

## White Paper

# Getting the Most from Oracle Database in the Cloud with Oracle Exadata

Sponsored by: Oracle

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## IN THIS WHITE PAPER

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It has been well established that the best possible environment for running Oracle Database is Oracle Exadata. This white paper focuses on the best solution for Oracle Database users who wish to enjoy the power and reliability of Exadata in conjunction with SaaS and other applications they are running on public cloud services. The paper considers the inherent compromises involved in running Oracle Database on non-Oracle, generic public cloud services, which do not support Oracle Exadata. Finally, the paper examines a solution that involves deploying Exadata in a colocation center that has a high-speed interconnect with the leading public cloud services, delivering Exadata power while overcoming the latency issue of connecting to applications in the public cloud.

## SITUATION OVERVIEW

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### Oracle Database in the Public Cloud

Increasingly, Oracle Database users are looking to move their applications to the public cloud or, in some cases, adopt SaaS applications while seeking to deploy Oracle Database in that public cloud, alongside the application. If the application is an Oracle application, the most straightforward way to do this is to move to the Oracle Cloud version of that application. For other applications, users are often choosing other cloud services, such as AWS, Microsoft Azure, or Google Cloud Platform (GCP).

For databases that do not have significant performance or scalability requirements, deployment in public cloud environments may be just fine. Many Oracle customers, however, depend on the performance, scalability, and robustness that they have come to expect from the Oracle Exadata platform. For them, deployment in these third-party cloud environments proves unacceptable for the following reasons:

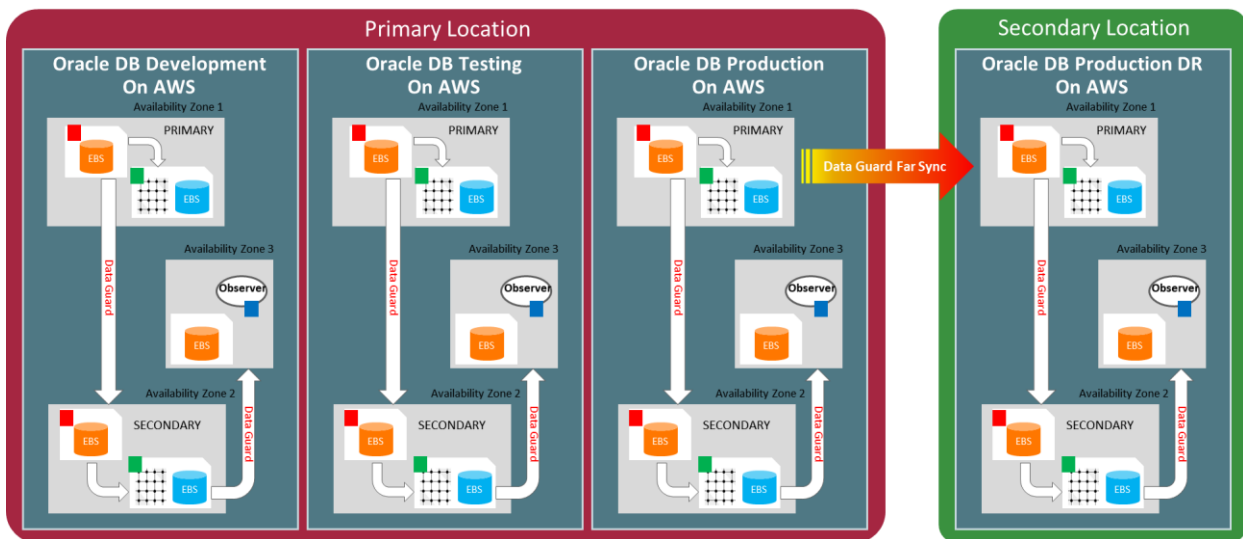
- The database is deployed on generic hardware that is not designed to optimize the performance of the Oracle Database.
- Key features that support scalability and database consolidation, such as real application clusters (RAC) and the Multi-Tenant Option are not deployable in third-party cloud environments.
- If used in combination with recoverability capabilities such as Data Guard, the deployment costs in terms of compute and storage fees become prohibitive in third-party clouds, and the Zero Data Loss Recovery Appliance (ZDLRA) is not available.

- Special Oracle Database optimizations developed for Exadata are not available – such as Automatic Indexing, AI-based Performance Monitoring, and Hybrid Columnar Compression – because third-party public clouds do not support the deployment of Exadata.

Some customers attempted to make up for these shortcomings through large-scale resource deployments and special configurations, but those efforts proved operationally complex and excessively expensive. When disaster recovery is attempted, using Oracle Data Guard Far Sync to establish a DR failover system at another cloud datacenter location, the cost balloons even more. Figure 1 illustrates a typical approach of this nature. Note that this configuration must be implemented for each database supported; the consolidation capability of Exadata is not available.

**FIGURE 1**

**An Attempted Oracle Database Deployment on AWS**



Source: Fortune 500 Oracle Customer, 2019

**Oracle Database on Generic Hardware versus Oracle Exadata**

Non-Oracle public clouds are not able to offer the Enterprise edition of the Oracle Database. Non-Oracle public cloud performance is frequently inadequate running on generic x86 hardware, networking, and storage. Effective database resilience features such as RAC and Oracle’s ZDLRA are also not available.

Moving on-prem Oracle Database licenses to non-Oracle public clouds also has significant performance and functionality challenges. When Oracle Database is deployed in the public cloud, it must run on generic hardware provided by the cloud datacenter. Even if it is running on dedicated hardware, it may not exhibit the speed and scalability to which the user is accustomed, because the hardware is not optimized for Oracle Database, and because the storage environment involves standard public cloud storage services, which in turn involve overhead that is not present in Exadata. None of the optimizations of Exadata, including the use of a specialized database storage server executing simple SQL to retrieve select table rows rather than whole blocks nor the use of flash arrays for more active data and for caching, are available in this environment.

The selection of compute instances in the public cloud is governed by maximum supported IOPS and throughput. In many cases, Oracle Databases cannot scale out across multiple compute instances and flash SSDs cannot be aggregated, thus bottlenecking performance. Applications utilizing Oracle Databases using native public cloud services will be fine if their requirements are lower than the max ceiling offered by the service provider. Cloud native services are usually inadequate for Oracle Database deployment when multiple applications are utilizing the same database or when a single database handles a lot of transactions. For users that have come to depend on the power and flexibility of Exadata, this may come as something of a shock. In addition to the optimization around specialized database storage servers and the use of flash arrays mentioned above, Exadata also allows for the shifting of database workload resources within a multitenant database environment in order to provide for things such as rolling upgrades and application of patches without taking the database down. These are not possible in a generic hardware environment, so some downtime must be expected.

Another workaround is the use of the public cloud provider's storage snapshots. Storage snapshots are convenient and easy to utilize; however, in many cases cloud storage snapshots of the Oracle Database are not mountable and instead must be recovered, making for longer recovery time objectives (RTOs).

An increasingly popular workaround is the use of cloud adjacent enterprise storage. This process puts higher performance storage in a colocation (co-lo) facility that is geographically close to public cloud datacenters. The storage can be owned by the customer or it can be a managed service provided by the storage vendor. The storage at the co-lo facility is connected to the public cloud via high-bandwidth low-latency interconnect typically at 10 Gbps or greater.

While cloud adjacent enterprise storage is a better answer for database and database application IOPS, throughput, and security, it could be affected by higher latency, which can in turn result in significantly slower database and database application response times. Storage systems require multiple round trips to the cloud database and back, as many as 30 per transaction for each one that Oracle Exadata does between compute and storage nodes. This is because unlike in the cloud adjacent enterprise storage case, with Oracle Exadata the database, compute, storage and networking are all integrated together in a single cage and cross-connected via server-to-server communications to application cloud services.

## Connecting Oracle Exadata to Public Cloud Applications

Fortunately, there is an option for connecting databases running on Oracle Exadata to applications running in the public cloud that does not involve the unacceptable latency inherent to the public internet. This option involves deploying the Exadata instance in a cage at a colocation center and using the colocation vendor's high-speed link to connect to applications in the selected public cloud. Equinix, CenturyLink, and Rackspace are among the colocation vendors that offer the ability to run dedicated hardware in their datacenters with a high-speed link to a public cloud.

Using a colocation center, Oracle Exadata users can set up an Exadata machine with the desired configuration and connect it to the public cloud that runs their applications. Because it is connected through a high-speed link, the database communicates with the application as if they were both in the same datacenter. In this way, the user gets all the advantages of Exadata, while still being able to deploy applications in AWS, Microsoft Azure, or GCP.

## The Cloud Adjacent Solution

Oracle's Exadata Cloud Adjacent architecture delivers very high database IOPS, throughput and extremely low latencies. According to Oracle, Exadata X8M delivers SQL read transactions in  $\leq 19\mu\text{s}$ . Even with the distance latency between the public cloud and the cloud adjacent co-lo, the total latency is a mere tiny fraction of what the enterprise storage systems by themselves can deliver.

Oracle Exadata Cloud Adjacent users get to utilize more than 60 Oracle Database capabilities only available on Exadata that accelerate performance and increase automation, availability, resilience, security, and data protection. Oracle Exadata Cloud Adjacent is deployed in a colocation center adjacent to most of the major cloud service providers as a private cloud or as the Exadata Cloud at Customer managed service. Oracle Exadata Cloud Adjacent delivers the following:

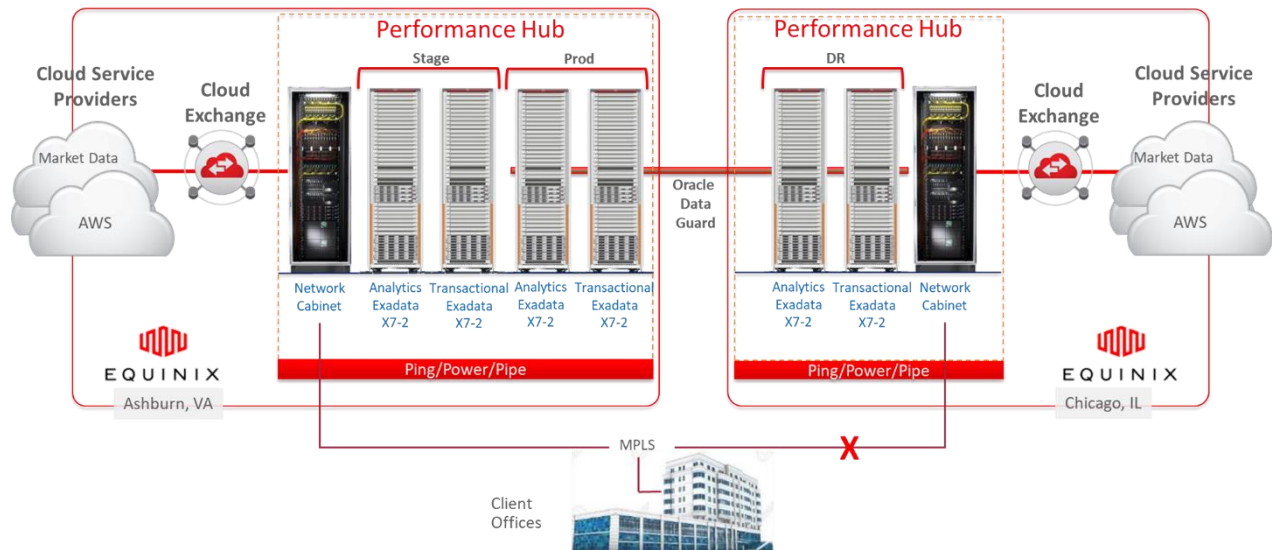
- Consistent and predictable database performance for any cloud application
- High availability and reliability
- Zero unplanned downtime
- Exadata's well-established scalability, not available in generic public cloud implementations, including the power of RAC
- Multitenant databases via container databases (CDBs) and pluggable databases (PDBs)
- Built-in AI machine learning with production hardened algorithms that do not need R programming to utilize
- End-to-end security
- Relatively lower license and support fees due to greater infrastructure efficiencies
- Workload isolation

Oracle Exadata Cloud Adjacent has proven especially popular with global financial services institutions which require high performance on very large databases, extreme scalability, and continuous availability. In many cases, these firms are under a mandate to shut down their datacenters and move their data processing operations to the public cloud. The cost and complexity of running Oracle Database on generic public cloud infrastructure have been a real roadblock in these regards, but the Oracle Exadata Cloud Adjacent solution has proven the best way to fully realize all the advantages of Oracle Exadata for public cloud applications.

Figure 2 illustrates an example of this solution, using Equinix as the colocation service and AWS as the public cloud service.

**FIGURE 2**

**Oracle Exadata Cloud Adjacent Configuration Using Equinix and AWS**



Source: Fortune 500 Oracle Customer, 2019

In this example, the user is receiving market data from a cloud data source and implementing applications that use that data on AWS. The database systems for both staging (development and testing) and production are together in one Equinix datacenter in Ashburn, Virginia, and a disaster recovery site is set up in another Equinix site in Chicago, Illinois. In both cases, high-speed connectivity with the market data source and with AWS are delivered using the Equinix Cloud Exchange. It should be noted that this solution makes sense regardless of the particular public cloud service chosen or the regions involved. Note also that the DR site is configured with both Oracle’s ZDLRA (not shown in this example) or Data Guard for the best possible RPO and RTO.

It should be clear, when comparing the topologies illustrated in Figure 1, and in Figure 2, that the latter represents a configuration that is operationally easier to manage and more cost-effective.

**FUTURE OUTLOOK**

The future of IT is rushing rapidly to real-time analytics and AI which demand much faster response times, lower latencies, higher transaction rates, and much greater throughput. Where the data, analytics, and AI reside will depend on the performance requirements, scalability, manageability, flexibility, security, data sovereignty, location (cloud, cloud adjacent, on-prem) and cost. For scenarios that demand maximum performance, scalability, manageability, and flexibility in support of public cloud-based applications, the Oracle Exadata Cloud Adjacent Architecture is the ideal choice for Oracle customers into the foreseeable future.

**CHALLENGES/OPPORTUNITIES**

For some who are considering this solution, its reliance on Oracle Exadata makes them concerned that this limits their future options for database deployment. However, for Oracle customers with significant database workload requirements, Exadata is the best option for managing their Oracle

databases, and this approach represents a reasonable solution to embracing the public cloud while retaining the benefits of Exadata. Oracle is challenged to make this point in its conversations with customers. For those Oracle customers that may be considering switching to another RDBMS, Oracle needs to articulate clearly the Exadata value proposition over any competing cloud vendor RDBMS.

## CONCLUSION

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Many enterprises are under a mandate to move their data processing operations to the public cloud and shut down their datacenters. For some, the facilities offered by those public cloud providers will be sufficient for their needs. For others, however, the key reason they have remained with Oracle is due to the consistent performance, reliability, and manageability of the Oracle Database running on Exadata. For these enterprises, the alternatives are simply not acceptable.

Those enterprises that find themselves in this position, and that have extensive requirements for database size, scaling, transaction throughput, and query performance, are likely to find, or have found, that the Exadata engineered system is the right one for them. The challenge then becomes how to leverage the power of Exadata when the corresponding applications are running in the public cloud.

The answer may be to implement the Oracle Exadata Cloud Adjacent architecture, deploying one or more Exadata systems in a colocation center with a high-speed link to the applications running in the public cloud. This solution retains the flexibility and affordability of the public cloud for application deployment, sought after by executive management, while retaining the powerful productivity features of Exadata.

It should also be noted that Oracle Database customers have complete flexibility and architectural equivalency from on-premise to public cloud, as the Exadata platform powers Oracle's public cloud services such as Autonomous Database, the Exadata Cloud Service and Exadata Cloud at Customer, and is of course available as either Exadata X8M or Exadata X8 for on-premise deployments. With the same software, management tools and APIs across all these offerings, Oracle Database customers who get accustomed to Exadata can expect the same performance, security and scale when they begin to leverage the cloud. For those customers who aren't ready to go to a full public cloud model yet, the hybrid capabilities of Exadata Cloud Adjacent enables them to benefit from the best of both worlds while making no changes to the underlying platform or database.

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