ORACLE

Oracle Exadata Cloud Infrastructure X9M

Run the world's most advanced database services - Oracle Autonomous Database and Oracle Exadata Database Service - on the most powerful, available, and secure database cloud platform, with the simplicity, agility, and elasticity of a public cloud deployment.

EXADATA CLOUD INFRASTRUCTURE

Exadata Cloud Infrastructure is the premiere public cloud platform for Oracle databases, integrating the world's #1 database technology, Oracle Database, with the most powerful database platform, Exadata. It offers the same extreme performance and availability realized by thousands of organizations deploying Exadata on-premises. Full Oracle Database compatibility simplifies and reduces the risk of critical cloud migrations. With online server expansion and support for the largest workloads, Exadata Cloud Infrastructure helps maximize business agility and operational flexibility as workload requirements grow. The combination of cloud economics, powerful automation and infrastructure maintained by Oracle experts also lowers IT costs, eliminates most operational tasks, and frees personnel to focus on core business functions.

EXADATA CLOUD INFRASTRUCTURE X9M

Exadata Cloud Infrastructure X9M brings more CPU cores, increased storage, and a faster network fabric to the public cloud. Exadata X9M storage servers include Exadata RDMA Memory (XRMEM), creating an additional tier of storage, boosting overall system performance. Exadata X9M combines XRMEM with innovative RDMA algorithms that bypass the network and I/O stack, eliminating expensive CPU interrupts and context switches, reducing latency by 10x compared to the traditional network and I/O stack, from over 200μs to less than 19μs.

Exadata Cloud Infrastructure X9M increases the throughput of its 100 Gbps active-active Remote Direct Memory Access over Converged Ethernet (RoCE) internal network fabric, providing a faster interconnect than previous generations with extremely low-latency between all compute and storage servers. The servers now use PCIe4 to enable the full 200Gbps aggregate bandwidth of the active-active RoCE fabric.

THE BEST DATABASE ON THE BEST CLOUD PLATFORM

Oracle Exadata has been the industry leading database platform for over 10 years and has been established as the best performing, highest available, and most secure platform for deploying Oracle databases. Exadata was designed from the beginning as a cloud architecture featuring scale-out database servers and scale-out intelligent storage servers. It

delivers many smart hardware and software innovations for Oracle databases, distinguishing itself from other generic converged systems.

Oracle Exadata has been engineered to run Oracle Database, the world's most popular and most versatile database technology. With decades of technology innovation, Oracle Database has become the industry standard for mission-critical deployments. Oracle Database on Exadata delivers Online Transaction Processing (OLTP), Data Warehousing (DW), In-Memory Analytics, and Mixed/Hybrid workloads, making it the ideal database consolidation platform. Exadata is available on-premises, as a hybrid cloud with Exadata Cloud@Customer, and in the public cloud with Exadata Cloud Infrastructure.

EXADATA CLOUD INFRASTRUCTURE: THE BEST PUBLIC CLOUD DATABASE PLATFORM

Exadata Cloud Infrastructure combines enterprise-proven, robust database technology on the best database platform with a cloud-based consumption model. It includes all the Oracle Database and Exadata capabilities, including exceptional performance, availability, and security in the public cloud. Fully elastic expansion allows customers to provision the database compute and storage resources for any workload and provides the scale for any size database.

Customers have the option of running Autonomous Database, Exadata Database Service, or both on Exadata Cloud Infrastructure. Autonomous Database with machine-learning–driven automated tuning, scaling, and patching eliminates human labor and error, thereby reducing cost and complexity while ensuring higher reliability, security, and greater operational efficiency. Exadata Database Service is co-managed by Oracle and customers. Oracle manages the infrastructure while customers manage the operating systems and databases in virtual machines running on the system using cloud automation, giving customers more control over their operating environment.

Both Autonomous Database and Exadata Database Service on Exadata Cloud Infrastructure are deployed according to best practices that have been proven at thousands of mission-critical Exadata sites around the world. Infrastructure managed by Oracle experts eliminates much of the effort customers spend supporting these database services. When combined with built-in automation, this significantly reduces administration costs and risk, freeing IT to focus on higher business value tasks that improve overall efficiencies and business results. Customers see further savings through cloud economics and pay-per-use that aligns usage with cost and lowers total cost of ownership.

Exadata Hardware

Exadata Cloud Infrastructure is built with powerful database servers, scale-out intelligent storage servers, XRMEM, PCIe NVMe flash, and high-capacity disk drives. Internal connectivity between database and storage servers is enabled by a low-latency RoCE fabric. External connectivity to the Exadata Cloud Infrastructure system is provided using standard 50 Gigabit Ethernet.

The database-optimized data tiering between DRAM, XRMEM, flash and disk implemented in Exadata provides lower latency, higher capacity, and faster performance than other flash-based solutions. Flash storage arrays cannot match the throughput of Exadata's integrated and optimized architecture with full RoCE-based scale-out, high speed XRMEM, PCIe NVMe flash, offload of data intensive operations to storage, and algorithms that are specifically optimized for databases.

Exadata Cloud Infrastructure offers elastic infrastructure shapes to support workloads of different sizes. Customers can deploy flexible shapes that range from a Quarter Rack, 2 database and 3 storage servers, up to 32 database and 64 storage servers to meet a variety of CPU processing and storage requirements. It also supports database and storage server expansion post deployment as well as a Base System that provides a cost-effective Exadata entry point with a fixed, non-elastic shape that is hardware generation agnostic.

Exadata Cloud Infrastructure Key Benefits

- World's fastest OLTP and Analytics database cloud
- All Exadata capabilities - exceptional performance, availability, and security
- Fully elastic database and storage server expansion
- No workload or database too large
- Exadata infrastructure management by Oracle reduces effort and risk
- Choice of Autonomous Database and/or Exadata Database Service
- Compatible with on-premises databases
- Cloud UI and REST APIs simplify provisioning and lifecycle management
- Autonomous Database eliminates labor and error
- CapEx to OpEx cloud economics
- Pay-per-use aligns usage with costs and lowers TCO
- Choice of License-included or Bring Your Own License (BYOL)
- Database consolidation increases value

Elastic Compute

- 3rd Generation AMD EPYC™ Processors
- Up to 4,032 Database Server Cores
- Up to 44 TB of DDR4 DRAM

Scalable Storage

- Up to 3.1 PB Database Size (High Redundancy, Without Compression)
- Up to 1.6 PB PCI NVMe Flash
- Up to 96 TB Exadata RDMA Memory
- 3rd Generation Intel® Xeon® Scalable Processors
- Up to 3,072 Storage Server Cores

Fastest Networking

- 100 Gbps RoCE Internal Fabric
- 50 Gbps Ethernet shared for client and backup connections

Exadata Software

The technology that enables Exadata's unparalleled performance without any of the bottlenecks of traditional storage arrays is Exadata Storage Server software. This software powers the Exadata Storage Servers, providing an extremely efficient and database-optimized storage infrastructure. All Exadata Storage Server software features are included in Exadata Cloud Infrastructure.

One of the many unique features of Exadata Storage Server software is Smart Scan technology, which offloads data intensive SQL operations from the database servers directly into the storage servers. By pushing SQL processing to the storage servers, data filtering and processing for databases of any size occurs immediately and in parallel across all storage servers, as data is read from XRMEM, flash, and disk. Only the rows and columns that are directly relevant to a query are sent to the database servers. This greatly accelerates analytic queries, eliminates bottlenecks, and significantly reduces the CPU usage of the database servers.

AI Smart Scan, another Exadata unique feature, greatly accelerates AI Vector Search with optimizations that deliver extremely low-latency, high-throughput, and parallelized scans across massive volumes of vector data. AI vector data is processed at memory speed, leveraging XRMEM and flash in the storage servers, avoiding unnecessary network data transfer and database server processing.

In addition to Smart Scan, Exadata includes a vast array of software capabilities that enable its unparalleled scalability, performance and availability. Some of these Exadata software features are:

- Exadata RDMA Memory Data Accelerator uses RDMA to read data from XRMEM with unprecedented low latency

- Smart Flash Log Write-Back and Smart Flash Log eliminate storage disks as a potential log write throughput bottleneck and provide consistent log write latency

- Storage Indexes avoid unnecessary I/O operations by replacing them with a few in-memory lookups

- Exafusion Direct-to-Wire Protocol allows database processes to read and send Oracle RAC messages directly over the RoCE network, which considerably improves OLTP response time and scalability in Exadata

- Hybrid Columnar Compression utilizes a combination of row and columnar methods to greatly compress data, enabling tremendous cost-savings and performance improvements due to reduced storage capacity and reduced I/O, especially for analytic workloads

- In-Memory columnar formats in Flash Cache extend the Exadata Columnar Flash Cache by automatically transforming data into In-Memory columnar formats as it's loaded into flash cache. Smart Scans then leverage ultra-fast Single Instruction Multiple Data (SIMD) Vector instructions, thus processing multiple column values with a single instruction

Exadata Cloud Infrastructure systems can be used to deploy a large number of databases, enabling high database consolidation. To ensure consistent performance in a highly consolidated environment, Exadata provides unique end-to-end prioritization and resource management capabilities spanning database servers, network and storage.

Maximum Availability Architecture (MAA)

Exadata is engineered to provide the highest levels of availability with completely redundant hardware components. It has also been designed with Oracle Maximum Availability Architecture (MAA) in mind, a set of tiered best practices and blueprints for the use of Oracle's High Availability (HA) and Disaster Recovery (DR) technologies. These technologies include Real Application Clusters (Oracle RAC), ASM, RMAN, Flashback, Active Data Guard, and Application Continuity and optimize availability to meet the business continuity requirements of critical applications. Further, Exadata-specific HA capabilities such as Instant Detection of Database and Storage Server Failures and Exadata I/O Latency Capping, significantly enhance the availability of Exadata. Autonomous Database and Exadata Database Service are deployed with MAA best practices enabling customers to take immediate advantage of key HA and DR features including Oracle RAC and Autonomous or Active Data Guard.

Exadata Software

- Smart Scan
- Exadata RDMA Memory Data Accelerator
- Storage Indexes
- Data Mining Offload
- Hybrid Columnar Compression
- Smart Flash Cache
- Smart Flash Logging
- In-Memory Fault Tolerance
- I/O Resource Management
- Network Resource Management
- Instant Failure Detection
- Sub-second I/O Latency Capping
- Columnar Flash Cache
- JSON/XML Smart Scan
- Direct-to-Wire OLTP protocol
- Test/Dev Snapshots
- Fastest RAC Node Failure Recovery
- Fastest Data Guard Redo Apply

Related Products

- Oracle Autonomous Database
- Oracle Exadata Database Service
- Oracle Database Enterprise Edition
- Real Application Clusters
- Active Data Guard
- Multitenant
- Database In-Memory
- Partitioning
- Advanced Compression
- Advanced Security
- Real Application Testing
- Advanced Analytics
- Enterprise Manager
- Database Management Service

Multiple Virtual Machine Clusters

Database services run securely in Virtual Machine (VM) Clusters running on Exadata Cloud Infrastructure. Each Exadata Cloud Infrastructure system can run multiple VM Clusters to increase value through greater consolidation. They provide isolated operating environments for different database workloads through separate access rules and network configurations as well as customizable compute, memory, and storage resources. Each VM Cluster can run Autonomous Database or Exadata Database Service, which allows Autonomous Database to be deployed alongside Exadata Database Service on the same infrastructure, eliminating the need to deploy separate systems for these services. VM Clusters are easily provisioned through the Cloud Control Plane.

ORACLE CLOUD INFRASTRUCTURE

Exadata Cloud Infrastructure is available in Oracle's next-generation cloud, Oracle Cloud infrastructure (OCI). Built on the foundation of the most modern datacenter, network and server technology, Oracle Cloud Infrastructure services are architected from the ground up with a fundamentally different approach to Cloud platform deployment. The following Oracle Cloud Infrastructure features provide a set of unique benefits for Exadata Cloud Infrastructure around availability, performance and ease of cloud integration: Regions and Availability Domains, a modern network infrastructure, Virtual Cloud Network and high-performance compute infrastructure.

- Oracle Cloud Infrastructure services are deployed in Regions and Availability Domains. A region is a localized geographic area, and an Availability Domain is one or more data centers located within a region. Availability Domains are isolated from each other, fault tolerant, and very unlikely to fail simultaneously. All the Availability Domains in a region are connected to each other by a low latency, high bandwidth network.

- Oracle Cloud Infrastructure network infrastructure is comprised of a high performance, non-oversubscribed, flat physical network which provides the latency and throughput of rack adjacency across the network within an Availability Domain.

- Oracle Cloud Infrastructure provides a secure, private software-defined Virtual Cloud Network (VCN) that allows customers to treat OCI services as a secure and elastic extension of their on-premises network. Customers can configure their Exadata Cloud Infrastructure system in their preferred VCN with complete flexibility that includes assigning their own private IP address space, creating subnets, creating route tables and configuring stateful firewalls. Customers can configure the VCN with an optional Internet Gateway to handle public traffic, an optional Service Gateway to privately access Oracle services or an optional IPSec VPN connection to securely extend their on-premises network.

Figure 1: Oracle Cloud Infrastructure Virtual Cloud Network (VCN) Details

- Oracle Cloud Infrastructure services also offer fully dedicated bare metal and virtualized compute infrastructure instances with powerful processors, high memory, and latest generation NVMe SSDs, which provides unrivaled raw performance ideal to run CPU and I/O intensive applications. These applications connect to the databases deployed on Exadata Cloud Infrastructure over a secure, high speed network connection, delivering unparalleled performance for any enterprise-scale application deployment.

Oracle Cloud Infrastructure is currently available globally, and Oracle is rapidly building more regions with the goal to offer proximity and meet data residency requirements, as well as provide true disaster protection with multiple geographically distributed cloud regions in every country. Oracle Cloud serves commercial businesses and governments with distinct regions to meet specific compliance and tenancy requirements. Oracle also has unique hybrid cloud options, including Dedicated Region Cloud@Customer which offers all Oracle Cloud services in customer data centers. Exadata Cloud Infrastructure is available for deployment in commercial, government, and dedicated regions.

Oracle Database@Azure runs Exadata Database Service on Exadata Cloud Infrastructure located in Microsoft Azure regions. Applications in Azure benefit from low-latency, native access to Oracle databases running on Exadata, providing the highest levels of performance, scalability, and availability.

For more information on Oracle Cloud Infrastructure, visit www.oracle.com/cloud

CLOUD CONTROL PLANE

The Cloud Control Plane is a sophisticated software suite which runs in Oracle Cloud Infrastructure. Customers can connect to the Cloud Control Plane through a secure link using a web browser, command line interface (CLI), REST APIs, or language-specific SDKs.

The Cloud Control Plane includes integrated identity management which allows multiple departments or groups to share an Oracle Cloud Infrastructure tenancy. Compartments enable access control across resources and provide an effective mechanism to organize and control access to resources such as Exadata Cloud Infrastructure within a single tenancy.

The Cloud Control Plane is used to deploy Exadata Cloud Infrastructure and databases running on the system. It is also used to perform lifecycle operations such as provisioning, patching, backup, and configuring Data Guard. Policies can be used to grant fine-grain permissions within a single database for separation of duty. Another key function of the Cloud Control Plane is to track customer usage and bill only for what they use.

The Cloud Control Plane used by Exadata Cloud Infrastructure is the same as the one used in Exadata Cloud@Customer. This allows customers to have the same experience in both the public cloud and Exadata Cloud@Customer, using the same UX and REST APIs.

ENTERPRISE CLASS SECURITY

Oracle Exadata benefits from scrutiny by Oracle security experts and by hundreds of industry experts around the world. Exadata Cloud Infrastructure delivers Exadata as a service and is based on comprehensive security measures deployed in the hardware infrastructure, network, Exadata platform, and Oracle Database. The security features of Exadata Cloud Infrastructure segregate customer data access and Oracle Cloud Operations and secure data that enters, leaves, and resides on the system, authenticate access to the system, and validate Oracle provided software that runs on the system. Oracle Cloud automation further enhances security by enforcing strong passwords, encrypting data for all Oracle databases, and making it fast and easy for customers to keep databases updated with the latest security updates from Oracle.

Exadata Cloud Infrastructure security protects the physical servers and components that are the building blocks of the system. Infrastructure security features include:

- Vendor signed firmware on most hardware components from the vendor that supplied that component
- Hardware acceleration that delivers near-native encryption and decryption speed so that encryption can always be used for all Oracle Database data
- Infrastructure optimizations that uniquely move decryption processing to Exadata Storage Server infrastructure
- For Exadata Database Service, virtual machines to provide secure isolation between customer data and Oracle Cloud Operations
- For Autonomous Database, Oracle Database Vault is deployed in Operations Control mode to provide secure isolation between customer data and Oracle Cloud Operations

Customers have full control of the data in Oracle Database so it can only be accessed by users with explicit rights to access that data. Oracle Cloud Operations does not access customer data to carry out their duties of infrastructure support.

Exadata Cloud Infrastructure network security is implemented with isolated networks, and each network is equipped with additional security measures to secure critical data processing tasks. Network security features include:

- Internal RoCE network: RoCE Secure Fabric isolates and protects storage and Oracle RAC interconnect traffic
- Customer client network: Oracle Net Encryption secures application traffic to databases
- Customer backup network: Oracle Net Encryption secures traffic for high-bandwidth use cases such as backup, data loading, and disaster protection using Data Guard
- Customer controlled VCN mapped directly to the database VMs

Exadata Cloud Infrastructure platform security leverages virtual machine isolation. The operating system deployment for the Exadata Cloud Infrastructure platform includes:

- A minimal Linux distribution ensures that just the packages needed to run Oracle Database are installed and enabled
- Minimal open ports and running services that minimize attack surfaces
- Comprehensive logging and auditing that tracks access and modification

With Autonomous Database, customers have no access to the virtual machines running their databases. All service automation is performed through autonomous software operations. In contrast, with Exadata Database Service, customers have full root access to the virtual machines using Token-based SSH access, and they can add additional tools to implement their existing security best practices such as installing software agents, configuring the iptables firewall, and LDAP authentication.

Exadata Cloud Infrastructure also supports all enterprise security features of the Oracle Database. TDE encryption keys are stored in a password protected Oracle wallet in the customer's database VM by default, and customers can optionally configure Oracle Cloud Infrastructure Vault for key management. Data transmitted over the network is secured between the client application and the database using Oracle Native Network Encryption. Backups are encrypted in Oracle Cloud Infrastructure.

ORACLE CLOUD OPERATIONS

Oracle Cloud Operations manages, monitors, and maintains components for Exadata Cloud Infrastructure.

- Components managed include:
    - Exadata storage servers and physical database servers
    - Power distribution units (PDUs)
    - RoCE network and switches
    - Management switch
    - Control plane servers
    - Oracle KVM (hypervisor)
    - Exadata system software and all firmware

- Additional components managed for Autonomous Database only:
    - VM Clusters
    - Database homes
    - Grid Infrastructure
    - Operating systems

- Monitoring activities include:
    - Exadata Cloud Infrastructure layer incident monitoring, management, and root cause analysis
    - Threshold performance analysis

- Maintenance activities include:
    - Bug and security fixes inside hypervisor
    - Exadata System Software updates and upgrades
    - Firmware updates and upgrades to any of the hardware components including networking components and RoCE switches
    - Proactive infrastructure upgrades to update software and firmware as required

- Additional maintenance activities for Autonomous Database only:
    - Grid Infrastructure and Database updates
    - Operating system updates

INFRASTRUCTURE SERVICE AND SOFTWARE LICENSING MODELS

Infrastructure Service

Exadata Cloud Infrastructure is available as a pay-per-use service offering that requires a minimum term of 48 hours. Customers can choose to deploy customizable Exadata Cloud Infrastructure X9M shapes or an entry level Base System, which is not expandable. The X9M shapes start with 2 database and 3 storage servers and can be customized with additional database and storage servers to enable higher compute and storage capacity. All the disk/flash, IOPS and memory for the configuration chosen is dedicated to the customer and included in the price. There is no charge for network communication to the Exadata Cloud Infrastructure system. Detailed specifications for the typical Exadata Cloud Infrastructure X9M shapes as well as individual database and storage servers are provided in Table 1.

Software Licensing Models

Both Autonomous Database and Exadata Database Service offer two software licensing models:

- License Included
- Bring Your Own License (BYOL)

Autonomous Database software licensing is based on the number of compute cores (OCPUs) consumed by actively running Autonomous databases. As workload requirements change, Autonomous Database automatically scales compute cores online. Exadata Database Service software licensing is based on OCPUs allocated to a VM Cluster. Customers can scale compute cores online, thus paying only for the processing power they require.

License Included

This license model includes all the features of Oracle Database Enterprise Edition, plus all the Oracle Database Enterprise Manager Packs and all Oracle Database Enterprise Edition Options. These industry-leading capabilities include Database In-Memory, Real Application Clusters (Oracle RAC), Multitenant, Active Data Guard, Automatic Storage Management (ASM), Partitioning, Advanced Compression, Advanced Security, Database Vault, Real Application Testing, OLAP, Advanced Analytics and Spatial and Graph. This model is ideal for customers without existing Oracle Database licenses, or customers seeking to use Oracle Database features beyond what they are currently licensed to use.

Figure 2: Exadata Cloud with all Database and Exadata features

Bring Your Own License (BYOL)

Bring Your Own License (BYOL) is designed to minimize costs when migrating to the cloud. In a BYOL model, customers can deploy their existing Oracle Database Enterprise Edition and Database Option licenses on Exadata Cloud Infrastructure. Oracle Database Standard Edition is not supported on Exadata Cloud Infrastructure. When a customer brings an Oracle Database Enterprise Edition license entitlement to Exadata Cloud Infrastructure, they are granted the

rights to use Transparent Data Encryption (TDE), Diagnostics Pack, Tuning Pack, Data Masking and Subsetting Pack, and Real Application Testing without bringing license entitlements for those Database Options and Management Packs. The Exadata System software is also included with BYOL so customers do not have to bring a license entitlement for the Exadata System Software. For BYOL customers deploying Autonomous Database on Exadata Cloud Infrastructure, an Oracle RAC license is required if an Autonomous Database will be larger than 16 OCPUs, and if Autonomous Data Guard is deployed, an Active Data Guard license is also required.

EXADATA DATABASE SERVICE ON DEDICATED INFRASTRUCTURE

Exadata Database Service on Dedicated Infrastructure is a highly advanced yet flexible database service deployed on Exadata Cloud Infrastructure in the public cloud. It gives customers the flexibility to control many aspects of their database service, providing capabilities similar to those of their on-premises environments while facilitating the transition from on-premises to the cloud with no application changes. Powerful cloud automation enables customers to manage the system with minimal effort while still providing full access to the database instances, database homes, and Grid Infrastructure. Customers have root access to the virtual machines (VMs) in the Exadata database servers, as well as full DBA privileges for the databases they provision. Customers can configure the database VMs as they require and deploy additional agent software, such as backup and monitoring agents.

Lifecycle operations for Exadata Database Service on Dedicated Infrastructure are performed using the web browser UI or REST API-driven automation available through the Cloud Control Plane, including provisioning, updating, scaling, and backup. Customers can create and manage their database services by deploying multiple container databases and one or more pluggable databases within each container database. Operating system and database updates are applied by customers based on their preferred schedule. The underlying infrastructure for Exadata Cloud Infrastructure, including the database and storage servers, RoCE network, hypervisor, and Exadata System Software, is deployed, monitored, and managed by Oracle Cloud Operations. Customers can set a time preference that determines the infrastructure maintenance window. This flexibility improves customer productivity and reduces business risk by enabling customers to focus on their core business while scheduling infrastructure maintenance around critical business activities.

Customers can easily scale their OCPU resources as business conditions change. Flexible scaling avoids the costly practice of sizing for the highest possible peak workload, which is often required for on-premises systems. Use cases that leverage such dynamic OCPU scaling are workloads whose busy periods vary depending on the time of day, week, month, quarter, or year -for example, a retailer whose workload peaks during the holidays. Databases remain completely online while OCPUs are scaled in this manner.

Exadata Database Service on Dedicated Infrastructure enables database backups to Oracle Database Zero Data Loss Autonomous Recovery Service or Oracle Cloud Infrastructure Object Storage. Customers can also enable Data Guard through the Cloud Control Plane to protect mission-critical databases from unplanned failures or reduce downtime for planned maintenance activities.

"We migrated over 100 custom application environments and over 50 databases from a legacy data center to OCI with Exadata Database Service on Dedicated Infrastructure in half of the expected time for greater stability, security, and efficiency."

Bradley Mills
Head of Software Engineering
Talcott Resolution

"We are very satisfied with the Exadata servers in Oracle Cloud. They meet our requirements for data throughput, data volume, complexity, and response time."

Jochen Hinderberger
Director of IT Applications
Dialog Semiconductor

"We are extremely satisfied with Autonomous Data Warehouse and Oracle Analytics Cloud. We trust in Oracle as well as the capabilities of its solutions, which is why we chose Oracle Cloud."

Santosh Chandrasekaran
Financial and Operations IT Systems
Cognizant

AUTONOMOUS DATABASE ON DEDICATED EXADATA INFRASTRUCTURE

Autonomous Database is the simplest cloud database service for running any application, at any scale or criticality. It uses machine learning driven automation to eliminate human labor, human error, and manual tuning, thereby reducing deployment costs and administrative complexities while ensuring the highest reliability, security, and operational efficiency.

Autonomous Database on Dedicated Exadata Infrastructure provides customers governance controls and automated best practices for the overall health, availability, and cost management of Autonomous Database. Customers can

customize operational policies to meet their governance requirements and use a clean separation of roles between fleet administrators who setup operating environments and database consumers (developers and application DBAs) who self-service Autonomous databases in their assigned environments, without visibility into the underlying infrastructure. This separation of fleet administrator and database consumer allows simple budgeting controls and resource isolation without interfering with line of business execution.

Autonomous Database on Dedicated Exadata Infrastructure is highly secure, locking down many SYSDBA privileges and disallowing customer access to VMs hosting the database instances, which are wholly managed by Oracle Cloud Operations. Fleet administrators can configure one or more container databases in VMs, each of which can contain one or more Autonomous databases, configured for workloads such as transaction processing or data warehousing. Customers perform Autonomous Database lifecycle operations such as create, delete, clone, backup, restore, and audit as well as configure OCPU count and storage capacity using the Cloud Control Plane web browser UI or REST APIs. Oracle Cloud Operations is responsible for managing the maintenance updates for operating systems, databases, and Grid Infrastructure. Although customers can customize operational policies and the timing of updates, all operations are still fully automated by Oracle's cloud software.

Database backups for Autonomous databases are done automatically. In addition, customers can enable Autonomous Data Guard, which automates disaster recovery with capabilities such as Fast-Start Failover. Autonomous Database can also automatically scale compute cores online as workload requirements change, requiring no manual intervention, enabling customers to only pay for actual core usage.

With its end-to-end automation and with Oracle Cloud Operations assuming all maintenance and management responsibilities, Autonomous Database is the ideal cloud database service for cloud-native application development while also satisfying the availability, scalability, performance, and security demands of mission-critical enterprise workloads.

MIGRATION TO EXADATA CLOUD INFRASTRUCTURE

Full compatibility between on-premises databases and databases deployed on Exadata Cloud Infrastructure makes migration to Exadata Cloud Infrastructure simple and low risk. Review MyOracle Support Note 742060.1 - Release Schedule of Current Database Releases for the latest supportability status of Oracle databases for both Exadata Database Service on Dedicated Infrastructure and Autonomous Database on Dedicated Exadata Infrastructure.

Oracle recommends using Zero Downtime Migration as a best practice for moving your database workloads to Exadata Cloud Infrastructure. Oracle ZDM makes it easy to migrate online, and from Linux x86, AIX and Solaris platforms.

For more information on moving your databases to Oracle Cloud, visit www.oracle.com/goto/move

CONCLUSION: TRANSFORM IT, UNLEASH BUSINESS POTENTIAL

Exadata Cloud Infrastructure is the world's fastest OLTP and Analytics cloud database platform. Exadata in the public cloud features the most advanced database cloud services – Autonomous Database or Exadata Database Service – to offer the industry's most powerful, available, and secure database solutions.

With more compute, storage, and networking resources in the latest generation platform along with its extreme scale-out capability, customers can consolidate even more mixed database workloads on less infrastructure. Granular scalability of database and storage servers lowers infrastructure costs by enabling customers to properly size their hardware configuration to match their workload requirements. Customers also only pay for the processing power they require by elastically scaling compute cores online.

Enterprise-proven database capabilities are now instantly available to maximize productivity, lower risk and accelerate time-to-value. To embrace the Cloud, customers no longer have to compromise their SQL functionality, performance, availability, data models, or transactional integrity. No changes to on-premises applications are required either, enabling rapid and easy migration to the cloud, or deployment of a hybrid cloud strategy. Customers no longer have to dedicate limited IT talent to managing and maintaining infrastructure. Built-in automation simplifies database management and it is fully automated with Autonomous Database.

With a database platform uniquely engineered for extreme performance, along with fast deployment, simplified management, low operating costs and reduced risks, Exadata Cloud Infrastructure is the best public cloud database platform available.

For more information on Oracle Exadata Cloud Infrastructure, visit www.oracle.com/exadata

Table 1: EXADATA CLOUD INFRASTRUCTURE: Technical Specifications

Exadata Cloud Infrastructure Typical Hardware Configurations

Service item	Base System[1]	Quarter Rack X9M	Half Rack X9M	Full Rack X9M
Number of Database Servers	2	2	4	8
Number of Storage Servers	3	3	6	12
Total Usable Cores in DB Servers per System	48	252	504	1,008
Min # of DB Cores per VM	2	2	2	2
Total Memory Available for VMs (GB)	720	2,780	5,560	11,120
Max # of VMs per DB Server	1	8	8	8
Max # of VM Clusters per System	1	8	8	8
Max Usable Local Storage Per DB Server[2] (GB)	900	2,243	2,243	2,243
Max Usable Local Storage Per VM[2] (GB)	900	900	900	900
VM Image Size Minimum and Default[2] (GB)	244	244	244	244
Total Cores in Storage Servers	144	144	288	576
Total XRMEM Capacity[3] (TB)	0	4.5	9.0	18.0
Total Flash Capacity (TB)	38.4	76.8	153.6	307.2
Total Usable Disk Capacity[4] (TB)	73	190	381	763
Max DB Size – No Local Backup[4] (TB)	58	152	305	610
Max DB Size – Local Backup[4] (TB)	29	76	152	305
Max SQL Flash Bandwidth[5] (GB/s)	25	135	270	540
Max SQL Read IOPS[3,6]	562,500	5,600,000	11,200,000	22,400,000
Max SQL Write IOPS[7]	518,000	1,842,000	3,684,000	7,368,000
Max SQL Disk Bandwidth[5] (GB/s)	2.7	5.4	10.8	21.5
Max SQL Disk IOPS[6]	3,900	7,800	15,600	31,000
Max Data Load Rate[8] (TB/hr)	3.8	7.5	15.0	30.0
Network Connectivity (GbE)	10	50	50	50

Exadata Cloud Infrastructure: Elastic Server Expansion[9,10]

Server Type	Total Usable Cores	Total Memory Available (GB)
X9M Database Server (32 Maximum)	126	1,390

Server Type	Total Cores	XRMEM Capacity (TB)	Total Flash Capacity (TB)	Total Usable Disk Capacity (TB)[4]
X9M Storage Server (64 Maximum)	48	1.5	25.6	63.6

Exadata Cloud Infrastructure: Individual Server Performance Metrics

Server Type	Maximum SQL Flash Bandwidth (GB/s)[5]	Maximum SQL Read IOPS[3,6]	Maximum SQL Write IOPS[7]
X9M Database Server	n/a	2,800,000	1,500,000
X9M Storage Server	45	2,300,000	614,000

[1] Base System is hardware generation agnostic and is not expandable. It only supports a single VM Cluster.

[2] The maximum usable local storage per database server is 2,243 GB. Each VM requires a VM image size minimum and default that includes 60GB for /u02. The file system used for Oracle homes can be up to 900 GB per VM. The maximum size may be less than 900 GB as it is limited by the amount of local storage used by file systems of all VMs.

[3] Exadata RDMA Memory (XRMEM) in Exadata Cloud Infrastructure X9M is implemented using Persistent Memory (PMem) and is included with Quarter Rack, Half Rack, Full Rack, and Elastic configurations. It is not supported with Base System.

[4] Usable capacity is measured using normal powers of 2 space terminology with 1 TB = 1024 * 1024 * 1024 * 1024 bytes. It is the actual space available to create a database after taking into account space needed for ASM high redundancy and recovering from a drive failure, but before database compression.

[5] Bandwidth is peak physical scan bandwidth achieved running SQL, assuming no database compression. Effective user data bandwidth is higher when database compression is used.

[6] Based on 8K I/O requests running SQL.

[7] Based on 8K I/O requests running SQL. Flash write I/Os measured at the storage servers after ASM mirroring, which issues multiple storage I/Os to maintain redundancy.

[8] Load rates are typically limited by database server CPU, not I/O. Rates vary based on load method, indexes, data types, compression and partitioning.

[9] Elastic infrastructure shapes range from a Quarter Rack, 2 database and 3 storage servers, up to a total of 32 database and 64 storage servers to achieve the exact ratio of compute to storage required, or to create the typical Half Rack and Full Rack configurations.

[10] Exadata Database Service supports scaling the number of database server VMs in an existing VM Cluster. Autonomous Database does not support scaling the number of database server VMs in an existing Autonomous VM Cluster.

Additional Notes on Technical Specifications:

1) Refer to the product documentation for the latest information on product features.

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