

Oracle Cloud Infrastructure (OCI) GoldenGate

Real-world Examples

Y V Ravi Kumar
Raghavendra S
Ankur Goel

Foreword by Jeffrey T. Pollock



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ISBN-13 (pbk): 979-8-8688-0302-4
<https://doi.org/10.1007/979-8-8688-0303-1>

ISBN-13 (electronic): 979-8-8688-0303-1

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Cover designed by eStudioCalamar

Cover image designed by WikiImages from Pixabay

Distributed to the book trade worldwide by Springer Science+Business Media New York,
1 New York Plaza, Suite 4600, New York, NY 10004-1562, USA. Phone 1-800-SPRINGER, fax (201)
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from multiple streams of enterprise, engineered systems, cloud migration, and many more. Additionally, he possesses a solid understanding of BIGDATA technologies, encompassing Hadoop, HDFS distributions, Hive, HBase, Kafka, ODI/DI, and data lake/lakehouse concepts. Throughout his professional journey, he has been actively involved in various projects.



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About the Technical Reviewers



Naresh Kumar Miryala, a distinguished engineering leader at Meta, possesses an extensive background in cloud and platform engineering honed over nearly two decades in the field. His deep understanding of both technical and business intricacies empowers him to pioneer innovative solutions spanning diverse domains such as database systems, large-scale back-end infrastructure, multicloud environments (AWS/GCP/OCI/Azure), automation, cloud infrastructure, DevOps, Kubernetes, and Elasticsearch.

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ABOUT THE TECHNICAL REVIEWERS

comprehensive understanding of the multifaceted technical and business challenges intrinsic to such projects.

Naresh's affiliations include membership in IEEE, OATUG, AIM leadership council, and fellowship at RSA. He holds certifications as a professional in cloud and database platforms and actively engages as a blogger, tech reviewer, and frequent speaker in international conferences.



Arun Kumar Samayam is an experienced technology architect and a seasoned database professional with a profound passion for innovation. Arun is a Principal Cloud Solutions Architect in the Cloud and Engineering platform team at a global airline company. Arun is part of the Cloud Center of Excellence (CCoE) team, where he drives the organization's cloud transformation journey through cloud governance practices.

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Acknowledgments

I am grateful to God who gave us all the strength, courage, perseverance, and patience in this sincere and honest attempt of knowledge sharing. This sixth book of mine as a coauthor would not have been possible without the following people: Shri. Yenugula Venkata Pathi and Smt. Yenugula Krishna Kumari, my parents who instilled in me good thoughts and values, and Shri B. Suresh Kamath (founder of LaserSoft and Patterns Cognitive), my mentor, my guru, my strength, and my guide, who has inspired me for the last 26 years.

Shri B. Suresh Kamath is an immensely talented and technically sound individual. He taught me how to be well-read with no compromises. He led by example in being content yet hungry for knowledge. He motivated me to go that extra mile in attempting and experimenting with newer technologies and environments and in being regularly out of my comfort zone.

Anitha Ravi Kumar, my wife, was immensely tolerant with me. “Behind every successful man, there is a good woman,” as they say. I believe she is the embodiment of this well-known belief. Special thanks to my daughter, Sai Hansika, and my son, Sai Theeraz, for giving me time to write a sixth book in the last six years.

I would like to thank Naresh Miryala and Arun Samayam for accepting to be the technical reviewers for this book. Special thanks to three people, Shobana Srinivasan, Celestin Suresh John, and Laura Berendson, at Apress for giving me an opportunity to write my fifth book for Apress. Thank you to the readers for picking up this book. We have attempted to be as simple and straightforward as possible when sharing this knowledge, and we truly believe that it will help you to steadily deep dive into various interesting concepts and procedures.

I would like to express my gratitude to the complete Oracle GoldenGate team – Jagdev Dhillon, Jeffrey T. Pollock, Alex Lima, Tomas

ACKNOWLEDGMENTS

Vavra, Volker Kuhr, Denis Gray, Julien Testut, Alex Kotopoulos, Mack Bell, Werner He, Peter Inzana, Deniz Sendil, and Jorge Antonio Martínez.

I would also like to thank the complete Infolob Global team – Vijay Cherukuri, Tim Fox, Josh Turnbull, Nivas Nadimpalli, Satyendra Pasalapudi, and DSK.

My heartfelt gratitude to Binay Rath, Mohit Singh (my RAC guru), Rohit Rahi, Mariami Kupatadze, Lucia Hustatyova, Bal Mukund Sharma, and all of my LaserSoft colleagues.

Y V Ravi Kumar

Writing this book has been a journey that stretched beyond my imagination and capability, one that I could not have embarked on alone. This is a small token of my immense gratitude to Y. V. Ravi Kumar for his guidance and inspiration along this path.

I would like to extend my heartfelt thanks and deepest gratitude to my beloved wife, Sahana BP, and my son, Jashith R. Your support, patience, and love have been the cornerstone of my strength and perseverance throughout this journey. I would also like to thank my peer Ankur Goel and technical reviewers Naresh Miryala and Arun Samayam for providing critical feedback and refining my thoughts.

Special thanks to Apress for giving me an opportunity to write this book. Last but not least, I thank all the readers. I hope this book provides you with valuable insights and ignites further exploration.

Raghavendra Sreenivas Murthy

Completing this book has been an incredible journey, exceeding my expectations. I would like to express my immense gratitude to Y. V. Ravi Kumar for the guidance, my wife Khushboo Goel for the steadfast support, and my manager Anirudhya Das Gupta for the motivation. Special thanks to Apress and the readers. May this book offer valuable insights and inspire further exploration.

Ankur Goel

Foreword

The emergence of cloud computing as the dominant paradigm for enterprise workloads has forever changed data architecture and design. Distributed data is the new normal. Real-time streaming data is no longer just a niche answer to high-end problems. Decentralized, heterogeneous data transactions are mandatory attributes of a modern multicloud data architecture. Fresh, up-to-the-minute data is crucial for accurate answers in enterprise generative AI solutions.

For more than 20 years, GoldenGate has been the world's most trusted software solution for distributed real-time data transactions. Now Oracle Cloud Infrastructure (OCI) GoldenGate is the most trusted solution for multicloud distributed data architecture.

I've been creating data-driven business software for more than 30 years, and there's never been a more exciting and dynamic time in the industry than right now. The emergence of data fabric and data mesh has redefined consumer expectations for data integration. Now more than ever, CIOs and CTOs recognize the value of real-time data events, data mesh, event mesh, and service mesh designs. OCI GoldenGate is on the cutting edge of these trends, providing a microservices-based solution for streaming data, changed data (DML, DDL), AsyncAPI, CloudEvents format, and integrations across all major public cloud infrastructure. What a time to be a data engineer!

This book is aimed at cloud developers, database administrators, and data engineers responsible to deliver a robust data fabric platform using OCI GoldenGate. Congratulations to Y. V. Ravi Kumar, Raghavendra Sreenivas Murthy, and Ankur Goel in putting together the industry's first book on cloud-native services for real-time data transactions. I'm certain

FOREWORD

this will be a useful guidepost for many engineers seeking to learn more and accelerate their productivity with the service.

Jeff Pollock

Vice President of Products for GoldenGate, Stream Analytics, and Data
Migrations
Oracle Development

CHAPTER 1

Introduction to Oracle GoldenGate Microservices Architecture

Before delving into GoldenGate for Microservices, let us first grasp the concept of microservices in the context of the software industry.

Oracle GoldenGate Microservices Architecture

Microservices constitute a software architecture that organizes an application into a set of small, independent, and loosely interconnected services. Each microservice corresponds to a distinct business feature and operates as an individual process or container. These services communicate via well-defined APIs (application programming interfaces), collaborating cohesively to provide the application's complete functionality.

Oracle GoldenGate Microservices Architecture (OGG MA) is a modern and flexible way to deploy and manage Oracle GoldenGate, a data replication and integration tool provided by Oracle Corporation. GoldenGate Microservices Architecture was introduced in Oracle

GoldenGate version 12.3 and is designed to meet the evolving needs of organizations dealing with real-time data integration, replication, and data streaming across various platforms.

In conventional/traditional/classic GoldenGate deployments, a monolithic architecture is employed, wherein a single process (manager process) oversees all data replication operations. Although this architecture is efficient, managing and scaling it becomes challenging with a growing number of replication processes and data sources.

What Is Oracle GoldenGate?

Oracle GoldenGate (OGG) is a software solution for real-time data integration and replication. It allows organizations to capture, transform, and move transactional data from one database to another, across different platforms and data environments, with minimal latency and impact on system performance. This ensures that databases remain synchronized, facilitating high availability, data migration, and real-time analytics.

Oracle GoldenGate Classic Architecture

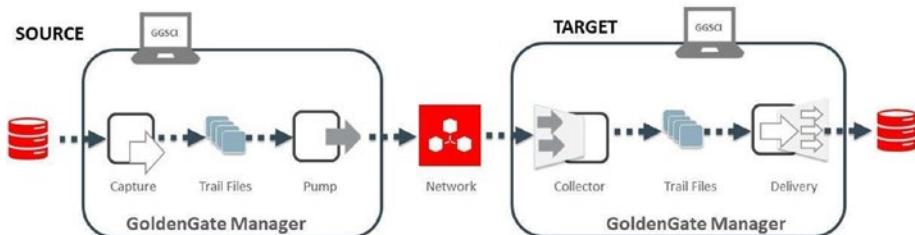


Figure 1-1. *GoldenGate classic architecture*

As shown in Figure 1-1, Oracle GoldenGate's classic architecture, before the advent of the Microservices model, consists of several core components. Here's a brief overview of the core components and their respective roles within the classic Oracle GoldenGate architecture:

1. Manager

- Role: This is the core component/controlling process for GoldenGate operations on a system. It starts other GoldenGate processes, manages resources, and oversees trail file management.

2. Extract

- Role: This is the capture process responsible for extracting transactional changes from the source database redo or transaction logs. Extract can operate in different modes, such as initial load, online change synchronization, or both.

3. Trail Files

- Role: These are intermediary files that store the captured data changes. They can reside on the source system, target system, or both, depending on the configuration.

4. Pumps

- Role: This is a secondary Extract process that reads from the local trail file and then routes that data to remote trail files, possibly transforming or filtering the data along the way. This component is particularly useful in multitier Oracle GoldenGate configurations.

5. Replicat

- Role: This is the apply process that takes the changes captured in the trail files and applies them to the target database.

6. Checkpoint Files

- Role: These files store the recovery checkpoints for the Extract and Replicat processes. In case of a failure or restart, the processes can pick up from the last known checkpoint, ensuring data consistency and no data loss.

7. Parameter Files

- Role: These configuration files store the settings for GoldenGate processes (like Extract, Replicat, and Manager). They define the behavior, mapping, filtering, and transformation rules for data replication.

Oracle GoldenGate Microservices Architecture Core Components

Oracle GoldenGate Microservices Architecture

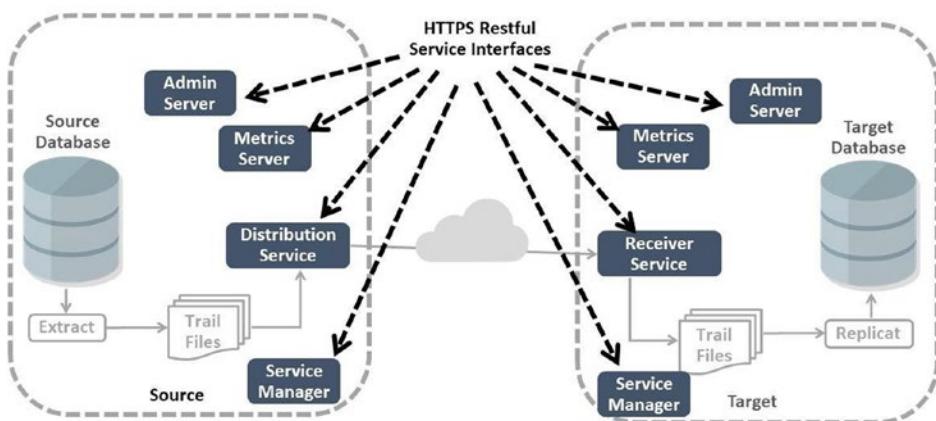


Figure 1-2. GoldenGate Microservices Architecture

As shown in Figure 1-2, GoldenGate Microservices Architecture offers a more modular and distributed approach to manage replication. It introduces several components or microservices, each responsible for a specific function, making the system more flexible, scalable, and easier to maintain. Key components of GoldenGate Microservices Architecture are

1. Service Manager (SM): This component manages the life cycle of other microservices. It starts, stops, and monitors microservices and provides a central point of control for managing the entire deployment.
2. Administration Server: It acts as the central control point for controlling and keeping track of different GoldenGate microservices. Administrators may set up, deploy, and manage GoldenGate instances using the Administration Server's web-based user interface and RESTful APIs.
3. Distribution Server: This evolved from the pump process of the classic architecture. It handles one or more tails to multiple destinations to the target systems.
4. Receiver Server: This is in charge of incoming trail files, one of the core components handling all the incoming trail files from the distribution server.
5. Performance Metrics Server: A vigilant observer, it continually amasses performance metrics, offering real-time insights.
6. Replicat: Retaining its role, Replicat remains instrumental in the transaction application to target databases. Process responsible for applying transactional data to target systems.

7. Admin Client: This administrative command-line interface takes over from the classic GGSCI (GoldenGate Software Command Interface) utility, yet coexists with it.

Why Embrace the Microservices Architecture?

Benefits of adopting the Microservices Architecture include a modern web-based user interface for management, security measures, RESTful API integration for better compatibility with other applications, and enhanced monitoring capabilities.

In essence, Oracle GoldenGate's Microservices Architecture offers a modular and more contemporary approach to data replication and integration, positioning GoldenGate to better serve the complex and diverse needs of modern data environments.

Key Benefits of OCI GoldenGate Microservices Architecture

Oracle GoldenGate's transition to a Microservices Architecture has brought several critical benefits, helping organizations meet the rising demands of today's complex data ecosystems. The following are some of the most noteworthy advantages:

Remote Administration

In a globally distributed business environment, the capability to administer and manage data integration processes remotely is indispensable. Oracle GoldenGate Microservices Architecture allows for web-based administration, making it easier to handle tasks like configuration, monitoring, and troubleshooting from anywhere in the world.

SSL Support

Security is a paramount concern for any organization dealing with data. SSL (Secure Sockets Layer) support in OCI GoldenGate Microservices ensures that data is encrypted during transit, providing an additional layer of security. This feature is particularly valuable for industries that have to comply with strict regulatory guidelines.

HTML Web Pages for Each Service/Server

Having a dedicated HTML web page for each service or server simplifies management and monitoring. These web pages provide an intuitive interface for administrators, streamlining tasks like configuration adjustments, performance monitoring, and issue resolution.

Additional Replication Protocols (WSS, WS, UDP, OGG)

The support for multiple replication protocols like Web Socket Secure (WSS), Web Socket (WS), UDP-based Data Transfer (UDT), and Oracle GoldenGate (OGG) means that you can choose the best protocol for your specific use case. This flexibility enhances interoperability and allows for optimized data transfer methods suited to your organization's needs.

Real-Time Performance Metrics

In today's fast-paced business environment, having real-time insights into your systems' performance is crucial. Oracle GoldenGate Microservices Architecture offers real-time performance metrics, enabling you to make timely decisions. This feature can help you quickly identify bottlenecks, assess system health, and allocate resources more efficiently.

What You Will Learn

- Fundamental Concepts: Get a solid understanding of what microservices are and why Oracle GoldenGate has adopted this architecture.

- Components Breakdown: Learn about the individual microservices in Oracle GoldenGate and how they work together to provide a cohesive data integration solution.
- Operational Advantages: Discover how the architecture improves scalability, resilience, and manageability.
- Implementation Guidelines: Gain practical insights into deploying and managing Oracle GoldenGate Microservices.
- Case Studies: Real-world examples to showcase how organizations have benefited from adopting Oracle GoldenGate Microservices.

Who This Book Is For

This book is for anyone who is involved in data integration, database management, or cloud migration projects and wants to get the most out of Oracle GoldenGate's advanced features. Whether you are new to GoldenGate or an experienced professional, you will find valuable lessons and techniques to enhance your skill set and solve real-world challenges.

Summary

Oracle GoldenGate's move to Microservices Architecture is a transformative shift that brings numerous benefits but also new complexities. This book aims to serve as a comprehensive guide, easing your journey into this new paradigm and helping you unlock its full potential for your data integration needs.

Stay tuned as we delve deep into the intricacies and potentials of Oracle GoldenGate Microservices Architecture.

CHAPTER 2

Oracle GoldenGate HUB Architecture

A HUB Architecture refers to a configuration where a central GoldenGate instance manages the data replication across various source and target systems, in comparison to typical installation of GoldenGate installed on each specific source and target systems. A central HUB is utilized to move data directly between sources and targets.

Oracle GoldenGate Traditional Architecture

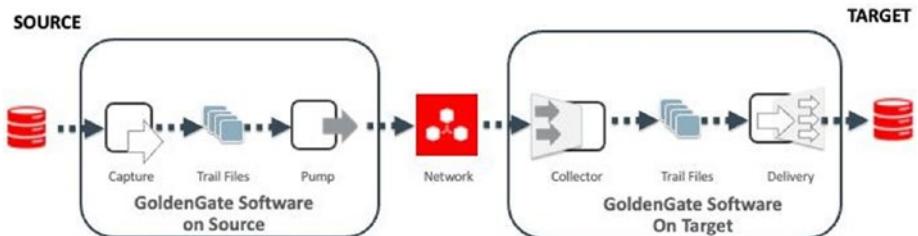


Figure 2-1. Oracle GoldenGate traditional architecture

Oracle GoldenGate HUB Architecture

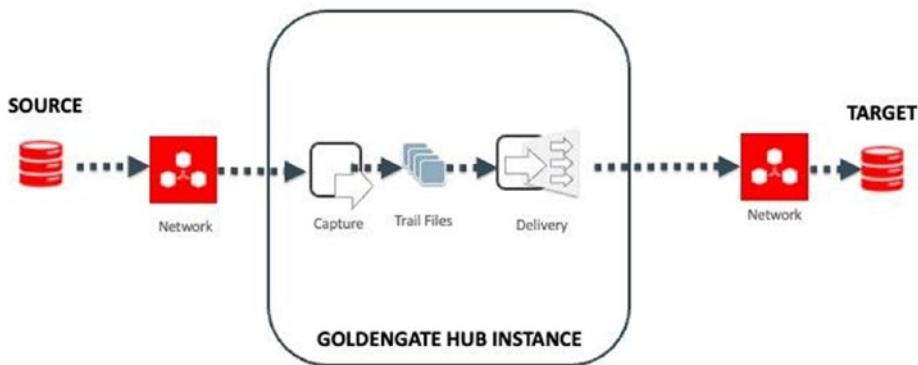


Figure 2-2. Oracle GoldenGate HUB Architecture

Here are some sample architecture examples that differentiate traditional architecture from HUB Architecture.

Benefits of a HUB Architecture with Oracle GoldenGate

- Centralized Management: Managing configurations, processes, and troubleshooting becomes more streamlined when all the GoldenGate instances are centralized.
- Scalability: It is easier to scale out as you can add more sources or targets without affecting existing connections.
- Reduced Complexity: A HUB setup can reduce the number of direct connections that need to be maintained. This is especially true if you have multiple sources and targets.

Core Components of the HUB Architecture

- Capture Processes: These are processes on the source system that capture the DML and DDL activities. These processes read the redo logs or transaction logs of the database and send the captured data from source systems and write the data into trail files on a HUB Instance.
- HUB Processes: These are the central GoldenGate instances where all data is routed through. They receive data from various sources, possibly transform or filter it, and then route it to the appropriate targets.
- Delivery Processes: On the target side, these processes receive data from the HUB and apply it to the target databases.

Setting Up a GoldenGate HUB

- Provision the OCI GoldenGate Services and create a deployment for the source and target. This is like setting up a VM on-premises and installing the GoldenGate software.
- Connections: Set up the source and target connections.
- Set Up Capture on Sources: Configure the Extract processes on the source databases to capture the required data and send it to the HUB.

- Set Up Delivery on Targets: Configure the Replicat processes on the target databases to receive data from the HUB and apply it to the databases.
- Start Processes: Once everything is configured, start the processes in order – Extract, Distribution Path, and Replicat.
- Monitor: Regularly monitor the processes, check error logs, and ensure that data is being replicated without issues.

Considerations

- Ensure that there is enough network bandwidth between the HUB, that is, OCI deployment and source/target.
- The HUB can be a single point of failure. Consider setting up a secondary HUB or using Oracle's built-in high availability solutions. This can be setting up multiple deployments across multiple regions.
- Regularly back up the HUB configurations/deployments and ensure disaster recovery plans are in place. Auto backup will be in place for OCI deployments for 60 days by default; however, manual deployment can be configured with Object Storage.

Summary

An Oracle GoldenGate HUB Architecture provides a centralized, scalable, and potentially more streamlined framework for overseeing data replication between numerous sources and destinations.

By channeling all data via a core HUB, greater control and simpler management can be achieved. Nonetheless, it's vital to guarantee that the HUB is sturdy, dependable, and equipped with the resources to manage the volume of data.

CHAPTER 3

Setting Up Oracle GoldenGate on the OCI Marketplace

Oracle GoldenGate is available on the Oracle Cloud Infrastructure (OCI) Marketplace as a prebuilt image that can be launched as an instance in the OCI environment. The GoldenGate image on the OCI Marketplace comes with preinstalled software and configurations to enable easy deployment and use of GoldenGate for data integration and replication.

The Oracle Cloud Infrastructure (OCI) Marketplace offers a range of prebuilt images for Oracle GoldenGate, including options for data replication to Relational Database Management System (RDBMS) and Big Data targets.

GoldenGate for RDBMS targets allows users to replicate data to various RDBMS systems, including Oracle Database, Microsoft SQL Server, IBM DB2, MySQL, and others.

GoldenGate for Big Data targets allows users to replicate data to various Big Data systems, including Apache Hadoop, Apache Kafka, Apache Cassandra, and others.

- Provisioning Oracle GoldenGate Microservices on the Marketplace
- Connecting to multiple data sources
- Working with RDBMS and Big Data targets

Introduction to Oracle GoldenGate on the OCI Marketplace

What is OCI Marketplace? Oracle's online store, OCI Marketplace, also known as Oracle Cloud Infrastructure Marketplace, offers a wide variety of preconfigured software programs, development stacks, and solutions that are prepared for deployment on OCI. Customers can use it as a central platform to find, buy, and deploy third-party software and services on Oracle Cloud.

The OCI Marketplace offers both open source and license-based software solutions in a carefully vetted inventory. These solutions span a wide range of fields, including networking, databases, analytics, machine learning, security, and DevOps. Customers may quickly and simply deploy these apps and services into their OCI infrastructure. Provisioning any apps through the Marketplace cuts down on the deployment and configuration time and effort.

Customers can benefit from prebuilt, verified, and certified software solutions that are made to work with Oracle Cloud Infrastructure by utilizing the OCI Marketplace. To improve their cloud environments and quicken their development processes, it provides a straightforward way to access and use a wide range of tools and apps.

Preparing the OCI Environment for GoldenGate

To set up Oracle GoldenGate in the Oracle Cloud Infrastructure (OCI) environment, certain prerequisites and criteria must be met before deploying the GoldenGate Stack. These consist of setting up IAM policies, designing security rules, and generating network resources.

A summary of the procedures is provided as follows:

Create a Virtual Cloud Network (VCN): To offer networking capabilities for the GoldenGate deployment, start by constructing a VCN. Follow the directions to construct a VCN in the OCI Console's Networking section. Include the subnet, Classless or Classless Inter-Domain Routing (CIDR) block, and any other pertinent information.

Configure Security Lists and Rules: To manage incoming and outgoing network traffic, configure security lists and rules inside the VCN. Make the relevant security lists to permit communication between the GoldenGate parts and the source/target database instances. Create rules that will allow the necessary protocols and ports.

Create Subnets: To separate and manage the resources, create subnets within the VCN. Depending on the network needs, decide on the number and size of subnets.

Configure Route Tables: Set up route tables to specify how traffic moves through the VCN. Ensure that subnets are properly routed and can access the Internet.

Define IAM Policies: Set up Identity and Access Management (IAM) policies to allow individuals, groups, or service principals the required access rights, so they may manage and use GoldenGate resources. Actions like generating and maintaining computing instances, networking devices, and storage resources should be permitted under these regulations.

Networking for GoldenGate: Make sure that the compute instances hosting GoldenGate can connect with the source and destination databases by configuring the networking for GoldenGate. For the necessary network connectivity, update the listener settings, firewall rules, and security lists.

These steps provide a high-level idea of how to set up the OCI environment ready for Oracle GoldenGate. Depending on the unique requirements and the networking architecture you choose to use, the details and configurations may change. For comprehensive instructions and best practices, it is advised to review the official Oracle GoldenGate documentation and OCI documentation. This book does not cover the details of setting up the OCI network process.

How to Access the OCI Marketplace

Go to the Oracle Cloud Infrastructure (OCI) Console by visiting the OCI website:

www.oracle.com/cloud/

Sign in to your OCI account using your credentials.

CHAPTER 3 SETTING UP ORACLE GOLDENGATE ON THE OCI MARKETPLACE

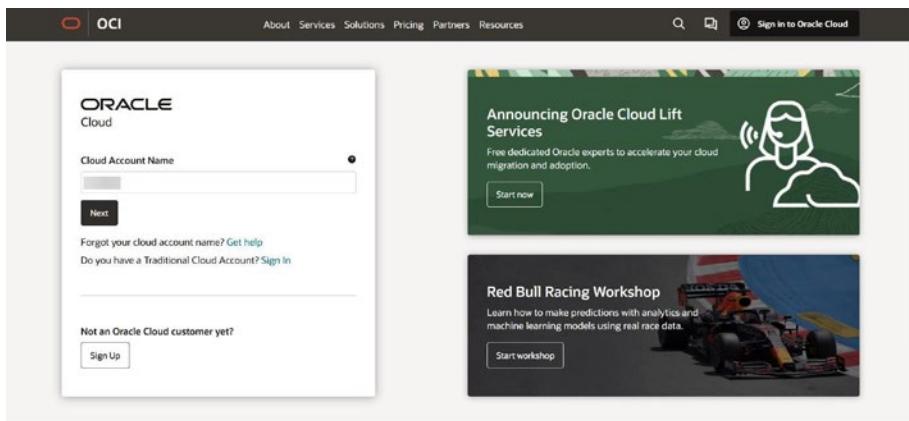


Figure 3-1. Log in to OCI using Cloud Account Name

Select “Marketplace” from the primary navigation menu after logging in to access the OCI Marketplace.

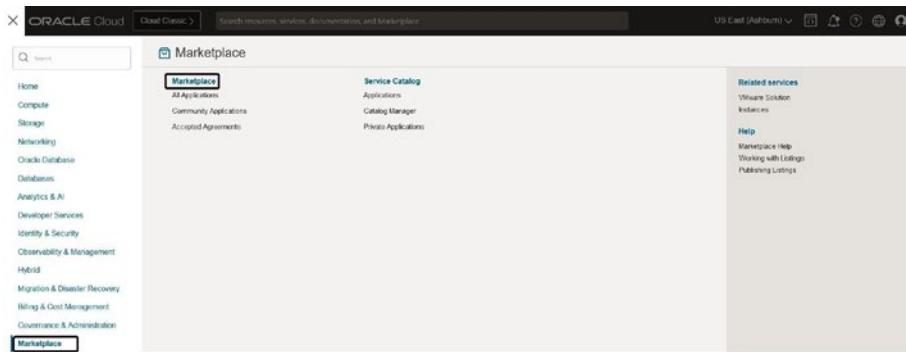


Figure 3-2. Marketplace section in OCI

A list of accessible products and services divided into several categories can be found in the OCI Marketplace. To discover offerings, either use the search box or the category navigation.

Click the listing of the solution you are interested in to access additional information, including the description, cost, and user reviews.

In our scenario, GoldenGate will be the application.

CHAPTER 3 SETTING UP ORACLE GOLDENGATE ON THE OCI MARKETPLACE

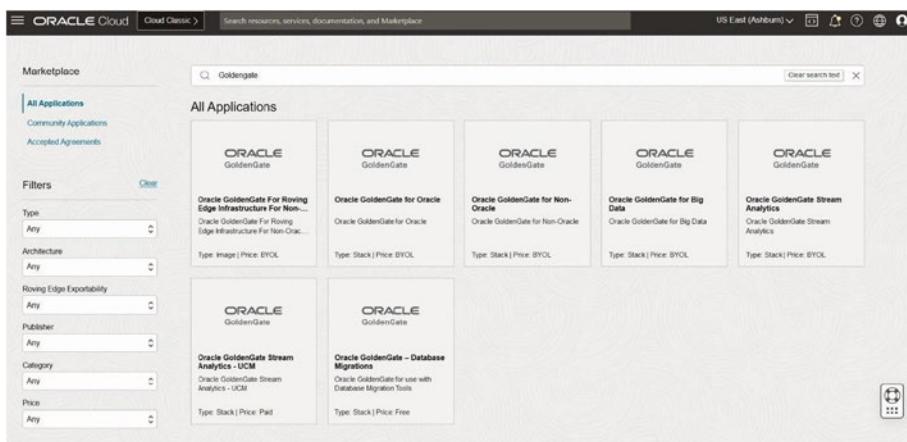


Figure 3-3. *GoldenGate search in the Marketplace section of OCI*

Launching Oracle GoldenGate from the OCI Marketplace

After logging in to OCI ► Marketplace, use the search box or the available listings to find “GoldenGate” in the OCI Marketplace.

For many use cases and scenarios, the Oracle GoldenGate images are available in the OCI Marketplace. GoldenGate for Oracle, GoldenGate for Big Data, GoldenGate for Non-Oracle Databases, and Oracle GoldenGate for Migration Stacks are some of the examples.

This book focuses on the deployment and configuration of Oracle GoldenGate specifically for Oracle Databases, covering the setup of the source and target databases for replication. The underlying concepts and principles discussed can be applied to other products within the GoldenGate suite.

CHAPTER 3 SETTING UP ORACLE GOLDENGATE ON THE OCI MARKETPLACE

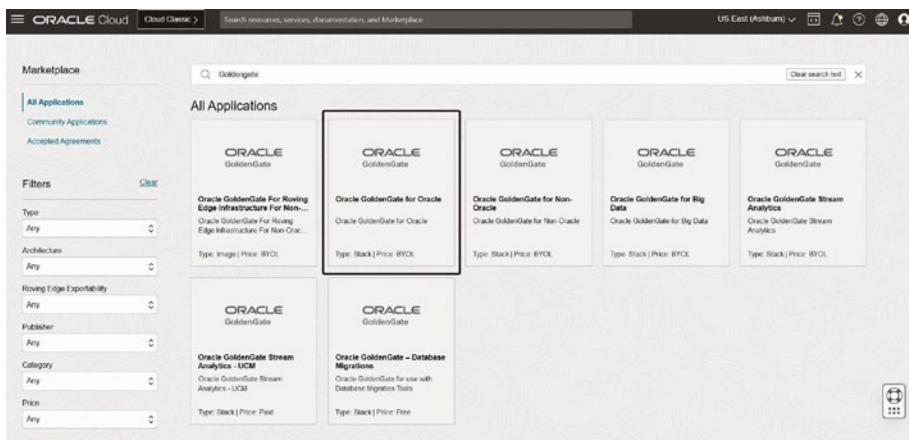


Figure 3-4. Selecting GoldenGate for Oracle in the Marketplace of OCI

Select the Oracle GoldenGate for Oracle from the stack. Click Launch Stack.

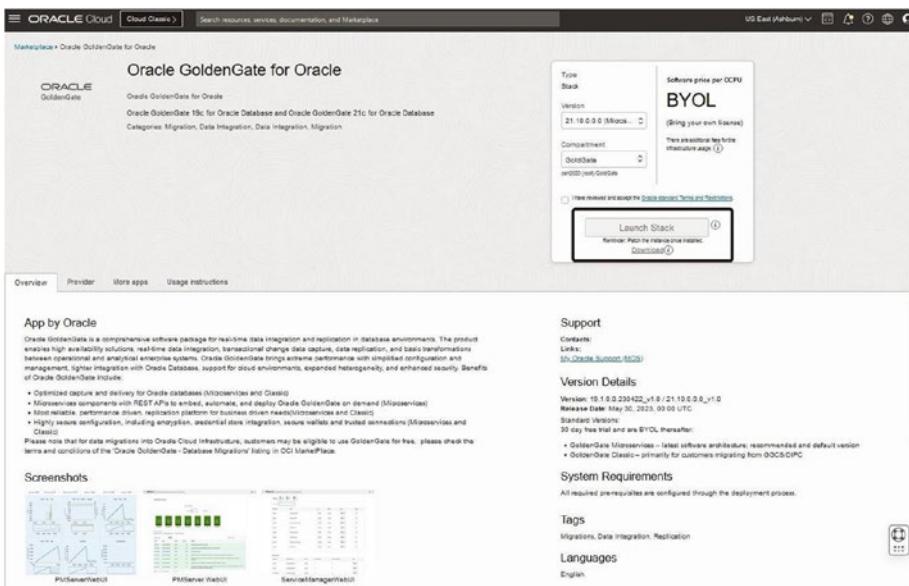


Figure 3-5. Launching the stack of GoldenGate from the Marketplace

CHAPTER 3 SETTING UP ORACLE GOLDENGATE ON THE OCI MARKETPLACE

Before launching the stack, make sure to select the appropriate compartment. Once launched, these are the information that needs to be filled in:

- Name
- Description
- Compartment
- Tags – Optional
- Display Name
- Host DNS
- Network Settings like VCN and Subnet Information
- Instance Settings like AD, Compute Shape, Public IP, and Custom Volume Sizes
- Deployment Name and SSH Public Key

The following screens assist to articulate the required information that needs to be filled in.

CHAPTER 3 SETTING UP ORACLE GOLDENGATE ON THE OCI MARKETPLACE

The screenshot shows the Oracle Cloud 'Create stack' interface. At the top, there's a navigation bar with the Oracle Cloud logo, 'Cloud Classic >', and a search bar. Below the header, the title 'Create stack' is displayed. The main area is divided into several sections:

- Stack information:** A note states: "Your application will launch as part of a stack that includes the infrastructure resources required to ensure that the application deploys and runs properly." It includes a preview icon showing three stacked boxes and the text "Oracle GoldenGate 21.10.0.0 Microservices Edition for Oracle".
- Custom providers:** A checkbox labeled "Use custom Terraform providers" is present, with a note below it: "Store custom Terraform providers in a bucket".
- Name (Optional):** The input field contains "GoldenGate for Oracle".
- Description (Optional):** The input field contains "Golden Gate for Demo Provisioning".
- Create in compartment:** A dropdown menu shows "GoldGate" and "oci0220 (inst)@GoldGate".
- Terraform version:** A dropdown menu shows "0.14.x".

At the bottom of the form, there are "Next" and "Cancel" buttons.

Figure 3-6a. Stack information to launch GoldenGate

CHAPTER 3 SETTING UP ORACLE GOLDENGATE ON THE OCI MARKETPLACE

The screenshot shows the Oracle Cloud 'Create stack' interface. At the top, there's a navigation bar with the Oracle Cloud logo, 'Cloud Classic >', and a search bar. Below the navigation bar, the title 'Create stack' is displayed. On the left, a vertical sidebar lists three steps: '1 Stack information', '2 Configure variables', and '3 Review'. The main area is titled 'Configure the variables for the infrastructure resources that this stack will create when you run the apply job for this execution plan.' It contains two sections: 'Name for New Resources' and 'Network Settings'.

Name for New Resources

- Display Name:** OGG 21c-Oracle
- Host DNS Name (Optional):** ogg21cora

Network Settings

- Create New Network:** (Use this field to indicate whether you want to create new network resources or use existing ones)
- VCN Network Compartment (Optional):** GoldGate
- VCN:** GG_VCN
- Subnet Network Compartment (Optional):** GoldGate
- Subnet:** Public Subnet-GG_VCN (Regional)

Figure 3-6b. Stack information to launch GoldenGate

CHAPTER 3 SETTING UP ORACLE GOLDENGATE ON THE OCI MARKETPLACE

The screenshot shows the Oracle Cloud 'Create stack' interface. The top navigation bar includes the Oracle Cloud logo, 'Cloud Classic >', and a search bar. The main area is titled 'Create stack'.

Instance Settings

- Availability Domain:** QINs-US-ASHBURN-AD-1
- Compute Shape:** VM Standard2.4
- Assign Public IP:** (checkbox checked)
- Custom Volume Sizes:** (checkbox unchecked)

Create OGG Deployment

- Deployment Name:** DEMO-MP
- Deployment - Autonomous Database:** (checkbox unchecked)

Shell Access

SSH Public Key:
JnZG3SkICF9/QGHMK4fn7bjx2T+CSDH1IEpKQNPE+yYaxFr3OWvSx6oDVEyalDzZsqxHzahrZzH6n/m1Vek9OvQLXPy0WDmedC

Public Key for allowing SSH access as the 'sgc' user

At the bottom are buttons for 'Previous', 'Next', and 'Cancel'.

Figure 3-6c. Stack information to launch GoldenGate

CHAPTER 3 SETTING UP ORACLE GOLDENGATE ON THE OCI MARKETPLACE

The screenshot shows the Oracle Cloud 'Create stack' interface. At the top, there are three tabs: 'Stack Information' (selected), 'Configure variables', and 'Review'. Below the tabs, the 'Network Settings' section lists VCN Network Compartment (vbgqhg) and VCN (xnlkma). The 'Subnet Network Compartment' section lists Subnet (vbgqhg) and Subnet (prceba). Under 'Instance Settings', the Availability Domain is QHNs-US-ASHBURN-AD-1. In the 'Create OGG Deployment' section, the Deployment Name is DEMO-MP. The 'Shell Access' section shows an SSH Public Key (DenvdCv). A callout box at the bottom asks 'Run apply on the created stack?' with a note: 'Immediately provision the resources defined in the Terraform configuration by running the apply action on the new stack.' A checkbox labeled 'Run apply' is checked. At the bottom of the screen are 'Previous', 'Create' (highlighted in blue), and 'Cancel' buttons.

Figure 3-6d. Review the stack and create

CHAPTER 3 SETTING UP ORACLE GOLDENGATE ON THE OCI MARKETPLACE

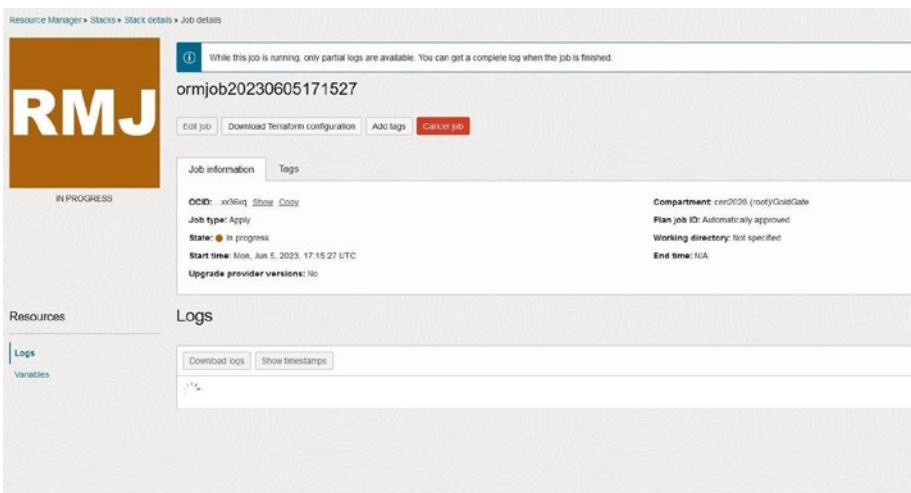


Figure 3-7. Progress of provisioning the GoldenGate

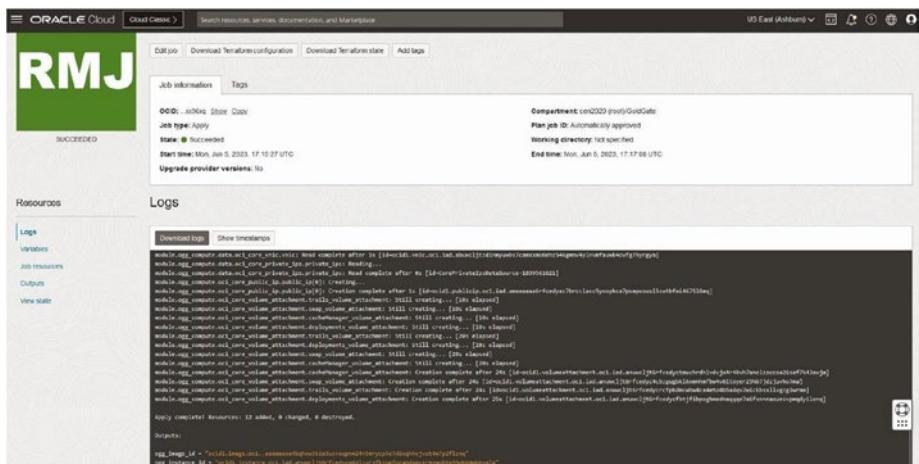


Figure 3-8. Screenshot after successful provision from the OCI Marketplace

Note The same deployments can also be configured and run through Terraform code; however, we will not be covering the Terraform topic in this book.

After successfully deploying Oracle GoldenGate from the OCI Marketplace, you can access and configure it by following these steps:

1. Check the IP address/complete hostname with FQDN to log in to the shell. You can use any tools like PuTTY and MobaXterm to access the shell.
(Download it from www.putty.org and <https://mobaxterm.mobatek.net>.)

The screenshot shows the Oracle Cloud Infrastructure (OCI) Compute Instances page. On the left, there's a sidebar with options like Overview, Instances (which is selected), Dedicated Virtual Machine Hosts, Instance Configurations, Instance Pools, Cluster Networks, Compute Clusters, AutoScaling Configurations, Capacity Reservations, and Custom Images. Below that is a List scope section with a compartment dropdown set to 'GoldGate' and a filtering section with a 'State' dropdown set to 'Any state'. The main area is titled 'Instances in Compartment' and contains a table with one row. The table columns are Name, State, Public IP, Private IP, Shape, OCPU count, Memory (GB), Availability domain, Fault domain, and Created. The single row shows 'Oracle_GoldenGate_21.10.0.0_Microservices_Edition_for_Oracl...' with a status of 'Running', Public IP '129.0.149.243', Private IP '10.0.0.23', Shape 'VM.Standard2.0', OCPU count '4', Memory '60', AD-1, FD-1, and a creation date of 'Mon, Jun ...'. There are also 'Create instance' and 'Table settings' buttons at the top of the table.

Figure 3-9. Viewing the provisioned Marketplace Image under the Compute Instance section

2. After logging in to the Compute VM Instance, make a note of the username and password listed under ogg-credentials.json.

```
-bash-4.2$ ls -la
total 0
drwxr-xr-x. 5 opc  opc  75 Jun  5 17:32 .
drwxr-xr-x. 3 root root 17 May  2 12:45 ..
drwxrwxr-x. 3 opc  opc  18 Jun  5 17:32 .cache
drwxrwxr-x. 3 opc  opc  18 Jun  5 17:32 .config
lrwxrwxrwx. 1 opc  opc  37 Jun  5 17:18 ogg-credentials.json -> /u02/deployments/ogg-credentials.json
drwx----- 2 opc  opc  29 Jun  5 17:17 .ash
-bash-4.2$ cat ogg-credentials.json
{"username": "oggadmin", "credential": "4%inuOs091Gh_sW3"}
-bash-4.2$ 
```

Figure 3-10. GoldenGate username and password retrieval

3. Use the IP address/hostname in any of the browsers and log in to the Microservice UI page of GoldenGate.

Example: <https://129.80.140.243>

Username: oggadmin

Password: inuOs091Gh_sW3

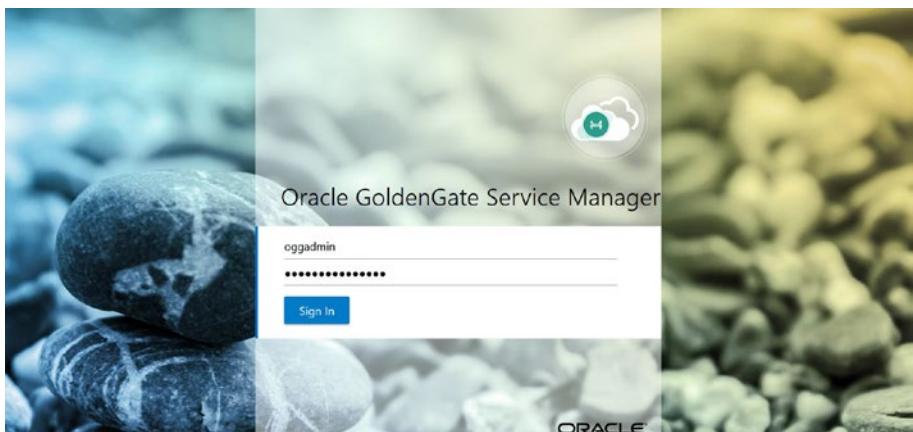


Figure 3-11. Welcome screen of the GoldenGate UI in Microservices

Configuring the Oracle GoldenGate Marketplace

- After logging in, the Service Manager page would be displayed here.

The “GoldenGate Service Manager” is a component or service responsible for managing and coordinating Oracle GoldenGate instances within the microservices ecosystem. Oracle GoldenGate deployments can be controlled on a localhost with the Service Manager.

The screenshot shows the Oracle GoldenGate Service Manager interface. At the top, there are four status indicators: Running (4), Aborted (0), Down (0), and Error (0). Below this is a deployment selector set to 'All'. The main area is divided into two tables: 'Services' and 'Deployments'.

Deployment	Service	Port	Status	Action	Details
DEMO-MP	Administration Service	9011	Running	Action	⋮
DEMO-MP	Distribution Service	9012	Running	Action	⋮
DEMO-MP	Performance Metrics Service	9014	Running	Action	⋮
DEMO-MP	Receiver Service	9013	Running	Action	⋮

Deployment	GoldenGate Home	Status	Running Services	Not Running Services	Action
DEMO-MP	/opt/app/ogg	Running	4	0	Action
ServiceManager	/opt/app/ogg	Running	0	0	Action

Figure 3-12. Service Manager UI page

- Select Deployment Name, in this example DEMO-MP, and click Configuration.

Make sure to add the TNS entries of SOURCE and TARGET database information in this location on the preconfigured VM.

CHAPTER 3 SETTING UP ORACLE GOLDENGATE ON THE OCI MARKETPLACE

The screenshot shows the Oracle Goldengate configuration interface for a deployment named 'DEMO-MP'. On the left, there's a sidebar with options like Overview, Debug Log, Diagnosis, Administrator, and Certificate Management. The main area has tabs for Overview, Deployment Information, Configuration (which is selected), Certificates, and Authorization Profiles. Under Configuration, there's a section for Environment Variables with a plus sign icon. A table lists two variables: TNS_ADMIN with a value of /u02/deployments/DEMO-MP/etc, and JAVA_HOME with a value of \${OGG_HOME}/jdk. Each row has edit and delete icons in the Actions column.

Variable Name	Variable Value	Actions
TNS_ADMIN	/u02/deployments/DEMO-MP/etc	
JAVA_HOME	\${OGG_HOME}/jdk	

Figure 3-13. Deployment configuration

3. Add the TNS entries of both SOURCE and TARGET databases under /u02/deployments/DEMO-MP/etc by creating new tnsnames.ora as follows:

ORCL_SOURCE = SOURCE DATABASE (On-Premise Database)

OCIDBAAS_TARGET = TARGET DATABASE (DBaaS on OCI)

OCIDBAAS_TARGET_PDB = TARGET DATABASE PDB

CHAPTER 3 SETTING UP ORACLE GOLDENGATE ON THE OCI MARKETPLACE

```
ORCL_SOURCE =
(DESCRIPTION =
  (ADDRESS = (PROTOCOL = TCP)(HOST = 10.0.0.8)(PORT = 1521))
  (CONNECT_DATA =
    (SERVER = DEDICATED)
    (SERVICE_NAME = ORCL)
  )
)

OCIDBAAS_TARGET =
(DESCRIPTION =
  (ADDRESS = (PROTOCOL = TCP)(HOST = 10.0.0.80)(PORT = 1521))
  (CONNECT_DATA =
    (SERVER = DEDICATED)
    (SERVICE_NAME = OCIDB_tv4_iad.sub10051757060.ggvn.oraclevcn.com)
  )
)

OCIDBAAS_TARGET_PDB =
(DESCRIPTION =
  (ADDRESS = (PROTOCOL = TCP)(HOST = 10.0.0.80)(PORT = 1521))
  (CONNECT_DATA =
    (SERVER = DEDICATED)
    (SERVICE_NAME = ocldb_pdb1.sub10051757060.ggvn.oraclevcn.com)
  )
)
```

Figure 3-14. TNS entry configuration

4. Now let us configure the Extracts to capture the changes from the source database ORCL.

Select port 9011 to launch the administrative service, as shown in Figure 3-15, and choose the Configuration option.

CHAPTER 3 SETTING UP ORACLE GOLDENGATE ON THE OCI MARKETPLACE

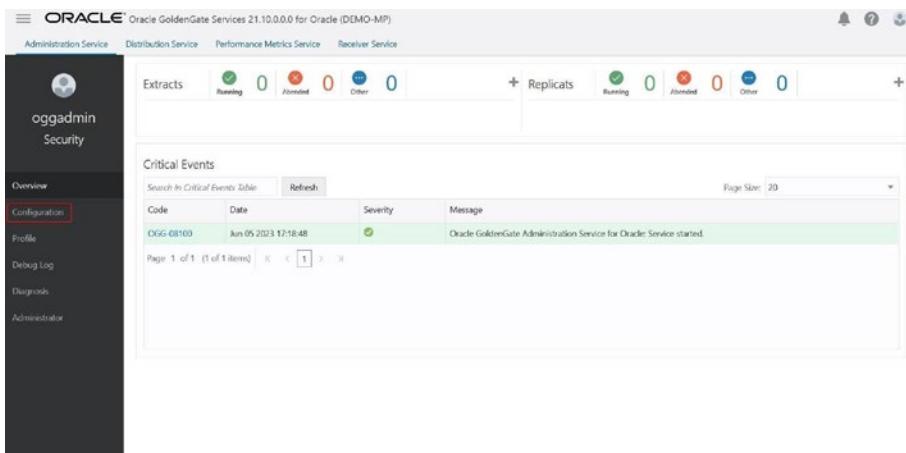


Figure 3-15. Deployment configuration section

- Now in the configuration, let us create the entry for both SOURCE and TARGET databases. Make sure you create a ggadmin user on both the databases with the following privileges:

Check Supplemental Logging

```
SQL> SELECT supplemental_log_data_min, force_logging FROM v$database;
```

If the result is YES, the database meets the Oracle GoldenGate requirement.

If the result is NO from the above output, please proceed with the following steps.

```
SQL> ALTER DATABASE ADD SUPPLEMENTAL LOG DATA;
```

For Extracts and Replicats

Enable_Goldengate_Replication Parameter

CHAPTER 3 SETTING UP ORACLE GOLDENGATE ON THE OCI MARKETPLACE

```
SQL> alter system set enable_goldengate_replication=true
scope=both sid='*';
```

```
SQL> show parameter ENABLE_GOLDENGATE_REPLICATION
Value should be True.
```

Create Users And Tablespaces In Container Database (CDB) and Pluggable Database (PDB)

```
SQL> create tablespace TBS_GGS datafile '+DATAC1' size 500m;
Tablespace created.
```

```
SQL> create user c##ggadmin identified by "Password_123"
default tablespace TBS_GGS temporary tablespace temp;
User created.
```

```
SQL> alter user c##ggadmin quota unlimited on TBS_GGS;
User altered.
```

```
SQL> alter user c##ggadmin identified by "Password_123";
User altered.
```

```
SQL> exec dbms_goldengate_auth.grant_admin_privilege('c##ggadmin'
,container=>'all');
PL/SQL procedure successfully completed.
```

```
SQL> show pdbs
2 PDB$SEED    READ ONLY    NO
3 PDB1        READ WRITE   NO
```

```
SQL> alter session set container=PDB1;
Session altered.
```

```
SQL> create tablespace TBS_GGS datafile '+DATAC1' size 500m;
Tablespace created.
```

```
SQL> create user c##ggadmin identified by "Password_123"
```

```
default tablespace TBS_GGS temporary tablespace temp;  
User created.
```

```
SQL> alter user c##ggadmin quota unlimited on TBS_GGS;  
User altered.
```

```
SQL> alter user c##ggadmin identified by "Password_123";  
User altered.
```

Grant Privileges in CDB + PDB

- grant connect,resource to c##ggadmin;
- grant create session to c##ggadmin;
- grant select any dictionary, select any table,SELECT ANY TRANSACTION to c##ggadmin;
- grant create table, alter any table to c##ggadmin;
- grant flashback any table to c##ggadmin;
- grant execute on dbms_flashback to c##ggadmin;
- grant execute on utl_file to c##ggadmin;
- grant select on system.logmnr_session\$ to c##ggadmin;

Now let's add connection details of the database into GoldenGate.

Select Configuration ➤ Credentials ➤ +.

SOURCE DATABASE

- Credential Domain: OracleGoldenGate
- Credential Alias: SOURCEDB
- UserID: ggadmin@ORCL_SOURCE (as added in the TNS Entry)
- Password: DB password of the ggadmin

CHAPTER 3 SETTING UP ORACLE GOLDENGATE ON THE OCI MARKETPLACE

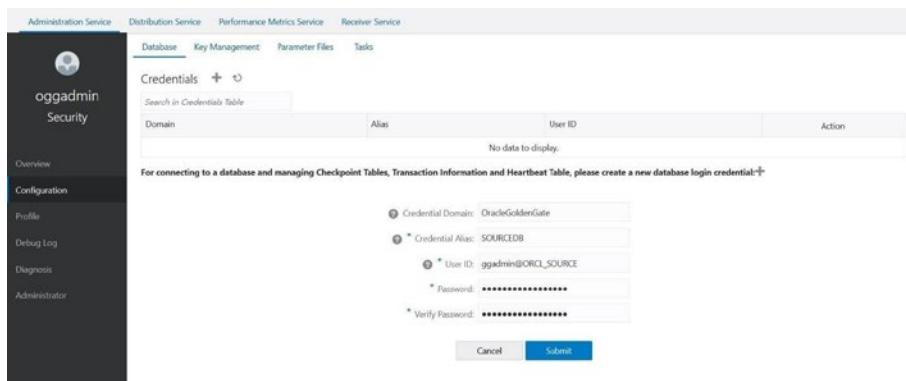


Figure 3-16. Deployment credential configuration section for source

TARGET DATABASE – CDB

- Credential Domain: OracleGoldenGate
- Credential Alias: TARGETDB
- UserID: c##ggadmin@OCIDBAAS_TARGET (as added in the TNS Entry)
- Password: DB password of the c##ggadmin

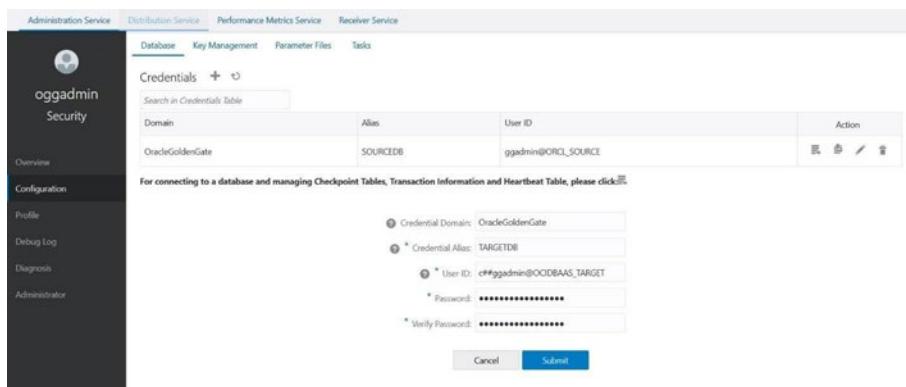


Figure 3-17. Deployment credential configuration section for target CDB

TARGET DATABASE – PDB

- Credential Domain: OracleGoldenGate
- Credential Alias: TARGETDB_PDB
- UserID: c##ggadmin@OCIDBAAS_TARGET_PDB (as added in the TNS Entry)
- Password: DB password of the c##ggadmin

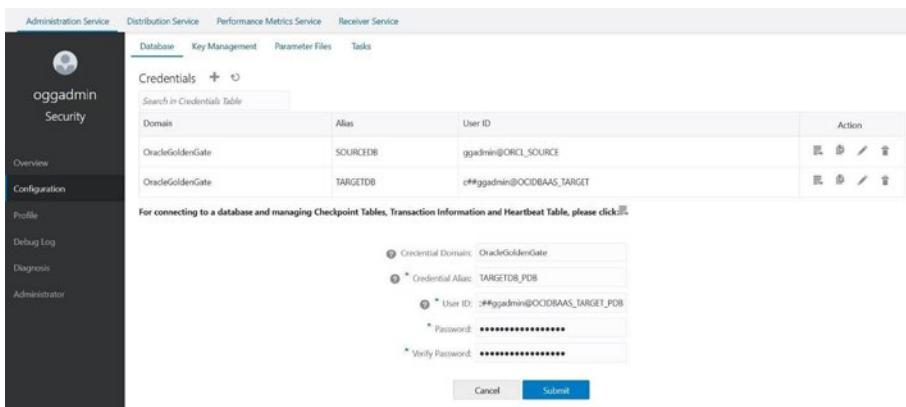


Figure 3-18. Deployment credential configuration section for target PDB

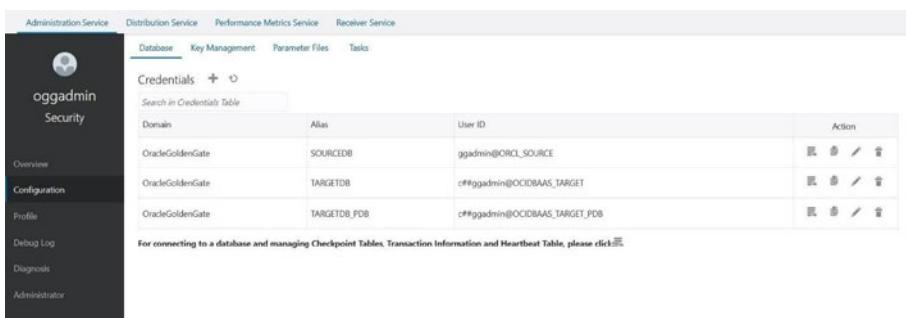


Figure 3-19. Final screen after creating connections for SOURCE DB, TARGET CDB, and TARGET PDB

Creating an Extract

This topic is dedicated to setting up an Extract that targets the Oracle Database for capturing change data, and records these changes into trail files.

Extracts are responsible for capturing data changes from the source database, such as inserts, updates, and deletes. They identify and Extract the modified data records.



Figure 3-20a. Creating an Integrated Extract

There are two types of Extracts. One is the integrated Extract for Change Data Capture (CDC) changes, and the other one is the initial load Extract, which Extracts data from the source.

Add New Extract

The parameters are listed as follows:

- Process Name: EXTORCL
- Trail Name: lt
- Trail Subdirectory: /u02/trails
- Trail Size: 50 MB (This value can be changed according to requirements.)

CHAPTER 3 SETTING UP ORACLE GOLDENGATE ON THE OCI MARKETPLACE

The screenshot shows the 'Add Extract' wizard with three steps: 'Extract Type' (selected), 'Extract Options', and 'Parameter File'. The 'Basic Information' step is active, displaying fields for Process Name (EXTORCL), Description (Extract process from Source Oracle), Intent (Unidirectional), Begin (Now), Trail Name (lt), Trail Subdirectory (A00/trails), Trail Size (MB) (50), Trail Sequence (0), Trail Offset (0), and Remote (unchecked). A note indicates to enter a number between 1 and 2,000 for Trail Size.

Figure 3-20b. Creating an Integrated Extract

Select Credential Domain and Credential Alias as created prior in the connection segment.

The screenshot shows the 'Source Database Credential' configuration. It includes sections for 'Create new credential' (with Credential Domain set to OracleGoldenGate and Credential Alias to SOURCEDB), 'Registration Information' (with CSN, Share set to Automatic, Optimized, and Downstream Capture options), and 'Encryption Profile' and 'Managed Options' sections. Navigation buttons 'Back <' and 'Next >' are at the bottom.

Figure 3-20c. Creating an Integrated Extract

Add Schema and Tables: In the example below, we have added the SOE schema along with all its tables, denoted by the asterisk (*) symbol.

CHAPTER 3 SETTING UP ORACLE GOLDENGATE ON THE OCI MARKETPLACE

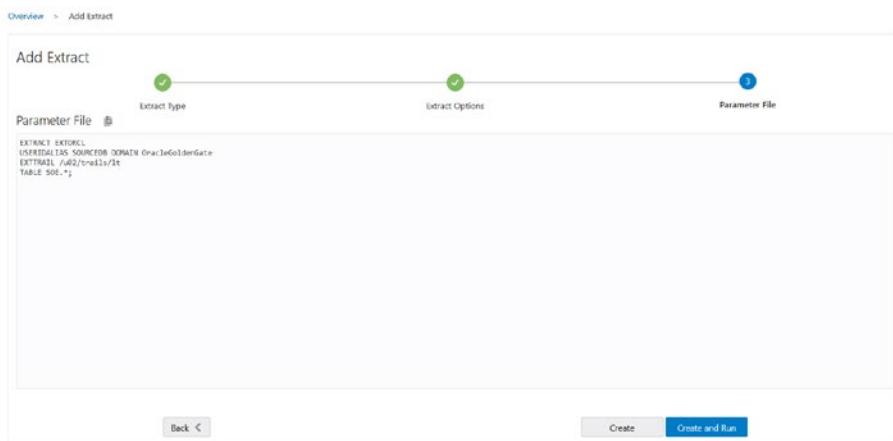


Figure 3-20d. Creating an Integrated Extract

Click Create and Run Extract. The process will be created and will be turned into green as shown in Figure 3-20e.

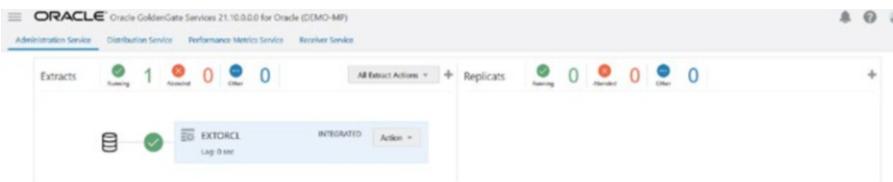


Figure 3-20e. Created Integrated Extract

Creating a Replicat

GoldenGate Replicat processes apply the captured data changes from source databases to target databases, ensuring consistency and integrity across the replicated data to the target.

There are many Replicat process types offered by Oracle GoldenGate; each type is created to cater to certain replication scenarios and needs. Here are the many Replicat process types offered by Oracle GoldenGate:

Classic Replicat

Classic Replicat is the traditional Replicat process used in Oracle GoldenGate. It applies captured data changes to the target database using SQL statements.

Integrated Replicat

Integrated Replicat is an optimized Replicat process that leverages Oracle Database's integrated capture feature. It operates in coordination with Oracle LogMiner, allowing for high-performance and low-impact data replication. Integrated Replicat is specifically designed for Oracle Database to Oracle Database replication scenarios.

Coordinated Replicat

Coordinated Replicat is an enhanced version of Classic Replicat that offers improved parallelism and performance. It allows for the concurrent execution of multiple Replicat threads to apply changes in parallel.

Coordinated Replicat is beneficial when replicating large volumes of data or when there is a need to minimize replication latency.

Non-Integrated Replicat

Non-Integrated Replicat refers to a type of Replicat process in Oracle GoldenGate that operates independently of the integrated capture feature provided by Oracle Database. Unlike Integrated Replicat, which works in conjunction with Oracle LogMiner, Non-Integrated Replicat uses its own mechanisms to capture and apply data changes to the target database.

Here is a way to create the Replicat Process on the OCI GoldenGate Marketplace Image.

CHAPTER 3 SETTING UP ORACLE GOLDENGATE ON THE OCI MARKETPLACE



Figure 3-21a. Creating an Integrated Replicat

Parameters:

- Replicat Name: RPTARGET
- Trail Name: lt
- Trail Subdirectory: /u02/trails
- Credential Domain: Select as created prior in the connection segment.
- Credential Alias: TARGETDB_PDB (as created prior in the connection segment)

CHAPTER 3 SETTING UP ORACLE GOLDENGATE ON THE OCI MARKETPLACE

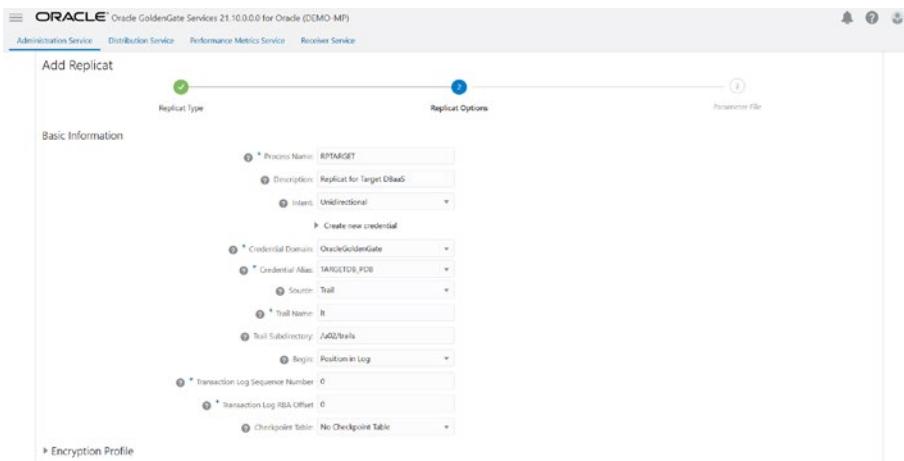


Figure 3-21b. Creating an Integrated Replicat

MAP SCHEMA.TABLES, TARGET SCHEMA.TABLES

In Figure 3-21c, the wildcard * has been used.

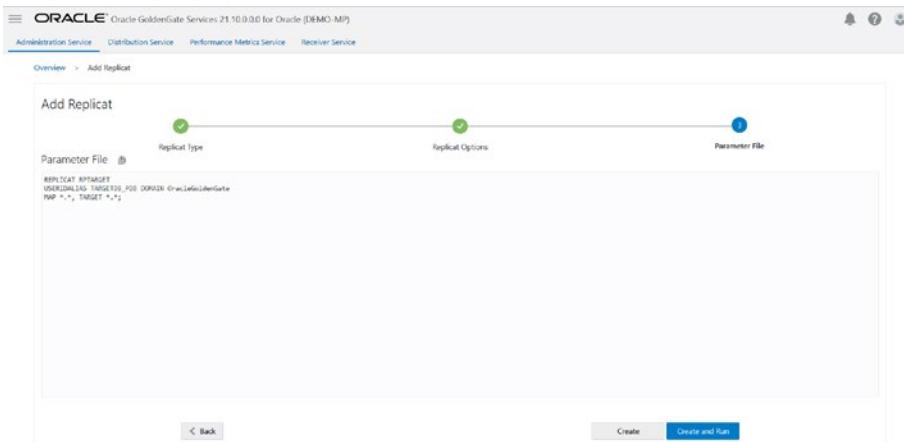


Figure 3-21c. Creating an Integrated Replicat

Click Create and Run Replicat. The Replicat process will be created and turned into green status.

CHAPTER 3 SETTING UP ORACLE GOLDENGATE ON THE OCI MARKETPLACE



Figure 3-21d. Created Integrated Replicat

Testing the DML Replication

One of the key aspects of GoldenGate is its ability to handle Data Manipulation Language (DML) operations effectively. In this topic, we will delve into the world of DML operations in GoldenGate, exploring how it captures, processes, and replicates insert, update, and delete operations.

INSERT DATA in the SOURCE DATABASE

SOURCE DATABASE: ORCL

OPERATION: INSERT, UPDATE, and DELETE

CHAPTER 3 SETTING UP ORACLE GOLDENGATE ON THE OCI MARKETPLACE

The screenshot shows a Worksheet window titled "Query Builder". The code entered is:

```
select name from v$database;  
Insert into SOE.CARDS  
(CARD_ID,CUSTOMER_ID,CARD_TYPE,CARD_NUMBER,EXPIRY_DATE,IS_VALID,SECURITY_CODE)  
values (1403370,47761,'Cheque',12345678,sysdate,'Y',3721);  
  
Insert into SOE.CARDS  
(CARD_ID,CUSTOMER_ID,CARD_TYPE,CARD_NUMBER,EXPIRY_DATE,IS_VALID,SECURITY_CODE)  
values (1403371,47762,'Cheque',12345678,sysdate,'Y',1234);  
commit;  
  
update SOE.CARDS set security_code=1234 where card_id=1403370 and customer_id=47761;  
commit;  
  
delete from SOE.CARDS where CARD_ID=1403371;  
commit;
```

The "Script Output" tab shows the results of the operations:

```
1 row inserted.  
1 row inserted.  
Commit complete.  
1 row updated.  
Commit complete.  
1 row deleted.  
Commit complete.
```

Figure 3-22. DML operation on the source database

VALIDATE THE DATA on the TARGET DATABASE

TARGET DATABASE: OCIDB

The screenshot shows a Worksheet window titled "Query Builder". The code entered is:

```
select name from v$database;  
select * from SOE.CARDS where card_id like '140337%'
```

The "Script Output" tab shows the results of the query:

```
NAME  
-----  
OCIDB
```

The "Query Result" tab shows the data in the SOE.CARDS table:

CARD_ID	CUSTOMER_ID	CARD_TYPE	CARD_NUMBER	EXPIRY_DATE	IS_VALID	SECURITY_CODE
1403370	47761	Cheque	12345678	06-JUN-23 01:57:37	Y	3721

Figure 3-23. DML operation reflected on the target database

CHAPTER 3 SETTING UP ORACLE GOLDENGATE ON THE OCI MARKETPLACE

The same validation can be performed on the statistics tab:

2 Inserts

1 Update

1 Delete

The screenshot shows two separate Oracle GoldenGate interface windows. Both windows have a top navigation bar with 'Overview' and 'Process Information' tabs, and a sub-header indicating the process is 'INTEGRATED'. Below this is a 'Statistics' tab, which is highlighted in blue, and other tabs like 'Checkpoint', 'Cache Manager Statistics', 'Parameters', and 'Report'. A dropdown menu shows 'Total' selected. On the right side of the top bar is a 'Refresh' button.

EXTORCL (INTEGRATED) Statistics View:

Table Name	Inserts	Updates	Deletes	Truncates	Ignores	Discards
SOE.CARDS	2	1	0	0	0	0

RPTARGET (INTEGRATED) Statistics View:

Source Table	Target Table	Inserts	Updates	Deletes	Truncates	Ignores	Discards	Conflicts
SOE.CARDS	OCIDE_PDB1.SOE.CARDS	2	1	0	0	0	0	0

Figure 3-24. Validation of DML under the statistics tab of GoldenGate

The Oracle GoldenGate Marketplace offers a valuable resource for simplifying the setup of Extracts and replicats for replication. By leveraging preconfigured templates, users can streamline the process, saving time and effort. With the steps outlined in this chapter, users can easily deploy the templates, configure the necessary processes, and achieve real-time data replication with confidence and efficiency.

Using CLI AdminClient for Microservices Architecture

The GoldenGate AdminClient tool is similar in interface in comparison to the classic GGSCI command-line utility. GoldenGate deployment is controlled and configured via the REST API published by the MSA Servers.

Usage:

connect https://HOSTNAME or IP-Address deployment

Deployment_Name as Username password "Password"!

The default behavior of AdminClient is HTTPS with a valid certificate. To override the certificate issue, use the ! at the end of the CONNECT command.

```
-bash-4.2$ cd /u01/app/ogg/bin
-bash-4.2$ ./adminclient
Oracle GoldenGate Administration Client for Oracle
Version 21.10.0.0.0 OGGMORE_21.10.0.0.OGGRU_PLATFORMS_230413.1303
Copyright (C) 1995, 2023, Oracle and/or its affiliates. All rights reserved.

Oracle Linux 7, x64, 64bit (optimized) on Apr 13 2023 14:32:44
Operating system character set identified as UTF-8.

OGG (not connected) 1> connect https://10.0.0.231 deployment DEMO-MP as oggadmin password "4%inuOs091Gh_SW3" !
OGG (https://10.0.0.231 DEMO-MP) 2> info all
Program      Status     Group      Type          Lag at Chkpt  Time Since Chkpt
ADMINSRVR    RUNNING
DISTSRVR    RUNNING
PMSRVR      RUNNING
RECVSRVR    RUNNING
EXTRACT      RUNNING    EXTRACTCL   INTEGRATED   00:00:00    00:00:01
REPLICAT    RUNNING    RPTARGET   INTEGRATED   00:00:00    00:00:07

OGG (https://10.0.0.231 DEMO-MP) 3> exit
```

Figure 3-25. Validation of DML under the statistics tab of GoldenGate

Managing and Monitoring Marketplace GoldenGate

Oracle GoldenGate Marketplace deployments can be managed and tracked for streamlined replication operations and address any potential problems in case of any failures. Here are a few steps involved for monitoring Extracts and replicats while using the Oracle GoldenGate Marketplace.

Custom Alerts Using Shell/Perl Script: Custom alerts can be a powerful tool for monitoring and managing GoldenGate status and for LAG Report. By using shell or Perl scripting, you can create tailored alerts that notify you when specific conditions are met or events occur.

Set Up Alert Delivery: Decide how you want to receive the alerts. You can configure email notifications, SMS messages, or even push notifications to a mobile device. Integrate the appropriate functionality within your script to send the alert to the desired recipients.

Oracle Enterprise Manager (OEM) offers a robust platform for managing and monitoring various Oracle products, including Oracle GoldenGate. By leveraging the alerting capabilities within OEM, administrators can proactively monitor GoldenGate deployments and promptly address critical events in case of process failure or LAG information.

Grafana supports OCI as a data source to query and visualize data stored in OCI services like Oracle Database, Object Storage, GoldenGate, and other services. To use OCI as a data source in Grafana, we will need to configure an OCI data source in Grafana using the appropriate credentials and settings. Once configured an OCI data source in Grafana, we can use it to create dashboards and panels that display OCI data in various formats like charts, tables, and graphs. We can also set up alerts in Grafana based on OCI data to notify you of important events or issues. Grafana uses real-time monitoring and visualization of GoldenGate data from OCI metrics and can be used to monitor GoldenGate.

Summary

Oracle GoldenGate on OCI Marketplace offers a streamlined and efficient solution for deploying and managing Oracle GoldenGate instances in the Oracle Cloud Infrastructure (OCI) environment with a few simple steps.

CHAPTER 3 SETTING UP ORACLE GOLDENGATE ON THE OCI MARKETPLACE

This comprehensive offering enables users to easily access, launch, configure, and optimize Oracle GoldenGate deployments. By leveraging the features provided by OCI Marketplace, users can set up real-time data integration and replication solutions with ease. With the support of troubleshooting resources and best practices, users can effectively manage and optimize their Oracle GoldenGate deployments on OCI Marketplace, facilitating seamless data synchronization and integration across their cloud infrastructure.

CHAPTER 4

Setting Up OCI Oracle GoldenGate Service for RDBMS

The Oracle GoldenGate PaaS Service for RDBMS simplifies the setup and management of GoldenGate, providing a user-friendly interface for configuring and deploying GoldenGate deployments.

To set up a PaaS service, it is required for a user to have an account on OCI (Oracle Cloud Infrastructure) with adequate service limits.

This particular PaaS service is exclusively dedicated to the creation and management of deployments and connection details.

Log in to the OCI Console, navigate to the GoldenGate Service, and create a new GoldenGate instance. Choose the desired compartment, region, and instance name, configure the required network settings, and create a GoldenGate instance.

After creating the instance, create a new deployment by specifying the source and target database details and replication direction.

- Configuring the source database
- Configuring the target database
- Examples of ORACLE, SQL SERVER, POSTGRES Databases
- Configuring the GoldenGate replication process

Introduction to Oracle GoldenGate PaaS Service for RDBMS

Oracle GoldenGate on Oracle Cloud Infrastructure is a complete fully administered cloud-native service capable of real-time, scalable data movement. It handles data as it transitions from one or multiple data management platforms to designated databases. Moreover, it allows for the planning, execution, coordination, and oversight of data replication activities without the need for setting up or maintaining any computing resources.

The following keywords are important for effectively understanding and implementing the GoldenGate Service on OCI:

1. Compartment: A compartment acts as a framework for grouping and segregating various cloud assets like cloud networks, computing instances, block storage volumes, and Oracle Cloud Infrastructure GoldenGate setups and database enrollments. Access to resources in a compartment is restricted to users who have been granted the appropriate permissions. Within the OCI GoldenGate environment, compartments also function as a security perimeter. Only setups and database registrations residing in the same compartment have the ability to interact with each other.

2. Deployment: This is a container that holds all the Oracle Cloud Infrastructure GoldenGate assets.
3. Database Registration: This stores authentication details for source and target databases and facilitates network communication between OCI GoldenGate Service's Virtual Cloud Network (VCN) and your own VCN via a private endpoint. The database registration establishes the connection information required for reaching source or target endpoints.
4. Deployment Backup: This is a snapshot of a deployment's existing condition that is preserved for a 60-day period by default. It can serve as a foundation for either restoring the original deployment or initiating a new one based on the status of the original at the moment the backup was captured.
5. Extract, Replicat, and Trail Files: Extract is a process that operates on the source database to Extract or collect data. Replicat is a process that operates on the target database to apply the captured data. Trail files are used for storing captured changes from the source database before they are applied to the target database.
6. VCN: A VCN (Virtual Cloud Network) is a customizable, private network in Oracle Cloud Infrastructure. It closely resembles a traditional network, with firewalls and specific types of communication gateways (e.g., Internet Gateway, NAT Gateway, Service Gateway) that you can use to enable traffic in and out.

7. Subnets: Subnets are subdivisions within a VCN. You can think of them as segments of the VCN where you can place resources (like compute instances, databases, etc.). Each subnet exists in a specific availability domain and consists of a contiguous range of IP addresses that do not overlap with other subnets in the VCN.

Provisioning Oracle GoldenGate Service for RDBMS

Create Deployment

An OCI GoldenGate deployment refers to the setup and configuration of the GoldenGate Service within the Oracle Cloud Infrastructure (OCI). A deployment acts as a container or a framework that consists of various resources and configurations required for replication tasks.

In the navigation menu of the Console, select Oracle Database and then choose GoldenGate.

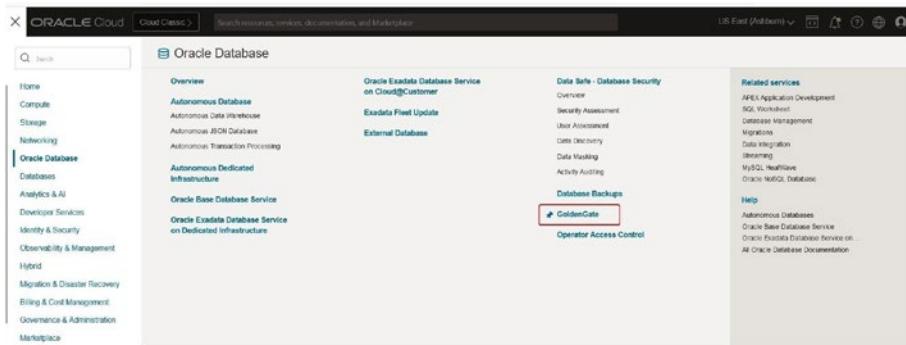


Figure 4-1. Navigating to OCI GoldenGate

CHAPTER 4 SETTING UP OCI ORACLE GOLDENGATE SERVICE FOR RDBMS

On the Deployments screen, select the option to Create Deployment.

- Enter the Deployment Name.
- Description: This is an optional information for the deployment.
- Compartment: Select the appropriate compartment. In this case, the precreated GoldenGate Compartment has been used.
- Oracle Compute Unit (OCPU) Count: Select the number of OCPUs according to the workload.
- Subnet: Select the precreated subnet.
- Choose License Type: If the organization already has a license of GoldenGate, then BYOL (bring your own license) will work. If there is no license acquired prior, the LICENSE INCLUDED option needs to be selected.

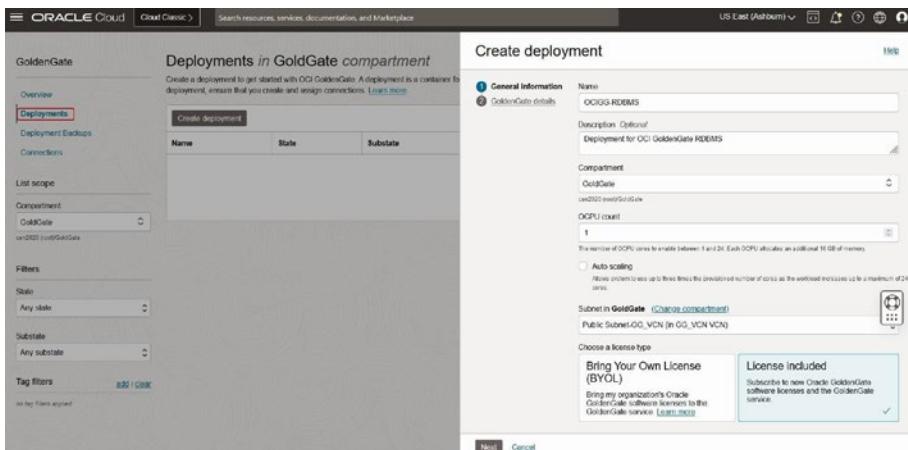


Figure 4-2. Create OCI GoldenGate deployment

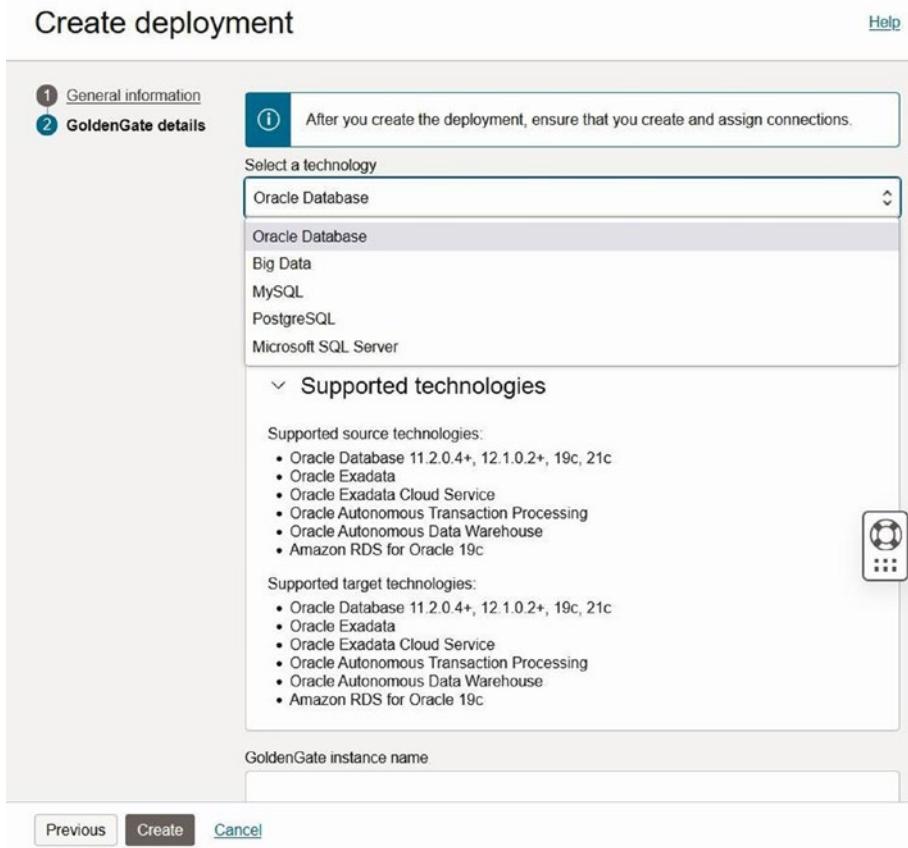


Figure 4-3. Select deployment technology

Fill in the instance name, administrator name, and password and click Create.

The screenshot shows the second step of a 'Create' wizard for Oracle GoldenGate. It has two tabs at the top: 'General information' (selected) and 'GoldenGate details'. The 'GoldenGate details' tab is currently inactive. The main content area is titled 'Supported technologies' with a dropdown arrow icon.

Supported source technologies:

- Oracle Database 11.2.0.4+, 12.1.0.2+, 19c, 21c
- Oracle Exadata
- Oracle Exadata Cloud Service
- Oracle Autonomous Transaction Processing
- Oracle Autonomous Data Warehouse
- Amazon RDS for Oracle 19c

Supported target technologies:

- Oracle Database 11.2.0.4+, 12.1.0.2+, 19c, 21c
- Oracle Exadata
- Oracle Exadata Cloud Service
- Oracle Autonomous Transaction Processing
- Oracle Autonomous Data Warehouse
- Amazon RDS for Oracle 19c

Below the technologies section, there are input fields for 'GoldenGate instance name' (set to 'Oracle-RDBMS'), 'Administrator username' (set to 'oggadmin'), and 'Administrator password' (a masked password). There is also a 'Confirm administrator password' field with a matching masked password. A small circular icon with a gear and dots is positioned next to the 'Administrator username' field.

Figure 4-4. Select supported technologies

Note Create and store credentials in OCI secrets. OCI secrets will store sensitive information of oggadmin passwords in encrypted format and store it securely in the cloud.

When configuring Oracle GoldenGate, simply reference the secret stored in OCI Secrets. This approach enhances security by minimizing exposure of sensitive information.

A new OCI GoldenGate deployment has been created in the compartment.

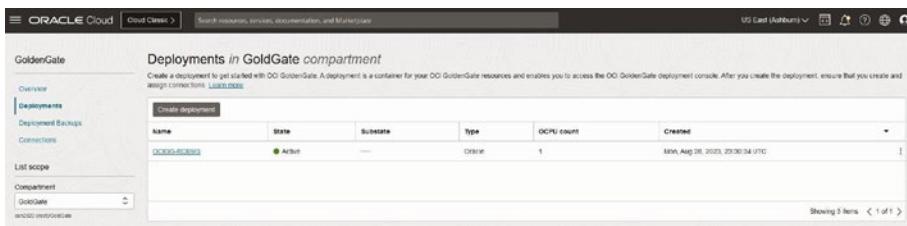


Figure 4-5. Deployment completion

Create Connection

A connection contains the information required for connecting to a source or target database. In this particular connection, we will establish connectivity from an on-premises Oracle source database to an Oracle Cloud Infrastructure Autonomous Database as the destination.

On-Premises Source Database Info:

Name: ORCL

IP Address: 10.0.0.8

OCI Target Database Info:

Name: ATPDB

Create Source Connection On-Premises Oracle Database

From the Overview page of OCI GoldenGate, select Connections, then choose Create Connection.

CHAPTER 4 SETTING UP OCI ORACLE GOLDENGATE SERVICE FOR RDBMS

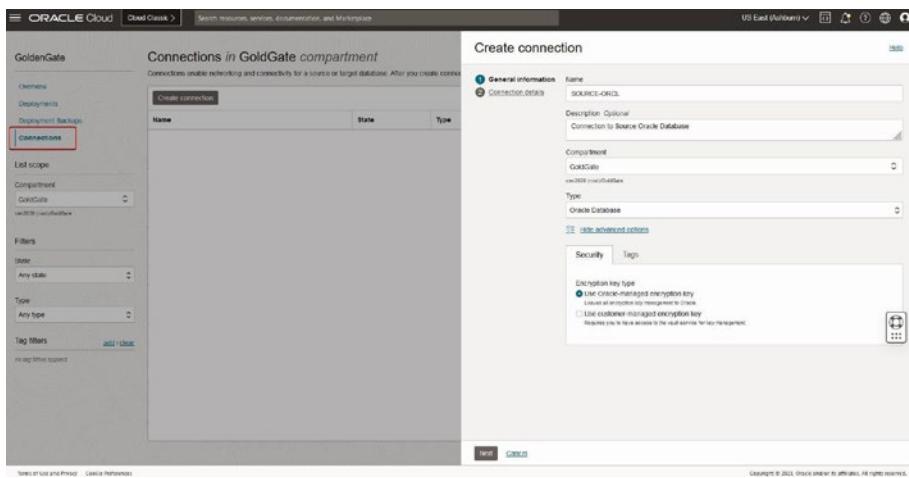


Figure 4-6. Create a connection (A)

- Input the name for connection, for example, SOURCE-ORCL.
- Description: Optional information.
- Compartment: Select the appropriate compartment in the OCI Console.
- Type: Select the appropriate database type, for example, Oracle Database.

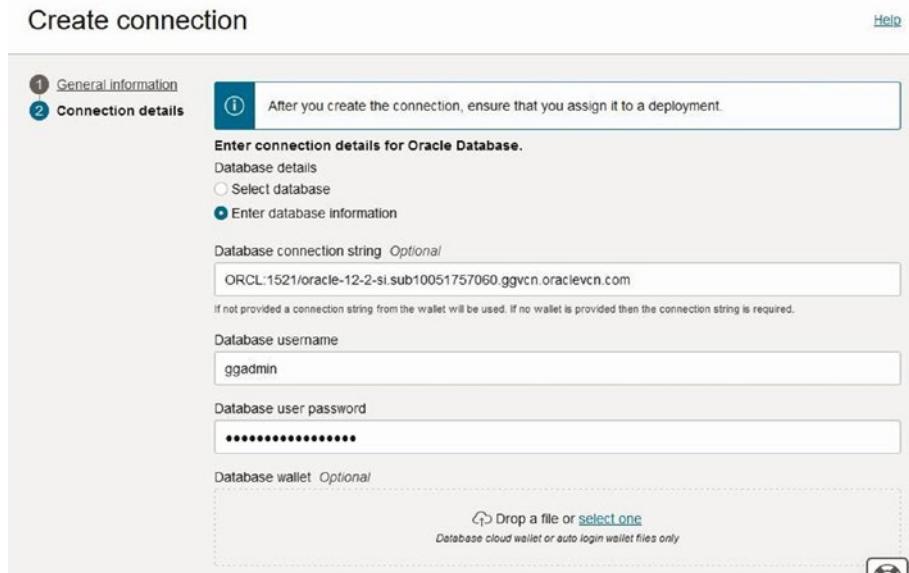


Figure 4-7. Create a connection (B)

- Input the database connection string.
- Input the database username. Example: ggadmin.
- Input the database user password.
- Click Create connection.

Once the connection is successfully created, assign the connection to the deployment. Here, in this case, assign it to the previously created deployment: OCIGG-RDBMS.

CHAPTER 4 SETTING UP OCI ORACLE GOLDENGATE SERVICE FOR RDBMS

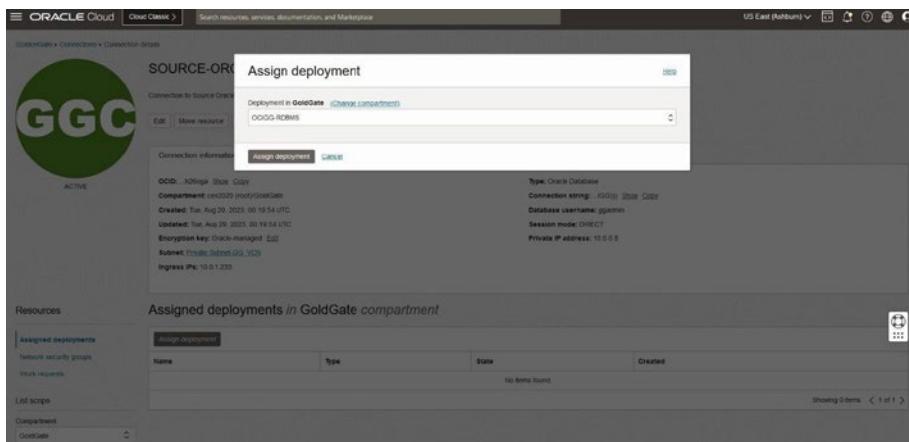


Figure 4-8. Assign connection to deployment

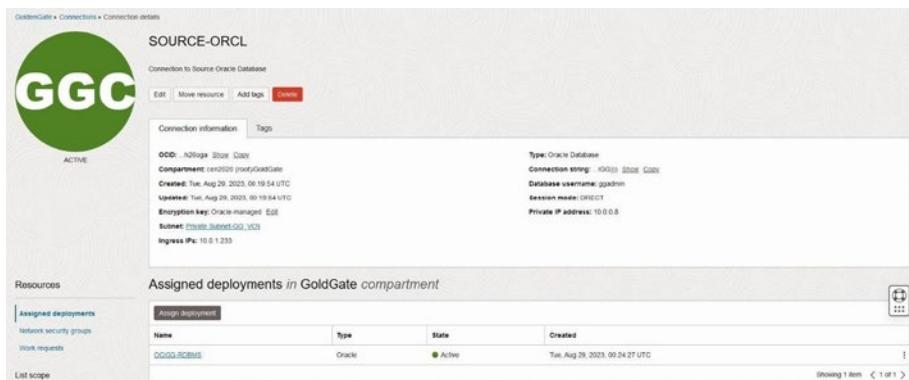


Figure 4-9. Final active screen after assigning the connection to deployment

Create Target Connection OCI Autonomous Database

From the Overview page of OCI GoldenGate, select Connections, then choose Create Connection.

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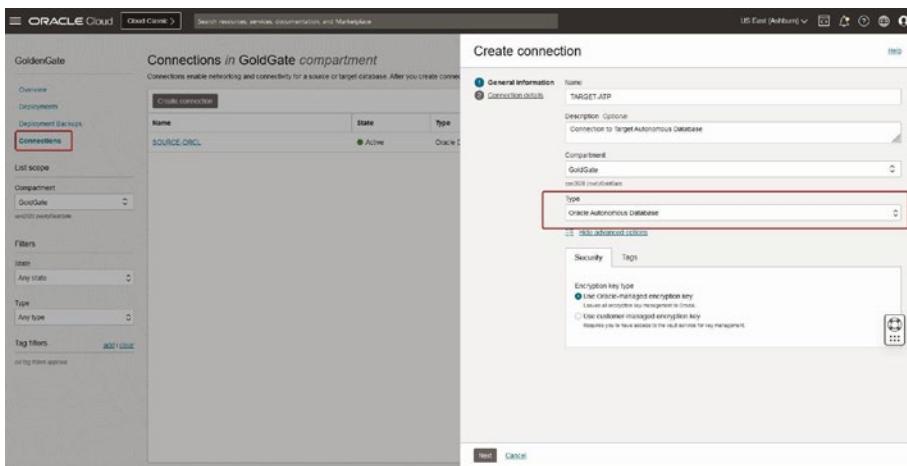


Figure 4-10. Create connection for Autonomous

- Input the name for the connection, for example, TARGET-ATP.
- Description: Optional information.
- Compartment: Select the appropriate compartment in the OCI Console.
- Type: Select the appropriate database type, for example, Oracle Autonomous Database.

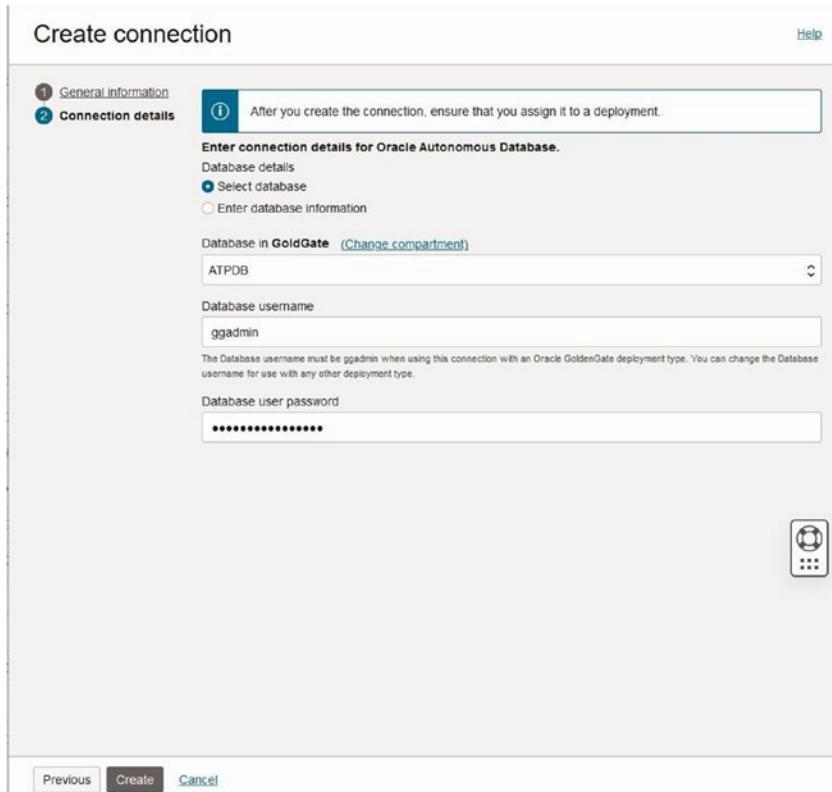


Figure 4-11. Create connection for Autonomous

- Select the appropriate Autonomous database in the compartments.
- Supply the username of the Autonomous database.
- Input the database password. In the example, it is ggadmin.

Once the connection is successfully created, assign the connection to the deployment. Here, in this case, assign it to the previously created deployment: OCIGG-RDBMS.

CHAPTER 4 SETTING UP OCI ORACLE GOLDENGATE SERVICE FOR RDBMS

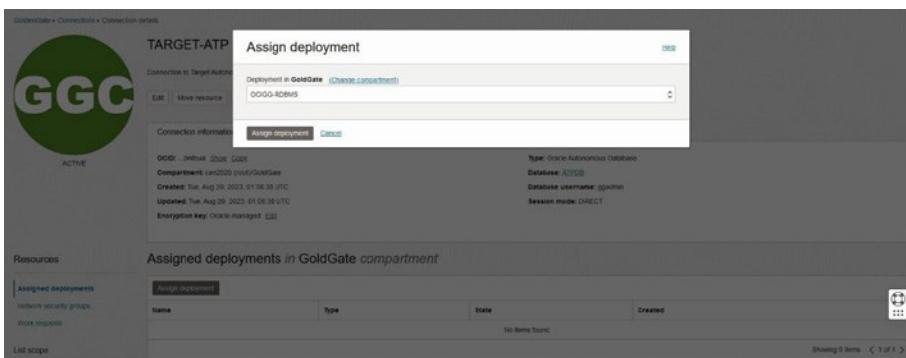


Figure 4-12. Assign the connection to the deployment

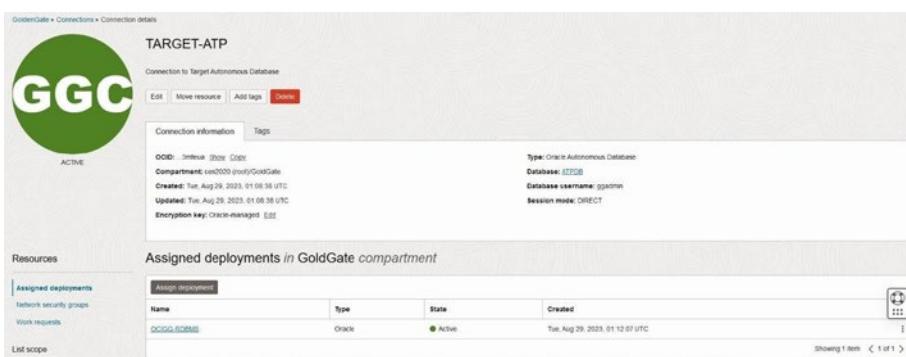


Figure 4-13. Final screen after assigning the ATP connection to the deployment

Accessing Oracle GoldenGate Service for RDBMS

In the navigation menu of the Console, select Oracle Database and then choose GoldenGate, then select the deployment.

Example in this case: OCIGG-RDBMS

CHAPTER 4 SETTING UP OCI ORACLE GOLDENGATE SERVICE FOR RDBMS

The OCI GoldenGate Service UI can be accessed using the Launch Console button from the OCI page or using the private IP address from the browser.

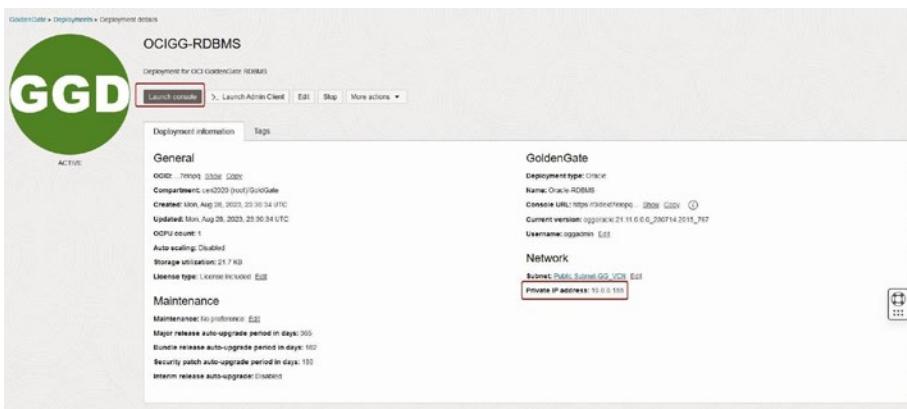


Figure 4-14. Accessing the GoldenGate UI

Click Launch console and supply the credentials of oggadmin user and password.

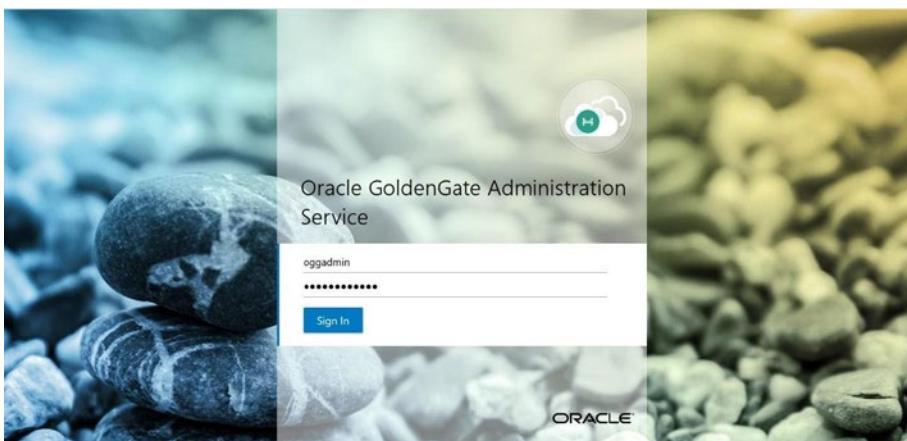


Figure 4-15. OCI GoldenGate UI login screen

CHAPTER 4 SETTING UP OCI ORACLE GOLDENGATE SERVICE FOR RDBMS

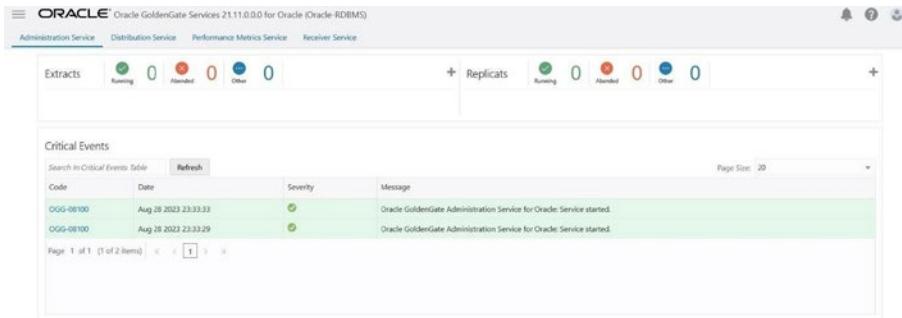


Figure 4-16. OCI GoldenGate welcome screen

Testing Source and Target DB Connection

After assigning the connection to the deployment, validate the connection to the source and target database from GoldenGate connection options.



Figure 4-17. Testing the source and target database connection

Click the Connect button on the Action tab, and that will successfully log in the connection to the database.

Check this connection for both source and target databases.

Set Up and Configure Source Extract

After successfully validating the source and target connection, it's time to create an Extract to capture all the source transactions from the database. To achieve that, let's create an Extract from the OCI GoldenGate UI main page.

Click the + symbol next to the Extracts and start filling in the information.

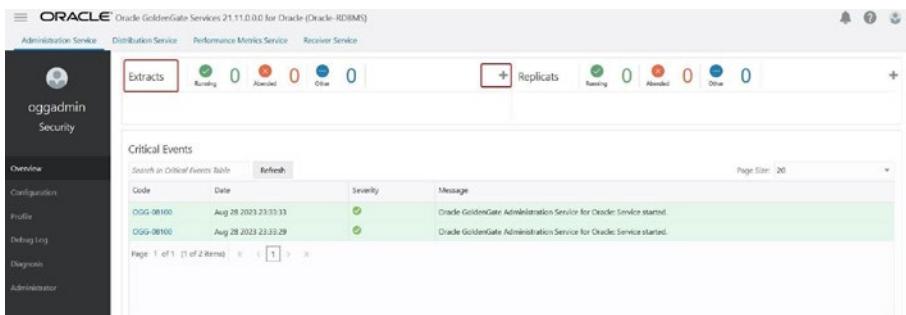


Figure 4-18. Create Extract by clicking +

Select the Integrated Extract.



Figure 4-19. Create Extract - Integrated Extract

CHAPTER 4 SETTING UP OCI ORACLE GOLDENGATE SERVICE FOR RDBMS

Overview > Add Extract

Add Extract

Extract Type: ✓ Extract Options: ✗ Parameter File: (3)

Basic Information

* Process Name: EXONPRM
Description: Extract Process for On Premise
Intent: Unidirectional
Begin: Now
* Trail Name: OP
Trail Subdirectory:
Trail Size (MB): 500
Trail Sequence: 0
Trail Offset: 0
Remote:

Enter a number between 1 and 2,000.

Figure 4-20. Create Extract

Source Database Credential

Create new credential

* Credential Domain: OracleGoldenGate
* Credential Alias: SOURCECORCL

Registration Information

CSN:
Share: Automatic
Optimized:
Downstream Capture:

Encryption Profile

Managed Options

Back < Next >

Figure 4-21. Create Extract

- Process Name: Extract name.
- Description: Optional.
- Trail Name: Input only two characters here. These two characters are the prefix for trails. Example OP here.
- Trail Size: 500 MB by default; change accordingly.
- Credential Domain: Default Oracle GoldenGate.
- Credential Alias: Select the SOURCE database.

CHAPTER 4 SETTING UP OCI ORACLE GOLDENGATE SERVICE FOR RDBMS

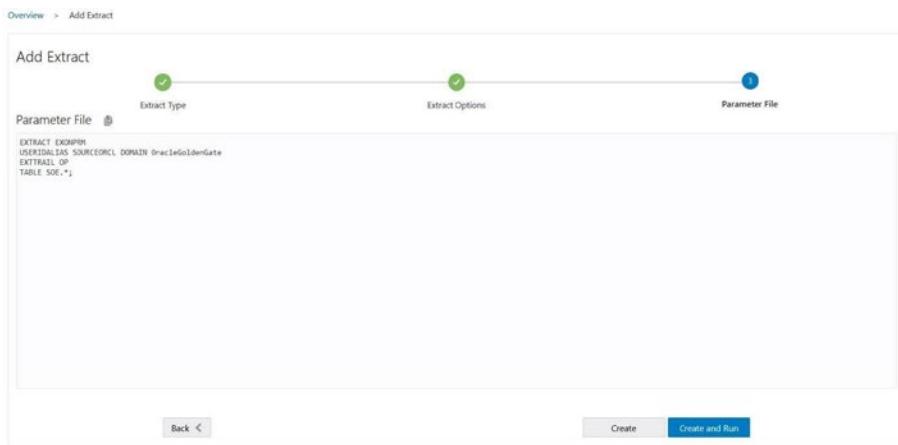


Figure 4-22. Extract parameter

Add a schema.table name to start capturing the transactions on specific tables. In this example, all the tables of SOE schema are set for extraction.

Click Create and Run to start the Extract.

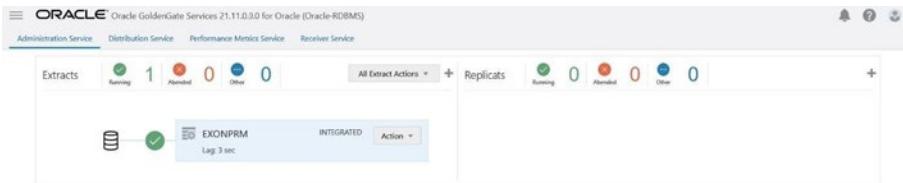


Figure 4-23. Extract process up and running

Set Up and Configure Target Replicat

After successfully creating the Extract to the source Oracle Database, let's create the Replicat to the target OCI Autonomous Database.

Click the + symbol next to the Replicat and start filling in the information.

CHAPTER 4 SETTING UP OCI ORACLE GOLDENGATE SERVICE FOR RDBMS

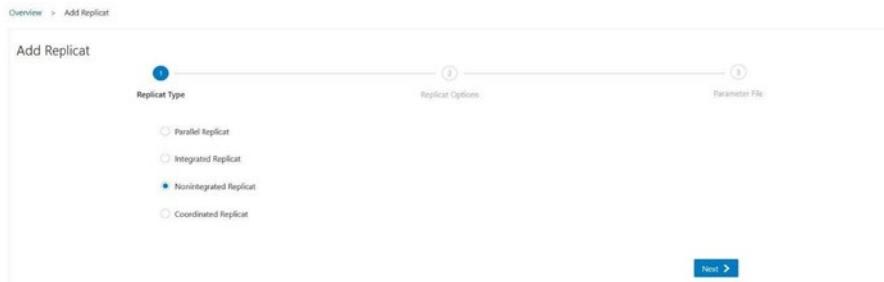


Figure 4-24. Create Replicat – select Non-Integrated Replicat

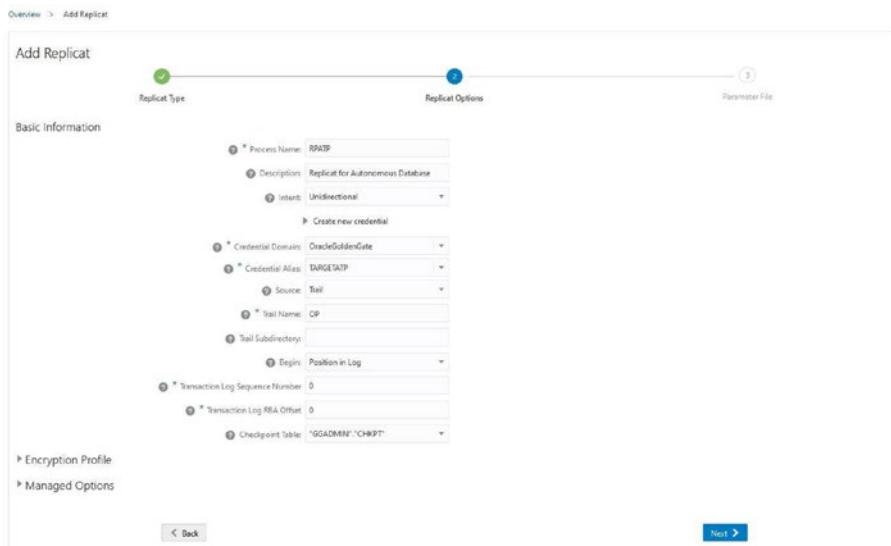


Figure 4-25. Create Replicat

Input the parameters for Replicat:

- Process Name: Replicat name – an example here is RPATP.
- Description: Optional.
- Credential Domain: Oracle GoldenGate – default.

CHAPTER 4 SETTING UP OCI ORACLE GOLDENGATE SERVICE FOR RDBMS

- Credential Alias: Target ATP – created earlier during the connection phase.
- Source: Trail.
- Trail Name: OP

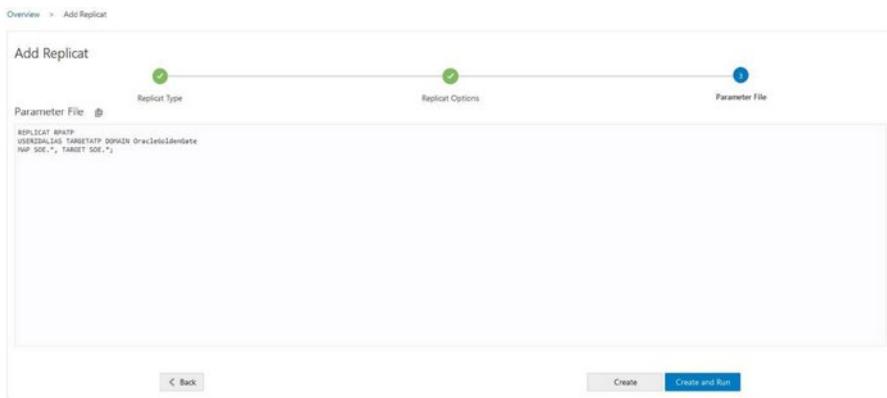


Figure 4-26. Sample Replicat parameters

Click Create and Run.



Figure 4-27. Replicat process up and running

Summary

OCI Oracle GoldenGate PaaS Service for RDBMS provides a comprehensive and fully managed solution for real-time data integration and replication in the Oracle Cloud Infrastructure (OCI) environment. This service simplifies the process of setting up and configuring Oracle GoldenGate for RDBMS deployments. Users can easily provision the service, connect their source and target databases, and configure the Extract and Replicat processes to capture and replicate data changes in real time.

CHAPTER 5

Setting Up OCI Oracle GoldenGate Service for BIGDATA

The GoldenGate PaaS service for BIGDATA Targets simplifies the setup and management of GoldenGate, providing a user-friendly interface for configuring and deploying GoldenGate deployments.

To set up a PaaS service, a user should have an account on OCI with sufficient service limits. In this PaaS service, only deployments and connection information are created and managed.

Log in to the OCI Console, navigate to the GoldenGate Service, and create a new GoldenGate instance. Choose the desired compartment, region, and instance name, configure the required network settings, and create a GoldenGate instance.

After creating the instance, create a new deployment by specifying the BIGDATA Targets.

BIGDATA Targets can be like AWS S3 Storage, Kafka, Hadoop systems, OCI Object Storage, OCI Streaming Service (OSS), Azure Event Hubs, MongoDB, Cassandra, and many more.

In this chapter, we will cover the following topics:

- Create GoldenGate deployment for BIGDATA
- Create the connection for BIGDATA Targets of Kafka
- Examples of various BIGDATA Targets and configurations
- Configure the GoldenGate replication process

Introduction to Oracle GoldenGate Service for BIGDATA Targets

Oracle GoldenGate on Oracle Cloud Infrastructure is a complete fully administered cloud-native service capable of real-time, scalable data movement. It handles data as it transitions from one or multiple data management platforms to designated BIGDATA Targets. Moreover, it allows for the planning, execution, coordination, and oversight of data replication activities without the need for setting up or maintaining any computing resources.

The following keywords are important for effectively understanding and implementing the GoldenGate Service on OCI.

1. Compartment: A compartment acts as a framework for grouping and segregating various cloud assets like cloud networks, computing instances, block storage volumes, and Oracle Cloud Infrastructure GoldenGate setups and database enrollments. Access to resources in a compartment is restricted to users who have been granted the appropriate permissions. Within the OCI GoldenGate environment, compartments also function as

a security perimeter. Only setups and database registrations residing in the same compartment have the ability to interact with each other.

2. Deployment: A container that holds all the Oracle Cloud Infrastructure GoldenGate assets.
3. Database Registration: This stores authentication details for source and target databases and facilitates network communication between OCI GoldenGate Service's Virtual Cloud Network (VCN) and your own VCN via a private endpoint. The database registration establishes the connection information required for reaching source or target endpoints.
4. Deployment Backup: This is a snapshot of a deployment's existing condition that is preserved for a 60-day period by default. It can serve as a foundation for either restoring the original deployment or initiating a new one based on the status of the original at the moment the backup was captured.
5. Extract, Replicat, and Trail Files: Extract is a process that operates on the source database to Extract or collect data. Replicat is a process that operates on the target database to apply the captured data. Trail files are used for storing captured changes from the source database before they are applied to the target database.

6. VCN: A VCN (Virtual Cloud Network) is a customizable, private network in Oracle Cloud Infrastructure. It closely resembles a traditional network, with firewalls and specific types of communication gateways (e.g., Internet Gateway, NAT Gateway, Service Gateway) that you can use to enable traffic in and out.
7. Subnets: Subnets are subdivisions within a VCN. You can think of them as segments of the VCN where you can place resources (like compute instances, databases, etc.). Each subnet exists in a specific availability domain and consists of a contiguous range of IP addresses that do not overlap with other subnets in the VCN.

Provisioning Oracle GoldenGate Service for BIGDATA Targets

Create Deployment

An OCI GoldenGate deployment refers to the setup and configuration of the GoldenGate Service within the Oracle Cloud Infrastructure (OCI). A deployment acts as a container or a framework that consists of various resources and configurations required for replication tasks.

In the navigation menu of the console, select Oracle Database and then choose GoldenGate.

CHAPTER 5 SETTING UP OCI ORACLE GOLDENGATE SERVICE FOR BIGDATA

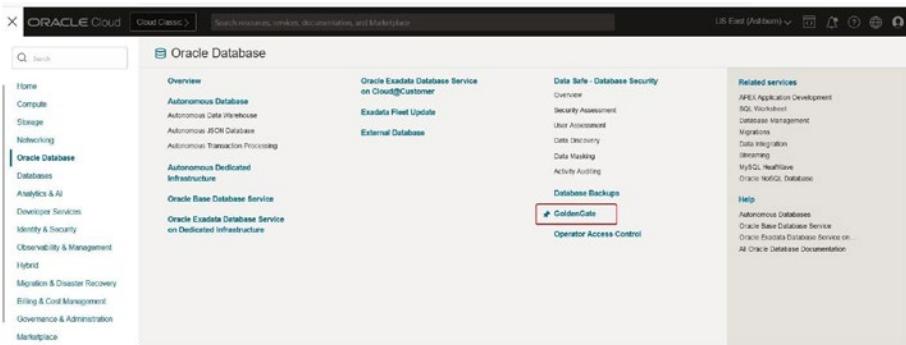


Figure 5-1. Navigating to OCI GoldenGate

On the Deployments screen, select the option to Create Deployment. Enter the deployment name.

- Description: This is an optional information for the deployment.
- Compartment: Select the appropriate compartment. In this case, the precreated GoldenGate Compartment has been used.
- OCPU Count: Select the number of OCPUs according to the workload.
- Subnet: Select the precreated subnet.
- Choose License Type: If the organization already has a license of GoldenGate, then BYOL (bring your own license) will work. If there is no license acquired prior, the LICENSE INCLUDED option needs to be selected.

CHAPTER 5 SETTING UP OCI ORACLE GOLDENGATE SERVICE FOR BIGDATA

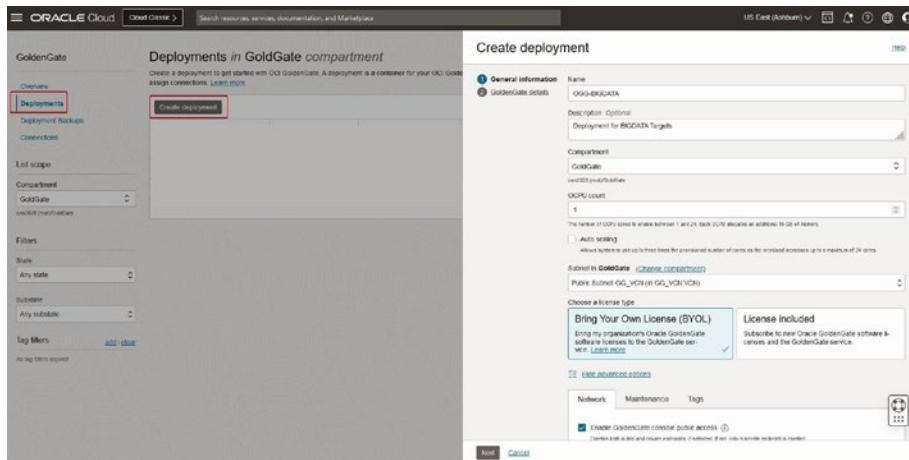


Figure 5-2. Create OCI GoldenGate deployment for BIGDATA

Create deployment

[Help](#)

General information

GoldenGate details

After you create the deployment, ensure that you create and assign connections.

Select a technology

Big Data

Version ⓘ

oggbigdata:21.10.0.0.0_230713.1632_786

Change version

Supported technologies

Supported source technologies:

- OCI Streaming
- Azure Event Hubs
- Apache Kafka
- Confluent Kafka

Supported target technologies:

- OCI Object Storage
- OCI Streaming
- Oracle Autonomous Database
- Azure Data Lake Storage
- Azure Event Hub
- Azure Synapse Analytics
- Apache Kafka
- Confluent Kafka

GoldenGate instance name

BIGDATA

Administrator username

oggadmin

Administrator password ⓘ

Previous Create Cancel

Figure 5-3. Select technology - Big Data

Fill in the instance name, administrator name, and password and click Create.

Note Enhancements have been made by OCI to create and store credentials in OCI secrets. OCI secrets will store sensitive information of oggadmin passwords in encrypted format and store it securely in the cloud.

CHAPTER 5 SETTING UP OCI ORACLE GOLDENGATE SERVICE FOR BIGDATA

If the result is NO from the above output, please proceed with the following steps. This approach enhances security by minimizing exposure of sensitive information.

A new OCI GoldenGate deployment of BIGDATA has been created in the compartment.

The screenshot shows the OCI GoldenGate interface. On the left, there's a sidebar with options like Overview, Deployments, Deployment Details, Connections, List scope, Compartment, and a search bar. The main area is titled 'Deployments in GoldGate compartment' and contains a table with one row. The table columns are Name, State, Substate, Type, OCPU usage, and Created. The single entry is 'OGG-BIGDATA' with 'Active' status, 'Big Data' type, 1 OCPU usage, and a creation date of 'Tue Aug 29 2023 19:42:41 UTC'.

Figure 5-4. Deployment completion – BIGDATA

Create Connection

A connection contains the information required for connecting to the BIGDATA source or target. In this particular connection, we will establish connectivity from an on-premises Oracle source database to an Apache Kafka.

On-Premises Source Database Info:

Name: ORCL

IP Address: 10.0.0.8

BIGDATA Target: Apache Kafka

Topic Name: OGG TOPIC

Create BIGDATA Target Kafka Connection

From the Overview page of OCI GoldenGate, select Connections, then choose Create Connection.

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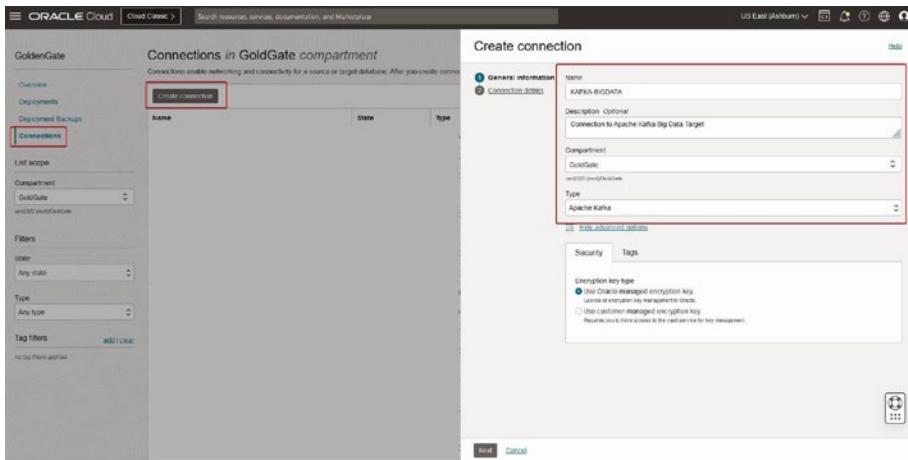


Figure 5-5. Create a connection to the Apache Kafka BIGDATA Target

- Input the name for the connection, for example, KAFKA-BIGDATA.
- Description: Optional information.
- Compartment: Select the appropriate compartment in the OCI Console.
- Type: Select the appropriate BIGDATA Target type, for example, Apache Kafka.

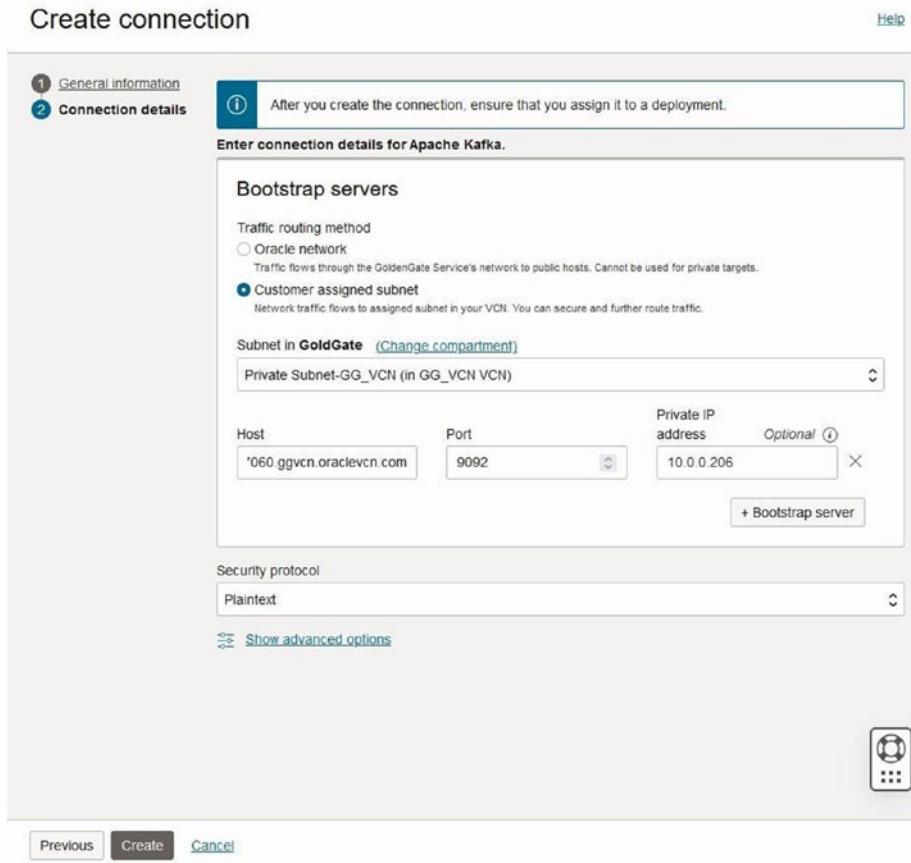


Figure 5-6. Create a connection to the BIGDATA Target

- Select the customer-assigned subnet on which the Kafka Bootstrap server has been hosted.
- Input the hostname of Kafka, port number, and the IP address.
- Select the appropriate security protocol. Here in the example, it has been selected as plaintext.

CHAPTER 5 SETTING UP OCI ORACLE GOLDENGATE SERVICE FOR BIGDATA

Once the connection is successfully created, assign the connection to the deployment. Here, in this case, assign it to the previously created deployment: OGG-BIGDATA.

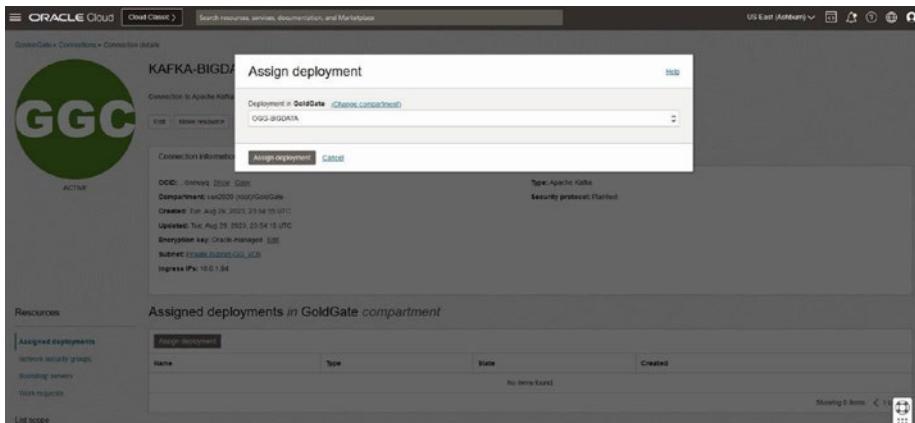


Figure 5-7. Assign the connection to the deployment

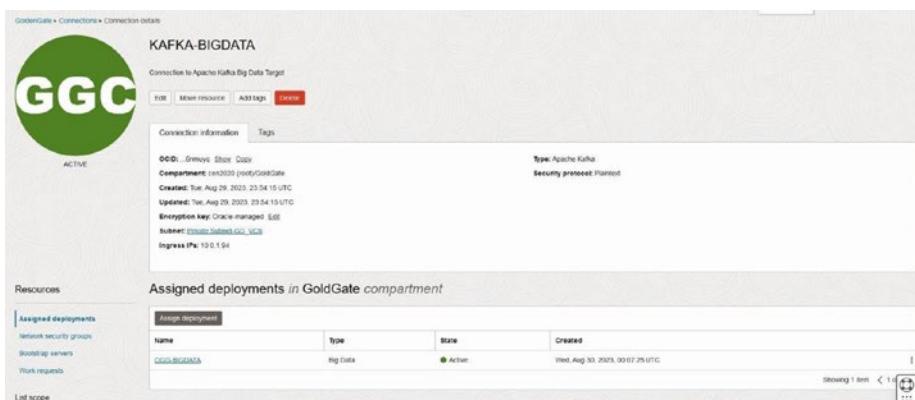


Figure 5-8. Final screen after assigning the Apache connection to the BIGDATA deployment

Accessing Oracle GoldenGate Service of BIGDATA

In the navigation menu of the console, select Oracle Database and then choose GoldenGate and select the deployment.

Example in this case: OGG-BOGDATA

The OCI GoldenGate Service UI can be accessed using the Launch console button from the OCI page or using the private/public IP address from the browser.

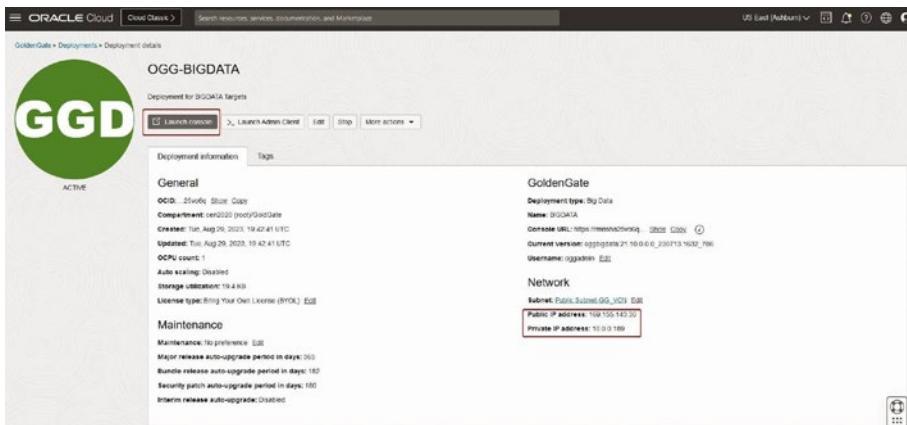


Figure 5-9. Accessing the GoldenGate UI

Click Launch console and supply the credentials of the oggadmin user and password.

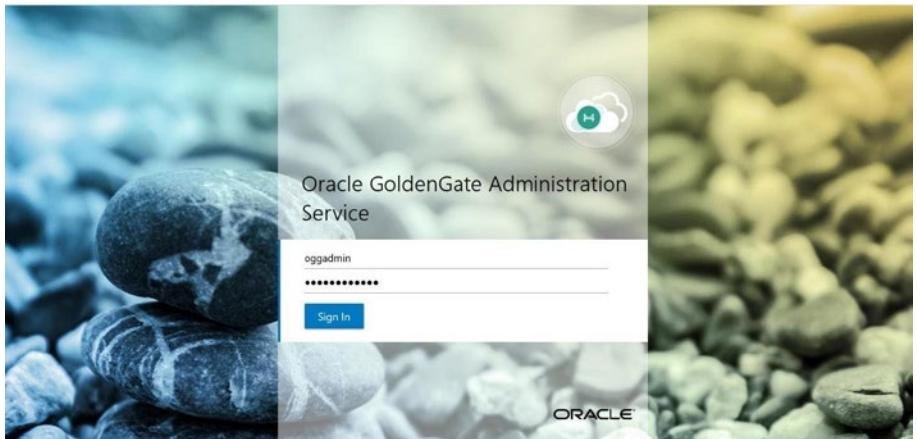


Figure 5-10. OCI GoldenGate UI login screen

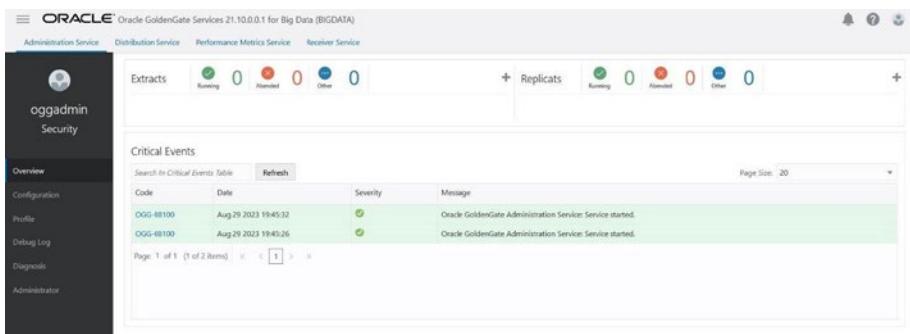


Figure 5-11. OCI GoldenGate welcome screen

Set Up and Configure Target Replicat

After successfully creating the connection to Apache Kafka, let us create the Replicat to apply the data to the target.

Click the + symbol next to the Replicat and start filling in the information.

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Figure 5-12. Create Replicat – select Classic Replicat

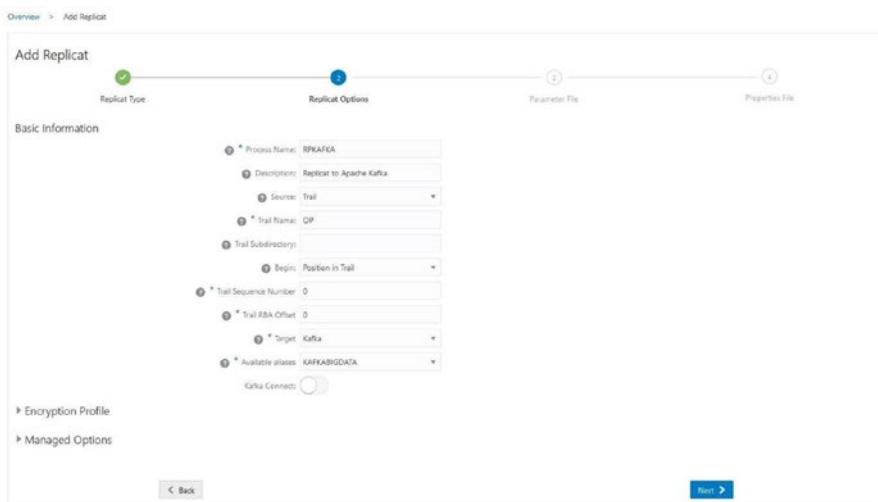


Figure 5-13. Create Replicat

Input the parameters for Replicat:

- Process Name: Replicat name, for example, RKAFKA
- Description: Optional
- Source: Trail

CHAPTER 5 SETTING UP OCI ORACLE GOLDENGATE SERVICE FOR BIGDATA

- Trail Name: OP
- Target: kafka
- Available aliases: KAFKABIGDATA - this was created during connection.

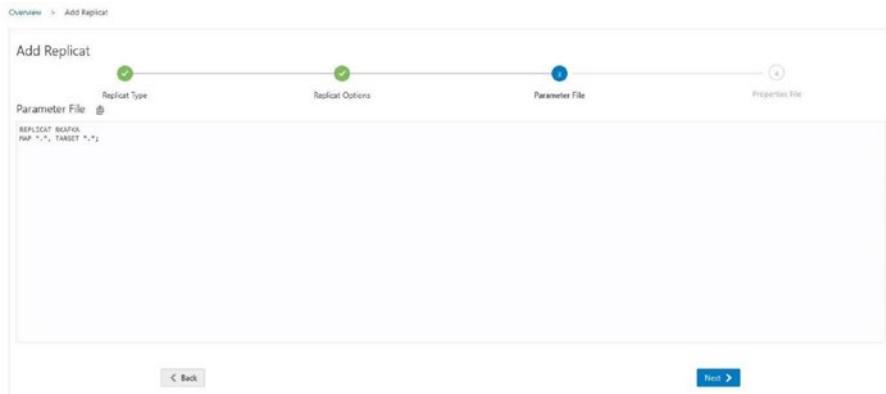


Figure 5-14. Sample Replicat parameters



Figure 5-15. Sample Replicat properties

CHAPTER 5 SETTING UP OCI ORACLE GOLDENGATE SERVICE FOR BIGDATA

PROPS/properties file is generated automatically in OCI GG by using the respective OCID and the connection information that was created. There is no need to change any parameters in the properties file.

Sample example:

```
# Properties file for Replicat RKAFKA
#Kafka Connect Handler Template
gg.handlerlist=kafkaconnect
gg.handler.kafkaconnect.type=kafkaconnect
gg.handler.kafkaconnect.connectionId=ocid1.
goldengateconnection.oc1.iad.
amaaaaaaa6rfcedyafj4pkwsyjye35zz4qrakfy4bpiosfauk7h3i7b6nmuyq
gg.handler.kafkaconnect.mode=op
#TODO: Set the template for resolving the topic name.
gg.handler.kafkaconnect.topicMappingTemplate=
gg.handler.kafkaconnect.keyMappingTemplate=${primaryKeys}
gg.handler.kafkaconnect.messageFormatting=row
gg.handler.kafkaconnect.metaColumnsTemplate=${obje
ctname[table]},${optype[op_type]},${timestamp[op_
ts]},${currenttimestamp[current_ts]},${position[pos]}
gg.handler.kafkaconnect.converter=json
#TODO: Set the location of the Kafka client libraries
gg.classpath=$THIRD_PARTY_DIR/kafka/*
jvm.bootoptions=-Xmx512m -Xms32m
```

Click Create and Run.

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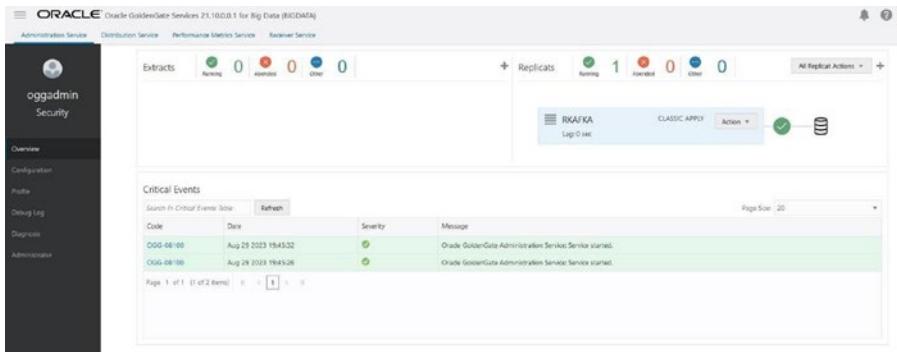


Figure 5-16. Replicat process up and running

Summary

OCI Oracle GoldenGate PaaS Service for Big Data is a fully managed solution that enables real-time data integration and replication in the Oracle Cloud Infrastructure (OCI) environment.

This service simplifies the setup and configuration of Oracle GoldenGate for Big Data deployments, allowing users to easily connect their source and target Big Data systems and configure replication processes.

CHAPTER 6

Managing and Monitoring Oracle GoldenGate on OCI

Monitoring and notification are essential features for maintaining the health, performance, and reliability of OCI GoldenGate Services. Oracle Cloud Infrastructure (OCI) provides built-in monitoring and notification tools to help you keep an eye on your GoldenGate deployments, set up alerts, and diagnose any issues that may arise.

This can be achieved in multiple ways:

1. Oracle Cloud Infrastructure (OCI) Observability and Management services
2. Custom scripting to alert via email notifications
3. Using Grafana for trend dashboards and alerts

Monitoring Features

Metrics: OCI Monitoring provides key metrics like latency, throughput, and error rates that can be viewed on the console or query programmatically. These metrics are essential for assessing the performance and health of the GoldenGate Service.

Logs: OCI Logging service captures detailed logs that can be analyzed for troubleshooting and performance tuning. These logs can also be exported for long-term retention or analysis using third-party tools like Grafana, Splunk, etc.

OCI Dashboards: You can create custom dashboards in OCI to visualize metrics, track performance trends, and detect anomalies.

Resource Health: Monitor the availability and health status of various GoldenGate components, such as capture processes, Replicats, and Distribution Path.

Notification Features

Alert Rules: Set up rules to trigger alerts based on specific conditions or thresholds (e.g., latency exceeding a certain limit, error rates, etc.).

Notification Channels: Define how you'd like to be notified when an alert is triggered. Options usually include email, PagerDuty, Slack, or OCI Notifications service.

Incident Management: Integrate with incident management tools to automate the process of incident creation, assignment, and resolution.

Proactive Monitoring: Advanced machine learning algorithms can be employed to predict potential issues before they become critical, enabling proactive maintenance.

Oracle Cloud Infrastructure (OCI) Observability and Management Services

This topic will cover the basic concepts of Oracle Cloud Infrastructure (OCI) Observability and Management services and monitoring the GoldenGate resources, using a specific example. We will demonstrate how to use OCI O&M on an Extract process within a GoldenGate deployment and send out email alerts in the event of a failure.

What Is OCI Observability and Management Services?

The OCI Observability and Management (O&M) Platform is a suite of cloud services designed to offer comprehensive monitoring, analysis, and management of both applications and infrastructure. It provides full-stack visibility, ready-to-use analytics, and automation features.

These capabilities are crucial for maintaining the health, efficiency, and dependability of your cloud resources and software solutions. When integrated with Oracle GoldenGate, these services offer invaluable perspectives into your real-time data synchronization and replication activities.

CHAPTER 6 MANAGING AND MONITORING ORACLE GOLDENGATE ON OCI

The diagram in Figure 6-1 depicts the high-level architecture on how the GoldenGate deployments are connected to OCI Observability and Management systems and send out notifications in case of any failures.

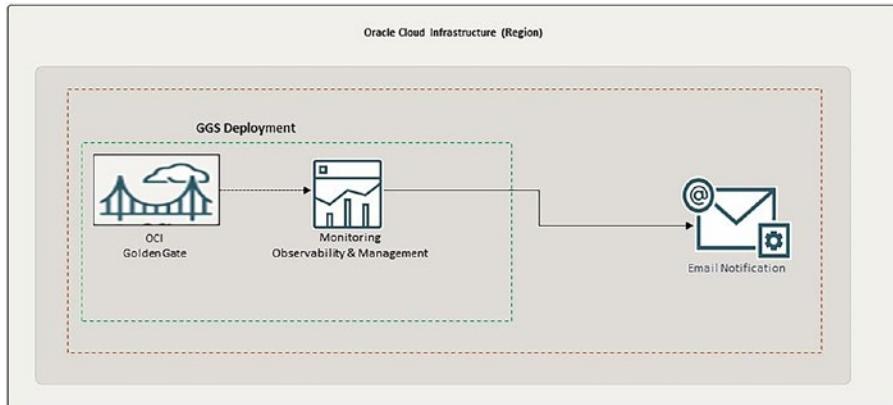


Figure 6-1. Architecture of O&M

Create Topic

Log in to the OC Console, and from the main menu of home, select Developer Services and then choose Notifications.

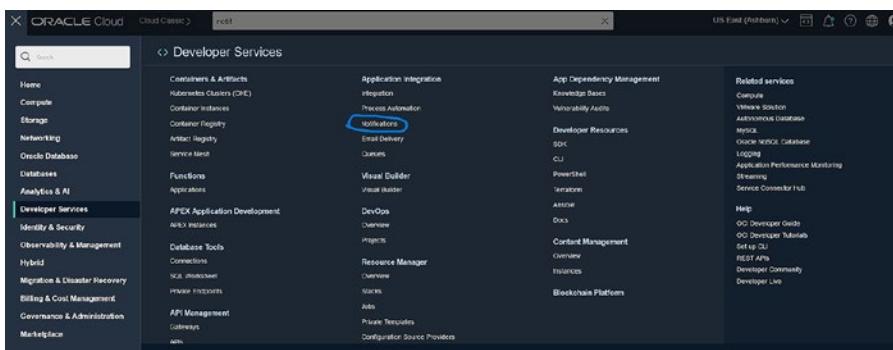


Figure 6-2. Setting up the Notifications main page

The screenshot shows the 'Create Topic' page in the OCI console. At the top left, it says 'Topics in cen2020'. A note below states: 'The Notifications service helps you stay informed when your data is breached, or to directly publish.' On the right, there's a 'Help' link. The main area has a title 'Create Topic' and a sub-instruction: 'To create a topic in a different compartment, click here.' Below this is a 'Name' field containing 'GG-Notification'. A note next to it says: 'Topic name must contain fewer than 256 characters. Only alphanumeric characters plus hyphens (-) and underscores (_) are allowed.' There's also a 'Description' field with the placeholder 'Notification for OCI GG Alerts' and a note: 'Description must contain fewer than 256 characters.' A 'Show advanced options' link is present. A callout box with an info icon contains the text: 'Once the topic is created, an administrator needs to create an identity policy to enable access.' At the bottom are 'Create' and 'Cancel' buttons, and a small circular icon with three dots.

Figure 6-3. Create topic information

Input the following parameters:

- Name: This is the topic name, for example, GG-Notification.
- Description: This is optional, for example, Notification for OCI GG Alerts.

Create Subscription

From the Notifications ➤ Topic, click Create subscription.

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The screenshot shows the OCI console interface. At the top, there's a navigation bar with 'ORACLE Cloud' and 'Create Topic'. Below it, a breadcrumb trail says 'Notifications > Topics > Topic Details'. On the left, a sidebar titled 'Resources' has 'Subscriptions' selected. The main content area is titled 'GG-Notification'. It shows a large green circular icon with a white 'T' and the word 'ACTIVE'. Below the icon are buttons for 'Publish Message', 'View Resource', 'Add tags', and a red 'Delete' button. A 'Topic Information' tab is active, displaying details: 'Description: Notification for OCI GG Alerts', 'OCID: oc1:ashburn-1::topic/gz0y', 'Short Topic ID: ggz0y', 'Compartment: Goldgate', and 'Created: Wed, Oct 14, 2022, 16:59:27 UTC'. There's also a 'Tags' tab. Below this, a 'Subscriptions' section contains a 'Create Subscription' button and a table with one item: 'Subscription OCID: ggz0y', 'State: Enabled', 'Protocol: Email', and 'Endpoint: Raghavoraclegg@gmail.com'. A note at the bottom says 'Showing 1 item < 1 of 1 >'.

Figure 6-4. Create subscription

This screenshot shows the 'Create Subscription' dialog. At the top, it says 'Create Subscription' and has a 'Help' link. Below that, a note says 'View steps for creating subscriptions and learn about supported subscription protocols.' The 'Subscription Topic' field contains 'GG-Notification'. The 'Configure Subscription' section has a 'Protocol' dropdown set to 'Email'. The 'Email' field contains 'Raghavoraclegg@gmail.com'. A blue info box provides instructions: 'Email notifications use the sender "noreply" at a region-specific notification domain. Example sender: noreply@notification.us-ashburn-1.oc1.oraclecloud.com'. It also says 'Creating a subscription for Email...'. At the bottom, there's a 'Show advanced options' link, a 'Create' button, a 'Cancel' button, and the Oracle logo.

Figure 6-5. Create subscription details

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Input the following parameters:

- Subscription Topic: This is the subscription topic name, for example, GG-Notification.
- Protocol: Email.
- Email: Enter the target email recipient.

Subscription OCID	State	Protocol	Endpoint	Topic Name	Created
oci...3ef07a	Active	Email	Raghav...@...com	GG-Notification	Wed Dec 14, 2022, 16:56:57 UTC

Figure 6-6. Confirmation of subscription

Create Service Metrics and Alarms

Now in order to send notifications to the email recipient, Service Metrics needs to be enabled.

From the OCI Console, select Observability Management ➤ Monitoring and Service Metrics.

The screenshot shows the OCI console interface with the 'Observability & Management' section selected. The 'Monitoring' category is highlighted. Other monitoring-related options shown include 'Metrics Explorer' and 'Alert Status'. To the right, there are sections for 'Database Management', 'Management Agent', and 'Help'. A sidebar on the left provides navigation links for various cloud services.

Figure 6-7. Service Metrics

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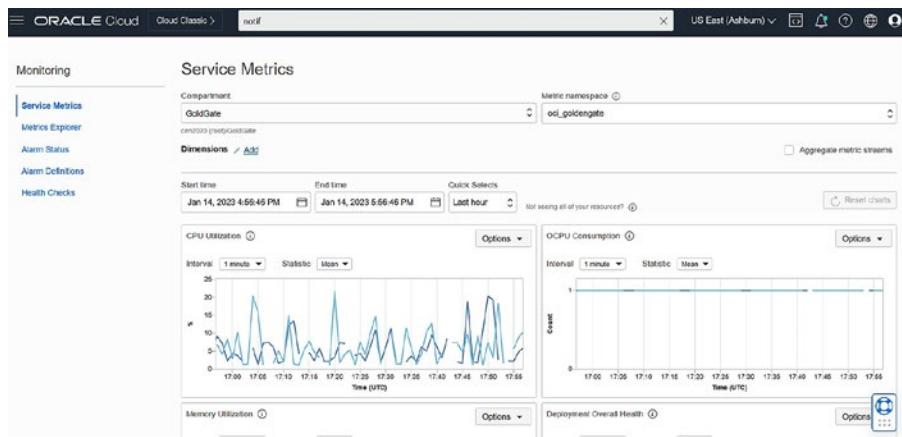


Figure 6-8. Service Metrics – oci_goldengate

Select the compartment where the OCI GoldenGate Service has been deployed. In the preceding example, it is in

Compartment: GoldGate

Metric namespace: oci_goldengate

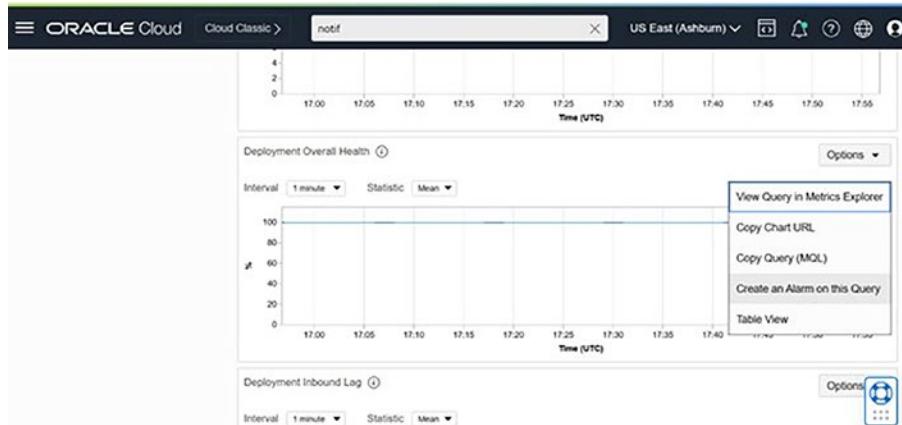


Figure 6-9. Service Metrics – create an alarm on this query

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So now let's create an alert on one of the processes in OCI GoldenGate. In the following example, it has been created for Extract; the same approach can be applied for Replicats and the Distribution Path process.

The screenshot shows the 'Create Alarm' page under the 'Monitoring' section. On the left sidebar, 'Alarm Definitions' is selected. The main form is titled 'Create Alarm' with a sub-section 'Define alarm'. It includes fields for 'Alarm name' (set to 'Extract-Down-Notification'), 'Alarm severity' (set to 'Critical'), and an 'Alarm body' message ('Extract Down notification for DSAFKA'). A note at the top says 'Your alarm is almost complete. Fill in all remaining required fields below.' Below the main form is a 'Tags (optional)' section with a note about tagging for organization and tracking. It shows a dropdown 'Tag namespace' set to 'None (apply a freeform tag)', a 'Tag key' input field containing 'Enter a tag key', and a 'Value' input field containing 'Enter a tag key value'. There is also a '+ Additional tag' button.

Figure 6-10. Create an alarm for Extract UP/DOWN

Input the following parameters:

- Alarm Name: Input the alarm name. Here, in this case, it is for Extract.
- Alarm Severity: Critical.
- Alarm Body: Message for the specific process. In this example, it is for Extract.

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The screenshot shows the configuration of a metric description for an Extract process. In the 'Metric description' section, the compartment is set to 'GoldGate', the metric namespace to 'oci_goldengate', and the resource group to 'No resource group'. The metric name is 'ExtractStatus', the interval is '1 minute', and the statistic is 'Mean'. In the 'Metric dimensions' section, the dimension name is 'ExtractName' and the dimension value is 'EXKAFKA'. There is also an unchecked checkbox for 'Aggregate metric streams' and a button to add additional dimensions.

Figure 6-11. Create an alarm metrics description

Parameters are

- Compartment: Select the appropriate compartment.
- Metric Namespace: oci_goldengate.
- Interval: 1 minute. This can be changed according to the environment.
- Statistic: Mean.
- Dimension Name: Process of GoldenGate; here, in this example, it is Extract.
- Dimension Value: Process name.

The screenshot shows the configuration of a trigger rule. The condition is set to 'operator: equal to', 'Value: 0', and 'Trigger delay minutes: 1'. The unit is '%'. The trigger rule is used to put the alarm in the firing state.

Figure 6-12. Create a trigger rule

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When the value is equal to zero of the process, the notification will be triggered in one minute.

The screenshot shows the OCI console interface for creating a trigger rule. At the top, there are dropdown menus for 'Destination service' (Notifications), 'Compartment' (GoldGate), and 'Topic' (GG-Notification). A 'Create a topic' button is also visible. Below these, the 'Message grouping' section indicates that the alarm applies to 1 metric streams and offers options to 'Group notifications across metric streams' (selected) or 'Split notifications per metric stream'. The 'Message Format' section includes options for sending formatted messages (selected), Pretty JSON messages, or raw messages. It also has checkboxes for 'Repeat notification?' and 'Suppress notifications'. At the bottom left are 'Save alarm' and 'Cancel' buttons, and at the bottom right is a small help icon.

Figure 6-13. Create a trigger rule with a topic

Select the topic that was previously created and enable the alarm.

The screenshot shows the OCI monitoring dashboard. On the left, a sidebar lists 'Monitoring', 'Service Metrics', 'Metrics Explorer', 'Alarm Status', 'Alarm Definitions' (which is selected), and 'Health Checks'. The main area displays '1 alarms in GoldGate Compartment' with a note to use the Monitoring service to set up alarms. A table titled 'Alarms' shows one entry: 'Extract-Down-Notification' with status 'Active', severity 'critical', metric namespace 'oci_goldengate', notifications destination 'Notifications', and suppressed status 'Not suppressed'. The table includes columns for 'Actions' and a search bar. At the bottom, it shows 'Showing 1 item < 1 of 1 >'.

Alarms						
1 alarms in GoldGate Compartment						
Use the Monitoring service to set up alarms to notify you when a condition occurs.						
Actions	Create Alarm	Actions ▾	Search			
Alarm name	Extract-Down-Notification	Status	Active	Severity	critical	Metric namespace
						oci_goldengate
						Notifications
						Not suppressed
0 Selected						Showing 1 item < 1 of 1 >

Figure 6-14. Alarm has to be in active state

Now let us kill/terminate the Extract in the OCI GoldenGate console and check our email for alerts.

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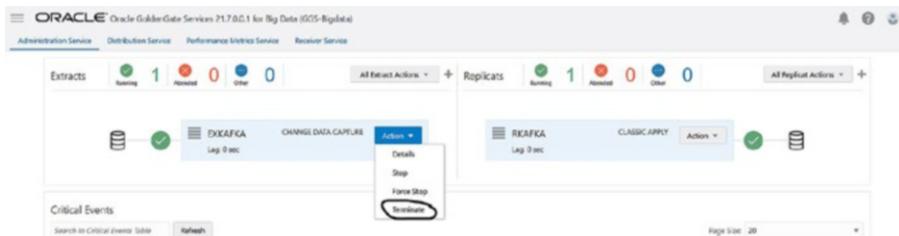


Figure 6-15. Kill/terminate the Extract process

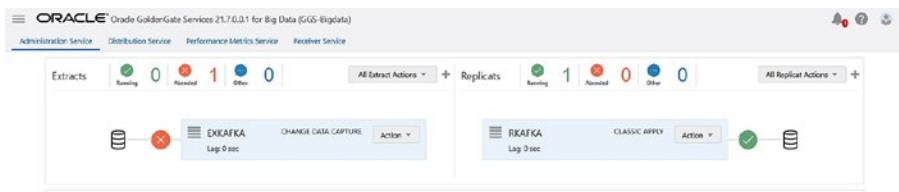


Figure 6-16. Extract process is DOWN

After terminating the process, an email will be triggered with the alert: **OK_TO_FIRING**.

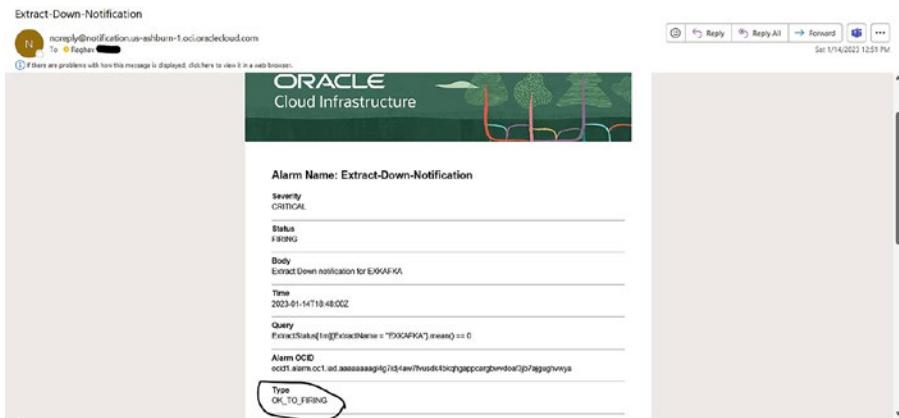


Figure 6-17. Email notification for the process DOWN

Now let's start the Extract process back on OCI GoldenGate. Once the process is restarted, there will be another email alert type stating **FIRING_TO_OK**.



Figure 6-18. Email notification for the process UP

- **OK_TO_FIRING:** Process is DOWN.
- **FIRING_TO_OK:** Process is UP.

A similar approach can be used to monitor all GoldenGate components:

1. Replicat status UP/DOWN
2. Deployment status UP/DOWN
3. Extract/Replicat Lag – Inbound Lag/Outbound Lag
4. Deployment CPU utilization

Custom Scripting to Alert via Email Notifications

To use the custom script for monitoring the OCI GoldenGate Service, one needs to have a basic understanding of scripting and the commands used to monitor the performance of the GoldenGate. The objective of the script is to monitor the status of Extract and Replicat processes and the lag time between the source and target databases.

The ideal environment for the script is a Linux virtual machine (VM) that has been granted access to the OCI GoldenGate Service components.

AdminClient has to be installed on the VM and should have all the access to the OCI GoldenGate deployment.

SMTP has to be set in OCI, and Mailx has to be configured to trigger an email.

Sample logic using a shell script:

```
for rp in $REP
do
    echo
    echo =====
=====
    echo $rp
    echo -----
-----
    STATUS=0
    curl -i --insecure -X GET -u oggadmin:Password -H request-
header:value https://100.100.100.1/services/v2/replicats/$rp/
info/status > $OPLOG/$rp.out
    tail -1 $OPLOG/$rp.out | jq . > $OPLOG/$rp.json
    pstatus=`egrep -o -c 'running' $OPLOG/$rp.out` 
    plag=`egrep -o '"lag": [0-9]+' $OPLOG/$rp.out` 
    plag_delay=`echo $plag | egrep -o '[0-9]+'`
```

```
prelicat=$rp
pstatus_text=`egrep -o '"status": "[A-Za-z0-9]+"' $OPLLOG/$rp.out` 
echo -----
echo "$dt,$prelicat,$pstatus_text,$plag" | tee -a $OPLLOG/$rp.log $OPLLOG/ALL_TASKS.log
echo -----
if [ $pstatus -eq 1 ]; then
    echo "Process $rp is RUNNING"
else
    echo "Process $rp is not RUNNING" | tee -a $OPLLOG/GG_REP_Status_ERR$dt.log
    ((STATUS=STATUS+1))
fi
if [ $STATUS -gt 0 ]
then
    echo " Replicat $rp is not running on Test Environment"
    | mail -v -s "Test GG Replicat Process is down" -r "Raghav@oraclegg.com" -S replyto="Raghav@oraclegg.com" -S smtp="smtp.email.us-ashburn-1.oci.oraclecloud.com:25" -S
fi
if [ $plag_delay -gt 300 ]
then
    cat $OPLLOG/$rp.json | mail -v -s "GG TEST - Replicat $rp is behind $plag_delay " -r "Raghav@oraclegg.com" -S replyto="Raghav@oraclegg.com" -S smtp="smtp.email.us-ashburn-1.oci.oraclecloud.com:25" -S
fi
done
```

In conclusion, scripting is a simple and effective way to monitor the performance of the OCI GoldenGate Service process. By automating the process, you can ensure that the service runs smoothly and be alerted of any issues in a timely manner.

Using Grafana for Trend Dashboards and Alerts

Grafana is a widely adopted open source platform specialized in analytics and data visualization. With its user-friendly interface, powerful query capabilities, and compatibility with a broad array of data sources, Grafana has become the go-to solution for monitoring and analysis across different datasets, including servers, applications, Internet of Things (IoT) devices, and business-related metrics. Regardless of the location of the data or the database system in use, Grafana offers versatile integration options.

Grafana supports OCI as a data source to query and visualize data stored in OCI services like Oracle Database, Object Storage, GoldenGate, and other services. To use OCI as a data source in Grafana, we will need to configure an OCI data source in Grafana using the appropriate credentials and settings.

Once configured an OCI data source in Grafana, we can use it to create dashboards and panels that display OCI data in various formats like charts, tables, and graphs. We can also set up alerts in Grafana based on OCI data to notify you of important events or issues.

In this chapter, we will cover how to use Grafana for real-time monitoring and visualization of GoldenGate data from OCI metrics.

Prerequisites:

- Install Grafana on VM that has connection to OCI GG deployment.
- Network and security have to be in place.

Connecting OCI GoldenGate to Grafana

To access the Grafana console, go to the browser and type `http://<ip>:3000`. The default username and password are `admin/admin`. Password change will be prompted in the initial login.

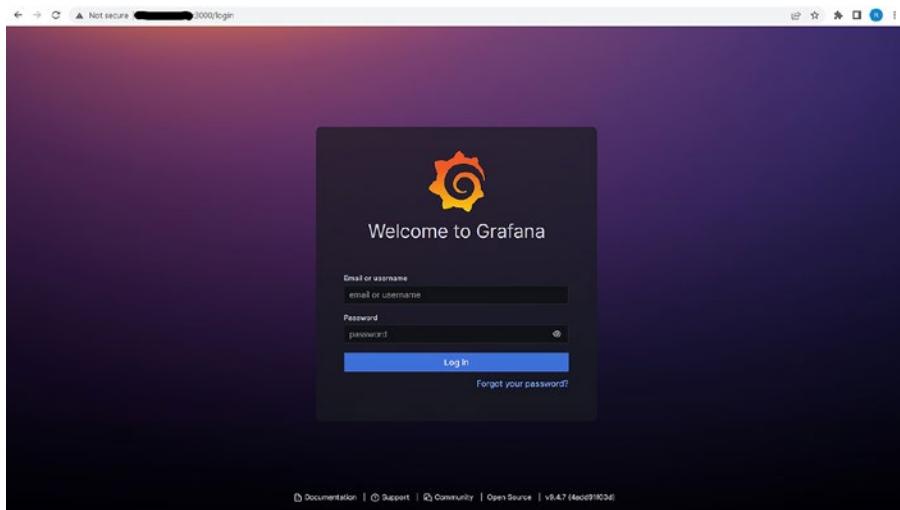


Figure 6-19. Grafana login page

After signing in to Grafana, the subsequent step involves setting up the data source. Please click on settings-Add a DataSource. In this particular example, the data source being configured is Oracle Cloud Infrastructure.

CHAPTER 6 MANAGING AND MONITORING ORACLE GOLDENGATE ON OCI

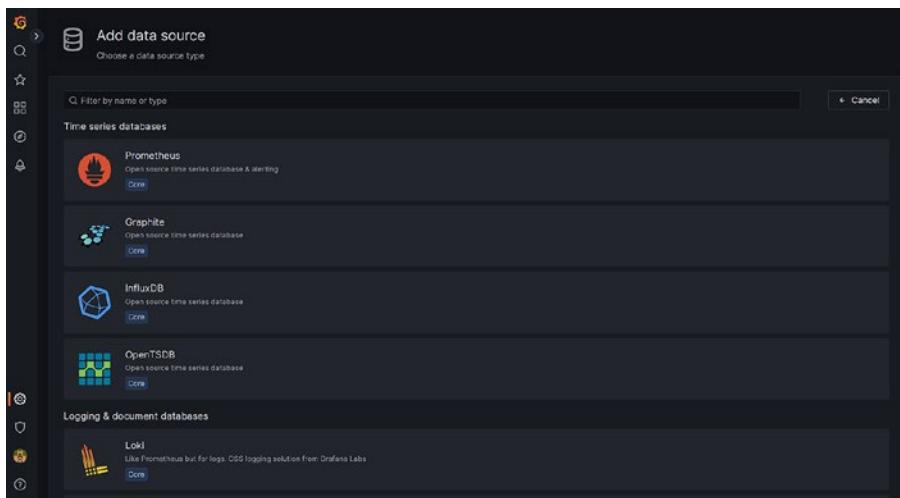


Figure 6-20. *Grafana data source setting*

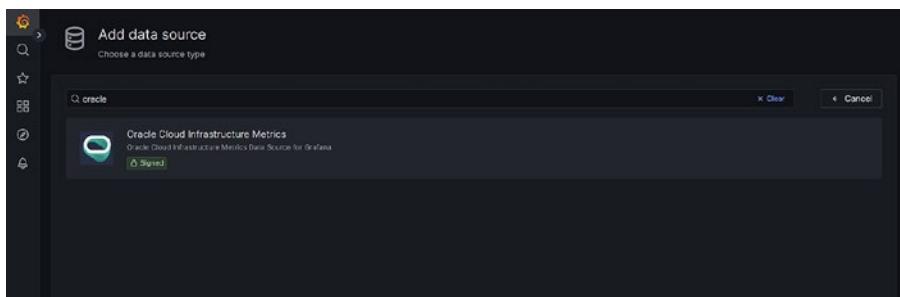


Figure 6-21. *Add OCI data source*

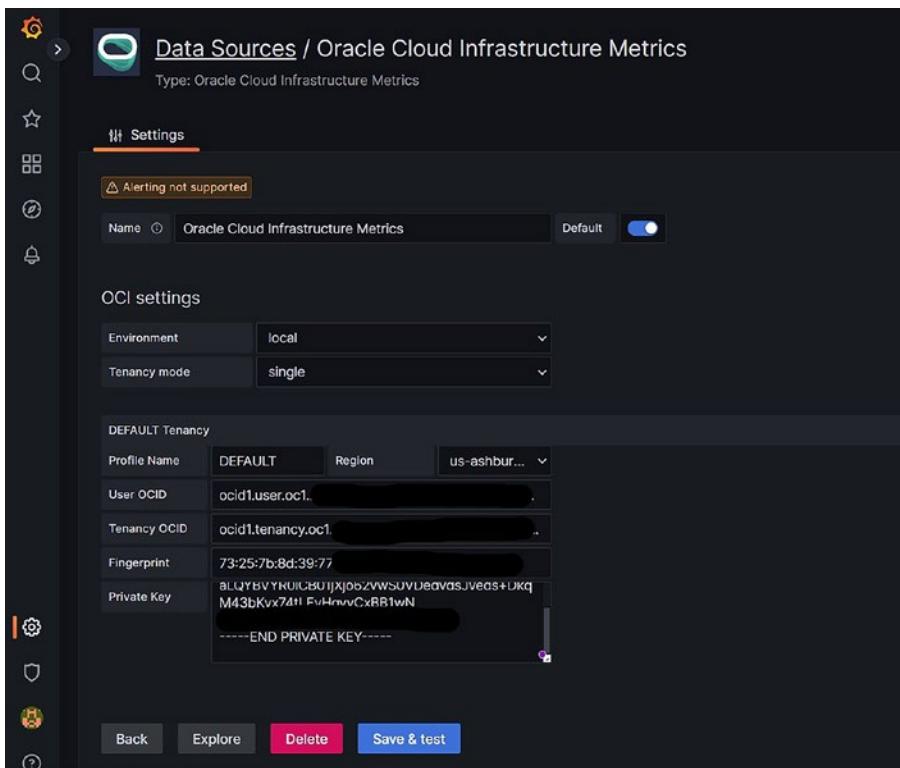


Figure 6-22. Add OCI data source settings

Input the following information in the setting page:

- Environment: Local
- Tenancy Mode: Single
- Profile Name: It can be DEFAULT or a custom name.
- User OCID, Tenancy OCID, Fingerprint, Private Key: These values should have been pre-generated from the OCI Console and need to be supplied here. As an administrator, these settings are available in the OCI tenancy console page.

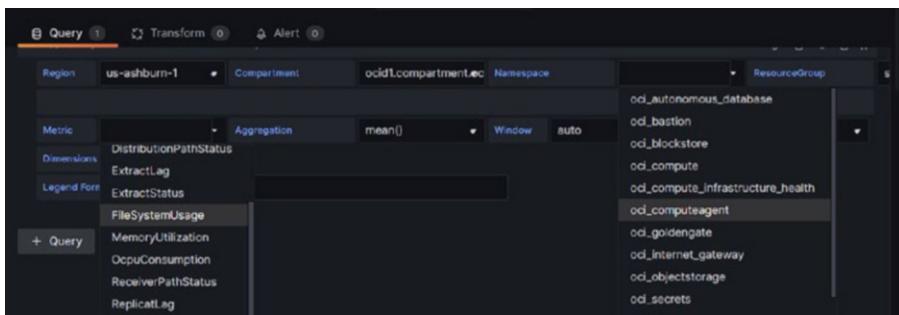


Figure 6-23. Add a custom query to get the metrics

Input the appropriate information in this page. From OCI, all resource metrics will be pushed into Grafana, but our use case is OCI GoldenGate, hence please `oci_goldengate` resource group.

Select the region, compartment, and metric that need to be monitored.

Once these metrics are added, Grafana will provide you the drag-and-drop facility to arrange these metrics in a dashboard. Play around with the dashboard and place the metrics that needs to be highlighted in the dashboard.

Figures 6-24 and 6-25 display example outputs from Grafana for OCI GoldenGate.

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Figure 6-24. Sample output1



Figure 6-25. Sample output2

Summary

By utilizing OCI Observability and Management services, organizations using custom scripts and Grafana can achieve real-time insights into their GoldenGate deployments. They benefit from monitoring and alert mechanisms for process failures, log ingestion for analysis of future incidents, proactive monitoring enhancements, and improved reliability. Additionally, this approach helps ensure compliance and security.

CHAPTER 7

Comparing OCI GoldenGate Service with Cloud Marketplace

In this chapter, we will focus on comparing OCI GoldenGate Service with the OCI Marketplace VM Image. Oracle Cloud Infrastructure (OCI) GoldenGate and Oracle GoldenGate on the Cloud Marketplace are two offerings designed for real-time data integration and replication, and it is important to distinguish between these two offerings as they differ in several key aspects such as deployment, manageability, and feature sets.

Table 7-1 shows a comparison to understand these differences.

Table 7-1. Comparison Chart of OCI GoldenGate Service and Marketplace VM

	OCI GoldenGate Services	GoldenGate on Cloud Marketplace
1	Fully Managed Service: This is a cloud-native service, meaning Oracle manages the underlying infrastructure and software upgrades.	Self-Managed: Deployed on virtual machines or containers, requires to manage the infrastructure and software upgrades including the operating system and patches.
2	Integration: Deeply integrated with other OCI services like OCI Monitoring, Logging, and Notifications.	Integration: Less tightly integrated with OCI services; you may need to set up monitoring and logging manually.
3	Flexibility: Supports a wide range of source and target databases, both cloud based and on-premises.	Flexibility: While it does support various databases, you may need to manage connectivity and data transfer yourself.
4	Scalability: Being cloud-native, it can dynamically scale resources based on the workload.	Scalability: Scaling resources may require manual intervention and could be less dynamic compared to OCI GoldenGate.
5	High Availability: Built-in features to ensure high availability and fault tolerance.	High Availability: You may have to configure high availability and fault tolerance manually.
6	Pricing: Typically billed based on the resources you use (compute, storage, data transfer, etc.).	Pricing: Usually involves the cost of the software license (BYOL) plus the infrastructure costs.

(continued)

Table 7-1. (continued)

OCI GoldenGate Services	GoldenGate on Cloud Marketplace
7 VM Access: No access to the host server/VM where the GoldenGate is running. The only access to the process is through the UI Console or AdminClient.	VM Access: Complete access to the host server/VM. Can physically call the files and process.
8 Backups: Oracle managed the GoldenGate deployment backup.	Backups: User needs to schedule backups for GoldenGate deployments and binaries.
9 Only supported GoldenGate versions are Microservices Architecture.	Supports both Microservices Architecture as well as classic for legacy customers.
10 Autonomous DB Wallet integration is completely managed automatically.	Autonomous DB Wallet integration needs to set up manually with Marketplace deployment.

Use Cases Between OCI GoldenGate Services and Cloud Marketplace GoldenGate

OCI GoldenGate Services

Use Case 1: Real-Time Analytics for a Growing Startup

Scenario:

A rapidly expanding tech startup wants real-time analytics to make data-driven decisions.

Why OCI GoldenGate Service?

Being a fully managed service, the startup doesn't need to divert its limited IT resources for management and can scale easily as it grows.

Outcome:

The startup successfully sets up real-time analytics with minimal IT overhead and leverages OCI's tight integration with other cloud services for enhanced analytics.

Use Case 2: Data Lake on OCI Cloud

Scenario:

A multinational company wants to create a data lake/lakehouse in OCI Cloud for near real time.

Why OCI GoldenGate?

Its deep integration with OCI services makes data movement smooth, and it supports a wide range of source and target databases.

Outcome:

The enterprise successfully moves its multi-terabyte data into OCI with minimum latency.

Cloud Marketplace GoldenGate

Use Case 3: Legacy System Integration for Financial Services

Scenario:

A financial institution with multiple legacy systems wants to integrate them for better data consistency.

Why Cloud Marketplace GoldenGate?

The institution has strict regulatory requirements and needs more control over the deployment and the servers hosting the GoldenGate.

Outcome:

The financial service company successfully integrates its legacy systems while adhering to compliance standards.

Use Case 4: IoT Data Integration for Manufacturing

Scenario:

A manufacturing company wants to integrate data from its IoT devices into its central database for real-time monitoring.

Why Cloud Marketplace GoldenGate?

The company has specialized requirements for data transformation that need custom configurations.

Outcome:

By leveraging GoldenGate from the Cloud Marketplace, the manufacturing company can customize its data integration pipeline to meet its specific needs, successfully achieving real-time monitoring.

Summary

OCI GoldenGate Services are often more suitable for organizations looking for a hassle-free, scalable, and fully managed solution. GoldenGate on Cloud Marketplace is generally better for businesses that have specialized requirements or need more control over their data integration process.

Both offerings have their pros and cons, and the best choice will depend on an organization's specific needs, expertise, and strategic goals.

CHAPTER 8

Migration of Databases with Near-Zero Downtime

A system, such as a database, can be moved from one environment to another with little to no impact on its availability and operation referred to as “near-zero downtime migration.” The objective is to guarantee that the system is accessible and functional during the migration process while minimizing the impact on users and business continuity.

The preceding approach can be implemented by configuring the complete initial load of the database from the source, setting up the GG Extract to capture the transaction and create a Replicat on the target database to apply.

One of the biggest advantages of using Database Migration Service (DMS) in the migration is it eliminates complex infrastructure preparation, and even for seasoned professionals with expertise in these technologies, configuring them can be a time-consuming, error-prone, and challenging process, particularly when dealing with a large number of databases.

Recognizing these challenges, Oracle has developed an exceptional solution called “Zero Downtime Migration.” This tool simplifies and streamlines the process of migrating databases to the cloud, ensuring a seamless transition for migration projects.

Oracle Zero Downtime Migration (ZDM) is a software solution available at no cost, designed to automate the migration of Oracle Databases to Oracle Cloud. Initially, ZDM focused on Data Guard-based migrations; however, now with the latest release of ZDM version 21c, logical migration with the use of Data Pump and Oracle GoldenGate offers seamless migrations to Oracle Cloud Database without any downtime.

ZDM provides four distinct approaches for database migration:

1. Logical online migration using GoldenGate
2. Logical offline migration using Data Pump
3. Physical online migration using Data Guard
4. Physical offline migration using Recovery Manager (RMAN)

In this chapter, we will focus on how to migrate a database from on-premises to OCI with “ZDM logical online migration using GoldenGate.”

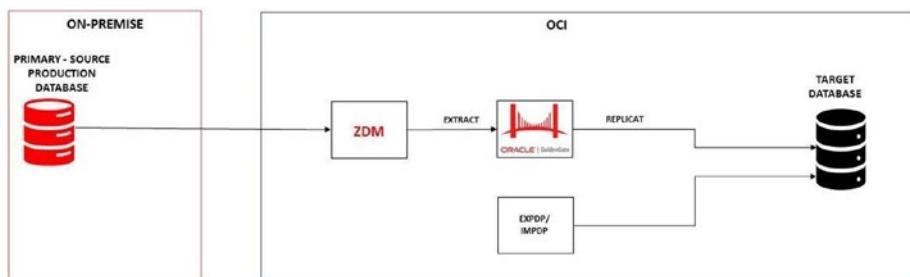


Figure 8-1. Architecture of ZDM

Install ZDM Software on OCI Linux Compute VM

To run the ZDM software, it is necessary to have a compute VM where the necessary software will be installed. This topic provides you the insight on how to install the ZDM.

Provision the Compute VM

To begin, access the OCI web console and navigate to “Compute” followed by “Instances.” Click the “Create Instance” option.

For the instance name, let’s use “zdm-host” and select Oracle Linux 8 as the operating system. Provision the compute VM.

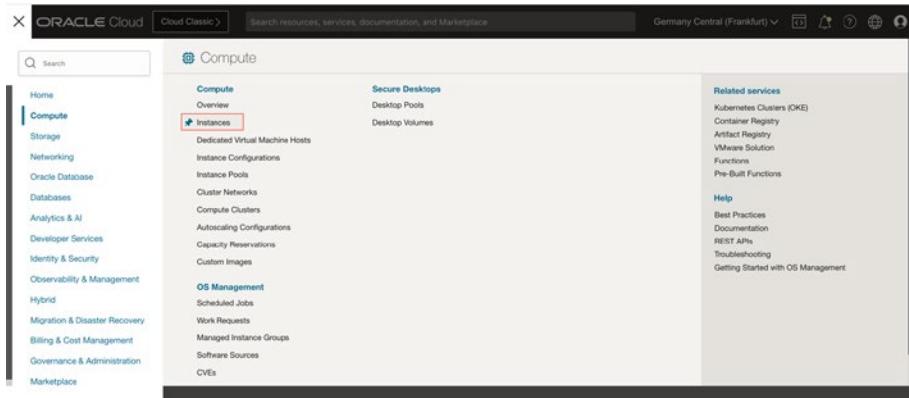


Figure 8-2. Creation of VM –for ZDM (A)

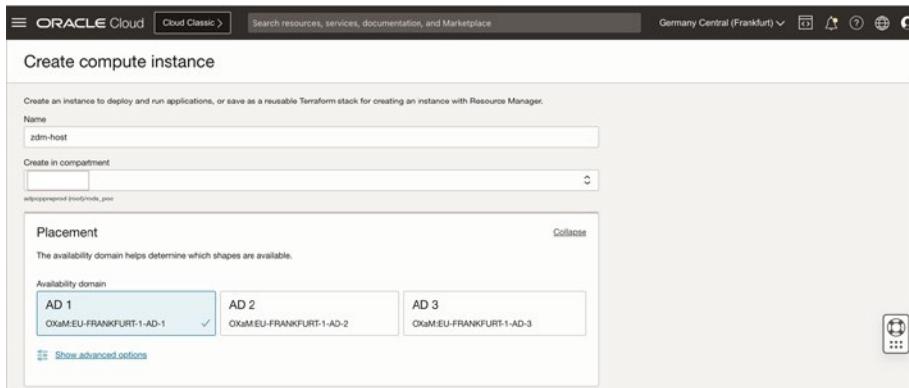


Figure 8-3. Creation of VM –for ZDM (B)

CHAPTER 8 MIGRATION OF DATABASES WITH NEAR-ZERO DOWNTIME

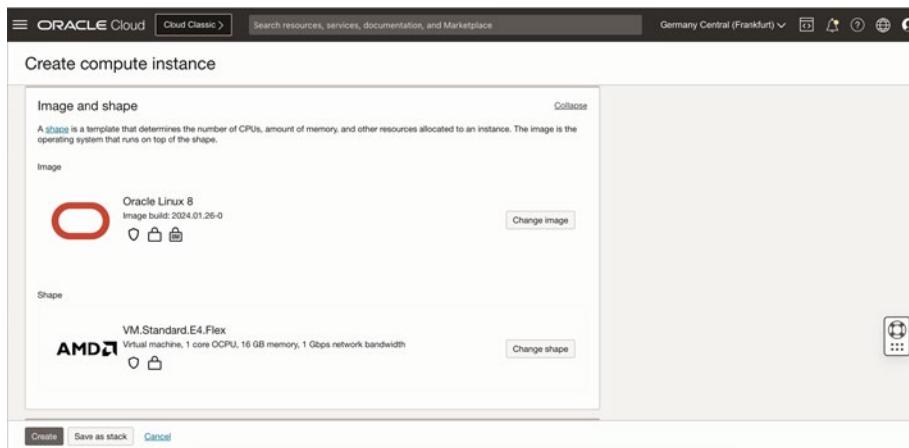


Figure 8-4. Creation of VM - for ZDM (C)

ZDM Software Installation

Log in to zdm-host using ssh and switch to the root user:

```
sudo -s
[root@zdm-host opc]# df -h
Filesystem           Size  Used Avail Use% Mounted on
devtmpfs              7.7G   0    7.7G  0% /dev
tmpfs                7.7G   0    7.7G  0% /dev/shm
tmpfs                7.7G  8.7M  7.7G  1% /run
tmpfs                7.7G   0    7.7G  0% /sys/fs/cgroup
/dev/mapper/ocivolume-root 189G  9.6G  180G  6% /
/dev/mapper/ocivolume-oled  10G 106M  9.9G  2% /var/oled
/dev/sda2             1014M 334M  681M 33% /boot
/dev/sda1              100M  5.1M  95M  6% /boot/efi
tmpfs                1.6G   0    1.6G  0% /run/user/0
tmpfs                1.6G   0    1.6G  0% /run/user/988
tmpfs                1.6G   0    1.6G  0% /run/user/1000
```

As the root user, create a new group, user, and the necessary directories for zdm:

```
[root@zdm-host opc]# groupadd zdm
[root@zdm-host opc]# useradd -g zdm zdmuser
[root@zdm-host opc]# mkdir -p /home/zdmuser/zdminstall
[root@zdm-host opc]# mkdir /home/zdmuser/zdmhome
[root@zdm-host opc]# mkdir /home/zdmuser/zdmbase
[root@zdm-host opc]# chown -R zdmuser:zdm /home/zdmuser/
```

As the root user, proceed to install the necessary software packages:

```
[root@zdm-host opc]# yum install glibc-devel expect unzip
libaio oraclelinux-developer-release-el8 -y
```

Download the ZDM software from the Oracle website: www.oracle.com/database/technologies/rac/zdm-downloads.html.

Switch to the ZDM user and set the environment variable:

```
export ZDMHOME=/home/zdmuser/zdmhome
export ZDMBASE=/home/zdmuser/zdmbase
[zdmuser@zdm-host zdminstall]$ unzip V1034023-01.zip
Archive: V1034023-01.zip
    creating: zdm21.4/
    inflating: zdm21.4/CredentialsDriver.class
    creating: zdm21.4/rhp/
    extracting: zdm21.4/rhp/zdm.build
    extracting: zdm21.4/zdm_home.zip
    inflating: zdm21.4/README
    inflating: zdm21.4/zdminstall.sh
    inflating: zdm21.4/schema_operations.sh

[zdmuser@zdm-host ~]$ /home/zdmuser/zdminstall/zdm21.4/
zdminstall.sh setup oraclehome=$ZDMHOME oraclebase=$ZDMBASE
ziploc=/home/zdmuser/zdminstall/zdm21.4/zdm_home.zip -zdm
```

CHAPTER 8 MIGRATION OF DATABASES WITH NEAR-ZERO DOWNTIME

```
ZDM kit home: /home/zdmuser/zdminstall/zdm21.4  
/home/zdmuser
```

```
-----  
Validating zip file...
```

```
-----  
Adding Certs to ZDM
```

```
-----  
ZDM service setup finished successfully...
```

Start the ZDM and verify the status of ZDM:

```
[zdmuser@zdm-host ~]$ $ZDMHOME/bin/zdmservice start  
No instance detected, starting zdmservice  
Return code is 0  
Server started successfully.
```

```
[zdmuser@zdm-host ~]$ $ZDMHOME/bin/zdmservice status
```

```
-----  
Service Status  
-----
```

```
Running:      true  
Tranferport:  
Conn String:  jdbc:mysql://localhost:8899/  
RMI port:     8897  
HTTP port:    8898  
Wallet path:  /home/zdmuser/zdmbase/crsdata/zdm-host/security
```

ZDM – Logical Online Migration Using GoldenGate

This topic offers a comprehensive guide on configuring ZDM with the necessary minimal parameters. It outlines a step-by-step process where Data Pump is utilized to generate the initial load, while GoldenGate Extract and replicate functions ensure continuous synchronization between the source and target databases.

It's worth noting that you don't require in-depth knowledge or you don't need to be an expert on Oracle GoldenGate on how to do the initial data load creating Extracts and replicats. ZDM automates these tasks for you, adhering to the best practices of the Maximum Availability Architecture for Migration.

Setup Required

1. ZDM HOST as previously provisioned.
2. Source Oracle Database on-premises 12.2: Available from on-premises.
3. Target OCI DBaaS 19.19: Provision it on OCI.
4. Oracle GoldenGate: Database migrations from OCI Marketplace. Provision it on OCI.

Provision VM for Oracle GoldenGate – Database Migrations

To locate and select the desired GoldenGate application, navigate to the main menu and click “Marketplace.”

From there, go to “Applications” and initiate a search for “GoldenGate.”

Choose the option titled “Oracle GoldenGate – Database Migrations” and make sure to keep the default version as “21.x.x.x (Oracle DB – Microservices Edition – Promotional).”

SSH Key Exchange for Passwordless Connectivity

Copy the ZDM HOST zdmuser public key to the on-premises Oracle Database. This is required for passwordless connectivity between the source database and ZDM:

```
/home/opc/.ssh  
-rw----- 1 opc opc 381 Jun 27 00:02 authorized_keys  
-rw----- 1 opc opc 1823 Jun 27 19:02 id_rsa  
-rw-r--r-- 1 opc opc 394 Jun 27 19:02 id_rsa.pub  
-rw-r--r-- 1 opc opc 170 Jun 27 19:11 known_hosts  
  
ssh-copy-id -i ~/.ssh/id_rsa.pub oracle@SOURCEDB
```

Set Up the Source Database

Check Supplemental Logging

```
SQL> SELECT supplemental_log_data_min, force_logging FROM v$database;
```

If the result is YES, the database meets the Oracle GoldenGate requirement.

If the result is NO from the above output, please proceed with the following steps.

```
SQL> ALTER DATABASE ADD SUPPLEMENTAL LOG DATA;
```

```
ENABLE_GOLDENGATE_REPLICATION database parameter to true
```

```
SQL> alter system set enable_goldengate_replication=true;
```

```
SQL> show parameter ENABLE_GOLDENGATE_REPLICATION
```

Value should be True.

```
-----  
SQL> create tablespace TBS_GGS datafile size 500m;  
Tablespace created.
```

```
CREATE TABLESPACE TBS_GGS  DATAFILE '/u01/app/oracle/oradata/  
ORCL/tbs_ggs_pdb01.dbf'  SIZE 500M ;
```

```
SQL> show pdbs
```

CON_ID	CON_NAME	OPEN MODE	RESTRICTED
2	PDB\$SEED	READ ONLY	NO
3	DB19C_PDB1	READ WRITE	NO

```
SQL> alter session set container = DB19C_PDB1;(Please change  
the PDB Name accordingly in the script).
```

Session altered.

```
SQL> create tablespace TBS_GGS datafile size 500m;  
Tablespace created.
```

```
SQL> create user c##ggadmin identified by "WelcomeYear##2023"  
default tablespace TBS_GGS temporary tablespace temp;  
User created.
```

```
SQL> alter user c##ggadmin quota unlimited on TBS_GGS;  
User altered.
```

```
SQL> exec dbms_goldengate_auth.grant_admin_privilege('c##ggadmi  
n',container=>'all');  
PL/SQL procedure successfully completed.
```

Grant Privileges

- grant connect,resource to c##ggadmin;
- grant create session to c##ggadmin;
- grant select any dictionary, select any table,SELECT ANY TRANSACTION to c##ggadmin;
- grant create table, alter any table to c##ggadmin;
- grant flashback any table to c##ggadmin;
- grant execute on dbms_flashback to c##ggadmin;
- grant execute on utl_file to c##ggadmin;
- grant select on system.logmnr_session\$ to c##ggadmin;

Set Up the GoldenGate Host

Add the source and target database TNS entries to tnsnames.ora under /u02/deployments/GGZDM/etc directory:

```
ORCL_SOURCE =
(DESCRIPTION =
  (ADDRESS = (PROTOCOL = TCP)(HOST = 10.0.0.8)(PORT = 1521))
  (CONNECT_DATA =
    (SERVER = DEDICATED)
    (SERVICE_NAME = ORCL)
  )
)

OCIDB_TARGET =
(DESCRIPTION =
  (ADDRESS = (PROTOCOL = TCP)(HOST = 10.0.0.182)
  (PORT = 1521))
```

```
(CONNECT_DATA =
  (SERVER = DEDICATED)
  (SERVICE_NAME = ocidb_pdb1.sub10051757060.ggvn.
  oraclelevcn.com)
)
)
```

Add Hostnames – ZDM HOST

Add the source and target database hostname entries in the /etc/hosts files. This information is required to resolve the hostnames while doing the migration.

These hostnames enable the migration tools and processes to accurately locate, connect to, and interact with the source (existing database) and target (new OCI Database) systems. It ensures proper connectivity, security, and configuration, facilitating a smooth and secure transfer of data from the existing database environment to the new one in OCI, aiming for minimal to zero downtime during the transition.

```
127.0.0.1 localhost localhost.localdomain localhost4
localhost4.localdomain4
::1           localhost localhost.localdomain localhost6
localhost6.localdomain6
10.0.0.9 zdm-host.sub10051757060.ggvn.oraclelevcn.com zdm-host
10.0.0.182 ocidb.sub10051757060.ggvn.oraclelevcn.com ocidb
10.0.0.8 oracle-12-2-si.sub10051757060.ggvn.oraclelevcn.com
oracle-12-2-si
```

Create a ZDM Response File

The parameters in a ZDM response file are very important in the migration scenarios. Here are some common components that can be found in a typical response file:

Migration Details: Includes the migration ID, description, and the migration method (e.g., online, offline, logical)

Source Database Information: Hostname, port, service name, and credentials of the source database

Target Database Information: OCI details such as the target DB system ID, database name, and credentials

Connectivity Configuration: Details about the connectivity method, such as SSH details, network configuration, and any required tunnels or VPNs

Migration Preferences: Any specific preferences or settings for the migration, including performance tuning parameters, data encryption settings, or exclusion lists for specific schemas or tables

Monitoring and Logging: Configuration for how the migration should be monitored and logged, including log file locations and verbosity levels

On the ZDM host, you can locate a template file called “zdm_logical_template.rsp” at the path “\$ZDMHOME/rhp/zdm/template”.

This file provides a concise explanation of the parameters and their respective potential values. We will utilize this template to generate a new response file with only the essential parameters included.

Here is the sample parameter file:

```
# METHOD OF MIGRATION
MIGRATION_METHOD=ONLINE_LOGICAL
DATA_TRANSFER_MEDIUM=OSS

# DATA PUMP SETTINGS
DATAPUMPSETTINGS_JOBMODE=SCHEMA
DATAPUMPSETTINGS_METADATA_REMAPS-1=type:REMAP_TABLESPACE,oldValue:USERs,newValue:DATA
DATAPUMPSETTINGS_DATABUCKET_NAMESPACE=id3nodyt06el
DATAPUMPSETTINGS_DATABUCKET_BUCKETNAME=ZDM-BUCKET
DATAPUMPSETTINGS_DATAPUMP_PARAMETERS_EXPORT_PARALLELISM_DEGREE=2
DATAPUMPSETTINGS_DATAPUMP_PARAMETERS_IMPORT_PARALLELISM_DEGREE=2
DATAPUMPSETTINGS_EXPORT_DIRECTORY_OBJECT_NAME=DATA_PUMP_DIR

# SOURCE DATABASE DATA_PUMP_DIR
DATAPUMPSETTINGS_EXPORT_DIRECTORY_OBJECT_PATH=/u01/app/oracle/
admin/ORCL/dpdump/
DATAPUMPSETTINGS_IMPORT_DIRECTORY_OBJECT_NAME=DATA_PUMP_DIR
DATAPUMPSETTINGS_CREATE_AUTH_TOKEN=False
DATAPUMPSETTINGS_DELETEDUMPS_IN_OSS=True
SOURCEDATABASE_CONNECTIONDETAILS_HOST=oracle-12-2-si
SOURCEDATABASE_CONNECTIONDETAILS_PORT=1521
SOURCEDATABASE_CONNECTIONDETAILS_SERVICE_NAME=orcl
SOURCEDATABASE_ADMIN_USERNAME=SYSTEM
SOURCEDATABASE_GGADMIN_USERNAME=ggadmin

# TARGET DATABASE DETAILS
TARGETDATABASE_OCID=ocid1.dbsystem.oc1.iad.
anuwcljt6rfcedyag.....
TARGETDATABASE_CONNECTIONDETAILS_HOST=ocidb
TARGETDATABASE_CONNECTIONDETAILS_PORT=1521
TARGETDATABASE_CONNECTIONDETAILS_SERVICE_NAME=ocidb_pdb1
```

```
TARGETDATABASE_ADMINUSERNAME=SYSTEM
TARGETDATABASE_GGADMINUSERNAME=c##ggadmin

# OCI INFORMATION
OCIAUTHENTICATIONDETAILS_USERPRINCIPAL_USERID=ocid1.user.oc1...
OCIAUTHENTICATIONDETAILS_USERPRINCIPAL_TENANTID=ocid1.
tenancy.oc1...
OCIAUTHENTICATIONDETAILS_USERPRINCIPAL_FINGERPRINT=73:25:7b:8
d:39:77:25:fc:b3:76:f4:73:d5
OCIAUTHENTICATIONDETAILS_USERPRINCIPAL_PRIVATEKEYFILE=/home/
zdmuser/.oci/oci_api_key.pem
OCIAUTHENTICATIONDETAILS_REGIONID=us-ashburn-1

# GOLDENGATE INFORMATION
GOLDENGATEHUB_ADMINUSERNAME=oggadmin
GOLDENGATEHUB_SOURCEDEPLOYMENTNAME=GGZDM
GOLDENGATEHUB_TARGETDEPLOYMENTNAME=GGZDM

#GOLDENGATE HOSTNAME
GOLDENGATEHUB_URL=https://ogg21czdm.sub10051757060.ggvn.
oraclevcn.com
GOLDENGATEHUB_COMPUTEID=ocid1.instance.oc1....
```

Testing the Whole Configuration

Eval Mode: ZDM provides a feature known as “evaluation mode” or “eval mode,” designed to assess the environment and migration plan before actually performing the migration. This mode is particularly useful for identifying potential issues, validating the migration setup, and ensuring that all prerequisites are met, thereby increasing the possibility of a successful migration with minimal downtime.

On the ZDM HOST:

```
[zdmuser@zdm-host ~]$ $ZDMHOME/bin/zdmcli migrate database \
-rsp /home/zdmuser/logical_online_migration.rsp \
-sourcenode oracle-12-2-si \
-sourcesid ORCL \
-srcauth zdmauth \
-srcarg1 user:opc \
-srcarg2 identity_file:/home/zdmuser/.ssh/id_rsa \
-srcarg3 sudo_location:/usr/bin/sudo \
-eval
```

Enter source database administrative user "SYSTEM" password:
Enter source database administrative user "ggadmin" password:
Enter source container database administrative user "SYSTEM"
password:

Enter source container database administrative user
"c##ggadmin" password:

Enter target database administrative user "ADMIN" password:
Enter target database administrative user "ggadmin" password:
Enter Oracle GoldenGate HUB administrative user "oggadmin"
password:

Enter Authentication Token for OCI user "ocid1.user.oc1...":
Enter Data Pump encryption password:
Operation "zdmcli migrate database" scheduled with the job
ID "35".

Validate the Job Status

ZDM provides command-line utilities to check the status of migration jobs, allowing to assess whether the migration is proceeding as expected, if it has completed successfully, or if there were any errors or issues that need to be addressed.

To check the status of a migration job in Oracle ZDM, use the ZDM command-line interface (CLI) by running the following query:

```
zdmcli query job -jobid <your_job_id>  
[zdmuser@zdm-host ~]$ $ZDMHOME/bin/zdmcli query job -jobid 35  
Job execution elapsed time: 2 minutes 12 seconds  
ZDM_VALIDATE_TGT ..... COMPLETED  
ZDM_VALIDATE_SRC ..... COMPLETED  
ZDM_SETUP_SRC ..... COMPLETED  
ZDM_PRE_MIGRATION_ADVISOR ..... COMPLETED  
ZDM_VALIDATE_GG_HUB ..... COMPLETED  
ZDM_VALIDATE_DATAPUMP_SETTINGS_SRC .... COMPLETED  
ZDM_VALIDATE_DATAPUMP_SETTINGS_TGT .... COMPLETED  
ZDM_CLEANUP_SRC ..... COMPLETED
```

Start the Migration Process

With the environment prepared, the target set up, and the response file ready and validated by eval mode, the actual migration process can be started.

ZDM supports the ability to pause and resume migration jobs, providing flexibility in managing long-running or complex database migrations. This feature is particularly useful for addressing issues that may arise during the migration process without having to start over from the beginning. It also allows for better alignment with business requirements, such as pausing the migration during peak business hours to minimize impact.

Additionally, pause the migration process after reaching the step “ZDM_MONITOR_GG_LAG”. This action will enable continuous data replication until the migration is resumed:

```
[zdmuser@zdm-host ~]$ $ZDMHOME/bin/zdmcli migrate database \
-rsp /home/zdmuser/ logical_online_migration.rsp \
-sourcenode oracle-12-2-si \
-sourcesid ORCL \
-srcauth zdmauth \
-srcarg1 user:opc \
-srcarg2 identity_file:/home/zdmuser/.ssh/id_rsa \
-srcarg3 sudo_location:/usr/bin/sudo \
-pauseafter ZDM_MONITOR_GG_LAG
```

Enter source database administrative user "SYSTEM" password:
Enter source database administrative user "ggadmin" password:
Enter source container database administrative user "SYSTEM"
password:

Enter source container database administrative user
"c##ggadmin" password:

Enter target database administrative user "ADMIN" password:
Enter target database administrative user "ggadmin" password:
Enter Oracle GoldenGate HUB administrative user "oggadmin"
password:

Enter Authentication Token for OCI user "ocid1.user.oc1....":
Enter Data Pump encryption password:
Operation "zdmcli migrate database" scheduled with the job
ID "45".

Validate the Job Status of Actual Migration

```
[zdmuser@zdm-host ~]$ $ZDMHOME/bin/zdmcli query job -jobid 45
Job ID: 45
User: zdmuser
Client: zdmhost
Job Type: "MIGRATE"
```

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...

Current status: PAUSED

Current Phase: "ZDM_MONITOR_GG_LAG"

Result file path: "/home/zdmuser/zdmbase/chkbase/scheduled/job-43-2023-06-27-18:25:44.log"

...

ZDM_VALIDATE_TGT	COMPLETED
ZDM_VALIDATE_SRC	COMPLETED
ZDM_SETUP_SRC	COMPLETED
ZDM_PRE_MIGRATION_ADVISOR	COMPLETED
ZDM_VALIDATE_GG_HUB	COMPLETED
ZDM_VALIDATE_DATAPUMP_SETTINGS_SRC	COMPLETED
ZDM_VALIDATE_DATAPUMP_SETTINGS_TGT	COMPLETED
ZDM_PREPARE_GG_HUB	COMPLETED
ZDM_ADD_HEARTBEAT_SRC	COMPLETED
ZDM_ADD_SCHEMA_TRANDATA_SRC	COMPLETED
ZDM_CREATE_GG_EXTRACT_SRC	COMPLETED
ZDM_PREPARE_DATAPUMP_SRC	COMPLETED
ZDM_PREPARE_DATAPUMP_TGT	COMPLETED
ZDM_DATAPUMP_EXPORT_SRC	COMPLETED
ZDM_UPLOAD_DUMPS_SRC	COMPLETED
ZDM_DATAPUMP_IMPORT_TGT	COMPLETED
ZDM_POST_DATAPUMP_SRC	COMPLETED
ZDM_POST_DATAPUMP_TGT	COMPLETED
ZDM_ADD_HEARTBEAT_TGT	COMPLETED
ZDM_ADD_CHECKPOINT_TGT	COMPLETED
ZDM_CREATE_GG_REPLICAT_TGT	COMPLETED
ZDM_MONITOR_GG_LAG	COMPLETED
ZDM_SWITCHOVER_APP	PENDING
ZDM_RM_GG_EXTRACT_SRC	PENDING
ZDM_RM_GG_REPLICAT_TGT	PENDING

```
ZDM_DELETE_SCHEMA_TRANDATA_SRC ..... PENDING
ZDM_RM_HEARTBEAT_SRC ..... PENDING
ZDM_RM_CHECKPOINT_TGT ..... PENDING
ZDM_RM_HEARTBEAT_TGT ..... PENDING
ZDM_CLEAN_GG_HUB ..... PENDING
ZDM_POST_ACTIONS ..... PENDING
ZDM_CLEANUP_SRC ..... PENDING
```

Please note the current status of the job, which is currently in a PAUSED state. Additionally, the progress has halted after the completion of the ZDM_MONITOR_GG_LAG phase.

During this stage, any modifications made to the source database are instantly synchronized with the target database. When your application is prepared for migration, you can proceed by resuming the job.

Complete the Migration Process

Proceed to resume the job from the previous step:

```
[zdmuser@zdm-host ~]$ $ZDMHOME/bin/zdmcli resume job -jobid 45
```

Once again, check the status and patiently wait until all phases are successfully completed.

Troubleshooting:

ZDM generates logs that are essential for troubleshooting, monitoring the migration process, and understanding the details of each step. These logs can provide insights into the execution flow, errors, and warnings that occur during the migration process. Knowing where ZDM stores these logs is crucial for effectively managing and troubleshooting the migrations.

Default Log Location: <ZDM_HOME>/logs/

Here, <ZDM_HOME> represents the directory where ZDM is installed. Inside the logs directory, there will be different types of log files, including ZDM Service Logs, Migration Job Logs, and CLI Logs.

Summary

ZDM's primary focus is on orchestrating the migration process, managing steps such as initial data load, continuous data replication (for online migrations), switchover to the target system, and finalizing the migration. It uses underlying Oracle technologies like Data Guard, GoldenGate, or RMAN for the heavy lifting of data transfer and synchronization.

ZDM requires initial effort in the setup process. Once the setup is completed, all the steps can be performed in a few clicks.

This includes initial data load with Data Pump taking export and importing the data to the target. Also, ZDM takes care of creating necessary schema and configuration for real-time synchronization.

If there are replication issues, such as data not being replicated correctly or in a timely manner due to network bottlenecks or configuration errors, ZDM's role is not to fix these issues automatically. Instead, it would require to troubleshoot the replication technology being used (e.g., GoldenGate) to identify and solve the root cause of the replication problem.

CHAPTER 9

Troubleshooting Oracle GoldenGate on OCI

Every robust system, irrespective of its capabilities, can encounter challenges and errors out while it is functional. Oracle GoldenGate on OCI is no different and can run into issues, warnings, and sometimes process-related errors. This chapter is dedicated to help GoldenGate experts in diagnosing and resolving common issues that may arise when using GoldenGate Service on Oracle's cloud platform.

Troubleshooting demands a methodical process: beginning with identifying the symptoms, diving deep into determining the root cause, and then applying the solution. Given the situation of Oracle GoldenGate's processes, databases, and cloud services, a well-organized troubleshooting plan is essential to resolve many complicated situations.

Throughout this chapter, we will navigate a series of common challenges, understand their underlying causes, and explore solutions to ensure seamless data replication and integration on OCI.

Classify the Common Encountered Issues with GoldenGate

1. Diagnosing Connectivity Issues Between the Source and the Target
2. Performance Bottleneck Identification
3. High Transaction Volumes
4. Data Conflicts and Consistency Issues
5. Logdump in OCI GGS

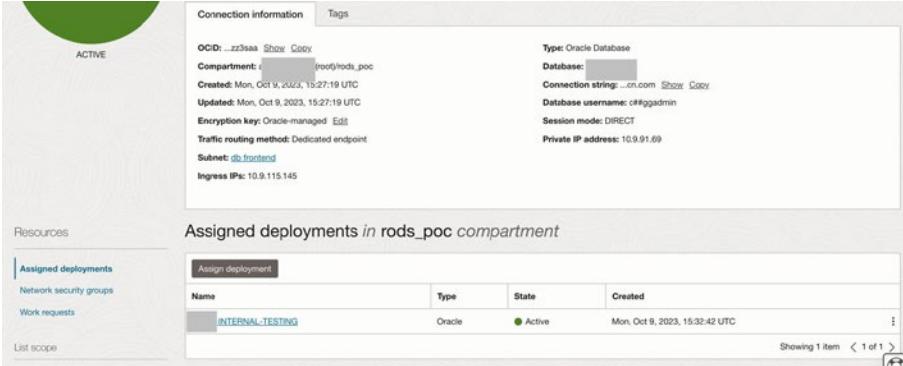
Diagnosing Connectivity Issues Between the Source and the Target

During the initial setup or when modifications are made to the source or target, various challenges might emerge, such as issues connecting GoldenGate to the designated target. These problems could be attributed to factors like inaccurate credentials, network obstacles, or configuration mishaps.

Step 1: Test the connection of the source and target in the OCI Console.

In the OCI Console, select GoldenGate Instance and go to the Connection settings.

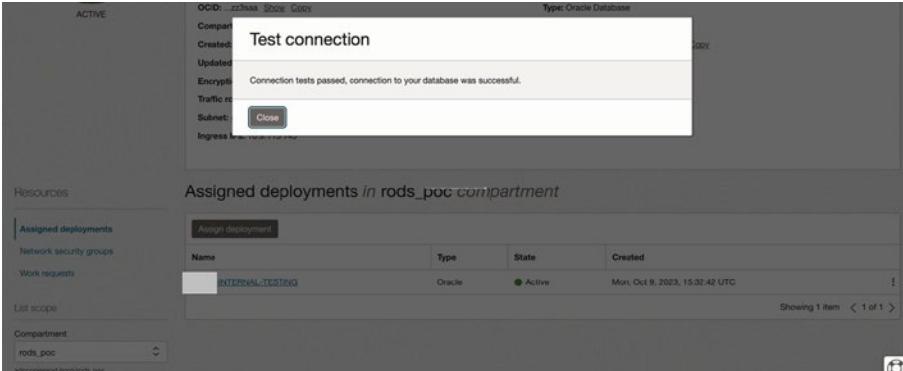
CHAPTER 9 TROUBLESHOOTING ORACLE GOLDENGATE ON OCI



The screenshot shows the OCI Console interface for a GoldenGate deployment. At the top, there's a green circular icon labeled 'ACTIVE'. Below it, the 'Connection information' tab is selected, showing details like OCID, Compartment, Created, Updated, Encryption key, Traffic routing method, Subnet, and Ingress IP. The 'Tags' tab is also visible. The main content area displays 'Assigned deployments in rods_poc compartment' with a table showing one item: INTERNAL-TESTING (Oracle, Active, Mon, Oct 9, 2023, 15:32:42 UTC). On the left sidebar, there are links for Assigned deployments, Network security groups, Work requests, and List scope. A dropdown menu for 'Compartment' is open, showing 'rods_poc'.

Figure 9-1. OCI Console GoldenGate assigned deployment

Select the three dots at the right and click Test Connection.



This screenshot shows the same OCI Console interface as Figure 9-1, but with a modal dialog box titled 'Test connection' overlaid. The dialog contains the message 'Connection tests passed, connection to your database was successful.' with a 'Close' button. The background shows the list of assigned deployments and the compartment dropdown.

Figure 9-2. OCI Console GoldenGate connection test

Step 2: Test the connection of the source and target in the GoldenGate Console.

Log in to OCI GoldenGate. Click Configuration; under the Action, click the Connect button.

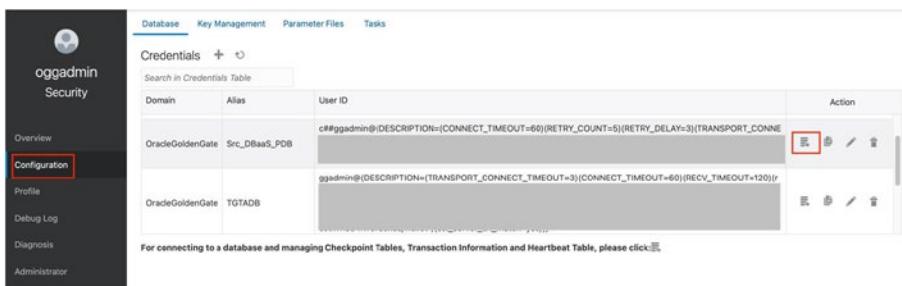


Figure 9-3. *GoldenGate Console connection test*

If the preceding two steps are successful, then it indicates that the connection information, including credentials and network configurations, is accurate.

Performance Bottleneck Identification

In the realm of real-time data replication and migration facilitated by Oracle GoldenGate on Oracle Cloud Infrastructure (OCI), managing lag is crucial to maintaining optimal performance and data consistency across systems.

“LAG” in the GoldenGate environment refers to the delay in data replication between source and target systems, and it can originate in different aspects of the replication process.

Resource Constraints: Inadequate CPU, memory, or I/O can slow down data processing.

Validate the metrics of the CPU and memory utilization in OCI GoldenGate Metrics. This is readily available in the OCI Console of GoldenGate deployment.



Figure 9-4. OCI GoldenGate Metrics – resource consumption

Auto-scaling: Implement auto-scaling in OCI GoldenGate to dynamically adjust resources based on the load. If auto-scaling is not enabled, regularly review and adjust allocated resources to ensure they meet processing demands.

Network Latency: Network latency or bandwidth limitations can affect GoldenGate components or connections from OCI to on-premises systems, as well as GoldenGate's connection to their respective source and target systems.

Define standards for acceptable levels of lag and throughput volume for both Extract and Replicat processes. Remember that Extract typically outpaces Replicat due to the nature of the tasks it performs comparing Replicat.

With time, you will be able to determine whether the observed difference is within normal bounds or if it signals a need for tuning or troubleshooting. If you observe latency in the network, please check with the network expert to further optimize the latency.

High Transaction Volumes

Managing high transaction volumes effectively is pivotal in ensuring smooth and efficient data replication with Oracle GoldenGate. Let's delve into strategies and practices that can be employed to handle, optimize, and tune GoldenGate under the pressures of heavy transaction loads:

Batching Transactions: Modify configurations to allow Extract and Replicat processes to handle transactions in batches. Parameters like BATCHSQL will be effective here. This reduces the overhead of committing transactions individually and batches similar set of transactions into one and applies as one shot on the target.

Parallel Processing: Implement Parallel Replicat to utilize Integrated Replicat processes to leverage parallel apply, especially beneficial for databases that support parallel DML. If the target doesn't support integrated apply, modify it to non-integrated and allow the Replicat to apply the data in multiple threads to the target.

Range Partitioning: The strategy here is to divide the data into partitions based on defined ranges to manage high transaction tables effectively. Also, implement parallelism in Replicat by ensuring that range-partitioned tables are processed with multi-threaded Replicat.

Compression: A trail file compression parameter enables compression for trail files to conserve bandwidth and enhance transfer speeds between the source and the target.

Continuous Tuning: Regularly review and adjust tuning strategies to cater to evolving transaction volumes and data characteristics.

Data Conflicts and Consistency Issues

Ensuring data consistency while managing conflicts is a fundamental approach when dealing with real-time data replication and migration using Oracle GoldenGate. Let's explore strategies and best practices for addressing data conflicts and ensuring data consistency in a GoldenGate environment.

The fundamental key to avoid any data issues is **initial data load**, also known as **instantiation**, and it is critical in the Oracle GoldenGate implementation process. It pertains to the copying of data from the source database to the target, ensuring both databases are synchronized before the replication of ongoing changes begins. Effective management of this phase ensures data consistency and integrity throughout the GoldenGate replication setup.

What are some of the common data conflict scenarios?

- Simultaneous Updates: When the same data point is updated almost simultaneously in different databases
- Delete-Update Conflicts: When one node deletes a record that another node is trying to update
- Insert Conflicts: When two nodes insert a record with the same unique identifier
- Data Modeling/Design Issues: Data design for the tables missing with primary keys or conflicting with other data

Where to look for errors in OCI GoldenGate Service?

Select the Extract or Replicat process. Click Details.

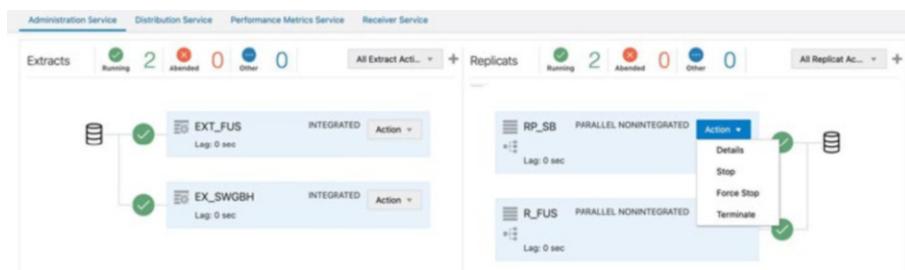


Figure 9-5. OCI GoldenGate Report details

Select the Report from the Details page.

CHAPTER 9 TROUBLESHOOTING ORACLE GOLDENGATE ON OCI

The screenshot shows a web-based interface for managing Oracle GoldenGate processes. At the top, there are tabs for Administration Service, Distribution Service, Performance Metrics Service, and Receiver Service. Below these, a breadcrumb navigation shows 'Overview > Process Information'. A sub-header 'RP_SB (PARALLEL NONINTEGRATED)' is displayed. A horizontal menu bar includes Process Information, Checkpoint, Statistics, Parameters, Report (which is selected), and Heartbeat. On the right side, there is a 'Refresh' button. The main content area is titled 'Report Files' and lists several files: RP_SB.rpt, RP_SB0.rpt, RP_SB1.rpt, RP_SB2.rpt, RP_SB3.rpt, RP_SB4.rpt, RP_SB5.rpt, RP_SB6.rpt, RP_SB7.rpt, and RP_SB8.rpt. Each file entry has a small preview icon. To the right of the file list, detailed log information is shown for RP_SB.rpt, including the Oracle GoldenGate delivery version (21.11.0.0.5_OGGOR8E_21.11.0.0.0_OOGGRH_PLATFORMS_230912.1108_P80), the operating system (Oracle Linux 7, x64, 44bit optimized), and the database version (Oracle Database 21c and lower supported versions on Sep 12 2023 15:54:29). The log also contains copyright information from 1995 to 2023, starting at 2023-10-09 21:20:45, and a section on process limits (soft limit, hard limit) for Address Space Size, Stack Size, File Size, and CPU Time. It also shows the process ID (19083) and a description (Replicat for Swing Bench).

Figure 9-6. OCI GoldenGate report file

A **report file** provides detailed logging of GoldenGate process information, such as Extract and Replicat, offering insights into operations, performance metrics, and potential issues. It contains status information, statistics, and encountered errors or warnings during processing.

Example:

```
ERROR    OGG-00519 Fatal error executing DDL replication: error
[Error code [1418], ORA-01418: specified index does not exist
], no error handler present.

ERROR    OGG-01296 Error mapping from PDB.SOE.ORDERS to
G9544FCABB4BB11_ADW.SOE.ORDERS.

GGS WARNING 218 Aborted grouped transaction on 'PDB.SOE.
ORDERS', Database error 100 (retrieving bind info for query).

GGS WARNING 218 Repositioning to rba 163614680 in seqno 2.

GGS WARNING 218 SQL error 1403 mapping PDB.SOE.ORDERS to PDB.
SOE.ORDERS.
```

Conflict Detection

Implement conflict detection to identify and log conflicts during the replication process. Manual Resolution establishes protocols for manual

conflict resolution, usually involving data analysis and intervention by DBAs.

Data Validation Approach for the Source and Target in Data Replication

Ensuring the accuracy and consistency of data between the source and target is imperative in any data replication or migration process. A rigorous data validation approach not only safeguards data integrity but also assures stakeholders about the reliability of the replication process. Here is an approach to validate data between source and target databases, particularly in the context of data replication tools like Oracle GoldenGate:

Row Count Validation: Continuously verify that the number of records in source and target tables remains consistent.

Checksum Validation: Implement checksum validation for data blocks to verify data integrity during transmission.

Data Comparison: Utilize data comparison tools or custom written scripts to validate data on a sample basis or at specific checkpoints or at specific date intervals.

Oracle GoldenGate Veridata: This tool is a high-speed data comparison solution by Oracle that identifies, reports, and resolves data discrepancies between heterogeneous databases without interrupting ongoing business processes. This solution is particularly vital in environments where precise data synchronization is crucial, such as data replication, migration, and business continuity strategies.

Details of Veridata are outside the scope of this book. Please do check the Oracle Documentation for further information.

Logdump in OCI GGS

The logdump utility is an essential tool in Oracle GoldenGate that allows users to inspect, navigate, and analyze the content within GoldenGate trail files and Extract logs. This utility is essential for diagnosing issues, validating data, and ensuring synchronization between source and target data environments.

How to Use Logdump for OCI GGS?

Provision the compute VM in OCI or use one of the available VMs that OGG 21c installed with logdump utility. If it is not, you can just copy the BIN directory from any of the installed GG binaries.

Use the compute VM to log in to logdump.

```
-rwxrwxr-x. 1 opc opc 1899896 Apr 25 2021 convchk
-rwxrwxr-x. 1 opc opc 3071096 Apr 25 2021 convprm
-rwxrwxr-x. 1 opc opc 5676840 Apr 25 2021 defgen
-rwxrwxr--. 1 opc opc 12266512 Apr 25 2021 distsrvr
-rwxrwxr-x. 1 opc opc 4987944 Apr 25 2021 emscnt
-rwxrwxr--. 1 opc opc 11937056 Apr 25 2021 extract
-rwxrwxr-x. 1 opc opc 5005900 Apr 25 2021 gacmd
-rwxrwxr-x. 1 opc opc 112920 Apr 25 2021 oggagent
-rwxrwxr-x. 1 opc opc 5564488 Apr 25 2021 logdump
-rwxrwxr--. 1 opc opc 108362 Dec 16 2020 oggca.sh
-rwxrwxr-x. 1 opc opc 1690360 Apr 25 2021 oggerr
-rwxrwxr-x. 1 opc opc 1690360 Apr 24 2021 orapki
-rwxrwxr-x. 1 opc opc 8923832 Apr 25 2021 pmsrvr
-rwxrwxr--. 1 opc opc 10192504 Apr 25 2021 recvsrvr
-rwxrwxr--. 1 opc opc 11073072 Apr 25 2021 replicat
-rwxrwxr-x. 1 opc opc 1686264 Apr 25 2021 retrace
-rwxrwxr-x. 1 opc opc 8401936 Apr 25 2021 ServiceManager
-rwxrwxr-x. 1 opc opc 6809 Oct 18 2018 XAGTask
[opc@rodsmv bin]$ ./logdump

Oracle GoldenGate Log File Dump Utility for Oracle
Version 21.1.0.0.1 OGGCORE_21.1.0.0.0_PLATFORMS_210424.1610

Copyright (C) 1995, 2021, Oracle and/or its affiliates. All rights reserved.

Logdump 1 > [ ]
```

Figure 9-7. Logdump

Make sure to back up the OCI GoldenGate deployment manually to one of the buckets in Object Storage.

Here are the steps: go to OCI GoldenGate console deployment ➤ Deployment backups.

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The screenshot shows the Oracle Cloud interface for creating a manual backup. On the left, there's a sidebar with various navigation options like Resources, Metrics, Network security groups, Deployment backups, Upgrades, Assigned connections, Trail files, Master key wallet operations, Work requests, Logs, List scope, Compartment, and Filters. The main area displays 'Deployment backups in poc compartment' with a table of existing backups. A modal window titled 'Create backup' is open on the right, prompting for a 'Name' (OCIGG-ManualBKUP), 'Compartment' (poc), 'Object storage bucket in rods_poc' (OCIGG-Bucket), and 'Object name' (Manual-BKup). There are also 'Show advanced options' and 'Cancel' buttons.

Name	State	Backup type	Backup size
INTERNAL-TESTING - 10/14/23	Active	Full	627.7 MB
INTERNAL-TESTING - 10/13/23	Active	Full	627.9 MB
INTERNAL-TESTING - 10/12/23	Active	Full	625.3 MB
INTERNAL-TESTING - 10/11/23	Active	Full	624.1 MB
INTERNAL-TESTING - 10/10/23	Active	Full	3 MB
INTERNAL-TESTING - 10/9/23	Active	Full	2.3 MB
INTERNAL-TESTING - 10/9/23	Active	Full	1.8 MB
INTERNAL-TESTING - 10/7/23	Active	Full	1.9 MB
INTERNAL-TESTING - 10/6/23	Active	Full	1.8 MB

Figure 9-8. Manual backup creation

Manual backup has been completed into the Object Storage Bucket.

This screenshot shows the same Oracle Cloud interface after the manual backup has been created. The 'Deployment backups in poc compartment' table now includes a new entry: 'OCIGG-ManualBKUP'. An arrow points to this new entry. The rest of the table remains the same as in Figure 9-8, listing automatic backups from October 6 to 14, 2023.

Name	State	Backup type	Backup size	Source type	Created
OCIGG-ManualBKUP	Active	Full	627.7 MB	Manual	Sun, Oct 15, 2023, 21:30:51 UTC
INTERNAL-TESTING - 10/14/23	Active	Full	627.7 MB	Automatic	Sat, Oct 14, 2023, 22:00:30 UTC
INTERNAL-TESTING - 10/13/23	Active	Full	627.9 MB	Automatic	Fri, Oct 13, 2023, 22:00:28 UTC
INTERNAL-TESTING - 10/12/23	Active	Full	625.3 MB	Automatic	Thu, Oct 12, 2023, 22:00:22 UTC
INTERNAL-TESTING - 10/11/23	Active	Full	624.1 MB	Automatic	Wed, Oct 11, 2023, 22:00:34 UTC
INTERNAL-TESTING - 10/10/23	Active	Full	3 MB	Automatic	Tue, Oct 10, 2023, 22:00:25 UTC
INTERNAL-TESTING - 10/9/23	Active	Full	2.3 MB	Automatic	Mon, Oct 9, 2023, 22:00:29 UTC
INTERNAL-TESTING - 10/9/23	Active	Full	1.8 MB	Automatic	Sun, Oct 8, 2023, 22:00:21 UTC
INTERNAL-TESTING - 10/7/23	Active	Full	1.9 MB	Automatic	Sat, Oct 7, 2023, 22:00:29 UTC
INTERNAL-TESTING - 10/6/23	Active	Full	1.8 MB	Automatic	Fri, Oct 6, 2023, 22:00:16 UTC

Figure 9-9. Manual backup completed

Once the manual backups are completed, download the backups to the compute VM and perform the logdump.

Common Commands in Logdump

1. OPEN: To load a trail file
2. COUNT: To tally the number of records

3. POS: To position the pointer to a particular record
4. NEXTHDR: To navigate to the next header
5. GGSTOKENS: To display tokens, such as metadata, within the records

OCI GoldenGate Diagnostics ggserr.log Rpt Files Log Files

Since we will not have physical access to the deployments or container of OCI GoldenGate, let's check how to gather the OCI GoldenGate diagnostics ggserr.log Rpt Files Log Files and other diagnostic data to work with product support team or to investigate these logs for errors and fix in time.

Prerequisites for collecting the diagnostic data: Object Store Bucket

In this scenario, a bucket named GGS-Diagnostics was created.

Proceed to GoldenGate Deployment and select the deployment. In Deployment, click More Actions ➤ Collect Diagnostics.

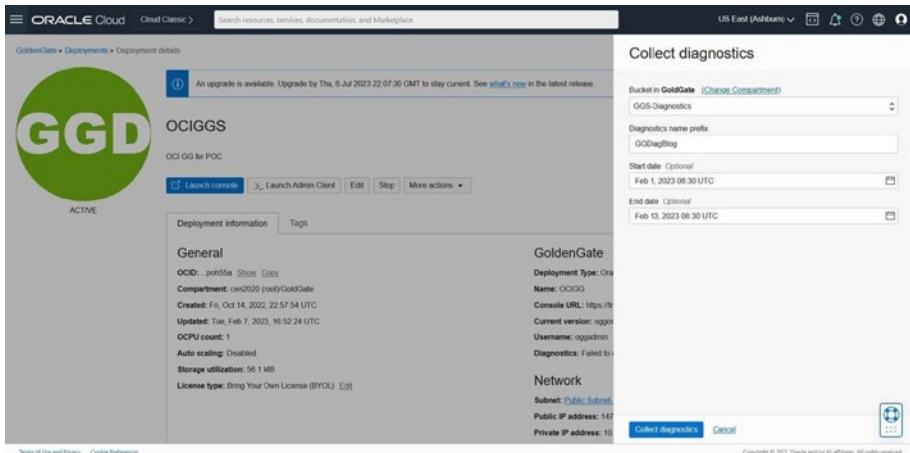


Figure 9-10. Create diagnostics

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The diagnostic data collection can be monitored from the “Work requests” submenu.

Resources Work requests

Operation	State	% complete	Accepted	Started	Finished
Collect deployment diagnostic	● In progress	40%	Tue, Feb 14, 2023, 16:58:00 UTC	Tue, Feb 14, 2023, 16:58:59 UTC	—

Show 1 item < 1 of 1 >

Figure 9-11. Create diagnostics – work requests

After the request is done, the output file is placed to the bucket specified during the request submission or by using the file name shown in the Diagnostics field. This file can be downloaded for further troubleshooting.

Deployment information Tags

General

OCID: po65sa Show Copy
Compartment: cm020 (root/GoldGate)
Created: Fri Oct 14, 2022, 22:57:54 UTC
Updated: Tue, Feb 14, 2023, 16:58:00 UTC
OCIPU count: 1
Auto scaling: Disabled
Storage utilization: 56.1 MB
License type: Bring Your Own License (BYOL) Edit

GoldenGate

Deployment Type: Oracle
Name: GG00
Console URL: https://llnksgt65sa.GG_VCN Edit
Current version: ggupgrade21.8.0.0_221014.1235_596 Upgrade
Username: ggadmin Edit
Diagnostics: GGLogBlob 1679303689412.zip Download

Network

Subnet: Public Subnet GG_VCN Edit
Public IP address: 147.154.0.148
Private IP address: 10.0.0.197

Resources Work requests

Operation	State	% complete	Accepted	Started	Finished
Collect deployment diagnostic	● Succeeded	100%	Tue, Feb 14, 2023, 16:58:00 UTC	Tue, Feb 14, 2023, 16:58:59 UTC	Tue, Feb 14, 2023, 17:00:17 UTC

Show 1 item < 1 of 1 >

Figure 9-12. Create diagnostics – work request completed

Collecting diagnostic files is straightforward, and they can effortlessly be submitted to the service request (SR) support analyst or utilized for further troubleshooting. View a sample file screenshot in Figure 9-13.

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ER-events.log	2/14/2023 3:41 PM	Text Document	15 KB
error.log	2/14/2023 12:02 AM	Text Document	132 KB
EX_MINED.prm	11/11/2022 3:38 PM	PRM File	1 KB
EX_SWING.dsc	2/14/2023 3:33 PM	DSC File	1 KB
EX_SWING.prm	1/11/2023 6:53 PM	PRM File	1 KB
EX_SWING.rpt	2/14/2023 3:41 PM	RPT File	8 KB
EX_SWING0.dsc	2/14/2023 3:32 PM	DSC File	1 KB
EX_SWING0.rpt	2/14/2023 3:32 PM	RPT File	42 KB
EX_SWING1.dsc	1/30/2023 7:42 PM	DSC File	1 KB
EX_SWING1.rpt	1/31/2023 3:04 AM	RPT File	8 KB
EX_SWING2.dsc	1/21/2023 12:57 AM	DSC File	1 KB
EX_SWING2.rpt	1/21/2023 12:57 AM	RPT File	48 KB
EX_SWING3.dsc	1/11/2023 6:54 PM	DSC File	1 KB
EX_SWING3.rpt	1/11/2023 6:53 PM	RPT File	5 KB
EXTMINE.prm	11/11/2022 3:50 PM	PRM File	1 KB
extract.log	2/14/2023 3:41 PM	Text Document	456 KB
gglog-EX_MINED.dmp	11/11/2022 3:46 PM	DMP File	1,140 KB
gglog-EX_SWING.dmp	1/21/2023 12:57 AM	DMP File	1,636 KB
gglog-EXTMINE.dmp	11/22/2022 3:55 AM	DMP File	5 KB
ggser.log	2/14/2023 4:59 PM	Text Document	4,644 KB
ggser.log.1	2/14/2023 12:04 AM	1 File	10,240 KB

Figure 9-13. Diagnostics – listed file output

Summary

This chapter provided a comprehensive understanding of common issues, troubleshooting techniques, and best practices for maintaining the stability and reliability of GoldenGate replication processes.

This chapter covered the collection of diagnostic files, execution of logdump, and the resolution of data conflicts, issues, and performance-related problems.

CHAPTER 10

On-Premises Database Migration to OCI

In this chapter, we provide a comprehensive introduction to the concept of database migration and the powerful capabilities of GoldenGate in facilitating a smooth and efficient migration process.

As organizations increasingly adopt cloud technologies, the need to migrate on-premises databases to OCI has become a critical consideration. GoldenGate, as a leading data integration tool, plays a crucial role in enabling seamless data replication and synchronization between on-premises databases and OCI.

Setup and Provisioning of OCI GoldenGate Service

For instructions on setting up and provisioning the OCI GoldenGate Service on the OCI Cloud, please refer to Chapters 3 and 4.

Configure GoldenGate Extract to Capture from On-Premises

The objective of this chapter is to set up a real-time data replication from an on-premises database to an OCI Database as a Service/DBaaS Instance.

Make sure to establish connectivity between an on-premises data center and OCI for a seamless movement of the traffic network either using an IPsec or Fast Connect method.

Prepare the Source Database

Ensure that the on-premises source database is properly configured and running.

This includes the following.

1. Enable Minimum Supplemental Logging at the Database Level

For data replication solutions like Oracle GoldenGate, more logging is required. It makes sure that all necessary details, including column-level metadata, are recorded for changing data into the redo logs. Hence, minimum supplemental logging needs to be enabled.

To enable minimum supplemental logging at the database level, follow these steps:

Connect to the Database as sysdba: sqlplus / as sysdba

Check Supplemental Logging: Verify the current supplemental logging settings in the database by executing the following SQL query:

```
SQL> SELECT supplemental_log_data_min, force_logging FROM
v$database;
SUPPLEMENT FORCE_LOGGING
-----
NO      NO
```

This query will show the current values for minimum supplemental logging and primary key supplemental logging.

Enable Minimum Supplemental Logging: To enable minimum supplemental logging, execute the following SQL statement:

```
SQL> ALTER DATABASE ADD SUPPLEMENTAL LOG DATA;
Database altered.
```

This command adds supplemental log groups to the database. Supplemental logging is now enabled at the minimum level, which includes column-level logging for all tables.

ENABLE_GOLDENGATE_REPLICATION PARAMETER

```
SQL> alter system set enable_goldengate_replication=true
scope=both sid='*';
SQL> show parameter ENABLE_GOLDENGATE_REPLICATION
```

The value should be true.

CREATE USERS AND TABLESPACES IN CDB+PDB

```
SQL> create tablespace TBS_GGS datafile '+DATAC1' size 500m;
Tablespace created.
```

```
SQL> create user c##ggadmin identified by "Password_123"
default tablespace TBS_GGS temporary tablespace temp;
User created.
```

```
SQL> alter user c##ggadmin quota unlimited on TBS_GGS;
User altered.
```

CHAPTER 10 ON-PREMISES DATABASE MIGRATION TO OCI

```
SQL> alter user c##ggadmin identified by "Password_123";
User altered.

SQL> exec dbms_goldengate_auth.grant_admin_privilege('c##ggadmin',container=>'all');
PL/SQL procedure successfully completed.

SQL> show pdbs
 2 PDB$SEED READ ONLY NO
 3 PDB1 READ WRITE NO

SQL> alter session set container=PDB1;
Session altered.

SQL> create tablespace TBS_GGS datafile '+DATAC1' size 500m;
Tablespace created.

SQL> create user c##ggadmin identified by "Password_123"
default tablespace TBS_GGS temporary tablespace temp;
User created.

SQL> alter user c##ggadmin quota unlimited on TBS_GGS;
User altered.

SQL> alter user c##ggadmin identified by "Password_123";
User altered.
```

Grant Privileges in CDB+PDB

- grant connect,resource to c##ggadmin;
- grant create session to c##ggadmin;
- grant select any dictionary, select any table,SELECT ANY TRANSACTION to c##ggadmin;
- grant create table, alter any table to c##ggadmin;
- grant flashback any table to c##ggadmin;

- grant execute on dbms_flashback to c##ggadmin;
- grant execute on utl_file to c##ggadmin;
- grant select on system.logmnr_session\$ to c##ggadmin;

Check Connectivity

- Use telnet from the source to the target to check the connectivity.

For example: telnet <hostname> <portnumber>

- sqlplus /nolog connect c##ggadmin/Pasword_124@
CONNECTION_STRING

2. Create a Connection from OCI GoldenGate to the On-Premises Database

Before creating an Extract, it is necessary to establish a connection from OCI GoldenGate to an on-premises database. To achieve that, let's follow these steps.

From the OCI Console, select GoldenGate ► Connections ► Create Connection.

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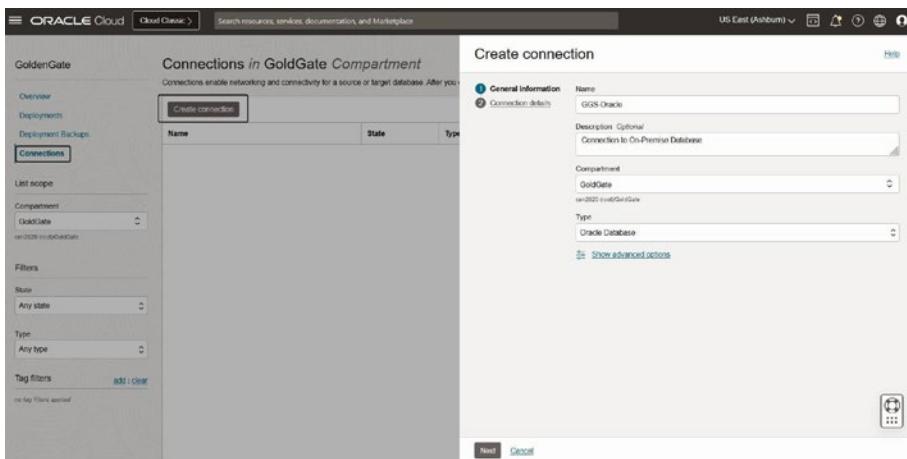


Figure 10-1a. Create GoldenGate connection

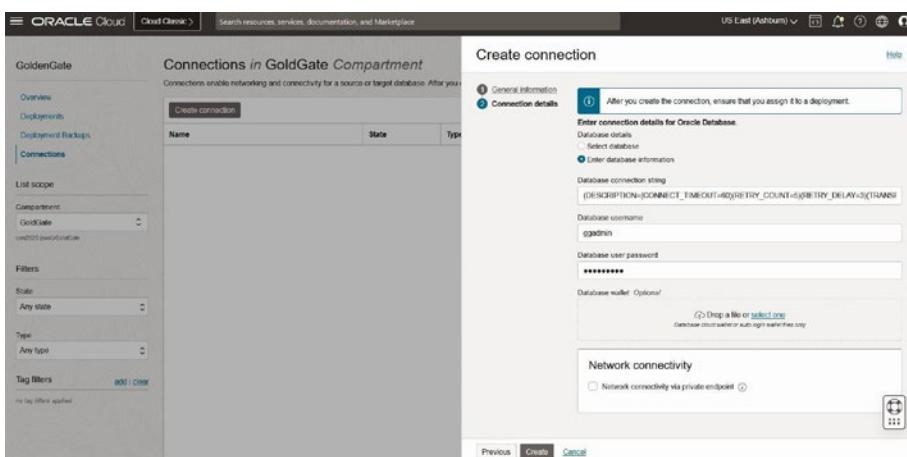


Figure 10-1b. Create GoldenGate connection

After establishing the connections in the OCI Console, they should be visible on the GoldenGate home page ► Configuration.

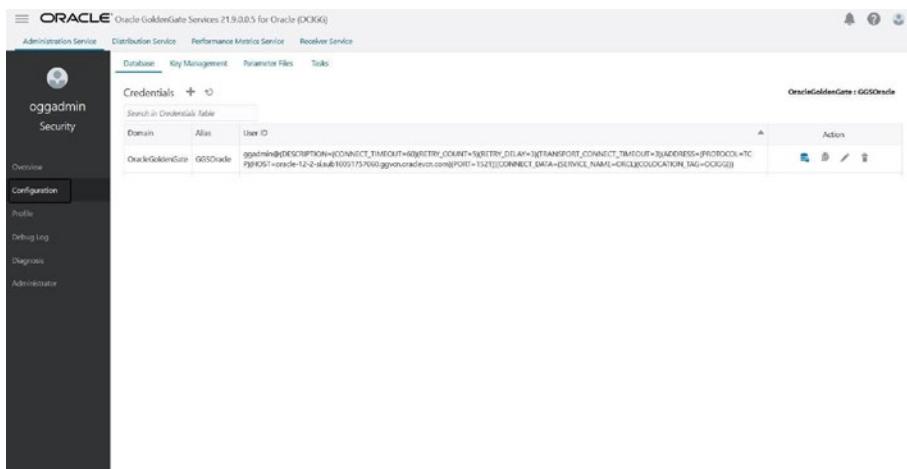


Figure 10-2. Validate the connection

3. Enable Minimum Supplemental Logging on the Object Level

To enable minimum supplemental logging on a specific table, it can be achieved in two ways: one through using the SQLPLUS level and the other through GoldenGate.

To enable using SQLPLUS, you can use the following:

- `ALTER TABLE table_name ADD SUPPLEMENTAL LOG DATA (ALL) COLUMNS;`
- `ALTER TABLE table_name ADD SUPPLEMENTAL LOG DATA (PK) COLUMNS`

To enabled it using OCI GoldenGate, please follow these steps, that involve the process of adding TRANDATA:

Log in to the OCI GoldenGate Administration page.

Select Administration > Configuration > Connect to a database.

Click + next to Trandata Information. Add Schema/Table.

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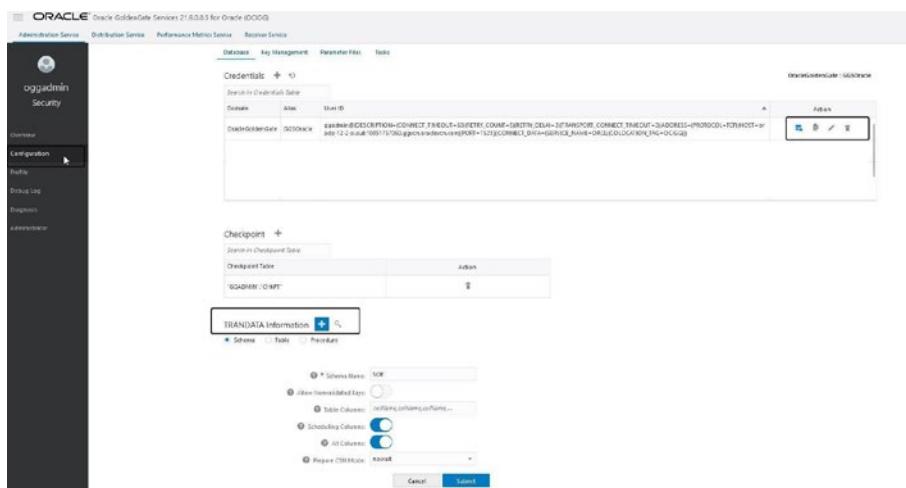


Figure 10-3. Enable Trandata

4. Configure the Extracts to Capture On-Premises Changes

Now let's create an Extract process to capture the source Change Data Capture (CDC) changes and record those transactions into the trail files. Before setting up the initial load data, it is a good practice to keep the Extract process up and running.

Perform the following steps to create the Extract from the OCI GoldenGate console.

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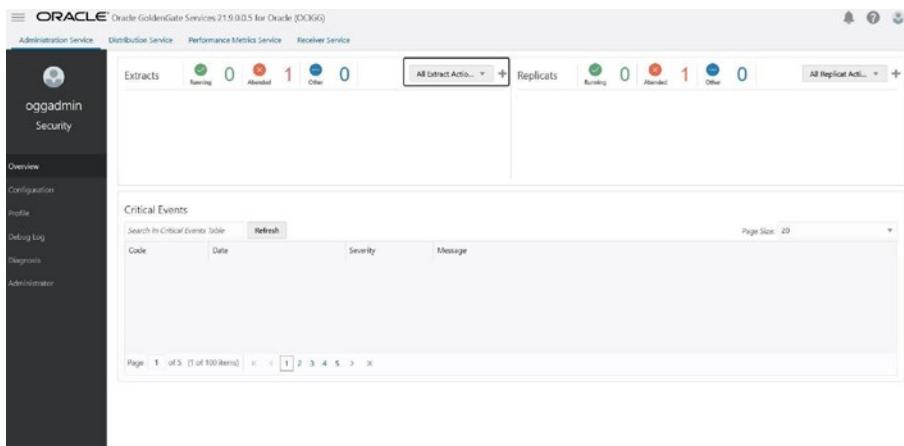


Figure 10-4a. Create an Extract through OCI GoldenGate

Click the + mark next to All Extract Actions to create the new Extract.

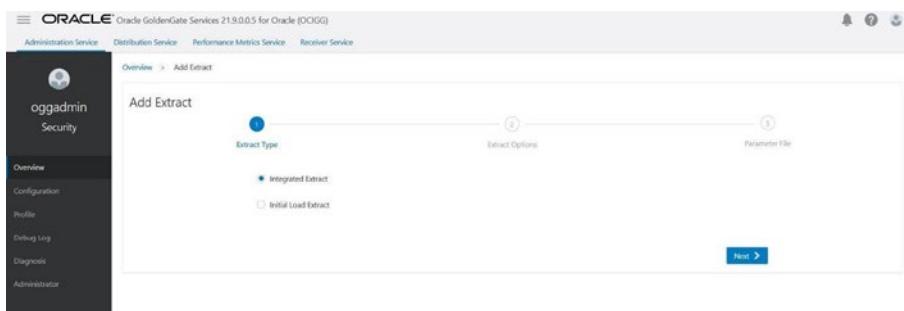


Figure 10-4b. Select Integrated Extract

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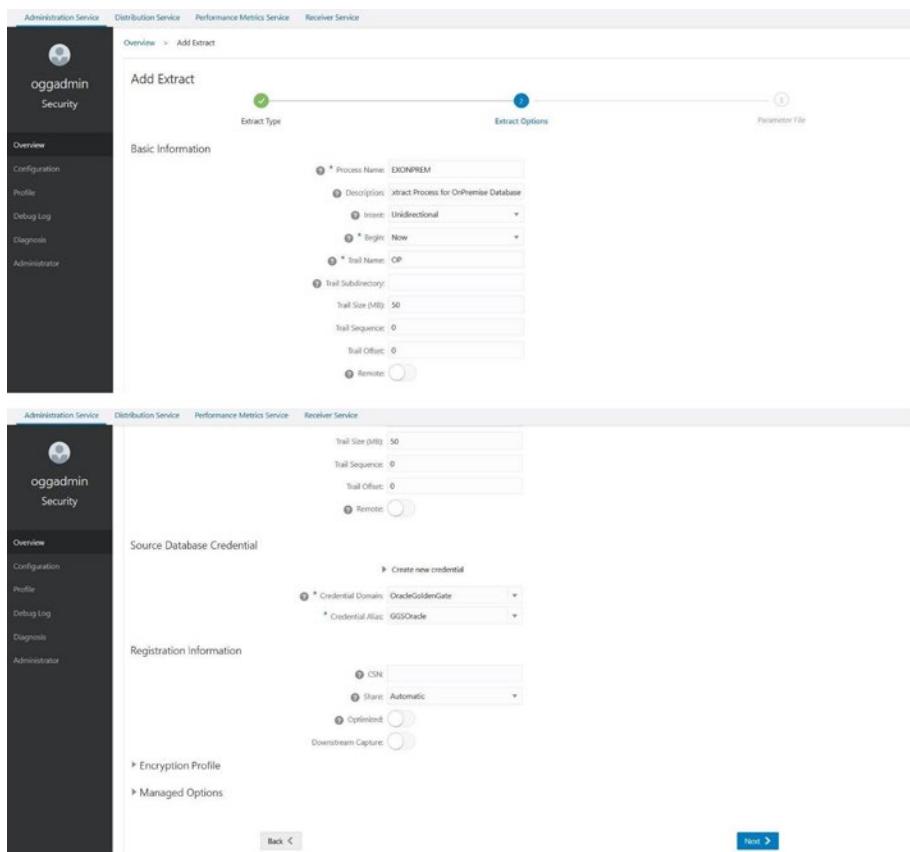


Figure 10-4c. Fill in the information for Extract parameters

EXONPREM (INTEGRATED)

Process Information Checkpoint Statistics Cache Manager Statistics **Parameters** Report

```
EXTRACT EXONPREM
USERID=LAS_OGGSORACLE DOMAIN OracleGoldenGate
EXTRAIL_OB
TABLE SOCIT;
```

Figure 10-4d. Sample Extract parameter file

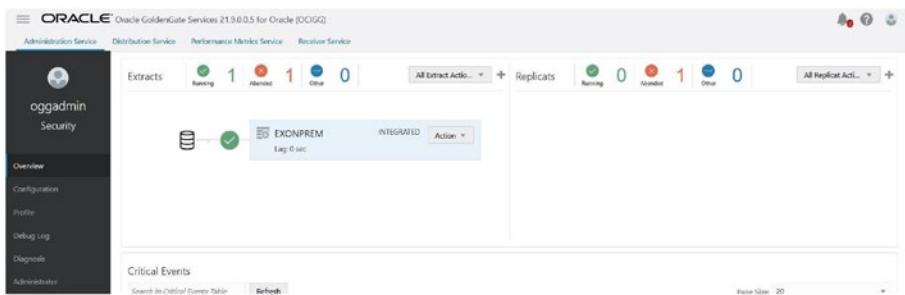


Figure 10-4e. Extract created and running

The process of creating a GoldenGate Extract, including establishing the necessary connections from OCI GoldenGate to an on-premises database, has been successfully completed and started capturing the changes from the source. Now, the configured Extract should be visible on the GoldenGate home page.

Configure a GoldenGate Replicat to Apply It to the OCI Database

To configure a GoldenGate Replicat to apply changes to an Oracle Cloud Infrastructure (OCI) database, let's perform the following series of steps.

1. Enable_Goldengate_Replication Parameter

```
SQL> alter system set enable_goldengate_replication=true
scope=both sid='*';
SQL> show parameter enable_goldengate_replication
```

NAME	TYPE	VALUE
enable_goldengate_replication	boolean	TRUE

2. Create User and Tablespaces

```
SQL> create tablespace TBS_GGS datafile size 500m;
Tablespace created.

CREATE TABLESPACE TBS_GGS  DATAFILE '/u01/app/oracle/oradata/
ORCL/tbs_ggs_pdb01.dbf'  SIZE 500M ;
```

SQL> show pdbs

CON_ID	CON_NAME	OPEN	MODE	RESTRICTED
2	PDB\$SEED	READ ONLY	NO	
3	OCIDB_PDB1	READ WRITE	NO	

SQL> alter session set container = DB19C_PDB1; (Please
change the PDB Name accordingly in the script).

Session altered.

```
SQL> create tablespace TBS_GGS datafile size 500m;
Tablespace created.

SQL> create user c##ggadmin identified by "WelcomeYear##2023"
default tablespace TBS_GGS temporary tablespace temp;
```

User created.

```
SQL> alter user c##ggadmin quota unlimited on TBS_GGS;
```

User altered.

```
SQL> exec dbms_goldengate_auth.grant_admin_privilege('c##ggadmin',container=>'all');
```

PL/SQL procedure successfully completed.

Grant Privileges

- grant connect,resource to c##ggadmin;
- grant create session to c##ggadmin;
- grant select any dictionary, select any table,SELECT ANY TRANSACTION to c##ggadmin;
- grant create table, alter any table to c##ggadmin;
- grant flashback any table to c##ggadmin;
- grant execute on dbms_flashback to c##ggadmin;
- grant execute on utl_file to c##ggadmin;
- grant select on system.logmnr_session\$ to c##ggadmin;

3. Create a Connection from OCI GoldenGate to OCI DBaaS

Before creating a Replicat, it is necessary to establish a connection from OCI GoldenGate to the OCI DBaaS database. To achieve that, let us perform the following steps.

From the OCI Console, select GoldenGate ► Connections ► Create Connection.

CHAPTER 10 ON-PREMISES DATABASE MIGRATION TO OCI

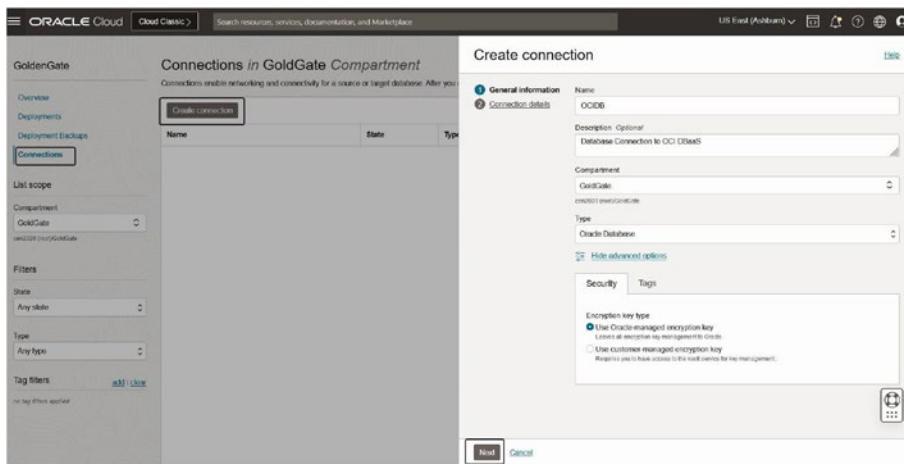


Figure 10-5a. Create a Replicat connection in the OCI Console

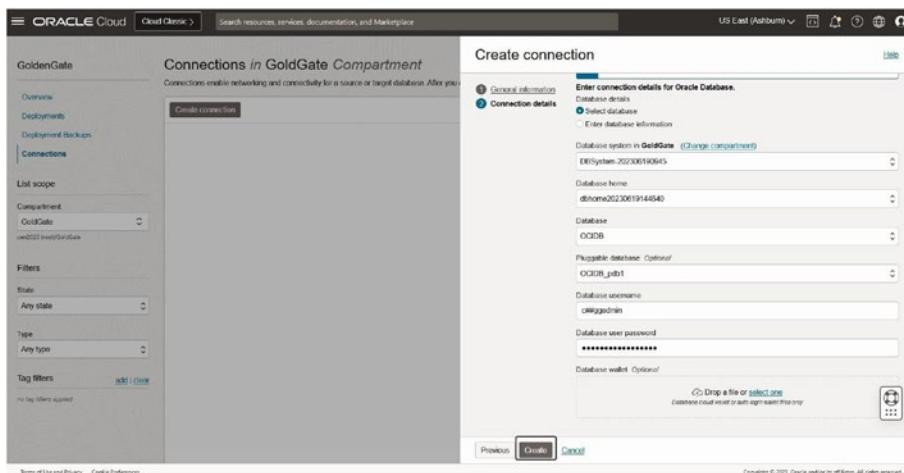


Figure 10-5b. Create a Replicat connection in the OCI Console – contd

After creating the connection, assign the connection to the deployment.



Figure 10-6. Validate the Replicat connection in OCI GoldenGate

4. Configure the Replicat to Apply It to the Target OCI DBaaS Database

Now let us create a Replicat process to apply the changes to the target database from the trail files that have been regenerated by the Extract process. In this process, we will create the Replicat process and configure it. We will not start the Replicat until we complete the initial load/history load of data from the source database to the target database.

- Perform the following steps to create the Replicat from the OCI GoldenGate console.
- As you can see from Figure 10-7a, the Extract is already created and running.

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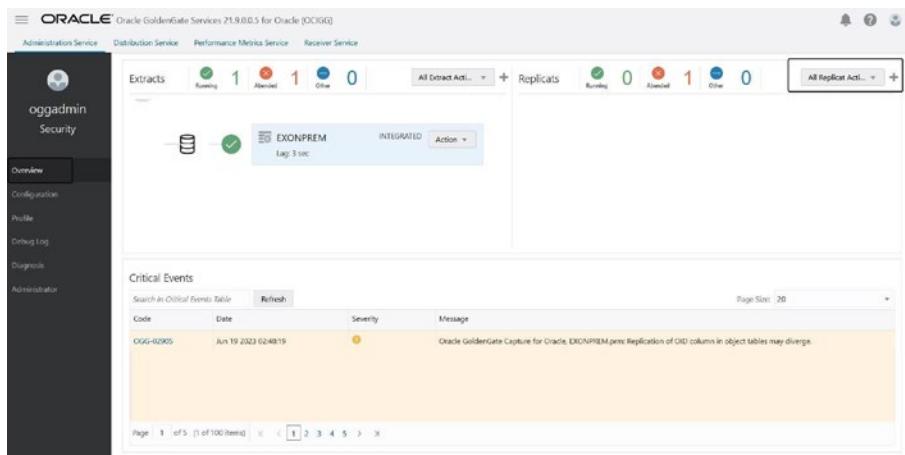


Figure 10-7a. Create a Replicat from the OCI GoldenGate console

- Click the + mark on the top right to start creating the Replicat.

Select the Replicat Type; Since the data transfer is occurring from an Oracle to another Oracle Database, it is recommended to choose Integrated Replicat.

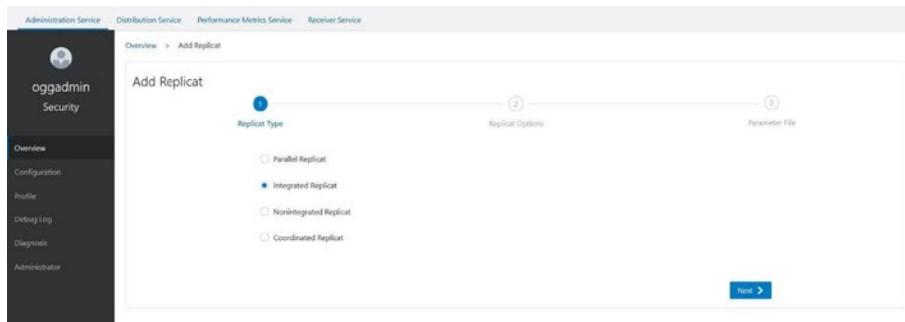


Figure 10-7b. Create a Replicat – select Integrated Replicat

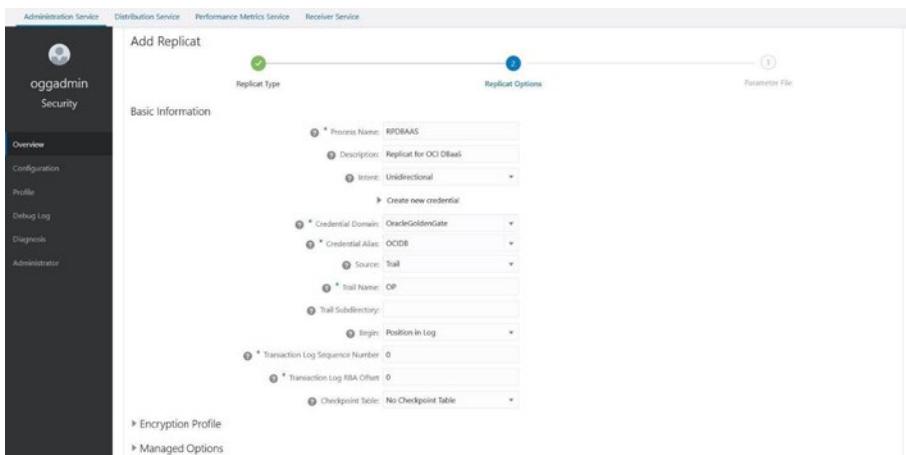


Figure 10-7c. Create a Replicat – filling in the required details

- Process Name: RPDBAAS
- Description: Replicat for OCI DBaaS
- Credential Domain: OracleGoldenGate
- Credential Alias: OCIDB – as previously created connection from the OCI Console.
- Trail Name: OP

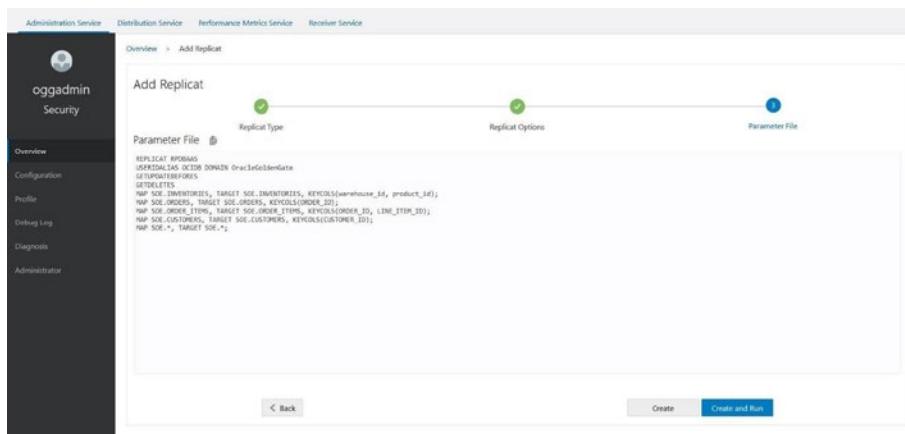


Figure 10-7d. Create a Replicat – sample Replicat parameter file

Add the MAP parameter from the source to the target and click the Create button.

Here, in this case:

- MAP SOE.* , TARGET SOE.*
- SOE is the schema name and * indicates all the tables in the SOE schema.

The Replicat has been successfully created.

Note Do not start the Replicat until we finish the initial load.

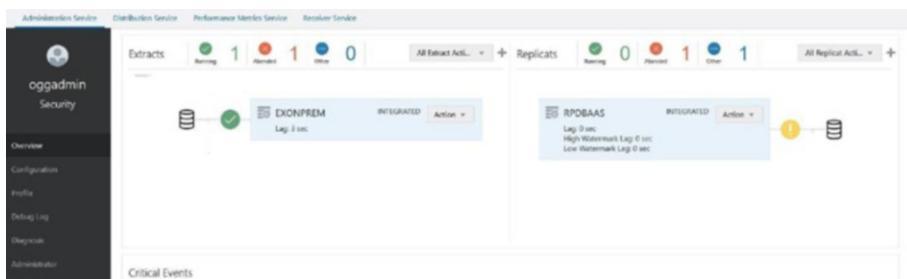


Figure 10-7e. Replicat created

Initial Data Load

A very important stage in setting up a real-time data replication is the target instantiation, often known as the initial data load. Before real-time replication begins, the procedure makes sure that the database objects between the source and target databases are in sync.

You can select from the following methods when configuring an instantiation for a based-on source and targets:

1. Oracle Data Pump (EXPDP/IMPDP)
2. Oracle RMAN
3. Oracle GoldenGate Initial Load

1. Oracle Data Pump (EXPDP/IMPDP)

Oracle Data Pump, comprising the EXPDP (export) and IMPDP (import) utilities, is an integral part of the Oracle Database. This tool enables you to export and import data from an Oracle Database at various levels, including the database, schema, or individual tables. It can also be utilized for the purpose of performing the target database instantiation.

The steps are described as follows:

1. Set up and initiate the Extract process following the guidance in the previous topic. Refer to the section “Configure the Extracts to Capture On-Premises Changes” for detailed instructions.
2. Verify the System Change Number (SCN) of the source database.

To ensure that Oracle GoldenGate captures all the new transactions following a specific System Change Number (SCN), it is important to verify the database SCN once the Extract process has started. This step guarantees that any transactions occurring after this SCN will be successfully captured by Oracle GoldenGate.

```
SQL> select current_scn from v$database ;  
CURRENT_SCN  
-----  
60140074
```

3. Perform a data export from the source database.
Example: expdp \"/ as sysdba\" directory=DBA_DUMP schemas=SOE dumpfile=SOE.dmp logfile=SOE_Exp.log flashback_scn=60140074
4. Perform a data import into the target database.
Example: impdp \"/ as sysdba\" schemas=SOE DIRECTORY=DBA_DUMP DUMPFILE=SOE.dmp LOGFILE=SOE_IMP.log
5. Start the Replicat process using the afterCSN method.

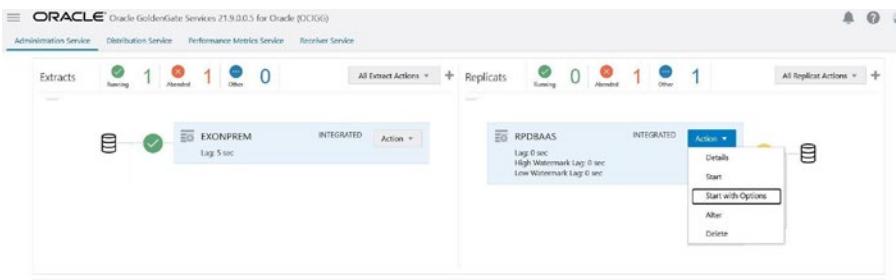


Figure 10-8a. Start the Replicat based on CSN for EXPDP/IMPDP

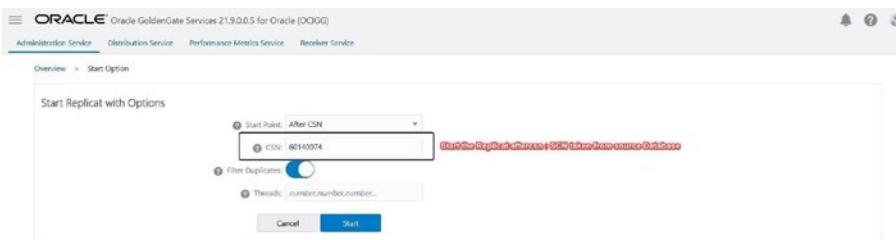


Figure 10-8b. Start the Replicat based on CSN for EXPDP/IMPDP – contd

2. RMAN Backup and Restore

Perform a full backup of the source database.

Example:

```
RUN {
  ALLOCATE CHANNEL ch1 DEVICE TYPE disk;
  BACKUP DATABASE FORMAT '/backup/%U';
  BACKUP ARCHIVELOG ALL FORMAT '/backup/%U';
  RELEASE CHANNEL ch1;
}
```

Restore the backup to the target database.

Example:

```
RUN {  
    ALLOCATE CHANNEL ch1 DEVICE TYPE disk;  
    RESTORE DATABASE;  
    RECOVER DATABASE;  
    RELEASE CHANNEL ch1;  
}
```

After the RMAN restore process is finished, examine the Oracle alert log to retrieve the most recent System Change Number (SCN) to which the database was recovered.

Search for the specified entry in the Oracle alert log.

RESETLOGS after incomplete recovery UNTIL CHANGE 60140074.

Start the Replicat using the afterCSN method.

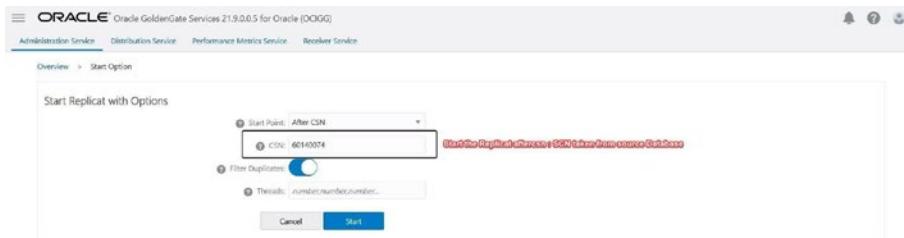


Figure 10-9. Start the Replicat based on CSN for RMAN

GoldenGate Initial Load Method

Initial Load Extract

Prior to generating the initial load Extract, it is necessary to verify the System Change Number (SCN) representing the initial position. In the absence of any existing transactions, the CURRENT SCN is utilized. To accomplish this, log in to the source database and execute the following SQL statement:

```
SQL> select current_scn from v$database ;  
CURRENT_SCN  
-----  
60140074
```

Click the “+” symbol to initiate the creation of the Extract. Select the Initial Load Extract.



Figure 10-10a. Initial Load Extract

Input the process name.

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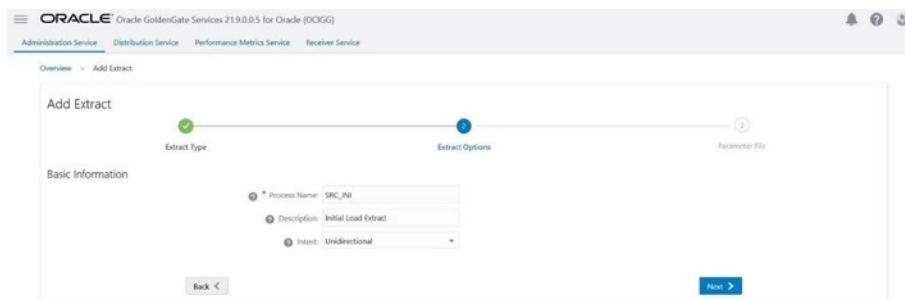


Figure 10-10b. Initial Load Extract - contd

Add these parameters to your source Extract:

- USERIDALIAS GGSoracle DOMAIN OracleGoldenGate
- EXTFILE IL MEGABYTES 500 PURGE
- TABLE SOE.*; SQLPREDICATE "AS OF SCN 60140074";

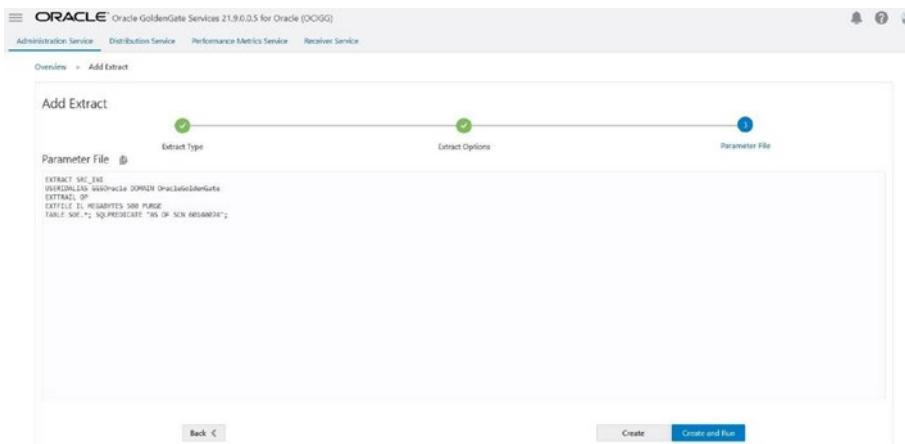


Figure 10-10c. Initial Load Extract - sample parameter

Create the Extract and start.

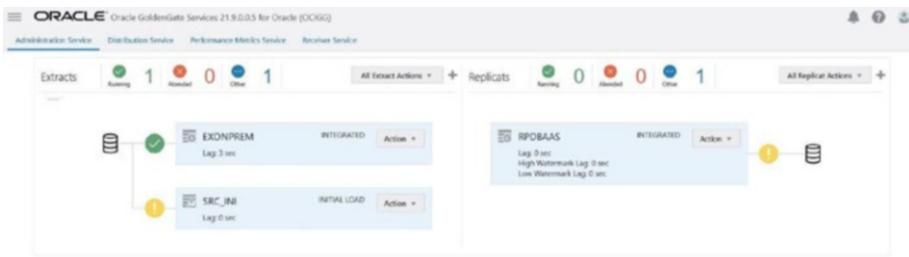


Figure 10-10d. Initial Load Extract created

Initial Load Replicat

Click the “+” symbol to create the Replicat. Select the Integrated Replicat.

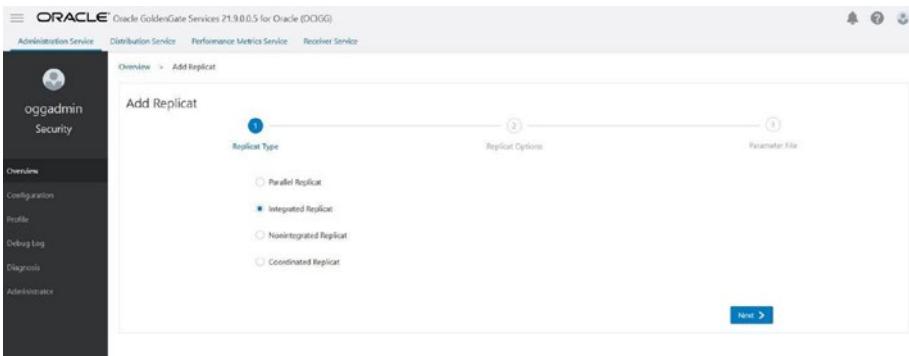


Figure 10-11a. Initial Load Replicat

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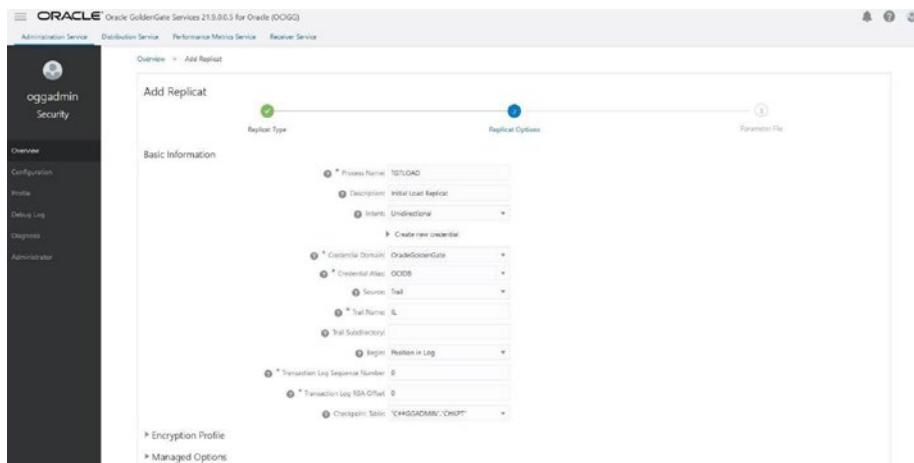


Figure 10-11b. Initial Load Replicat – filling in details

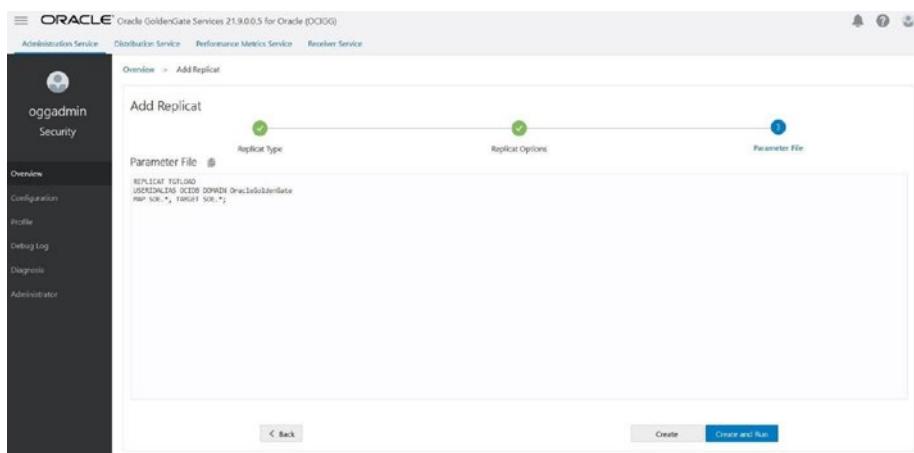


Figure 10-11c. Initial Load Replicat – sample parameter

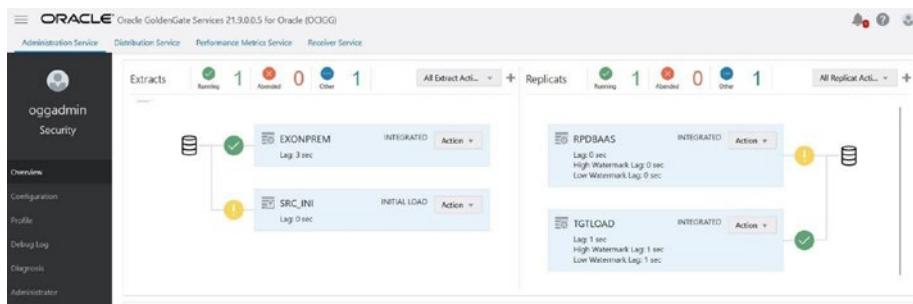


Figure 10-11d. Initial Load Replicat – STARTED and ACTIVE

Point in Time to Start GoldenGate Replication

Once the initial data load is complete, start the GoldenGate processes on the target database using the afterCSN method. This will enable the continuous replication of data changes from the source database to the target database in OCI.

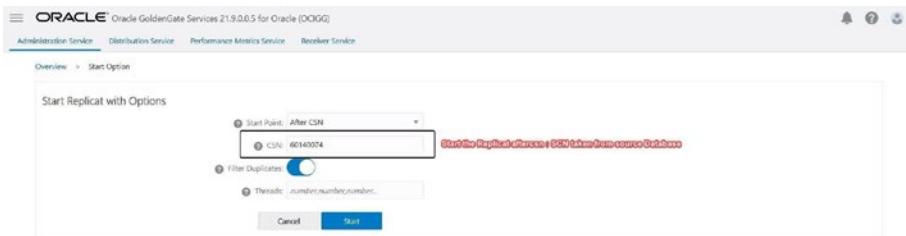


Figure 10-12. Start the Replicat based on CSN

Monitoring the OCI Golden Service Process

OCI GoldenGate Service processes like Extracts, Replicats, Service Manager, and Distribution Path can be monitored by following methods:

1. OCI Observability and Management method
2. Oracle Enterprise Manager
3. Custom Scripts to Monitor OCI GG from the Compute VM
4. Grafana Monitoring

OCI Observability and Management Method

Using Observability and Management services under OCI, alerting mechanisms can be set if the GoldenGate Service goes down. High-level steps to create these alerts are as follows:

- a) Create a topic.
- b) Confirm subscription to email.
- c) Create service metrics.
- d) Create an alarm.

Covering observability and management in detail for alerts is beyond the scope of this book.

Oracle Enterprise Manager

Oracle Enterprise Manager serves as a centralized monitoring solution for various Oracle products. To monitor GoldenGate targets, it is possible to utilize a custom Perl or shell script as a GoldenGate metric extension. However, it is important to note that the GoldenGate plugins designed for Oracle Enterprise Manager cannot be employed to monitor OCI GoldenGate Services. Nonetheless, these plugins can be utilized for monitoring Marketplace Images that have access to the underlying virtual machines.

Custom Scripts to Monitor OCI GG from the Compute VM

Create a shell/Perl script using AdminClient logic. The AdminClient is a command-line utility that serves a similar purpose as GGSCI within the context of Oracle GoldenGate Microservices Architecture (MA).

Create a compute VM that has connectivity to OCI GoldenGate Service Deployment access. Make sure the compute VM has SMTP configured to run Mailx. Next, develop a custom logic code that monitors the process and sends email alerts accordingly.

Grafana Monitoring

Grafana has built-in support for OCI as a data source, allowing users to query and visualize data stored in various OCI services such as Oracle Database, Object Storage, GoldenGate, and more. To leverage OCI as a data source in Grafana, it is necessary to configure the OCI data source by providing the appropriate credentials and settings.

Once the OCI data source is configured in Grafana, it becomes possible to create visually appealing dashboards and panels that present OCI data in different formats, including charts, tables, and graphs. Furthermore, Grafana offers the capability to set up alerts based on OCI data, enabling users to receive notifications about significant events or issues.

Cut Over the Replication from On-Premises Synchronization and Data Catch-Up

Synchronize the data between the source and target systems to minimize the gap in data. Make sure there is no LAG that exists between the source and the target and also make sure the sequence number and Relative Byte Address (RBA) are up to date.

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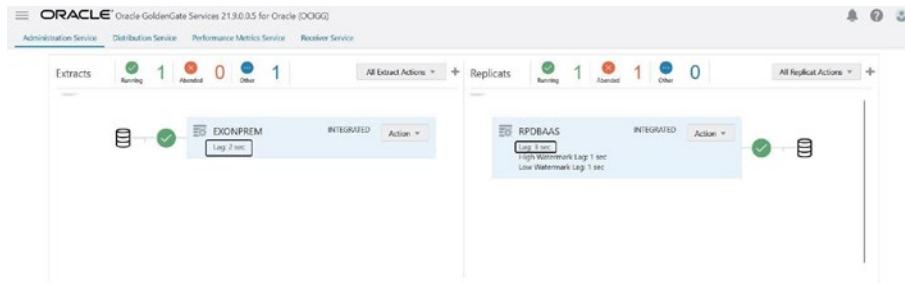


Figure 10-13. Extract and Replicat LAG validation

Make sure the checkpoint number and sequence number are matched between the source and target databases.

Source Extract Information: Click Details ► Checkpoint tab.

A screenshot of the Oracle GoldenGate Services interface showing checkpoint details for an extract named 'OP'. The 'Checkpoint' tab is selected under the 'Process Information' section. It displays basic information: Checkpoint Log Name: 'OP', Trail Subdirectory: '...', Timestamp: '2023-06-24 19:31:36', and Sequence: '0'. Below this, the 'Output Checkpoints' table lists the current checkpoint: Checkpoint: 'current', Timestamp: '2023-06-24 19:31:36', Offset: '1012300', Name: 'OP', Trail Subdirectory: '...', Sequence: '0', and Sequence Length: '9'. A 'Refresh' button is located at the top right of the checkpoint table.

Figure 10-14. Extract checkpoint information

Target Replicat Information: Click Details ► Checkpoint tab.

The screenshot shows the Oracle GoldenGate Services interface for Oracle Database 19c. The top navigation bar includes links for Administration Service, Distribution Service, Performance Metrics Service, and Receiver Service. Below the navigation is a breadcrumb trail: Overview > Process Information. The main content area is titled 'RPDBAAS (INTEGRATED)' and shows 'Process Information' selected. A sub-menu for 'Checkpoint' is open, with 'Checkpoint Basic Information' highlighted. The 'Checkpoint Log Name: OF' and 'Last Subjectory:' fields are displayed. Below these are 'Timestamp:', 'Sequence:', and 'Offset:' fields, each containing the value '2023-06-24 204951'. A 'Refresh' button is located in the top right corner of this section. Below this, a table titled 'Input Checkpoints' lists two rows: 'starting' and 'current'. The 'starting' row has a timestamp of '2023-06-24 204951'. The 'current' row has a timestamp of '2023-06-24 204951' and an offset of '1022320'. The table has columns: Checkpoint, Timestamp, Offset, Name, Sequence, and Sequence Length.

Checkpoint	Timestamp	Offset	Name	Sequence	Sequence Length
starting	2023-06-24 204951	0	OF	0	9
current	2023-06-24 204951	1022320	OF	9	9

Figure 10-15. Replicat checkpoint information

Coordinate with relevant stakeholders to schedule a suitable maintenance window for the cutover process. Communicate the planned downtime to all affected users and teams.

Stop the application and data replication processes on the source system. Switch the application or workload to use the target OCI Database system as the new primary database.

Validate the application and database for the new data getting into the OCI Database.

Post-Migration Tasks

After the cutover, perform any necessary post-migration tasks, such as updating applications or configurations to point to the new OCI Database. Also, ensure that backups, monitoring, and disaster recovery plans are in place for the OCI environment.

Summary

This chapter concluded by providing the comprehensive approach and concept of database migration using OCI GoldenGate Services from on-premises to OCI. Utilizing this methodology of direct migration approach, it is possible to seamlessly transfer on-premises databases to Oracle Cloud Infrastructure with minimal downtime while concurrently upgrading them to the latest version in OCI. This streamlined GoldenGate migration process minimizes expenses, overall time required for end-to-end migration, and the effort needed for testing during such migrations.

CHAPTER 11

Replicat Data Across Multicloud Using OCI GoldenGate

Using a multicloud strategy means utilizing multiple cloud services from different cloud providers. This approach provides organizations with the flexibility to seamlessly shift various workloads across providers choosing the best one. This capitalizes on the strengths of each provider while mitigating the shortcomings of being on a single provider. The following are the few reasons why organizations choose a multicloud environment.

Avoiding Locking in a Single Cloud Vendor

Multicloud offers the flexibility to choose and switch between cloud providers based on changing requirements or better pricing. Having multiple vendors in play allows organizations to have better negotiation leverage on prices and terms.

Cost Optimization

Different cloud providers might offer more competitive rates for certain services. Organizations can use the most cost-effective service from each provider. Spreading resources across providers can help manage and optimize costs based on different pricing models.

Performance Optimization

Latency: Cloud providers have data centers in various regions around the world. By hosting applications in data centers closest to the end users, organizations can reduce latency, providing a faster user experience.

Balancing Traffic: Distributing applications or workloads across multiple cloud providers can effectively balance traffic and prevent any single provider's infrastructure from being a bottleneck.

Features

Each cloud provider may have unique services or features that are industry-leading. A multicloud strategy allows organizations to utilize the best services from each provider.

Infrastructure

Each cloud provider might have unique infrastructure or platform services that better fit certain organizational needs.

Risk Mitigation

If one cloud service faces an outage, having a presence on another cloud ensures business continuity.

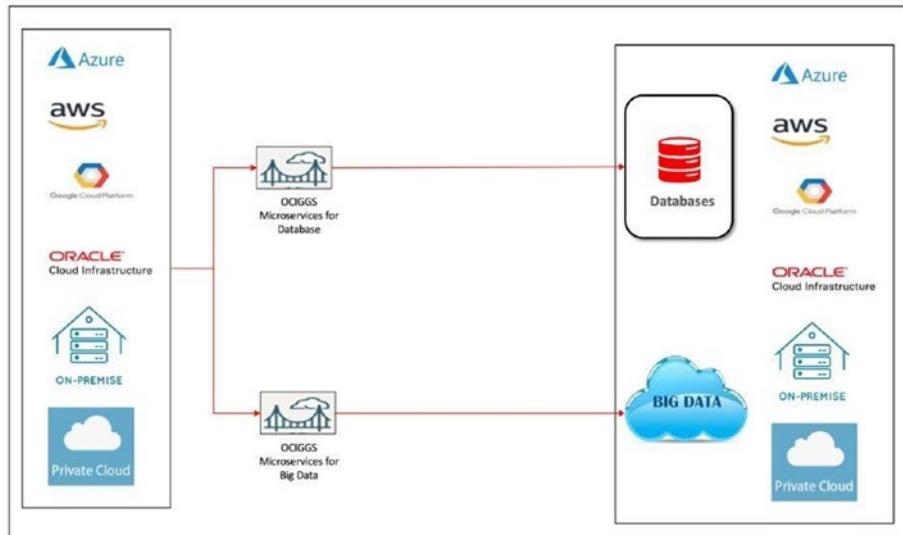


Figure 11-1. Understanding multicloud replication

Architectural Consideration

Data transfer and network latency are very important considerations when architecting a multicloud environment. The performance, cost, and reliability of the multicloud setup depend significantly on how data flows between the clouds and the speed of this data transfer. Below are the architectural considerations related to data transfer and network latency in a multicloud environment.

Data Transfer Implications

- Cost: Transferring data, especially out of a cloud provider's network, often incurs costs. Egress charges, in particular, can be substantial, and they vary among providers. It is essential to understand and factor in these costs when estimating the total cost of ownership for a multicloud strategy.
- Volume: The volume of data moving between clouds can impact performance and cost. Large-scale data migrations or continuous data replication requires a lot of bandwidth and could increase costs.
- Data Sensitivity: Transferring sensitive or regulated data across clouds requires strict security measures. Encryption during transit is critical, as is ensuring compliance with relevant data protection regulations.

Network Latency Implications

- Performance: High network latency can slow down applications and processes that rely on real-time or near-real-time data synchronization across clouds.
- User Experience: For customer-facing applications, high latency can degrade user experience, leading to user dissatisfaction.
- Data Consistency: In database replication scenarios, higher latency might lead to increased lag between the source and the replica, potentially affecting data consistency in certain scenarios.

Architectural Factors to Address These Issues

- Dedicated Interconnects: Some cloud providers offer dedicated connections (like OCI FastConnect, AWS Direct Connect, Azure ExpressRoute, or Google Cloud's Interconnect) to their infrastructure. These connections can provide lower latency and higher bandwidth compared to the public Internet.
- Data Transfer Optimization Tools: Consider using tools and services that optimize data transfer by compressing, deduplicating, or using other methods to reduce the amount of data sent.
- Location Proximity: Choose cloud regions/data centers that are geographically close to minimize latency. If your primary cloud is in the US East region, try to choose a secondary cloud provider's US East region as well.

- CDNs and Edge Computing: For customer-facing applications, consider using Content Delivery Networks (CDNs) and edge computing solutions to cache and process data closer to end users, mitigating latency issues.

Few platforms like Equinix and Aviatrix provide direct and secure connections between various partners, customers, and providers. It is a go-to solution for businesses that need reliable and fast connectivity, especially in multicloud and hybrid cloud scenarios.

Effective management of data transfer and network latency is critical for a successful multicloud strategy. By understanding the implications and incorporating architectural best practices, organizations can ensure efficient, cost-effective, and reliable operations across multiple cloud platforms.

Configuring OCI GoldenGate Services from OCI to AWS

In this topic, let's explore how to send the data from OCI Database service to AWS RDS. Setting up Oracle GoldenGate to replicate data from Oracle Cloud Infrastructure (OCI) to Amazon Web Services (AWS) Relational Database Service (RDS) is a very common situation for real-time data integration and replication across multicloud platforms. We walk through the steps to configure this setup, ensuring a smooth and efficient replication process.

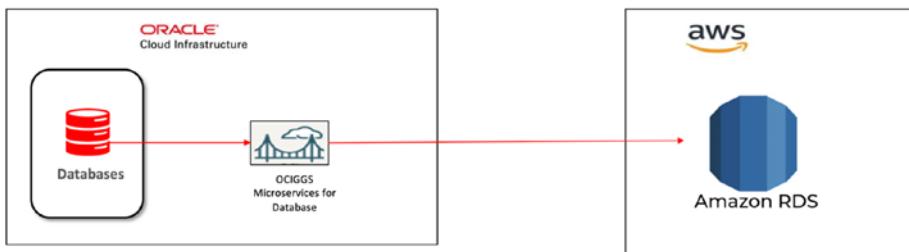


Figure 11-2. OCI to AWS replication

Prerequisites

- Oracle Cloud Infrastructure Account: Access to an OCI account with required permissions to provision databases like Base Database Services, Autonomous Database, or Database under Exadata Infrastructure. Make sure to provision either one of the databases in OCI.
- AWS Account: Access to an AWS account with RDS setup permissions. You can provision Oracle, Postgres, or MySQL. In this example, let's consider doing PostgreSQL.
- Network Connectivity: Ensure OCI can communicate with AWS over VPN/Direct Connect. Enabling multicloud connectivity between Oracle Cloud Infrastructure (OCI) Virtual Cloud Networks (VCNs) and Amazon Virtual Private Cloud (VPC) with low-latency connectivity is a strategic approach to creating a cohesive, efficient, and high-performance multicloud environment. In this topic, for the sake of simplicity, we will use public IPs as examples.

CHAPTER 11 REPLICAT DATA ACROSS MULTICLOUD USING OCI GOLDENGATE

- Database Compatibility: The source in OCI and the target in AWS RDS must be compatible with GoldenGate.

All the prerequisites have been achieved as illustrated in Figures 11-3 to 11-5:

1. Provisioned the database on OCI
2. Provisioned RDS Instance on AWS
3. Provisioned the OCI GoldenGate Service deployment for Oracle on OCI

The screenshot shows the Oracle Cloud Infrastructure interface for managing DB Systems. The top navigation bar includes 'Overview', 'Oracle Base Database', and 'DB Systems'. The main title is 'DB Systems in GoldGate Compartment'. A sub-header states: 'The DB system includes the hardware, storage software, and networking configuration required to run Oracle Databases in the Oracle cloud.' Below this is a 'Create DB system' button. The main content area displays a table with one row of data:

Display name	Status	Availability domain	Shape	CPU core count	Created
DBOCI	Available	ReNO-PHX-AD-1	VM.Standard.E4.Flex	1	Sun, Nov 12, 2023, 16:13:04 UTC

At the bottom right of the table, it says 'Showing 1 item < 1 of 1 >'.

Figure 11-3. Provisioned the database on OCI

The screenshot shows the AWS Amazon RDS console. The left sidebar menu includes 'Dashboard', 'Databases', 'Query editor', 'Performance insights', 'Schemas', 'Exports in Amazon S3', 'Automated backups', 'Reserved instances', and 'Proxies'. Under 'Databases', there is a link to 'Amazon Aurora'. The main content area shows a message about 'Introducing Aurora I/O-Optimized' and a note about 'Consider creating a Blue/Green Deployment to minimize downtime during upgrades'. Below this is a table titled 'Databases (1)'. The table has columns: 'DB Identifier', 'Status', 'Role', 'Engine', 'Region & AZ', 'Size', 'Actions', and 'CPU'. One row is listed: 'rtboreclde' (Status: Available, Instance: Oracle Enterprise Edition, Region & AZ: us-east-1b, Size: db.m5.large, Actions: 4, CPU: 3.53%).

Figure 11-4. Provisioned RDS on AWS



Figure 11-5. Provisioned OCI GoldenGate Service deployment on OCI

Create OCI GoldenGate Connections for OCI Database and AWS RDS

To set up an Extract process in OCI GoldenGate, it's crucial to establish connections to the OCI Database. The following steps will guide you through creating and registering these connections for the Extract component.

Navigate to the Connections tab under GoldenGate Deployments. Create a connection. This connection will be pointing to CDB of the Oracle Database.

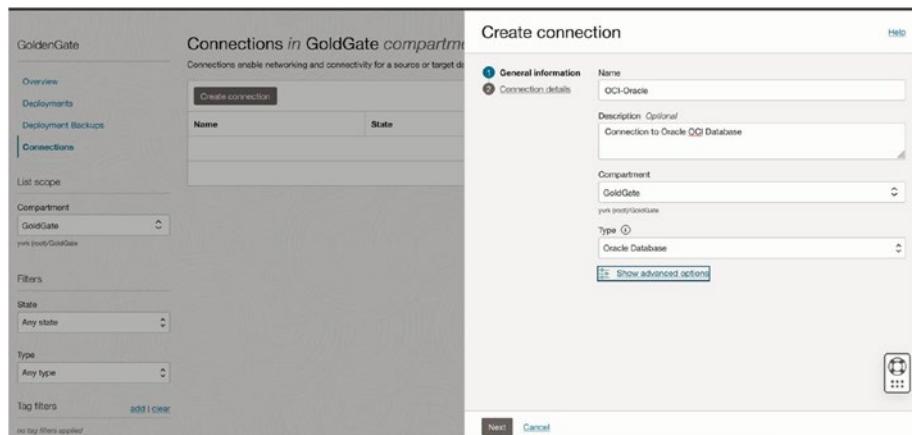


Figure 11-6. Create a connection to OCI Oracle Database

CHAPTER 11 REPLICAT DATA ACROSS MULTICLOUD USING OCI GOLDENGATE

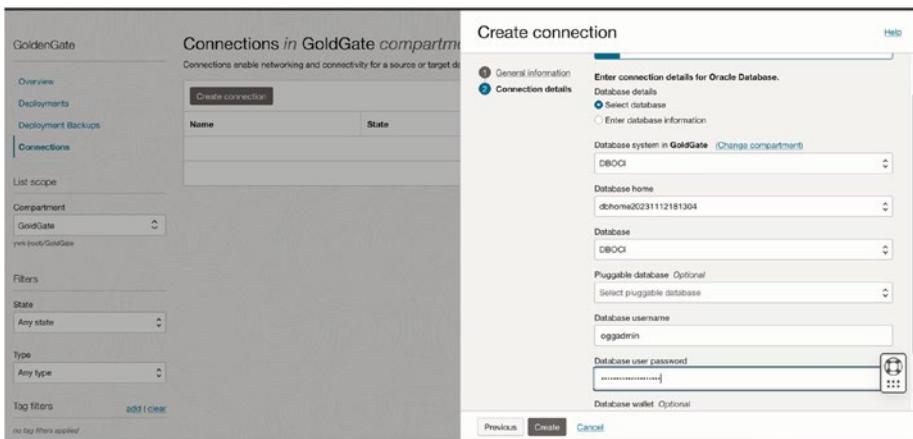


Figure 11-7. Create a connection to OCI Oracle Database

Assign the newly created OCI connection to the deployment of OCI GoldenGate Services.

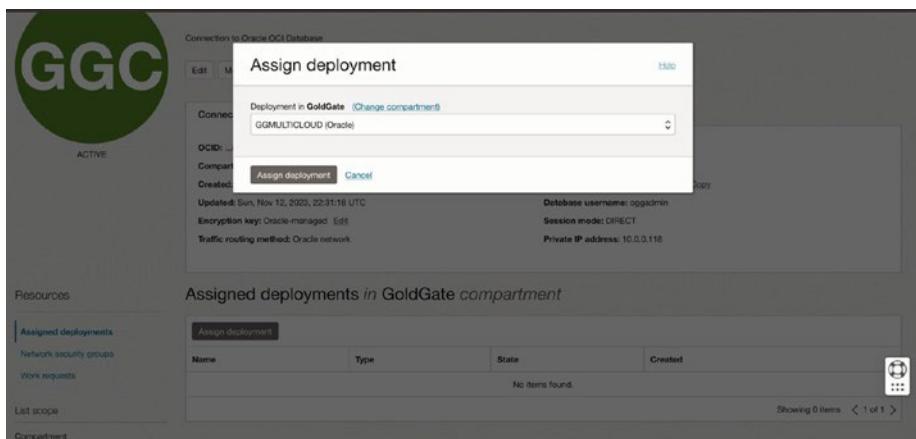


Figure 11-8. Assign a connection to the deployment

Create a Connection to AWS RDS

To set up the Replicat process in OCI GoldenGate, it is essential to establish connections to the target AWS RDS Database. The following steps will guide you through creating and registering these connections for the Extract component.

Navigate to the Connections tab under GoldenGate Deployments. Create a connection. This connection will be pointing to AWS RDS of the Oracle Database.

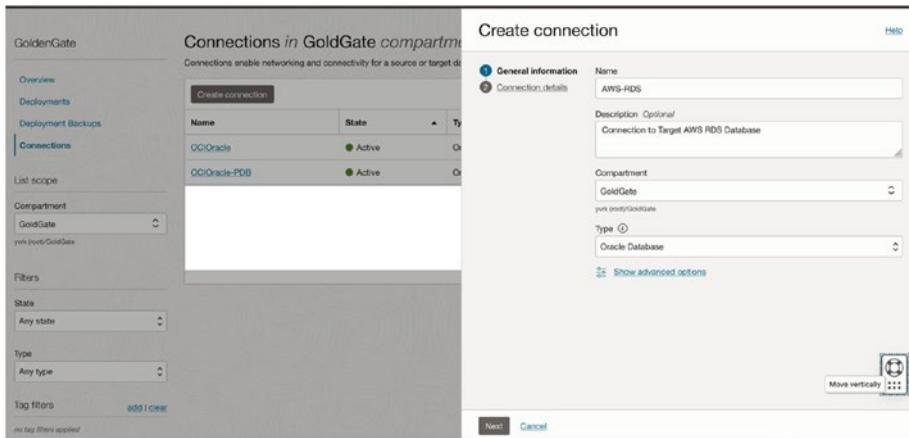


Figure 11-9. Create a connection to AWS RDS Database screen 1

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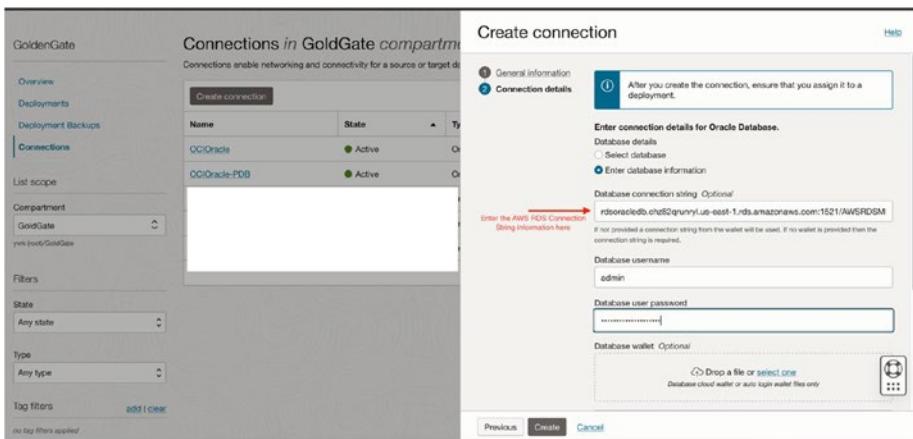


Figure 11-10. Create a connection to AWS RDS Database screen 2

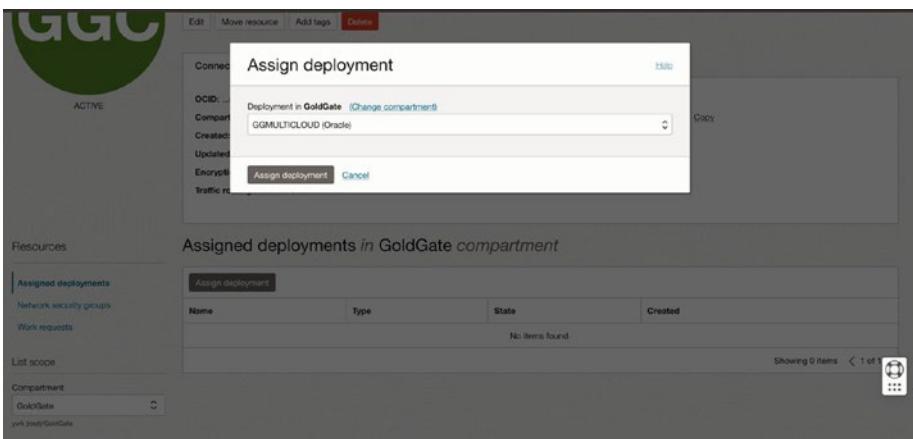


Figure 11-11. Assign the RDS connection to the deployment

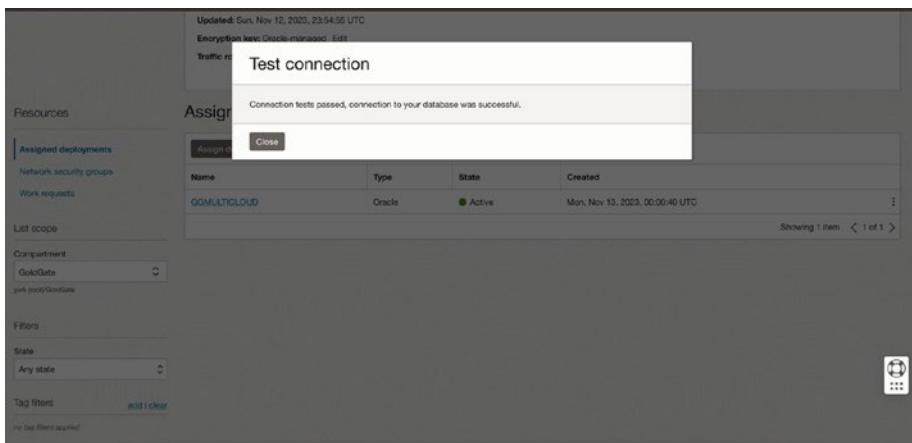


Figure 11-12. Test the assigned connection for RDS

Create an Extract

Now let us set up the Extract in OCI GoldenGate Services to capture the data from OCI Database. This should be straightforward to set up as it was showcased in earlier chapters.

Log in to the GoldenGate console and click + to create a new Extract.

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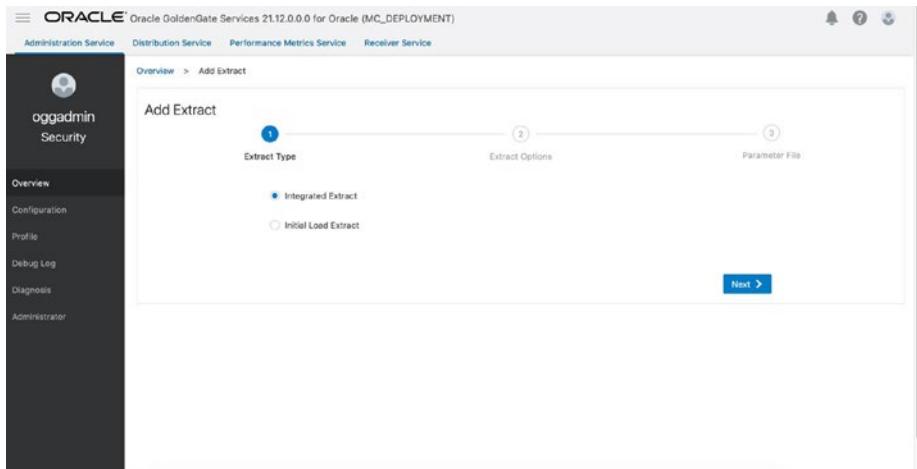


Figure 11-13. Create the Integrated Extract

Fill in the details like Extract name, description, trail name format, and credential information.

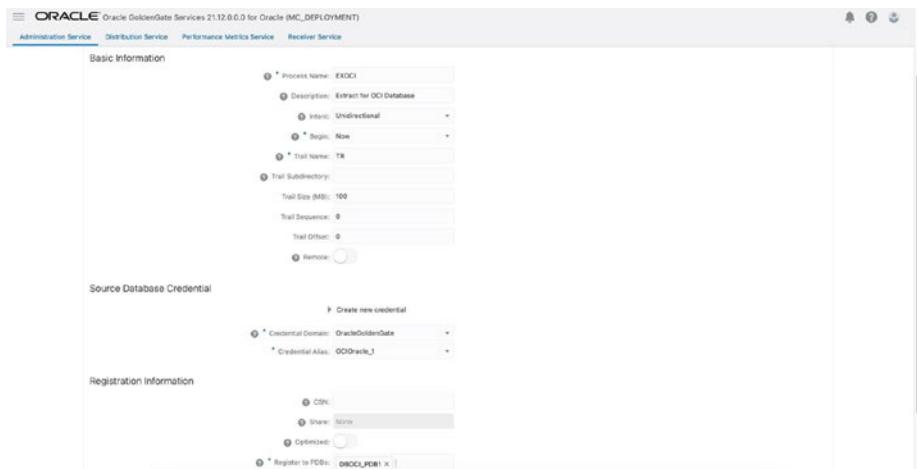


Figure 11-14. Fill in the Extract information

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Add the parameter information. Here, in this case, all the tables under the SOE schema need to be captured for GoldenGate replication. Hence, TABLE SOE.* had been added along with all the DDLs.

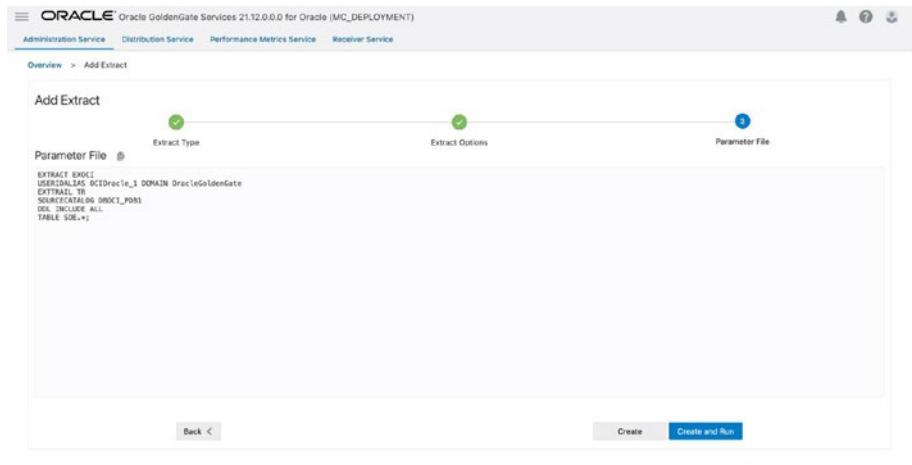


Figure 11-15. Sample Extract parameter

Click the Create button to create the Extract pointing to OCI Database.

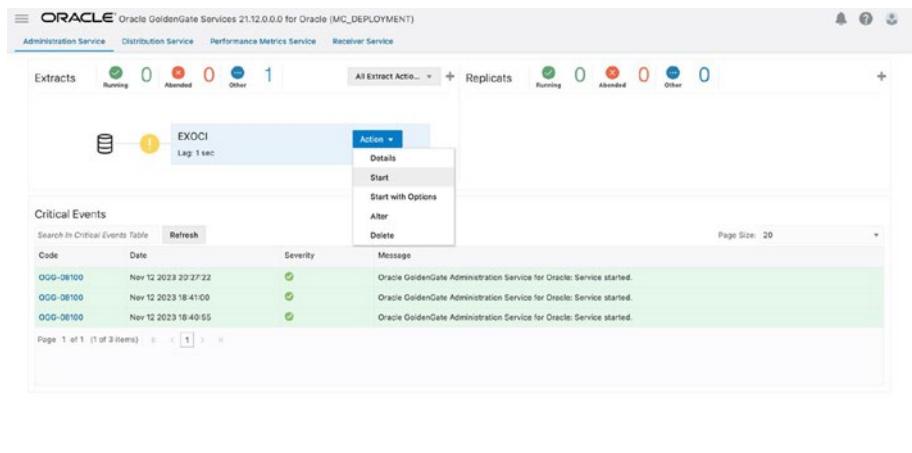


Figure 11-16. Extract created

Select Actions and click Start. This should start the Extract pointing to the source database.

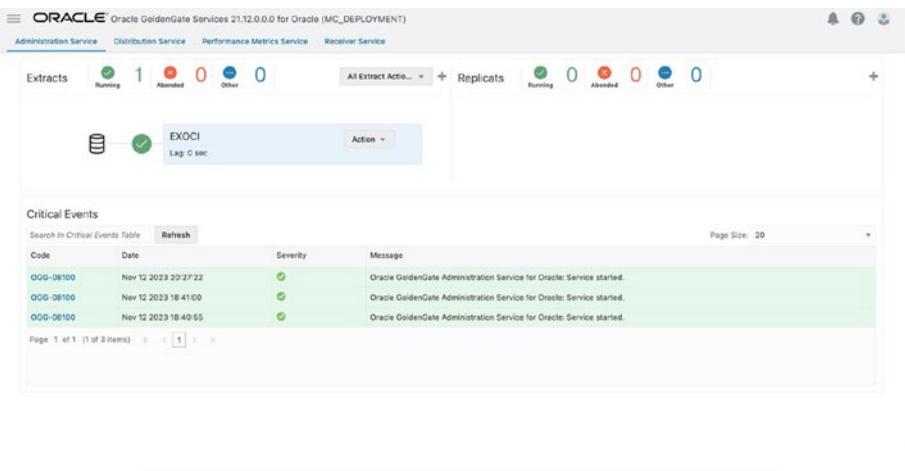


Figure 11-17. Extract running

Create a Replicat

Now let us set up the Replicat in OCI GoldenGate Services to apply the data to AWS RDS Database. Log in to the GoldenGate console and click + to create a new Replicat.

Click Create Replicat and select the Integrated Replicat.

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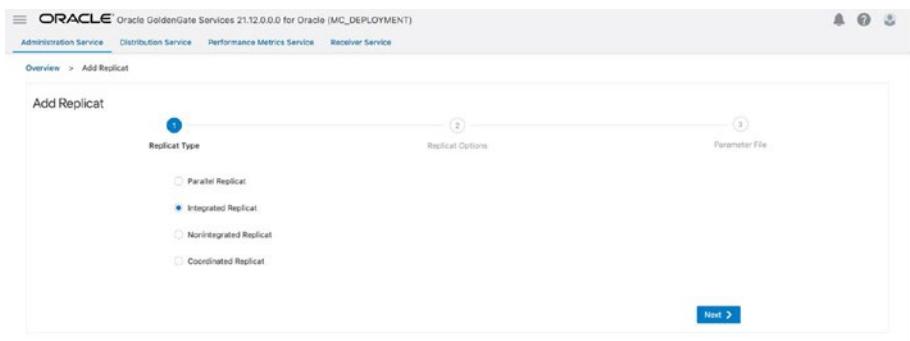


Figure 11-18. Integrated Replicat

Enter details such as the replicat name, trail name, credentials, etc. Here, in this case, the Replicat name has been created as RPAWS.

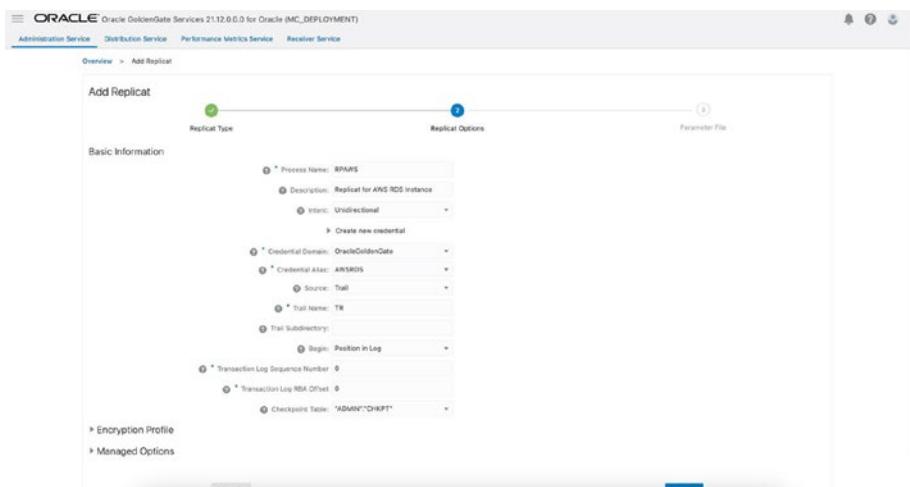


Figure 11-19. Replicat information

Since we are replicating from a container database, we need to add the pluggable database as a prefix. Here, the MAP statement is PluggableDB. SCHEMA.TABLE.

SOURCEDB

TARGETDB

MAP DBOCI_PDB1.SOE.* , TARGET SOE.*;

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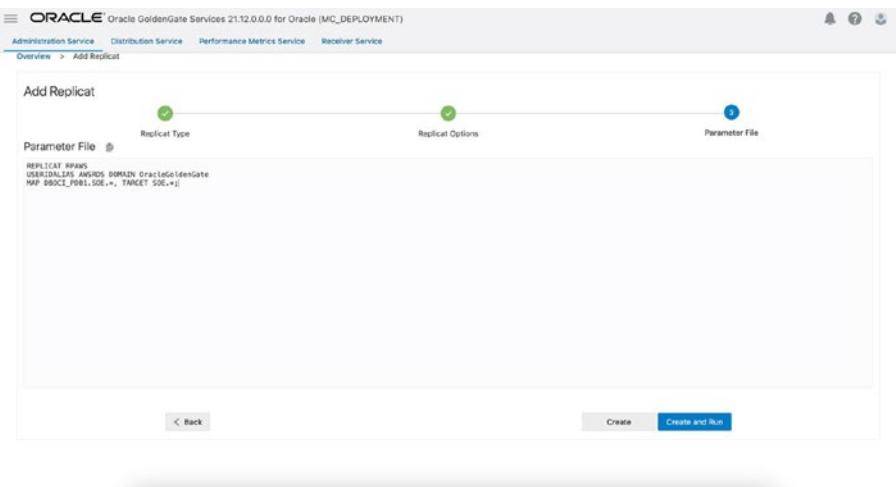


Figure 11-20. Replicat parameter sample

Click the Create button to create the Replicat pointing to AWS RDS Database.

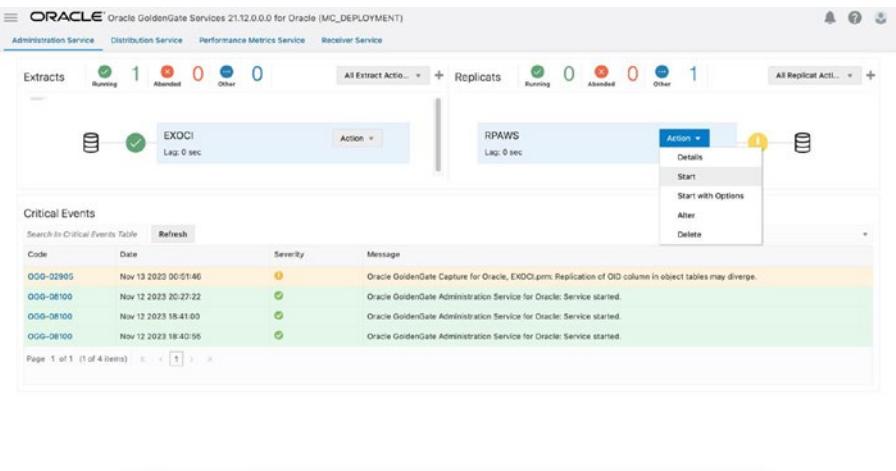


Figure 11-21. Replicat created and started up

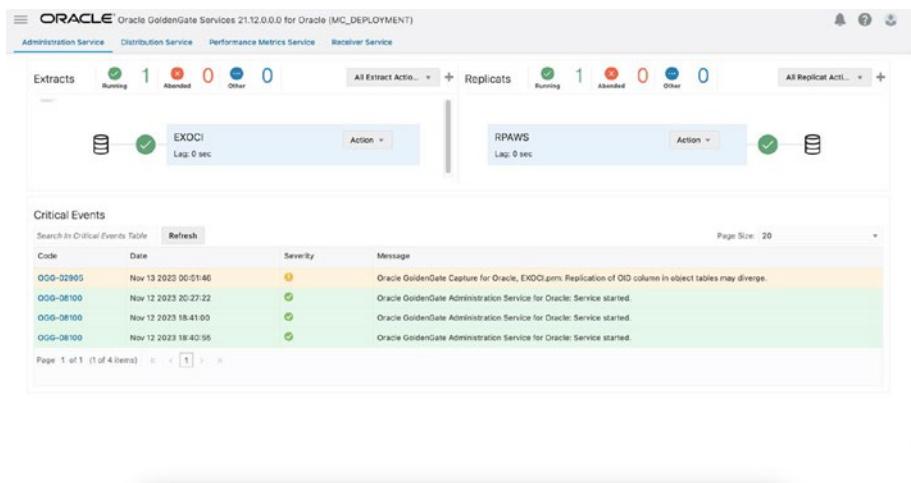


Figure 11-22. Replicat created and in running state

Validating Transactions with OCI GoldenGate Services

Now that we have established the Extract and Replicat processes in OCI GoldenGate Services running between OCI and AWS RDS, the next critical step is to validate their effectiveness by running a few transactions. This validation is essential to confirm that the setup is correctly capturing and replicating data changes from the source to the target system.

Understanding Transaction Validation

Transaction validation in GoldenGate involves initiating a controlled data change in the source database and then verifying that this change is accurately captured by the Extract process, transferred, and applied by the Replicat process to the target database. This process is crucial for confirming the operational integrity of the GoldenGate replication setup.

CHAPTER 11 REPLICAT DATA ACROSS MULTICLOUD USING OCI GOLDENGATE

Stats provides the number of DMLs like INSERT, UPDATE, and DELETE information for each process. Here are the screenshots.

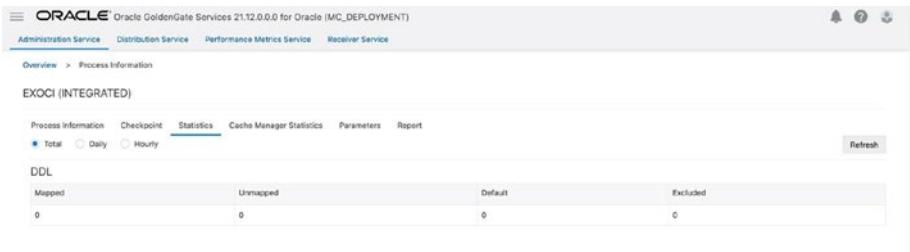


Figure 11-23. Extract stats information

As you can see from the screen, everything is zero here for Extract.

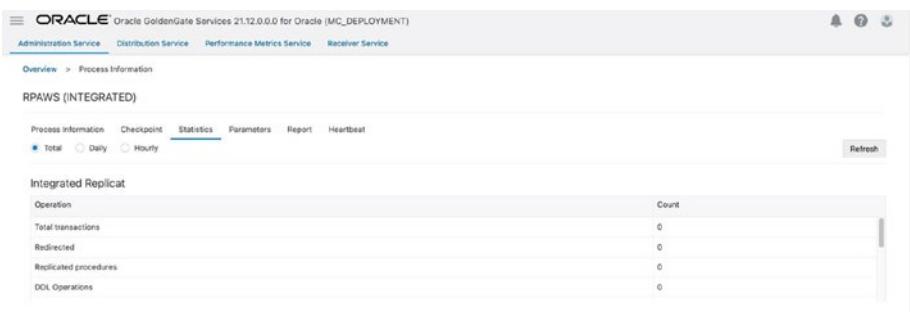


Figure 11-24. Replicat stats information

As you can see from the screen, everything is zero here for Replicat.

Now let's run the transaction load and validate the counts of DDLs and DMLs.

CHAPTER 11 REPLICAT DATA ACROSS MULTICLOUD USING OCI GOLDENGATE

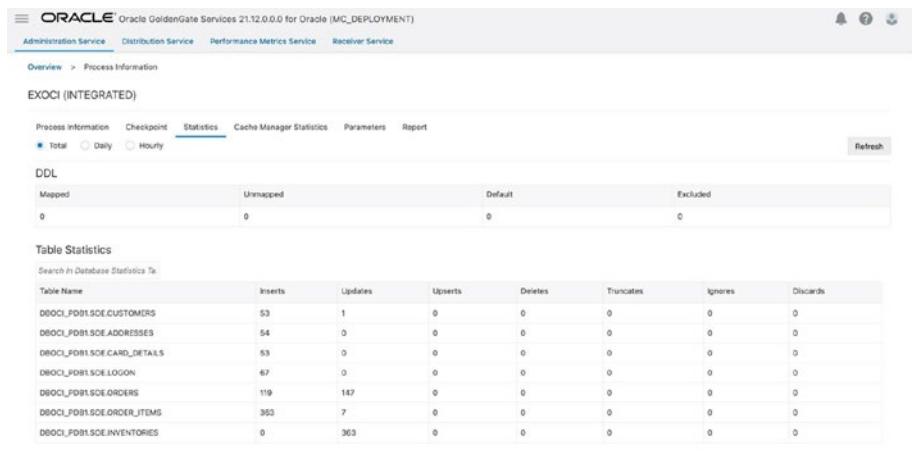


Figure 11-25. Extract stats after transaction

This statistical information provides the number of inserts and updates recorded in the stats section. Let us take an example of the CUSTOMERS table; it has 53 inserts and 1 update. Let's compare the stats of Replicat now.

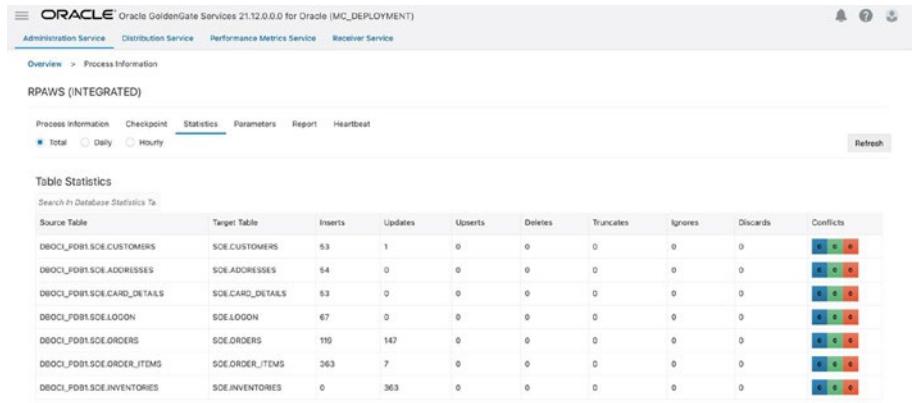


Figure 11-26. Replicat stats after transaction

This statistical information provides the number of inserts and updates recorded in the stats section for Replicat RPAWS. Let us take an example of the CUSTOMERS table; it has 53 inserts and 1 update that is exactly the same as it has been captured. So essentially, the applied transaction and captured transaction have matching values; hence, the replication is successful and smooth.

Summary

Successfully validating a transaction in GoldenGate is a significant milestone in ensuring that the data replication setup is functional and reliable. This process not only confirms the operational effectiveness of the setup but also provides peace of mind that the data integrity is maintained across databases. Regular validation and monitoring are recommended best practices to ensure continuous and smooth operation of your GoldenGate environment.

For multicloud environments, a network setup is the key component, whether it has been set up through VPN or a dedicated line or through a public network.

CHAPTER 12

Real-World Examples of Oracle GoldenGate on OCI

Oracle GoldenGate (OGG) Services on Oracle Cloud Infrastructure (OCI) have been leveraged across various industries and sectors to facilitate real-time data integration and replication, ensuring that data is accurate, available, and accessible wherever it is needed. The following sections are hypothetical case studies illustrating how businesses might employ OGG on OCI to solve diverse data management challenges.

Navigating through a spectrum of industries and a variety of organizational hurdles, let us explore the imaginative case studies showcasing the inventive utilizations of Oracle GoldenGate on OCI. These narratives not only highlight the technological unification of OGG but also emphasize its crucial role in uplifting data management, analytics, and operational efficiency across diverse business terrains.

Case Study 1: Implementing Active-Active Database Replication on OCI GoldenGate Services

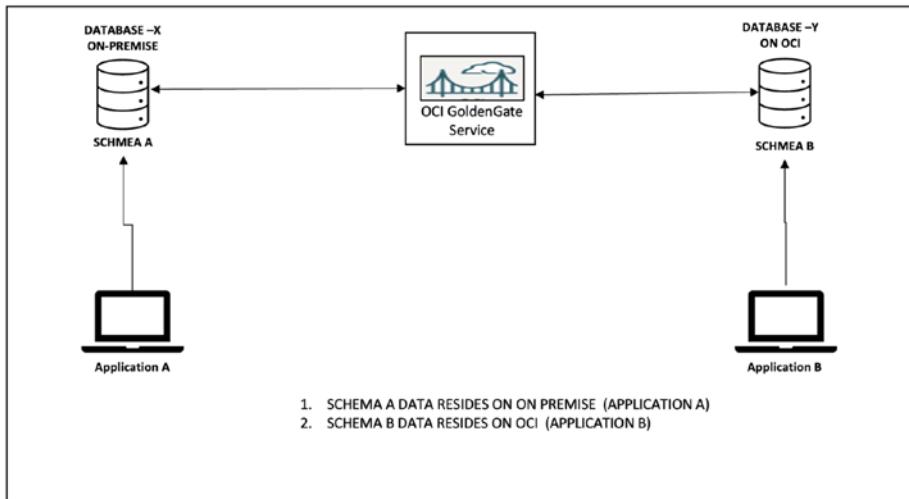


Figure 12-1. Bidirectional GoldenGate replication

Context

Imagine a global financial entity FinCorp, harnessing extensive datasets residing in on-premises data centers located in North America and Europe. To elevate its data management and accessibility and derive enhanced analytics, FinCorp decides to migrate its data centers to Oracle Cloud Infrastructure (OCI) using Oracle GoldenGate (OGG). The primary objective is to establish an active-active database replication between the on-premises data centers and OCI, ensuring a smooth, zero-downtime migration, while maintaining data consistency and accessibility during the transition.

Challenges

- Continuous Accessibility: Ensuring all the data availability during migration without disrupting global operations
- Data Consistency: Upholding data consistency and integrity across on-premises and cloud environments during the transition
- Security and Compliance: Ensuring the security of sensitive financial data and adherence to regulatory compliance during and post migration
- Latency and Performance: Managing data transfer latency and maintaining optimal performance throughout the migration process

Implementing Active-Active Replication with Oracle GoldenGate on OCI

Perform in-depth planning, which includes dependencies and workflows. Set up the OCI GoldenGate Services between on-premises and OCI. Configure the replication to flow the data to and from on-premises to OCI.

Gradual Transition to OCI

Partial Cutover: Gradually redirect workloads from the on-premises data centers to OCI, ensuring seamless transition and operations. At this time, part of the application would be using the data from OCI and sending the same data writing back to on-premises.

Gather the feedback during the transition and make requisite optimizations to system configurations. Also, check there is no business impact and business as usual.

Finalize Migration and Decommission On-Premises Setup

Full Cutover: Once assured of the stability and reliability of the OCI setup, fully transition all workloads to the cloud. Methodically decommission on-premises data centers, ensuring all dependencies have been addressed and migrated to OCI.

Conduct a post-migration audit to evaluate performance, security, and cost-efficiency, ensuring the migration aligns with organizational objectives.

Outcome

Through the strategic implementation of Oracle GoldenGate on OCI, FinCorp seamlessly migrates its global data centers from on-premises setups to the cloud. The active-active replication ensures constant data availability, safeguarding FinCorp's global operations from disruptions during the migration while providing a sturdy foundation for future scalability, enhanced data analytics, and global data management in the cloud environment.

Case Study 2: Real-Time Data Ingestion to BIGDATA Using OCI GoldenGate Services

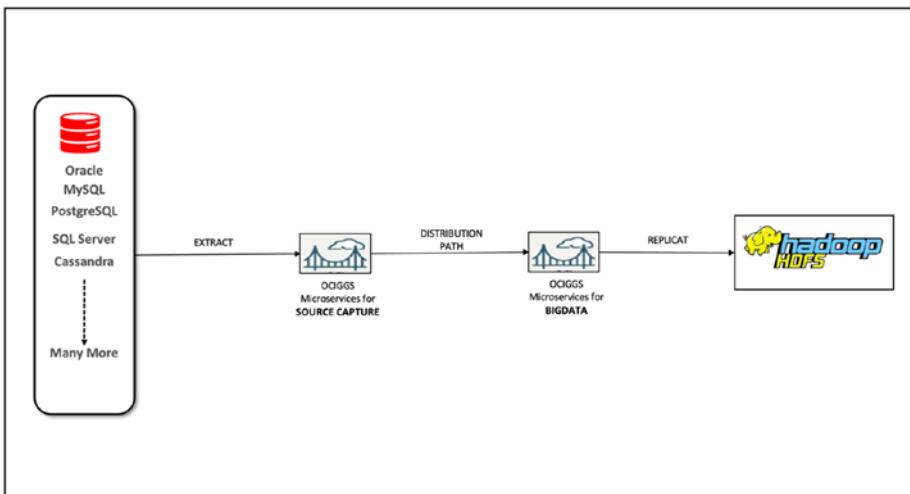


Figure 12-2. Real-time data ingestion to BIGDATA Hadoop

Context

A consumer goods company with thousands of products worldwide aimed to optimize customer experiences through personalized offers and streamlined inventory management, requiring real-time data ingestion into their Big Data platform from various transactional databases to perform the real-time analytics.

In this example, the company has multiple database vendors like Oracle, SAP, Microsoft, and DB2 wanting to send their data into a data lake that has been built on the Hadoop platform.

Solution

Implement Oracle GoldenGate (OGG) enabled to stream transactional data (such as purchase history, customer preferences, and inventory levels) in real time into their Big Data environment.

For example, GoldenGate for Oracle on the source has been used to Extract the data from Oracle Databases; similarly, GoldenGate for SQL Server has been used to Extract the data from SQL Server Database and henceforth.

Once the trail files are generated from these sources, using the Distribution Path it has been pushed to BIGDATA deployment.

OCI GoldenGate Services for BIGDATA will apply these data into the target Hadoop environment.

Advanced analytics applied to this real-time data allowed for crafting personalized offers and enhancing customer experiences while optimizing inventory allocation based on purchasing trends.

Outcome

The real-time data ingestion facilitated dynamic pricing, personalized marketing, and efficient inventory management, significantly enhancing customer satisfaction and operational efficiency.

Case Study 3: Fraud Detection with Streaming Analytics Using OCI GoldenGate Services

Context

In the financial sector, fraud detection is essential for protecting customer assets and maintaining trust. Immediate identification and mitigation of fraudulent activities necessitate real-time data analysis. Using Oracle

GoldenGate Services on OCI, financial firms can create an architecture that allows for real-time data ingestion and streaming analytics to promptly detect and prevent potentially fraudulent activities.

Solution

Implement GoldenGate along with streaming analytics.

Key Components Using GoldenGate Fraud Detection Architecture

1. Real-Time Data Ingestion: GoldenGate facilitates real-time data ingestion from source transactional databases into analytical platforms or data lakes. This ensures that every transaction is immediately available for analysis, enabling the prompt detection of suspicious activities.
2. Streaming Analytics: Streaming analytics like OSA (Oracle Stream Analytics) engines can analyze data in motion, identifying patterns that may indicate fraudulent activities. Integration with GoldenGate allows this analysis to occur in real time, as transactions are happening.
3. Machine Learning Models: Machine learning models trained on historical transaction data can predict the likelihood of a transaction being fraudulent. These models can be integrated into the streaming analytics platform, providing real-time predictive capabilities on the data ingested by OGG.

4. Alerts and Automated Actions: Upon detection of a potentially fraudulent activity, the system can generate alerts for manual review. Additionally, automated actions, such as blocking a transaction or freezing an account, can be initiated based on predefined criteria or predictive insights.

Benefits

Prompt Fraud Detection: Identify and respond to fraudulent activities as they occur, minimizing potential damage.

Enhanced Customer Trust: Improve customer trust by proactively identifying and mitigating fraudulent activities.

Regulatory Compliance: Ensure adherence to regulatory requirements regarding fraud detection and response.

Optimized Operational Efficiency: Automate fraud detection and response mechanisms, reducing the manual workload and optimizing operational efficiency.

Outcome

Leveraging Oracle GoldenGate Services on OCI for real-time data ingestion along with streaming analytics and machine learning models empowers financial firms to construct a potent, real-time fraud detection system. This approach not only safeguards assets but also reinforces customer trust and adherence to regulatory compliances by ensuring immediate identification and mitigation of fraudulent activities.

Case Study 4: SaaS Application Data into Enterprise

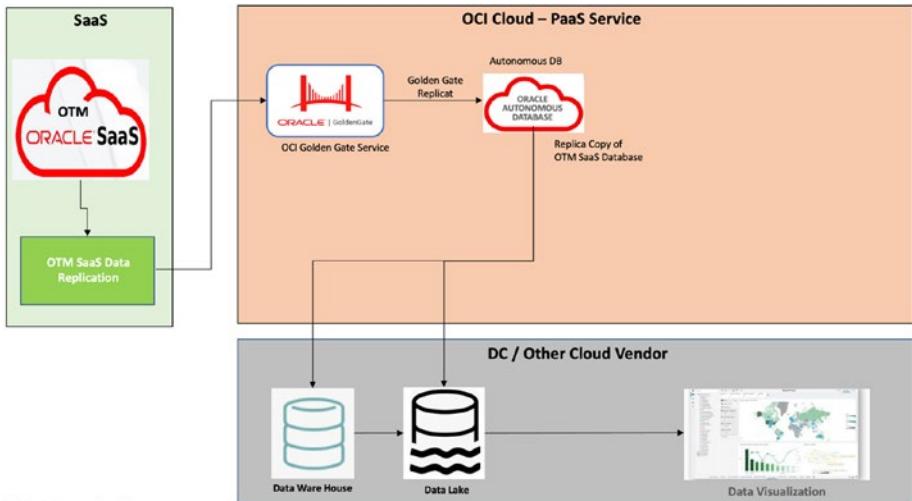


Figure 12-3. SaaS application example to data lake

Context

Imagine a logistics and transportation enterprise, “LogiCorp,” that heavily relies on Oracle Transportation Management (OTM) as a part of its Oracle Cloud Infrastructure (OCI) Software as a Service (SaaS) suite. The firm manages a complex network of shipments, storage, and delivery, necessitating real-time analytics and reporting to optimize routes, manage resources, and enhance customer satisfaction by ensuring timely deliveries. For analytics purposes, the company needs the data from OCI SaaS into their enterprise data lake.

Solution

Implement Oracle GoldenGate Services to take the data out that has been pushed from the SaaS team to the customer data center. Secure Data Transfer establishes encrypted data channels for secure transfer of data from OTM to the data warehouse or data lake.

Outcome

Oracle GoldenGate has proven instrumental for LogiCorp by bridging the data flow from Oracle Transportation Management (OTM) SaaS to a centralized analytics platform. The real-time data replication facilitated by OGG has not only enriched operational decision-making with timely data insights but also enhanced resource management and customer satisfaction. This case study underscores the potential of Oracle GoldenGate in enhancing real-time analytics and reporting capabilities, particularly in logistics and transportation management scenarios where real-time data is paramount for operational success and customer satisfaction.

Case Study 5: Disaster Recovery Solution with Oracle GoldenGate Services on OCI

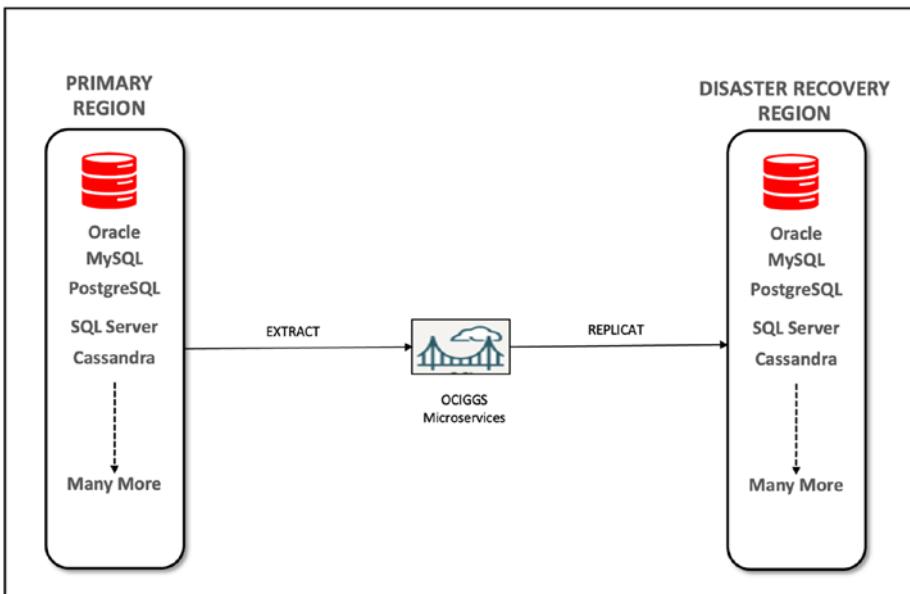


Figure 12-4. DR strategies using OCI GoldenGate Services

Context

Let's consider "FinTech," a global financial organization handling numerous transactions daily and managing extensive databases that are critical for their operation. Maintaining data availability and integrity is critical for their ongoing business operations, particularly due to the regulatory compliance necessary in the financial industry. Therefore, implementing a comprehensive disaster recovery solution becomes imperative.

Challenges

1. Data Availability: Guaranteeing uninterrupted data availability in the event of a disaster
2. Data Consistency: Maintaining data consistency across primary and disaster recovery sites
3. RTO and RPO: Achieving minimal Recovery Time Objective (RTO) and Recovery Point Objective (RPO) to ensure business continuity
4. Compliance: Adhering to regulatory compliances and safeguarding data during replication

Solution

Implement disaster recovery with Oracle GoldenGate on OCI.

Step 1: Identifying and Analyzing Critical Data

Data Mapping: Enumerating databases and data that are critical for business continuity

Compliance Adherence: Ensuring that the data replication and storage abide by global financial regulatory standards

Step 2: Oracle GoldenGate Deployment on OCI

OGG Deployment: Setting up Oracle GoldenGate on OCI, ensuring secure and real-time data replication

Secure Channels: Establishing secure data transmission channels, ensuring end-to-end encryption and security

Step 3: Establishing Data Replication

Active-Passive Replication: Implementing active-passive replication with the primary site as active and the disaster recovery site on OCI as passive.

Real-Time Synchronization: Using OGG to synchronize data in real time between the primary site and the disaster recovery site on OCI

Step 4: Configuring Automated Failover Mechanisms

Automated Failover: Configuring automated failover to the disaster recovery site on OCI in the event of a failure

Data Integrity Checks: Regularly validating data integrity and consistency between the primary and recovery sites

Outcome

With Oracle GoldenGate facilitating real-time data replication to OCI, FinTech successfully implemented a robust disaster recovery solution with high availability, data integrity, regulatory adherence, and business continuity with minimal RTO and RPO, ensuring that the business operations remain unaffected during and post disaster.

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