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Working with Exadata Cloud@Customer

Student Guide

S1102500GC10

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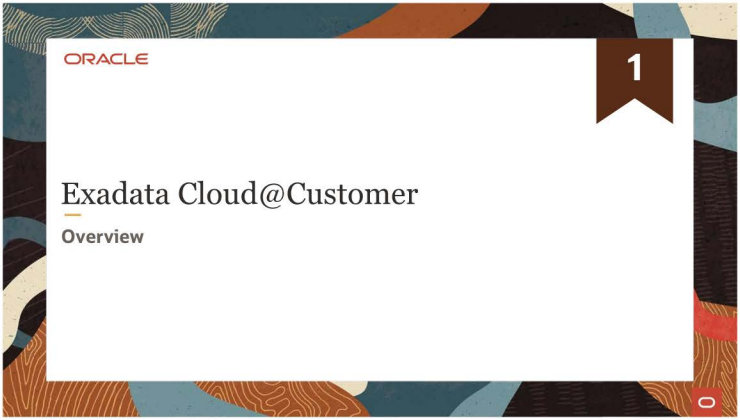

Objectives

After completing this lesson, you should be able to describe:

- Exadata Vision
- Exadata Deployment Models
- Exadata Platform
- Exadata Cloud@Customer Service Overview
- Autonomous Database on Exadata Cloud@Customer

Exadata Vision

Extreme Performance and Availability at Lowest Cost

- Ideal Database Hardware – Scale-out, database optimized compute, networking, and storage for fastest performance and lowest cost
- Database Aware System Software – Specialized algorithms vastly improve OLTP, analytics, and consolidation
- Automated Management – Fully automated and optimized configuration, performance, fault-tolerance, and updates

Identical On-Premises and in the Cloud

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Before we get started, let's take a look at the Exadata platform. Exadata is the best platform for running the Oracle database. It provides superior performance, scalability, security, and availability at the lowest cost. Deep engineering integrates the hardware and software to create this optimized database platform. We use the best hardware available in the market, but what makes Exadata special is the smart database aware system software. This software implements specialized algorithms to improve all types of workloads including OLTP, analytics, batch processing, and of course, consolidation.

We then combine that with smart management tools to make Exadata easy to manage and to ensure that it is always deployed and configured consistent with the best practices. Lastly, note that Exadata is available both on premises and in the cloud. It's the Exadata deployment in Oracle Cloud known as **Exadata Cloud Service** which we will focus on today.

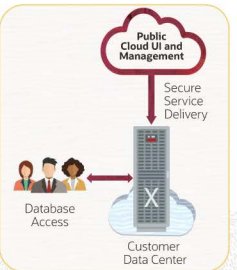
Exadata Deployment Model

Exadata is available on premises, in the public cloud and running the Exadata Cloud Service in the customer data center known as Exadata Cloud at Customer. Exadata Cloud at Customer is the deployment we will focus on for this presentation.

Gen 2 Exadata Cloud@Customer

Public Cloud Simplicity and Elasticity Behind Your Firewall

- High performance Oracle Database Cloud in customer data center
  - Databases provisioned and subscribed to, as a service
  - Deployed on Exadata, with all best practices (e.g. MAA) built-in
  - Customers retain database ownership
  - Oracle manages Exadata infrastructure
  - Control plane deployed on chosen public cloud (OCI) region
- Consistent public cloud experience
  - Public Cloud UI/API-driven database provisioning & management
  - Same financial model: Simply subscribe to infrastructure & compute cores, pay-per-use
- Most efficient cloud adoption strategy
  - No IT disruption: Leverage data center investment / infrastructure
  - Maintain data gravity: Keep data next to your applications
  - Maintain existing data security standards & data residency compliance
  - Low risk, high reward: Same functionality-rich Oracle database with Exadata scale and cloud agility



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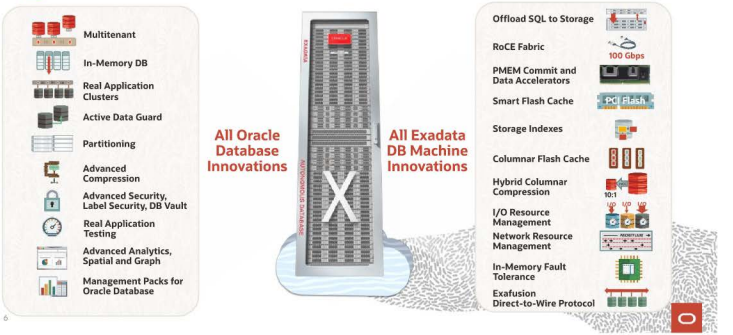
Exadata Cloud at Customer is on it's second generation. The service provides the same Oracle Database on Exadata Cloud Service in Oracle Cloud Infrastructure (OCI) experience, utilizing the OCI control plane, running in your chosen public OCI region, to manage the resources deployed on the Exadata Infrastructure running in the customer data center.

The Oracle databases provisioned on Exadata Cloud@Customer include all the advanced database features and options. You can license everything as a service or bring your Oracle database licenses to the service. Since it runs on the same Oracle database you run on-premises, it is 100% compatible with existing applications. For all practical purposes, it looks exactly like an Oracle Database running on standard Exadata on-prem hardware. The big difference is the cloud features and benefits—specifically, the simplicity and elasticity. Elastic scaling means you can grow and shrink your service to match your workload requirements. This means you only pay for what you use, and this pay-per-use capability is how you can really lower your Total Cost of Ownership. In addition, Oracle manages all the infrastructure for you, so you can focus on your business, and not on the infrastructure. And, for those operations you do continue to manage, Exadata Cloud Service provides sophisticated automation making most operations as easy as pushing a button.

Exadata Cloud: Most Powerful Database and Platform



This is just a quick summary of some of the capabilities you get with Exadata Cloud at Customer. On the left, are all the features available in the Oracle database. On the right, all the Exadata innovations available with the platform. Everything you expect from Exadata is available with the Exadata Cloud at Customer.

Gen 2 ExaC@C

Technical Details

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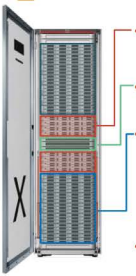
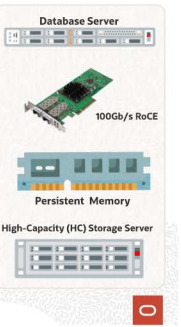
Exadata X8M Hardware for Exadata Cloud@Customer

(Changes from X8 in Red)

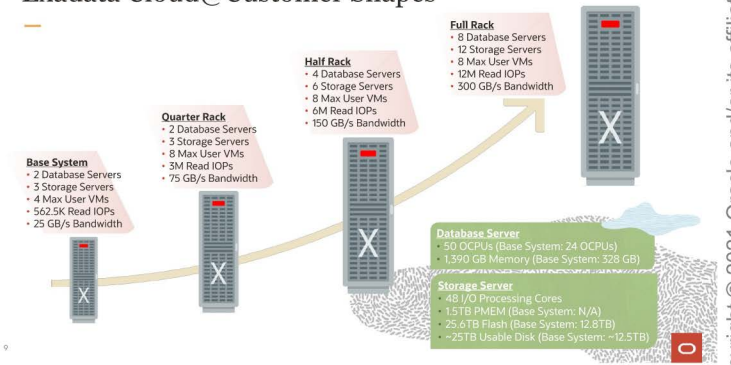


- Scale-Out 2 Socket Database Servers
  - 26-core Intel Cascade Lake CPUs
- Ultra-fast 100Gb/s RDMA over Converged Ethernet (RoCE) Internal Fabric
- Scale-Out ***intelligent*** 2-Socket Storage Servers
  - 24-core Intel Cascade Lake CPUs
  - 1.5 TB Persistent Memory per storage server
  - Three tiers of storage: PMEM, NVMe Flash, HDD
- Enhanced consolidation using Linux KVM



Exadata Cloud at Customer provides the latest generation Exadata X8M hardware, which includes several new hardware innovations. This includes persistent memory, or PMEM, and a new secure network fabric based on RDMA or Remote Direct Memory Access, over Converged Ethernet, known as RoCE. As we will discuss in a minute, this gives **Exadata Cloud at Customer** some great performance benefits. The X8M also switched from Xen virtualization to KVM virtualization, which means Exadata Cloud at Customer now uses the same virtualization technology as the rest of the Oracle Cloud.

Exadata Cloud@Customer Shapes



Exadata Cloud at Customer is available in multiple shapes. Customers can choose an entry level Base System or subscribe to specific generational shapes like the X8M. The X8M shapes start with a Quarter Rack and expand up to a Full Rack. The base systems provides 2 database servers and 3 storage servers, like a quarter rack, but with a smaller capacity of OCPU, memory, and storage resources. The half rack then doubles the number of servers and resources in a quarter rack, and the full rack doubles the half rack.

Cloud-Automated Extreme Performance and Availability

Unique new generation RAC scale-out for any workload

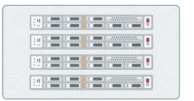
- Application-transparent database scalability & availability

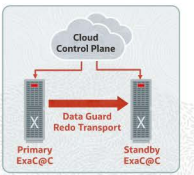
Unique database RDMA accelerates OLTP messaging

Unique smart storage offloads queries and columnarizes data for fast analytics

Unique fully active remote DB copy

- Offers disaster protection
- Allows SQL read/write
- Prevents corruptions





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Exadata Cloud at Customer provides extreme performance and availability.

One of the advanced features supported on Exadata Cloud at Customer is Oracle Real Application Clusters, also known as Oracle RAC. RAC allows you to scale database instances across multiple database servers for greater performance and higher availability. With Exadata Cloud at Customer, you can provision Oracle RAC with a single-click using Oracle Cloud Infrastructure automation.

Second, remote direct memory access, or RDMA, is used to accelerate OLTP messaging along with SQL reads and writes – more on that in a minute.

Third, one of the really great features of Exadata in general is what we call Smart Scan, which offloads basic operations like SQL queries, analytics processing, and machine-learning algorithms from database server cores to the CPU cores in intelligent storage servers. This has 3 major effects - it accelerates run times, it frees up database server cores to work on other processing, and it reduces costs – particularly on Exadata Cloud at Customer – because the CPU cores in intelligent storage servers do not require Oracle Database licenses so you get more work done per database OCPU you enable.

And finally, Exadata Cloud at Customer offers fully-active remote database copies to a second Exadata Cloud@Customer infrastructure. These are typically created for disaster recovery purposes but can also be used for secondary processing like reporting, QA, or development and testing.

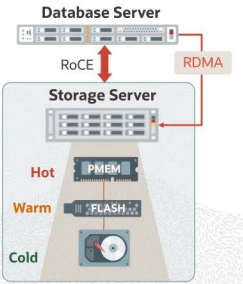
Latency and Throughput

New leading-edge RDMA fabric

- Based on 100 Gb/sec Converged Ethernet

Persistent memory in storage accessed using RDMA

- 10X better transaction processing IO latency – 19 usec
- 2.5X higher transaction processing IOs



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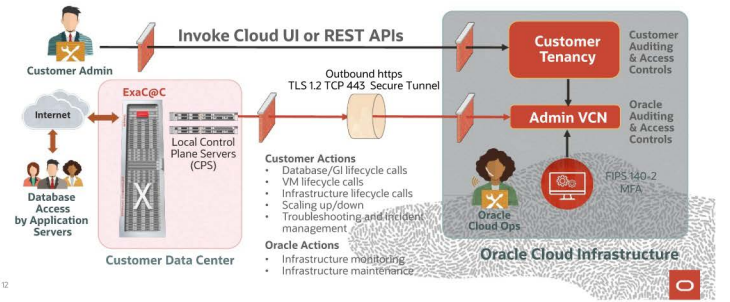
I mentioned RDMA earlier and promised that we would come back to it, so here it is.

RDMA allows the Database CPU cores to read data from and write data directly into the memory of intelligent storage servers, without involving operating system or networking stack overhead.

This combines with the extremely low latency of Persistent Memory located in intelligent storage servers to lower both SQL read and write latencies, which are two of the most critical factors impacting OLTP performance on a database system. With the combination of RDMA, fast networking, and Persistent Memory, SQL write latencies are reduced by up to a factor of 8X, read latencies are 10X better – as low as 19 microseconds, and overall transaction processing IOPS are increased by up to 2.5X.

Effectively, this makes Exadata Cloud at Customer X8M the best place for OLTP in the cloud, with the lowest latencies, highest throughput, and lowest costs (because your workloads consume fewer resources – which is what you're actually paying for.)

Gen 2 Exadata Cloud@Customer Architecture Overview



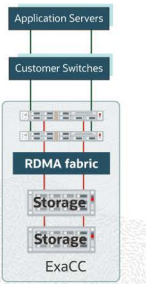
Here is an architecture overview of the **Gen 2 Exadata Cloud at Customer Service**. Customer administrators provision and manage via lifecycle calls invoked through the OCI Cloud UI or APIs.

These calls are communicated with the Exadata Cloud at Customer in the customer data center through control plane servers (CPS) located in the Exadata Cloud at Customer rack. This communication requires no inbound TCP connections. The CPS requires outbound access on TCP/443 to OCI.

Exadata Cloud at Customer database servers connect directly to the customer network.

Simple Connectivity to Data Center Network

- ExaC@C database servers connect directly to customer network
  - 10Gbps/25 Gbps fiber or 10 Gbps copper
- Customers use their standard switches just like on-premises Exadata
  - Can optionally place switches inside Exadata rack
- Customers control client network configuration
  - Support for flexible VLAN configurations
  - Separate client and backup networks
  - Customer DNS, NTP, and routers



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Exadata Cloud at Customer offers simple connectivity to the customer's data center network. Network connectivity is established via a direct layer 2 network connection from the database servers to the customer's network switches.

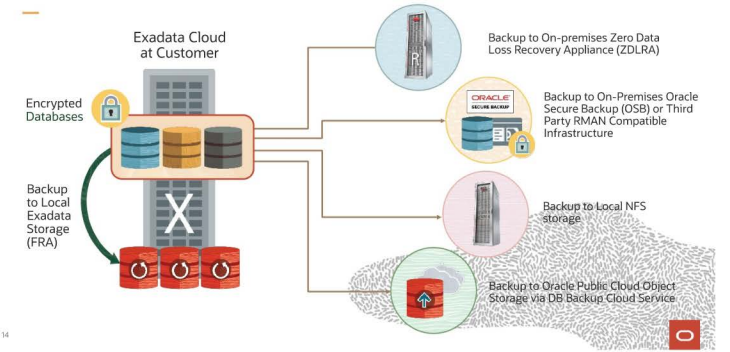
Customers control the client network configuration. There are two networks established for each VM Cluster on the Exadata Cloud at Customer.

The **Client network** is used for client access to the database. Applications access databases on Exadata Cloud at Customer through this network using Single Client Access Name (SCAN) and Oracle Real Application Clusters (Oracle RAC) Virtual IP (VIP) interfaces. By default, **the Oracle Net configuration secures data in transit by using native encryption and integrity capabilities.**

The **Backup network** is a similar but separate network to the client access network. It can be used for access to the database servers for various purposes, including backups and bulk data transfers.

The networks use the customer's own DNS, NTP, and routers.

Database Backup Options



Exadata Cloud at Customer provides a variety of Database Backup Options. Using Cloud Automation you can backup to:

- the Zero Data Loss Recovery Appliance
- local NFS-attached storage
- Oracle Public Cloud Object Storage
- or to Local Exadata Storage (FRA)

Options also exist for manual backup configuration to other existing on-premises backup infrastructure. In this case, the customer would install backup agents in the VM and configure RMAN.

Exadata Cloud@Customer Service Overview

Service Operation

- Oracle owns and manages Exadata Infrastructure
- Customers configure and manage VM Guests and Databases
- Releases support Exadata Hardware & Software
- Oracle Database 19c, 18c, 12.2.0.1, 12.1.0.2, 11.2.0.4

Deployment

- Control Plane available in Oracle Cloud Infrastructure (OCI) regions
- Hardware deployed in customer data center

Lifecycle

- Automated UI, CLI, SDK, API - provisioning, scaling, patching, backup, disaster recovery

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Now, I'll provide a brief overview of the service…

In terms of the service operation, Oracle manages the Exadata infrastructure. Customers manage everything running in the database VM.

As you would expect, both the Exadata hardware and software releases are supported with Exadata Cloud at Customer and the service currently supports Oracle Database versions 11.2.0.4 to 19c.

Exadata Cloud at Customer simplifies lifecycle tasks such as provisioning, scaling, patching, backup, and disaster recovery through cloud automation.

Exadata C@C Cloud Management Interfaces

Oracle Cloud (OCI) Infrastructure Control Plane

- OCI UI: Browser access via https – great for one-time and ad-hoc actions
- OCI REST APIs: Programmatic access via https
- Developer Interfaces to REST APIs
  - OCI Command Line Interface (CLI)
    - Extend the Console's functionality
    - Convenient to automate tasks through scripting
  - Software Development Kits (SDKs)
    - Build & deploy apps that integrate with OCI services
    - Java SDK, Python SDK, Ruby SDK, Go SDK
  - DevOps Tools: Terraform and Ansible
    - Programmatically manage, version, and persist infrastructure as code

OCI Console

OCI CLI and SDK

Terraform and Ansible

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Exadata Cloud at Customer provides a wide choice of management interfaces. The easiest to use is the web-browser interface, which allows you to use a browser to graphically configure and initiate operations. This is great for one-time actions, but most customers prefer a more programmatic interface for things done repeatedly, such as provisioning and patching databases. Anything you can do with the browser, you can also do with a corresponding REST API.

Similar to the browser, the REST APIs transit the internet via https, and require no special software installed on the local system. All interfaces are also exposed via a command line interface that can be used for scripting, and for building custom tooling, there are software development kits to integrate with common languages such as Java, Python, Ruby, and Go. If you prefer to manage your infrastructure as code, there are also Terraform and Ansible interfaces.

Simple Cloud Management Model in Your Data Center

Exadata Cloud at Customer follows a simple cloud management model.

As mentioned previously, Oracle owns and manages the infrastructure. This includes the database servers, Hypervisor Hosts, storage servers, and the fabric network. Customers have flexibility in scheduling maintenance windows for Oracle to perform infrastructure maintenance.

When customers subscribe to Exadata Cloud at Customer, they are responsible for managing everything running in the database VMs. They manage the VMs, grid infrastructure, and the databases using the cloud automation tools I previously mentioned.

And of course, customers own and manage everything inside the database. This includes schemas, data, and encryption keys.

Elastic Cloud Financial Model in Your Data Center

Cloud subscription for a minimum 4-year term

- Infrastructure subscription to standardized Exadata shapes
- Database compute core (OCPU) subscription based on pay-per-use

Scale active CPUs based on business peaks

- Online scaling from 2 OCPUs per VM to full capacity of system
- API or Cloud UI enables and disables OCPUs

Two licensing models – both use Universal Cloud Credits

- Enterprise Edition Extreme Performance subscription
  - Full Oracle Database Enterprise Edition with all Options included - RAC, ADG, Multitenant, etc.
- Bring Your Own Database Licenses (BYOL) and just subscribe to DB Service
  - Included: EM Packs (Diagnostic, Tuning, Data Masking, Subsetting), TDE, and Real Application Testing

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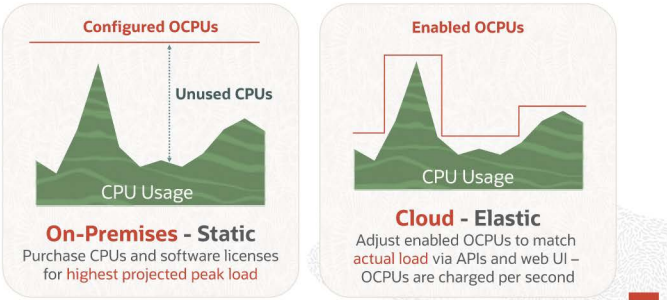
With Exadata Cloud at Customer, customers benefit from cloud economics and only pay for what they use. Customers pay for database and storage server infrastructure with a four-year minimum term. Customers also pay for the OCPUs with per second billing.

Customers have a choice of license models in the cloud. They can subscribe to our Enterprise Edition Extreme Performance service, which includes a license to use all Oracle database features and options as well as all database management packs. It also includes all Exadata software features. This is the best option for customers without existing database licenses, or those with databases having variable workloads that can benefit from pay-for-use pricing.

If a customer already has all the needed licenses, they can also bring their own licenses to the cloud. This entitles the customer to use all options and packs they are licensed for on the Exadata Cloud@Customer at a greatly reduced subscription price. As part of the BYOL platform service, Oracle also provides no-additional-cost entitlements to use Transparent Data Encryption, which is mandatory in the cloud, Data Masking and Subsetting management pack, Diagnostics pack, Tuning pack, and Real Application Testing. In addition, all Exadata software features are included.

Last point… customers can switch between the two models at any time, as often as they like. This means, for example, they could use BYOL most of the time, but switch over to the license service to handle infrequent spikes on workload that require more capacity than they have licensed via BYOL.

Elastic Scaling to Reduce Costs



Let's take a minute to discuss the importance of vertically scaling your virtual machines. Scaling VMs as workload scales, up and down, is important to reducing costs, and is one of the greatest advantages of cloud over on-premises deployments. A traditional on-prem system must be sized to handle peak workload, as on-prem deployments do not support dynamically scaling up and down. In fact, usually these systems are oversized as they are difficult to scale and capacity needs to be ensured for workload spikes. However, during most normal operations, the system is under utilized resulting in paying licensing fees on un-used CPUs.

Contrast that with a cloud deployment, where the **service can be scaled up and down to meet peak or seasonal demands allowing paying for the DB service only when needed**. Scaling operations can be done on-demand or **programmatically, using the various APIs and CLIs, based on on metrics or on a schedule**. And unlike most cloud database services, Exadata allows you to scale online, with no disruption to the database service.

Exadata C@C Enforces High Security Standards in Every Component

Best Practices Developed by Industry and Oracle Experts World-Wide

Infrastructure
- FIPS 140-2 compliant authentication, keystroke logging, Oracle Global Information Security oversite
- Regular security scans, monthly security updates, compliant with PCI DSS, ISO-27001, HIPAA

Network
- Layer 2 VLAN isolation, Oracle Native Network Encryption, dedicated networks for specific traffic

Platform
- STIG hardened, token-based SSH access, minimal packages, full customer control of operating system

Database
- Oracle Transparent Data Encryption (ASO), complex passwords, automation for security updates
- Optional use of external keystore (e.g., Oracle Key Vault), Database Vault, and Advanced Security Options
- Database Security Assessment Tool (DB SAT)

Automation
- Oracle Cloud Infrastructure Identity and Access Management (IAM) with compartments
- Automation path protected mTLS 1.2 over https on port 443

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Next, let's go over security. Exadata Cloud at Customer enforces high security standards, based on best-practices developed by industry and Oracle experts, throughout its stack. Infrastructure security standards compliance, network controls, encryption and identity and access management are built into Exadata Cloud at Customer to ensure end-to-end data protection. It should also come as no surprise that Exadata Cloud at Customer supports all Oracle Database Security Options.

Gen 2 ExaC@C

Complementary Solutions

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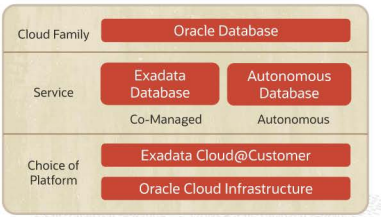
Choice of Database Services for Exadata Cloud@Customer

Exadata Cloud@Customer is a platform

- ExaC@C can run either Exadata Database Service or Autonomous Database

The same services run in OCI and on ExaC@C

- Identical look-and-feel
- Same API
- Same database
- Same feature set (different release dates)



Exadata Cloud at Customer is a platform that supports running either co-managed Oracle database as a service or Oracle Autonomous Database. These are the same database services that run in the Oracle Cloud Infrastructure public cloud offering the same look-and-feel, API, database, and feature set – though release dates may vary.

Autonomous Database Exadata Cloud@Customer

All benefits of Autonomous Database Dedicated in your data center

- Oracle fully automates and manages VMs and Databases
- Self-driving
- Self-securing
- Self-repairing

Customizable Isolation Policies

Customizable Operational Policies

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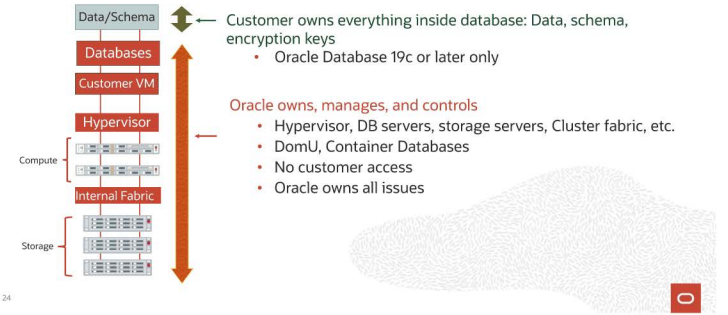
Let's discuss a little more about Autonomous Database on Exadata Cloud at Customer. Autonomous database dedicated offers all the benefits of Oracle's autonomous database running in your data center. In the autonomous database model, Oracle automates everything – including the VMs and Databases. This provides a true self-driving, self-securing and self-repairing solution.

Autonomous Management Model in Your Data Center



When we spoke of the Exadata Cloud at Customer cloud management model previously, we discussed how Oracle owns and manages the infrastructure and customers manage everything running in the database VMs.

In the **Autonomous** management model, in addition to the infrastructure, Oracle owns and manages the Customer VM and Databases as well. The customer continues to own and manage only things inside the database, e.g. data, schema, and encryption keys.

Gen 2 ExaC@C

Summary

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Gen 2 Exadata Cloud@Customer

The Most Advanced On-Premises Database Cloud Solution

- Most functionality-rich database
- Most secure database platform
- Most advanced cloud infrastructure

Cloud Benefits Without IT Disruption
oracle.com/exadata

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Summary

After completing this lesson, you should have learned to describe:

- Exadata Vision
- Exadata Deployment Models
- Exadata Platform
- Exadata Cloud@Customer Service Overview
- Autonomous Database on Exadata Cloud@Customer

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Exadata Cloud@Customer - Create VM Cluster Network

VM Cluster Network

- Required before VM Cluster creation
- Needed before database creation
- Specifies the network resources allocated to the ExaCC

When you click **Create VM Cluster Network**, the **Data Center Network Details** page requires:

- A VM cluster network display name
- Client network details and Backup network details
- VLAN ID, CIDR block, Netmask, Gateway, Hostname Prefix, and Domain Name
  - **Note**: The CIDR block is specified only as a convenience for allocating IP addresses, which can be edited manually before configuration is finalized on the subsequent screen.
- DNS and NTP server details

2

The VM cluster provides a link between your ExaCC infrastructure and the Oracle Databases.

Before you can create any databases on your ExaCC infrastructure, you must create a VM cluster, and before creating a VM Cluster, you have to create a VM Cluster Network for the VM Cluster to use.

The VM cluster network specifies IP addresses to use for the Oracle Database environment within each VM and the SCAN addresses. Each Database Server, referenced by host name, will have a VM for a given VM cluster, and each will require relevant IP addresses. The VM cluster network includes definitions for the Exadata client network and the Exadata backup network that are used to connect databases to both database clients and to backup destinations.

When you create a **VM Cluster Network**, the **Data Center Network Details** page requires:

- A VM Cluster network display name
- Client network details and Backup network details, including: VLAN ID, CIDR block, Netmask, Gateway, Hostname Prefix, and Domain Name

Note: The CIDR block is specified only as a convenience for allocating IP addresses, which can be edited manually before configuration is finalized on the subsequent screen.

- DNS and NTP server details

Exadata Cloud@Customer - Validate VM Cluster Network

You can only validate a VM cluster network if its current state is **Requires Validation**, and if the underlying Exadata infrastructure is activated.

1. Open the navigation menu. Under Database, click **Exadata Cloud@Customer.**
2. Choose the **Region** and **Compartment** for the Infrastructure associated with the VM cluster network to validate.
3. Click **Exadata Infrastructure.**
4. Click the name of the Oracle Exadata infrastructure you are interested in.
5. Click the name of the VM cluster network you want to validate.
6. Click **Validate VM Cluster Network**. This button is only available if the VM cluster network requires validation.
7. In the resulting dialog, click **Validate** to confirm the action.

After a successful validation, the state changes to **Validated** and it is ready to use.

To validate the the VM cluster network, its current state must be in **Requires Validation** and the Exadata Infrastructure must be activated.

Open the navigation menu. Under **Database**, click Exadata **Cloud@Customer**.

Choose the **Region** and **Compartment** for the Infrastructure associated with the VM cluster network to validate.

Click **Exadata Infrastructure**.

Click the name of the **Oracle Exadata infrastructure** you are interested in.

Click the name of the VM cluster network you want to validate.

Click **Validate VM Cluster Network**. This button is only available if the VM cluster network requires validation.

In the resulting dialog, click **Validate** to confirm the action.

The state should be Validated and the VM Cluster network is ready to use.

Exadata Cloud@Customer - Move VM Cluster to Another Compartment

Compartment change for a VM Cluster

- Change applied to VM Cluster
- Also applied to compute nodes and databases
- Does not affect other resources

Procedure:

1. Open the Navigation menu. Under Database, click **Exadata Cloud@Customer.**
2. Choose the **Region** and **Compartment** that contains the VM cluster that you want to move.
3. Click **VM Clusters.**
   * **Note**: The **VM Cluster Details** page displays information about the selected VM cluster.
4. Click the name of the VM cluster that you want to move.
5. Click **Move Resource.**
6. In the resulting dialog, choose the new compartment for the VM cluster, and click **Move Resource**.

When you move a VM cluster, the compartment change is also applied to the compute nodes and databases that are associated with the VM cluster. However, the compartment change does not affect any other associated resources, such as the Exadata infrastructure, which remains in its current compartment.

To make the change:

1. Open the Navigation menu. Under Database, click **Exadata Cloud@Customer.**
2. Choose the **Region** and **Compartment** that contains the VM cluster that you want to move.
3. Click **VM Clusters**. The **VM Cluster Details** page displays information about the selected VM cluster.
4. Click the name of the VM cluster that you want to move.
5. Click **Move Resource.**
6. In the resulting dialog, choose the new compartment for the VM cluster, and click **Move Resource.**

Exadata Cloud@Customer - Create a VM Cluster

To create a VM cluster, choose a **Region**, click the **Create VM Cluster** button, and provide:

- A Compartment
- A Display name

Next, you'll need to:

- Select the ExaCC Infrastructure.
- Select a VM Cluster Network.
- Choose the Grid Infrastructure version.
- Specify the OCPU count per VM (min. 2.)
- Specify the memory per VM (min 30GB.)
- Specify the Local File System size per VM (min. 60GB.)
- Configure the Exadata Storage:
  - Usable Storage (min. 2TB)
  - Allocation of storage, including Snapshots or Local Backups
- Add a public SSH Key.
- Choose a License Type (BYOL or License Included.)
- Choose a Timezone in the Advanced Options.
- Click Create **VM Cluster.**

To create a VM cluster, choose a **Region**, click the **Create VM Cluster** button and then fill in the necessary information. A few things to take note of:

When specifying the OCPU count per VM, the minimum is 2 and the maximum is the number of cores that have not been allocated.

The amount of memory per VM is specified in multiples of 1 gig.

The local file system per VM has a minimum of 60 GB.

When configuring Exadata storage, the minimum is 2TB of usable storage.

There are two options for License Type, BYOL and License Included. This selection is based upon your organizations choices during time of procurement. If you had chosen to apply your own, previously existing licenses, then select BYOL. If you had procured your Exadata Cloud@Customer to include Database licensing in the cost of the OCPUs, select License Included. Finally, make sure to go into **Advanced Options** to choose a Timezone. Then click **Create VM Cluster**.

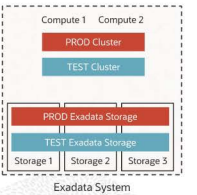
Exadata Cloud@Customer - Multiple VM Clusters

Allows customers to better utilize their ExaCC system:

- Provide isolation across departments and uses
- Each VM cluster is allocated OCPUs (split evenly between nodes) as well as Memory, Local Filesystem, and ASM storage
- ASM Storage can be allocated for Snapshots and Local Backups

You can create **multiple** VM Clusters per Exadata rack:

- Each VM Cluster has its own Grid Infrastructure software.
- Each VM Cluster has complete network isolation.
- Each VM Cluster has dedicated OS and Storage partitions.
- Each VM Cluster can run different versions of software.
- Each VM cluster has its own public/private key pair access.



By leveraging multiple VM Clusters, customers can better utilize their ExaCC system. Multiple VM Clusters provides isolation across departments and different use cases like production and test. Each VM cluster is allocated OCPUs, memory, local filesystems, and ASM storage allowing for better resource control. ASM storage can be allocated for Snapshots and local backups.

Each VM Cluster created has its own Grid Infrastructure software, complete network isolation, dedicated OS and Storage partitions, public/private key pair access and can run different versions of the software.

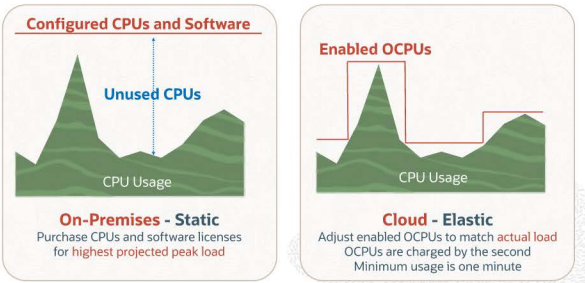
Exadata Cloud@Customer - ASM Storage Allocation Percentage

Note: You cannot change the options for the Exadata storage allocation after the VM Cluster has been created.

Allocate Exadata Snapshots	Allocate Local Backups	ASM Disk Group Storage Allocation Percentage		
		Data %	Reco %	Sparse %
No	No	80	20	0
No	Yes	40	60	0
Yes	No	60	20	20
Yes	Yes	35	50	15

When creating the ASM storage allocations, the table here shows the different allocation percentages. Keep in mind that you cannot change the options for the Exadata storage allocation after the VM cluster has been created.

Exadata Cloud@Customer - Elastic OCPU Scaling



With **On-Premises** systems, you purchase and allocate based on your highest project peak load. With **cloud based** systems, they have elastic scalability. This means that they can scale up and use resources as needed and then scale back down when they are not needed. The billing is normally done on a per minute basis, saving a significant amount of money.

You can scale the service up and down to meet peak or seasonal demands and pay for DB software and DB Service only when you need it. Scale active OCPUs up and down depending on time. Run standby DB with minimal cores, scale up when it becomes the primary DB.

You can also programmatically scale the system up and down, either on metrics or on a schedule. Scale using CLI, REST API, SDK, or Terraform. Scaling is fully online, no downtime required.

Exadata Cloud@Customer - Scaling VM Cluster Resources

You may wish to scale up or down the resources on a VM Cluster:

- **Use Case 1:** If you have allocated all of the resources to one VM Cluster, you can scale down resources as needed in order to create additional new VM Clusters.
- **Use Case 2:** If you want to allocate different resources to cater for different workloads, then you can scale up or down accordingly, balancing resource requirements and cost.

You can scale any combinations of the following resources:

- OCPU
- Memory
- Local storage
- Exadata storage

Each individual operation can take approximately 15 minutes and all the operations run in a series if multiple scale down is executed. In general, local storage and memory scale down takes the most time.

Let's take a look at a few use cases. You may wish to scale up or down the resources on a VM Cluster. You could use this either to scale down the resources on the one VM Cluster to free up resources as needed to create the additional VM Clusters. You could also allocate different resources to cater for different workloads, scaling up to meet additional needs, or scaling down to reduce costs.

The resources that you are allowed to scale are OCPU, Memory, Local Storage, and Exadata Storage. A few things to keep in mind. Each individual operation can take approximately 15 minutes. If multiple resources are scaled as one action, all of the scaling operations run in a series.

Exadata Cloud@Customer - Roles and Responsibilities

Oracle owns and manages Exadata infrastructure:

- Servers, storage, storage software, networking inside rack, firmware, hypervisor, etc.
- Routine management is automated and executed through agents accessed through REST APIs
- Oracle Cloud OPS accesses infrastructure to diagnose and correct issues (no access to user VM or DBs)

Customer subscribes to VM and database services:

- Up to 8 VM clusters on each X8M Exadata infrastructure
- Number of database services limited by available memory and storage resources
- 11.2.0.4, 12.1.0.2, 12.2.0.1, 18c, and 19c database versions supported by cloud automation

Customers manage VMs and databases using Oracle Automation:

- Only customer has credentials to access customer VMs and databases
- Customer has root access to customer VMs and DBA access to databases
- Oracle provides automation for lifecycle of Database, Grid Infrastructure, agents, operating system, etc.

Customers configure and run VMs and databases as they like:

- Manage database schemas, users, database access, and encryption keys

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It's important to understand the roles and responsibilities between Oracle and the Customer.

Oracle owns and manages the Exadata Infrastructure. Routine management is automated and execute through agents accessed through rest APIs. Oracle Cloud OPS accesses the infrastructure to diagnose and correct issues but has no access to user VMs or DBs.

Customers subscribe to VM and database services. They can run up to 8 VM clusters on each X8M. The number of database services are limited by available memory and storage resources. The specific database versions that are supported by cloud automation are listed here.

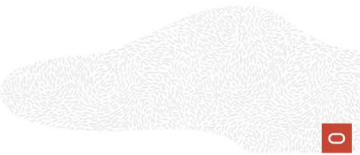
Customers manage VMs and databases using Oracle Automation. Only the customer has the credentials to access their VMs and databases. The customer has root access to their VMs and DBA access to their databases. Oracle provides automation to the customer for the lifecycle of the various components.

Customers configure and run their VMs and databases as they like. They manage database schemas, users, database access, and encryption keys.

Exadata Cloud@Customer - Command Line Tools

There are multiple local command line tools that allow management and monitoring of Exadata Cloud@Customer. These are only recommended in cases where the OCI API, OCI Console, or OCI Command Line cannot be used to complete an action.

- DBAASCLI
- EXACLI
- BKUP_API



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In addition to the OCI tools for management, there are some local command line tools that allow for the management and monitoring of Exadata Cloud at Customer. Generally, it is recommended to always leverage the OCI tools whenever possible, but these commands can be useful when OCI tools cannot be used. (For example, if you find yourself in a disconnected state from OCI and need to take urgent administrative actions, or when a needed action is not available via the OCI tools.)

- **DBAASCLI**: You can use the dbaascli utility to perform various life-cycle and administration operations. Operations include, but are not limited to, TDE, Oracle Home management, Listener control, Pluggable database lifecycle management, patching.
- **EXACLI:** The exacli command provides a subset of the commands found in the on-premises Exadata command line utility. For ExaCC deployments, exacli enables you to obtain real-time information from the cell metrics and diagnostic information.
- **BKUP_API:** It can be used for command line backup and recovery operations.

Exadata Cloud@Customer - Console Automation Highlights

Database and Grid Infrastructure

- Autonomous database
- Create, delete, start, stop, and restart
- Backup, restore
- Patch apply, patch rollback
- Shared Oracle Homes
- Move DB to a different Oracle Home
- DB sync
- Data Guard setup, switchover, switchback
- Data Guard failover and failback
- Transparent data encryption
- Oracle Native Network Encryption

Virtual Machine Cluster

- Multiple VM clusters per system
- Create, delete, start, stop, and restart
- Resource scaling:
  - OCPU
  - Memory
  - Local storage
  - Exadata storage
- OCPU scaling
- Install ssh access tokens
- Change license model
- Storage configuration
- Patch apply, patch rollback, upgrade via command line tools

Exadata Cloud@Customer - Create Database Homes

Oracle Database Homes

- Created using Oracle Cloud Infrastructure Console, the API, or the CLI
- Contains Oracle Database software binary files

- Open the navigation menu. Under **Database**, click **Exadata Cloud@Customer.** Choose your **Compartment**. From the list of the VM Clusters displayed, click the VM cluster on which you want to create the Database Home.
- Under **Resources**, click **Database Homes.**
- Click **Create Database Home.**
- In the dialog box, enter:
  - **Database Home display name**: The display name for the Database Home
  - **Database version**: The Oracle Database version for this Database Home
  - Supported versions are 11g Release 2, 12c Release 1, 12c Release 2, 18c, and 19c
- Click **Create**. When the Database Home creation is complete, the status changes from Provisioning to **Available**.

2

You can add **Oracle Database Homes** (referred to as Database Homes in Oracle Cloud Infrastructure) to an existing VM cluster by using the Oracle Cloud Infrastructure Console, the API, or the CLI. A Database Home is a directory location on the Exadata database compute nodes that contains Oracle Database software binary files. To create an Oracle Database home in an existing VM cluster with the Console, be prepared to provide values for the fields required.

Open the navigation menu. Under **Database**, click **Exadata Cloud@Customer**. Choose your **Compartment**. From the list of VM Clusters displayed, click the VM cluster on which you want to create the **Database Home.**

Under **Resources**, click **Database Homes**.

Click **Create Database Home.**

In the dialog box, enter:

Database Home display name: The display name for the Database Home

Database version: The Oracle Database version for this Database Home

Supported versions are 11g Release 2, 12c Release 1, 12c Release 2, 18c, and 19c.

Click **Create**. When the Database Home creation is complete, the status changes from Provisioning to **Available.**

Exadata Cloud@Customer - View Database Homes

You can use the Console to view information about an Oracle Database Home.

To view the configuration details of an Oracle Database home, use this procedure.

- Open the navigation menu. Under **Database**, click **Exadata Cloud@Customer.**
  - *VM Clusters is selected by default.*
- Click **Compartment**, and select your compartment.
- A list of VM Clusters is displayed for the compartment you selected.
- In the list of VM clusters, click the VM cluster that contains the Database Home in which you are interested.
- Under **Resources**, click **Database Homes.**
- In the list of Database Homes, find the Database Home you want to view, and then click the Database Home name to display details about it.

3

You can use the **Console** to view information about an Oracle Database Home.

To view the configuration details of an Oracle Database home, use this procedure:

- Open the navigation menu. Under **Database**, click **Exadata Cloud@Customer**.

  VM Clusters is selected by default.
- Click **Compartment**, and select your compartment.
- A list of VM Clusters is displayed for the compartment you selected.
- In the list of VM clusters, click the VM cluster that contains the **Database Home** in which you are interested.
- Under **Resources**, click Database Homes.
- In the list of Database Homes, find the Database Home you want to view, and then click the Database Home name to display details about it.

Exadata Cloud@Customer - Delete Database Homes

To delete a Database Home with the Console, use this procedure.

Note: You cannot delete a Database Home while it still contains Databases. Before you can delete a Database Home, you must first move or terminate the Databases within the Database Home.

- Open the navigation menu. Under **Database**, click **Exadata Cloud@Customer**. VM Clusters is selected by default.
- Select **Compartment**, and choose the Compartment that you want to view. A list of VM Clusters is displayed for the chosen Compartment.
- In the list of VM Clusters, click the VM Cluster that contains the Database Home that you want to delete.
- Under **Resources**, click **Database Homes.**
- In the list of Database Homes, find the Database Home that you want to delete, and click the Database Home name to display details about it.
- On the Database Home Details page, click **Delete**.

To delete a Database Home with the Console, use this procedure.

Note: You cannot delete a Database Home while it still contains Databases. Before you can delete a Database Home, you must first move or terminate the Databases within the Database Home.

- Open the navigation menu. Under **Database**, click **Exadata Cloud@Customer**. VM Clusters is selected by default.
- Select **Compartment**, and choose the Compartment that you want to view. A list of **VM Clusters** is displayed for the chosen Compartment.
- In the list of VM Clusters, click the VM Cluster that contains the Database Home that you want to delete.
- Under **Resources**, click **Database Homes**.
- In the list of Database Homes, find the Database Home that you want to delete, and click the Database Home name to display details about it.
- On the **Database Home Details** page, click **Delete**.

Exadata Cloud@Customer - Database Editions and Licenses

Oracle Database Software Releases

Exadata Cloud@Customer supports the following Oracle Database software releases:

- Oracle Database 19c
- Oracle Database 18c
- Oracle Database 12c Release 2
- Oracle Database 12c Release 1
- Oracle Database 11g Release 2

Bring Your Own License (BYOL)

Customers that use the **Bring Your Own License** (BYOL) option with Oracle Enterprise Edition are granted the rights to use Oracle Transparent Data Encryption (TDE), Diagnostics Pack, Tuning Pack, Data Masking and Subsetting Pack, and Real Application Testing. The Exadata System software is also included in a BYOL subscription.

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You can create one or more databases on each Exadata Cloud@Customer system. Other than the storage and processing limits of your Oracle Exadata system, there is no maximum for the number of databases that you can create. By default, databases on Exadata Cloud@Customer use Oracle Database Enterprise Edition - Extreme Performance. This edition provides all the features of Oracle Database Enterprise Edition, plus all of the database enterprise management packs, and all of the Enterprise Edition options, such as Oracle Database In-Memory, and Oracle Real Application Clusters (Oracle RAC). If you use your own Oracle Database licenses, then your ability to use various features is limited by your license holdings.

Here you can see the supported Oracle Database software releases.

When using Bring your own License, you are granted the rights to use the following options.

Exadata Cloud@Customer Console - Create a Database

From the Console, you can create a new database. A summary of the steps can be seen below. For the full details, please consult the documentation.

- From the VM Cluster, or the Database Home details page, from where you wish to create a database, select **Create Database.**
- Provide the **database name.**
- Provide a **unique name** for the database.
- Select a **database version.**
- Database Home
- Provide the name of the first **PDB.**
- Provide the **administration password.**
- Choose the **database workload type**.
- Backup Destination Type

From the Console, you can create a new database. A summary of the steps can be seen below, for full details please consult the documentation.

- From the VM Cluster, or the **Database Home** details page from where you wish to create a database, select **Create Database.**
- Provide the database name: Specify a user-friendly name that you can use to identify the database.
- Provide a unique name for the database: Optionally, specify a unique name for the database. This attribute defines the value of the **DB_UNIQUE_NAME** database parameter.
- Select a database version: From the list, choose the Oracle Database software release that you want to deploy.
- Database Home: Select an existing Database Home or create one as applicable. Note that this field is not available when you create a Database from the Database Home details page.
- Provide the name of the first PDB: (Optional) Specify the name for the first PDB.
- Provide the administration password: Provide and confirm the Oracle Database administration password.
- Choose the database workload type: Select the workload type that best suits your application.
- Backup Destination Type: Select a backup destination for the database. From the list, choose an option of None, Local Storage, Object Storage, NFS, or Zero Data Loss Recovery appliance.

Exadata Cloud@Customer Console - Moving a Database

From the Console, you can move an existing database to a different home. This can be useful for out-of-place patching and consolidation of Database Homes.

- On the **Database Details** page of the database you want to move, click **Move Database.**
- In the resulting dialog box, select the target **Database Home.**
- Click **Move Database.**
- The database will be stopped in the current home and then restarted in the destination home. While the database is being moved, the Database Home status displays as **Moving Database**. When the operation completes, Database Home is updated with the current home. If the operation is unsuccessful, the status of the database displays as **Failed**, and the Database Home field provides information about the reason for the failure.

7

From the Console, you can move an existing database to a different home. This can be useful for out-of-place patching and consolidation of Database Homes.

- On the **Database Details** page of the database you want to move, click **Move Database.**
- In the resulting dialog box, select the target Database Home.
- Click **Move Database.**
- The database will be stopped in the current home and then restarted in the destination home. While the database is being moved, the Database Home status displays as **Moving Database**. When the operation completes, Database Home is updated with the current home. If the operation is unsuccessful, the status of the database displays as **Failed**, and the Database Home field provides information about the reason for the failure.

Exadata Cloud@Customer Console - Terminate a Database

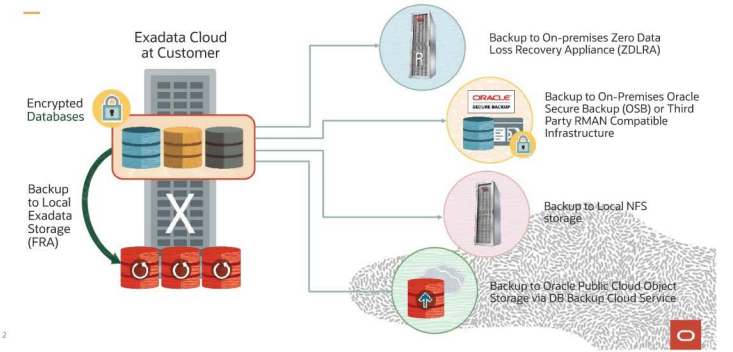
From the Console, you can terminate an existing database. A summary of the steps can be seen below. Once a database is terminated, it is not possible to restore it and all the data will be erased.

- Open the navigation menu. Under **Database**, click **Exadata Cloud@Customer**. VM Clusters is selected by default.
- Choose your **Compartment** that contains the VM cluster that hosts the database that you want to terminate.
- Click the name of the VM cluster that contains the database that you want to terminate.
- In the Resources list of the VM Cluster Details page, click **Databases**.
- Click the name of the database that you want to terminate. The Database Details page displays information about the selected database.
- Click **Terminate**.
- In the resulting dialog, enter the name of the database, and then click **Terminate Database** to confirm the action.

From the Console, you can terminate an existing database. A summary of the steps can be seen below. Once a database is terminated, it is not possible to restore it and all the data will be erased.

- Open the navigation menu. Under **Database,** click **Exadata Cloud@Customer.** VM Clusters is selected by default.
- Choose your **Compartment** that contains the VM cluster that hosts the database that you want to terminate.
- Click the name of the VM cluster that contains the database that you want to terminate.
- In the **Resources** list of the **VM Cluster Details** page, click Databases.
- Click the name of the database that you want to terminate. The **Database Details** page displays information about the selected database.
- Click **Terminate.**
- In the resulting dialog, enter the name of the database, and then click **Terminate Database** to confirm the action.

Exadata Cloud@Customer - Database Backup Options



The database backup options with the Exadata cloud at customer include using cloud automation to back up to an on-premises zero data loss recovery appliance, an on-premises RMAN compatible infrastructure, local NFS storage, or the oracle public cloud object storage. You can also manually configure backups to existing on-premises backup infrastructure using backup agents and configuring RMAN.

Database Backup Options with ExaCC:

- Using Cloud Automation
  - Oracle Public Cloud Object Storage
  - Object Storage and Local Exadata Storage (FRA)
  - Zero Data Loss Recovery Appliance
  - Local NFS-Attached Storage
- Manual configuration to existing on-premises backup infrastructure
  - Customer must manage backup agents and configure RMAN manually

Exadata Cloud@Customer - Backup Locations

Backups:

- Exadata Cloud@Customer backup facility
- Configure a backup location
- Backup location cannot be changed once set
- Selecting "None" disables backups

Backup locations:

- Configure on backup location per database
- Use local Exadata storage, object storage, network file storage, or Oracle Recovery Appliance
- Local Exadata storage option and object storage option requires no explicit backup location
- Oracle Recovery Appliance or network file storage requires creation of a backup destination

3

For backups, you can either use the Exadata Cloud@Customer backup facility, or you can configure a backup location on a location you manage. Once a backup location has been selected for a database, it cannot be changed. If none is the selected backup location, then no backup will be configured – an option that can be changed later to enable backups.

Backup locations are configured per database, and can use either local storage on the Exadata, OCI Object Storage, network file Storage (NFS), or an Oracle Recovery Appliance (ZDLRA). For local Exadata storage and Oracle Object Storage, a backup location does not need to be explicitly created by the user.

If you want to store backups on an Oracle Recovery Appliance, or on a network file storage (NFS) location that you manage, then you must first create a backup destination. Each backup destination defines the properties that are required to connect to the Recovery Appliance or NFS location, and each backup destination must be accessible in your data center from the VM cluster nodes.

Exadata Cloud@Customer - Automatic Backups

Oracle Exadata Cloud@Customer provides automatic database backup facilities that use Oracle Recovery Manager (RMAN). When you create a database, you can specify a backup destination and enable automatic backups.

After database creation, you can also:

- View a list of available backups.
- Enable or disable automatic backups.
- Edit backup settings.
- Restore a database.

You can perform these operations by using either the Console, or the API.

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- View a list of available backups.
- Enable or disable automatic backups.
- Edit backup settings.
- Restore a database.

You can perform these operations by using either the Console, or the API

Exadata Cloud@Customer - Automatic Backup Details

Automatic backups are scheduled daily. The automatic backup process can run at any time within the daily backup window, which is between midnight and 6:00 AM in the time zone of the virtual machine (VM) cluster that hosts the database.

Automatic backups use a combination of full (RMAN level 0) and incremental (RMAN level 1) database backups:

- Zero Data Loss Recovery Appliance, after an initial full backup is performed, Zero Data Loss Recovery Appliance creates and validates virtual full backups from each daily incremental backup.
- For backups to NFS, OSS, or Local, the default interval between level 0 backups is seven days. The default level 0 day is Sunday.

5

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Exadata Cloud@Customer - Backup Retention Periods

The retention period defines the period for which automatic backups are maintained

For backups to:

- **Zero Data Loss Recovery Appliance**, the retention policy that is implemented in the appliance controls the retention period
- **Local Exadata Storage**, a preset retention period of: 7 days, or 14 days; the default retention period is 7 days
- **Oracle Cloud Infrastructure Object Storage**, a preset retention period of: 7 days, 14 days, 30 days, 45 days, or 60 days; the default retention period is 30 days
- **Network File System (NFS) Backups**, a preset retention period of: 7 days, 14 days, 30 days, 45 days, or 60 days; the default retention period is 30 days

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For backups to:

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- **Local Exadata Storage**, a preset retention period of: 7 days, or 14 days; the default retention period is 7 days
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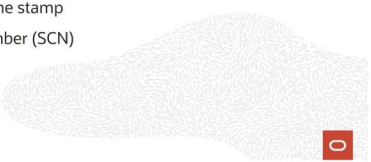
- **Network File System (NFS) Backups**, a preset retention period of: 7 days, 14 days, 30 days, 45 days, or 60 days; the default retention period is 30 days

Exadata Cloud@Customer - Backup and Recovery

While a backup is in progress, Oracle recommends that you avoid performing actions that could interfere with availability, such as restarting compute nodes, or applying patches. If an automatic backup operation fails, then the backup is deferred until the next day's backup window.

When required, you can restore Oracle Database to:

- The latest available restore point
- A specific point in time by providing a time stamp
- An Oracle Database System Change Number (SCN)



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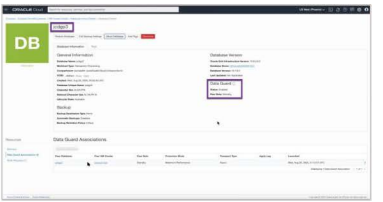
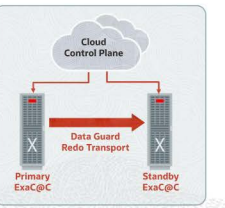
- A specific point in time by providing a time stamp
- An Oracle Database System Change Number (SCN)

The backup and recovery facilities cater only for database backup and recovery, which includes Oracle Database data files, log files, control files, and the server parameter (SP) file. You are responsible for backing up other files on your compute nodes. In particular, Oracle strongly recommends that you back up the Transparent Data Encryption (TDE) keystore (wallet). Without the TDE keystore, the Oracle Database backups are effectively useless, because you cannot read the data contained in the backup.

Exadata Cloud@Customer - Disaster Recovery Using Data Guard





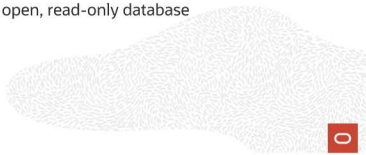
- Real-time, database-optimized disaster recovery
- Ultra-low RTO, zero RPO
- Cloud automation for Create/Delete/Switchover/Failover/Reinstate
- CLI-support to configure additional Data Guard attributes

Oracle Data Guard can also be configured from the Exadata Cloud@Customer OCI Console or API to simplify setting up a Disaster Recovery environment.

Exadata Cloud@Customer - Configuring Data Guard

When you use the Console or the API to enable Data Guard for an Exadata database compute node database:

- The standby database is a physical standby
- The peer databases (primary and standby) are in the same compartment and the database versions are identical
- You are limited to one standby database for each primary database
- The standby database is deployed as an open, read-only database (Active Data Guard)



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To configure a Data Guard system across regions or between on-premises and Exadata database compute nodes, or to configure your database with multiple standbys, you must access the database host directly and set up the Data Guard manually.

Exadata Cloud@Customer - Working with Data Guard

Data Guard maintains the standby database by transmitting and applying redo data from the primary database. If the primary database becomes unavailable, you can use Data Guard to switch or fail over the standby database to the primary role.

Switchover - reverses the primary and standby database roles

Failover - transitions the standby database into the primary role after the existing primary database fails or becomes unreachable

A failover might result in some data loss when you use the **Maximum Performance** protection mode.

Reinstate - reinstates a database into the standby role in a Data Guard association

You can use the reinstate command to return a failed database into service after correcting the cause of failure.

10

Data Guard maintains the standby database by transmitting and applying redo data from the primary database. If the primary database becomes unavailable, you can use Data Guard to switch or fail over the standby database to the primary role.

Switchover - reverses the primary and standby database roles

Each database continues to participate in the Data Guard association in its new role. A switchover ensures no data loss. You can use a switchover before you perform planned maintenance on the primary database. Performing planned maintenance on a Exadata database compute node with a Data Guard association is typically done by switching the primary to the standby role, performing maintenance on the standby, and then switching it back to the primary role.

Failover - transitions the standby database into the primary role after the existing primary database fails or becomes unreachable

A failover might result in some data loss when you use Maximum Performance protection mode.

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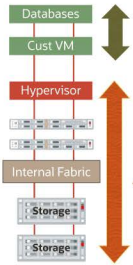
Exadata Cloud@Customer - Patching Responsibilities



Customer subscribes to database services in a Customer VM:

- Automation for create, delete, patch, backup, scale up/down, etc.
- Runs all supported Oracle Database versions 11.2.0.4 to 19c
- Customer controls access to customer VM
- Customer can install and manage additional software in customer VM
- Oracle staff is not authorized to access customer VM
- Customer responsible for all patching within the Customer VM

Oracle owns, manages, and patches the infrastructure:

- Hypervisor, physical database and storage servers, storage network
- Patching, security scans, security updates
- Monitoring and maintenance
- Customer not authorized to access Oracle infrastructure

Let's look at the patching responsibilities. Oracle owns, manages, and patches the infrastructure. You can see from the list of activities this includes patching, security updates, maintenance and in general, activities that require access to the Oracle infrastructure. Customers subscribe to database services in a Customer VM. They are responsible for patching, access to and activities within the VM itself. Oracle does not have access to the customer VM and so the customer is responsible for these tasks.

Exadata Cloud@Customer - Oracle Updates and Patching

- Oracle updates all of the Oracle-managed system components on ExaCC. This includes:
  - Physical Compute Nodes (Dom0 / Host OS)
  - Network Switches
  - Power Distribution Units (PDUs)
  - Integrated Lights-Out Management (ILOM) Interfaces
  - Exadata Storage Servers
- The customer will usually receive advance communication about these updates to help them plan, along with recommended updates for the Customer to patch on the virtual machines (VMs.)
- Wherever possible, scheduled updates are performed in a manner that preserves service availability throughout the update process. However, there can be some noticeable impact on performance and throughput, while the individual system components are unavailable during the update process.

3

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- The customer will usually receive advance communication about these updates to help them to plan for them, along with recommended updates for the Customer to patch on the virtual machines (VMs.)
- Wherever possible, scheduled updates are performed in a manner that preserves service availability throughout the update process. However, there can be some noticeable impact on performance and throughput while individual system components are unavailable during the update process.
  - For example, Dom0 patching typically requires a reboot. In such cases, wherever possible, the compute nodes are restarted in a rolling manner, one at a time, to ensure that the service remains available throughout the process. However, each compute node is unavailable for a short time while it restarts, and the overall service capacity diminishes accordingly.

Exadata Cloud@Customer - Staging of Quarterly Patches

Patches are staged to the Control Plane servers by Oracle:

- Oracle Cloud Ops upload updates (OS, GI, and DB patches) to OCI quarterly.
- Updates are available for download about a week after release in MOS.
- Updates are automatically downloaded and staged on the Control Plane Servers.

Patches are applied using the **dbaascli** tool or the **Console UI**:

- Customers check for available updates using dbaascli utility or the UI on the **DB Homes** page.
- Local Control Plane Servers provide patches that are applied in a rolling manner.

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ExaC@C Patching Documentation (Console and dbaascli)

https://docs.oracle.com/en/engineered-systems/exadata-cloud-at-customer/eccad/eccpatching-console.html#GUID-6F03BF88-5C60-4344-ABBF-1E08E6117D80

https://docs.oracle.com/en/engineered-systems/exadata-cloud-at-customer/eccad/eccpatching.html#GUID-F7941D92-99F6-4503-A487-A0CCEF4F5D57

Exadata Cloud@Customer - Prerequisites for Patching

Before you apply the latest Cloud patches that are downloaded and made available by Oracle on the CPS host, it is recommended to ensure that the following conditions are met to avoid patching failures:

- The /u01 directory on the database host file system has at least 15 GB of free space for the execution of patching processes.
- The Oracle Clusterware is up and running on the VM cluster.
- All nodes of the VM cluster are up and running.

Before you begin manual patching, it is also recommended to update to the latest version of the Cloud Tooling:

- Check the Installed Cloud Tooling Release: **# dbaascli patch tools list**
- Update the Cloud Tooling Release to the latest version: **#dbaascli patch tools apply – patchid LATEST**

5

Before you apply the latest Cloud patches that are downloaded and made available by Oracle on the CPS host, it is recommended to ensure that the following conditions are met to avoid patching failures:

- The /u01 directory on the database host file system has at least 15 GB of free space for the execution of patching processes.
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Before you begin manual patching, it is also recommended to update to the latest version of the Cloud Tooling:

- Check the Installed Cloud Tooling Release. Take note of the dbaascli command to do this.
- Update the Cloud Tooling Release to the latest version. Take note of the dbaascli command to do this.

Exadata Cloud@Customer - Apply GI/DB Patch using Console

To apply Quarterly Patches using the Console, select your Compartment and navigate to the VM cluster Page (GI), then click **View Patches.**

You can also review the Database Home patches.

General steps
(which are illustrated in following slides) are:

1. List available patches.
2. Select the desired patch, perform a Precheck.
3. Verify that Precheck passed successfully.
4. Apply the patch.

The patches are then automatically applied on each node in the VM Cluster in a rolling manner.

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1. List the available patches.
2. Select the desired patch and perform a Precheck.
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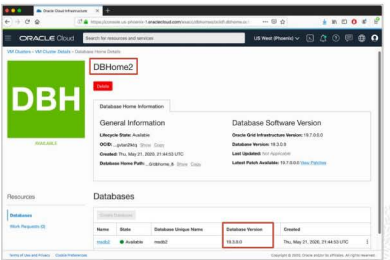
Exadata Cloud@Customer - Example GI Patch 19.3 -> 19.5 using UI



Navigate to the **Oracle Home** to check the current Database Version (19.3.0) and the Latest Patch Available (19.7.0).

7

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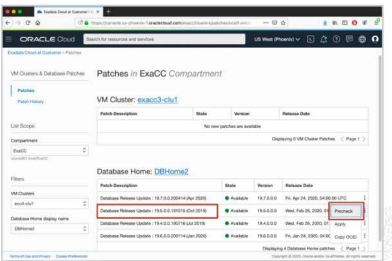
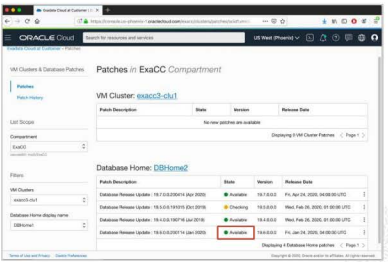
Exadata Cloud@Customer - Example GI Patch 19.3 -> 19.5 using UI



Click the 3 dots at the end of the Patch you wish to apply, in this case 19.5.0, and select the **Precheck** option.

Click view patches to get to this screen and then click the 3 dots at the end of the patch you wish to apply, in this case 19.5.0, and select the **Precheck** option.

Exadata Cloud@Customer - Example GI Patch 19.3 -> 19.5 using UI



The patch status will change to **Checking**.

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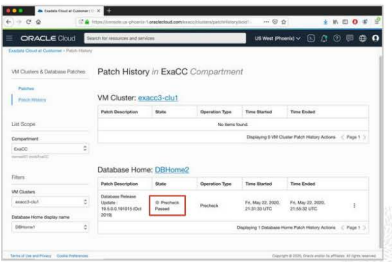

When the Precheck has completed, check the **Patch History** page to ensure that the status is **Precheck Passed**.

10

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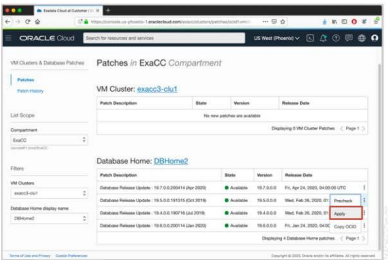
Exadata Cloud@Customer - Example GI Patch 19.3 -> 19.5 using UI



On the **Patches** page, run the **Apply** option for the patch.

11

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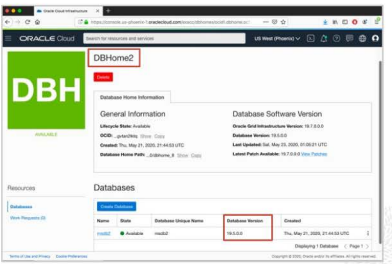
Exadata Cloud@Customer - Example GI Patch 19.3 -> 19.5 using UI



The **Database Home** patch will now show that the Database Version has been updated to **19.5.0** as requested.

12

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Exadata Cloud@Customer - List Available Patches using dbaascli

You can use the command line tool dbaascli to check whether Quarterly Database patches are available for deployment. The command must be run as the root user from your DomU:

#dbaascli patch db list --oh hostname:oracle_home

In this command, --*oh hostname:* specifies a compute node, and *oracle_home* specifies the Oracle home directory for which you want to list the available patches. In this context, an Oracle home directory may be an Oracle Database home directory or the Oracle Grid Infrastructure home directory.

13

You can use the command line tool dbaascli to check whether Quarterly Database patches are available for deployment. The command must be run as the root user from your DomU.

Take note of the dbaascli command here to do this.

In this command, --*oh hostname*: specifies a compute node, and *oracle_home* specifies the Oracle home directory for which you want to list the available patches. In this context, an Oracle home directory may be an Oracle Database home directory or the Oracle Grid Infrastructure home directory.

The list of available patches is determined by interrogating the database to establish the patches that have already been applied. When a patch is applied, the corresponding database entry is made as part of the SQL patching operation, which is run at the end of the patch workflow. Therefore, the list of available patches may include partially applied patches along with patches that are currently being applied.

Exadata Cloud@Customer - GI/DB Patch Options using dbaascli

The command line tool dbaascli patch db is run by the root user to patch a databases in your DomU. It can be run for a specific instance, or by specifying only database names using the following options:

- *--patchid*
- --instance1 hostname:oracle_home
- --dbnames dbname [,dbname2 …]
- -alldbs .
- --run_datasql 1

14

The command line tool dbaascli patch db is run by the root user to patch a databases in your DomU. It can be run for a specific instance, or by specifying only database names using the following options.

patchid identifies the patch that you want to apply.

instance1 hostname:oracle_home specifies a compute node and Oracle home directory that is subject to the patching operation. In this context, an Oracle home directory may be either an Oracle Database home directory, or the Oracle Grid Infrastructure home directory.

dbnames dbname [,dbname2 …] specifies the database names for the databases that are the target of the patching operation. If you use this argument to patch a database that uses a shared Oracle home, and you do not specify the -alldbs option, then a new Oracle home containing the patched Oracle Database binaries is created, and the database is moved to the new Oracle home.

alldbs patches all of the databases that share the same Oracle Database binaries (Oracle home) as the databases specified in the --dbnames argument. After the operation, the Oracle home directory location remains unchanged; however, the patch level information embedded in the Oracle home name is adjusted to reflect the patching operation.

run_datasql 1 instructs the command to execute patch-related SQL commands.

List the Available Quarterly Grid Infrastructure/Database Patches

- `# dbaascli patch db list --oh `hostname`:/u01/app/19.0.0.0/grid`
  - Available Patches:
  - patchid :30116789-GI (Database Release Update : 19.5.0.0.191015 (Oct 2019))
  - patchid :30501910-GI (Database Release Update : 19.6.0.0.200114 (Jan 2020))
  - patchid :30899722-GI (Database Release Update : 19.7.0.0.200414 (Apr 2020))

Run the Precheck first for GI 19.7:

- `# dbaascli patch db prereq --patchid 30899722-GI --dbnames grid`

Then, apply the GI 19.7 patch if the precheck was successful:

- `# dbaascli patch db apply --patchid 30899722-GI --dbnames grid`

Note: To patch the Grid Infrastructure Home, the **--dbnames** option is specified as **grid**.

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Here, you can see the dbaascli command. First, it lists all of the patches. Then, it runs a pre check for the GI 19.7 patch listed above. Then, apply the GI 19.7 patch if the precheck was successful. One thing to take note of is that to patch the Grid Infrastructure Home, the --dbnames option is specified as grid.

Exadata Cloud@Customer - Example of DB Patching using dbaascli

- From dbaascli, as root, run: **db patch prereq** or **apply** or **switchback using:**
  - --patchid <patch number>
  - --dbnames – *specify one or more database* (--alldbs for all databases)
  - --instance1 – *specify a hostname:database home on one node (optional)*
- Run the Prereq check first across all nodes:
  - `# dbaascli patch db prereq -patchid 30899645 --dbnames GPE`
- Apply the database patch one node at a time (all patches are rolling):
  - `# dbaascli patch db apply --patchid 30899645 --dbnames GPE --instance1 ecce01:<orahome> --skipPrecheck`
  - … `repeat for other nodes until the last node then use run_datasql 1`
  - `# dbaascli patch db apply --patchid 30899645 --dbnames GPE --instance1 ecce02:<orahome> --skipPrecheck --run_datasql 1`
- Repeat for any other Oracle Homes on the Cluster you wish to patch.

16

From dbaascli, as root, run: db patch prereq or apply or switchback using the parameters listed.

Run the Prereq check first across all nodes.

Then, apply the database patch one node at a time (all patches are rolling.)

Repeat for other nodes until the last node, then use run_datasql 1.

Repeat for any other Oracle Homes on the Cluster you wish to patch.

Exadata Cloud@Customer - Software Images

When you create a new Oracle Home, it will be created with the RU that is set as the default image for that database version. If you want to create a new Oracle Home with an RU that is higher or lower than the default image, you need to activate a default image to match the version you require for the new Oracle Home. You can find out about Software Images by running dbaascli commands:

- Viewing Information about Downloaded Software Images:
  # dbaascli dbimage list
- Viewing Information about Available Software Images:
  #dbaascli cswlib list
- Downloading a Software Image:
  # dbaascli cswlib download --version **software_version** --bp **software_bp** [--oss_uri download_location]
- Activating a Software Image:
  # dbaascli dbimage activateBP --version **software_version** --bp **software_bp** [--oss_uri download_location]

Where: software_version is 11204, 12102, 12201, 18000, 19000 and software_bp is APR2018, JAN2019, JUL2020 etc.

17

When you create a new Oracle Home, it will be created with the RU that is set as the default image for that database version. If you want to create a new Oracle Home with an RU that is higher or lower than the default image, you need to activate a default image to match the version you require for the new Oracle Home. You can find out about Software Images by running dbaascli commands. Here, you can see various dbaascli commands. Take some time to review these.

Exadata Cloud@Customer - Prepare for an Operating System Update

Before you update your operating system on ExaCC, review this checklist of tasks:

- Determine the latest software update by reviewing the Exadata Cloud Service Software Versions in My Oracle Support note 2333222.1.
- For feature release updates only, Oracle recommends that you lodge a service request with Oracle Support Services to ensure that Oracle is aware of your plans, and is prepared to assist if there are any difficulties. Feature release updates change any of the first 4 digits. So 12.2.1.2.0 to 12.2.1.3.0 would be a future release update, 12.2.1.2.0 to 12.2.1.2.2 would not.
- If you are going to apply the patch using Yum, then you will need to specify a YUM repository and then configure it.

18

Before you update your operating system on ExaCC, review this checklist of tasks:

Determine the latest software update by reviewing the Exadata Cloud Service Software Versions in My Oracle Support note 2333222.1.

For feature release updates only, Oracle recommends that you lodge a service request with Oracle Support Services to ensure that Oracle is aware of your plans, and is prepared to assist if there are any difficulties. Feature release updates change any of the first 4 digits. So 12.2.1.2.0 to 12.2.1.3.0 would be a future release update, 12.2.1.2.0 to 12.2.1.2.2 would not.

If you are going to apply the patch using Yum, then you will need to specify a YUM repository and then configure it.

Exadata Cloud@Customer - Operating System Update - patchmgr

The **patchmgr** utility updates the Operating System on the customer VM.

- It has full instructions at MoS Note #1553103.1
- It runs the **dbnodeupdate.sh** utility under the covers.
- It uses a driving or launch node to update a target node.
- It can patch multiple nodes (rolling or non-rolling.)
- It updates the node by installing an ISO image.
- It logs all actions on the driving or source node.
- It can take a backup in order to rollback any changes.
- It requires access to a yum repository or ISO of Exadata RPMs.

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Exadata Cloud@Customer - Operating System Update - Workflow

- Exachk Health Check
- Perform a first prerequisite check with –nomodify_at_prereq
  - patchmgr -dbnode -precheck -nomodify_at_prereq
- Perform a "backup only" run using the -backup flag
  - patchmgr -dbnodes dbs_group –backup
- Perform second prerequisite check
  - patchmgr -dbnodes dbs_group –precheck
- Update database servers
  - patchmgr -dbnode -dbnode_upgrade -nobackup [-rolling]
- Exachk Health Check

20

When performing an operating system update, here is the general workflow. An Exachk Health Check is performed. Then, perform a first prerequisite check with –nomodify_at_prereq, then a "backup only" run using the -backup flag, then a second prerequisite check, then update database servers, and then finally perform another Exachk Health Check.

Exadata Cloud@Customer - Database Server Customization

The best-practice is to resist customization and keep them minimal if you do make changes.

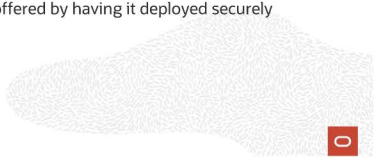
- Firmware
  - Maintained automatically during Exadata update process – do not customize
- Linux packages (RPMs)
  - Acceptable to update supplied packages to later versions (ULN or public-yum)
    - **Except** kernel and boot related packages
  - Acceptable to add new packages
    - Automate install / removal - some Exadata updates require custom package remove / reinstall
    - New package dependencies introduced must be customer-managed
- Disk layouts
  - Do not change RAID configuration
  - Do not change supplied LVM configuration, but feel free to add volumes if required
  - Do not change supplied filesystem configuration

21

The best practice is to resist customization and if you do need to customize, keep them minimal. Here you can see a list of best practices to follow. Firmware is maintained automatically during the Exadata update process. Linux packages can be updated to later versions using utilities like yum assuming they are not kernel or boot related packages. If new packages are introduced, they need to be customer-managed as far as dependencies. Default disk layouts should not be changed. You can add additional volumes if needed.

Autonomous Database Cloud@Customer - Introduction

- Oracle Autonomous Database on Oracle Exadata Cloud@Customer combines the benefits of:
  - Self-driving
  - Self-securing
  - Self-repairing
- It offers enhanced security and control offered by having it deployed securely on-premises behind your firewall.



2

Oracle Autonomous Database on Oracle Exadata Cloud@Customer combines the benefits of a self-driving, self-securing, and self-repairing database management system and the security and control offered by having it deployed securely on-premises behind your firewall.

After purchasing Autonomous Database on Oracle Exadata Cloud@Customer and creating, provisioning, and activating its Exadata Infrastructure hardware and Oracle Cloud resource, several additional resource types become available in the Exadata Cloud@Customer section of the Oracle Cloud Infrastructure console: Autonomous Exadata VM Clusters, Autonomous Container Databases and Autonomous Databases. You can use these resources to create and manage your secure, on-premise deployment of Oracle Autonomous Database.

Autonomous Database Cloud@Customer

All the benefits of the Autonomous Database Dedicated in your data center:

- Oracle fully automates and manages DomUs and Databases
- Self-driving
- Self-securing
- Self-repairing

Customizable Isolation Policies

Customizable Operational Policies

3

With Oracle Autonomous Database Cloud at Customer, you get all of the benefits of the Autonomous Database Dedicated in your data center. Oracle fully automates and manages DomUs and Databases, and you get a database that is self-driving, self-securing, and self-repairing. You also get the ability to customize isolation policies and operational policies.

Autonomous Database Cloud@Customer - Resource Types

- Oracle Exadata Cloud@Customer Infrastructure
- Autonomous Exadata VM Clusters
- Autonomous Container Database
- Autonomous Database

Oracle Exadata Cloud@Customer Infrastructure: Hardware rack that includes compute nodes and storage servers, tied together by a high-speed, low-latency internal network and intelligent Exadata software

Oracle Exadata Cloud@Customer infrastructure is common for both Autonomous and Non-Autonomous resources.

Autonomous Exadata VM Clusters on Exadata Cloud@Customer Infrastructure: Today, there is a single VM cluster that is a set of symmetrical VMs across all Compute nodes. Autonomous Container, and Database run all the VMs across all nodes enabling high availability. It consumes all the resources of the underlying Exadata Infrastructure.

Autonomous Container Database: Provides a container for multiple Autonomous Databases. Allows you to control isolation of different databases that can have different software versions and different replication architectures to support different Service Level Objectives.

Autonomous Database: You can create multiple Autonomous Databases within the same Autonomous Container Database. You can configure Oracle Autonomous Database for either transaction processing or data warehouse workloads.

Autonomous Exadata Cloud@Customer - Lifecycle

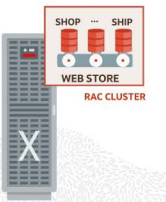
I.T. Fleet Group configures the Exadata infrastructure and deploys the Autonomous Exadata VM cluster.

With the infrastructure in place, Autonomous Container Databases can then be deployed to the Exadata VM cluster:

- A maximum of 12 container databases can be provisioned on X8
- A maximum of 20 container databases can be provisioned on X8M

Database users and developers use self-service UI or API to provision databases within container databases:

- Users just specify DB compute (OCPUs) and max storage
- CPU and storage can elastically grow or shrink online
- For X8M up to 250 Autonomous Databases, per container database can be deployed (dependent on underlying Exadata physical resources) when using Fractional OCPUs. Containers that deliver an SLO are limited to 200 Autonomous Databases for an 99.95 SLO and 25 Autonomous Databases when using Autonomous Data Guard and a target SLO of 99.995.



A typical life lifecycle is shown here. I.T. Fleet Group configures the Exadata infrastructure, and deploys the autonomous VM cluster to it. With the infrastructure in place, autonomous container databases can then be deployed to the VM cluster. Remember a maximum of 12 container databases can be provisioned. Database users and developers use self-service UI or API to provision databases within container databases. Users just specify DB compute (OCPUs) and max storage. They can then elastically grow or shrink CPU and storage online. Another limit to remember is that up to 200 pluggable autonomous databases per container database can be deployed (dependent on underlying Exadata shape).

Autonomous Exadata Cloud@Customer - Shapes

Specification	Exadata X8-2 ¼ Rack	Exadata X8-2 ½ Rack	Exadata X8-2 Full Rack
Number of Compute Nodes	2	4	8
Total Maximum Number of Enabled CPU Cores	100	200	400
Total RAM Capacity (double the numbers for X8M)	1440 GB	2880 GB	5760 GB
Number of Exadata Storage Servers	3	6	12
Total Raw Flash Storage Capacity	76.8 TB	153.6 TB	307.2 TB
Total Usable Storage Capacity	149.7 TB	299.4 TB	598.7 TB
Maximum Number of Autonomous Container Databases	12 (20 X8M)	12 (20 X8M)	12 (20 X8M)
Maximum Number of Autonomous Databases per Autonomous Container Database (X8M)	250/200/25 : None/99.95/99.995 SLA	250/200/25 : None/99.95/99.995 SLA	250/200/25 : None/99.95/99.995 SLA

Autonomous Exadata Cloud@Customer - VM Cluster

Follow these steps to create an **Autonomous Exadata VM cluster**:

- Open the navigation menu. Under **Database**, click **Exadata Cloud@Customer.**
- Click **Autonomous Exadata VM Clusters.**
- Click **Create Autonomous Exadata VM Cluster.**
- In the **Create Autonomous Exadata VM Cluster** dialog, enter the following general information:
  - Compartment
  - Display Name
  - Exadata Infrastructure
  - VM Cluster Network
- Configure the Exadata Storage.
- Choose the License type.
- Click **Create Autonomous Exadata VM Cluster**.

An Autonomous Exadata VM Cluster is a set of symmetrical VMs across all Compute nodes. Autonomous Container and Database run all the VMs across all nodes enabling high availability. It consumes all the resources of the underlying Exadata Infrastructure. Follow these steps to create an Autonomous Exadata VM cluster:

- Open the navigation menu. Under **Database**, click **Exadata Cloud@Customer**.
- Click **Autonomous Exadata VM Clusters**.
- Click **Create Autonomous Exadata VM Cluster**.
- In the Create Autonomous Exadata VM Cluster dialog, enter the following general information: **Compartment**: Specify the compartment in which the Autonomous Exadata VM Cluster will be created.
- **Display Name**: A user-friendly description or other information that helps you easily identify the infrastructure resource. The display name does not have to be unique. Avoid entering confidential information.
- **Exadata Infrastructure**: Select an Exadata Infrastructure.
- **VM Cluster Network**: Select a VM Cluster Network.
- **Configure the Exadata Storage**: Optionally, you can **Allocate Storage for Local Backups**.

- Choose the license type you wish to use. Your choice affects metering for billing. You have the following options:

  Bring your own license: If you choose this option, make sure you have proper entitlements to use for new service instances that you create.

  License included: With this choice, the cost of the cloud service includes a license for the Database service.

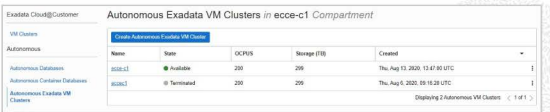
- Click **Create Autonomous Exadata VM Cluster**.

Autonomous Exadata Cloud@Customer - VM Cluster

Follow these steps to view detailed information about an autonomous **Exadata VM cluster:**

- Open the navigation menu. Under **Database**, click **Exadata Cloud@Customer.**
- Click **Autonomous Exadata VM Clusters.**

This will provide a list of all Autonomous Exadata VM Clusters in that compartment. Click the display name of the Exadata VM cluster you wish to view detailed details of for a VM cluster.



Follow these steps to view detailed information about an autonomous Exadata VM cluster:

- Open the navigation menu. Under **Database**, click **Exadata Cloud@Customer.**
- Click **Autonomous Exadata VM Clusters**.

This will provide a list of all Autonomous Exadata VM Clusters in that compartment. Click the display name of the Exadata VM cluster you wish to view detailed details of for a VM cluster.

Autonomous Exadata Cloud@Customer - VM Cluster

Follow these steps to move an autonomous Exadata VM cluster on an Oracle Exadata Cloud@Customer system from one compartment to another compartment.

- Open the navigation menu. Under **Database**, click **Exadata Cloud@Customer**.
- Click **Autonomous Exadata VM Clusters**.
- In the list of Autonomous Exadata VM Clusters, click the display name of the Exadata VM cluster you wish to administer.
- Click **Move Resource**.
- Select the new compartment.
- Click **Move Resource**.

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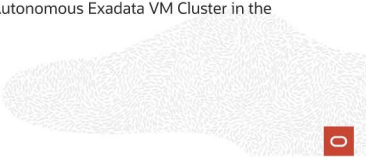
Follow these steps to move an autonomous Exadata VM cluster on an Oracle Exadata Cloud@Customer system from one compartment to another compartment.

- Open the navigation menu. Under **Database**, click **Exadata Cloud@Customer.**
- Click **Autonomous Exadata VM Clusters.**
- In the list of **Autonomous Exadata VM Clusters,** click the display name of the Exadata VM cluster you wish to administer.
- Click **Move Resource.**
- Select the new compartment.
- Click **Move Resource.**

Autonomous Exadata Cloud@Customer - VM Cluster

Follow these steps to terminate an autonomous VM Cluster on an Autonomous Oracle Exadata Cloud@Customer system:

- Open the navigation menu. Under **Database**, click **Exadata Cloud@Customer**.
- In the list of Autonomous Exadata VM Clusters, click the display name of the Exadata VM cluster you wish to administer.
- Click **Terminate**.
- Confirm that you wish to terminate your Autonomous Exadata VM Cluster in the confirmation dialog.
- Click **Terminate VM Cluster**.



Follow these steps to terminate an autonomous VM Cluster on an Autonomous Oracle Exadata Cloud@Customer system.

- Open the navigation menu. Under Database, click Exadata Cloud@Customer.
- In the list of Autonomous Exadata VM Clusters, click the display name of the Exadata VM cluster you wish to administer.
- Click **Terminate.**
- Confirm that you wish to terminate your Autonomous Exadata VM Cluster in the confirmation dialog.
- Click **Terminate VM Cluster.**

Autonomous Exadata Cloud@Customer - Container Database

An **Autonomous Container Database** resource provides a container for your Autonomous Databases. You can create multiple (up to 12) Autonomous Container Database resources in a single Autonomous Exadata VM Cluster resource, but you must create at least one before you can create any Autonomous Databases. Follow these steps to create an autonomous container database:

- Open the navigation menu. Under **Database**, click **Exadata Cloud@Customer**.
- Click **Autonomous Container Databases**.
- Click **Create Autonomous Container Database**
- Choose the compartment in which your autonomous container database will be created.
- **Display Name**: Enter a user-friendly description
- Select the Autonomous Exadata VM Cluster you wish to use to create your autonomous container database.
- Optionally, you can modify the automatic maintenance schedule.
- Optionally, you can configure an automatic maintenance schedule.
- Select a **Backup Destination Type**: (Exadata Local Storage/Network File System/Recovery Appliance.)
- Click **Create Autonomous Container Database**.

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An **Autonomous Container Database** resource provides a container for your Autonomous Databases. You can create multiple (up to 12) Autonomous Container Database resources in a single Autonomous Exadata VM Cluster resource, but you must create at least one before you can create any Autonomous Databases. Follow these steps to create an autonomous container database:

- Open the navigation menu. Under Database, click Exadata Cloud@Customer.
- Click Autonomous Container Databases.
- Click Create Autonomous Container Database.
- Choose the compartment in which your autonomous container database will be created.
- **Display Name**: Enter a user-friendly description
- Select the Autonomous Exadata VM Cluster you wish to use to create your autonomous container database.
- Optionally, you can modify the automatic maintenance schedule.
- Optionally, you can configure an automatic maintenance schedule.
- Select a Backup Destination Type: (Exadata Local Storage/Network File System/Recovery Appliance.)
- Click Create Autonomous Container Database.

Autonomous Exadata Cloud@Customer - Container Database

Follow these steps to view a list of an autonomous container databases in a given autonomous Exadata VM cluster:

- Open the navigation menu. Under **Database**, click **Exadata Cloud@Customer.**
- Click **Autonomous Exadata VM Clusters.**
- Click the display name of the Autonomous Exadata VM Cluster that you interested in. On the Autonomous Exadata VM Clusters Details page, a list of Autonomous Container Databases is displayed.

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Follow these steps to view a list of an autonomous container databases in a given autonomous Exadata VM cluster:

- Open the navigation menu. Under Database, click Exadata Cloud@Customer.
- Click Autonomous Exadata VM Clusters.
- Click the display name of the Autonomous Exadata VM Cluster that you interested in. On the Autonomous Exadata VM Clusters Details page, a list of Autonomous Container Databases is displayed.

In the list of Autonomous Container Databases, clicking the display name of the database you wish to view will bring up the container database details page.

Autonomous Exadata Cloud@Customer - Move Container Database

Follow these steps to move an autonomous container database on an Oracle Exadata Cloud@Customer system from one compartment to another compartment:

- Open the navigation menu. Under **Database**, click **Exadata Cloud@Customer**.
- Click **Autonomous Container Databases**.
- In the list of Autonomous Container Databases, click the display name of the container database you wish to move.
- Click **Move Resource**.
- Select the new compartment.
- Click **Move Resource**.

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Before making a move, here's one thing to know. To move an autonomous container database, you must have the right to manage it in its current compartment and in the compartment you are moving it to. As soon as you move an autonomous container database to a different compartment, the policies that govern the new compartment apply and affect access to the autonomous container database. Therefore, both your and other Oracle Cloud users' access to it may change, depending on the policies governing the user account's access to resources.

Follow these steps to move an autonomous container database on an Oracle Exadata Cloud@Customer system from one compartment to another compartment.

- Open the navigation menu. Under Database, click Exadata Cloud@Customer.
- Click Autonomous Container Databases.
- In the list of Autonomous Container Databases, click the display name of the container database you wish to move.
- Click Move Resource.
- Select the new compartment.
- Click Move Resource.

To move an autonomous container database, you must have the right to manage it in its current compartment and in the compartment you are moving it to. As soon as you move an autonomous container database to a different compartment, the policies that govern the new compartment apply and affect access to the autonomous container database. Therefore, both your and other Oracle Cloud users' access to it may change, depending on the policies governing the user account's access to resources.

Autonomous Exadata Cloud@Customer - Terminate Container Database

Follow these steps to terminate an autonomous container database on an Oracle Exadata Cloud@Customer system.

- Open the navigation menu.
- Under **Database**, click **Exadata Cloud@Customer**.
- Click **Autonomous Container Databases**.
- In the list of Autonomous Container Databases, click the display name of the infrastructure resource you are interested in.
- Click **Terminate**.
- In the confirmation dialog, type the name of the Autonomous Container Database, and then click **Terminate Autonomous Container Database**.

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Follow these steps to terminate an autonomous container database on an Oracle Exadata Cloud@Customer system:

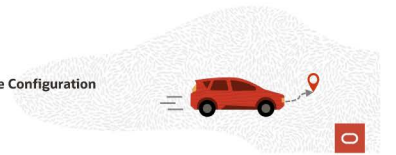
- Open the navigation menu.
- Under Database, click Exadata Cloud@Customer.
- Click Autonomous Container Databases.
- In the list of Autonomous Container Databases, click the display name of the infrastructure resource you are interested in.
- Click Terminate.
- In the confirmation dialog, type the name of the Autonomous Container Database, and then click Terminate Autonomous Container Database.

Remember you must terminate all Autonomous Databases within a container database before you can terminate the container database itself.

Autonomous Exadata Cloud@Customer - Create Autonomous Database

Follow these steps to create an autonomous database on an Oracle Exadata Cloud@Customer system:

- Open the navigation menu. Under **Database**, click **Exadata Cloud@Customer**.
- Click **Autonomous Databases**.
- Click **Create Autonomous Database**.
- In the Create Autonomous Database dialog, enter the following Basic Database Information:
  - **Compartment**
  - **Display Name**
  - **Database Name**
  - **Workload Type**
  - **Autonomous Container Database**
  - **Database CPU Core Count and Storage Configuration**
  - **Administrator Credentials**
- Click **Create Autonomous Database**.



An Autonomous Database resource is a user database. When you create an Autonomous Database, you choose the Autonomous Container Database for it and you specify "Data Warehouse" or "Transaction Processing" as its workload type to create an Autonomous Data Warehouse database or an Autonomous Transaction Processing database.

Follow these steps to create an autonomous database on an Oracle Exadata Cloud@Customer system.

- Open the navigation menu. Under Database, click Exadata Cloud@Customer.
- Click Autonomous Databases.
- Click Create Autonomous Database.
- In the Create Autonomous Database dialog, enter the following Basic Database Information:
  - **Compartment:** Select the compartment of the Autonomous Database.
  - **Display Name:** A user-friendly description.
  - **Database Name:** The database name must consist of letters and numbers only, starting with a letter. The maximum length is 14 characters. Avoid entering confidential information.
  - **Workload Type:** Select either Autonomous Transaction Processing or Autonomous Data Warehouse
  - **Autonomous Container Database:** Select an Autonomous Container Database.
  - **Compartment:** Specify the compartment containing the Autonomous Container Database you wish to use.
  - **Database CPU Core Count and Storage Configuration:** Specify the number of OCPUs and TBs of storage required.
  - **Administrator Credentials:** Set the password for the Autonomous Database Admin.
- Click **Create Autonomous Database.**

Autonomous Exadata Cloud@Customer - Scale Autonomous Database

Follow these steps to scale the CPU core count or storage of an autonomous database on an Oracle Exadata Cloud@Customer system up or down:

- Open the navigation menu. Under **Database**, click **Exadata Cloud@Customer**.
- Click **Autonomous Databases**.
- In the list of Autonomous Databases, click the display name of the database you wish to view the details of.
- Click **Scale Up/Down**.
- Enter a new value for CPU Core Count or Storage between 1 and the number of OCPUs available in the physical infrastructure. The number you enter represents the desired total (final) value for your database's CPU core count or storage. The maximum number of CPU Core Count or Storage depends on the infrastructure shape and what is already consumed by other Autonomous Databases.
- Click **Update**.

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Follow these steps to scale the CPU core count or storage of an autonomous database on an Oracle Exadata Cloud@Customer system up or down:

- Open the navigation menu. Under Database, click Exadata Cloud@Customer.
- Click Autonomous Databases.
- In the list of Autonomous Databases, click the display name of the database you wish to view the details of.
- Click **Scale Up/Down.**
- Enter a new value for CPU Core Count or Storage between 1 and 128. The number you enter represents the desired total (final) value for your database's CPU core count or storage. The maximum number of CPU Core Count or Storage depends on the infrastructure shape and what is already consumed by other Autonomous Databases.
- Click **Update.**

Autonomous Exadata Cloud@Customer - AutoScale Autonomous Database

Oracle Autonomous Database on Oracle Exadata Cloud@Customer systems provides an auto scaling feature that automatically increases the number of cores an Autonomous Database during periods of increased demand and, as demand returns to normal, automatically decreases the number of cores down to the database's base number.

Note the following points regarding the auto scaling feature:

With auto scaling enabled, the database can use up to three times more CPU and Flash IO resources than specified by the number of OCPUs currently shown in the Scale Up/Down dialog.

- Follow these steps to enable or disable auto scaling for an autonomous database.
- Open the navigation menu. Under **Database**, click **Exadata Cloud@Customer.**
- Click **Autonomous Databases.**
- In the list of Autonomous Databases, click the display name of the database you wish to view details of.
- Click **Scale Up/Down.**
- Check **Auto Scaling** to enable the auto scaling feature, or uncheck **Auto Scaling** to disable the feature.
- Click **Update**.

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Oracle Autonomous Database on Oracle Exadata Cloud@Customer systems provides an auto scaling feature that automatically increases the number of cores an autonomous database during periods of increased demand and, as demand returns to normal, automatically decreases the number of cores down to the database's base number.

Note the following points regarding the auto scaling feature:

With auto scaling enabled, the database can use up to three times more CPU and IO resources than specified by the number of OCPUs currently shown in the Scale Up/Down dialog.

- Follow these steps to enable or disable auto scaling for an autonomous database.
- Open the navigation menu. Under Database, click Exadata Cloud@Customer.
- Click Autonomous Databases.
- In the list of Autonomous Databases, click the display name of the database you wish to view details of.
- Click **Scale Up/Down.**
- Check Auto Scaling to enable the auto scaling feature, or uncheck Auto Scaling to disable the feature.
- Click **Update.**

Autonomous Exadata Cloud@Customer - Move Autonomous Database

Follow these steps to move an autonomous database on an Oracle Exadata Cloud@Customer system from one compartment to another compartment.

- Open the navigation menu. Under **Database**, click **Exadata Cloud@Customer**.
- Click **Autonomous Databases**.
- In the list of Autonomous Databases, click the display name of the database you wish to move.
- From the **More Actions** drop-down list, select **Move Resource**.
- Select the new compartment.
- Click **Move Resource**.

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Before moving an autonomous database, make sure you know that to move an autonomous database, you must have the right to manage it in its current compartment and in the compartment you are moving it to.

As soon as you move an autonomous database to a different compartment, the policies that govern the new compartment apply immediately and affect access to the autonomous database. Therefore, both your and other Oracle Cloud users' access to it may change, depending on the policies governing the user account's access to resources. For example, a user may lose the ability to manage the autonomous database, given its new compartment.

Follow these steps to move an autonomous database on an Oracle Exadata Cloud@Customer system from one compartment to another compartment.

- Open the navigation menu. Under Database, click Exadata Cloud@Customer.
- Click Autonomous Databases.
- In the list of Autonomous Databases, click the display name of the database you wish to move.
- From the **More Actions** drop-down list, select **Move Resource.**
- Select the new compartment.
- Click **Move Resource**.

To move an autonomous database, you must have the right to manage it in its current compartment and in the compartment you are moving it to.

As soon as you move an autonomous database to a different compartment, the policies that govern the new compartment apply immediately and affect access to the autonomous database. Therefore, both your and other Oracle Cloud users' access to it may change, depending on the policies governing the user account's access to resources. For example, a user may lose the ability to manage the autonomous database, given its new compartment.

Autonomous Exadata Cloud@Customer - Terminate Autonomous Database

Follow these steps to terminate an Autonomous Database on an Oracle Exadata Cloud@Customer system.

WARNING:

Terminating an Autonomous Database permanently deletes it. The database data will be lost when the system is terminated. However, automatic backups are not deleted if you have chosen **Recovery Appliance** or **NFS** as a backup destination. You can delete automatic backups directly from the Recovery Appliance or from NFS.

- Open the navigation menu. Under **Database**, click **Exadata Cloud@Customer**.
- Click **Autonomous Databases**.
- In the list of Autonomous Databases, click the display name of the database you wish to terminate.
- From the **More Actions** drop-down list, select **Terminate**.
- Confirm that you wish to terminate your Autonomous Database in the confirmation dialog.
- Click **Terminate Autonomous Database**.

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Before terminating the autonomous database, remember, **Terminating an Autonomous Database** permanently deletes it. The database data will be lost when the system is terminated. However, automatic backups are not deleted if you have chosen Recovery Appliance or NFS as a backup destination. You can delete automatic backups directly from the Recovery Appliance or from NFS.

Follow these steps to terminate an Autonomous Database on an Oracle Exadata Cloud@Customer system.

- Open the navigation menu. Under Database, click Exadata Cloud@Customer.
- Click Autonomous Databases.
- In the list of Autonomous Databases, click the display name of the database you wish to terminate.
- From the More Actions drop-down list, select **Terminate.**
- Confirm that you wish to terminate your Autonomous Database in the confirmation dialog.
- Click **Terminate Autonomous Database.**

Autonomous Exadata Cloud@Customer - Autonomous Data Guard

When you enable **Autonomous Data Guard**, a separate Active Data Guard association is created for the primary and the standby database.

- You can enable Autonomous Data Guard during the provisioning steps of an autonomous container database. Select the **Autonomous Data Guard-enabled Autonomous Container Databases** checkbox, and then select **Autonomous Container Database**.
- Autonomous databases inherit DR protection from the parent autonomous container database.
- The standby will be always patched before primary and the default gap between standby and primary is 7 days. You have an option to change the default gap to anytime between 1 - 7 days.
- To view details of an Autonomous Data Guard enabled Autonomous Database, navigate to the Autonomous Database Details page, Under **Resources**, click **Autonomous Data Guard** to view the association details.

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When you enable Data Guard, a separate Data Guard association is created for the primary and the standby database.

- You can enable Data Guard during the provisioning steps of an autonomous container database. Select the Autonomous Data Guard-enabled Autonomous Container Databases checkbox, and then select an Autonomous Container Database.
- Autonomous databases inherit Data Guard settings from the parent autonomous container database.
- The standby will always be patched before primary and the default gap between standby and primary is 7 days. You have have an option to change the default gap to anytime between 1 - 7 days.
- To view Details of a Data Guard enabled Autonomous Database navigate to the autonomous database details page, Under Resources, click Autonomous Data Guard to view the association details.

Autonomous Exadata Cloud@Customer - Performance Hub

You can view real-time and historical performance data from the **Performance Hub**. Performance Hub shows Active Session History (ASH) analytics, SQL monitoring, and workload information.

- The Active Session History (ASH) tab
- The SQL Monitoring tab
- The ADDM tab

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You can view real-time and historical performance data from the **Performance Hub.** Performance Hub shows Active Session History (ASH) analytics, SQL monitoring, and workload information.

- The **Active Session History (ASH)** tab uses analytics charts to explore Active Session History data. You can drill down into database performance across multiple dimensions such as Consumer Group, Wait Class, SQL ID, and User Name.
- The **SQL Monitoring** tab can be used to monitor or kill running statements. Statements are only displayed if they've been running for at least five seconds or if they're run in parallel. The table displays monitored SQL statement executions by dimensions including Last Active Time, CPU Time, and Database Time.
- The **ADDM** tab provides access to analysis information gathered by the Automatic Database Diagnostic Monitor (ADDM) tool. ADDM analyzes (Automatic Workload Repository) snapshots on a regular basis, locates root causes of any performance problems, provides recommendations for correcting the problems, and identifies non-problem areas of the system. Because AWR is a repository of historical performance data, ADDM can analyze performance issues after the event.