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Learn the basics of cloud infrastructure

Gain insights into the business value of IaaS

Explore use cases and success stories

Lawrence Miller, CISSP

Oracle 5th Special Edition

About Oracle Cloud Infrastructure

Oracle Cloud Infrastructure delivers powerful compute and networking performance and a comprehensive portfolio of infrastructure and platform cloud services. Built from the ground up to meet the needs of the most demanding applications, Oracle Cloud supports all legacy workloads while delivering modern cloud development tools, so enterprises can bring forward their past as they build their future.

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Table of Contents

Introduction

To succeed in today's competitive environment, businesses need to free themselves from the limitations of legacy IT infrastructure. The days of purchasing hardware and maintaining massive data centers to run IT have to end. Managing and maintaining infrastructure is simply too expensive.

According to IDC, worldwide spending on public cloud services grew 26 percent in 2019 to a total of $233.4 billion, up from $185.2 billion in 2018. Utilizing cloud-based infrastructure with an elastic, pay-as-you-go service model not only reduces costs and worries, but also frees IT organizations to innovate in ways that will enhance business growth.

Foolish Assumptions

It has been said that most assumptions have outlived their uselessness, but I assume a couple things nonetheless:

- You work as a CIO, CTO, SVP, VP, director, or enterprise architect, responsible for some or all IT infrastructure components (such as compute,

storage, and networking) in an enterprise that has already adopted — or is currently developing — a cloud computing strategy.

- You have some familiarity with popular public cloud offerings, such as Amazon Web Services (AWS) and Microsoft Azure, but you're less aware of Oracle's cloud and portfolio of enterprise solutions.

Icons Used in This Book

Throughout this book, I occasionally use icons to call out important information. Here's what to expect.


REMEMBER

This icon points out information you should commit to memory.


TECHNICAL STUFF

This icon explains the jargon beneath the jargon.


TIP

This icon points out helpful suggestions and useful nuggets of information.

Beyond the Book

There's only so much I can cover, so if you find yourself at the end of this book thinking, "Where can I learn more?," just go to `www.oracle.com/cloud`. There, you can learn more about infrastructure as a service (IaaS) and Oracle Cloud Infrastructure (OCI). You can give IaaS a try at `www.oracle.com/cloud/free`.

IN THIS CHAPTER

- Getting started with a few cloud definitions
- Addressing enterprise workload requirements
- Realizing the cost and convenience benefits of IaaS
- Discovering Oracle Cloud Infrastructure (OCI)
- Extending Oracle Cloud to independent software vendors (ISVs)

Chapter 1
Challenges and Opportunities

In this chapter, you find out about IaaS, cloud computing, enterprise workloads, and the value they provide to businesses seeking to deliver more innovation and agility in their markets.

Defining Cloud Computing Fundamentals

The term *cloud* has become a part of our modern IT lexicon, and there are many definitions and distinctions of different cloud deployment and service models. To try to cut down a bit on the *cloudwashing* (a term Gartner uses to refer to the marketing practice of adding the word *cloud* to practically any technology product or service), let's keep it simple.

There are five essential characteristics of the cloud (as defined by the National Institute of Standards and Technology, or NIST):

- On-demand self-service
- Broad network access
- Resource pooling
- Rapid elasticity
- Measured service

And there are three basic cloud deployment models:

- Public
- Private
- Hybrid

Finally, there are three basic cloud service models:

- Software as a service (SaaS)
- Platform as a service (PaaS)
- Infrastructure as a service (IaaS)

A key difference among SaaS, PaaS, and IaaS is the level of control that the enterprise has with the cloud stack. The demarcation line for IaaS is typically at the operating system: The cloud provider manages the virtualization, servers, storage, networking, and data center, while the enterprise is responsible for configuring and maintaining software at the operating system layer and above, including middleware, runtime environments, data, and application software (see Figure 1-1).

Next-generation IaaS offerings extend customer control deeper into the cloud stack, with the option to manage virtualization, servers, and storage, while simultaneously offering higher levels of predictable performance, control, and security than first-generation IaaS platforms. Whereas first-generation IaaS offerings provide cloud-based virtual machines (VMs) in a multitenant environment (meaning several customers may share resources on the same server, while only being able to access the portion of the server that's allocated for their usage), second-generation IaaS offerings can also provide on-demand, single-tenant bare metal machines (where each physical server is dedicated solely to one customer).

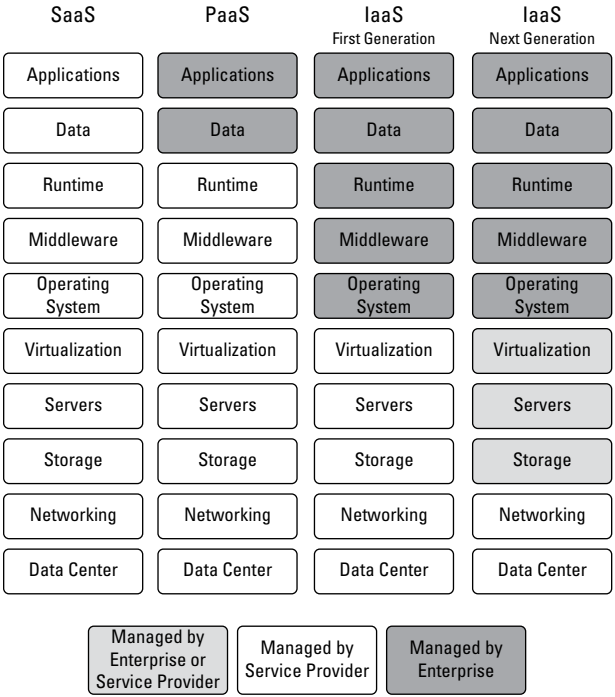

FIGURE 1-1: Different cloud service models provide different levels of control for the enterprise.

TIP

I tell you more about next-generation IaaS offerings in Chapter 2.

Characterizing the Enterprise Workload

Enterprise applications run the business. They range from core, indispensable systems to customer relationship management and social and mobile platforms, to name just a few. Every business is different, but at a very high level, common expectations for enterprise workloads in the cloud include the following:

- **Elasticity and massive scalability:** No resource is infinite or unlimited, but a world-class cloud service provider has more available capacity than enterprises, so resource utilization can be perfectly balanced in the cloud, where you can automatically scale up, out, and down as needed (provided you've architected your applications appropriately).
- **Predictability:** Enterprises are constantly tweaking infrastructure to provide consistent performance for their mission-critical applications. Though many first-generation IaaS cloud platforms don't offer this capability, it's key to successfully running enterprise workloads in the public cloud.
- **High performance:** Enterprise applications typically require very low latency, high throughput, and high input/output operations per second (IOPS).

- **Open standards and workload/data portability:** In the cloud, there aren't many industry standards governing things like application programming interfaces (APIs), management, and orchestration. For this reason, some clouds are quite proprietary and you risk getting "locked in" with a single provider. Also, with some providers, although it's relatively easy to move your applications and data to the cloud, moving them (or even the data they utilize) back can be very difficult if your cloud strategy or needs change.
- **Security and trustworthiness:** There are many layers to security in the cloud that need to be considered, and enterprises must feel confident that their workloads and data are secure.
- **Service-level agreements (SLAs):** SLAs vary widely in terms of the uptime and performance guarantees, as well as the remediation provided if an SLA violation occurs.

Enterprises also expect to be able to extend their governance models to the public cloud. IT leaders have been managing on-premises environments for years. They require visibility into who is accessing which resources and when, and they're accustomed to delegating permissions and granting access to resources. Systems of record and governance just don't change overnight. Your cloud provider should offer the ability to extend governance to the cloud natively with the following capabilities:

- **Identity and access management (IAM):** Authorize who can perform specific actions on specific resources, with full control and visibility to centrally manage cloud resources.
- **Role-based access control (RBAC):** You have different levels of control for providing access to various types of infrastructure resources at the account, sub-account, or resource level.
- **Resource visibility:** When IAM and RBAC are utilized and resources are logically defined, a unified view of permissions and security policies becomes available to IT administrators.
- **Quotas:** Limit which resources are available and when, based on specific criteria defined by the organization.
- **Showback/chargeback:** Audit trails allow infrastructure usage costs to be allocated to departments, business units, or individual users.
- **Tagging:** Enables users to search, control access, and do bulk actions on a set of resources based on the tag. For example, you can add tags to describe the business organizations that are responsible for a resource.

Understanding the Value of IaaS in the Enterprise

The motivations for businesses to adopt IaaS are diverse and can be broadly organized as follows:

- **Reducing dependence on the corporate data center:** Moving centralized IT workloads off-premises and lowering or eliminating the need to manage facilities and infrastructure
- **Using IaaS for specific initiatives:** Responding to line-of-business requests for on-demand infrastructure to support new application initiatives
- **Developing cloud-native applications:** Developing and deploying new applications using native cloud infrastructure capabilities and more agile technologies like containers and serverless computing

IaaS provides increased speed and agility by offering on-demand, self-service access to compute, storage, and networking resources in the cloud. Developers and application owners can get access to infrastructure to run their applications in minutes, and the cloud provides resource elasticity to scale up and down, providing significant flexibility that isn't typically possible in an on-premises environment. IaaS can enable significant IT

cost savings by reducing hardware and data center management overhead while offering a pay-only-for-what-you-use pricing model. This is in contrast to procuring hardware for peak capacity requirements and paying for idle capacity that is underutilized during nonpeak times.


TIP

According to 451 Research, "There is now a strong public cloud option for almost every kind of application and computing workload. An entire generation of IT talent has now effectively grown up with the IaaS model." Whether your business is already headed to the cloud or not, it's a safe bet that your competition is!

Introducing Oracle Cloud Infrastructure

Enterprises need a cloud environment that replicates their on-premises data center environment — whether for business applications, databases on a dedicated cluster, or a fully integrated and managed solution — while also providing all the benefits of the public cloud.

Oracle Cloud Infrastructure (OCI) is focused on transforming the cloud experience to become adaptable to your business and your desire to innovate. Oracle built a cloud that is autonomous, scalable, and purpose-built for

all enterprise workloads, from legacy to cloud native. Designed to serve the cloud-connected experience, Oracle Cloud offers lower, predictable, and globally consistent pricing to optimize the way data moves in the modern enterprise. OCI's pricing is among the most competitive in the industry.

With the Oracle Cloud, organizations get all the benefits of the cloud with the same control, isolation, security, and predictable performance as their on-premises data centers.

Oracle's IaaS offering includes the following types of services:

- **Compute:** Whether a workload requires a single VM or demands the high performance, consistency, and isolation offered by bare metal servers, Oracle offers a broad spectrum of cloud compute options that are equipped with Intel-, AMD-, and ARM-based CPUs. Oracle's compute options include VMs, bare metal instances, and GPUs with bare metal or VMs.
- **Storage:** Secure and scalable cloud-based storage solutions ideal for storing and accessing data from any environment connected to the Internet. Offerings include local Non-Volatile Memory Express (NVMe) flash storage, network file storage, network block storage, object storage, archive

storage, database backup storage, data transfer service, and even a software storage gateway.

- **Network:** Any on-premises data center can be connected to OCI via VPN or FastConnect, allowing organizations to have a private, secure, high-bandwidth, dedicated link between their on-premises data center and the Oracle Cloud.

TIP

OCI provides comprehensive networking and load balancing capabilities. Flexible load balancers, for example, scale load balancing needs based on minimum and maximum bandwidth specified by the customer. Oracle's Virtual Cloud Network features enable organizations to deploy highly available, secure network topologies and match on-premises setups, thus not having to rewrite networking specifications within applications.

- **Edge and connectivity:** Oracle also provides network edge services such as DNS. To enable hybrid deployments, Oracle offers dedicated connectivity between Oracle cloud regions and on-premises data centers via FastConnect, and secure Internet connectivity via VPN services.

- **Containers:** Oracle offers a production-grade environment to run container-based applications. Whether customers want to bring their own infrastructure or leverage Oracle's managed

Kubernetes service, applications can benefit from the high-performance, highly available infrastructure.

- **Autonomous Database:** OCI's Autonomous Database is a fully managed, preconfigured database environment with three workload types available — Autonomous Transaction Processing, Autonomous Data Warehouse, and Autonomous JSON Database. You don't need to configure or manage any hardware or install any software. After provisioning, you can scale the number of CPU cores or the storage capacity of the database at any time without impacting availability or performance.


TIP

In the *IDC 2020 Industry CloudPath* report, 935 IaaS customers *were surveyed* on their satisfaction with top IaaS vendors including Oracle, Amazon Web Services, Microsoft, IBM, and Google Cloud. Oracle IaaS (OCI) received the highest satisfaction score and the biggest year-over-year score increase of all IaaS vendors.

Oracle Cloud for Independent Software Vendors (ISVs)

With a global SaaS market valued at $117 billion as of 2021, independent software vendors (ISVs) are in a prime position to harness cloud technology and all its benefits,

whether it's to accelerate go-to-market strategies, unlock almost exponential global growth, or create more bespoke solutions to meet very specific customer needs.

Oracle provides cloud technology to ISVs around the world, helping them provide best-of-breed service and future-ready infrastructure to their customers. OCI is built specifically for enterprises looking for higher performance, lower costs, and easier cloud migration for their existing on-premises applications. But it's not just on-premises customers who are migrating. Many Oracle customers and partners have moved from other cloud vendors to Oracle's next-generation cloud infrastructure, benefiting from flexibility, competitive costs, rapid provisioning, and global-scale cloud support.

TIP

Chapter 4 provides examples of customers, including ISVs, that are using OCI.

View more information at `www.oracle.com/partnernetwork/isv`.

IN THIS CHAPTER

- Calculating compute choices
- Weighing storage options
- Selecting network services

Chapter 2
Exploring Oracle Cloud Infrastructure

In this chapter, you learn about the capabilities, features, and competitive differentiators of Oracle's infrastructure as a service (IaaS) offering, called Oracle Cloud Infrastructure (OCI).

Oracle Cloud Infrastructure Compute Shapes

Oracle Cloud offers a variety of compute options to suit your organization's needs with a resilient infrastructure service that provides rapidly provisioned bare metal and virtual machines (VMs) in single-tenant and multitenant configurations, respectively.

REMEMBER

A *single-tenant environment* in the cloud is a host machine dedicated entirely to a single customer, whereas a *multitenant environment* is a host machine in a VM model that often hosts multiple customers.

When you're trying to determine which compute options will meet your organization's needs, be sure to consider the following factors:

- **Available CPU sizes:** How much processing power do your applications and workloads require?
- **Available graphics processing units (GPUs):** How much graphics processing power do your workloads require?
- **Metered versus unmetered pricing:** Do you need a "pay-as-you-go" option or the option to pay for unlimited usage over a specific period?

- **Single tenant or multitenant:** Do your security and compliance requirements necessitate infrastructure that is dedicated solely to your organization?
- **Support for containers:** Are your developers actively writing next-generation applications using container technologies such as Docker and Kubernetes?

The table at `www.oracle.com/cloud/compute/pricing.html` will help you match the best compute service options to your organization's needs, based on your answers to the preceding questions.

OCI offers flexible shapes. These shapes allow you to customize the number of OCPUs and the amount of memory when launching or resizing your VM. This flexibility enables you to build VMs that match your workload, allowing you to optimize performance and minimize cost. Virtualized CPU instances can be selected from 1 to 64 cores and up to 64GB of memory per core, with a maximum of 1,024GB total. Networking speeds clock from 700 Mbps to 240 Gbps, and remote block storage or even 25.6TB of direct-attached NVMe flash storage are available.

An OCPU is the CPU capacity equivalent of one physical core of an Intel Xeon processor with hyperthreading enabled or one physical core of an Oracle SPARC processor.

For even higher performance, OCI bare metal servers provide customers isolation, visibility, and control of an entire dedicated server. For the most demanding applications, Oracle's bare metal instances scale up to 128 cores (the largest in the industry), 2TB of RAM, up to 1PB of block storage, networking from single 25 Gbps to dual 50 Gbps to 100 Gbps ultra-low-latency Remote Direct Memory Access (RDMA), and storage options including 51.2TB of NVMe flash storage.

OCI also offers a range of GPUs in both bare metal and virtualized configurations with a range of memory, storage, and networking — even including the GPU-specific NVIDIA Tesla (Pascal or Volta).

OCPU is defined as the CPU capacity equivalent of one physical core of an Intel Xeon processor with hyperthreading enabled. For Intel Xeon processors, each OCPU corresponds to two hardware execution threads, known as *vCPUs.*

You can find out more about compute options in the following sections.

In addition to Intel, Oracle Cloud also offers AMD- and ARM-based compute.

Oracle Cloud Infrastructure Compute Virtualization

By moving the virtualization layer off the server and onto the network (referred to as *off-box virtualization*), bare metal instances avoid the *hypervisor tax* (the performance degradation or overhead typically associated with virtualized compute infrastructure offered by first-generation cloud providers), enabling extremely high levels of raw and consistent performance — comparable to dedicated on-premises servers.

Oracle provides three compute offerings for flexibility to run your most demanding workloads, as well as less performance-intensive applications, in a secure and highly available cloud environment:

- **Bare metal instances:** For input/output (I/O)–intensive web applications (such as real-time analysis) or big data workloads (such as batch processing), bare metal servers are an ideal match. Oracle provides a fully dedicated bare metal server on a software-defined network (SDN), combining the power of bare metal servers (physical servers assigned to only one customer) with a secure, isolated Virtual Cloud Network (VCN, described later in this chapter). Bare metal servers provide extreme raw performance, including servers with

the latest generation Non-Volatile Memory Express (NVMe) drives delivering stellar input/output operations per second (IOPS).

- **VMs:** For workloads that don't require dedicated physical servers or the extreme performance of bare metal, VM instances are offered in different sizes, supporting many common workloads. VMs are offered with local NVMe storage (with optional network block storage) or with network block storage only.
- **GPUs:** GPU compute, which is optimized for workloads like high-performance computing (HPC) and machine learning, is available as bare metal instances or VMs. GPU compute is offered with different numbers of GPUs, different numbers of CPUs, and network block storage.


TIP

Choose bare metal compute instances when single tenancy is important and you need the highest performance and resilience for your production workloads.

Oracle Cloud Native Services

Cloud native technologies are characterized by the use of containers, microservices, serverless functions, development pipelines, infrastructure expressed as code,

event-driven applications, and application programming interfaces (APIs). Cloud native enables faster software development and the ability to build applications that are resilient, manageable, observable, and dynamically scalable to global enterprise levels.

Oracle Container Engine for Kubernetes is a developer-friendly and enterprise-ready managed service that runs highly available Kubernetes clusters with the control, security, and performance of OCI. Because the Container Engine uses standard Kubernetes that is certified by the Cloud Native Computing Foundation, you're guaranteed portability across clouds and on-premises deployments.

Other OCI services for Cloud Native and DevOps include the following:

- **Oracle Functions** is the next level of development abstraction after containers. It's a fully managed, multitenant, highly scalable, on-demand, functions-as-a-service platform. *Functions,* which run in containers, are snippets of code that can be executed based on events and API calls. Oracle Functions are based off the open-source Fn Project. Oracle Functions leverages containers and provides hybrid and multi-cloud portability to allow customers to focus on writing code to meet business needs. Users pay only for the compute time of the

functions and pay nothing when the functions aren't being used.

- **Oracle Cloud Infrastructure Events** enable users to create automation based on the state changes of resources throughout a tenancy. Events can trigger alerts or any specified functions.
- **Oracle Cloud Infrastructure API Gateway** is a highly available managed gateway to create HTTP/S interfaces for other services. API Gateway enables publication of APIs with private endpoints that are accessible from within your network and which you can expose with public IP addresses, if you want them to accept Internet traffic. The endpoints support API validation, request and response transformation, cross-origin resource shaping (CORS), authentication and authorization, and request limiting.
- **Oracle Cloud Infrastructure Registry** allows you to store, share, and manage development artifacts like Docker images.
- **Oracle Cloud Infrastructure Resource Manager** automates the process of provisioning all OCI resources with Terraform.

- **Oracle Cloud Infrastructure Streaming** provides a fully managed, scalable, and durable solution for ingesting and consuming high-volume data streams in real-time such as Internet of Things (IoT), security, and so on.
- **Oracle Cloud Infrastructure Monitoring** enables both active and passive monitoring of cloud resources to provide health, performance, and capacity metrics with dashboards and alerts.
- **Oracle Cloud Infrastructure Notifications** broadcasts messages to distributed components through a publish-subscribe pattern, delivering secure, highly reliable, low-latency, and durable messages for applications hosted on OCI and via external services such as email or PagerDuty.
- **Oracle Cloud Infrastructure Logging** is a highly scalable and fully managed single pane of glass for all the logs in your tenancy. Logging provides access to critical diagnostic information that describes how resources are performing and being accessed.


TIP

Take advantage of the full suite of cloud-native services when developing applications on OCI.

Platform services

Combine OCI services with offerings like Database Cloud Service to provide integrated building blocks for enterprise applications. Services integrated into OCI include the following:

- Analytics Cloud
- API Management
- Autonomous Data Warehouse
- Autonomous JSON Database
- Autonomous Transaction Processing
- Content and Experience Cloud
- Digital Assistant
- Integration and Migration
- NoSQL Database
- Observability and Management Platform
- Visual Builder

Migration services

OCI is developing new services to greatly simplify the process of moving on-premises databases to Oracle Cloud, including Application Migration Service, Database Migration Service, Zero Downtime Migration Service, and Data Migration Service.

Oracle Cloud Infrastructure Storage

All organizations back up and archive their data. Oracle offers a wide spectrum of storage and database solutions designed to meet your specific data requirements.

Local NVMe storage

NVMe flash drives provide the highest-performance storage, with millions of IOPS for compute instances in the Oracle Cloud. Local NVMe storage shapes are offered in 12.8TB and up to 51.2TB options and offer 10 to 100 microseconds latency.

Block volumes

All-flash block volumes offer high-speed network storage capacity with seamless data protection and recovery.

Network-attached block volumes deliver low latency and tens of thousands of IOPS per compute instance. Block volumes can scale up to 1PB per compute instance and offer consistent high-performance and scalable capacity as your data needs grow.

Oracle Database Cloud Service can be run on bare metal compute with NVMe or on VMs with network block storage.

File Storage

OCI File Storage is a fully managed, durable, scalable, secure, enterprise-grade network file system. With just a few clicks, companies can create and mount a file system accessible by a handful, or thousands, of compute resources within a region. This service supports NFSv3 and most third-party on-premises appliances, offering a seamless way to manage files in the cloud.

Object Storage

Object Storage offers virtually unlimited amounts of capacity, automatically replicating and healing data across multiple fault domains for high durability and data integrity. Running on the same low-latency network as compute, the object storage service also provides a

Hadoop Distributed File System (HDFS) interface for big data and data lake use cases.

Archive Storage

The Archive Storage service provides cost-effective archive storage for infrequently accessed, large-scale data sets, long-term data retention, rich media content, and scientific research archives. Archive Storage offers enterprise-grade security, resilience, and elastic scalability, coupled with pay-as-you-go and subscription-based models, so you can choose to pay only for what you use or take advantage of reduced rates with a longer commitment.

Data Transfer Service

Data Transfer Service is a petabyte-scale offline data transfer service. Using an Oracle-branded, purpose-built storage appliance to cost-effectively and easily move up to 150TB of data to the cloud streamlines migration. To move petabyte-scale data sets, you can simply order multiple transfer appliances. And it's all free — Oracle even pays for the shipping.

Database Service

Oracle Cloud Infrastructure's Standard Database Service and Enterprise Database Service are optimized for Oracle Databases. Supported versions include 11.2, 12.1, 12.2, 18c, 19c, and 21c, as well as Autonomous Data Warehouse. Databases can be run on bare metal or VMs in real application cluster (RAC) configurations or on Exadata, where DBs can be deployed in multiple availability domains with Active Data Guard for high availability.

Autonomous Database services

The Oracle Autonomous Database is the flagship of Oracle's complete data management services, which includes data integration, data management, and data analytics. With Autonomous Database, Oracle fully manages the life cycle; this automation allows customers to innovate more, pay less, and ensure that their data is more secure.

And what makes it so innovative are these core attributes:

- **It's self-driving,** which means it automatically provisions, secures, monitors, and tunes.
- **It's self-securing,** automatically applying security patches with no downtime.

- **It's self-repairing,** maximizing uptime and productivity with less than two and a half minutes of both planned *and* unplanned downtime a month.

So, how does it work? There are six key elements in the life cycle of a database that are absolutely unique to Oracle:

- **Provisioning** to rapidly and easily create highly available databases.
- **Security** for encrypting all data by default and managing privileges with Database Vault.
- **Management,** which automates all infrastructure and database management. It patches all software online and diagnoses all problems using artificial intelligence (AI) and machine learning (ML).
- **Protection** to recover from any failure without downtime.
- **Scaling** to scale online for highest performance and lowest cost, enabling instant online elasticity and pay per use.
- **Optimization,** where ML optimizes the database for each workload. It can optimize data formats, indexes for analytics, or online transactional processing (OLTP).

Find out more about the benefits of Oracle Autonomous Database at `www.oracle.com/autonomous-database`.

Database Backup Service

Oracle Database Backup Service is a reliable and scalable object storage solution and data protection service designed for the unique needs of Oracle Database customers. It provides direct, cost-effective integration with Oracle Recovery Manager (RMAN) so you can take advantage of cloud-based data protection with your current IT processes and staff.

Oracle Cloud Infrastructure Networking

Networking services provide organizations with connectivity *to* the cloud and *in* the cloud. In Chapter 3, you find out how to securely connect your organization to OCI with Oracle FastConnect and Oracle Virtual Private Network (VPN). An Oracle Virtual Cloud Network (VCN) extends your IT infrastructure into the Oracle Cloud with highly customizable private networks. A VCN is a private network that you set up on OCI, with firewall rules and specific types of communication gateways

that you choose. Within this network, you launch your virtual instances or access bare metal (single-tenant) resources.

Just like a traditional data center network, a VCN provides complete control over your network environment. You can customize your VCNs to mirror your internal networks or build new network topologies with granular control, including 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.

Key VCN features include the following:

- **Customizable VCNs:** Fully configurable IP addresses, subnets, routing, and firewalls support new or existing private networks for rapid flexibility and scalability. Modifiable VCNs can add or remove up to five /16 classless inter-domain routing (CIDR) blocks, with validation to ensure that adjusting a CIDR block will not affect an IP address that's in use.
- **End-to-end security:** Multiple security layers, including packet encapsulation, in-flight encryption, and IPSec VPN connectivity.

- **High performance:** A high-bandwidth, micro-second latency network enables high performance. Oracle's flat network design limits the number of *hops* (a hop occurs when network traffic traverses a device such as a router or switch), which permits real-time application workload processing (such as batch jobs and applications requiring real-time querying).
- **High availability:** Active and passive logical and physical network redundancy.

Find out how OCI can provide you secure connectivity across your physical and virtual networks at `www.oracle.com/cloud/networking`.

REMEMBER

Oracle's OCI compute, storage, and network service offerings provide customers with choice and flexibility to run their enterprise workloads in a scalable, fast, predictable, and resilient platform in the public cloud.

IN THIS CHAPTER

- Looking at options for connecting to the cloud
- Recognizing the need for a dedicated connection
- Leveraging a virtual private network over the Internet

Chapter 3

Connecting to Oracle Cloud Infrastructure

Oracle deploys its cloud infrastructure in data center cloud regions. Oracle's regional footprint spans across North America, Latin America, Europe, the Middle East, Africa, and Asia. Within each region, Oracle's highly scalable, flat network design limits the number of network hops between compute and storage. Between regions, high-bandwidth, fault-tolerant networks provide at least 99.95 percent reliability.

TIP

Oracle's goal is to offer proximity and meet data sovereignty requirements, as well as provide true disaster protection with multiple geographically distributed cloud regions in every country it serves. You can view more information on Oracle's global cloud regions and service availability at `www.oracle.com/cloud/architecture-and-regions`.

Oracle Cloud Infrastructure (OCI) offers connectivity options with high throughput, enterprise-grade security, and performance predictability, enabling your cloud workloads to deliver business results. In this chapter, you find out about your options for connecting your enterprise to the Oracle Cloud.

Enterprise Requirements for Connecting to the Cloud

When extending your enterprise workloads to the cloud, how you connect your on-premises environments to the cloud matters. The challenge for enterprises is to find a path to the cloud that meets current needs, preserves the usefulness and value of their existing investments, and provides options for the future. Technical challenges for connecting to the cloud include the following:

- The Internet is shared, consistent bandwidth is unpredictable, and the Internet by itself does not provide security.
- Applications that have consistent transaction requirements and/or need to transfer large volumes of data require higher sustained networking bandwidth than others.
- High-transaction applications are sensitive to network latency, large volumes of data transfers, or communication requiring consistent bandwidth.

Enterprises are looking to cloud providers to offer access to compute resources that behave as if they're simply extensions of their own corporate data centers. In connecting on-premises data centers to cloud, two key considerations are data transfer speed and security. OCI offers solutions to meet both needs:

- **Oracle FastConnect** links your data center and the Oracle Cloud, using a direct, private connection (circuit) provided by a networking partner (network service provider or data center provider).
- **Oracle VPN Connect** links your data center and the Oracle Cloud using your Internet connection by establishing an IP Security (IPsec) virtual private network (VPN) connection that links your data center and the Oracle Cloud, using an encrypted tunnel (IPsec) over the public Internet.

TIP

VPN solutions typically offer a lower-cost alternative, but a dedicated private network (FastConnect) is a better choice for businesses that transfer high volumes of data over dedicated connections, have an application that requires consistent (and/or low) latency, have sensitive data, and require a consistent use of bandwidth.

Oracle FastConnect

Oracle FastConnect extends enterprise workloads via a dedicated connection between your data center and the Oracle Cloud. To set up FastConnect, you provision a private, dedicated circuit from your network service provider (such as AT&T, CenturyLink, or Verizon) to connect your locations and/or data centers to the Oracle Cloud.

Here are the most common use cases for FastConnect:

- **Bidirectional transfer of large volumes of data (batch jobs):** The unpredictable nature of the Internet often results in significantly lower batch job performance or batch jobs not completing in time due to latency issues beyond your control. FastConnect overcomes this problem by moving traffic over a dedicated path, allowing batch processing to occur at the speed required by your applications.

- **Applications that require consistent latency and network performance:** Many enterprise applications are very sensitive to latency and any variations in latency. Applications often time out when the underlying request made by the application fails to get a timely response, due to latency somewhere in the network. If your application requires real-time, or very near real-time, responsiveness you need a dedicated, private networking solution like FastConnect.
- **Sensitive data transfers that can't traverse the public Internet:** If your data must never leave trusted boundaries, a direct connection is needed. Although data can be encrypted over the Internet, it can still take unexpected hops (for example, to a router in a foreign country) on its way to its destination. A dedicated connection like FastConnect provides a direct, secure connection (with optional encryption for additional security) from one endpoint to the other.

Key FastConnect features include the following:

- **Multiple port speeds:** You can choose port speeds ranging from 100 Mbps to 10 Gbps, depending on your use case and the amount of data you expect to transfer on a monthly basis. Choose the option that corresponds to the amount of traffic your applications produce to maintain the optimal balance between cost and throughput.

- **Standard Layer 3 routing:** FastConnect leverages industry-standard Border Gateway Protocol (BGP) routing to manage the exchange of data between the Oracle Cloud and your network. BGP offers many benefits, but perhaps the most important features are that it automatically finds the fastest route for your data to travel from one point to another, and it allows you to advertise routes across other provider networks so you can leverage two different network service providers (such as AT&T and Verizon) for network resilience.
- **Redundancy:** FastConnect can be configured as a fully redundant service with two physical connections from your network edge to the Oracle Cloud Platform network edge for high availability.
- **Cost:** Unlike other cloud providers with services similar to FastConnect, Oracle FastConnect does not charge additional fees for data ingress or egress. FastConnect fees are based on port hour consumption.

TIP

Knowing how much data your application generates is imperative. You can use lots of third-party software tools to accurately measure and monitor the amount of data your applications generate. With Oracle FastConnect, you aren't charged for the amount of data transferred; instead, you pay only for the port speed you've chosen.

If your enterprise data center happens to be in one of the same data centers as the Oracle Cloud, FastConnect enables you to access and manage your Oracle Dedicated Compute Service as an extension of your private network. Oracle is continuing to expand its number of dedicated networking partners; today it has more than 50 different partners to choose from (see `www.oracle.com/cloud/networking/fastconnect-providers.html` for more information).

REMEMBER

Some important factors that affect network latency include the distance between your data center and the Oracle Cloud, as well as the connectivity type. Cost is driven by the speed of your network service provider's circuit and the Oracle FastConnect port speed that you choose.

Oracle VPN Connect

A VPN creates an encrypted connection to another network over the Internet using the IPSec protocol. Benefits of a VPN include the following:

- Lower cost than dedicated private connections
- Ease of implementation
- Flexible deployment to any location

However, there are some important drawbacks associated with VPNs that an enterprise must consider:

- Variable bandwidth
- Lower reliability than dedicated private connections (because it relies on the availability of the public Internet)
- Higher latency than dedicated private connections (inherent on the public Internet)

For these reasons, VPN connections are appropriate for enterprises that have highly fluctuating data requirements or relatively low data volumes.

Oracle offers a site-to-site IPSec VPN for enterprises to securely connect their data centers to the Oracle Cloud Platform. Oracle VPN Connect solution supports the industry-standard encryption and authentication protocol with IKEv2 and NAT-T. Key Oracle VPN for Compute features include the following:

- **Data encryption:** 256-bit, 192-bit, and 129-bit Advanced Encryption Standard (AES) encryption is used to secure data between an enterprise's data center and the Oracle Cloud.
- **Authentication algorithm:** Verify the identity of users who connect to your database. Authentication can be configured in a variety of ways, such as

through the database itself, from the operating system, or across the network.

- **Configurable pre-shared key:** Symmetric key encryption using a pre-shared key enhances security and overall performance. Enterprises can manage and change their own keys. Additional key exchanges with support of Diffie-Hellman Groups 1, 2, 5, 14, 19, and 20.
- **Multiple tunnels:** Enterprises can set up multiple tunnels within the Virtual Cloud Network (see Chapter 2). This can be useful if you need to isolate a specific network path for certain traffic. For example, you may define a private network tunnel for an application calling back to a database to gather specific customer data, and that tunnel is never accessible from the Internet.
- **Configurable subnets:** Enterprises can configure a range of IP addresses for compute instances. This allows you to group virtual instances and/or create multiple groups of instances, all with predefined IP addresses.
- **Built-in redundancy:** Enterprises can benefit from utilizing multiple VPN connections to ensure redundancy and availability.

- **Dynamic and static routing options with BGP support for dynamic routing.**
- **Third-party hardware VPN support:** Oracle VPN supports many of the third-party VPN solutions that enterprises often deploy.

When connected to the Oracle Cloud, you can leverage Oracle Virtual Cloud Network (discussed in Chapter 2) to customize your private network and the high performance, predictability, and availability of Oracle's flat network design (see Chapter 5).

TIP

Explore more information at `www.oracle.com/cloud/networking/fastconnect`.

IN THIS CHAPTER

- Examining lift-and-shift use cases
- Leveraging high performance in the cloud
- Working with cloud-native applications
- Running custom apps in the cloud

Chapter 4

Examining IaaS Use Cases and Success Stories

In this chapter, you find out about common infrastructure as a service (IaaS) use cases and how customers are using Oracle Cloud Infrastructure (OCI) to address real-world challenges and achieve their strategic goals.

Lifting and Shifting Oracle Applications to the Cloud

Lifting and shifting refers to moving a workload (virtual machine [VM] or application) from an on-premises data center to the cloud. Many companies find that lifting and shifting existing workloads to the cloud enables IT to be more responsive to the business.

MARITZ

Maritz is a privately held holdings company that has been in business for more than 100 years. It operates three major business units, as well as several smaller ones, all specializing in offering sales and marketing services to Fortune 100 companies.

Challenges

Maritz's on-premises applications supported critical back-office operations that were running on aging Sun Microsystems hardware. The hardware was more than nine years old, and as the business grew, it struggled to keep up with the ever-growing workloads. What's more, the infrastructure had grown so complicated that executing failovers for disaster recovery (DR) was now

overly cumbersome, often taking 72 hours to complete a failover.

Solutions

Within a nine-month period, Maritz and its implementation partner, Keste, migrated sandbox, dev/test, production, and DR environments for E-Business Suite and an additional 25+ applications running on an Oracle back end, to OCI.

Results

- Ten times improvement in performance
- Concurrent financial processes that used to take two hours are now completed in ten minutes
- Reduced DR window from 72 hours to 4 hours
- Enhanced security posture with all data encrypted at rest

"The story with Oracle Cloud Infrastructure is that it's better, cheaper, and faster than what we had on-premises," explains Ron Hunsaker, VP of Enterprise Application Services. "We're seeing jobs that used to take a couple hours to run getting completed in minutes now on Oracle Cloud Infrastructure."

ALLIANCE DATA SYSTEMS

Alliance Data Systems is a publicly traded loyalty and marketing services company headquartered in Plano, Texas. It operates three lines of business:

- Alliance Data Card Services, which manages credit card programs for retail brands such as Pottery Barn and Walgreens
- LoyaltyOne, which offers loyalty marketing programs
- Epsilon, which provides a broad range of marketing services

Challenges

Alliance Data Systems's IT team faced a challenge common among modern businesses: renewing their current data center agreement or moving to the cloud. After a thorough investigation, they realized that maintaining their own hardware was no longer strategic, and they no longer wanted to struggle with capacity planning.

Solutions

Alliance Data Systems considered multiple cloud vendors, including Amazon Web Services (AWS).

It compared each vendor's offerings, cost, and the ability to keep its enterprise systems secure and available. However, it also knew from experience that its business had greatly benefited from the performance, scalability, and reliability of its Exadata database platform, and leaving that platform was risky and could affect the service it delivered to its customers. In the end, Alliance Data Systems decided that migrating to OCI was the best path forward. Its experience had proven time and time again that its database portfolio runs best on Exadata, and only OCI offered the same Exadata platform.

Results

- $1 million in overall savings in the first year.
- Running Hyperion was half the cost of the competing cloud.
- Exceptional support for Oracle applications.
- Unmatched database performance with Exadata.
- Consolidated three on-premises Exadata Quarter racks to two in the cloud.
- Mission-critical systems addressing compliance needs in the public cloud.

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> "Oracle and LTI [Larsen & Toubro Infotech] were with us every step of the way during the migration," said Suresh Tripathi, Director of IT, Software Engineering at Alliance Data Systems. "Originally, we were only going to migrate PeopleSoft, but we later decided to move all our Oracle Applications. We had many sessions with Oracle to look at each application and compared all different deployment options. This is the best support I've ever seen."

Utilizing High-Performance Computing (HPC)

Some of the most difficult workloads to successfully execute in the public cloud are those that require massive amounts of dedicated computing power (CPU cycles). Often "noisy neighbors" in a multitenant environment will limit the amount of CPU an application can use. OCI offers single-tenant, bare metal options where servers are dedicated entirely to one customer, so CPU cycles are never compromised. You can even utilize ultra-high-performance graphics processing units (GPUs) for specialized HPC applications.

ALTAIR

Altair Engineering is all about applying high-performance computing to engineering and product development. With its flagship HyperWorks platform, Altair helped establish graphics-based simulation as the first, rather than last, process in innovative product design. Its customers span a variety of industries, including aerospace, automotive, healthcare, energy, retail, process manufacturing, and consumer goods.

Challenges

For optimal use of its applications, Altair realized its customers would benefit from access to highly scalable compute and storage capacity — something cloud computing could provide. As Altair began to develop its design apps for use with high-speed graphics processors, the company needed a cloud partner expert in handling that technology with strong HPC capabilities to power complex simulation tools.

Solutions

Altair had partnered with Oracle previously, using the company's database as an integral element in its engineering toolset. That experience

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set expectations for how Oracle would work as a cloud partner.

Specifically, Altair turned to Oracle Cloud Infrastructure for its best-in-class bare metal (not virtualized) high-performance cloud compute cycles, high-speed cloud networking, and I/O-optimized cloud storage. Altair also saw Oracle's experience with graphics processing unit (GPU) engineering and application development as a distinct advantage.

Results

Oracle Cloud's bare metal compute and low-latency RDMA networking services deliver up to 25 percent better price-performance for Altair's Computational Fluid Dynamics (CFD) and Structural Mechanics solvers versus other cloud providers.

Running on Oracle Cloud, HyperWorks can, for example, provide complex vehicle simulation results in less than 12 hours.

"By using Oracle Cloud Infrastructure, Altair is able to not only cut costs, but also go to market with advanced products faster than previously. And our customers will gain the same advantage," said Sam Mahalingam, CTO, Altair Engineering.

Building and Deploying Cloud-Native Apps

Many businesses are turning to the public cloud to support Agile application development methodologies and DevOps environments. IaaS provides development teams with the most control of infrastructure in the public cloud, without requiring extensive hardware knowledge, and rapid, self-service provisioning with "pay-only-for-what-you-use" subscription-based pricing.

AGROSCOUT

AgroScout developed the first "self-service" artificial intelligence (AI) app for the early discovery of pests and diseases in agriculture by relying purely on user-generated content and user-owned drones. The process of detecting diseases and pests in crops involves uploading images collected by drones into a web/mobile app. Using AI algorithms, AgroScout then identifies those parts of the field that are affected so that appropriate pesticides can be applied. This reduces the use of pesticides, thereby reducing costs and improving the quality of fruits and vegetables.

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Challenges

AgroScout previously used another major cloud vendor but that vendor didn't offer the expertise and capability that AgroScout needed. In addition, the AI environment was scaling rapidly, and on-premises servers were inefficient and inadequate.

Solutions

Leverage OCI for AI and aerial imaging technologies that proactively detect and eliminate crop disease.

Results

AgroScout has seen significant improvements in

- **Performance:** The speed of downloading images, of which there are thousands, has been reduced from minutes to a few seconds. Tagging, viewing, and working with images are much faster, which improves the overall user experience.
- **Agility:** OCI systems engineers and technology have made the process of committing code, building, and delivering new releases

automatic. Prior manual processes would take at least a day and included no capability for notifications. AgroScout personnel now gets notified right away on their cellphones and can fix bugs much faster.

Previously AgroScout ran as a monolithic Heroku platform as a service (PaaS) on AWS. As part of the transition to OCI, AgroScout decoupled its services and containerized each one. With OCI, AgroScout can scale dynamically based on its demand. It expects to have tens of thousands of users in the next two to five years.

According to AgroScout CEO Simcha Shore, "The users before had challenges even working with our software. Oracle helped us address major issues on cloud native, containers, and DevOps. Deployment time has reduced from 24 hours to minutes and development velocity has increased by 5X."

Running Custom Apps on OCI

Many businesses are turning to the public cloud to deliver large-scale, high-performance services to their customers. OCI combines the performance and control of bare metal instances and industry-leading storage and

networking with the scale and flexibility of the cloud, allowing these businesses to deliver performance-intensive services to customers around the world.

CISCO TETRATION

Cisco Tetration offers application workload security for multi-cloud data centers by enabling a Zero Trust model using micro-segmentation, identifying workload behavior anomalies, and reducing the attack surface. The Cisco Tetration platform uses workload and network telemetry data to perform advanced analytics using an algorithmic approach (machine learning and behavioral analysis), and provides comprehensive workload protection for a multi-cloud data center.

Challenges

Cisco wanted to deliver its Tetration technology as a cloud service, and it built out its first offering on a traditional multitenant cloud offering. Unfortunately, the high performance demands of its application were a bad fit in a multitenant,

highly virtualized cloud. Its CPU utilization was very low, noisy neighbors impacted CPU and network performance, and its data access times were inconsistent due to random VM placement (AI needs to be close to the data). Cisco found that it kept having to spin up additional VMs to get the performance it needed. That led to very high cloud infrastructure costs, which it had to pass on to its customers.

Solutions

With OCI, Cisco could place the images on bare metal, orchestrate everything itself, and have complete control. Cisco didn't have to deal with noisy neighbors or VMs, and the data is right next to the CPU. Each Cisco Tetration cluster is 36 physical machines, with 1.8PB of storage. There are now 40 clusters, and Cisco is continuing to ramp up. The first instance was brought up and went live in two months.

Results

- CPU utilization went up from 5 percent or 10 percent to 75 percent.
- Sixty times application performance improvement over other clouds.

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- Two and a half times performance compared to on-premises.
- Higher CPU utilization lowered the cost structure, allowing Cisco to open up its offering to smaller businesses at lower price points.
- No noisy neighbors means consistent performance, and Cisco can now provide performance service-level agreements (SLAs) to its customers.

According to Navindra Yadav, founder of Cisco Tetration, "I asked my engineer team, 'Are we running all our tests right?' We were seeing 75 percent CPU utilization and 60 times — not 60 percent but 60 times — performance over our other cloud offerings." He also commented that "Customers can save up to 90 percent on total cost of ownership running Cisco Tetration on Oracle Cloud, compared to on-site."

TIP

Discover more OCI customer successes at `www.oracle.com/customers`.

IN THIS CHAPTER

- Delivering industry-leading price and performance
- Guaranteeing predictability and availability
- Leveraging an open and flexible cloud platform
- Ensuring control and visibility

Chapter 5

Ten (or So) Advantages of Oracle Cloud Infrastructure

In this chapter, I describe several key advantages of the Oracle Cloud Infrastructure (OCI) that enable organizations to migrate and extend their enterprise workloads to the public cloud.

Performance

Application performance is often characterized by latency, input/output operations per second (IOPS), and throughput. Different applications and architectures require different levels of each — at the right price point. First-generation clouds are primarily hypervisor-based and biased toward scale-out applications, forcing customers to compromise when they're trying to run more traditional scale-up applications and often requiring a substantial level of rearchitecting or re-platforming.

Enterprise back-office applications, high-performance computing (HPC), transactional database applications, real-time analytics, and many other applications require a level of peak performance and predictability that's unavailable in first-generation cloud providers. These cloud providers offer hypervisor-based compute options that are prone to noisy neighbors. OCI is built to achieve and sustain millions of transactions per second within a single compute instance at a significantly superior price per transaction. Consistent high performance means customers can run critical applications with confidence and run new high-performance applications they can't run anywhere else.


TIP

Oracle workloads have the highest performance running on OCI. Exadata Cloud Service X8M supports an industry-leading 12 million read and 5.6 million write IOPS.

Superior Economics

With Oracle, customers see significant cost savings because the infrastructure is automatically optimized to match resources with workloads. Workloads deployed on OCI need fewer compute servers and block storage volumes, resulting in predictable performance and lower cost of ownership. Customers can also take advantage of Oracle's low and consistent global pricing.

REMEMBER

OCI offers low networking prices, enabling customers to move significant volumes of data for less. Inbound data transfer is completely free. In addition, customers don't have to pay for up to 10TB per month of outbound data transfer. Plus, five-year total cost of ownership (TCO) for OCI can be 45 percent less than that for Amazon Web Services (AWS). Learn more about how OCI adds business value and reduces operational costs at `www.oracle.com/cloud/economics`.

Predictability

Enterprises have spent many years tuning their on-premises environments to meet the exacting standards of predictability and reliability that their most critical applications require. Unfortunately, early adopters of the

public cloud have had to give up much of that hard-earned experience, particularly for traditional scale-up application architectures.

But you don't have to sacrifice predictability to take advantage of the public cloud. Oracle offers the benefits of on-demand access, self-service, and scalability, with the dependability of dedicated resources. Oracle has built a next-generation cloud environment to provide each tenant with compute, storage, and networking capabilities that deliver predictable performance that often matches or exceeds enterprise on-premises environments.

Availability

Oracle is built on an enterprise-grade, fault-tolerant infrastructure that provides high availability with cross-availability-domain replication and recovery. Users first select what region of the world they want to have their workload hosted within — for example, the western United States. After they've chosen the region, there are multiple data centers — known as *availability domains* (ADs) — within each region in which cloud workloads can be deployed. Each availability domain is connected by a high-speed network backbone.

This approach to providing worldwide infrastructure availability provides the highest levels of failure protection and availability for the most demanding cloud applications that Oracle Cloud customers deploy and operate.

REMEMBER

Applications are becoming more complex and more distributed, thus elevating your business's need to run on a high-performance, fault-tolerant platform.

Each resource within an AD is connected by a flat network design that minimizes the number of hops, reducing the latency between compute and storage nodes and offering highly consistent performance. Low-latency, high-bandwidth network connections include 25 gigabit per second (Gbps) links between hosts in an AD with less than 100 microsecond latency. Latency for traffic between ADs is less than 500 microseconds.

Oracle ADs are stand-alone structures, each with its own independent and redundant power and cooling systems. At least three ADs, located within approximately 20 to 25 miles of each other, are interconnected with a low-latency network to make up a single cloud computing region. Traffic between regions and ADs is encrypted.

TIP

A good example of how Oracle's AD architecture can help deliver fault tolerance is databases. ADs provide a fault-tolerant foundation for traditional active/passive and active/active availability configurations (for example, Oracle Dataguard for Oracle Database).

Openness

Customers are choosing a variety of technology approaches to meet their needs, often with open-source technologies or custom applications. Oracle's approach to the cloud gives customers the flexibility to run a broad array of applications natively on its infrastructure. Whether it's other types of databases like Apache Cassandra, big data frameworks like Hadoop, or container orchestration technologies like Kubernetes, OCI has demonstrated the capability to run these technologies natively, with superior performance to other cloud providers. Oracle is a Platinum member of the Cloud Native Computing Foundation (CNCF), which oversees several projects. The CNCF states that "cloud native technologies enable software developers to build great products faster." This support of upstream open source, along with the support of a range of programming languages, middleware, major operating systems (OSes), and even hypervisors, demonstrates Oracle's commitment to solving customer problems while limiting lock-in and the associated overhead.

Choice of Deployment

Oracle offers the most versatile public cloud, allowing companies to run traditional and cloud-native workloads on the same platform, reducing operational overhead and

costs, and enabling connectivity and shared data between these workloads.

Oracle is working toward offering more choice to its customers with rapid expansions of both commercial and government cloud regions.

To accelerate cloud migration, Oracle has partnered with Microsoft Azure and VMware. The partnership with Microsoft Azure offers customers interoperability — the ability to run mission-critical enterprise workloads across both OCI and Microsoft Azure. Oracle Cloud VMware solution provides a customer-managed, native VMware-based cloud environment, installed within a customer's tenancy. With this solution, customers can move or extend VMware-based workloads to the cloud without rearchitecting applications or retooling operations.


TIP

Access the full list of Oracle Cloud Regions for Platform and Infrastructure Services at `www.oracle.com/cloud/data-regions`.

Oracle provides the broadest variety of deployment options that include not only public cloud, but also public cloud services in your data center (Oracle Dedicated Region Cloud@Customer, Oracle Autonomous Database on Exadata Cloud@Customer, and Oracle Exadata Cloud@Customer). Oracle customers can get access to a range of high-performance storage, networking, and compute shapes — bare metal servers, virtual machines (VMs),

and graphics processing units (GPUs). Customers can also use advanced services like Autonomous Database, Autonomous Linux, Autonomous Data Guard, and low-latency Remote Direct Memory Access (RDMA) cluster networks to run high-performance computing (HPC) workloads.

REMEMBER

For HPC workloads, Oracle offers high-bandwidth, low-latency RDMA-connected cluster networks of up to 20,000 cores.

Governance and Control

Given the global nature and complexity of businesses, it has become critical for IT to efficiently manage and secure digital identities of all users, applications, and resources while making sure they're secure and compliant.

Oracle started with complex organizations in mind, implementing the logical tools to make resources easier to segregate, provision, monitor, and audit. For example, compartments enable customers to assign access policies, usage quotas, and budget, on a per-project or per-group basis. IT administrators can manage multiple environments via a single policy and gain visibility into who is consuming what resources. Usage is rolled up under a single account structure, so IT doesn't have to

aggregate dozens or hundreds of accounts. Some enterprises choose to run their workloads within their own data centers to meet business, legislative, and regulatory reasons. For example, some companies and government agencies must keep their application development and data processing behind corporate firewalls to comply with security mandates or abide by data governance and compliance regulations.

To serve enterprises looking for the cloud's agility, automation, extensibility, and portability, in an on-premises environment under their control, Oracle Exadata Cloud Service allows customers to run Oracle Database workloads in the cloud. This tightly integrated service was designed from the ground up to deliver dedicated, scalable X8M infrastructure that offers isolation from other users and allows database teams to improve performance, uptime, and security. With flexible licensing options and pay-per-use pricing, customers can get the agility and elasticity of cloud-based deployments at lower costs while having a higher degree of control.

For customers wanting to transition to the cloud and needing to meet regulatory, data residency, and low-latency requirements, Oracle Dedicated Region Cloud@Customer provides OCI's public cloud services within their own data centers. Oracle Dedicated Region Cloud@Customer is certified to seamlessly run Oracle Cloud applications, including Oracle Fusion Cloud Applications

(Cloud ERP, Cloud HCM, Cloud SCM, and Cloud CX), making it a completely integrated cloud that runs on-premises. Customers only pay for services they consume. They can take advantage of the same predictable low pricing offered in Oracle's public cloud regions.

Observability and Management

Moving to the cloud can also mean changes to the tools and processes you use to manage and maintain your IT infrastructure. There's a good chance you're currently managing both legacy systems and cloud-based assets.

Oracle Cloud Observability and Management Platform offers a comprehensive set of management, diagnostic, and analytics capabilities that help customers reduce the complexity, risk, and cost of managing on-premises and multi-cloud environments. The platform provides a unified view across the entire software stack and enables easy diagnostics of cloud-native and traditional applications. With built-in machine learning, these services automatically detect anomalies and enable quick remediation in near real-time. The platform has adopted an open, standards-based approach that is vendor-agnostic, supporting ecosystem interoperability with Slack, Grafana, Twilio, PagerDuty, and other observability tools.

REMEMBER

Oracle Cloud Observability and Management Platform comprises these services: Logging, Logging Analytics, Database Management, Application Performance Monitoring, Operations Insights, Service Connector Hub, Monitoring, Notifications, Events, Functions, Streaming, and OS Management.

Scalability

One of the key advantages of the public cloud is massive on-demand scalability. OCI provides enterprises with scale-up and scale-out compute and storage capacity for their most demanding workloads and applications. Customers pay only for what they use and can scale down when their compute and storage needs change.

ADs (discussed in the "Availability" section, earlier in this chapter) are also excellent for scale-out availability configurations that often require odd numbers of sites for quorums. (A *quorum* is the minimum number of votes that a distributed transaction must obtain to be allowed to perform an operation in a distributed system.) Object (file) storage nodes are automatically and seamlessly replicated across three fault-independent ADs per region. Finally, each AD accommodates up to a million servers with on-demand elasticity and scalability to meet enterprise demands.

Optimized for Oracle Applications and Databases

OCI customers receive exclusive access to the Autonomous Database and its self-repairing autonomous services. Using machine learning (ML) and artificial intelligence (AI) automates all routine database tasks, ensuring higher performance, security, and operational efficiency. Those automated services also mean less time on coding and more time focused on building enterprise applications.

OCI also has a number of unique tools and programs that are geared to migrate and/or run Oracle's databases and business applications portfolio with unmatched performance, scalability, and reliability. Minimal architecture changes, coupled with automated migration tools, reduce the cost and length of time required to migrate to the cloud.

Proven technologies like Oracle Real Application Clusters (RAC) and Oracle Exadata are supported only on this cloud, retaining best practices and offering the same levels of confidence often experienced on-premises. Furthermore, the latest hardware and technologies are available, improving database and application performance and results.

TIP

To simplify the migration process, Oracle's Bring Your Own License (BYOL) program allows customers to apply licenses they already own for on-premises software toward OCI. You can find more information at `www.oracle.com/cloud/pricing.html`.

TIP

Experience OCI for free at `www.oracle.com/cloud/free`.

Security by Design

Oracle offers a wide array of capabilities to meet security and compliance requirements: identity and access management, data protection and encryption, unified security controls, and infrastructure protection, as well as incident identification and remediation.

OCI has been designed with a zero-trust, security-first architecture. OCI provides automated and easy-to-implement security controls. Oracle's infrastructure isolates compute and network resources to ensure that your organization's data and traffic are shielded from other tenants. OCI also separates your code, data, and resources from management machines, helping to prevent attackers from stealing or manipulating your data.

Service-Level Guarantees

Oracle understands that critical enterprise workloads need consistent performance and high availability. Additionally, Oracle customers demand the ability to manage, monitor, and modify resources in the cloud. Only Oracle offers end-to-end service-level agreements (SLAs) covering performance, availability, and manageability of services.

TIP

Learn more about Oracle service-level guarantees: `www.oracle.com/cloud/iaas/sla.html`.

ORACLE CUSTOMERS SHARE THEIR IaaS EXPERIENCES

"We explored multiple platforms, and Oracle Cloud Infrastructure was instrumental in helping us quickly scale our capacity and meet the needs of our new users."

—Eric S. Yuan, CEO, Zoom

"Oracle Cloud Infrastructure was undeniably the clear choice. There is no better solution for databases than Exadata, and Oracle is the only cloud that offers it."
—Sanjay Date, Senior Program Manager, Enterprise Infrastructure Group, 7-Eleven

"We looked at several platforms and chose Oracle Cloud Infrastructure for its strong security, outstanding price/performance, and world-class support."

—Vik Verma, CEO, 8x8

"We can typically failover to our disaster recovery site in 5 to 10 minutes, if that. That's given a lot of confidence to everybody on the infrastructure side ."

—Darren Owsley, CTO, Gonzaga University

"During our evaluation discussion, the team asked for our requirements. We were blunt and stated that we need a next-generation infrastructure that must scale. We were amazed when we had a proof of concept running in a matter of weeks, showing over 165,000 events per second."

—Chris Young, CEO, McAfee

"We needed our data platform to scale and deliver high performance at a lower cost. The migration from AWS to Oracle was one of the most successful migrations at OceanX."

—Vijay Manickam, vice president of Data and Analytics, OceanX

"What we are able to do more than anything is mimic an on-premises data center in Oracle Cloud. This works for us, works for Oracle, and it works for the customer. This is certainly unique within Oracle."

—Simon Ponsford, Chief Technical Officer, YellowDog

"We had a very clear view of our costs projection in 5 years' time, and we estimated that there was a 20% to 25% savings to be gained by moving to infrastructure in the cloud."

—Juan Aroche Terán, CIO, Aliat Universidades

"With Oracle Cloud Infrastructure services for Data Science, Blockchain, and Internet of Things in addition to Autonomous Database, Oracle is the perfect partner to support our digital transformation."

—Ahmad Sallakh, Chief Executive Officer, Nabil Foods

"With Oracle Cloud infrastructure we were able to reduce the time for daily data warehouse reporting by 75%. Now we can meet our business users' needs for accurate inventory data."

—Mark Dawson, Development Manager, BI and Data Management, KEMET

Explore the capabilities, benefits, and use cases of Infrastructure as a Service (IaaS)

To succeed in today's competitive market, enterprises need to free themselves from the traditional IT infrastructure that hinders business agility and growth. Infrastructure as a Service (IaaS) provides exactly this — on-demand access to IT infrastructure resources in the public cloud. Oracle Cloud Infrastructure offers scalable, resilient, next-generation infrastructure, built for running enterprise workloads. *IaaS For Dummies* explains how Oracle offers an unmatched breadth of computing options to suit your needs.

Inside…

- Find out more about IaaS for your business
- Explore how Oracle Cloud Infrastructure is built to meet the most demanding workloads
- Discover the benefits of Oracle Cloud Infrastructure and how Oracle's IaaS is different from the rest

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