Deep Dive into Automating Oracle GoldenGate using the New Microservices

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Oracle GoldenGate provides low-impact capture, routing, transformation, and delivery of database transactions across homogeneous and heterogeneous environments in real-time with no distance limitations.

* The most popular enterprise integration tool in history

Supports Databases, Big Data and NoSQL:
Agenda

1. New GoldenGate Microservices Architecture
2. Automating and Embedding GoldenGate
New GoldenGate Microservices Architecture

Simplifies large scale and cloud deployments

• GoldenGate components as micro services with comprehensive RESTful interfaces.

• Enables remote and secure configuration, administration, and monitoring capabilities.

• Enables Applications to embed, automate, and orchestrate GoldenGate.
New Services Architecture for Cloud and Large-scale Deployments

Administration, Distribution, Receiver, Metrics Services with RESTful Service Interfaces

Source Database

- Extract
- Trail Files

Source Manager

- Service Manager

Source

- Distribution Server

Target Database

- Replicat
- Trail Files

Target Manager

- Service Manager

Target

- Receiver Server

HTTPS RESTful Service Interfaces

- Metrics Server

GGSCI

- Admin Server

Manager
New GoldenGate Microservices

• Administration Service
  – Replaces GGSCI and Manager with a single administration service for managing replication processes

• Multi-threaded Distribution Service
  – Replaces multiple source-side Extract Pumps with a single instance service.
  – Lightweight filtering only (no transformations)

• Multi-threaded Receiver Service
  – Replaces the multiple discrete target-side Server/Collectors with a single instance service

• Performance Metrics Service
  – New service for monitoring metrics related to a particular deployment
  – Also available in the traditional architecture

• Service Manager
  – New service for managing multiple deployments on a local host
Administer GoldenGate with Variety of Clients
Command Line, Browsers, Programmatic RESTful Interfaces
REST based clients for Remote and Secure GoldenGate Administration

- Use browser to administer and monitor GoldenGate
- Each service has an embedded HTML5 app

- Thin Command Line client - similar to GGSCI
- Connect and administer local and remote deployments
Example RESTful Service Call to Create Extract

Single Call to create, update parameter file, register, and start integrated Extract

**POST** [https://xyz.us.oracle.com:9101/services/v2/processes/extracts/e001](https://xyz.us.oracle.com:9101/services/v2/processes/extracts/e001)

**JSON Payload:**

```json
{
    "$schema" : "ogg:extract",
    "credentials" : {
        "domain" : "OracleGoldenGate",
        "alias" : "gg1"
    },
    "config" : [
        
        "-- Parameter file for primary extract: e001",
        "extract e001",
        "useridalias gg1",
        "exttrail aa, format release 12.3",
        "tranlogoptions excludetag +",
        "eofdelaycsecs 10",
        "table u1.*",
    ],
    "status" : "running",
    "source" : {
        "tranlogs" : "integrated"
    },
    "registration" : {
        "csn" : "0.0",
        "share" : true
    },
    "targets" : [
        {
            "name" : "aa"
        }
    ]
}
```
Security Model

Standard TLS/SSL based authentication and Client Authorization

Client Authorization

- Identity via SSL user certificates or via username/password
  - Integrate with SSO configured in proxy/middleware.

- Roles
  - Security User
  - Administrator
  - Operator
  - User
WebSockets -- Default Data Communication Protocol

Industry standard HTTP(S) initiated full-duplex streaming protocol

• SSL based security

• Can seamlessly traverse through HTTP forward/reverse proxy servers
Allows Applications to Embed and Automate GoldenGate
Easily build self-service applications which automates GoldenGate

REST calls to configure, administer, and monitor GoldenGate

Catalog of RESTful APIs are available for all services
GoldenGate Automated in Oracle Database Sharding

N-way active-active replication automatically set up

• Automatic creation of replication processes
  • Extracts, Replicats, Distribution Paths
  • Automatic CDR for resolving conflicts
• Replication topology is automatically reconfigured upon sharding changes
Sharding - Automatic Oracle GoldenGate Configuration

1. Define replication topology

GDSCTL> create shardcatalog .... repl OGG ....

GDSCTL> add shardgroup ..shgrp1 -repfactor 3

GDSCTL>add shard -shardgroup shgrp1....
  gg_service host01:9000/deploy1 ....
GDSCTL>add shard -shardgroup shgrp1....
  -gg_service host02:9000/deploy1
GDSCTL>add shard -shardgroup shgrp1....
  -gg_service host03:9000/deploy1
  ....
GDSCTL>DEPLOY
Sharding - Automatic Oracle GoldenGate Configuration

1. Define replication topology
2. Send command to shards
3. https to OGG distribution path
4. Setup replication
5. Update status

OGG sharding orchestration logic issues REST calls to setup GoldenGate replication

GDSCTL > DEPLOY
Program Agenda

1. New GoldenGate Microservices Architecture
2. Automating and Embedding GoldenGate
Set up Replication using simple PL/SQL buildings blocks

Database

PL/SQL Procedures

- one_way_replication
- create_extract
- create_replicat
- create_distpath
- ....
- gg_send_request

HTTPS

GoldenGate Services

Note: We plan to publish example building blocks on OTN
SEND_GG_REQUEST

Uses UTL_HTTP to make REST calls

```
procedure send_gg_request
  ( gg_uri IN varchar2,
    verb IN varchar2,
    payload IN varchar2,
    resp_code OUT number,
    resp_text OUT NOCOPY varchar2
  )
```

- URI of GoldenGate Service Endpoint: https://<gghost>:9001/services/v2/processes/extracts/e001
- HTML Verb: POST, PATCH, DELETE, GET
- Payload: JSON object specifying the replication process
- Response_Code: 200 (OK), 201 (CREATED), ...
- Response_Text: <detailed Response from Service>
Procedures to create GoldenGate Processes

```sql
procedure create_[extract|replicat]
  ( [ext|rep]_name    IN  varchar2,
  , adminsrv_uri     IN  varchar2,
  , db_credentials   IN  varchar2,
  , [ext|rep]_trail  IN  varchar2,
  , [ext|rep]_params IN  varchar2
)
```

```sql
procedure create_distpath
  ( path_name    IN  varchar2,
  , ds_uri       IN  varchar2,
  , src_trail    IN  varchar2,
  , rs_uri       IN  varchar2,
  , tgt_trail    IN  varchar2
)
```
Orchestration Procedure to setup One-way Replication

Customize as needed

```sql
procedure one_way_replication
(db_src        varchar2
,gg_src        varchar2
,gg_trg        varchar2
,db_trg        varchar2
,tables        varchar2
,instantiation varchar2 [YES|NO]
,auto_CDR      varchar2 [YES|NO])
```

- **Generate ER process names**
- **Generate Trail file names**

- `create_extract`
- `create_distpath`
- `create_replicat`

**Database Utilities**
- `DBMS_DATAPUMP`
- `DBMS_FILE_TRANSFER`
- `DBMS_TTS`
- ...

- `DBMS_GOLDENGATE_ADM`
  - `ADD_AUTO_CDR(...)`
  - Requires DB 12.2+ & OGG 12.3
Setup One Way Replication

- Orchestration Package
- Database export/import to instantiate target
- Databases and Goldengate Services are up

```
BEGIN
  add_oneway_replication(
    db_src        => 'REPDB01',
    gg_src        => 'GG_Inst01',
    gg_trg        => 'GG_Inst02',
    db_trg        => 'REPDB02',
    tables        => 'HR.EMP',
    instantiation => 'YES',
    auto_CDR      => 'NO'
  );
END;
```
1. Creating Extract
2. Creating Distribution Path
3. Datapump Export
4. Datapump Import
5. Creating Replicat

POST HTTPS://gg_src:8001/....

```json
{
  "config": [
    "Extract E01AA",
    "ExtTrail et",
    "UseridAlias gg_src",
    "Table HR.EMP;"
  ],
  "source": {
    "tranlogs": "integrated"
  },
  "credentials": {
    "alias": "gg_src"
  },
  "registration": "default",
  "begin": "now",
  "targets": [
    {
      "name": "et"
    }
  ]
}
```
Create and Start Distribution Path

1. Creating Extract
2. Creating Distribution Path
3. Datapump Export
4. Datapump Import
5. Creating Replicat

POST HTTPS://gg_src:8002/....

```json
{
   "$schema" : "ogg:distPath",
   "name" : "AAtoAB",
   "description" : "distPath1",
   "source" : {
      "uri" : "trail://ggsource:8002/dirdat/et"
   },
   "target" : {
      "uri" : "ogg://ggtarget:9003/dirdat/rt"
   },
   "begin" : {
      "sequence" : 0,
      "offset" : 0
   },
   "status" : "running"
}
```
Datapump Export

1. Creating Extract
2. Creating Distribution Path
3. **Datapump Export**
4. Datapump Import
5. Creating Replicat

**Datapump Export (EXPDP)**

```sql
v_dp_handle:=dbms_datapump.open
dbms_datapump.add_file
...
dbms_datapump.set_parameter
dbms_datapump.metadata_filter
dbms_datapump.start_job
dbms_datapump.detach
```

Orchestration Database

---

**REPDB01**

**Extract**

**GoldenGate Services**

**REPDB02**

**GoldenGate Services**
Datapump Import

1. Creating Extract
2. Creating Distribution Path
3. Datapump Export
4. **Datapump Import**
5. Creating Replicat

**Datapump Import (IMPDP)**

```sql
v_dp_handle:=dbms_datapump.open
dbms_datapump.add_file
...
dbms_datapump.set_parameter
dbms_datapump.metadata_filter
dbms_datapump.start_job
dbms_datapump.detach
```

Diagram:
- Orchestration Database
- IMPDP
- DBLink
- REPDB01: Extract
- REPDB02
- GoldenGate Services

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Create and Start Replicat to complete setup
GoldenGate instantiation SCN features automatically filters pre-instantiation changes

1. Creating Extract
2. Creating Distribution Path
3. Datapump Export
4. Datapump Import
5. Creating Replicat

POST HTTPS://gg_trg:9001/....

```json
{
   "config": [
      "Replicat R01BA",
      "UseridAlias ggadmin",
      "Map HR.EMP",
      "Target HR.EMP"
   ],
   "source": {
      "name": "rt"
   },
   "credentials": {
      "alias": "gg_trg"
   },
   "checkpoint": {
      "table": "ggadmin.ckpt"
   }
}
```
Setup Bidirectional Active-Active Replication from PL/SQL

Using the same high level building block

BEGIN
  add_oneway_replication
    (db_src => 'REPDB01',
     gg_src => 'GG_Inst01',
     gg_trg => 'GG_Inst02',
     db_trg => 'REPDB02',
     tables => 'HR.EMP',
     instantiation => 'YES',
     auto_CDR => 'YES'
  );
END;

BEGIN
  add_oneway_replication
    (db_src => 'REPDB02',
     gg_src => 'GG_Inst02',
     gg_trg => 'GG_Inst01',
     db_trg => 'REPDB01',
     tables => 'HR.EMP',
     instantiation => 'NO',
     auto_CDR => 'YES'
  );
END;
Hub & Spoke Configuration
Two calls for every Hub/Spoke pair

BEGIN
add_oneway_replication
(db_src => 'HUB',
,gg_src => 'GG.Inst.HUB',
,gg_trg => 'GG.Inst.01',
,db_trg => 'Spoke01',
tables => 'HR.EMP',
,instantiation => 'YES',
,auto_CDR => 'YES'
);
END;

BEGIN
add_oneway_replication
(db_src => 'Spoke01',
,gg_src => 'GG.Inst.01',
,gg_trg => 'GG.Inst.HUB',
,db_trg => 'HUB',
tables => 'HR.EMP',
,instantiation => 'NO',
,auto_CDR => 'YES'
);
END;
Global Replication Catalog

Keep Track of Replication Deployments

- Control Replication Environments in replication catalog
- Create, modify or remove Replication Topologies from this catalog table
- Can manage replication with DML to table
  - Have a DML trigger execute the PL/SQL replication orchestration logic

| Source Database | Extract | Dist Path | Replicat | Target Database | ...
|-----------------|---------|-----------|----------|-----------------|----------------
| REPDB01         | E01AB   | A_to_B    | R01BA    | REPDB02         | ...
| REPDB01         | E02AC   | A_to_C    | R01CA    | REPDB03         | ...
| ...             | ...     | ...       | ...      | ...             | ...

DML Trigger Orchestration Logic

HTTPS

POST

PATCH

DELETE

GoldenGate Services
Monitor Replication from the Database
Retrieving information about Replication environments

- Use GET RESTful calls
- Check status, warnings/errors (if any), throughput, lag, ...

<table>
<thead>
<tr>
<th>Source Database</th>
<th>Extract</th>
<th>Dist Path</th>
<th>Replicat Target Database</th>
<th>Status</th>
<th>LAG [s]</th>
<th>Throughput [Changes/s]</th>
</tr>
</thead>
<tbody>
<tr>
<td>REPDB01</td>
<td>E01AB</td>
<td>A_to_B</td>
<td>R01BA REPDB02</td>
<td>OK</td>
<td>1.8</td>
<td>54,673</td>
</tr>
<tr>
<td>REPDB01</td>
<td>E02AC</td>
<td>A_to_C</td>
<td>R01CA REPDB03</td>
<td>OK</td>
<td>1.8</td>
<td>78,924</td>
</tr>
<tr>
<td></td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

Note: The table above shows the replication status between source and target databases. Each row represents a specific replication channel with details such as extract ID, distribution path, replication target database, status, lag, and throughput.
Easy Orchestration with New GoldenGate Microservices

Classic Architecture

❌ Combination of scripts
  – Shell Scripts, SQL scripts, ...
  – Obey Files, Parameter Files,...

❌ Requires OS access to DB hosts
  – Not secure

GoldenGate Microservices

✔ Simple and secure REST calls for all GoldenGate operations
New GoldenGate Microservices Architecture

Simplifies large scale and cloud deployments

• GoldenGate components as micro services with comprehensive RESTful interfaces.

• Enables remote and secure configuration, administration, and monitoring capabilities.

• Enables Applications to embed, automate, and orchestrate GoldenGate.
## Additional sessions and Demos

### Sunday, October 1
- Lift and Shift Workloads to Cloud with Oracle Data Integration Platform Cloud [SUN6653]
- Data Movement between On-Prem, Fusion ERP Cloud, Fusion HCM Cloud and Salesforce [SUN7286]
- Accelerate Migration to Cloud Infrastructure with Data Integration Platform [SUN6896]

### Monday, October 2
- Oracle Data Integration Platform Strategy and Roadmap [CON6646]
- Filling Your Data Lake with Potable Data, Using Data Integration [CON5465]
- **GoldenGate**: Deep Dive into Automating OGG using the new Microservices [CON6569]
- Oracle Data Integration Platform: Foundation for Cloud Integration [CON6650]
- Oracle Data Integration Platform Empowers Enterprise Grade Big Data Solutions [CON6893]
- Oracle Data Integration Platform Cloud Deep Dive [CON6651]
- Oracle GoldenGate Cloud Service: Real-Time Data Replication in the Cloud [HOL7715]

### Tuesday, October 3
- Oracle Data Integrator Product Update and Strategy [CON6654]
- Oracle Enterprise Data Quality: Product Overview and Roadmap [CON6656]
- Accelerate Cloud On-Boarding Using Oracle GoldenGate Cloud Service [CON6894]
- Oracle Enterprise Data Quality for All Types of Data [HOL7653]
- Oracle Data Integration Platform: a Cornerstone for Big Data [CON6655]
- **GoldenGate: MAA and Best Practices for Oracle GoldenGate Microservices** [CON6570]
- Oracle GoldenGate Product Update and Strategy [CON6897]

### Wednesday, October 4
- A Practical Path to Enterprise Data Governance with Enterprise Data Quality [CON6657]
- Oracle Data Integrator and Oracle GoldenGate for Big Data [HOL7708]
- Introduction to Oracle Data Integration Platform Cloud [HOL7673]
- An Enterprise Databus: GoldenGate in the Cloud Working with Kafka and Spark [CON6895]
- **GoldenGate: Best Practices & Deep Dive on OGG 12.3 Microservices at Cloud** [CON6568]
- Oracle GoldenGate for Big Data [CON6898]
- Oracle Data Integration Platform Cloud Service Governance Edition [CON6652]
- Oracle Sharding: Linear Scalability, Extreme Availability, and Geo-Distribution [CON6673]