Oracle Database Exadata Cloud Machine

Exadata Performance, with Cloud Simplicity

ORACLE
DATABASE
CLOUD SERVICE

Oracle Database Exadata Cloud Machine delivers the world's most advanced database cloud to customers who require their databases to be located on-premises.

Exadata Cloud Machine uniquely combines the world's #1 database technology and Exadata, the most powerful database platform, with the simplicity, agility and elasticity of a cloud-based deployment. It is identical to Oracle's Exadata public cloud service, but located in customers' own data centers and managed by Oracle Cloud Experts, thus enabling a consistent Exadata cloud experience for customers – whether on-premises or in Oracle public cloud data centers.

Every Oracle Database and Exadata feature and option is included with the Exadata Cloud Machine subscription, ensuring highest performance, best availability, most effective security and simplest management. Databases deployed on Exadata Cloud Machine are 100% compatible with existing on-premises databases, or databases that are deployed in Oracle's public cloud.

Exadata Cloud Machine is ideal for customers desiring cloud benefits but who cannot move their databases to the public cloud due to sovereignty laws, industry regulations, corporate policies, or organizations that find it impractical to move databases away from other tightly coupled on-premises IT infrastructure.

The Best Database on the Best Cloud Platform

Oracle Database Exadata Cloud Machine can consolidate all database workloads including Online Transaction Processing (OLTP), Data Warehousing (DW), In-Memory Analytics, and Mixed/Hybrid Workloads into a single Exadata system and deliver extreme performance, mission critical availability, and highest security.

Best Database Technology

Oracle Database is the most popular and most versatile database technology for both OLTP and Analytics. With decades of technology innovation, it has been proven at hundreds of thousands of mission-critical deployments around the world. Exadata Cloud

ORACLE

Machine makes this enterprise-proven, robust database technology available in a cloud-based consumption model, at the customers' data centers behind their firewalls. All of Oracle's industry-leading capabilities are included with Exadata Cloud Machine, such as Database In-Memory, Real Application Clusters (RAC), Active Data Guard, Automatic Storage Management (ASM), Partitioning, Advanced Compression, Advanced Security, Database Vault, Real Application Testing, OLAP, Advanced Analytics and Spatial and Graph. Also included is Oracle Multitenant, enabling high consolidation density, rapid provisioning and cloning, efficient patching and upgrades, and significantly simplified database management.

KEY BUSINESS BENEFITS

Exadata Cloud Machine combines the world's #1 database with Exadata, the most powerful database platform, controlled by Oracle Cloud software, and managed on-premises by Oracle Cloud experts.

- Cloud simplicity with on-premises deployment
- Faster time-to-market with web based database provisioning
- Pay-as-you-go subscription-based pricing
- Dynamic Compute Bursting lowers total costs
- Easily migrate existing databases with no application changes
- Reduced IT administration
- Fast local network connectivity delivers better response times than Public Clouds
- On-premises deployment eliminates compliance and data sovereignty issues
- Proven mission-critical database and platform
- Extreme performance for OLTP, Analytics, Hybrid, and Consolidation workloads
- Focus staff on improving business, not operating infrastructure

Most Powerful Database Platform

The platform that delivers Exadata Cloud is Oracle Exadata, which has been established as the highest performing, most cost effective and highest available platform for running Oracle Database. Exadata was designed from the beginning as a cloud architecture featuring scale-out database servers and scale-out intelligent storage servers connected by an ultra-fast InfiniBand network. Exadata includes state-of-the-art PCI flash storage to deliver the highest throughput and best response times along with high capacity disks and database-optimized compression to provide cost effective capacity for the largest databases.

Unique software algorithms in Exadata bring database intelligence to storage, PCI flash, and InfiniBand networking for higher performance and capacity at lower costs than other platforms. Deployed at thousands of sites around the world, Exadata delivers extreme performance for all types of database workloads including Online Transaction Processing (OLTP), Data Warehousing (DW), In-Memory Analytics and mixed workloads.

For additional information on Exadata, please visit http://www.oracle.com/exadata.

Best Cloud Offering for an Enterprise Database

On top of the rock-solid Oracle Database and Exadata platform, Exadata Cloud Machine adds the ease, simplicity and flexibility of the software that powers the Oracle Public Cloud. Organizations can now access Oracle Database on Oracle Exadata on a simple consumption/subscription model in their own data centers behind their firewall. Oracle experts manage the Exadata infrastructure on behalf of customers, which means human resources and IT administration costs are significantly reduced, and IT can focus on improving business results. Full Oracle Database functionality with Exadata Cloud Machine ensures that any existing application can be quickly migrated to a cloud model without changes. Provisioning and expanding the database service deployed on the Exadata Cloud Machine is driven through simple web interfaces, providing customers rapid elasticity to meet changing business demands.

Customer Benefits

Databases deployed on the Exadata Cloud Machine are 100% compatible with on-premises Oracle databases and existing applications. With Exadata Cloud Machine, organizations can easily embark on a cloud strategy and immediately leverage cloud computing benefits without going through a complex lift and shift to the public cloud. There are four distinct customer profiles that immediately benefit from Exadata Cloud Machine:

- Customers who are subject to data regulatory, data sovereignty and data residency laws or policies that require their data to be stored within a corporate entity or a political territory, and not in a public cloud data center.
- Customers whose applications require the throughput or latency of a local LAN rather than a WAN.
- Customers whose databases are tightly-coupled with existing applications and infrastructure and are not ready to move these applications to the public cloud.
- Customers that want the agility, simplicity, elasticity, and subscription based payment benefits of a database cloud, but are not ready to move their database to a public cloud.

Exadata: The Best Database Platform

Exadata Hardware

EXADATA HARDWARE

- Fastest Networking
  - 40Gbps InfiniBand Networking
- Fastest Storage
  - Ultra-fast NVMe Flash
  - Up to 257GB/sec Throughput
  - Up to 3.6 Million 8K I/Os per sec
  - ¼ millisecond response time
- Fastest Compute
  - Fastest x86 Processors
- Large Memory Capacity
  - 720 GB per Database Server
- Complete Redundancy

Exadata Cloud Machine utilizes powerful database servers, each with two 22-core x86 processors and 720 GB of memory. Exadata also utilizes scale-out, intelligent storage servers, each of which has two 10-core x86 processors, four PCI Flash cards (each with 3.2 TB raw capacity), and twelve 7,200 RPM disks (each with 8 TB raw capacity). Internal connectivity between database and storage servers is enabled by a low-latency 40 Gbps InfiniBand fabric. External connectivity to the Exadata Cloud Machine is provided using standard 10 Gigabit Ethernet.

Exadata Cloud Machine uses state-of-the-art 3D V-NAND flash technology for improved speed, power efficiency, and endurance compared to previous generations of Flash. The flash devices are placed directly on the high speed PCI bus rather than behind slow disk controllers and directors. Exadata flash uses the latest NVMe (Non-Volatile Memory Express) flash protocol to achieve extremely low latency and CPU overhead.

The database-optimized data tiering between RAM, flash and disk implemented in Exadata provides both higher capacity and faster performance than other flash-based solutions. Flash-only storage arrays cannot match the throughput of Exadata's integrated and optimized architecture with full InfiniBand based scale-out, fast PCI flash, offload of data intensive operations to storage, and algorithms that are specifically optimized for databases.

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 database-optimized storage 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 occur immediately and in parallel across all storage servers, as data is read from disk and flash. 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.

EXADATA SOFTWARE

All Exadata Software features, such as:

- Smart Scan
- 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
- Fastest Backup using Offload to Storage

Exadata includes a vast array of software capabilities that enables its unparalleled scalability, performance and availability. Some of these Exadata software features are:

- *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 InfiniBand network, which considerably improves OLTP response time and scalability in Exadata.
- *Smart Fusion Block Transfer* improves OLTP performance further by eliminating the impact of redo log write latency when moving blocks between nodes.
- *Smart Flash Logging* accelerates OLTP by using the flash memory in Exadata storage combined with the high speed RAM memory in the Exadata disk controllers to reduce the average latency of database commits.
- *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.

Exadata is engineered to provide the highest levels of availability. Each Exadata Cloud Machine has completely redundant hardware. In addition, Exadata Cloud Machine comes pre-integrated with Oracle Maximum Availability Architecture (MAA) best practices for Database High Availability (HA) technologies such as RAC, ASM, RMAN, Flashback and Data Guard. Further, Exadata-specific HA capabilities such as *Instant Detection of Compute and Storage Server Failures* and *Exadata I/O Latency Capping*, significantly enhance the availability of Exadata.

One single rack of Exadata Cloud Machine can be used to deploy a large number of databases, enabling massive 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 to network and storage. Space-efficient database snapshots can be quickly created for test and development purposes directly on Exadata. Exadata database snapshots are integrated with Oracle Multitenant to provide an extremely simple interface for creating new pluggable database snapshots.

Exadata Cloud Machine

Exadata Cloud Machine enables full-featured Oracle databases to run on the Exadata platform in customers' data centers, orchestrated by Oracle's cloud software, with infrastructure managed by Oracle's cloud experts. Exadata Cloud Machine instances come pre-configured according to best-practices that have been proven at thousands of mission critical Exadata sites around the world.

Service Overview

Exadata Cloud Machine is available through a subscription offering that requires a minimum term of 4 years. Databases provisioned include all the features of Oracle Database Enterprise Edition, plus all Oracle Enterprise Manager Packs and all Database Enterprise Edition Options. Customers can choose to deploy Oracle Database 11g Release 2 (11.2.0.4), Oracle Database 12c Release 1 (12.1.0.2), Oracle Database 12c Release 2 (12.2.0.1), or a combination of these. As shown in Fig. 1, Exadata Cloud Machine also includes all capabilities of the underlying Exadata platform.

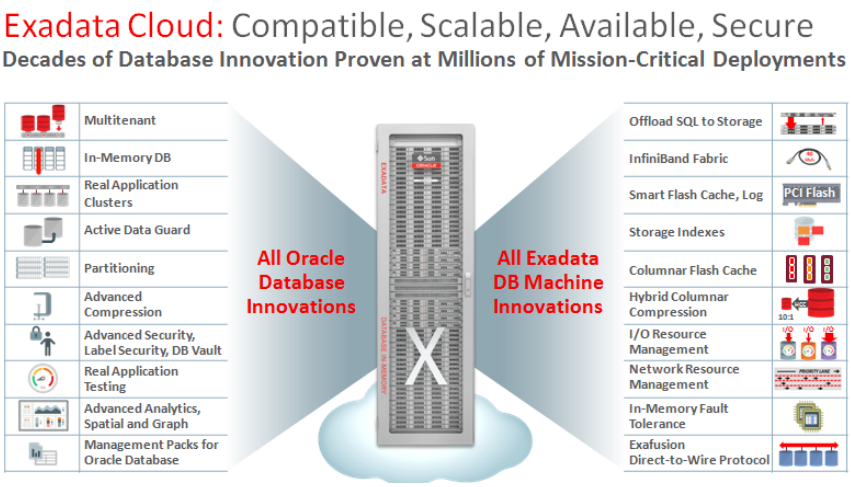

Figure 1: Exadata Cloud Machine with all Database and Exadata features

KEY FEATURES

- Most powerful Oracle Database with all options, features, and Enterprise Manager Database Packs
- All Exadata capabilities, ensuring extremely high levels of performance, availability and security
- Easy and rapid database provisioning in a few clicks
- Cloud automation software reduces administration
- Subscribe to only the compute cores needed by the application
- Online Compute Bursting allows elastic expansion during business peaks
- 100% compatibility with on-premises and Oracle Public Cloud databases
- Comprehensive database management through Oracle Enterprise Manager, as well as Cloud-based self-service
- Exadata infrastructure management and monitoring by Oracle Cloud Operations
- Low-latency connectivity with existing data center infrastructure and applications

Customers connect to the configured database from their applications using standard Oracle Net Services clients such as JDBC and OCI. Customers have full administrative privileges within the Virtual Machines running on the Database Servers of the Exadata Cloud Machine, while Oracle has administrative privileges over the underlying infrastructure such as the Exadata Storage Servers and InfiniBand switches.

Customers choose an Exadata configuration starting with an Eighth Rack which has 2 database servers and 3 storage servers. The database servers have a minimum and maximum number of compute cores (OCPUs) that can be enabled for the chosen configuration, and customers can specify their desired number of compute cores within these limits. Pricing is based on the number of enabled compute cores, and as business grows, customers can enable additional compute cores completely online, thus paying only for the processing power that they require. All the disk/flash storage, IOPs and memory for the configuration chosen is included in the subscription price. There is no charge for network communication to the Exadata Cloud Machine.

Customers with additional resource requirements may choose larger Exadata configurations, such as the Quarter, Half and Full Racks, enabling higher compute, network and storage capacity. Detailed specifications for each Exadata Cloud Machine configuration are provided in Table 1.

Online Compute Bursting

Exadata Cloud Machine features infrastructure that is dedicated to each customer, to ensure that response times and throughput are predictable for critical business processes. In addition, Exadata Cloud Machine also allows Compute Bursting, enabling customers to grow, and then later shrink, their database server CPU capacity over their base subscription level to meet their peak or seasonal demands. With this feature, customers can add database server OCPUs to achieve a total processor capacity up to double their base subscription level. Adjustments can be made completely online as frequently as the customer wants. The incremental processor capacity used in Compute

ORACLE DATABASE

- Oracle Database 12.2.0.1, 12.1.0.2, or 11.2.0.4
- All Oracle Database Options:
  - Active Data Guard
  - Advanced Analytics
  - Advanced Compression
  - Advanced Security
  - Database In-Memory
  - Database Vault
  - Label Security
  - Multitenant
  - On-Line Analytical Processing
  - Partitioning
  - RAC One Node
  - Real Application Clusters
  - Real Application Testing
  - Spatial and Graph
  - TimesTen Application-Tier Database Cache
- All Oracle Database Enterprise Manager Packs
  - Cloud Management Pack for Oracle Database
  - Data Masking and Subsetting Pack
  - Database Lifecycle Management Pack for Oracle Database
  - Diagnostics Pack
  - Tuning Pack

WORKLOADS

- Any combination or mix of OLTP, Data Warehousing, Reporting, OLAP, In-Memory Analytics, Spatial, Graph, JSON, XML, Objects, Large Objects
- Consolidate many physical databases or pluggable databases
- Deploy primary databases in Exadata Cloud Machine with Disaster Recovery standby databases in Exadata Cloud Service
- Full ACID compliance (Atomicity, Consistency, Isolation, Durability) greatly simplifies application development and ensures data correctness

Bursting is billed at the hourly Metered rate for peak usage within that hour.

Compute Bursting provides Exadata Cloud Machine customers with the best of both worlds: subscription pricing for their normal needs, plus the flexibility to rapidly adjust processor capacity as business conditions change. This avoids the costly practice of sizing for the highest possible peak workload, which is often required for on-premises systems and reserved cloud capacity on other cloud providers.

Administration

Customers have complete access to all Oracle Database and OS features to ensure smooth and simple migration from on-premises Oracle deployments to Exadata Cloud Machine. Each Exadata Cloud Machine instance is configured such that there is a single Virtual Machine (VM), called the domU, which is owned by the customer, in each database server of the Exadata system. Customers have root privileges for the Exadata database server domU and DBA privileges on the Oracle databases. Customers can configure the system as they like, and load additional agent software on the Exadata database servers to conform to business standards or security monitoring requirements.

Customers perform familiar database administration and OS administration tasks aided by cloud automation for backup, patching, and upgrades. Database and OS updates are initiated by customers on their preferred schedule. Underlying infrastructure for Exadata Cloud Machine is deployed, maintained and managed by Oracle Cloud experts, including Exadata InfiniBand network, physical Exadata Database and Storage servers, firmware, Dom0 and Exadata Storage Server Software. Data center power, space, cooling and networking is provided by the customer. This allows customers to focus on business application requirements, and not on database infrastructure management.

Cloud Control Plane through Oracle Cloud Machine

A subscription to the Exadata Cloud Machine also requires a separate subscription to the Oracle Cloud Machine (OCM), with OCM Model 288 being the minimal requirement. OCM is required to deploy the Oracle Cloud Control Plane, which is a sophisticated software suite that collectively brings the cloud experience to customers. It includes cloud infrastructure components that perform order management, subscription/billing/capacity management, account and identity management, REST services, and compute/storage/virtual networking management for multiple Cloud Machines. It also provides a consistent user interface portal for self-service of multiple cloud services deployed on OCM and Exadata Cloud Machine.

OCM can also be used as an Infrastructure as a Service (IaaS) platform in the customer data center. Besides, it offers optional services such as Java Cloud Service, Integration Cloud Service, and general purpose Database Cloud Service. These OCM services can be used by the customer to deploy application-specific Oracle Cloud Services, which subsequently connect into the databases deployed on the Exadata Cloud Machine.

Remote Monitoring through Oracle Advanced Support Gateway

Another essential component of the Exadata Cloud Machine configuration is the Oracle Advanced Support Gateway. The Oracle Advanced Support Gateway, which is part of Oracle Advanced Support Platform, has been used for a number of years to facilitate numerous Oracle Support Services at leading customer sites around the world.

The Gateway also acts as the central conduit to facilitate remote monitoring and

management of Exadata Cloud Machines. The Gateway platform is a software appliance, based on the Oracle Linux operating system and hosts a full stack of Oracle software, including Automated Service Request (ASR), Oracle Enterprise Manager, Oracle Configuration Manager (OCM), patch management (such as YUM services), and a suite of Java applications. Together, these applications aggregate and route telemetry messages from the Exadata Cloud Machine environment to the Oracle Support Services infrastructure. The Gateway provides remote access for Oracle engineers to access the Exadata Cloud Machine and Oracle Cloud Machine infrastructure to carry out required monitoring and management.

The Gateway is typically located in the customer data center DMZ behind a firewall, with network access to the Exadata Cloud Machines it is monitoring. It is not directly exposed to the Internet, but it should be continuously accessible from Oracle Cloud Operations infrastructure, using a TLS/VPN tunnel.

Deployment and Configuration

The following diagram shows a typical configuration of Exadata Cloud Machine, along with the Oracle Cloud Machine deployed with the Oracle Cloud Control Plane, the Oracle Advanced Support Gateway and Oracle Cloud Operations infrastructure.

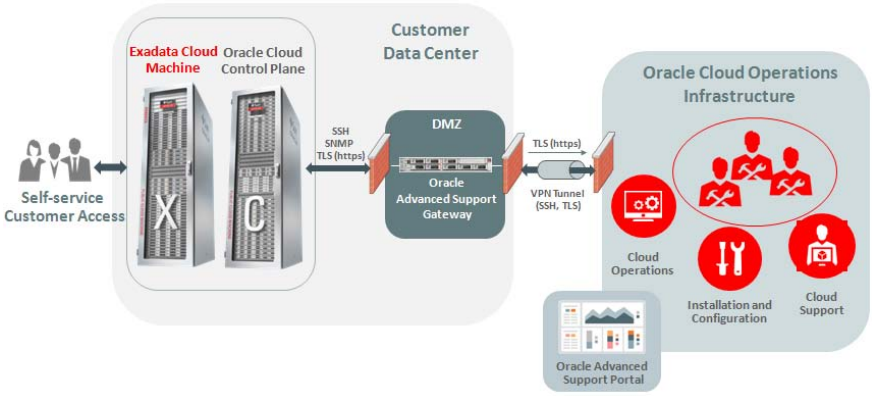

Figure 2: Typical Deployment of Exadata Cloud Machine

Oracle Cloud Operations

All hardware and software infrastructure associated with Exadata Cloud Machines is managed and maintained by Oracle Cloud Operations, powered by Oracle Advanced Customer Support (ACS). This is done via the Oracle Advanced Support Platform, which includes:

- Automation tools to deliver Oracle Advanced Support Service
- Oracle Advanced Support Gateway
- Oracle Cloud Operations delivery teams

Infrastructure management of the Exadata Cloud Machine consists of managing the following components:

- Exadata Database Servers

- Exadata Storage Servers
- Power Distribution Units (PDUs)
- InfiniBand Network and Switches
- Management Switch
- Oracle VM (Hypervisor)
- Exadata Storage Server Software and all firmware

With Oracle Cloud Operations managing the infrastructure and support for the Exadata Cloud Machine, customers are empowered to focus on application and business logic necessary for the core business. This in turn enables customers to accelerate time to market, increase availability, and reduce business risk.

This also brings ACS' global business and technical expertise directly to customer data centers. For more than 10 years, ACS has been helping 4000+ global customers drive rapid return on their Oracle investment through an outstanding global capability and local service affinity. ACS has 3000+ delivery professionals, with an average of 15 years Oracle experience, providing 24 x 7 monitoring and management to more than 100,000 targets. ACS utilizes ISO 27001:2013 and SSAE16/SOC 1 Type II compliant global competence centers to deliver such outstanding service.

For further details on ACS, please refer to https://www.oracle.com/support/advanced-customer-support/index.html.

Cloud Operations Service Included with Exadata Cloud Machine Subscription

A suite of Cloud Operations Services is available to customers as part of subscribing to Exadata Cloud Machine. All of these services are delivered by Oracle Cloud Operations. Some of the key services offered are:

- Pre-installation Services
  - orientation session
  - datacenter site survey
  - physical site readiness
  - analysis of customer network configuration requirements
  - maintenance window identification
- Installation and Configuration Services
  - installation of Oracle Cloud Machine / Oracle Advanced Support Gateway / Exadata Cloud Machine
  - connecting to necessary data center networks and firewalls
  - required configuration of the Exadata Cloud Machine
  - validation of the configuration
  - creation of one customer domain (domU) in each database server of the Exadata Cloud Machine
- Monitoring
  - Exadata Cloud Machine infrastructure layer incident monitoring / management / root cause analysis
  - threshold performance analysis
- Change Management for Exadata Cloud Machine / Oracle Cloud Machine / Advanced Support Gateway
  - regular infrastructure update & upgrade planning / scheduling / implementing
  - bug and security fixes inside Dom0

- Exadata Storage Software updates/upgrades
- firmware updates/upgrades to any of the hardware components including networking components and InfiniBand switches
- proactive infrastructure upgrades to make infrastructure software consistent with Oracle Public Cloud
- staging of Database / Grid Infrastructure updates for subsequent deployment by customers

Access and Security

Exadata Cloud Machine provides secure high-performance access from existing on-premises systems. To ensure consistent high-performance and isolation, multiple separate physical networks are provided on each Database Server.

- The Client Network provides 10Gbps connectivity for applications to send and receive data to and from databases.
- The Administration Network provides a separate physical network for customer administrators and Oracle Enterprise Manager.
- The Backup Network provides 10Gbps connectivity for high-bandwidth use cases such as backup, data loading, and disaster protection using Data Guard.

A secure isolated Cloud Infrastructure Management network is used by the Oracle Gateway to manage the servers, storage and switches. This network is not accessible to customers.

InfiniBand is used internally for ultra-high-speed networking between database servers and between database and storage servers. InfiniBand security is enforced using InfiniBand partitioning, which provides network isolation on the InfiniBand network. Since customer databases run in a VM container on Exadata database servers, they are isolated from the underlying hardware resources. An additional layer of at-rest data protection is provided by ensuring that all databases created on the Exadata Cloud Machine are encrypted with Tablespace Encryption, using the Transparent Data Encryption (TDE) capability of the Oracle Database.

Provisioning

Exadata Cloud Machine includes a simple easy-to-use web-based provisioning interface through which customers can quickly provision their chosen Exadata system and subsequently their database instances.

Upon subscribing to Exadata Cloud Machine, following deployment steps are carried out by Oracle Cloud Operations working with designated customer IT staff members:

- Deploying Oracle Advanced Support Gateway
- Deploying Oracle Cloud Machine (OCM) including Oracle Cloud Control Plane components
- Connecting the Gateway to the OCM
- Capturing required network/IP Address information, and executing Oracle Exadata Deployment Assistant (OEDA) to generate necessary configuration files
- Deploying Exadata Cloud Machine – this involves connecting Exadata Cloud Machine to customer data center network as well as to the OCM and the Gateway
- Provisioning Exadata Cloud Machine instance from the Oracle Cloud Control Plane

Once an Exadata system is provisioned, the designated customer account administrator gets notified that the system is available for database creation. Customers now can create their databases in a very simple manner through a web-based wizard. One of the early steps in this process is choosing the desired database version and additional attributes such as the database administration security credentials and backup & recovery parameters, such as shown below:

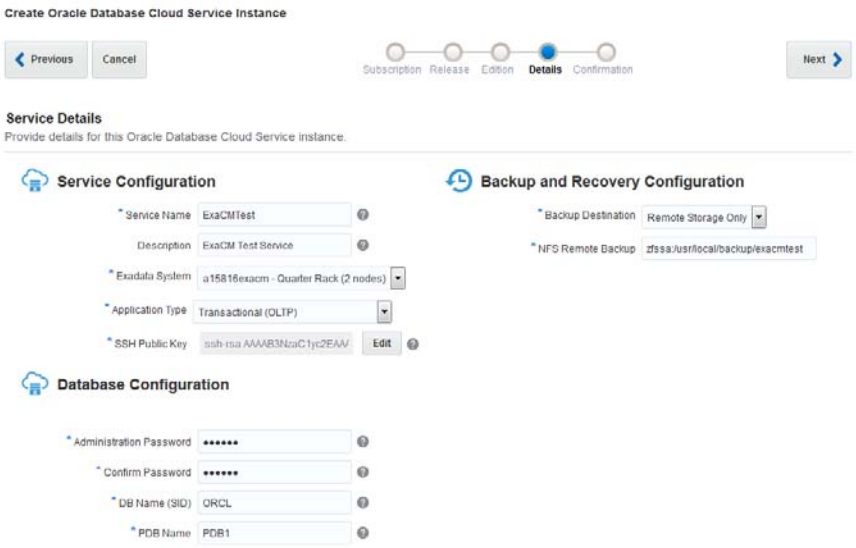

Figure 3: Self-service Database Cloud Service creation with Exadata Cloud Machine

After all of the required attributes are specified, customers can initiate the automated database creation process. Once the database is created, customers are presented with a summary of the system configuration, IP addresses as well as database connection strings, indicating that the database is available for data load and application access:

Backup & Recovery

Exadata Cloud Machine provides automatic built-in database backup facilities, with weekly full backups and daily incremental backups. The preferred backup destinations are the Oracle Zero Data Loss Recovery Appliance or the Oracle Database Backup Cloud Service, but there are many other options. At the time of service provisioning, customers can choose for backups to be stored on a customer-provided NFS server such as Oracle ZFS Backup Appliance, or local disk backups on the Fast Recovery Area (FRA) provisioned directly on the Exadata system:

Customers can also provision database backups to leverage their existing data center backup and recovery infrastructure such as third party backup appliances or tape drives.

Migration to Exadata Cloud Machine

Full compatibility between on-premises databases and databases deployed on Exadata Cloud Machine makes migration to Exadata Cloud Machine easy and low risk. Two types of migration methodologies, which leverage established Oracle Database best practices, are supported:

- Logical Migration – this methodology allows data reorganization as part of migration. Database solutions that can be used for this purpose are Oracle Data Pump and Oracle GoldenGate.
- Physical Migration – this methodology, which is a byte-to-byte copy of the data, offers the simplest way to migrate databases. Solutions that can be used for this purpose are RMAN backup, Transportable technologies, and Data Guard.

Scaling Exadata Cloud Machine

With Exadata Cloud Machine, customers can easily scale their business by expanding their allocated infrastructure. This can be done in two ways:

- Scaling up within an allocated Exadata system enables customers to add, or remove, compute node processing power within the existing Exadata system. Online Compute Bursting is one example of this kind of scaling.
- Scaling up to a different Exadata system enables customers to upgrade their allocated Exadata configuration to the next higher configuration, for example, from a Quarter Rack to a Half Rack. This is done when the required processing power, storage capacity or bandwidth exceeds the amount that is available within the current configuration.

Conclusion: Transform IT, Unleash Business Potential

Oracle Database Exadata Cloud Machine features the most versatile and functional database technology – Oracle Database, on the most powerful platform – Exadata, with the simplicity and cost effectiveness of Oracle Cloud software deployed in customer premises.

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. Finally, with Exadata Cloud Machine, organizations no longer have to dedicate limited IT talent to managing and maintaining infrastructure. Instead they can adopt a cloud strategy on their own terms, and leverage the cloud innovation benefits much more expeditiously.

With a database platform uniquely engineered for extreme performance, along with fast deployment, simplified management, low operating costs and reduced risks, Exadata Cloud Machine is the best cloud database platform available today for deployment in customer data centers.

Table 1. EXADATA CLOUD MACHINE X6-2: Technical Specifications

	Eighth Rack	Quarter Rack	Half Rack	Full Rack
Number of Database Servers	2	2	4	8
Number of OCPUs	16 – 68	22 – 84	44 – 168	88 – 336
Total Memory	480 GB	1,440 GB	2,880 GB	5,760 GB
Number of Storage Servers	3	3	6	12
Total Flash Capacity	19.2 TB	38.4 TB	76.8 TB	153.6 TB
Total Usable Disk Capacity[1]	42.7 TB	85.4 TB	170.9 TB	341.7 TB
Max DB Size (local backup)	17.1 TB	34.2 TB	68.4 TB	136.7 TB
Max DB Size (no local backup)	34.2 TB	68.3 TB	136.7 TB	273.4 TB
Max SQL Flash Bandwidth[2]	32 GB/sec	64 GB/sec	129 GB/sec	257 GB/sec
Max SQL Flash Read IOPs[3]	450 K	900 K	1.8 M	3.6 M
Max SQL Flash Write IOPs[4]	250 K	500 K	1 M	2 M
Max SQL Disk Bandwidth[2]	2.7 GB/sec	5.4 GB/sec	11.0 GB/sec	21.5 GB/sec
Max SQL Disk IOPs[3]	3,900	7,800	16,000	31,000
Max Data Load Rate[5]	2.5 TB/hr	5.0 TB/hr	10.0 TB/hr	20.0 TB/hr
Network Connectivity	Per Database Server: • 1x 1/10 Gb copper Ethernet port (customer admin) • 2x 1/10 Gb copper Ethernet ports (backup) • 2x 10 Gb optical Ethernet ports (client)			

1. After high-redundancy mirroring, but before database compression.
2. Bandwidth is peak physical scan bandwidth achieved running SQL, assuming no database compression. Effective user data bandwidth is higher when database compression is used.
3. Based on 8K I/O requests running SQL.
4. 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.
5. Load rates are typically limited by database server CPU, not I/O. Rates vary based on load method, indexes, data types, compression and partitioning.

Additional Notes on Technical Specifications:

- *Each rack is 42 RU (Rack Units) in height, has 2x redundant Power Distribution Units (PDUs), 2x 36-port QDR (40 Gb/s) InfiniBand switches and 1x 48-port Cisco Ethernet switch for infrastructure administration by Oracle Cloud Operations.*
- *Included Spare Parts Kit contains: 1 x 3.2 TB NVMe PCI Flash card and 1 x 8 TB High Capacity disk.*
- *Exadata Cloud Machine Half Rack and Full Rack Configurations differ from on-premises Half Rack and Full Rack. The Exadata Cloud Machine Half Rack is twice the size of a Quarter Rack and has six storage servers. The Exadata Cloud Machine Full Rack is twice the size of the Half Rack and has twelve storage servers.*
- *Eighth Rack is the minimum Exadata Cloud Machine configuration. The minimum OCPU requirement for an Eighth Rack is sixteen. Eighth Rack storage servers have half the disks and flash cards removed.*

EXADATA CLOUD MACHINE X6-2 ENVIRONMENTAL SPECIFICATIONS

Metric	Full Rack	Half Rack	Quarter Rack	Eighth Rack
Height Width Depth	• *78.66" - 1998 mm* • *23.62" – 600 mm* • *47.24" – 1200 mm*			
Acoustic noise (operating)	8.5 B	8.4 B	8.3 B	8.3 B
Weight	1762.5 lbs (799.5 Kg)	1142.5 lbs (518.2 kg)	840.5 lbs (381.2 kg)	810.3 lbs (367.6 kg)
Maximum power usage	13.3 kW (13.6 kVA)	7.1 kW (7.2 kVA)	4.0 kW (4.1 kVA)	3.3 kW (3.4 kVA)
Typical power usage [1]	9.3 kW (9.5 kVA)	5.0 kW (5.1 kVA)	2.8 kW (2.9 kVA)	2.3 kW (2.3 kVA)
Cooling at maximum usage	45,351 BTU/hour 47,845 kJ/hour	24,236 BTU/hour 25,569 kJ/hour	13,679 BTU/hour 14,432 kJ/hour	11,207 BTU/hour 11,823 kJ/hour
Cooling at typical usage	31,746 BTU/hour 33,492 kJ/hour	16,966 BTU/hour 17,899 kJ/hour	9,575 BTU/hour 10,102 kJ/hour	7,845 BTU/hour 8,276 kJ/hour
Airflow at maximum usage [2]	2100 CFM	1122 CFM	633 CFM	519 CFM
Airflow at typical usage [2]	1470 CFM	785 CFM	443 CFM	363 CFM

Operating temperature/humidity: 5 ºC to 32 ºC (41 ºF to 89.6 ºF), as measured by an industry grade temperature measurement device directed at the front bezel of the servers, 10% to 90% relative humidity, non-condensing

Altitude Operating: Up to 3,048 m, max. ambient temperature is de-rated by 1° C per 300 m above 900 m

[1] Typical power usage varies by application load.

[2] Airflow must be front-to-back.

EXADATA CLOUD MACHINE X6-2 REGULATIONS AND CERTIFICATIONS

Regulations [1]	**Safety:**	UL/CSA 60950-1, EN 60950-1, IEC 60950-1 CB Scheme with all country differences
	RFI/EMI:	EN55022, EN61000-3-11, EN61000-3-12
	Immunity:	EN 55024
	Emissions and Immunity:	EN300 386
Certifications [1]	North America (NRTL), European Union (EU), International CB Scheme, BSMI (Taiwan), C-Tick (Australia), CCC (PRC), MSIP (Korea), CU EAC (Customs Union), VCCI (Japan)	
European Union Directives [1]	2006/95/EC Low Voltage Directive, 2004/108/EC EMC Directive, 2011/65/EU RoHS Directive, 2012/19/EU WEEE Directive	

[1]All standards and certifications referenced are to the latest official version at the time the data sheet was written. Other country regulations/certifications may apply. In some cases, as applicable, regulatory and certification compliance were obtained at the component level.

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