Oracle Database
Exadata Cloud at Customer

Exadata Performance, with Cloud Simplicity

ORACLE
DATABASE
CLOUD SERVICE

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

Exadata Cloud at Customer 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 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 Cloud Infrastructure data centers.

Customers that already own database and database option licenses can choose to deploy them on Exadata Cloud at Customer to minimize costs. Customers that do not have existing database licenses can choose to use Oracle Database Enterprise Edition Extreme Performance which enables every Oracle Database feature and option, ensuring highest performance, best availability, most effective security and simplest management. All Exadata features are included in both cases. Databases deployed on Exadata Cloud at Customer are 100% compatible with existing on-premises databases, and databases that are deployed in Oracle Cloud Infrastructure.

Exadata Cloud at Customer 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, security requirements, network latency, 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 at Customer 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 at Customer makes this enterprise-proven, robust database technology available in a cloud-based consumption model and at customers' data centers behind their firewalls.

Most Powerful Database Infrastructure and 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 deploying Oracle databases. 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 NVMe 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 Automation for Enterprise Databases

On top of the rock-solid Oracle Database and Exadata platform, Exadata Cloud at Customer adds the ease, simplicity, and flexibility of the software that powers Oracle Cloud Infrastructure. Organizations can now access Oracle Database on Oracle Exadata with 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 at Customer 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 at Customer is driven through simple web interfaces, providing customers rapid elasticity to meet changing business demands.

KEY BUSINESS BENEFITS

Exadata Cloud at Customer 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
- Subscription-based pricing, with ability to bring your own licenses (BYOL) to cloud
- Online 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 to meet compliance and data sovereignty requirements
- Proven mission-critical database and platform
- Extreme performance for OLTP, Analytics, Hybrid, and Consolidation workloads
- Focus staff on improving business, not operating infrastructure

Customer Benefits

Databases deployed on the Exadata Cloud at Customer are 100% compatible with on-premises Oracle databases and existing applications. With Exadata Cloud at Customer, 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 five customer profiles that immediately benefit from Exadata Cloud at Customer:

- 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
- Security-conscious customers that need cloud deployments with enterprise-class, on-premises security controls

Exadata: The Best Database Platform

Exadata Hardware

Exadata Cloud at Customer comes in different infrastructure shapes to support workloads of different sizes. The Exadata Cloud at Customer Base System provides a cost-effective Exadata entry point, while traditional quarter, half, and full rack shapes can meet nearly arbitrary CPU processing and database storage requirements. Customers can also elastically expand their configurations by adding individual compute and storage servers to an existing machine. As workloads grow, database CPUs, storage, and networking can be added to grow the system in a balanced fashion to scale without bottlenecks. Online dynamic scaling of OCPU resources is available in every Exadata Cloud at Customer shape so that customers can pay only for the OCPUs that they use, dramatically reducing costs compared to a traditionally purchased platform.

All of the Exadata Cloud at Customer shapes are built on powerful database servers, scale-out intelligent storage servers, PCI NVMe flash, and high capacity disk drives. Internal connectivity between database and storage servers is enabled by a low-latency InfiniBand fabric. External connectivity to the Exadata Cloud at Customer system is provided using standard 10 Gigabit Ethernet.

The database-optimized data tiering between RAM, flash and disk implemented in Exadata provides lower latency, 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 NVMe flash, offload of data intensive operations to storage, and algorithms that are specifically optimized for databases.

EXADATA HARDWARE

- Fastest Networking
  - 40Gbps InfiniBand Networking
- Fastest Storage
  - Ultra-fast PCI NVMe flash
  - Up to 200 GB/sec Throughput
  - Up to 4.7 Million 8K I/Os per sec
  - ¼ millisecond response time
- Large Memory Capacity
  - Up to 720 GB per Database Server
- Complete Redundancy

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
- Fastest RAC Node Failure Recovery
- Fastest Data Guard Redo Apply
- Fastest Backup using Offload to Storage

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 at Customers.

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.

In addition to Smart Scan, 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 Servers 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
- *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 is engineered to provide the highest levels of availability. Each Exadata Cloud at Customer system has completely redundant hardware components. In addition, Exadata Cloud at Customer 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.

Exadata Cloud at Customer 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

EXADATA 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 at Customer with Disaster Recovery standby databases in Exadata Cloud Service
- Full ACID compliance (Atomicity, Consistency, Isolation, Durability) greatly simplifies application development and ensures data correctness

prioritization and resource management capabilities spanning database servers, network and storage.

Exadata Cloud at Customer

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

Subscription Overview

Exadata Cloud at Customer is available through a subscription offering that requires a minimum term of 4 years. Exadata Cloud at Customer has two subscription models:

- Exadata Cloud at Customer: Oracle Database Enterprise Edition Extreme Performance Included
- Exadata Cloud at Customer Bring Your Own License (BYOL)

Exadata Cloud at Customer Enterprise Edition Extreme Performance Included

This subscription model includes all of the features of Oracle Database Enterprise Edition, plus all of the Oracle Database Enterprise Manager Packs and all Database Enterprise Edition Options. These industry-leading capabilities include 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 in an Exadata Cloud at Customer PaaS subscription is Oracle Multitenant, enabling high consolidation density, rapid provisioning and cloning, efficient patching and upgrades, and significantly simplified database management. This subscription model is ideal for customers without existing Oracle database licenses, or customers seeking to use Oracle database features beyond what they currently have licenses for.

EXADATA PAAS FEATURES

- Oracle Database 18c, 12.2.0.1, 12.1.0.2, and 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
  - Real Application Clusters
  - Real Application Testing
  - Spatial and Graph
- Oracle Database Enterprise Manager Packs
  - Diagnostics Pack
  - Tuning Pack
  - Database Lifecycle Management Pack
  - Data Masking and Subsetting Pack
  - Cloud Management Pack for Oracle Database

Figure 1: Exadata Cloud at Customer PaaS with all Database and Exadata features

Exadata Cloud at Customer Bring Your Own License (BYOL)

Exadata Cloud at Customer 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 Enterprise Edition and Database Option licenses on Exadata Cloud at Customer. Standard Edition is not supported on any Exadata Cloud at Customer.

When a customer brings a Database Enterprise Edition license entitlement to Oracle Exadata Cloud at Customer, they are granted the rights to use Oracle Transparent Data Encryption (TDE), Diagnostics Pack, Tuning Pack, Data Masking and Subsetting Pack, and Real Application Testing without having on-premises license entitlements for those Database Options. The Exadata System software is also included in a BYOL subscription, so BYOL customers do not have to bring a license entitlement for the Exadata System Software.

Service Overview

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), Oracle database 18c, or a combination of these. Customers connect to databases from their applications using standard Oracle Net Services clients such as JDBC and OCI. As shown in Fig. 1, Exadata Cloud at Customer also includes all capabilities of the underlying Exadata platform.

Customers choose an Exadata configuration starting with a Base System, which has 2 database servers and 3 storage servers. Customers dynamically provision database servers with any number compute cores (OCPUs) within the hardware limits of the chosen configuration. Pricing is based on the number of enabled compute cores, and as business grows, customers can enable or disable 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 at Customer.

Customers with additional resource requirements may choose larger Exadata shapes, such as the Quarter, Half and Full Racks, enabling higher compute, network and storage capacity. Detailed specifications for each Exadata Cloud at Customer shape are provided in Table 1. In addition, customers can elastically expand any shape by adding compute and storage servers to their system.

Online Compute Bursting

Exadata Cloud at Customer infrastructure is dedicated to each customer to ensure that response times and throughput are predictable for critical business processes. In addition, Exadata Cloud at Customer also allows Online Compute Bursting, enabling customers to grow, and later shrink if necessary, their database server CPU capacity to meet their peak or seasonal demands. Adjustments can be made completely online

CLOUD AUTOMATION FEATURES

- 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 Cloud Infrastructure databases
- Comprehensive database management through Oracle Enterprise Manager, as well as Cloud-based self-service
- Exadata infrastructure management and monitoring by Oracle Cloud Operations

as frequently as the customer wants. The processor capacity used is billed at the hourly rate for peak usage within that hour.

Online Compute Bursting provides Exadata Cloud at Customer customers with 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 at Customer. Each Exadata Cloud at Customer Exadata Database Service is configured as a cluster of Virtual Machines (VMs), called DomUs, running on an Oracle VM hypervisor on a dedicated physical server. A physical Exadata Database Machine rack can support up to 8 VM clusters. Each VM cluster's networks are isolated at layer 2 (Ethernet) from all of the other VM cluster's networks, so VM clusters can be used for secure workload isolation. Customers have root privileges for the Exadata database server DomU and DBA privileges on the Oracle databases. Customers can configure the Exadata database server 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 database provisioning, backup, patching, and upgrades. Database and OS updates are initiated by customers on their preferred schedule. Underlying infrastructure for Exadata Cloud at Customer, including Exadata InfiniBand network, physical servers, hypervisors, Exadata Storage Servers, and Exadata System Software, is deployed, monitored, maintained and managed by Oracle Cloud Operations. This allows customers to focus on business application requirements, and not on database infrastructure monitoring and management.

Cloud Control Plane

A subscription to the Exadata Cloud at Customer requires a subscription to the Oracle Cloud at Customer Control Plane. The Cloud Control Plane is a sophisticated software suite that is deployed on separate hardware to bring the cloud experience to customers. It includes cloud infrastructure components that perform order management, subscription, billing, account and identity management, REST services, and compute/storage/virtual networking management for Exadata Cloud at Customer systems.

Remote Monitoring and Support through Oracle Advanced Support Gateway

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

The OASG acts as the central conduit to facilitate remote monitoring and management of Exadata Cloud at Customer systems. The OASG is based on the Oracle Linux operating system and hosts a full stack of Oracle software, including

Automated Service Request (ASR) and Oracle Configuration Manager. Together, these applications aggregate and route telemetry messages from the Exadata Cloud at Customer environment to the Oracle Support Services infrastructure. The OASG provides secure remote access for Oracle Cloud Operations to access the Exadata Cloud at Customer and Oracle Cloud Control Plane infrastructure for monitoring and maintenance purposes.

The OASG is located in the customer data center with network access to the Exadata Cloud at Customer systems it is monitoring. It does not need to be directly exposed to the Internet, but it should be continuously accessible from Oracle Cloud Operations infrastructure through a TLS/VPN tunnel.

Deployment and Configuration

The following diagram shows a typical configuration of Exadata Cloud at Customer, Oracle Cloud Control Plane, Oracle Advanced Support Gateway, and Oracle Cloud Operations.

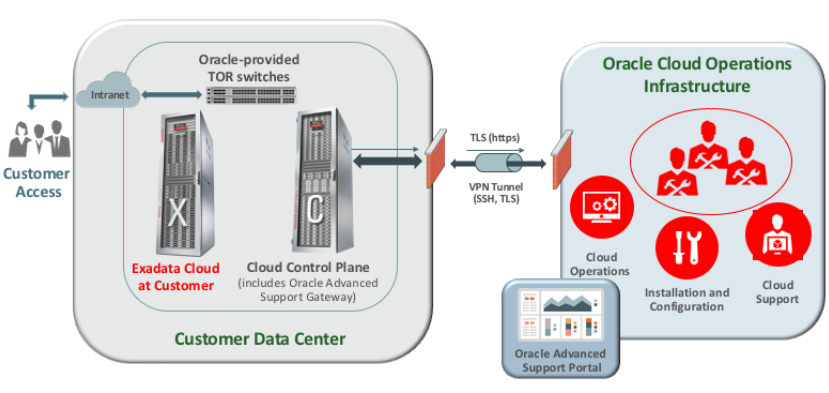

Figure 2: Typical Deployment of Exadata Cloud at Customer

Oracle Cloud Operations

All hardware and software infrastructure associated with Exadata Cloud at Customer systems are 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 at Customer consists of managing the following components:

- Exadata Storage Servers
- Power Distribution Units (PDUs)
- InfiniBand Network and Switches
- Management Switch

- Top of Rack (ToR) Switches
- Oracle VM (Hypervisor)
- Exadata System Software and all firmware

With Oracle Cloud Operations managing the infrastructure and support for the Exadata Cloud at Customer, employees can now be empowered to focus on application and business logic necessary for the core business, instead of getting bogged down with infrastructure maintenance projects. This 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[1].

A suite of Cloud Operations Services is available to customers as part of subscribing to Exadata Cloud at Customer. 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 Control Plane, Oracle Advanced Support Gateway, and Exadata Cloud at Customer
  - Connecting to necessary data center networks and firewalls
  - Required configuration of the Exadata Cloud at Customer
  - Configuration validation
  - Creation of one customer Domain (DomU) in each database server of the Exadata Cloud at Customer infrastructure
- Monitoring
  - Exadata Cloud at Customer infrastructure layer incident monitoring, management, and root cause analysis
  - Threshold performance analysis
- Change Management for Exadata Cloud at Customer, Oracle Cloud Control Plane, and Advanced Support Gateway
  - Regular infrastructure update & upgrade planning, scheduling, implementing
  - 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 InfiniBand switches

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

- Proactive infrastructure upgrades to make infrastructure software consistent with Oracle Public Cloud
- Staging of Database and Grid Infrastructure updates for subsequent deployment by customers

Enterprise Class Security with the Simplicity of Cloud, in Your Data Center

Exadata benefits from scrutiny by Oracle Security experts and by hundreds of industry experts around the world. Exadata Cloud at Customer delivers Exadata as an Oracle Cloud Service in the physical protection of a customer data center, and is based on comprehensive security measures deployed in the hardware infrastructure, network, Exadata platform, and Oracle database. The security features of Exadata Cloud at Customer segregate customer data access and Oracle Cloud Operations, and ensure that data that enters or leaves the Exadata Cloud at Customer is secure, data that resides on the system is secure, access to the system is secure, and the code that runs on the system is secure. Oracle Cloud Automation further enhances security by enforcing strong passwords and data encryption on all databases, and making it fast and easy for customers to keep databases updated with the latest security patches from Oracle.

Exadata Cloud at Customer 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 to ensure hardware components will only run valid code 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
- Virtual machines that provide secure isolation between customer domain and Oracle Cloud Operations

Customers can be assured that Oracle database data on Exadata infrastructure can only be accessed by users with explicit rights to access that data, and that Oracle Cloud Operations cannot access customer data.

Exadata Cloud at Customer 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 InfiniBand network: InfiniBand partitioning secures storage and 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
- Network isolation at layer 2 (Ethernet) between client and backup networks within a VM cluster and between the networks of different VM clusters

Exadata Cloud at Customer Platform Security is based on customer-accessible virtual machines that deliver the Exadata Cloud at Customer Compute Node platform.

The operating system deployment for the Exadata Cloud at Customer 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
- Token-based SSH that provides secure access to customer virtual machines
- Comprehensive logging and auditing that tracks access and modification

Customers have full root access to the virtual machines running the Exadata Compute Node software, 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 at Customer Database Security is based on the enterprise security features of the Oracle database. Customers have 2 deployment options:

- Exadata Cloud at Customer Enterprise Edition Extreme Performance subscription that includes all Oracle Advanced Security features, such as Transparent Data Encryption (TDE), Database Vault, Label Security, Redaction, Subsetting, and Masking
- BYOL commercial model which adds Transparent Data Encryption (TDE) and the Data Masking and Subsetting pack entitlements to any Oracle Database Enterprise Edition license they move to Exadata Cloud at Customer

TDE encryption keys are stored in a password protected Oracle wallet in the customer's Exadata Compute Node VM by default, and customers can optionally configure external key stores such as Oracle Key Vault and commercial hardware security modules (HSMs) to further separate access and duties.

Provisioning

Upon subscribing to Exadata Cloud at Customer, 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 Control Plane
- Connecting the Gateway to the Control Plane
- Capturing required network/IP Address information, and executing Oracle Exadata Deployment Assistant (OEDA) to generate necessary configuration files
- Deploying Exadata Cloud at Customer – this involves connecting Exadata Cloud at Customer systems to customer data center network as well as to the Control Plane and the Gateway
- Provisioning Exadata Cloud at Customer instance from the Control Plane

Once an Exadata system is provisioned, the designated customer account administrator gets notified that their service is available for use. Customers now can create users and groups and assign privileges to create, monitor, and manage their VM clusters and databases in a very simple manner through a web-based wizard, as shown below:

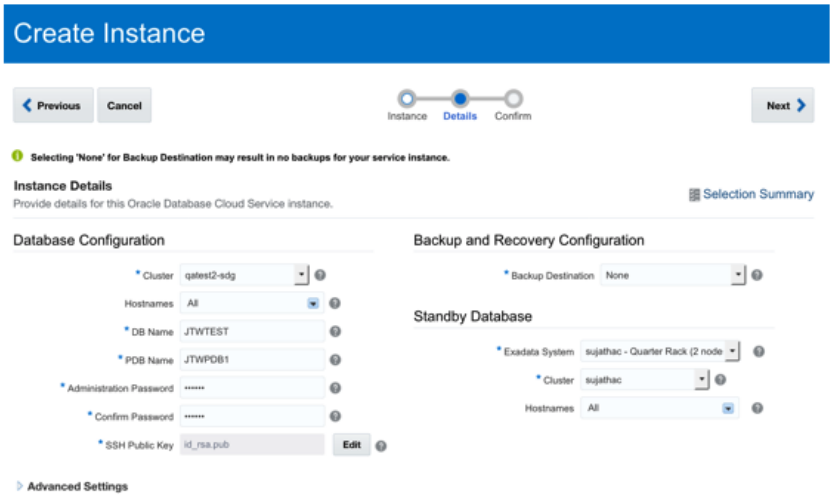

Figure 3: Self-Service Database Cloud Service creation with Exadata Cloud at Customer

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 at Customer provides automatic built-in database backup facilities, with weekly full backups and daily incremental backups. At the time of service provisioning, through the self-service portal, customers can choose backups to be stored on local disk backups on the Fast Recovery Area (FRA) provisioned directly on the Exadata system, or on the Oracle Cloud at Customer Object Storage service, or to a Zero Data Loss Recovery Appliance which may already be existing in the data center infrastructure. Customers can also use RMAN directly to provision database backups to leverage their other existing data center backup and recovery infrastructure such as ZFS Backup Appliance or tape drives.

Migration to Exadata Cloud at Customer

Full compatibility between on-premises databases and databases deployed on Exadata Cloud at Customer makes migration to Exadata Cloud at Customer 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; 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 at Customer

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

- Scaling up within an allocated Exadata service 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
- Elastically expanding an Exadata service enables customers to add compute or storage servers independently, increasing the overall capacity of their system.
- Adding an Exadata service enables enables customers to provision additional Exadata shapes to increase processing and storage capacity

Conclusion: Transform IT, Unleash Business Potential

Oracle Database Exadata Cloud at Customer features the most versatile and functional database technology – Oracle Database, on the fastest, most powerful, and most available 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. They can bring their existing on-premises database software license to Exadata Cloud, leveraging their existing investments. Finally, with Exadata Cloud, organizations no longer have to dedicate limited IT talent to managing and maintaining infrastructure.

Exadata Cloud uniquely delivers all these benefits in the public cloud with Oracle Database Exadata Cloud Service or in the customer's own data center with Oracle Database Exadata Cloud at Customer.

Table 1. EXADATA CLOUD AT CUSTOMER X7-2: Technical Specifications

	Base System	Quarter Rack	Half Rack	Full Rack
Number of Database Servers	2	2	4	8
Maximum Number of OCPUs	44	92	184	368
Total Memory (GB)	480	1,440	2,880	5,760
Number of Storage Servers	3	3	6	12
Total Flash Capacity (TB)	19.2	76.8	153.6	307.2
Total Usable Disk Capacity[1] (TB)	42.7	106.9	213.8	427.6
Max DB Size - Local backup[1] (TB)	17.1	42.8	85.5	171.1
Max DB Size - No Local Backup[1] (TB)	34.2	85.5	171.1	342.1
Max SQL Flash Bandwidth[2] (GB/s)	24	50	100	200
Max SQL Flash Read IOPS[3]	450,000	1,167,750	2,335,500	4,671,000
Max SQL Flash Write IOPS[4]	400,000	1,033,000	2,066,000	4,132,000
Max SQL Disk Bandwidth[2] (GB/s)	2.7	5.4	10.8	21.5
Max SQL Disk IOPS[3]	3,900	7,800	15,600	31,000
Max Data Load Rate[5] (TB/hr)	2	7.5	15	30
Network Connectivity	Per Database Server: • 2x10 Gb Ethernet (backup) • 2x10 Gb Ethernet (client)			

1. 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
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. Top of Rack (ToR) switches are included in Half Rack and Full Rack configurations.*
- *Included Spare Parts Kit contains: 1 x NVMe PCI Flash card and 1 x High Capacity disk.*
- *Base System is the minimum Exadata Cloud at Customer configuration.*
- *A Database Server in any Exadata Cloud at Customer X7 configuration has 8x600GB local drives*

EXADATA CLOUD AT CUSTOMER X7 CAPACITY AND PERFORMANCE METRICS: INDIVIDUAL SERVERS

Server Type	Maximum SQL Flash Bandwidth[2]	Maximum SQL Read IOPS[3]	Maximum SQL Write IOPS[4]	PCI Flash Capacity (raw)[5]	Disk Data Capacity(raw)
Database Server	NA	597,500	544,000	NA	2.4 TB
Storage Server HC[1]	25 GB/s	475,000	420,000	25.6 TB	120 TB
Eighth Rack Storage Server HC[1]	12.5 GB/s	237,500	210,000	12.8 TB	60 TB

[1]HC = High Capacity· EF = Extreme Flash. Actual system performance varies by application.
[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. Note that the I/O size greatly affects Flash IOPS. Other products quote IOPS based on smaller IOs that are not relevant for databases.

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

[5] Raw capacity is measured in standard disk drive terminology with 1 GB = 1 billion bytes.

ELASTIC EXPANSION OPTIONS

Starting Shape	Max Compute Servers	Max Storage Servers	Additional Compute Server Specifications	Additional Storage Server Specifications
Quarter/Half X7	8	12	46 cores, 720GB memory	25.6TB Flash, 35TB HDD Usable
Quarter X6	2	12	n/a	12.8TB Flash, 28TB HDD Usable
Half X6	4	12	n/a	12.8TB Flash, 28TB HDD Usable
Base X7	8	12	22 cores, 240GB memory	6.4TB Flash, 14TB HDD Usable
Base X6	2	12	n/a	6.4TB Flash, 14TB HDD Usable

EXADATA CLOUD AT CUSTOMER X7 COMPONENT ENVIRONMENTAL SPECIFICATIONS

Metric	Database Server X7-2 Plus InfiniBand Infrastructure	Storage Server X7-2 High Capacity Plus InfiniBand Infrastructure	Eighth Rack Storage Server X7-2 High Capacity Plus InfiniBand Infrastructure
Height Width Depth	1.7 in. (42.6 mm) 17.2 in. (436.5 mm) 29.0 in. (737.0 mm)		
Acoustic noise (operating)	7.7 B	8.2 B	7.9 B
Weight	45.6 lbs (20.7 kgs)	75.9 lbs (34.4 kgs)	66.3 lbs (30.1 kgs)
Maximum power usage Typical power usage [1]	0.8 kW (0.8 kVA) 0.5 kW (0.6 kVA)	0.6 kW (0.6 kVA) 0.4 kW (0.4 kVA)	0.5 kW (0.5 kVA) 0.3 kW (0.3 kVA)
Cooling at maximum usage Cooling at typical usage	2,631 BTU/hour (2,775 kJ/hour) 1,842 BTU/hour (1,943 kJ/hour)	2,146 BTU/hour (2,264 kJ/hour) 1,502 BTU/hour (1,585 kJ/hour)	1,588 BTU/hour (1,676 kJ/hour) 1,112 BTU/hour (1,173 kJ/hour)
Airflow at maximum usage [2] Airflow at typical usage [2]	122 CFM 85 CFM	99 CFM 70 CFM	74 CFM 51 CFM

EXADATA CLOUD AT CUSTOMER X7 STANDARD CONFIGURATIONS ENVIRONMENTAL SPECIFICATIONS

Metric	Full Rack		Half Rack		Quarter Rack		Base System	
Height Width Depth	• *78.74" - 2000 mm* • *23.66" – 601 mm* • *47.13" – 1197 mm*							
Acoustic noise (operating)	9.4 B		9.1 B		8.8 B		8.8 B	
Weight	1,906.6 lbs	864.8 kg	1,266.8 lbs	574.6 kg	910.9 lbs	413.2 kg	882.2 lbs	400.1 kg
Maximum power usage	15.4 kW	15.7 kVA	8.5 kW	8.7 kVA	4.3 kW	4.4 kVA	3.5 kW	3.6 kVA
Typical power usage [1]	10.8 kW	11.0 kVA	6.0 kW	6.1 kVA	3.0 kW	3.1 kVA	2.5 kW	2.5 kVA
Cooling at maximum usage	52,414 BTU/hr 55,297 kJ/hr		29,013 BU/hr 30,609 kJ/hr		14,822 BTU/hr 15,638 kJ/hr		12,096 BTU/hr 12,761 kJ/hr	
Cooling at typical usage	36,690 BTU/hr 38,708 kJ/hr		20,309 BTU/hr 21,426 kJ/hr		10,376 BTU/hr 10,946 kJ/hr		8,467 BTU/hr 8,993 kJ/hr	
Airflow at maximum usage [2]	2,427 CFM		1,343 CFM		686 CFM		560 CFM	
Airflow at typical usage [2]	1699 CFM		940 CFM		480 CFM		392 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

Full and half rack configurations include top-of-rack (ToR) switches. Quarter rack and Base System do not include top-of-rack (ToR) switches.

[1] Typical power usage varies by application load.

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

EXADATA CLOUD AT CUSTOMER X7-2 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]	2014/30/EU Low Voltage Directive, 2014/30/EU 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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For more information about Oracle Database Exadata Cloud at Customer, visit oracle.com/exadata or call +1.800.ORACLE1 to speak to an Oracle representative.

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