

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 The first two have typically required modifications or even rewrites to run in the cloud, while the third has often been replaced by SaaS alternatives.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.

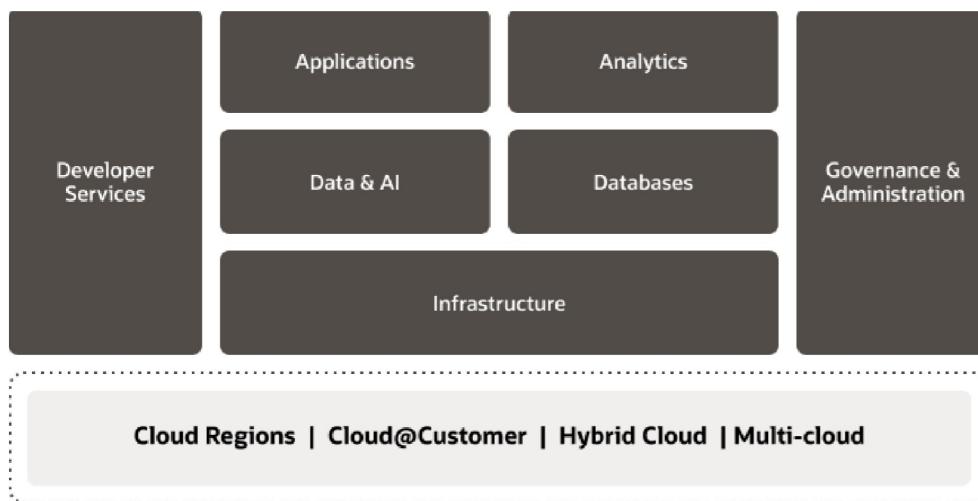


Figure 1: Oracle Cloud services

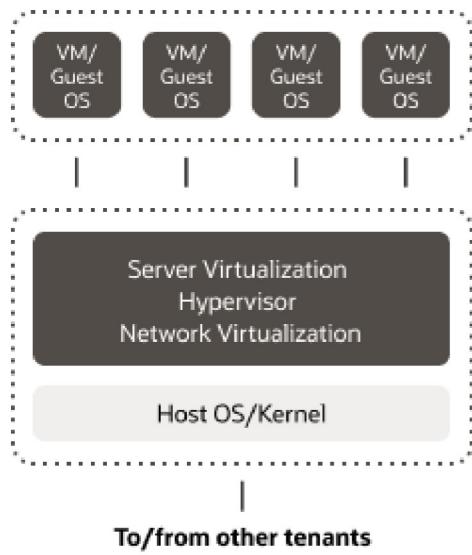
To address all five major classes of applications in a single cloud, we made design choices and innovated at every layer. We built our cloud regions with [greater resiliency down to the individual node](#) to make it easier to run enterprise applications with high availability (HA). We minimized hops 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.

### Host server virtualization

Most prevalent today



### Isolated network virtualization

Oracle Cloud Infrastructure all regions

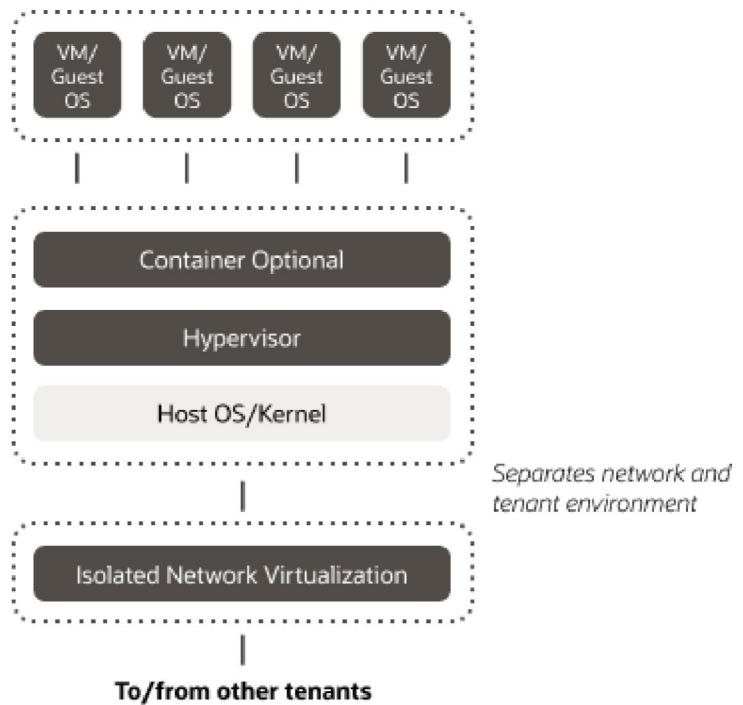


Figure 2: Oracle Cloud Infrastructure Off-Box Network Virtualization

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 reimagine 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.

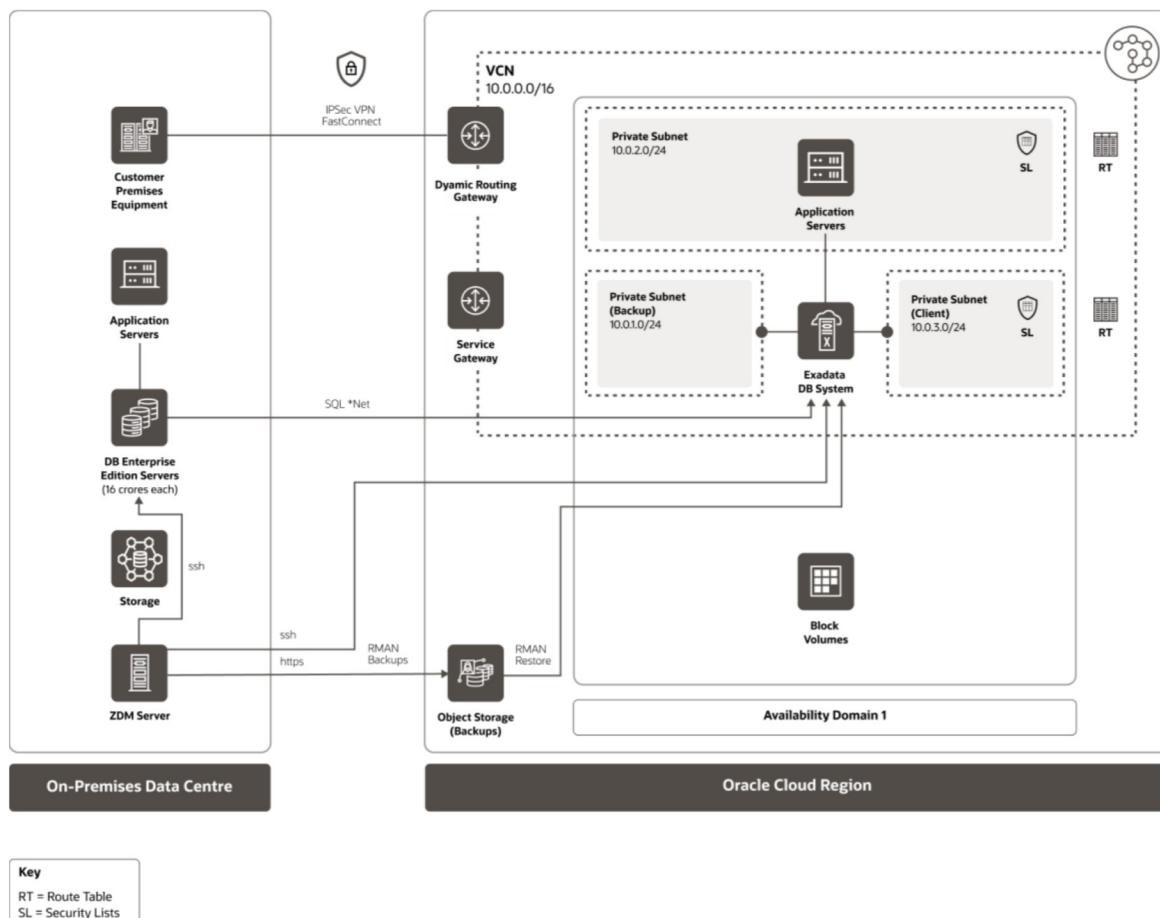


Figure 3: Oracle Exadata Cloud Service and Real Application Cluster (RAC) on Oracle Cloud Infrastructure