

# Oracle Cloud Infrastructure

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*Build cloud-native applications with  
Oracle Cloud Infrastructure (OCI)*

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**Vijay Kumar**



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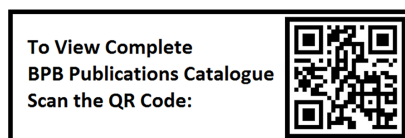
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**Dedicated to**

*My wonderful mother **Sushila**  
and  
My loving wife **Preeti***

## About the Author

**Vijay Kumar** has been working in IT industry for more than 12 years and have played different roles in multiple projects as IT Analyst, Consultant and project lead. He has delivered IT Modernization, Automation and Migration projects using VMware and cloud technologies for Financial Institutions, Government agencies, Telecom and Enterprise customers in India, Europe and the United States.

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# Preface

Cloud Native Applications are at the heart of every agile, fast paced, and adaptive organization. These applications greatly reduce the time to market for a new business idea, can be quickly modified based on user feedback and evolve over time to meet the changing business requirements.

However, building cloud native applications is quite different than building traditional applications. These need extensive experience on public cloud services, application architecture and at time can be quite expensive to start with.

The book starts off with an introduction to Oracle Cloud Infrastructure and takes you through OCI cloud native services which can help you easily navigate the build of your first cloud native applications. The book also covers the *Why* of cloud native applications and talks about traditional application development methods and contrasts these with rapidly growing DevOps methodology. Additionally, the book covers No Code/ Low Code, AI and Data Solutions available to developers on OCI.

The book introduces you to the exciting world of cloud native applications, helps you understand why these applications are the need of the hour, how the cloud native applications help businesses drive and adopt to changes at a faster rate. By going through the book, you will understand the key component of OCI and Service available on the cloud to build, manage and run Cloud Native apps.

This book is intended for application developers, operators and architects who are starting to look at the cloud as an increasingly viable option to build and run business applications. The book is also helpful for cloud experts and introduces them to the core concepts of Oracle Cloud and dives deep into different Oracle Cloud Native services.

**Chapter 1: Oracle Cloud Infrastructure: Overview and Getting Started** - Oracle Cloud Infrastructure or simply OCI is an enterprise cloud service, tailored to run any application be it Traditional or Cloud Native. In this chapter we are going to learn about Oracle Cloud Infrastructure, how it is different from any other public cloud and how to get started with **Oracle Cloud Infrastructure (OCI)**. We will see how to create an account on OCI, explore the cloud UI and understand different cloud service categories ie IaaS, PaaS and SaaS.

**Chapter 2: Introduction to Cloud-Native Applications** – This chapter outlines what is a cloud native application. We will look at the evolution of application development methodologies from Waterfall to Agile to DevOps. The chapter also outlines the why and how of Cloud Native apps – why we need cloud native apps and their popularity. The difference between cloud native apps different and traditional applications.

Every breakthrough or trend in technology can be traced back to business challenges and requirements. We will see what are some business and technological challenges that cloud native applications solve and how these applications can fuel business growth.

**Chapter 3: Cloud-Native Services in Oracle Cloud Infrastructure** – This chapter gives you a sneak peek into all the cloud native services the OCI has to build, run and manage your applications. This chapter provides a brief description of major Platform services that we are going to dive deeper into in the upcoming chapters. We will also talk about different use cases where these services can be used and some alternatives to these services.

**Chapter 4: Infrastructure as Code with OCI** – One of the fundamental principles of DevOps is to treat underlying infrastructure as application resource and manage it with the same principles. This chapter introduces the imperative and declarative method to building and managing infrastructure required to run cloud applications. The chapter also covers Terraform for resource management and OCI Resource Manager, which can be used to define, manage and maintain Oracle Cloud resources using Terraform code. The chapter also provides example code to deploy Virtual Machines and Networks to get started with Resource Manager.

**Chapter 5: Containers and Container Instances in OCI** – This chapter goes into details of Containers, we look at the brief history of how containers came to be synonymous with agile, scalable and highly performant systems. We also go into details of how to build and run containers.

The chapter also outlines Container Instance service on OCI and how you can use Container Instances to run containers on serverless compute without the hassle of setting up infrastructure, networking and security for your application containers.

**Chapter 6: OCI Container Registry** – In this chapter we focus on Container Registry, understand how you can use this service to store, manage and secure application images. We will also understand the basics of repositories, tagging, image management, updates and security best practices when working with a public or private container registry.

**Chapter 7: OCI Container Engine for Kubernetes** – With the popularization of Containers, Kubernetes has become synonymous with Cloud Native applications. This chapter provides a brief overview of Kubernetes and how it is being used to fuel the growth of cloud native applications. We will see how Kubernetes lets you build platform independent, self-healing and scalable applications irrespective of underlying infrastructure.

We will also learn about Container Engine for Kubernetes, this service from Oracle Cloud Infrastructure lets you build, run and manage Kubernetes clusters on demand. We will learn how to create these clusters, how to control access, build pod networks, manage security, updates and upgrades.



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**Chapter 8: Serverless with OCI Functions** – This chapter focuses on Oracle Cloud Infrastructure Functions service. Functions service lets you run your application code without building the underlying infrastructure or platform. We will explore different runtimes supported by OCI functions, build a test function, explore the management, access control and observability for the functions. We will also look at how you can integrate the functions with OCI Events to automate the application execution.

**Chapter 9: APIs and OCI API Gateway** – API's gives the developers freedom to build their application in small, standardized parts and seamlessly integrate those parts by abstracting the underlying code. This chapter sheds light on what are API's, what are the benefits of using APIs in your application and how can you use API Gateway on OCI to host and manage your API's. We also look at how to create and manage API Gateways and Resources in the cloud along with securing the resources.

**Chapter 10: OCI Events and Streaming Service** – This chapter focuses on the Event and Streaming services in OCI. We look at different type of events generated by OCI services and resources, go through the filters available for these rules and discuss how you can use the event rules to automate parts of your application.

We will also get an overview of Streaming service, understand the pub-sub model, how you can build and use streams for your applications and see how Streaming service integrates with Apache Kafka.

**Chapter 11: Low Code/No Code Platform in OCI** – OCI provides many low code/no code services to build your next application. We start by looking at Visual Builder, see how to setup visual builder instances and manage these instances. Then we get to Visual Builder Studio, look at how to setup Visual Builder studio, integrate it with CI/CD tools and pipelines and manage the deployments.

**Chapter 12: AI Services for Developers** – In this chapter, we look at different pretrained and customizable models available on OCI for the application developers. We'll see how to use Digital Assistant to integrate chatbots to you applications, use Vision to detect, classify and extract text from images and use Forecasting to predict future trends from gathered data.

**Chapter 13: Database Solutions Overview for Developers** – This chapter goes into details of OCI Data Solutions and focuses on Autonomous databases, build, run and management of these databases along with NoSQL services to work with applications dealing with large amount of unstructured data.

# Code Bundle and Coloured Images

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The code bundle for the book is also hosted on GitHub at  
**<https://github.com/bpbpublications/Oracle-Cloud-Infrastructure>**.

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# CHAPTER 1

# Oracle Cloud Infrastructure: Overview and Getting Started

## Introduction

We will start this chapter with an introduction to **Oracle Cloud Infrastructure (OCI)**. We will understand how OCI differs from other public cloud offerings and how you can start with OCI. We will then set up our first account on OCI and look at OCI Free Tier, and at last, we will understand how OCI categorizes different services that the platform offers.

## Structure

The chapter covers the following topics:

- Overview of Oracle Cloud Infrastructure
- Getting started with Oracle Cloud
- Creating an account with Free Tier
- First time login and multi-factor authentication setup
- Cloud portal walkthrough
- Understanding service categories

## Objectives

At the end of this chapter, you will understand what OCI is and what makes OCI different from other public cloud offerings like **Amazon Web Services (AWS)**, **Google Cloud Platform (GCP)**, or Azure. You will also have an OCI Free Tier account that you can use to launch and utilize different OCI services.

## Overview of Oracle Cloud Infrastructure

OCI is a public cloud platform for running any and every kind of application. OCI is built from the ground up to support enterprise-grade applications with built-in high-performance, low latency, high availability, and security. OCI is a relatively new cloud platform launched in October 2016 as Oracle Bare Metal Cloud Services with only a single global region and core infrastructure services across computing, networking, and storage. It was rebranded as OCI and dubbed Oracle's Second-Generation Cloud.

At the time of writing this book, OCI has grown to support 48 cloud regions, including commercial, government, and private cloud regions, and has expanded the service catalog to over 100 services across infrastructure, platform, and software.

While other public cloud platforms, or Gen-1 clouds, were built with public applications with a scale-out architecture in mind, Oracle had the late movers advantage in the cloud space and took this opportunity to design OCI to support all kinds of enterprise applications from traditional monolithic applications running on relational databases, large data processing application requiring **High-Performance Compute (HPC)** or cloud-native applications built on containers, Kubernetes, functions and microservices. To support this wide range of applications on a single cloud platform with reliant performance, Oracle had to innovate at every stage of the designing process. Let us discuss some of those differentiated design decisions.

## Off-box virtualization

To run a virtual machine instance on a physical server requires a hypervisor that controls the compute allocation along with virtual machine network processing, and because the network processing happens inside the hypervisor kernel, this process takes a toll on the overall infrastructure performance. OCI was the first public cloud vendor to offer off-box virtualization, which offloads the network processing task to a dedicated network interface card, a Smart NIC. Using Smart NICs, OCI can derive better performance from the underlying hardware, provide isolated networks, and avoid noisy neighbors. The following figure showcases off-box virtualization with OCI:

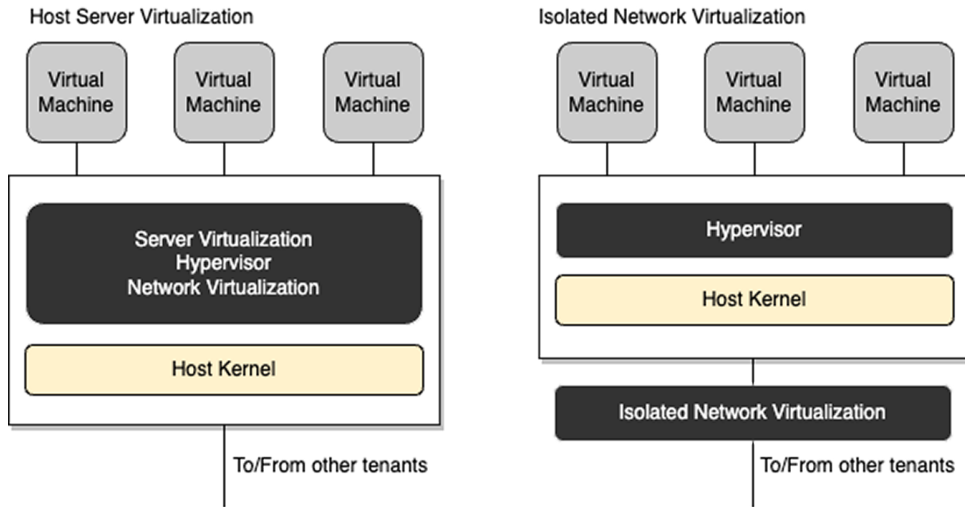


Figure 1.1: Off-box virtualization with OCI

## Non-blocking networks

Generally, whenever we think of the cloud, the first thing that comes to mind is Compute, how to spin up an instance, databases, and how to manage these. However, the underlying network plays a vital role in the scalability and performance of the applications that you run in the cloud. OCI physical network has been designed keeping this thing in mind. OCI Services run on a non-blocking, non-oversubscribed, flat network for faster access to services with predictable performance. OCI is also the first in industry to offer performance SLAs for select services over and above Availability SLAs.

## Remote direct memory access cluster networking

**Remote Direct Memory Access (RDMA)** allows two compute hosts on a network to access each other's memory content without the CPU overhead of traditional networks. Latency and jitter-sensitive applications that cannot tolerate packet losses over traditional networks are the best candidates for RDMA networks. While most RDMA network implementations relied on InfiniBand, OCI uses **RDMA over converged ethernet (RoCE)** for its purpose-built and dedicated RDMA network.

## Flexible infrastructure

Let us start this section by stating the obvious: all applications are built differently and have different compute and storage requirements. It is hard to map these requirements in clearly defined compute boxes or t-shirt sizes. This is why OCI has no fixed compute capacity shapes or t-shirt sizes. While deploying your application instances, you can

customize the CPU, memory, and storage independently to meet your requirements. This avoids performance challenges due to a smaller compute shape and avoids resource wastage by selecting a larger compute shape.

## Getting started with Oracle Cloud

Before deploying any application or service on OCI, we need to be familiar with some key concepts on OCI. We will be looking at the following concepts as the parts of this section:

- OCI regions
- Availability domains
- Fault domains
- Tenancy
- Compartment
- Subscription
- Identity policies
- Virtual cloud network

### OCI regions

Regions are physical locations globally where OCI services are deployed and made available for public consumption. An OCI region can have one or multiple **Availability Domains (ADs)**. OCI regions provide a highly available, performant, and scalable environment for OCI services. Most OCI services are regional, which means they are confined to the region where they are deployed. As of writing this book, OCI has 48 global regions, including commercial, GovCloud, and dedicated cloud regions. Oracle is constantly adding more regions, so expect this number to increase.

### Availability domains

Every OCI region can have one or multiple availability domains. Availability domains are physical data centers that host the compute, storage, and networking components necessary to run the OCI services. Availability domains have isolated infrastructure components. Failure of one availability domain does not impact the services in another availability domain inside a region. They are connected over a low-latency network to facilitate seamless service communications.

### Fault domains

Fault domains are a collection of hardware, including compute, networking, and storage. They provide an additional layer of protection against hardware failures. The failure of a fault domain hardware does not impact the instances running in other fault domains, so

while deploying your application, you can distribute your application instances across different fault domains for higher availability and resiliency against hardware failures.

## Tenancy

Tenancy within the OCI is equivalent to your account on OCI. However, it also provides a secure and isolated way to deploy, manage, and run your application instances in OCI. When you sign up for an OCI account, your tenancy is created inside the first region you subscribe to, also called your home region. Tenancy is sometimes also referred to as root compartment. Later, you can subscribe your tenancy to as many regions as needed.

## Compartment

Compartments are logical groupings of related components. Every resource that you create in OCI must be placed inside a compartment. Compartments also allow you to manage resource access using identity and access policies. When you sign up for an OCI account, the root compartment is created by default for your account and holds all of your OCI resources. You can create more compartments based on your organization's requirements and even create nested compartments. OCI currently supports up to six levels of nested compartments.

## Subscription

Oracle Cloud services are available with different pricing and service levels. When you sign up for an individual Oracle Cloud account, you start with a Free Tier subscription, which you can upgrade to a pay-as-you-go model, and these two are the most common subscription types. However, Oracle offers several other subscription types to suit your application and organization requirements. These subscription types are as follows:

- Universal credit services
- **Bring Your Own License (BYOL)**
- Metered services – prepaid
- Nonmetered services

## Identity domains

An identity domain in OCI, is a collection of users, groups, their roles, security policies, that is, MFA, SSO, and so on. An identity domain in OCI represents a group of users, who share similar authentication requirements and security settings.

Identity domains are treated as any other OCI resource and can be created, moved, managed and tagged as needed. You can also use IAM policies defined in the next section to control who can create, manage, read or control the Identity domains.

A default identity domain is created when you subscribe to a new OCI cloud account. The default identity domain is created in the root compartment and holds the initial administrative user account and administrator group, the default administrator account holds the permissions to manage any resource within the OCI tenancy. This account can never be deleted until the tenancy itself is deleted.

You can create additional domains based on your requirements. You can build the domains based on application environments, user types, security policies etc.

## Identity policies

Identity policies are the primary mechanism within OCI to control who has access to which resources within which compartment. In OCI, cloud users are members of certain groups inside an identity domain. Identity domains are a logical representation of users, roles, identity providers, and security settings like **Multi Factor Authentication (MFA)** and **Single-Sign On (SSO)** for the users.

Policies can be applied to a group and grant the members of that group access to specific resources inside a compartment. Permissions assigned to the tenancy/root compartment are automatically propagated to all child compartments.

## Virtual cloud network

**Virtual Cloud Network (VCN)**, is a software-defined network inside OCI. It is one of the first resources you deploy after setting up your tenancy. A VCN can have multiple non-overlapping IPV4 CIDR blocks, or you can enable IPv6 for the VCN, and a /56 prefix will be automatically allocated to the VCN. The CIDR blocks defined while creating the VCN are then used to create network subnets that provide connectivity to the compute instances. A VCN is always tied to a region. However, while defining the subnets inside the VCN, you can select whether the subnet will be regional or AD-specific.

You can also define different types of gateways inside a VCN to provide connectivity to the outside world or OCI services. Network security policies or network security groups govern access to the resources connected to the VCN or subnet.

## Creating an account with Free Tier

Oracle offers a Cloud Free Tier account with Always Free Services. You can use these services to build, test, and run cloud applications for as long as you want without any time limitations. When you create an Oracle Cloud Account and sign up for Free Tier, you also get US\$300 cloud credit that you can use to try services not included in the Free Tier; this cloud credit must be utilized within 30 days of signing up for the account.

The following *Table 1.1* is a list of OCI services eligible for Always Free Tier. Although you can use these services, there are certain limitations around the service configuration.