

Oracle Cloud Infrastructure Platform Overview

Improve performance and security,
while reducing costs for your enterprise
and performance-intensive applications

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Purpose statement

This document provides an overview of features and enhancements included in release Oracle Cloud Infrastructure. It is intended solely to help you assess the business benefits of upgrading to Oracle Cloud Infrastructure and to plan your I.T. projects.

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Oracle Cloud Infrastructure (OCI) is a platform of cloud services that enable you to build and run a wide range of applications in a highly-available, consistently high-performance environment. This paper showcases how OCI is designed to help companies run their entire application portfolio, especially their mission critical workloads, in the cloud. Customers are growing new lines of business, improving their user experiences, speeding their operations, and lowering their risks and costs on OCI.

Introduction

Oracle Cloud Infrastructure launched in October 2016 with a single region and core services across compute, storage, and networking. Since then, Oracle Cloud has expanded to more than 70 services available in 29 cloud regions worldwide with plans to reach 38 total regions by the end of 2021. OCI offers relational, OLAP, JSON, and NoSQL databases, containers, Kubernetes, serverless functions, Spark, streaming, Jupyter notebooks, VMware—the range of cloud services necessary for nearly any workload. In 2020 alone, Oracle Cloud Infrastructure launched nearly 400 new services, features, and enhancements.

While other clouds were originally designed to support web and "scale out" cloud native applications, we saw an opportunity to build our cloud differently. Most companies have three additional classes of applications: enterprise applications that use relational databases, technical applications, and departmental applications. The first two have typically required modifications or even rewrites to run in the cloud, while the third has often been replaced by SaaS alternatives. Oracle has invested deeply to build core infrastructure services from the ground up to make it easy for customers to run all five classes of applications. Atop Oracle Cloud Infrastructure, Oracle also offers a broad and deep array of cloud applications (SaaS) for nearly any departmental and industry-specific need.

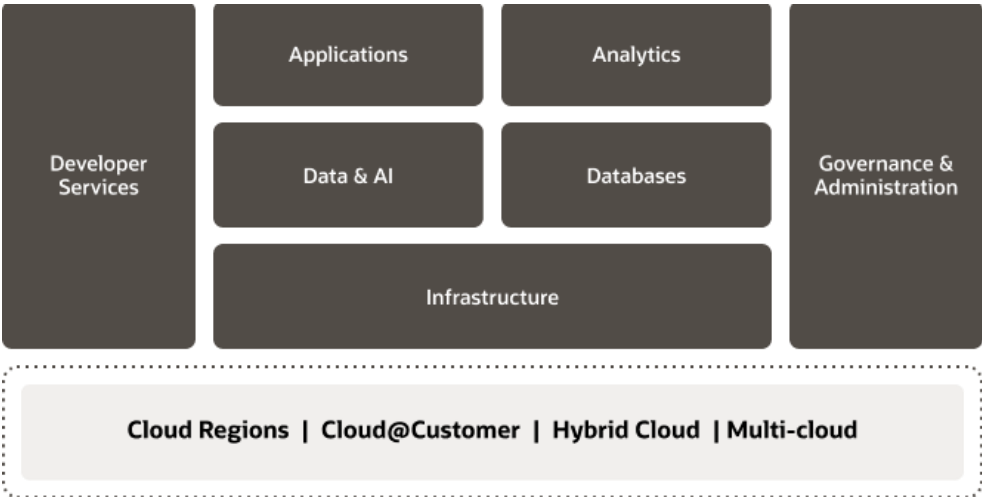


Figure 1: Oracle Cloud services

To address all five major classes of applications in a single cloud, we made design choices and innovated at every layer. We built our cloud regions with [greater resiliency down to the individual node](#) to make it easier to run enterprise applications with high availability (HA). We minimized hops and protocol translations in the physical network to achieve sub-millisecond latency within availability domains. At the virtual networking layer, we don't oversubscribe, so every resource gets maximum bandwidth without contention from other tenants. We're the first cloud provider to [implement Layer 2 network virtualization](#), which enables customers to natively run VMware underneath enterprise applications in our cloud, and supports other key requirements like clustered databases for HA.

Oracle Cloud Infrastructure was also the first major cloud provider to implement "off-box" or isolated network virtualization, which takes network and IO virtualization out of the server stack and compute hypervisor and puts it in the network. As a result, customers can provision self-service, dedicated hosts with no hypervisor overhead, noisy

neighbors, or shared resources with a full software-defined Layer 3 network topology. Virtual Machines (VMs) also benefit from this technology with reduced hypervisor overhead and improved isolation. All Oracle Cloud services that use compute also benefit with consistent high performance—everything from our Container Engine to our MySQL service.

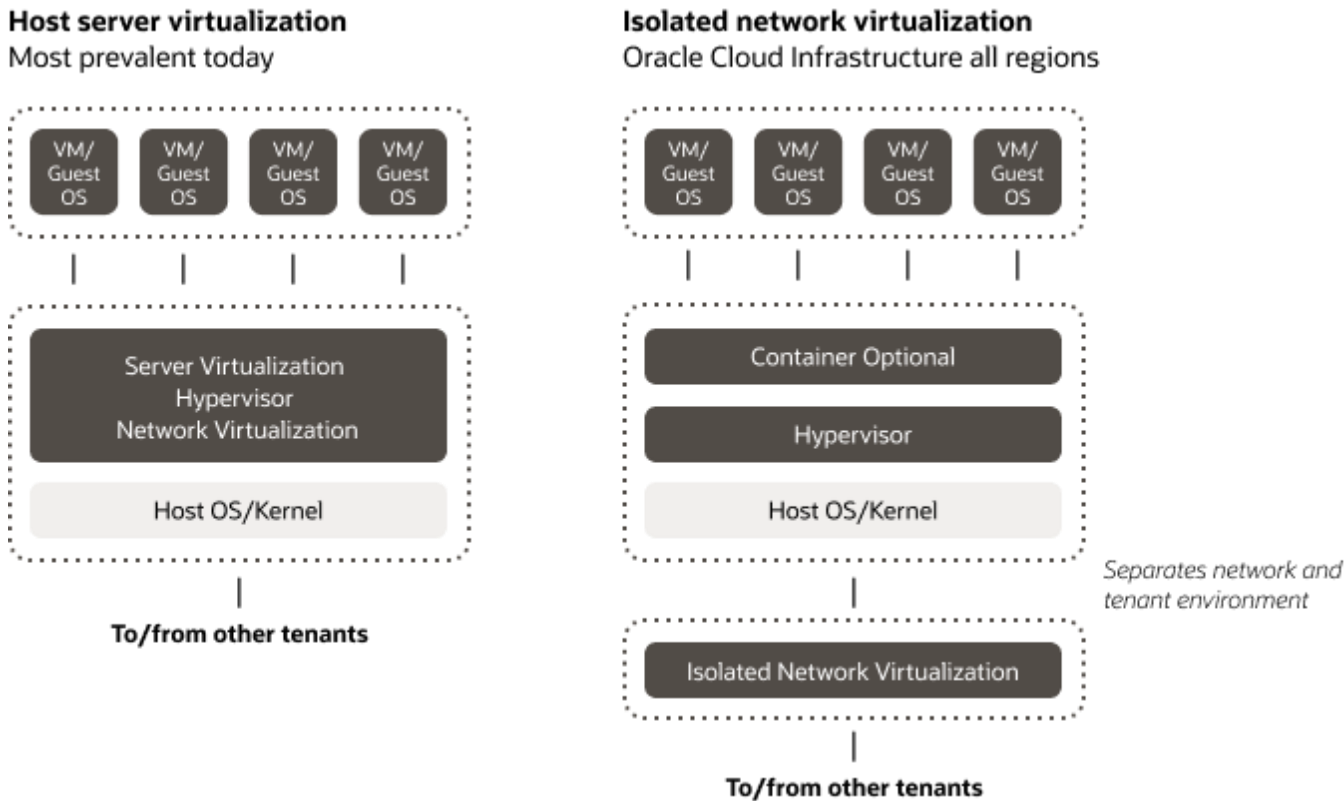


Figure 2: Oracle Cloud Infrastructure Off-Box Network Virtualization

Off-box network virtualization enables running bare-metal instances side-by-side with any class of systems—from VMs to containers to optimized database systems like Oracle Exadata—all using the same set of APIs. With Oracle Cloud, customers can leverage unique Exadata capabilities (tens of millions of IOPS, IO prioritization, columnar compression) to run Oracle Databases, together with the cloud-native security and governance capabilities of a Layer 3 virtual cloud network.

Oracle Cloud Infrastructure benefits

Superior performance

Oracle Cloud Infrastructure is designed for applications that require consistent high-performance, including stateful connections to databases, raw processing through CPUs or GPUs, millions of storage IOPS, and GB/s of throughput. Non-blocking networks guarantee that each resource gets predictable high-performance and low latency. Oracle Cloud Infrastructure leverages the latest CPUs, GPUs, networking, and storage technology like NVMe SSD drives. For example, OCI offers bare-metal instances with 51.2 TB of NVMe solid state storage capable of millions of read and write transactions per second. Based on third party testing, [Oracle's compute and storage offer 2-5 times the I/O performance of comparable on-premises or AWS products](#), with more consistent low latency. Great performance translates into faster results for end customers and greater productivity. For example, [financial processes that used to take 2 hours for marketing firm Maritz, now take 10 minutes](#).

Superior economics

Oracle Cloud Infrastructure's Compute offerings are roughly 50% less than comparable AWS or Azure products. Flexible compute shapes enable customers to tailor and pay for instances with the exact amount of cores and memory they need, saving over coarser-grained "t-shirt sized" instances. Oracle's block storage and database storage are as much as 95% less than other cloud providers. We don't charge for outbound bandwidth for up to 10TB per month and beyond that charge a fraction of other cloud providers. We offer the same everyday low prices in every global region, including our US and UK government regions. The only price that varies globally is outbound bandwidth, where we add a consistent margin on more expensive network provider costs, yet still offer substantial savings over other cloud providers. Our lower product costs translate into 20-60% lower TCO across a range of workloads versus comparable on-premises or AWS infrastructure. [8x8, an unified communications vendor, saved 80% on their networking costs by moving from AWS to OCI](#). Many Oracle Cloud Infrastructure services are metered on a per second basis so that you can scale resources when you need them and only pay precisely for those you consume. Discounted annual commitment pricing is available as well via Oracle's Universal Credits program.

Built-in security

Oracle Cloud Infrastructure starts with a zero-trust architecture. This means that not only are tenants isolated from one another, but tenants are also isolated from Oracle and vice versa. The isolated network virtualization mentioned earlier plays a role in this clean separation, as well as [a custom hardware root of trust to reimage every instance prior to a new customer receiving it](#). Above Oracle Cloud's core infrastructure are layer upon layer of defenses including default data encryption, least-privilege identity and access management, and granular resource and network control all the way out to the edge. Oracle Cloud also has strict code security development and deployment processes, a full compliance team which is constantly auditing new regions and services, and a round-the-clock Security Operations Center to guard against threats. [Oracle Cloud Infrastructure is compliant with over 80 global, regional, and industry standards including SOC, ISO, PCI-DSS, HIPAA, FedRAMP, IL-5, GDPR, and more](#). The combination of secure architecture, technology, development, and process provides a more secure environment than most on-premises facilities, as well as other clouds.

Broad regional availability and complete hybrid cloud solutions

Oracle Cloud has cloud regions around the world and a significant roadmap of new regions. Oracle plans to have at least two geographically separated cloud regions in each country to provide true disaster protection while maintaining data sovereignty. Available Oracle Cloud regions include:

- Asia Pacific: Tokyo, Osaka, Seoul, Chuncheon, Mumbai, Hyderabad, Sydney, Melbourne
- Americas: San Jose, Phoenix, Ashburn, Toronto, Montreal, São Paulo, Santiago
- Europe: Frankfurt, London, Newport, Zürich, Amsterdam

- Middle East: Jeddah, Dubai
- United States Government: two general U.S. Government regions, three U.S. Department of Defense specific Government regions, and U.S. National Security regions
- United Kingdom Government: two U.K. Government regions

If multi-tenant public regions, or limited-tenancy government regions aren't a fit, Oracle has multiple hybrid cloud options. [Oracle Dedicated Region Cloud@Customer](#) is a completely managed cloud region that brings all of Oracle's public cloud infrastructure services and Oracle Fusion cloud applications into your datacenter, keeping your data and the control plane in your premises. It delivers cloud services with the highest performance; and reduces your costs with consumption-based cloud subscription pricing—all while meeting stringent latency requirements. [NRI, a large Japanese consultancy, uses Dedicated Region to host critical SaaS applications that are used by about 70% of the capital market firms in Japan.](#) [Oracle Autonomous Database on Exadata Cloud@Customer](#) combines all the benefits of having Exadata in your data center with the simplicity of a cloud service. It helps you meet strict data sovereignty and security requirements and eliminate many manual database and infrastructure management tasks while supporting on-premises enterprise applications with the highest Oracle Database performance. Applications best-suited for running on Oracle Cloud Infrastructure.

Simple, yet powerful APIs and developer tools

The Oracle Cloud Infrastructure APIs are REST APIs that use HTTPS requests and responses. This intuitive API along with a command-line interface and common SDKs in Java, Python, Typescript, Javascript, .NET, Go, and Ruby let you manage large-scale workloads and automate everything. In addition, Oracle Cloud has native support for [Terraform](#) automation and [cloud-init](#) capabilities. Oracle Cloud Infrastructure lets you provision and manage single-tenant, dedicated physical hosts, or multi-tenant VMs using the same set of APIs. Oracle Cloud empowers you to develop and test your application with VMs, but deploy with dedicated physical hosts or vice-versa: you don't need to change your app as the single and multi-tenant models share the same cloud-optimized hardware, firmware, software stack, and networking infrastructure and all it takes is a couple of clicks (in the GUI console or API calls).

Applications best-suited for running on Oracle Cloud Infrastructure

Enterprise applications that use relational databases

Many existing enterprise applications, including Oracle applications like E-Business Suite, third party applications like Manhattan Associates and SAP, and custom applications, leverage a backend Oracle Database. Oracle Database offers major advantages in three areas: high-performance, high-availability, and rich functionality.

Oracle Real Application Clusters (RAC) is the feature of the Oracle Database that enables multiple clustered instances of Oracle to simultaneously access a single shared database. This provides the low latency, high availability and online maintenance that many traditional enterprise applications require. Oracle RAC uses Oracle Clusterware for the infrastructure to bind the interconnected servers so they appear as a single system to end users and applications, and a dedicated, high-speed, low latency, private network known as cluster interconnect to synchronize activity and share information between instances. Creating an on-premises RAC infrastructure can be expensive, time-consuming and error-prone. Customers can instead leverage Oracle Cloud Infrastructure Database service to create a 2-node managed RAC instance (or Exadata service to create quarter, half, or full-rack Exadata systems with RAC) which provide all the benefits of RAC but removes the pain-points associated with running RAC on-premises. The reference architecture below shows [an Exadata environment, including RAC, on Oracle Cloud Infrastructure](#).

Customers like [Alliance Data Systems saved over \\$1 million in their first year](#) of running Oracle on-premises applications in the Oracle Cloud. Other customers like [TruGreen saw application end user performance increase 4-5 times](#) over their on-premises environment.

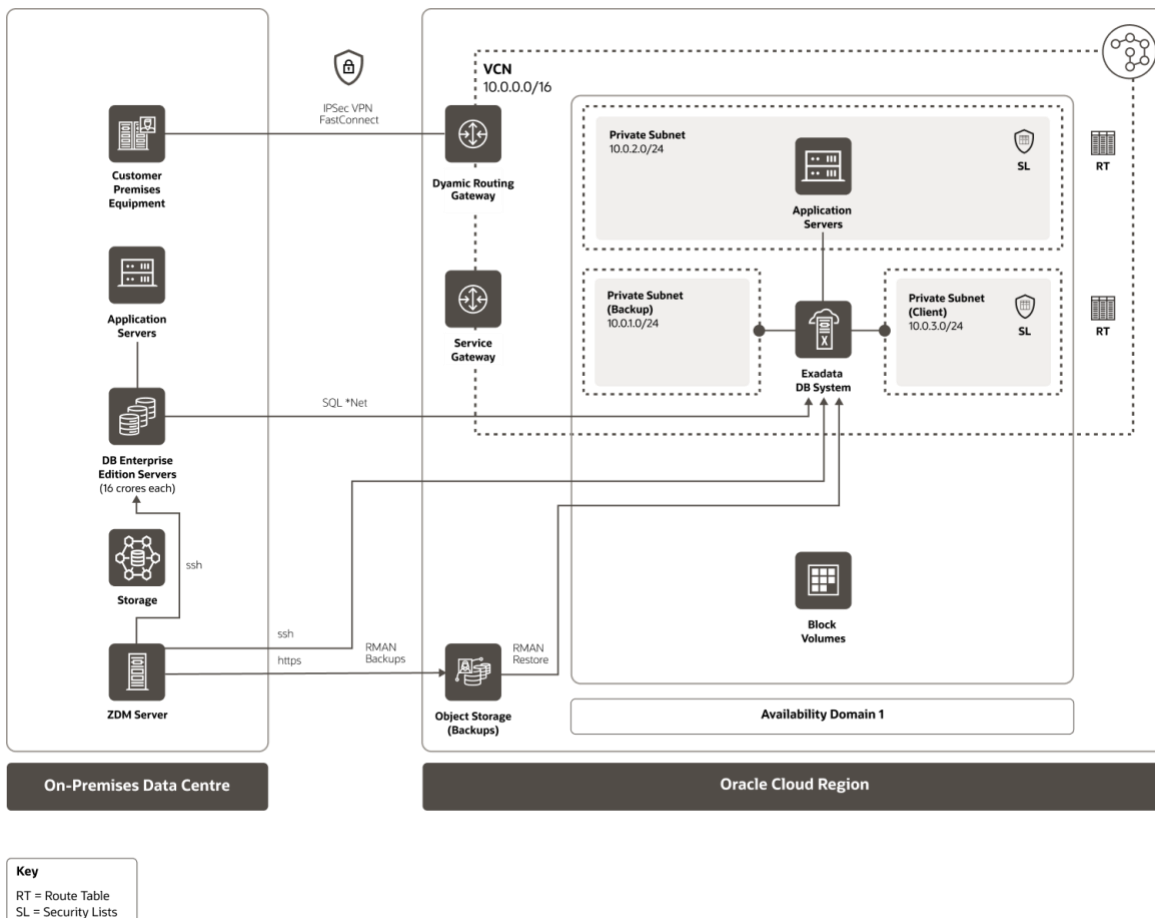


Figure 3: Oracle Exadata Cloud Service and Real Application Cluster (RAC) on Oracle Cloud Infrastructure

High Performance Computing (HPC) workloads

Oracle Cloud Infrastructure is a natural fit for many high-performance and I/O intensive computing workloads such as crash and aerodynamic simulations, risk modeling, and digital twins. These workloads involve huge data sets that need to be analyzed using large-scale compute jobs, which demand high performance, high throughput, and low variability. On-premises environments are difficult to size properly. It's easy to over-provision and underutilize, or build too small of an environment and slow down projects. High performance can be attained, but components like GPUs can be out of date quickly, and large scale HPC networks can be difficult to maintain. There is also a long provisioning cycle for HPC clusters on-premises. Other cloud offerings typically have hypervisor overhead and performance variability (often referred to as noisy neighbors).

Oracle makes HPC clusters fully on-demand. You can spin up single or hundreds of instances in minutes. Oracle's single-tenant model eliminates hypervisor overhead and noisy neighbors. OCI's bare-metal instances come with 25 Gbps network throughput (and dual 25 Gbps NICs) which help move massive amounts of data quickly. OCI also uniquely offers [cluster networking as a service](#), which enables customers to deploy clusters of high frequency CPU instances or GPU instances with a 100 Gbps backplane and 1.5 μ s latency. This capability natively supports MPI (Message Passing Interface) workloads that were once only possible on-premises.

Superior performance, unique cluster networking, and ability to provision bare-metal servers in minutes make Oracle Cloud Infrastructure platform an ideal choice for running HPC workloads. Customers like [Nissan were finally able to move their digital product design and testing infrastructure into the cloud](#). [Yellow Dog, a 3D animation studio, has seen 10 times greater HPC performance on the Oracle Cloud](#) versus on-premises or other cloud providers. The [HPC reference architecture](#) below shows a typical HPC workload running on Oracle Cloud Infrastructure.

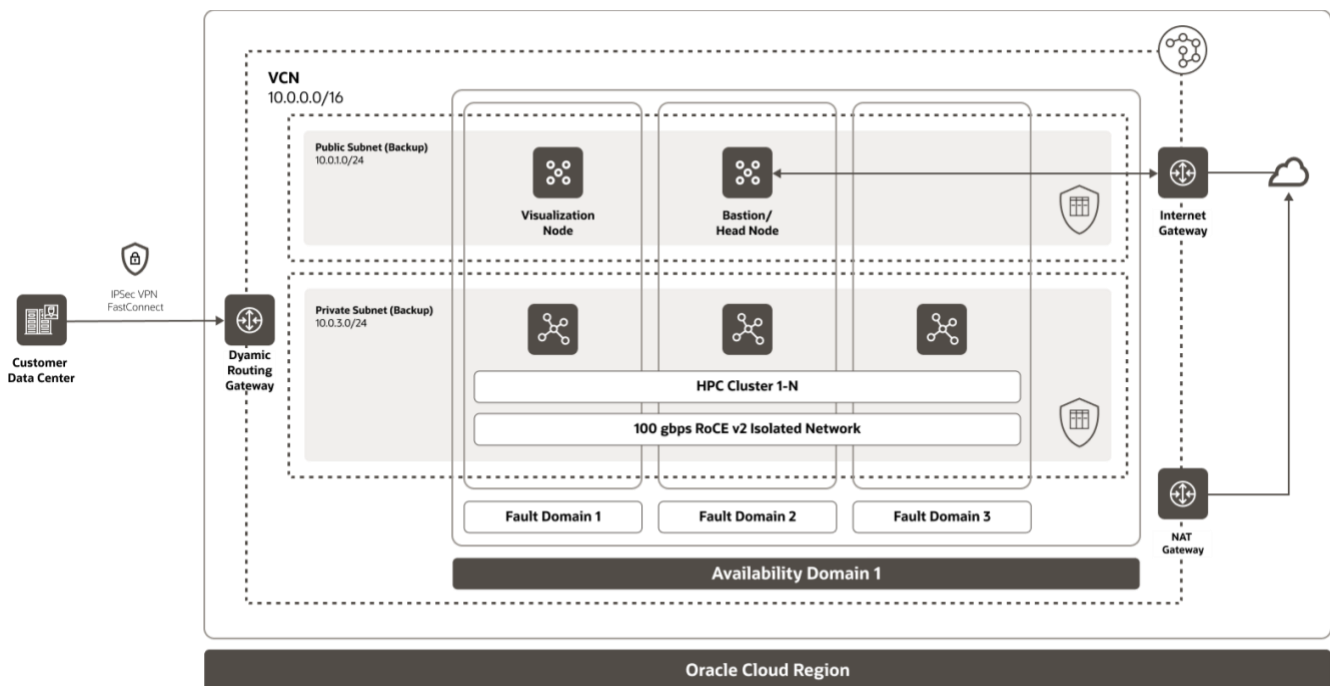


Figure 4: High performance computing application on Oracle Cloud

Data Warehouse and Data Lake workloads

Oracle Cloud Infrastructure provides a flexible data platform to enable you to build Big Data applications at massive scale. You can ingest nearly any type of data in a broad range of data formats with native tools for Oracle Database, the OCI Data Integration service, or the [Kafka Connector enabled OCI Streaming](#). You can create data pipelines to store and process the data using any combination of OCI Object Storage, OCI Data Flow (Spark), Oracle Big Data (Hadoop), or Oracle Autonomous Data Warehouse. Then you can analyze or train models with the data using Oracle Analytics Cloud, OCI Data Science, Oracle Machine Learning, or a range of third-party tools. Customers like [Cisco Tetration](#) have seen [big data performance improvements of 2-3 times](#) over running the same software on-premises or in other cloud providers. The reference architecture below shows [a data pipeline using Oracle Cloud Infrastructure's Data Flow](#) (Spark), Object Storage, and Autonomous Data Warehouse services.

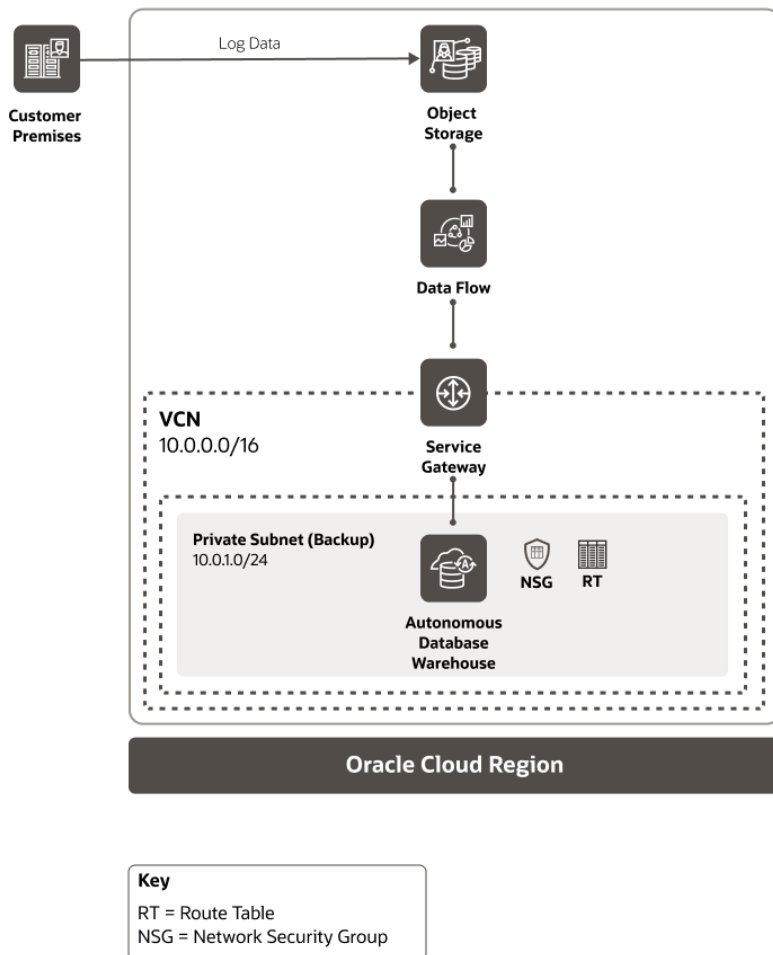


Figure 5: Processing log data with Oracle Cloud Infrastructure Data Flow (Spark) and Autonomous Data Warehouse

Web and cloud native applications

Creating scalable and highly-available web apps can be complex and time-consuming. Moreover, it is hard to predict traffic patterns in advance for web apps, which often results in capacity over provisioning and low utilization of expensive on-premises hardware and data center resources. Oracle Cloud Infrastructure provide a robust, scalable, highly-available and cost-effective infrastructure platform for hosting your most demanding web applications. OCI supports a broad range of application infrastructures, including bare-metal, VM, containers, or functions, with many different runtime and managed data persistence options. The reference architecture below shows a scalable and [highly-available web app running on Oracle Cloud Infrastructure](#).

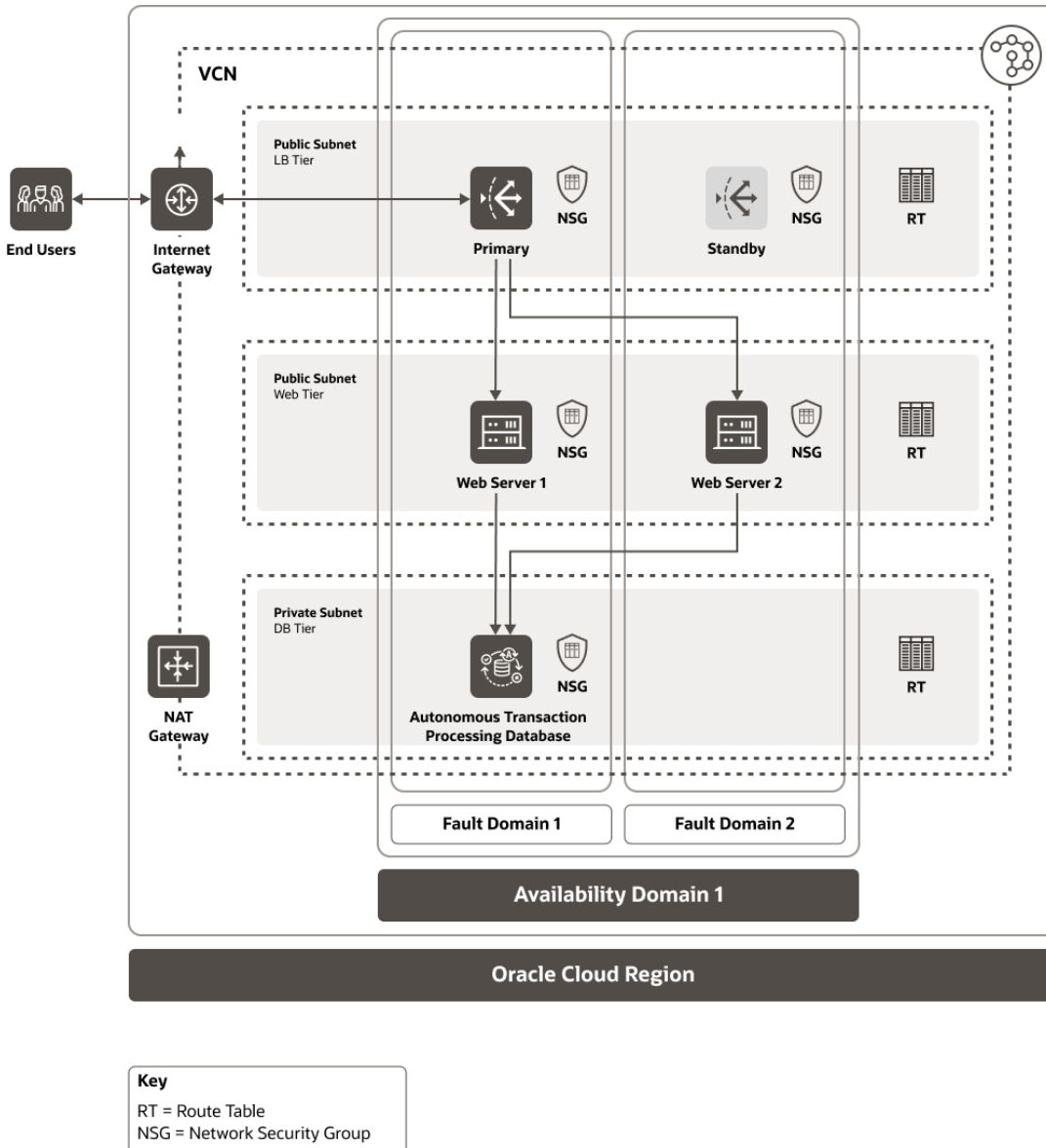


Figure 6: Scalable, highly-available web app on Oracle Cloud Infrastructure

VMware workloads in the cloud or in a hybrid cloud configuration

Many companies, particularly large enterprises, use VMware vSphere to run and manage their applications in their datacenters. They want to migrate these applications to the cloud without incurring the cost and risk of re-architecture and changing familiar IT processes. Oracle offers a solution that third-party analysts consider "[the most consistent experience with on-premises vSphere.](#)" With Oracle Cloud VMware Solution, customers maintain full control of their VMware version, patch cycle, and security while benefiting from elastic infrastructure and native access to the rest of OCI's services. [The architecture shows the solution and provides deployment guidance.](#)

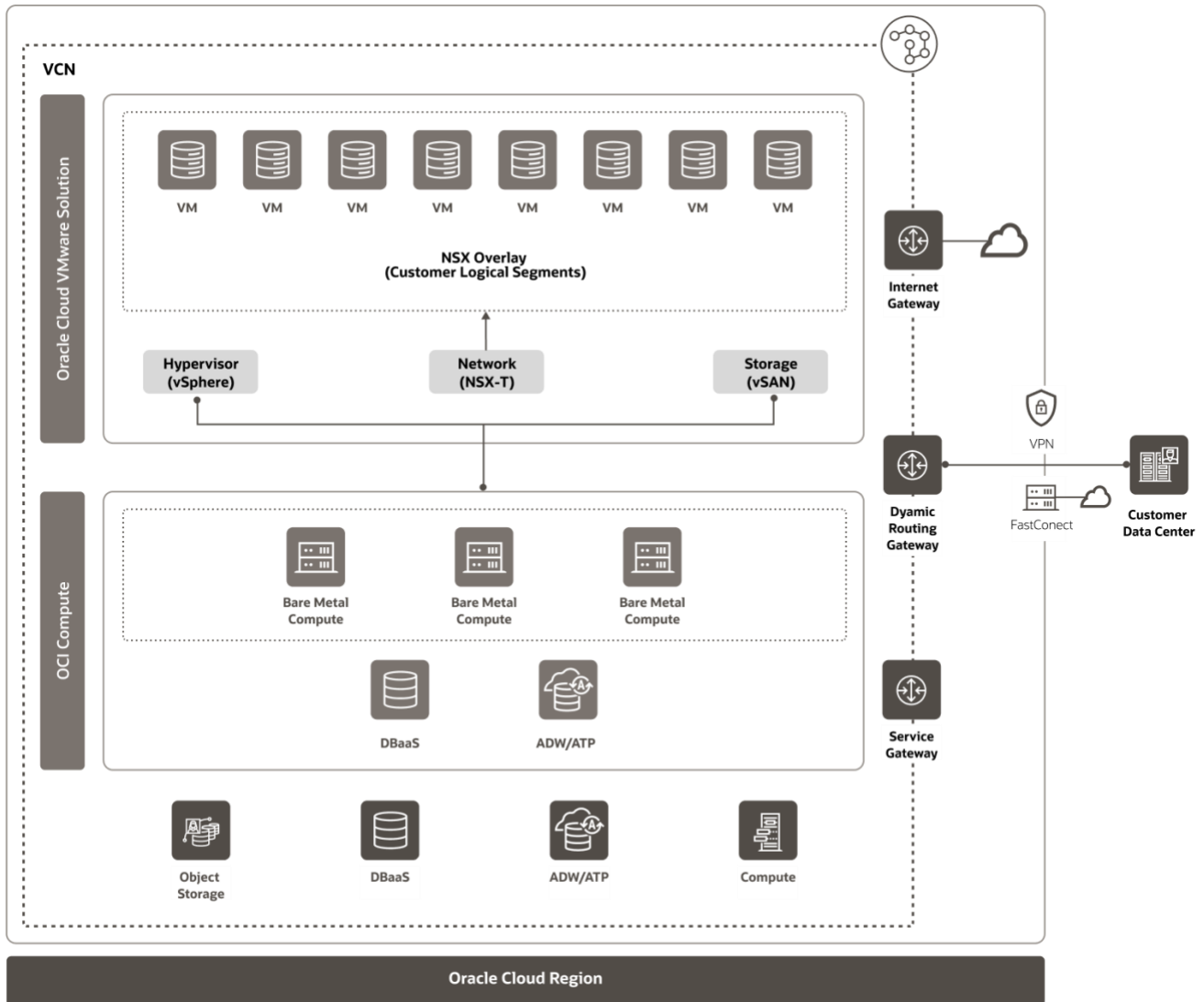


Figure 7: Oracle Cloud VMware Solution on Oracle Cloud Infrastructure

Oracle Cloud Infrastructure core products overview

Oracle Cloud Infrastructure offers over 70 cloud services, so we will cover only the high-level domains.



Figure 8: Oracle Cloud Infrastructure service domains

Compute and containers

[Oracle Cloud Infrastructure Compute](#) lets you provision and manage single-tenant servers (dedicated bare-metal servers), multi-tenant VMs, or dedicated-host VMs using the same set of APIs. You can spin-up truly elastic, self-service, pay-by-the-hour bare-metal servers in a few minutes or flexible VMs, where you can select exactly the amount of OCPUs (i.e. cores) and memory you need, in seconds. Oracle offers Intel and AMD X86 CPUs, Ampere Arm CPUs, and Nvidia GPUs. [Oracle Cloud Infrastructure Container Engine for Kubernetes](#) is a fully-managed, scalable, and highly available service to deploy containerized applications in the cloud. Use Container Engine when your development team wants to reliably build, deploy, and manage cloud-native applications. You specify the compute resources that your applications require, and the Container Engine provisions them on Oracle Cloud Infrastructure in an existing OCI tenancy.

Networking and connectivity

[Oracle Cloud Infrastructure Networking](#) lets you create and manage a software-defined network we call a Virtual Cloud Network (VCN). A VCN is a virtual version of a traditional on-premises network, where customers can choose their own RFC 1918 IP addresses and define subnets, route tables, gateways and firewall rules to support routing of public and private traffic. [Oracle Cloud Infrastructure Load Balancing](#) allows you to create a highly available load balancer within your VCN so that you can distribute requests from the Internet, or within the VCN. OCI Load Balancing also offers flexible capabilities to scale up and down on-demand. [Oracle Cloud Infrastructure FastConnect](#) provides 1 or 10 Gbps private line connections between your facilities and the Oracle Cloud through over 50 global network

providers. Oracle also offers the unique ability to [directly connect to Microsoft Azure](#) in seven global locations with ~2 millisecond latency and federated identity, addressing a number of multi-cloud use cases.

Storage

[Oracle Cloud Infrastructure Block Volumes](#) provides high-performance network storage that supports a broad range of I/O intensive workloads. You can use block volumes to expand the storage capacity of your compute instances or to provide durable and persistent data storage that can be used with different compute instances and even across multiple compute instances (multi-attach). You can flexibly adjust Block Volume performance, as well as increase capacity, online. [Oracle Cloud Infrastructure Object Storage](#) provides high throughput storage with near infinite capacity for unstructured data like logs, images, and videos. Applications like Spark can use Object Storage for large scale persistence.

Databases

[Oracle Autonomous Database](#) offers fully automated databases optimized for transaction processing, data warehousing, or document-oriented workloads (JSON). These databases provide higher security and optimal experience by self-patching, self-tuning, and auto-scaling, without downtime. Oracle Autonomous Database is built on top of Oracle Exadata and offers shared or dedicated deployment options. The dedicated option isolates the underlying infrastructure resources to a single tenant. [Oracle Cloud Infrastructure Database and Exadata Cloud](#) let you easily build, scale, and secure Oracle databases with license-included or Bring Your Own License (BYOL) pricing. You create databases on VMs, bare-metal instances, or Exadata instances. With OCI Database services, you can then use your existing tools, RMAN, and the database CLI to manage your databases in the cloud the same way you manage them on-premises. Oracle also offers managed [MySQL](#) and [NoSQL](#) databases.

Data platform, data science, and analytics

[Oracle Cloud Infrastructure Data Integration](#), [Oracle Cloud Infrastructure Streaming](#), and a range of other tools enable ingest of nearly any data format from on-prem and cloud sources. [Oracle Cloud Infrastructure Data Catalog](#) enables customers to keep track of their data across multiple OCI data stores. Data scientists have a familiar range of Python-based tools to build, train, and manage machine learning models with [Oracle Cloud Infrastructure Data Science](#). Business and IT analysts can use [Oracle Analytics Cloud](#), a managed service for self-service analytics of data within your OCI environment, as well as external data sources.

Applications and integration

[Oracle Integration Cloud](#) offers broad application integration capabilities across Oracle and third-party SaaS, on-prem applications, and industry standards like FTP. Beyond cloud infrastructure, Oracle also offers a large range of business software as a service applications including Enterprise Resource Planning, Customer Experience, Human Capital Management, Supply Chain Management, and more. Available in the same global cloud regions, Oracle also offers a wide range of industry specific solutions for banking, risk management, clinical trial support, billing, and much more.

Security and governance

[Identity and Access Management \(IAM\)](#) service lets you control what type of access a group of users have and to which specific resources. Oracle simplifies governance with capabilities such as compartments (logical isolation of resources for usage and billing) and policies with a SQL-like syntax that is easier to create and manage. [Oracle Cloud Infrastructure Vault](#) service provides centralized management of data encryption and secrets. You can use Key Management to create or import master encryption keys, generate data encryption keys, rotate keys, enable or disable keys for use in cryptographic operations, assign keys to resources, and use keys for encryption and decryption. [Oracle Cloud Infrastructure Audit](#) provides visibility into activities related to your resources and tenancy. Audit log events can be used for security audits, to track usage of and changes to Oracle Cloud

Infrastructure resources, and to help ensure compliance with standards or regulations. [Oracle Cloud Observability and Management Platform](#) provides a comprehensive set of management, diagnostic, and analytics services that enables easy diagnostics of cloud-native and traditional technologies deployed in the cloud or on-premises. The platform adopts an open, standards-based approach that is vendor-agnostic, supporting ecosystem interoperability out-of-the-box with Slack, Twilio, PagerDuty and others.

Developer services

[Oracle DevOps](#) services and tools automate the software development lifecycle (SDLC), infrastructure operations, observability, and messaging for developers. Customers can use popular open-source tools such as Jenkins, Terraform, Grafana, and Spinnaker to integrate with Oracle Cloud Infrastructure. You can access Oracle Cloud Infrastructure through an intuitive graphical user interface, REST [APIs](#), [SDKs](#) or a command-line interface ([CLI](#)). OCI also offers a browser-based terminal called [Cloud Shell](#).

Getting started

- Sign up for Oracle Cloud Infrastructure for free, with always free services, and additional services available for 30 day trial, <https://www.oracle.com/free>
- Launch your first Linux or Windows instance, <https://docs.cloud.oracle.com/iaas/Content/Compute/Tasks/launchinginstance.htm>
- Learn more about Oracle Cloud Infrastructure SDKs, <https://docs.cloud.oracle.com/iaas/Content/API/Concepts/sdks.htm>
- Test out Oracle Cloud Infrastructure's APIs, <https://docs.cloud.oracle.com/iaas/Content/API/Concepts/usingapi.htm>
- Learn about different workloads that can run on OCI, understand the reference architectures and best practices, and automate the deployments using Terraform, <https://docs.oracle.com/solutions/>

Conclusion

Oracle Cloud Infrastructure provides a scalable, highly-available, and cost-effective cloud platform to meet the needs of the modern enterprise. The technologies provided by Oracle Cloud Infrastructure give developers and IT broad support for running existing workloads as well as creating cloud-native applications.

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