Mastering Cloud-Native Microservices

Designing and implementing Cloud-Native Microservices for Next-Gen Apps

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Dedicated to

My mother, who inspired me to pursue my dreams and always supported me at every step of the life. Her love and guidance continue to inspire me. I dedicate this book to her, as a gratitude for her unwavering belief in my potential. Her memory will forever be cherished.

About the Author

Chetan Walia is a senior techno-functional leader and Technology Advisor with over 24 years of experience in Cloud Computing, Digital Transformation, and IT Modernization. He has a proven track record of delivering successful business outcomes through technology innovation, with expertise in Cloud Computing, Digital Transformation, Application Modernization, Telecom Domain, and Financial Planning.

Chetan is an expert in Delivery Management, pre-sales, and client engagement. He has successfully delivered complex Cloud Migration and Digital Transformation programs worth over USD 100 million, and his client portfolio includes Microsoft, AT&T, Amazon Web Services, and more. He is a sought-after speaker, thought leader, and author, with a reputation for grasping the big picture and developing solutions that achieve results.

Chetan has led pre-sales, scoping, and solution-framing sessions and formulated and implemented design principles to strengthen cybersecurity. He has extensive experience in Cloud consulting to build Vision, Strategy, Architecture, and Roadmap.

Chetan's delivery experience includes driving Enterprise Cloud Transformation at Scale, devising and facilitating the biggest Azure Cloud Migration, and establishing Managed Services engagement. He has managed accounts for leading companies in North America, Latin America, and the Asia Pacific regions.

In his personal life, Chetan is a passionate traveler who enjoys exploring the far corners of the world. He is an accomplished photographer with self-published coffee table books based on his own expeditions. He is also passionate about mountains and has experience in high-altitude trekking and mountain-biking.

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Karthikeyan Shanmugam is an experienced Solutions Architect professional with about 22+ years of experience in the design & development of enterprise applications across industry domains. Currently he is working as Senior Solutions Architect at Amazon Web Services where he helps customers build scalable, secure, resilient and cost-efficient architectures on AWS. Prior to that, he has worked in companies like Ramco Systems, Infosys, Cognizant and HCL Technologies.

He is author of Kubernetes book ' **IoT Edge computing with MicroK8s**' published with Packt. His specializations include cloud, cloud-native, containers and container orchestration tools such as Kubernetes, IoT, digital twin and microservices domains and has obtained multiple certifications from various cloud providers.

He is also contributing author in leading journals such as InfoQ, ContainerJournal, DevOps.com, TheNewStack & Cloud Native Computing Foundation (CNCF.io) blog.

His articles on emerging technologies (includes Cloud, Docker, Kubernetes, Microservices, Cloud-native development, etc.) can be read on his blog upnxtblog.com.

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To all those mentioned above and to those who have been there for me, I am truly grateful. Thank you all from the bottom of my heart.

Preface

Microservice architecture is at the heart of cloud-native application architecture, and it has become a crucial tool for companies deploying cloud-based applications. Microservices-based cloud applications are becoming increasingly popular, and enterprises are looking for experienced architects, and DevOps experts who can build, run and develop them. In this book, you will learn how to break down a monolith, create microservices, overcome challenges, and strategize for cloud adoption. '**Mastering Cloud-Native Microservices**' is a guide to help you understand design and implementation steps using industry best practices and design patterns. In a practical case study approach, we will review challenges and solutions faced while identifying and implementing Cloud-native Microservices design patterns.

In this book, readers will learn how to break down a monolithic application into smaller, independent microservices, which can be developed and deployed separately. One of the key benefits of microservices-based cloud applications is that they are designed to take advantage of the elasticity, resiliency, and flexibility of the cloud. The book explores how microservices-based cloud applications can achieve these goals, and provides readers with a comprehensive understanding of the cloud-native concept.

The book is written in an example-driven approach, which makes it easier for readers to understand complex concepts. The book includes case studies that demonstrate how microservices-based cloud applications can be used in real-world scenarios, and provides readers with practical guidance on how to develop and deploy these types of applications.

Key Features:

Comprehensive Coverage: The book covers a wide range of topics related to cloud-native microservices adoption, including modern application design principles, microservice adoption frameworks, design patterns for microservices, cloud-powered microservices, inter-service communication, event-driven data management, the serverless approach, security by design, and cloud migration.

Case study-based approach: The book uses case studies to provide real-world examples of microservices implementation and best practices. This approach helps readers understand how to apply the concepts to their own projects.

Practitioner View: The book provides a practitioner's perspective on cloud-native microservices adoption, making it useful for solution architects, solution experts, pre-sales, and techno-functional roles. It helps readers to understand the challenges and benefits of adopting cloud-native microservices, and how to apply these principles in real-world scenarios.

This preface provides an overview of the chapters you will explore throughout this book, offering a glimpse into the valuable knowledge and insights you will gain.

Chapter 1: Cloud-Native Microservices- In this chapter, we delve into the world of cloud-native microservices, discussing their adoption in modern application architecture. We explore key principles, challenges, and the adoption framework for cloud-native microservices. Five industry success stories demonstrate the transformative power of cloud-native microservices.

Chapter 2: Modern Application Design Principles- The Chapter focuses on the design principles necessary for building resilient, scalable, and performant modern applications. We delve into the Twelve-Factor App methodology and explore design principles for availability, observability, security, and more.

Chapter 3: Microservice Adoption Framework- This chapter provides a structured approach to adopting microservices, covering strategies for breaking down monolithic applications, designing microservices, and building resilient systems. We explore enabling technologies such as Docker and Kubernetes, emphasizing the importance of technology adoption and DevOps processes.

Chapter 4: Design Patterns for Microservices- This chapter delves into essential design patterns for microservices, including integration, database management, observability, and cross-cutting concerns. By understanding and implementing these patterns effectively, you can build scalable and maintainable microservices that meet modern application architecture requirements.

Chapter 5: Cloud-Powered Microservices- In this chapter, we explore the powerful combination of microservices and cloud services. We discuss key design patterns that enhance the capabilities of cloud-powered microservices, such as data management, design and implementation, messaging, and reliability.

Chapter 6: Monolith to Microservices Case Study- The Chapter takes a deep dive into the practical aspects of transitioning from a monolithic architecture to microservices. It explores the challenges faced by legacy systems and provides

effective strategies for updating them. The chapter also covers successful database migration and showcases case studies of practitioners who have implemented microservices.

Chapter 7: Inter-Service Communication- In this chapter, the core concepts are of inter-service communication in microservices architecture. It covers different communication models, including synchronous and asynchronous communication, event-driven communication, and service mesh. The chapter highlights the importance of effective communication patterns for building complex microservices architectures.

Chapter 8: Event-Driven Data Management- The Chapter provides an in-depth discussion of event-driven data management for microservices. It explores technologies like event sourcing and CQRS, event-based data replication, validation, integration, access control, and lineage. The chapter explains how event-driven architectures enable communication between decoupled services and how events can be used to implement business transactions.

Chapter 9: The Serverless Approach- The Chapter explores the serverless approach to microservices development. It covers serverless architecture, frameworks, function-as-a-service platforms, edge computing, monitoring and logging, security, and best practices for serverless microservices development. The chapter showcases case studies of successful serverless microservices implementations.

Chapter 10: Cloud Microservices - Security by Design - The Chapter focuses on building secure microservices through a security-by-design approach. It covers practices for authentication, communication, and data security, container security, monitoring, compliance, infrastructure security, threat detection, and continuous security monitoring. The chapter addresses common security concerns and provides guidance on ensuring the confidentiality, integrity, and availability of microservices-based architectures.

Chapter 11: Cloud Migration Strategy- The Chapter serves as a comprehensive guide to the cloud migration journey. It covers the goals, principles, strategy, and lifecycle stages of cloud migration. The chapter provides an overview of the assessment, planning, design, execution, testing, cutover, and post-cutover stages, highlighting best practices for a successful migration.

I hope that this book will serve as a valuable resource, equipping readers with the knowledge and practical guidance needed to adopt and implement microservices successfully. Each chapter aims to provide in-depth insights, real-world examples, and best practices to ensure a comprehensive understanding of microservices architecture and its related concepts.

Let's embark on this exciting journey into the world of microservices and discover the immense potential it holds for modern application development.

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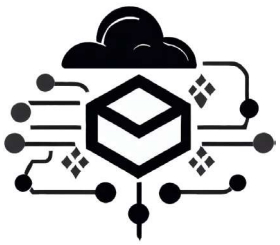

CHAPTER 1
Cloud-Native Microservices

Innovate at Scale with Cloud-Native Microservices

Introduction

Microservices have gained popularity due to their agility and cloud adoption readiness. The combination of microservices and cloud computing has become a key in enterprise architecture, and enterprises continue to reap the benefits of cloud computing. This chapter will cover the industry trends (with short case studies) and how Cloud-native Microservices adoption helping next generation applications. We will discuss the biggest challenges faced by organization when adopting microservices right from culture to technical complexity. Best practices to resolve these challenges and to have a seamless cloud adoption and microservices architecture implementation will be covered throughout this book.

- *According to Technavio the cloud microservices market share is expected to increase by USD 1.59 billion from 2021 to 2026, and the market's growth momentum will accelerate at a CAGR of 25.1%.*
- *According to the Microservices Architecture Market Research Report the Microservices Architecture industry is projected to grow from USD 5.49 Billion in 2022 to USD 21.61 Billion by 2030, exhibiting a compound annual growth rate (CAGR) of 18.66% during the forecast period (2022 – 2030).*
- *According to the 2021 Cloud Native Computing Foundation (CNCF) survey, 92% of respondents reported that they use containers in production, up from 84% in 2020.*

The Cloud Microservices market is growing worldwide, and that is no secret anymore. A large number of companies are upgrading their product portfolios so that they are not only cloud-ready but cloud-native with microservices architecture. The trend is in favour of cloud-native microservices, and organizations that move quickly will have an advantage. There have been tremendous success stories across all industry verticals, including retail and e-commerce, healthcare, telecom/media and entertainment, BFSI, government, and manufacturing. Certainly, there are challenges with respect to investment OPEX/CAPEX, Competitor Landscape, Timelines, ROI for such migrations and modernizations. It is very important for a company to comprehend all the aspects including the risk involved in order to strategize better. Therefore, the key question we should ask yourself would be:

"Cloud-native Microservices" Is it the right choice for your next application?

Companies have shifted from bare-metal infrastructures and monolithic architectures to microservices and container-based architectures in today's fast-paced environment. A better, more flexible, and scalable way to work is being established with cloud native microservices. Organizations can add new application components without revising entire applications or waiting for a release window. In other words, we are able to create new microservices quickly to achieve better results.

In this book, we will examine all aspects of cloud-native microservices, including scalability, flexibility, and resilience. By breaking down applications into small, loosely-coupled services that can be developed, deployed, and scaled independently, cloud-native microservices architecture can help organizations deliver applications faster and with greater reliability. However, adopting cloud-native microservices requires a significant shift in application development, deployment, and management practices, and may not be the best choice for every application. It is imperative to evaluate your specific needs and goals before making a decision. The purpose of this book is to provide you with the right tools, knowledge, and resources to plan, build and implement an optimal roadmap for your business.

Structure

In this chapter we will discuss following topics:

- Understanding the cloud native microservices
- Adopting cloud-native microservices
- Capability maturity level model
    - **Focus area:** People, Process and Knowledge to achieve End-to-end accountability

    - **Focus area:** Technology and Design Maturity for enabling Zero-touch operations
- Play Book for cloud-native microservices adoption
- Key principles of microservices
- **Short case study 01:** Snap on AWS
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- The biggest challenges with microservices adoption
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- **Short Case Study 05:** IMDb Video Team Builds Strategies for the Future
- Conclusion

Objectives

The purpose of this chapter is to provide you with an overview of the 'Cloud-Native Microservices' adoption framework and why it's the right choice for your next application. To bring the focus back to the three pillars of any transformation, we will discuss the capability maturity level model I devised. We will also talk about how we can move to the next level, whether it's through people, process, or technology. We will discuss the Cloud-native Microservices adoption framework playbook for successful digital transformation in detail. We will be covering five industry success stories to understand the importance of Cloud-Native Microservices and how they can change the game.

Understanding the cloud native microservices

So the key question to start with would be "Is it the right choice for your next application or enterprise?". Rather than being a monolithic entity, cloud-native microservices architectures develop large applications using loosely coupled microservices. A microservice is a small, autonomous, self-contained software component, organized around a business domain, which allows each part to be easily monitored, tested, and updated without affecting the others, enabling greater speed and agility in business and operations.

For any organization to make it a right choice, it is important to develop a strategy with strong governance before moving forward in terms of guiding principles, migration/modernization goals, and business priorities. The technology stack, cloud provider, partners, tools, and so on will be determined by the core strategy and target business value.

In microservices, pieces of code are logically separated so that they can run independently with as few dependencies as possible. However, individual microservices can still communicate with one another and work together to create a complex application. Using self-contained microservices reduces dependencies and the need to coordinate changes across services. As a result, one failed service will have less impact on the entire application.

Containers go well with cloud native microservices and we must plan accordingly when defining a key strategy for such a transformation. The use of containers allows developers to work without constraints imposed by hardware components because they are software-only solutions. Microservices can be designed and tested independently, each performing a specific function.

Likewise, microservices also offer many advantages, but for a successful digital transformation, we need to look beyond technology. It is only through understanding current capability maturity levels and how to reach desired maturity levels encompassing people, process, and technology that we will be able to answer our main question: Is it the right choice for your next application? Let us start with the cloud adoption framework and capability maturity level model.

Adopting cloud-native microservices

Cloud adoption framework required to help clients/organizations build, migrate, modernize, operate, expand, and optimize their applications, infrastructure, data, and analytics in the Cloud. Technology upgrades are only one aspect of the business value equation, but delivering the right value is the key. Hence, we need to consider all aspects like people, process, and technology in our framework.

Next generation application and digital transformation requires industry leaders to rethink their business priorities, strategies, and operations to ensure continued success and value-based delivery. For example, as illustrated in *Figure 1.1:* Key drivers for Cloud-native Microservices adoption can be achieved through a planned adoption.