Cloud Native Development with Azure

A practical guide to build cloud-native apps on Azure cloud platform

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Dedicated to

My beloved parents, who constantly inspire me:

Shri Thakur Prasad Verma
Smt. Laxmi Verma

and

My wife ***Anuradha*** *and my daughter* ***Palak***
to be always there to support me

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Pavan Verma is working as a Principal Engineer at McKinsey & Company with 20 years of industry experience, and previous to McKinsey, he worked with Accenture. Pavan has global experience working with Fortune 500 companies in defining and successfully executing digital business transformation initiatives.

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  I would like to thank my parents and son, Naitik, for the opportunity to contribute to this book.

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Acknowledgement

I want to express my sincere gratitude to several people who have supported me while writing this book.

I want to express my utmost gratitude to my parents, who have been a constant source of inspiration for me to do good. My mother was my first teacher who believed in my potential, and my father was a mentor who guided me and showed me the right path to take. I am incredibly grateful to my wife, Anuradha, and daughter, Palak, for their unwavering motivation and support throughout the process of writing this book. Without their encouragement, this book would not have been possible. Their support means everything to me, and I am genuinely thankful for the motivation they provided at every step.

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Preface

Cloud and cloud-native development have become buzzwords in the technology industry because they offer many benefits to organizations that adopt them. There are many cloud service providers in the market, and Azure is a critical public cloud service provider. Azure is a powerful cloud computing platform with a wide range of services, and reading this book can help you gain an in-depth understanding of these services and how to use them effectively. Azure is one of the most popular cloud computing platforms, and having knowledge and skills in Azure can be a valuable asset in your career.

Suppose you are planning to take a certification exam in Azure. In that case, reading this book can help you prepare for the exam by providing a detailed understanding of the concepts and topics covered in the exam. Azure is constantly evolving, with new features and services being added regularly. Reading books on Azure Cloud can help you stay up-to-date with the latest developments in the platform and keep your skills current.

This book is aimed at helping developers, designers, and architects using Azure as a Cloud Service Provider (CSP). This book will cover the Azure platform's primary offerings and how those can be used for building highly scalable, secure, and reliable applications. The book will also cover real-life implementation examples, providing Azure services' realization and how they are being used. The book anticipates that readers will have some basic knowledge of computers and the cloud, but it does not expect advanced expertise.

This book is divided into 11 chapters. We will start with learning about the basics of cloud computing and then learn about the various Azure features. By reading this book, readers will learn about Azure Functions, AKS, Cosmos DB, Azure Event Grid, EventHub, and Service Bus. In the last section, we will cover the real-life scenarios and architectures of Azure and the services it uses. The details of the book and its chapters are listed below.

Chapter 1: Introduction to Azure Cloud and Cloud Native Development - explains what cloud computing is and what type of services it provides in terms of delivery of computing services, including servers, storage, databases, networking, software, and analytics, over the internet.

Chapter 2: Azure Services for Cloud Native Development - covers the details of different Azure Services it provides for Cloud Native Development and see how they help in the software development life cycle.

Chapter 3: Data Storage Services on Azure Cloud - explains the data storage services available on Azure Cloud and how they help in every type of data need of the organization.

Chapter 4: Azure Kubernetes and Container Registry - covers the concept of containerization and its orchestrations. We will also review how it helps the scalability and availability of the applications at scale.

Chapter 5: Developing Application on Azure - explores the best practices and concepts around cloud native and microservices development. We will discuss developing more resilient, secure, and scalable services.

Chapter 6: Monitoring and Logging Applications on Azure - covers information about the monitoring and logging services provided by Azure and how they help developers identify and remedy issues.

Chapter 7: Security and Governance in Azure - explains the security and governance services provided by Azure and the security best practices everyone should follow.

Chapter 8: Deploying Applications on Azure - explains the CI/CD concepts and how Azure Cloud helps build pipelines that provide agility and speed to the development and deployment of the applications.

Chapter 9: Advanced Azure Services - will cover the advanced Azure services like cognitive, AI, and IoT and see how they help organizations.

Chapter 10: Case Studies and Best Practices - this chapter will go through the real-life case studies implemented by top organizations and how they benefit.

Chapter 11: Cloud, Generative AI, and Future Trends - explains a critical topic: Generative AI. We will go through the basics of the general concepts and their use.

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Chapter 1
Introduction to Azure Cloud and Cloud Native Development

Introduction

Cloud computing refers to delivering computing services, including servers, storage, databases, networking, software, and analytics, over the internet known as the cloud. Rather than managing and maintaining physical servers and infrastructure on-premises, organizations can leverage cloud computing to access these resources as needed and pay only for what they use.

Microsoft Azure is a cloud computing platform and service offered by Microsoft. It provides a wide range of cloud services, including computing, analytics, storage, and networking, to enable businesses to build, deploy, and manage applications and services in the cloud.

Azure allows organizations to scale their computing resources up or down as needed, enabling them to respond quickly to changing business demands.

Azure's pay-as-you-go model enables organizations to pay only for the resources they use rather than investing in and maintaining expensive on-premises infrastructure.

Azure offers robust security features and compliance certifications to help protect data and applications.

Overall, Azure's value proposition lies in its ability to provide organizations with a flexible, cost-effective, reliable, and innovative cloud platform to meet their computing needs.

Structure

In this chapter, we are going to discuss cloud computing and its evolutions:

- Brief history of cloud computing and its evolution
- PaaS, SaaS and IaaS offerings
- Monolithic and microservice application architectures
- Benefits of Azure Cloud for development

Objectives

The objective of this chapter is an overview of cloud-native development and why it is essential.

Cloud-native development is a software development approach specifically designed for cloud computing architectures. It is focused on building applications using cloud services and leveraging cloud platforms' scalability, reliability, and agility. Cloud service provides various on-demand services, making code development and deployment processes efficient and seamless. The Cloud Native Computing Foundation defines it as the following:

Cloud-native technologies empower organizations to build and run scalable applications in modern, dynamic environments such as public, private, and hybrid clouds. Containers, service meshes, microservices, immutable infrastructure, and declarative APIs exemplify this approach.

The traditional development approach creates one code base containing everything and has one binary file for deployment. It was called monolithic because, over a while, code became so huge that it was causing boilerplate problems and required lots of budgets from organizations to maintain and run.

Brief history of cloud computing and its evolution

Cloud computing has its roots in the 1960s when the concept of time-sharing was first introduced. Time-sharing allowed multiple users to access a single computer simultaneously and was the precursor to modern cloud computing.

However, it was only in the late 1990s and early 2000s that the term **cloud computing** began to be used. Several companies started offering web-based applications and services hosted in the cloud - a term that describes the Internet.

One of the first cloud computing services was **Salesforce.com**, which launched in 1999 and offered a web-based **customer relationship management** (**CRM**) platform. In 2002, **Amazon Web Services** (**AWS**) launched its **Elastic Compute Cloud** (**EC2**) service, which allowed users to rent computing resources on demand.

Over the next decade, cloud computing continued to evolve and mature. In 2006, Amazon launched its **Simple Storage Service** (**S3**), which allowed users to store and retrieve data from anywhere on the internet. In 2008, Google launched its App Engine service, which allowed developers to build and deploy web applications on Google's infrastructure.

In 2009, the **National Institute of Standards and Technology** (**NIST**) released a definition of cloud computing that helped to standardize the terminology and concepts used in the industry. This definition included the five essential characteristics of cloud computing: On-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service.

Today, cloud computing is a ubiquitous technology that organizations of all sizes and industries use. The major cloud providers, Amazon, Microsoft, and Google, offer a wide range of services that include **Infrastructure-as-a-Service** (**IaaS**), **Platform-as-a-Service** (**PaaS**), and **Software-as-a-Service** (**SaaS**) offerings. Additionally, cloud computing has enabled the rise of new technologies, such as containers and serverless computing, changing how developers build and deploy applications in the cloud:

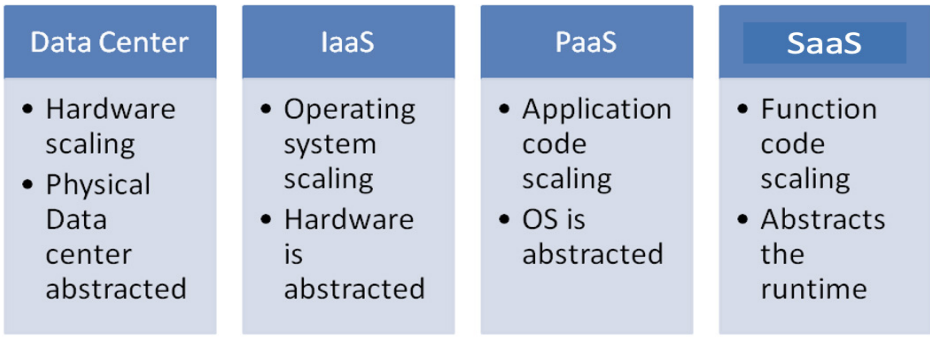

***Figure 1.1**: Cloud journey and evolution*

PaaS, SaaS, IaaS offerings

Cloud service providers provide several models, but PaaS, SaaS, and IaaS are the three primary models of cloud computing services. Each of these models offers different levels of abstraction and functionality to meet the needs of different types of applications and users:

Responsibility	On Prem	IaaS	PaaS	SaaS
Application	Customer	Customer	Customer	CSP
Data	Customer	Customer	Customer	CSP
Runtime	Customer	Customer	CSP	CSP
Middleware	Customer	Customer	CSP	CSP
Operating System	Customer	Customer	CSP	CSP
Virtualization	Customer	CSP	CSP	CSP
Servers	Customer	CSP	CSP	CSP
Storage	Customer	CSP	CSP	CSP
Networking	Customer	CSP	CSP	CSP

CSP – Cloud Service Provider

***Table 1.1**: Different cloud-type offerings*

Platform-as-a-Service (PaaS): PaaS provides a complete development and deployment environment in the cloud, allowing developers to build, test, and deploy applications without worrying about the underlying infrastructure. PaaS typically includes development tools, programming languages, databases, and other services necessary to build and run applications. Examples of PaaS offerings include AWS Elastic Beanstalk, Microsoft Azure App Service, and Google Cloud App Engine:

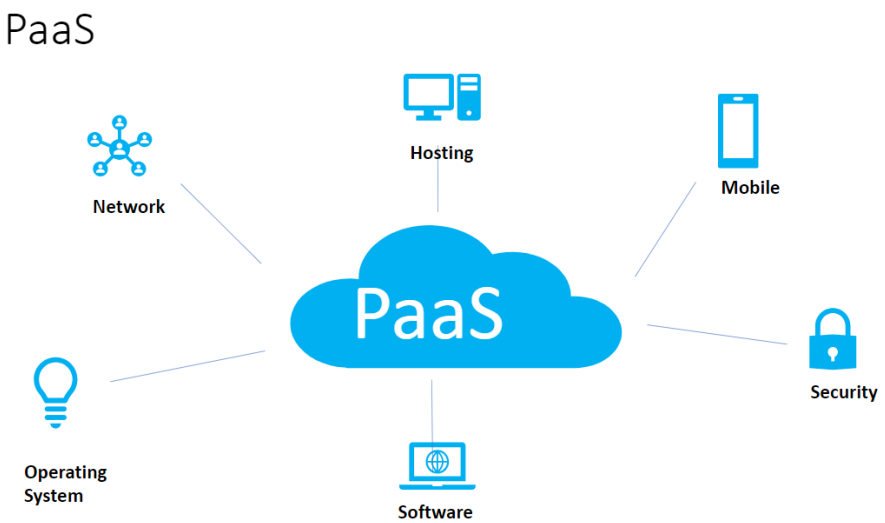

***Figure 1.2**: Platform as a Service (PaaS)*

Software-as-a-Service (SaaS): SaaS provides complete applications delivered over the internet, eliminating users needing to install and maintain software on their devices. SaaS

applications are typically accessed through a web browser or a mobile app and are often charged on a subscription basis. Examples of SaaS offerings include Salesforce, Dropbox, and Microsoft Office 365:

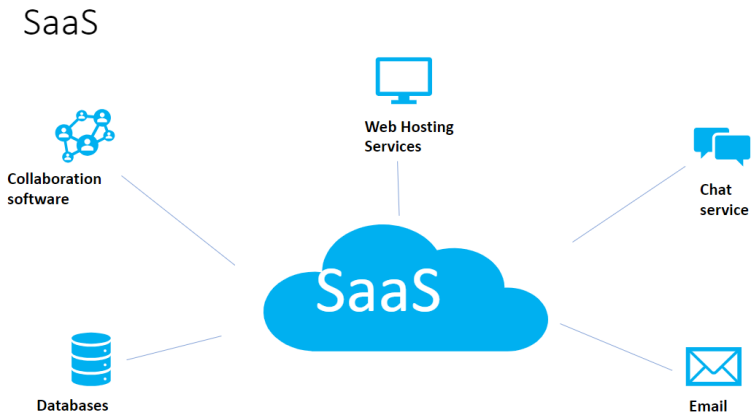

***Figure 1.3**: Software as a Service (SaaS)*

Infrastructure-as-a-Service (IaaS): IaaS provides virtualized computing resources, including servers, storage, and networking, that can be rented on demand. IaaS users have complete control over the operating system, middleware, and applications that run on the infrastructure. IaaS offerings are typically charged based on usage and are often used by organizations that need to run complex workloads that require high levels of customization and control. Examples of IaaS offerings include **Amazon Web Services** (**AWS**), **Elastic Compute Cloud** (**EC2**), Microsoft Azure Virtual Machines, and Google Cloud Compute Engine:

***Figure 1.4**: Infrastructure as a Service (IaaS)*

Monolithic and microservice application architectures

Monolithic architecture can be considered architecture where the whole building has been carved out from a single piece of stone. It is a traditional model of system development and architecture. In monolithic applications, as shown in *Figure 1.5*, everything UI, business logic, configuration, and data access components get bundled together as a single code unit. The problem with this approach is that for every small change, we need to build and deploy the entire package, and over time, when the code base keeps increasing, it becomes a bottleneck for the organizations. The team can not provide the agility and speed we need today.

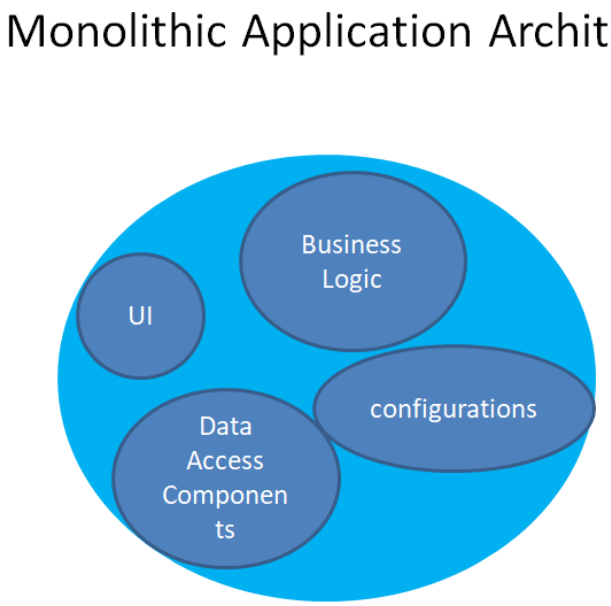

***Figure 1.5**: Monolithic architecture*

Cloud-native development typically involves designing and developing applications as microservices, each independently deployable and scalable. This approach allows developers to build more resilient, adaptable, and efficient applications than traditional ones. Cloud-native development also emphasizes containerization and container orchestration tools like Docker and Kubernetes. Containers provide a lightweight and portable way to package applications, while container orchestration tools allow developers to easily manage and scale their applications across multiple hosts and clusters. Kindly refer to the following figure for microservices architecture: