

Contents

1 Introduction

- Objectives 1-2
- Oracle GoldenGate: What Is It? 1-3
- Why Do You Need Oracle GoldenGate? 1-4
- Uses of Oracle GoldenGate 1-5
- Use Case Example Oracle GoldenGate for Operational Reporting 1-6
- Oracle GoldenGate for Oracle Database Eliminate Down Time for Migrations and Application Upgrades 1-7
- Oracle GoldenGate for Oracle Database Eliminate Down Time During Oracle Database Upgrades 1-8
- Oracle GoldenGate for Oracle Database Eliminate Unplanned Down Time with Active Data Guard 1-9
- Oracle GoldenGate Eliminate Unplanned Down Time with Live Standby 1-10
- Oracle GoldenGate Increase Return on Investment on Existing Servers and Synchronize Global Data 1-11
- Oracle GoldenGate for Oracle Database Complete Data Replication Platform for Sharded Database 1-12
- Oracle GoldenGate for Oracle Database Offload Redo Logs 1-13
- Oracle GoldenGate for Oracle Database Improve Production System Performance and Lower Costs 1-14
- Oracle GoldenGate Topologies 1-15
- Supported Databases 1-17
- Oracle GoldenGate for Big Data: Typical Data Flow 1-18
- Supported Operating Systems 1-19
- Oracle Middleware for Business Intelligence 1-20
- Oracle GoldenGate and Oracle Data Integrator 1-21
- Oracle GoldenGate Product Line 1-22
- Quiz 1-23
- Summary 1-26
- Practice 1 Overview: Verifying the Lab Environment 1-27

2 Oracle GoldenGate Architecture

- Objectives 2-2
- Oracle GoldenGate Architectures 2-3
- Classic Versus Microservices Architecture 2-4

Oracle GoldenGate Classic Architecture 2-5
Classic Architecture: Components of Oracle GoldenGate 2-6
Microservices Architecture 2-12
Microservices Architecture Example 2-13
Microservices Architecture: Main Components 2-14
Microservices Architecture: Additional Components 2-15
Microservices Architecture: REST API 2-16
The REST API 2-17
Microservices Architecture: Service Manager 2-18
Microservices Architecture: Security, Authentication, and Authorization 2-19
Microservices Architecture Authentication 2-20
Microservices Architecture: Secure and Nonsecure Deployments 2-21
Microservices Architecture: 19c Secure Deployment Options 2-22
Microservices Architecture: Target Initiated Paths 2-23
Microservices Architecture: ipACL 2-24
Microservices Architecture: Roles 2-26
Microservices Architecture: GoldenGate 19c Security Features 2-28
Microservices Architecture: Integration with External Key Management
Services 2-29
Oracle GoldenGate Process Groups 2-30
Process Group Naming Conventions 2-31
Classic Architecture: GGSCI 2-33
Parameter Files 2-34
Extract Types 2-35
Microservices Architecture: Capture and Delivery Using a Distribution Server
and Path 2-36
Classic Architecture: Capture and Delivery Workflow 2-37
Classic Architecture: Capture and Delivery Using a Data Pump 2-39
Distributed Topologies for Integrated Extract: Same Machine 2-40
Distributed Topologies for Integrated Extract: Different Machine, Real Time 2-41
Distributed Topologies for Integrated Extract: Different Machine,
Non-Real-Time 2-42
Online Versus Batch Operation 2-43
Running an Initial Load 2-44
Classic Architecture: Initial Load Workflow 2-45
Microservices Architecture: Initial Load Workflow 2-46
Checkpoints: Capture 2-47
Checkpoints: Pump (CA Only) 2-48
Checkpoints: Distribution Server Path (MA Only) 2-49
Checkpoints: Delivery 2-50
Commit Sequence Number 2-51

Discussion Questions 2-52

Quiz 2-53

Summary 2-54

3 Installing Oracle GoldenGate Microservices Architecture

Objectives 3-2

Operating System Requirements: Memory 3-3

Operating System Requirements: Swap 3-4

Operating System Requirements: Disk 3-5

Operating System Requirements: Network 3-6

Operating System Requirements: Privileges 3-7

Oracle GoldenGate 19c MA Software Bundle 3-8

Phase 1, Step 1: Select the Database Release 3-9

Phase 1, Step 2: Select the GoldenGate Home 3-10

Phase 1, Step 3: Install the Software 3-11

Phase 1, Steps 4 and 5: Monitor the Installation 3-12

Phase 2: Creating Certificates 3-13

Example: Create a Self-Signed CA Certificate 3-14

Example: Self-Signed Server Certificate Creation 3-15

Example: Self-Signed Client Certificate Creation 3-17

Adding Trusted Points 3-19

Configuring MA Servers/Services Using oggca 3-20

Phase 3, oggca.sh Step 1: Service Manager Details 3-21

Phase 3, oggca.sh Step 2: Deployment Configuration Option 3-22

Phase 3, oggca.sh Step 3: Deployment Details 3-23

Phase 3, oggca.sh Step 4: Deployment Home 3-24

Phase 3, oggca.sh Step 5: Deployment Home 3-25

Phase 3, oggca.sh Step 6: Administrator Account 3-26

Phase 3, oggca.sh Step 7: SSL/TLS Security 3-27

Phase 3, oggca.sh Step 8: Cryptography Protocols 3-28

Phase 3, oggca.sh Step 9: Servers and Monitoring 3-30

Phase 3, oggca.sh Step 10: Replication Options 3-31

Phase 3, oggca.sh Step 11: Click Finish or Save Response File 3-32

Phase 3, oggca.sh Step 12: Execute Configuration Scripts 3-33

Phase 3, oggca.sh Step 13: Select Close 3-34

Verifying Deployment Configuration Using Browser 3-35

MA Admin Client Overview 3-36

Admin Client and GGSCI: Similarities and Differences 3-37

Admin Client: MA-Specific Syntax 3-38

Admin Client Environment Variables 3-39

Connecting Using the adminclient 3-40

Verifying Deployment Configuration Using adminclient 3-41
Discussion Questions 3-42
Quiz 3-43
Summary 3-45
Practice 3 Overview: Installing Oracle GoldenGate Microservices Architecture 3-46

4 Installing Oracle GoldenGate Classic Architecture

Objectives 4-2
Operating System Requirements: Memory 4-3
Operating System Requirements: Disk 4-4
Operating System Requirements: Network 4-5
Downloading Oracle GoldenGate 4-6
Setting Environment Variables 4-7
Installation on UNIX, Linux, or z/OS Systems 4-8
Oracle Universal Installer GUI 4-9
Installation on Linux Using a tar Command 4-11
Installation on Windows Systems 4-12
Oracle GoldenGate Directories 4-13
GGSCI Command Interpreter 4-17
GGSCI Commands 4-18
GGSCI Examples 4-22
Obey Files 4-23
Running Oracle GoldenGate from the OS Shell 4-24
Discussion Questions 4-25
Summary 4-26
Practice 4 Overview: Installing Oracle GoldenGate Classic Architecture 4-27

5 Preparing the Environment

Objectives 5-2
Configuring Oracle GoldenGate: Overview 5-3
Configuring Oracle GoldenGate 5-4
Preparing the Environment: Enabling Oracle GoldenGate in the Database 5-5
Preparing the Environment: Defining Roles and Privileges 5-6
Create a Wallet and Credential Store 5-9
Preparing the Environment: Supplemental Logging 5-10
CA: Using Command Security 5-12
CA: Sample CMDSEC Statements 5-13
Handling TCP/IP Errors 5-14
The tcperrs File 5-15
CA: Preparing the Environment - Starting the Manager 5-16
CA: Preparing the Environment - Sample Manager Parameter File 5-17

Preparing the Environment: Generating an Optional Target Definitions File 5-18
Replication Lag Analysis 5-19
Quiz 5-20
Summary 5-22
Practice 5 Overview: Preparing the Environment 5-23

6 Configuring the Extracts

Objectives 6-2
Step 2: Change Capture 6-3
Extract: Overview 6-4
CA: Data Pump Overview 6-5
CA Data Pumps: One-to-Many Trails 6-6
CA Data Pumps: One-to-Many Target Systems 6-7
Configuring Extract: Basic Steps 6-8
MA Administration Server: Webpage Overview 6-9
MA Administration Server: Add Extract 6-10
MA Administration Server: Extract Options 6-11
MA Administration Server: Extract Parameters 6-12
MA Administration Server: Extract Report 6-13
The Add Extract Command 6-14
MA Add Extract: adminclient Examples 6-15
CA Add Extract: ggsci Examples 6-16
MA Editing Extract Parameters: adminclient Example 6-17
CA Editing Extract Parameters: ggsci Example 6-18
CA Passive Alias Extract 6-20
CA Add Extract Command for Alias Extract 6-22
Overview of Trails 6-23
CA: Adding a Local or Remote Trail 6-24
MA Starting the Extract: adminclient Example 6-25
CA Starting the Extract: ggsci Example 6-26
MA: Primary Extract Configuration for Oracle 6-27
CA: Primary Extract Configuration for Oracle 6-28
Data Definition Language Replication 6-29
CA: Data Pump Configuration for Oracle 6-30
Automatic Storage Management 6-31
Ensuring ASM Connectivity 6-32
ASM and DBLogReader 6-33
Discussion Questions 6-34
Summary 6-36
Practice 6 Overview: Configuring the Extracts 6-37

- 7 Oracle GoldenGate Microservices Architecture: Distribution Server**
 - Objectives 7-2
 - Step 2: Change Capture 7-3
 - Microservices Architecture Example 7-4
 - MA Distribution Server Overview 7-5
 - Data Pump Replacement 7-6
 - Multiple Protocols 7-7
 - Distribution Server Functionality 7-8
 - Embedded Web Server 7-9
 - Web Page Overview 7-10
 - Add a Path Using the Distribution Server 7-11
 - Add a Path Using the adminclient 7-13
 - Path Management Using the Distribution Server 7-14
 - Path Management Using the adminclient 7-15
 - The Path Information Page 7-16
 - Path Statistics 7-17
 - Quiz 7-18
 - Summary 7-19
 - Practice 7 Overview: Oracle GoldenGate Microservices Architecture: Distribution Server 7-20

- 8 Oracle GoldenGate Microservices Architecture: Receiver Server**
 - Objectives 8-2
 - Receiver Server Overview 8-3
 - Receiver Server Functionality 8-4
 - Receiver Server Interaction with a Distribution Server 8-5
 - Receiver Server Web GUI 8-7
 - Receiver Server: Path Information 8-8
 - Receiver Server Management using the adminclient 8-9
 - Microservices Architecture: Target Initiated Paths 8-10
 - Microservices: Target Initiated Paths 8-11
 - Secure GoldenGate Host Machine with Reverse Proxy 8-13
 - NGINX Reverse Proxy Prerequisites 8-14
 - Configuring NGINX Reverse Proxy 8-15
 - Quiz 8-17
 - Summary 8-18
 - Practice 8 Overview: Oracle GoldenGate Microservices Architecture—Receiver Server 8-19

9 Configuring Initial Load

- Objectives 9-2
- Configuring Oracle GoldenGate: Overview 9-3
- Initial Load: Advantages of Oracle GoldenGate Methods 9-4
- Initial Load: Resource Limitations 9-5
- Prerequisites for Initial Load 9-6
- Initial Load: Oracle Database Best Practice Methods 9-8
- Initial Load Using RMAN: Destination Auxiliary Instance 9-9
- Integration with Oracle Data Pump: Source Database 9-10
- Integration with Oracle Data Pump: Target Database 9-11
- MA Initial Load: Oracle GoldenGate Methods 9-12
- CA Initial Load: Oracle GoldenGate Methods 9-13
- Microservices Architecture: File to Replicat 9-14
- CA Initial Load: File to Replicat 9-15
- CA Initial Load: File to Database Utility 9-16
- CA Initial Load: Direct Load 9-18
- CA Initial Load: Direct Bulk Load (to Oracle) 9-20
- Discussion Questions 9-21
- Summary 9-22
- Practice 9 Overview: Configuring Initial Load 9-23

10 Configuring Replicat

- Objectives 10-2
- Configuring Oracle GoldenGate: Overview 10-3
- Replicat Overview 10-4
- Comparison of Replicats 10-5
- Nonintegrated or “Classic” Replicat 10-6
- “Integrated” Replicat aka “Integrated Delivery” 10-7
- Coordinated Replicat 10-8
- Parallel Replicat 10-9
- Components of Parallel Replicat 10-10
- Parallel Replication Architecture 10-11
- Parallel Replicat Performance Improvements 10-12
- Parallel Replicat Control Parameters 10-13
- MA Administration Server: Web Page Overview 10-14
- MA Administration Server: Add Replicat 10-15
- MA Administration Server: Replicat Options 10-16
- MA Administration Server: Replicat Statistics 10-17
- MA: Change Delivery Tasks 10-18
- CA: Change Delivery Tasks 10-19
- Checkpoint Table 10-20

MA: Sample Configuration 10-21
CA: Sample Configuration 10-22
Avoiding Collisions with Initial Load 10-23
Handling Collisions with Initial Load 10-24
Obtaining Process Information: adminclient or GGSCI 10-25
Process Report Files 10-27
Sample Extract Process Report 10-28
Discard Files 10-29
Using the ggserr.log Error Log 10-30
Using the System Logs 10-31
Discussion Questions 10-32
Quiz 10-33
Summary 10-35
Practice 10 Overview: Configuring Change Delivery 10-36

11 Managing Extract Trails and Files

Objectives 11-2
Extract Trails and Files: Overview 11-3
Extract Trails and Files: Distribution 11-4
Extract Trails and Files: Contents 11-5
Extract Trails and Files: Cleanup 11-6
Trail Format 11-7
Trail File Header Area 11-8
Record Header and Data Areas 11-9
Setting the Compatibility Level 11-10
Alternative Trail Formats 11-11
Logical Change Records (LCRs) 11-12
OutputFormat Text 11-13
OutputFormat Text Sample Output 11-14
OutputFormat SQL 11-15
OutputFormat SQL Sample Output 11-16
OutputFormat XML 11-17
OutputFormat XML Sample Output 11-18
The logdump Utility 11-19
Opening a Trail 11-20
Setting Up a View 11-21
Viewing the Trail File Header 11-22
Viewing Trail Records 11-23
Viewing Canonical Trail Records 11-24
Counting Records in the Trail 11-25
Filtering by a File Name 11-27

Locating a Hex Data Value 11-28
Metadata Encapsulation: Overview 11-30
Metadata in Trail Files 11-31
Support for Metadata Encapsulation in logdump 11-32
Saving Records to a New Trail 11-33
Keeping a Log of Your Session 11-34
Discussion Questions 11-35
Quiz 11-36
Summary 11-37
Practice 11 Overview: Managing Extract Trails and Files 11-38

12 Oracle GoldenGate Parameters

Objectives 12-2
Oracle GoldenGate Parameter Files 12-3
CA: Using Parameter Files 12-4
GLOBALS Versus Process Parameters 12-5
GLOBALS Parameters 12-6
MA Managed Process Settings Profile 12-7
CA Manager Parameters: Overview 12-9
CA Sample Manager Parameter File 12-10
CA Manager Parameter Categories 12-11
Managing Trail Files 12-12
Extract Parameter: Overview 12-13
Extract Parameter Defaults 12-14
CA Sample Extract Parameter File 12-15
Extract Parameter Categories 12-16
Extract Example: Table Parameter 12-18
Extract Example: TranLogOptions Parameter 12-19
Replicat Parameters: Overview 12-20
Replicat Parameter Defaults 12-21
Sample Replicat Parameter File 12-22
Replicat Parameter Categories 12-23
Replicat Example: Map Parameter 12-25
DBOptions 12-27
Discussion Questions 12-28
Summary 12-29
Practice 12 Overview: Oracle GoldenGate Parameters 12-30

13 Data Selection and Filtering

Objectives 13-2
Data Mapping and Manipulation: Overview 13-3

- Types of Definition Files 13-4
- Data Selection: Overview 13-5
- Data Selection: Where Clause 13-6
- Data Selection: Where Clause Examples 13-8
- Data Selection: Filter Clause 13-9
- Data Selection: Filter Clause Examples 13-10
- MA Distribution Server Path: Filter Clause 13-11
- Column Mapping: Overview 13-13
- Column Mapping: Example 13-14
- Column Mapping: Building History 13-15
- Data Transformation Using Functions 13-16
- Functions: Performing Tests on Column Values 13-17
- @IF Function 13-18
- Functions: Working with Dates 13-19
- @Date Function 13-20
- Functions: Working with Strings and Numbers 13-21
- @StrCat Function 13-23
- @StrExt Function 13-24
- Other Functions 13-25
- SQLEXEC: Overview 13-26
- SQLEXEC: Basic Functionality 13-27
- SQLEXEC: DBMS and Data Type Support 13-28
- SQLEXEC: Usage with a LOOKUP Stored Procedure 13-30
- SQLEXEC: Usage with a SQL Query 13-32
- SQLEXEC: Usage in a Table or Map Statement 13-33
- SQLEXEC: Usage as a Stand-Alone Statement 13-34
- Quiz 13-35
- Summary 13-37
- Practice 13 Overview: Data Selection and Filtering 13-38

14 Data Transformation and Configuration Options

- Objectives 14-2
- Macros: Overview 14-3
- Creating Macros 14-4
- Invoking a Macro 14-5
- Reusing Parameter Sets 14-6
- Creating Macro Libraries 14-8
- Tracing Macro Expansion 14-9
- User Tokens: Overview 14-10
- Environmental Values Available to @GETENV 14-11
- User Tokens Display 14-12

- Using User Tokens 14-13
- Viewing User Tokens in Logdump 14-14
- User Exits: Overview 14-15
- Uses for User Exits 14-16
- User Exits: High-Level Processing Logic 14-17
- Implementing User Exits 14-18
- User Exit Parameters 14-19
- Sample User Exits 14-20
- Calling User Exits 14-21
- Quiz 14-22
- Compression Options 14-24
- CA: Example of Compression 14-25
- Compression and Exadata 14-26
- Encryption: Overview 14-27
- Message Encryption 14-29
- Options: Message Encryption 14-31
- Trail or Extract File Encryption 14-32
- MA: Integration with External Key Management Services 14-33
- MA Encryption Profiles 14-34
- Trail Encryption with Wallet 14-37
- CA Password Encryption: Method 1 14-39
- CA Password Encryption: Method 2 14-40
- CA Password Encryption: Method 3 14-41
- Summary of Password Encryption 14-42
- Event Marker System 14-43
- Uses for Event Actions 14-44
- Event Actions Flowchart 14-45
- EventActions Order 14-46
- Implementing Event Actions: Examples 14-47
- Event Actions: Automated Switchover Example 14-48
- Event Actions: Automated Synchronization Example 14-49
- Quiz 14-50
- Summary 14-52
- Practice 14 Overview: Data Transformation and Configuration Options 14-53

15 Oracle GoldenGate Microservices Architecture—Performance Metrics Server

- Objectives 15-2
- Performance Metrics Server: Overview 15-3
- Performance Metrics Server Functionality 15-4
- Metrics and Counters by MA Component: 1 15-5
- Metrics and Counters by MA Component: 2 15-6

Metrics Server Overview Page 15-7
Extract Group: Process Performance Analysis 15-9
Extract Group: Thread Performance Analysis 15-10
Extract Group: Trail File Analysis 15-11
Extract Group: Database Statistics 15-12
Extract Group: Cache Statistics 15-14
Extract Group: Queue Statistics 15-15
Replicat Group: Process Performance Analysis 15-16
Replicat Group: Thread Performance Analysis 15-17
Replicat Group: Trail File Analysis 15-18
Replicat Group: Database Statistics 15-19
Quiz 15-21
Summary 15-22
Practice 15: Overview 15-23

16 Database Sharding Support, Replication Lag Management, Invisible Column Support

Objectives 16-2
Database Sharding Overview 16-3
Unsharded Table Versus Sharded Table (Three Databases) 16-4
Sharding in Details 16-5
Oracle Sharding: Typical Deployment 16-6
Oracle GoldenGate MA Support for Sharded Databases 16-7
Oracle GoldenGate MA Sharding Advantages 16-8
Oracle GoldenGate MA Shard Configuration 16-9
GDSCCTL Example: Shard Group 16-10
Heartbeat Mechanism 16-11
CA: Heartbeat Lag Management Setup with GGSCI 16-12
Heartbeat Lag Management Setup: MA Deployment 16-13
MA Deployment: Heartbeat Management 16-14
Heartbeat Table Objects 16-15
Accessing Heartbeat Statistics 16-16
Example: GG_LAG_HISTORY view 16-17
Example: GG_HEARTBEAT_HISTORY table 16-18
MA Example: GG_LAG_HISTORY query 16-19
CA Example: GG_LAG_HISTORY query 16-20
Invisible Columns in the Oracle RDBMS 16-21
Oracle GoldenGate Support for Invisible Columns 16-22
Quiz 16-23
Summary 16-24
Practice 16: Overview 16-25