for use with GoldenGate (Doc ID 1232303.1)
- Oracle GoldenGate Best Practices: Oracle GoldenGate high availability using Oracle Clusterware (Doc ID 1313703.1)
- Oracle GoldenGate Best Practice - sample parameter files (Doc ID 1321696.1)

Additionally, for the Oracle database, the following generic guidelines should be considered to achieve streamlined operations of Oracle GoldenGate:

Database

- Database archiving must be enabled at the source.
This will allow GoldenGate to recover with minimal impact upon the database and server in the event of an extended outage of the Capture process.

- Database supplemental logging must be enabled at the source.
  - MINIMAL supplemental logging adds no overhead to the database; however, it ensures that there is sufficient information needed to identify, group, and merge the redo operations associated with DML changes.
  - Use TRANSDATA to enable supplemental logging for each replicated table.
  - When replicating DDL changes, SCHEMATRANSDATA must also be enabled

- Sufficient disk space at the source and target.
  - There must be sufficient disk space at both the source and target locations to store trail files in the event of an extended network or target server outage.

- Adequate bandwidth.
  - The must be a TCP/IP communications link of sufficient bandwidth for data transmission between source and target.

**RAC**

- GoldenGate should reside on SAN disk shared by the RAC servers.
  - This will allow for an automated restart of the application should the RAC node where GoldenGate is installed become unavailable.

- Extract and Replicat processes run on the specific RAC instance where the connection is performed.

- Both Classic and Integrated capture mine the redo from all instances.

**ASM**

- When using Classic Capture, use a BEQ connection.
  - The use of BEQ database connections for data capture in environments using ASM has shown performance improvements.

- For Oracle Database versions 10.2.0.5 and above using Classic Capture, use the DBLOGREADER API for improved capture performance.
  - The combination of DBLOGREADER and BEQ database connection has shown a vast performance improvement when capturing from databases that use ASM.
LOGRETENTION

- With Classic Capture, if you want to ensure that RMAN will retain any needed logs, you must enable LOGRETENTION.
- With Integrated Capture, LOGRETENTION is automatically enabled.

GoldenGate Environment

- Use alpha characters only when naming GoldenGate groups and trail files.
  - Trail files (GoldenGate Trails) are identified by two characters defined during the configuration process. To this the application appends six digits starting with “000000”. By limiting the naming of these components to “A-Z, a-z” it eliminates confusion when troubleshooting error conditions.
  - The same generic rule applies for group names (capture, extract data pump, and delivery components). GoldenGate maintains a history of ten process report files on disk. These report files take the group name and append the number 0 through 9 to them, with “group.rpt” being the current and then “group0.rpt” through “group9.rpt” being reports that are aged from most recent to oldest.
    - Limiting the names of GoldenGate groups to alpha characters only eliminates a layer of confusion during error troubleshooting and recovery when trying to locate and view report files in correct order.
- Use a Data Pump when the target connection is via TCP/IP.
  - This allows the data capture and delivery to the target to be separated into two different processes, which isolates the Capture process from network issues.
  - In the Data Pump, use compression to improve transmit throughput.
  - When transmitting data over public networks, use the Data Pump encryption feature.

Summary

With Oracle GoldenGate’s real-time, heterogeneous database synchronization capabilities, Oracle Database users can replicate both DML and DDL operations. The product allows users to move, filter, and transform data between similar or dissimilar supported Oracle Database versions, or move, filter, and transform data between an Oracle Database and a database from another vendor. Oracle GoldenGate enables the world's largest enterprises to improve the availability, performance, and accessibility of the transactional data that drives mission-critical business processes.