White Paper

Oracle Exadata Cloud Service X8M: No Database or Workload Is Too Large

Sponsored by: Oracle Corporation

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February 2021

IN THIS WHITE PAPER

Enterprises are moving their databases to the cloud. They are looking for greater flexibility in deployment, better scalability, less risk due to human error, and more value for money through a pay-as-you-go charging model. For enterprises dependent on the scaling, performance, and advanced features of the converged Oracle Database, however, the single-purpose cloud database service options, deployed on generic hardware, may fall short of their expectations. For them, Oracle offers Oracle Database as a managed service – Oracle Exadata Cloud Service – on Oracle Cloud Infrastructure (OCI). The latest version of this offering is based on the latest Exadata technology, Oracle Exadata Database Machine X8M, but with a configuration designed specifically to run on OCI. This white paper reviews enterprise requirements and needs for a database cloud service, considers the higher needs of advanced Oracle Database users, and shows how the Oracle Exadata Cloud Service X8M is designed to meet those needs.

SITUATION OVERVIEW

The Drive Toward Databases in the Cloud

The public cloud offers many benefits to enterprises that are considering moving their workloads to the cloud. Routine operations are handled by public cloud service providers, relieving enterprises of the need to perform those functions. The workloads can run on the latest hardware, without the need to consider a plan for server and storage depreciation and replacement over time. Enterprises can, as a result, focus on activities related to the business rather than fuss with the technology. Because most serious workloads involve databases, moving them, or adopting new SaaS products with their associated databases, is a necessity. Many enterprises have already moved databases to the cloud, and many more are in the process of doing so. However, most of those are relatively simple, nonstrategic databases and workloads. The larger, more challenging and critical databases pose special problems when considering cloud-based management.

The Case for Cloud Databases

In many cases, enterprises have attempted to support their cloud-based applications by a "lift and shift" method of simply taking the databases they use in the datacenter and redeploying them in the cloud in virtual machines. This approach usually leads to trouble, however, as those database management systems (DBMSs) are not designed for cloud deployment and do not manage resources efficiently, which results in unexpected cost overruns. A better approach is to use a version of the

DBMS that is designed to run in the cloud and can allocate and free resources in a way that contains runtime cost. There are a variety of cloud-based DBMSs available that can be run in this manner, with the user organization assuming all responsibility for manually tuning the database to ensure proper performance and keeping security and patching current.

However, the best option is a fully managed cloud database service, running natively on cloud resources with database software maintenance, patching, and tuning all delivered as parts of the service. Such a service is generally delivered by a team of experts in the DBMS, who know how to get the most from the database. If a database is running on generic hardware, there will be natural limitations with regard to the database's ability to scale, both in size and in concurrent user support, and performance could become variable and anemic at times.

If a database is relatively simple, and changes are infrequent, then such constraints may not be problematic. For users of the largest databases, serving the most demanding, mission-critical business applications, however, such a database service simply will not do. For such users, especially users of the larger and more complex Oracle Database implementations, something more substantial is required. That something is a database service that runs on an infrastructure platform designed specifically to optimize the operation of that particular database – co-engineered at the source-code level.

Needs and Expectations of Oracle Customers

Oracle Database users are some of the most demanding in the world. The largest and most complex of their databases feature multiple terabytes of active data in OLTP systems and hundreds of terabytes of warehouse data maintained in hundreds of tables with thousands of foreign key relationships, all pounded away by thousands of users posting highly complex SQL queries. Those users need a database that can wring every ounce of performance out of the platform on which it is running and a platform that has the power to deliver peak levels of sustained performance.

The most demanding Oracle Database users are already accustomed to running Oracle Database on the Oracle Exadata platform in their datacenters. They know the high levels of scalability and performance that the platform delivers. As they move to the cloud, they expect a similar experience, with one thing extra: limitless scalability. Oracle Exadata running in the user datacenter comes in eighth rack size and in flexible configurations starting at two compute servers and three storage servers. When those systems need more resources, the user must acquire and install them, causing operational delays due to system reconfiguration. The ideal is an Oracle Exadata experience in the cloud that also scales without the need to purchase, install, or reconfigure additional physical components.

Oracle Exadata Cloud Service X8M

The Oracle Exadata Cloud Service X8M is unlike any other cloud database service in that the Oracle Database runs on a hardware platform designed specifically for it. This fact enables a degree of scalability, performance, and flexibility for the database that pushes the outer edge of the boundary of what is possible for any cloud database today. Although Oracle has been running Oracle Cloud Infrastructure workloads on Oracle Exadata for a while now, the Exadata X8M platform takes performance to a new level – a level beyond what is currently available in the marketplace. In fact, organizations can take any size or number of Oracle Databases and run them on Exadata Cloud Service X8M, where the dynamically scaling architecture automatically adjusts to match changing workloads, providing true pay per use.

Key Characteristics of Oracle Exadata X8M

Oracle Exadata is designed to optimize the separation of compute from storage for maximum deployment flexibility, in support of Oracle's shared-everything cluster architecture, Real Application Clusters (RAC). With Exadata X8M, communications between compute and storage nodes have been further enhanced by the use of the 100Gbps RoCE (RDMA over Converged Ethernet) internal fabric. RDMA is a mechanism that allows one node to insert data directly into the memory of another node without requiring interaction with that node's CPUs and bypassing network and I/O software. This is far more efficient than conventional request-and-respond packet protocols, causing many times faster data exchanges than is possible with databases that depend on those protocols.

Oracle Exadata X8M also features the use of Intel Optane Persistent Memory (PMEM). PMEM acts as a storage medium but is much faster than flash memory. More importantly, PMEM appears as DRAM to the system, allowing the database to use RDMA to read and write data as previously described. Oracle uses PMEM to cache the hottest data and to hold transaction log records. The combination of RDMA performance and faster storage access greatly increases transaction performance. Of course, faster completion of processing tasks equates to lower overall cloud usage costs.

Oracle Exadata X8M Optimized for the Cloud

Oracle Exadata X8M was first made available for the datacenter in traditional and Cloud@Customer deployment options but is now featured in OCI. In addition to the benefits outlined previously, Exadata X8M is also designed to deliver scaling on demand. When deployed on premises, the user must choose the system capacity up front to meet peak workloads. The OCI version, on the other hand, starts with a minimum HA configuration of two database servers and three storage servers. From there, the user can upgrade the capacity for compute or storage servers independently at any time, and the database service is increased or decreased as needed without downtime – a very uncommon feature in a cloud database service – while the user pays only for use of the service on a per-second basis. Exadata Cloud Service X8M's elastic scalability supports the largest databases – up to 2.5PB uncompressed databases and 25PB data warehouses, scaling as much as 25 times more than a leading cloud database service provider.

Oracle Exadata Cloud Service X8M is built from the ground up for nondisruptive elastic scalability. It's designed for any size workload at any scale. Application and workload database scalability is both transparent and highly available. Oracle Cloud Processing Units (OCPUs) are scalable at a fine-grain level, increasing on demand and non-disruptively while decreasing as demand ebbs.

It can do this because scaling CPU can be done online while the database is active. Changes that do require restarting the database instance are done to parallel instances, one at a time, while the database remains fully accessible. This same capability means that patches and most software upgrades can be applied without incurring any downtime. Users have a range of subscription options available, including both capacity-level subscriptions and a pay-per-use model.

Key Benefits

In summary, the key benefits of Oracle Exadata Cloud Service X8M are as follows:

- Continuous operation, even during Exadata software upgrades, patches, and capacity expansion operations
- High transaction throughput optimized through operation on Exadata X8M, a physical platform designed specifically for the Oracle Database at the source-code level, enhanced with the use of RoCE and PMEM
- On-demand elastic scalability to support the largest databases and workloads without disruption
- High-speed complex analytic query processing supported by Exadata X8M, a physical system designed specifically to optimize the efficiency of RAC and the in-memory hybrid columnar compressed capability (High performance is combined with elastic scalability and pay per use to lower total cloud usage costs.)
- Full compatibility with any existing Oracle Database workload (It will also support Oracle Autonomous Database for self-management and self-tuning.)

FUTURE OUTLOOK

Clearly, as we move forward, there are cloud database services that are developing characteristics similar to those described in this document, including separation of storage and compute, use of hybrid-columnar types of compression, and increasingly flexible pay-as-you-go models. Although some cloud services have made enhancements to their physical environments to boost database performance, thus far, none offer a purpose-built platform. In contrast, Exadata is fully designed, top to bottom, specifically to deliver the best Oracle Database experience possible. We expect the Oracle Exadata technology to build on X8M and continue to advance its cloud capabilities.

CHALLENGES/OPPORTUNITIES

In the area of cloud database services, there are a range of challengers. Most of these cannot address the variety, depth, and size of problems that the Oracle Exadata Cloud Service X8M solves but do fairly well with much smaller and limited workloads, particularly in analytics. These could be seen as chipping away at Oracle's overall opportunity in this lower-end segment of this space.

On the other hand, it could also be argued that, with its ability to scale from small to large, with appropriate pricing at each level and with the self-serve nature of this service, enabling smaller organizations to engage directly, the Oracle Exadata Cloud Service X8M opens up new opportunities to attract net-new customers at the lower end of the market.

CONCLUSION

The movement to the cloud is inexorable. Already, a number of analytic workloads are running in the cloud using a range of data services. Although most enterprises acknowledge the cloud as the eventual target for most of their database workloads, we are still at an early stage of adoption, especially for the most demanding and mission-critical databases and applications. Most cloud-optimized DBMSs are good at doing particular jobs in specific areas of analytics or operational data management but few can deliver a combination of such functionality or handle the largest and most

critical databases and workloads. As enterprises consider their next move in this area, they need to look at technology that will support their operational and analytic database needs as they expand over time.

There are a variety of cloud database services available; some are offered by cloud platform vendors, and others are offered by third-party vendors. While cloud database services, regardless of vendor, run on generic hardware, Oracle Exadata Cloud Service X8M stands out as one that is built on a physical platform specifically designed to optimize the operation of Oracle Database. Oracle Exadata Cloud Service X8M also stands out for its support of both operational and analytic workloads as well as multiple data types and databases (JSON, spatial, graph, time series, etc.) on the same converged Oracle Database, with scalability and high performance across all functionalities. The speed and efficiency enhancements in this platform, including its use of RoCE for compute-to-storage node data transfers and its implementation of PMEM, serve as additional distinguishing characteristics.

The performance of Exadata Cloud Service X8M makes it practical not only for OLTP or data warehousing but for other workloads, including key value document databases, XML object databases, time series databases, AI and machine learning, graph/spatial databases, and in-memory analytics, as well as consolidation of mixed workloads. All of these database models are built into the Oracle Database.

Enterprises evaluating various options for their strategic data management needs in the cloud should consider doing the following:

- Take stock of all the databases of significance in the enterprise.
- Ask all stakeholders how important performance, scalability, and availability are for each Oracle Database.
- Estimate the cost and risk of managing all of them in the cloud, based on each of the non-Oracle cloud database services that might be under consideration.
- Convert the resulting information from the points mentioned previously into a total cost and risk assessment.
- Investigate the cost of consolidating Oracle Databases on the Oracle Exadata Cloud Service X8M.
- Compare the resulting cost and risk of running Oracle Databases on non-Oracle cloud database services to those of running Oracle Databases on Oracle Exadata Cloud Service X8M, taking into account the faster completion of processing tasks that equates to lower overall cloud usage costs as well as the reduced technical staff with the Oracle option.

The resulting cost-risk evaluations should favor the Oracle option, but even if they net out evenly, the simplicity of moving Oracle Databases to the Oracle Exadata Cloud Service X8M with no changes should motivate a plan for such a conversion.

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