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WHITE PAPER

ORACLE DATABASE

ON

ORACLE CLOUD INFRASTRUCTURE

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INTRODUCTION

Cloud computing has grown in popularity as it provides flexibility for enterprises, everything from saving time and money to improve agility and scalability. Cloud computing provides almost same level of reliable and secure IT solutions with lower capital and operational investments on IT.

In this document, we are going to discuss about having Oracle Database on Oracle Cloud Infrastructure (OCI).

Oracle Database Cloud Service provides you the ability to deploy Oracle databases in the Cloud, with each database deployment containing a single Oracle database or Oracle Data Guard or Oracle RAC configuration. Oracle Database Cloud Service provides automated, customer managed Oracle Database services available in flexible configurations to meet your needs, large or small, with the performance of dedicated hardware.

These choices allow you to start at the cost and capability level suitable to your use case and then gives you the flexibility to adapt as your requirements change over time. Database Cloud Service relies on an underlying component of Oracle Cloud named Platform Service Manager (PSM) to provide its service console. The Platform Service Manager (PSM) component of Oracle Cloud uses SSH to access the compute nodes that comprise your database deployments, in order to perform predefined Platform Service actions like backup and patching.

A separate SSH key pair is used for each database deployment to perform this internal communication. All SSH actions performed by the Platform Service Manager (PSM) component on your compute nodes are logged and can be audited. The Oracle Cloud Operations team does not have access to any SSH keys residing on your compute nodes and has no way to access your compute nodes, unless you explicitly provide access to the keys for troubleshooting purposes

ABOUT ORACLE DATABASE CLOUD SERVICE

AVAILABLE ORACLE CLOUD DATABASE SHAPES

Oracle currently offers several distinct Oracle cloud database services as mentioned below.

01 Database Cloud Service - Virtual Machines

A virtual machine with the Oracle software pre-installed and tooling to simplify the management. This is a customer managed service.

- Scale from 1 to 48 Cores with up to 640 GB of RAM
- 256 GB - 40 TB remote NVMe SSD Block Volumes
- Standard or Enterprise Edition Oracle Databases
- Up to 25 gbps (for 24 core or 48 core shapes)

02 Database Cloud Service - Bare Metal

Like the VM offering, but the database will be running in a dedicated host. This is a customer managed service.

- Scale from 1 to 52 Cores with 768 GB of RAM
- Up to 51.2 TB of local NVMe SSD Database Storage
- Standard or Enterprise Edition Oracle Databases
- 2x 25 gbps Network Interface

03 Exadata Cloud Service

An Exadata system housed in an Oracle data centre, with additional tooling. This is a customer managed service.

- Scale to 368 Cores with up to 5.7 TB of RAM
- Over 300 TB of NVMe Flash Cache Available
- Up to 340 TB of Database Storage
- 2x 25 gbps Network Interfaces

AVAILABLE ORACLE CLOUD DATABASE SHAPES

04 Exadata Cloud at Customer

The same Exadata Cloud Service experience, but the servers are located in your own data center.

- Scale to 368 Cores with up to 5.7 TB of RAM
- Over 300 TB of NVMe Flash Cache Available
- Up to 340 TB of Database Storage
- 2x 10 Gbps Network Interfaces

05 Autonomous Transaction Processing

A fully automated database service tuned and optimized for transaction processing based on the Oracle database running on Exadata.

06 Autonomous Data Warehouse

A fully automated database service tuned and optimized for data warehouse based on the Oracle database running on Exadata.

There are two primary cloud database models, Traditional and Database as a service (DBaaS).

01 Traditional

This is very similar to an onsite, in-house managed database—except for infrastructure provisioning. In this case, an organization purchases virtual machine space from a cloud services provider, and the database is deployed to the cloud. The organization's developers use a DevOps model or traditional IT staff to control the database. The organization is responsible for oversight and database management.

02 Database as a service (DBaaS)

With DBaas, an organization contracts with a cloud services provider through a fee-based subscription service. The service provider offers a variety of real-time operational, maintenance, administrative, and database management tasks to the end user. The database runs on the service provider's infrastructure.

This usage model typically includes automation in the areas of provisioning, backup, scaling, high availability, security, patching, and health monitoring. The DBaaS model provides organizations with the greatest value, allowing them to use outsourced database management optimized by software automation rather than hire and manage in-house database experts.

CLOUD DATABASE DEPLOYMENT MODELS

Oracle Database Cloud Service currently supports Oracle Database versions
11.2.0.4,
12.1.0.2,
12.2.0.1,
18.1.0.0

SUPPORTED ORACLE DATABASE SOFTWARE VERSIONS

SUPPORTED ORACLE DATABASE SOFTWARE EDITIONS

01 Standard Edition

Includes the Oracle Database Standard Edition Package.

02 Enterprise Edition

Includes the Oracle Database Enterprise Edition Package, Data Masking and Sub-setting Pack, Diagnostics and Tuning Packs, and Real Application Testing.

03 Enterprise Edition High Performance

Extends the Enterprise package with the following options: Multitenant, Partitioning, Advanced Compression, Advanced Security, Label Security, Database Vault, OLAP, Advanced Analytics, Spatial & Graph, Database Lifecycle Management Pack, and Cloud Management Pack for Oracle Database.

04 Enterprise Edition Extreme Performance

Extends the High-Performance package with the following options: Real Application Clusters (RAC), In-Memory Database, and Active Data Guard.

ACCESS TO ORACLE CLOUD INFRASTRUCTURE

You can access Oracle Cloud Infrastructure using the Console (a browser-based interface) or the REST API by providing your cloud tenant, your username, and your password.

REST APIs (REpresentational State Transfer): The Oracle Cloud Infrastructure APIs are typical REST APIs that use HTTPS requests and responses. A RESTful API is an application program interface (API) that uses HTTP requests to GET, PUT, POST, and DELETE data. ... REST technology is generally preferred to the more robust Simple Object Access Protocol (SOAP) technology because REST leverages less bandwidth, making it more suitable for internet usage.

AUTHENTICATION AND AUTHORIZATION

Each service in Oracle Cloud Infrastructure integrates with IAM for authentication and authorization, for all interfaces (the Console, SDK or CLI, and REST API). An administrator in your organization needs to set up groups, compartments, and policies that control which users can access which services, which resources, and the type of access.

GROUPS: A collection of users who all need a particular type of access to a set of resources or compartment.

COMPARTMENTS: A collection of related resources that can be accessed only by certain groups that have been given permission by an administrator in your organization.

POLICIES: An IAM document that specifies who has what type of access to your resources. It is used in different ways: to mean an individual statement written in the policy language; to mean a collection of statements in a single, named “policy” document (which has an Oracle Cloud ID (OCID) assigned to it); and to mean the overall body of policies your organization uses to control access to resources.

SECU

ACCESS SECURITY WITH ORACLE CLOUD INFRASTRUCTURE

URITY

ORACLE VIRTUAL CLOUD NETWORK (VCN) is a customizable private network in Oracle Cloud Infrastructure. Just like a traditional data centre network, a VCN provides you with complete control over your network environment. This includes assigning your own private IP address space, creating subnets, creating route tables and configuring stateful firewalls. A single tenant can have multiple VCNs, thereby providing grouping and isolation of related resources.

By deploying into a VCN by default, you get the security and flexibility of:

» Deploying your databases into a private network, protected from the internet.
» Configuring security lists (inbound/outbound) to protect malicious users from accessing the DB system.

IDENTITY AND ACCESS MANAGEMENT (IAM):

» With IAM, you can configure your cloud environment to support your security and compliance requirements.
» From a database perspective, you configure IAM policies that allow you to restrict access to bare metal and virtual machine DB systems only to a select set of users (DBAs) from a management perspective.

DATABASE AUDIT:

» With full root access to the DB system you can configure auditing for all operations on the DB system.
» Audit records include information about the operation that was audited, the user performing the operation, and the date and time of the operation.

DATA SECURITY

In Oracle Database Cloud Service databases, data security is provided for data in transit and data at rest. Security of data in transit is achieved through network encryption. Security of data at rest is achieved through encryption of data stored in database data files and backups

01 Security for data in transit

» Encryption of network data provides data privacy so that unauthorized parties are not able to view data as it passes over the network.

» In addition, integrity algorithms protect against data modification and illegitimate replay. Oracle Database provides the Advanced Encryption Standard (AES), DES, 3DES, and RC4 symmetric cryptosystems for protecting the confidentiality of Oracle Net Services traffic.

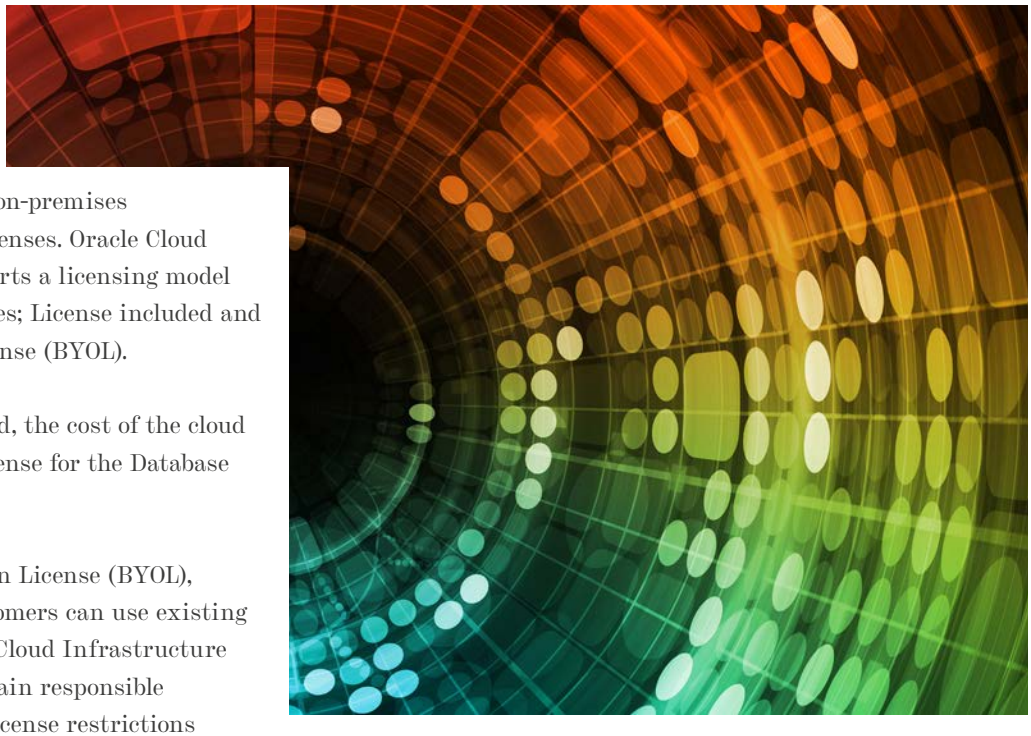
» It also provides a keyed, sequenced implementation of the Message Digest 5 (MD5) algorithm or the Secure Hash Algorithm (SHA-1 and SHA-2) to protect against integrity attacks.

02 Security for data in rest

» Oracle Database Cloud Service uses Oracle Transparent Data Encryption (TDE) to encrypt data in the database data files and in backups.

» Encrypted data is also protected in temporary tablespaces, undo segments, redo logs and during internal database operations such as JOIN and SORT.

Licensing Types



There is no separate on-premises licenses and cloud licenses. Oracle Cloud Infrastructure supports a licensing model with two license types; License included and Bring Your Own License (BYOL).

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

With Bring Your Own License (BYOL), Oracle Database customers can use existing licenses with Oracle Cloud Infrastructure while customers remain responsible for complying with license restrictions applicable to their BYOL licenses, as defined in their program order for those licenses.

ORACLE CLOUD INFRASTRUCTURE

Billing Model

Oracle Cloud Infrastructure supports Oracle's Universal Credit Model with both licenses included and bring your own license pricing. Pricing is flexible with both pay as you go, as well as discounted commit prices through Oracle Sales.

Oracle Database is charged on the following usage elements:

- HOSTED ENVIRONMENT PER HOUR: Hosted Environment is defined as the base DB system instance which has a base CPU capacity, local storage (for bare metal only), and enabled OCPUs for the edition of your choice. Each partial Hosted Environment Hour consumed is billed as a full hour.
- OCPU (ORACLE COMPUTE UNIT) PER HOUR: You can enable additional OCPUs (CPU capacity equivalent of one physical core of an Intel Xeon processor with hyper threading enabled. Each OCPU corresponds to two hardware execution threads, known as vCPUs) per Hosted Environment or DB system. Each partial OCPU Hour consumed is billed as a full hour
- BLOCK VOLUMES: Database service on VM uses remote block volumes. You can attach storage anywhere from 256GB to 40TB and pay for the total storage, which is the sum of available storage, reco storage, and software size. Available storage is selected by you, while Reco storage is automatically calculated based on available storage, and software size is a fixed size Oracle database cost.
- OBJECT STORAGE: Your automatic incremental backups, on-demand full backups and on-premises to cloud backups are stored in Oracle Cloud Infrastructure Object Storage and you will be charged standard object storage cost. Please refer to Storage pricing for more details.

Oracle Cloud Infrastructure is hosted across globe in the forms of Realms, Regions, Availability Domains and Fault Domains.

» REALMS: A logical collection of regions. Realms are isolated from each other and do not share any data. Your tenancy exists in a single realm and can access the regions that belong to that realm.

» REGION: A region is a localized geographic area, and an availability domain is one or more data centres located within a region. A region is composed of one or more availability domains.

» AVAILABILITY DOMAINS: Availability domains are isolated from each other, fault tolerant, and very unlikely to fail simultaneously. Because availability domains do not share infrastructure such as power or cooling, or the internal availability domain network, a failure at one availability domain within a region is unlikely to impact the availability of the others within the same region.

The availability domains within the same region are connected to each other by a low latency, high bandwidth network, which makes it possible for you to provide high-availability connectivity to the internet and on-premises, and to build replicated systems in multiple availability domains for both high-availability and disaster recovery

» FAULT DOMAINS: A fault domain is a grouping of hardware and infrastructure within an availability domain. Each availability domain contains three fault domains. Fault domains let you distribute your instances so that they are not on the same physical hardware within a single availability domain. A hardware failure or Compute hardware maintenance that affects one fault domain does not affect instances in other fault domains

Your tenancy exists in a single realm and can access all regions that belong to that realm. You can't access regions that are not in your realm. Currently, Oracle Cloud Infrastructure has two realms, The Commercial Cloud Realm and The Government Cloud Realm.

Region Name	Region Location	Region Key	Realm Key	Availability Domains
ap-seoul-1	Seoul, South Korea	ICN	OC1	1
ap-tokyo-1	Tokyo, Japan	NRT	OC1	1
ca-toronto-1	Toronto, Canada	YYZ	OC1	1
eu-frankfurt-1	Frankfurt, Germany	FRA	OC1	3
uk-london-1	London, United Kingdom	LHR	OC1	3
us-ashburn-1	Ashburn, VA	IAD	OC1	3
us-phoenix-1	Phoenix, AZ	PHX	OC1	3

Table 1: Commercial Cloud Realm Locations.

Region Name	Region Location	Region Key	Realm Key	Availability Domains
us-langley-1	Ashburn, VA	LFI	OC2	1
us-luke-1	Phoenix, AZ	LUF	OC2	1

Table 2: Government Cloud Realm Locations.

Locations

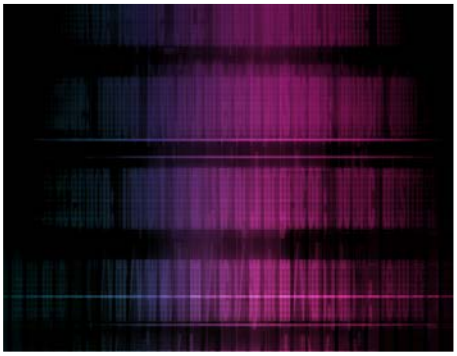
MIGRATION

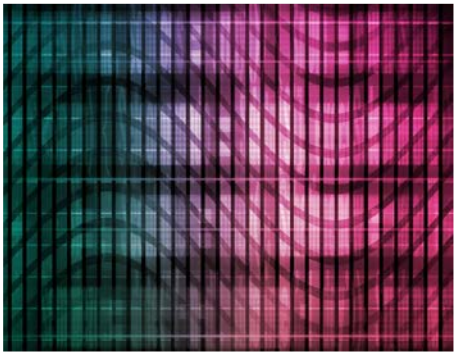
CREATING NEW ORACLE DATABASES IN ORACLE CLOUD SERVICE

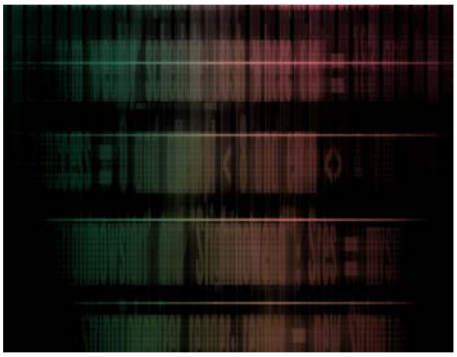
Once you've created an Oracle Cloud Infrastructure account, you can create an Oracle database on Database Cloud Service by using the console, REST APIs, CLI and SDKs.

Following are the high-level steps for creating new Oracle Database on Oracle Cloud:

1. Log into the Oracle Cloud and navigate to the Oracle Cloud Infrastructure (OCI) console.
2. Create a Virtual Cloud Network (VCN).
3. Create SSH Key pair for authentication.
4. Select the "Bare Metal, VM and Exadata" option in the menu.
5. Select the compartment and enter all the details about the service you want to provision, including the system, networking and database details.
6. Upload your public key for operating system access.
7. Click the "Launch DB System" button.
8. Connect to the "opc" operating system user by specifying your private key and the public IP address from your DB Systems page.
9. Once connected, you can switch to the "oracle" OS user and do all regular database tasks.





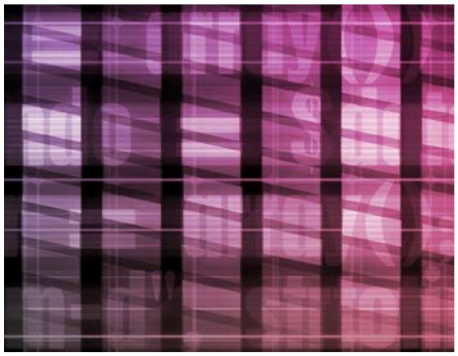


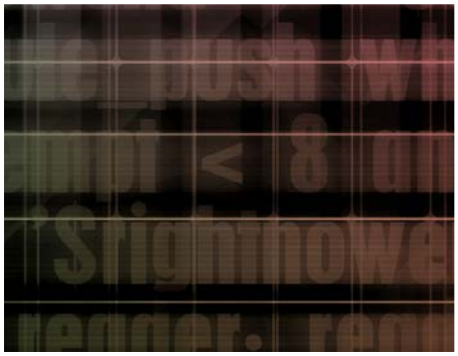
MIGRATING ON-PREMISES ORACLE DATABASES TO ORACLE CLOUD SERVICE

You can migrate your on-premises Oracle Database to an Oracle Database Cloud database using a number of different methods that use several different tools. Not all migration methods apply to all migration scenarios. Many of the migration methods apply to a given migration scenario depends on several factors, including the version, character set, and platform endian format of the source and target databases.

Migration Methods:

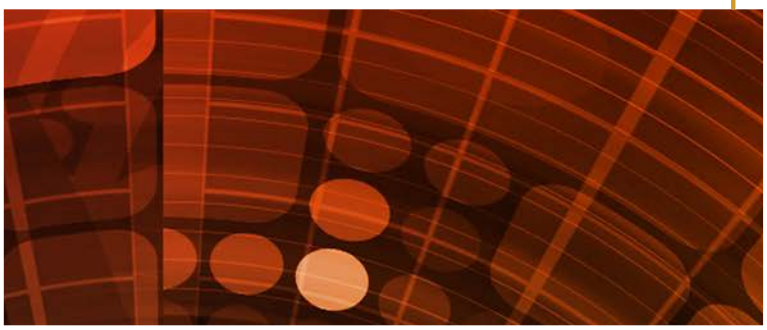
- Data Pump Conventional Export/Import
- Data Pump Full Transportable
- Data Pump Transportable Tablespace
- Remote Cloning a PDB
- Remote Cloning Non-CDB
- RMAN Cross-Platform Transportable PDB
- RMAN Cross-Platform Transportable Tablespace Backup Sets
- RMAN Transportable Tablespace with Data Pump
- RMAN CONVERT Transportable Tablespace with Data Pump
- SQL Developer and INSERT Statements to Migrate Selected Objects
- SQL Developer and SQL*Loader to Migrate Selected Objects
- Unplugging/Plugging a PDB
- Unplugging/Plugging Non-CDB





DATABASE ADMINISTRATIVE TASKS

1



01 PATCHING

» The Database Cloud Service patching feature simplifies the steps required to patch your DB systems and databases.

» You can use the Oracle Cloud Infrastructure console and APIs to view applicable patches for your DB system or database home and submit a patching request. The Database Cloud Service will then run the end-to-end patching steps for you while displaying the status.

» You can view all patches that have been applied, and if required, re-apply a patch. In addition, you can use Oracle Identity and Access Management (IAM) controls to manage access to patching features.

02 BACKUP & RECOVERY

» There are multiple options available for storing and recovering your backups. You can use the backup and restore feature either within the Oracle Cloud Infrastructure Console, CLI or REST APIs, or manually set up and manage backups using dbcli or RMAN.

» When you use the Console, you can create full backups or set up automatic incremental backups with a few clicks.

» All your backups are encrypted with the same master key used for TDE encryption.

» Since backups are stored in Oracle Cloud Infrastructure Object Storage and the service fees apply for storing your backups.

» Oracle database on virtual machines enables scaling storage from 256 GB to 40 TB, with no downtime when scaling up storage

2

03 HARDWARE UPGRADE

» You can change the hardware configuration of a database system to adjust capacity in response to changes in workload. This includes the number of Oracle Compute Units (OCPUs), amount of memory (RAM) and storage that you want to allocate.

» For Bare Metal systems you can change the number of cores used by the DB system from the console directly or through our APIs without any down time. Core scaling is currently not supported for virtual machines.

3

04 HIGH AVAILABILITY

» You can launch DB systems in different Availability Domains and configure Data Guard for setting up highly available Oracle databases.

» Oracle Data Guard ensures high availability, data protection, and disaster recovery for enterprise data.

» All Enterprise database editions support Data Guard. Enterprise Extreme Performance edition supports Active Data Guard.

» Oracle Database Cloud Service supports a “cloud-first” Oracle RAC on virtual machines within a virtual cloud network.

4

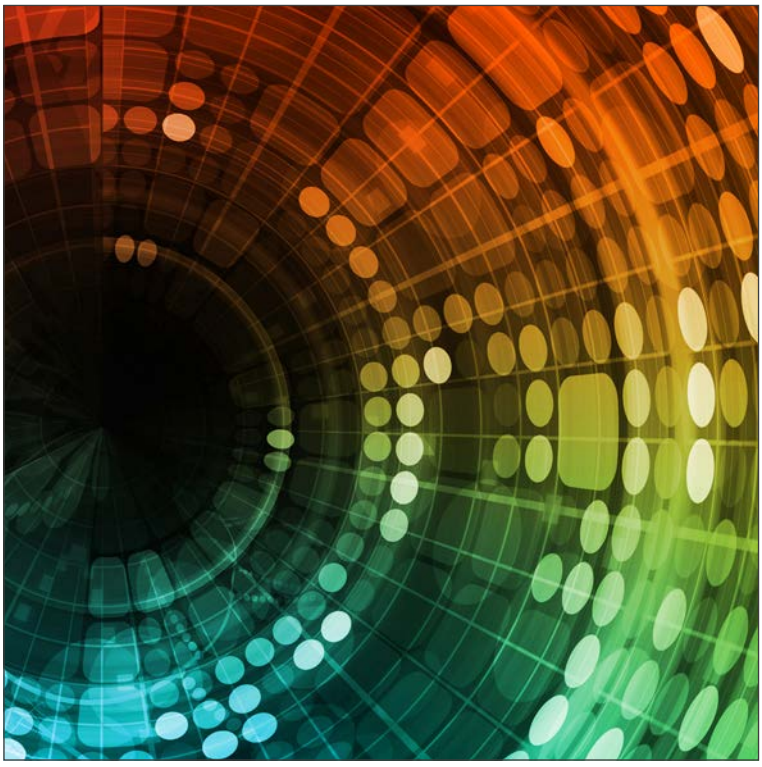
CONCLUSION

Cloud computing has become a key strategy for business and IT alignment and is starting to dominate architecture roadmap discussions. Most enterprises have either adopted, or have plans to adopt, Cloud as a strategic choice in support of their business and technology goals. There are many vendors and options available to organizations looking for a cloud database solution for their enterprise.

You will want to select a model that works best for your specific business needs based on security features, performance and capital and operational investments. Online and independent scaling of compute and storage, patching, and upgrade will ensure that your database's capacity meets your enterprise's needs as they fluctuate, without interrupting operations. Automated and online performance optimization, such as auto-indexing, is a must. You'll also want scale-out clustering for both read and write to ensure that your mission-critical, real-time workloads run seamlessly.

Robust security features are paramount. Any database model you select should be able to perform data encryption at rest and in flight and provide automated security updates. It's also essential to ensure a strict separation of duties so operations cannot access customer data. Strong data redaction capabilities help ensure that visibility to sensitive data is limited and controlled. External attack detection and prevention driven by machine learning provides an additional layer of real-time security.

Lastly, for your most business-critical applications, you'll want a dedicated cloud infrastructure that includes hardware isolation from other tenants.



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