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Performance Considerations for OCI GoldenGate

March 2025, Version [1.1]

Public

Purpose statement

This document provides an overview of Oracle Cloud Infrastructure (OCI) GoldenGate features that can be used for data / delta lakehouse ingestion performance improvements.

It is intended to discuss different configurations for performance tuning, their potential impacts on your architecture, and guide you to the most optimal technical design for your business requirements.

Disclaimer

Table of contents

Introduction

OCI GoldenGate is the only cloud-native service providing the best-in-class data replication functionality with Oracle GoldenGate in a fully managed cloud environment. Using OCI GoldenGate, you can easily replicate your data securely, in real-time, at scale across heterogeneous cloud and on-premises systems.

OCI GoldenGate provides unique advantages:

- Auto scaling: When enabled, OCI GoldenGate deployment can automatically scale up to handle peak workloads.
- Upgrades and patching: With OCI GoldenGate, customers can apply patches and upgrades with a single click.
- Integration with native OCI Services: OCI GoldenGate deeply integrates cloud-native OCI services (like OCI Vault, OCI Monitoring, or OCI Networking) to provide unmatched cloud-native capabilities.
- Ease of use: OCI GoldenGate provides REST APIs for easy scripting and a comprehensive Web User Interface that allows for self-service configurations.

OCI GoldenGate supports dozens of different source and target technology combinations to support various use cases, from migrations to distributed analytics. Since OCI GoldenGate's release, real-time data ingestion into cloud storage services has been one of the most common use cases.

OCI Object Storage, Azure Data Lake Storage (Azure Storage), Amazon S3, and Google Cloud Storage are the cloud storage technologies supported by OCI GoldenGate. OCI GoldenGate supports JSON, Delimited Text, Parquet, Avro, and Avro OCF formats.

This technical paper focuses solely on performance considerations. Refer to the OCI GoldenGate Documentation and Oracle Blogs for other configuration details.

Figure 1. OCI GoldenGate supported source and target technologies.

Replication performance factors

Three primary factors impact OCI GoldenGate replication performance. They are replicat type, network characteristics, and the GROUPTRANSOP parameter. This paper contains the results of twelve performance tests designed to help you optimize cloud storage ingestion performance.

Let's first discuss these performance factors.

Replicat types

OCI GoldenGate provides two replicat types for cloud storage targets: *Classic Replicat* and *Coordinated Replicat*.

Classic Replicat is a single-threaded process that applies the messages to target cloud storage services.

Coordinated Replicat is a multi-threaded process where multiple threads read the OGG trail file independently and apply transactions in parallel. Each thread handles the filtering, mapping, conversion, and error handling for its assigned workload. By using THREADRANGE parameter in the replicat mapping, you can partition the workloads within the same replicat. Depending on the load in your tables, you can assign different threads for each mapping within the same replicat.

For example:

MAP test.table1, TARGET test.table1, THREADRANGE(1-3, ID));

MAP test.table2, TARGET test.table2, THREADRANGE(4-9, ID));

MAP test.table3, TARGET test.table3, THREADRANGE(9-10, ID));

Network characteristics

Independent of OCI GoldenGate service performance, network characteristics including public and private connections, bandwidth, latency, and stability are consequential factors that impact replicat performance.

GROUPTRANSOPS parameter

OCI GoldenGate cloud storage replicat process optimizes processing with *transaction grouping*. The GROUPTRANSOPS parameter groups multiple small transactions into a single larger transaction applied to cloud storage targets. The GROUPTRANSOPS parameter counts the database operations (inserts, updates, and deletes) and only commits the transaction group when the number of operations equals or exceeds the GROUPTRANSOPS configuration setting. GROUPTRANSOPS defers the transaction commit call until the larger transaction is completed. When a transaction is committed, the replicat flushes the operations.

The GROUPTRANSOPS parameter controls how frequently the flush process is called. By default, GROUPTRANSOPS is set to 1,000. Having a smaller value would result in more frequent flush calls, and having a bigger one would result in fewer. Fewer flush calls improve performance.

Performance tests

Twelve test cases were run to understand how three different factors (GROUPTRANSOPS settings, replicat types, and network types) impact replication performance. The object storage target was an Azure Data Lake Storage using the Parquet format. Both the OCI GoldenGate source and Azure Storage target were co-located in the OCI Frankfurt data center.

The OCI GoldenGate deployment was configured with 4 OCPUs (the recommended minimum for production workloads), and auto scaling (which can increase the resources up to 3 times) was enabled. We used a single replicat process with the same data set from the same GoldenGate trail file in all our tests. Our data set represented OLTP workload and was made of 73,634,600 records, resulting in a 3.3 GB file in Azure Storage. OGG replication data transfer rates ranged from ~5 MB/sec up to ~40 MB/sec.

Important note: These tests were conducted to provide performance *guidance* for OCI GoldenGate and cloud storage services. Your replication performance ***will differ*** depending on the size and type of data replicated, the number of replicats you are running, cloud region locations, network settings, and replicat configuration settings. We recommend you work with an Oracle engineer and test your scenarios to find your most optimal configuration.

Network Tests

Two network tests were conducted to evaluate the difference between a public and dedicated (OCI – Azure Interconnect 1 Gbps) connection. There was only a 3% difference between these two connections. This was expected because OGG replication throughput was in the range between ~5 MB/sec to ~40 MB/sec, whereas even public network was providing around 100 MB/sec bandwidth. Still, a dedicated connection provides more stable and secure connectivity, while the actual throughput improvement we observed was not more than 3%.

Replicat Types

Classic and Coordinated Replicats were tested with two different GROUPSTRANSOPS settings. In general, performance improvements come at an additional memory cost. Coordinated Replicat uses more memory as it runs multiple threads. Each OCI GoldenGate OCPU resource has a fixed amount of memory, therefore additional OCPUs will meet also increase memory requirements.

Using *Coordinated Replicat* with 20 threads and *GROUPTRANSOPS* set to *1,000*, there was nearly 5 times improvement compared to *Classic Replicat* with *GROUPTRANSOPS* set to *1,000*. Coordinated Replicat used 8 OCPUs maximum for this test case.

Using *Coordinated Replicat with 20 threads and GROUPTRANSOPS* set to *20,000*, there was nearly 3 times improvement compared to *Classic Replicat* with *GROUPTRANSOPS* set to *20,000*. Coordinated Replicat used 12 OCPUs maximum for this test case.

GROUPTRANSOPS Parameter

We tested both Classic and Coordinated Replicats with two different GROUPSTRANSOPS settings. In the first test, we used the default setting (1000). In the second test, we increased the GROUPTRANSOPS value to 20,000.

In *Classic Replicat* with *GROUPTRANSOPS* set to *20,000*, we saw almost 3 times (300%) performance improvement compared to *Classic Replicat* with *GROUPTRANSOPS* set to 1,*000*. We saw only a marginal (~15%) change in resource utilization between these two cases. Both cases had 4 OCPUs allocated to GGS deployment.

In *Coordinated Replicat* with *GROUPTRANSOPS* set to *20,000*, we saw nearly 50% performance improvement compared to *Coordinated Replicat* with *GROUPTRANSOPS* set to *1,000*. In Coordinated Replicat, with GROUPTRANSOPS set to 20,000, the deployment had 12 OCPUs, while it used 8 OCPUs max with GROUPTRANSOPS set to 1,000.

Conclusion

In our tests, increasing GROUPTRANSOPS setting provided better performance. For better performance/higher throughput consider using Coordinated Replicat. You can easily configure the GROUPTRANSOP and do your own tests. But also be aware that Coordinated Replicat will use more CPU resources because it increases number of replicat threads.

Replicat Type	GroupTransOps Setting	Max OCPU	Performance Improvement
Classic Replicat	1,000	4	1x
Classic Replicat	20,000	4	3x
Coordinated Replicat with 20 threads	1,000	8	5x
Coordinated Replicat with 20 threads	20,000	12	8x

Table 1. The observed performance improvements for different Replicat settings.

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