AWS Cloud Engineer Guide

Building scalable cloud solutions with AWS

Sizwe Molefe

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Dedicated to

The woman who raised me
and continues to inspire, my mother:
Joyce Fikile Vezi

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About the Author

Sizwe Molefe has been working in Information Technology for more than 14 years, having been in many roles in numerous projects as a technical point of contact, technical leader, project co-ordinator, project manager, and delivering projects. The projects delivered include but are not limited to SAP ERP Migrations, Microsoft Exchange, Active Directory, Database, and Cloud Migrations, and quite a few more others. Sizwe has worked for multi-international companies, the likes of MRI Systems, Zando a Jumia Group subsidiary, and Amazon. Currently, he is a Solutions Architect at Amazon Web Services. He is an Information Technology graduate and holds multiple AWS certifications. Furthermore, he is also an accredited AWS Redshift Subject Matter Expert. He also runs a research and consulting startup called Zuluchain, which has a primary focus on Blockchain and Web3.0 technologies. He is a Web3.0 enthusiast and actively participates in the Web3.0 community.

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About the Reviewer

Dhirendra Kumar is a Kubernetes cloud Architect, presently working in the USA with 20 years of experience in Kubernetes (certified) as a platform engineer. His interests include multi-cloud, hybrid-cloud, distributed systems, and security-oriented cloud engineering. He is currently focused on and working with cloud-native solutions and tools, including AWS, Kubernetes, and Terraform. He is also focused on Infrastructure as Code and monitoring the correct thing with tools such as Dynatrace, Prometheus, and ELK Stack, with a passion for automating everything and avoiding doing anything that resembles manual work.

I would like to thank my wife, *Geethashri Ananda*, and my parents for always supporting me and motivating me to contribute to society.

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I am grateful for my wife's (Luyanda) support as well as my two kids, Refiloe and Dithapelo.

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Last but not least, I would like to thank the readers who have shown interest in the contents of this book by purchasing it. Your support goes a long way.

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Preface

The journey to cloud computing can be an overwhelming and complex experience. This is especially true for companies that have had their IT infrastructure hosted on-premise for years. The idea of data migration and having data hosted in the cloud can sound daunting. In that sense, the cloud journey requires that one has a comprehensive understanding of the many cloud services that cloud service providers offer.

This book is designed as a guide on how to make use of the different AWS Cloud Services. Here, we focus on the core services that you will likely cross paths with in your AWS cloud journey. These services include EC2, S3, VPC, RDS, CloudFormation, and a lot more. These are some of the core services likely to be used in migration cases.

In the course of this book, you will gain knowledge on AWS Services and their key features. You will learn how to use each service, different use cases, and gain in-depth knowledge by performing knowledge checks on each chapter. The book will give you a theoretical idea on how to design a cloud infrastructure. You will also learn about the best practices of each service described and examples.

This book is intended for students pursuing IT/computer science, solutions architects, developers, and IT professionals who are new to the AWS cloud. This book will help them expand their horizon when it comes to AWS and improve their skills in building scalable and resilient environments on AWS.

With this book, you will gain the knowledge and skills to become a proficient AWS Cloud Engineer using critical AWS Services. I hope you will find it informative and helpful.

Chapter 1: Creating an AWS Environment – This chapter provides a comprehensive introduction to creating and managing an AWS environment. Here, we will cover key concepts that include setting up an AWS Account, using the Free Trial, Account Security best practices, installing AWS CLI and Boto3. This chapter also introduces key concepts and tools that will be expanded upon later, such as **Elastic Compute Cloud** (**EC2**).

Chapter 2: Amazon Elastic Compute Cloud – This chapter covers the introduction to EC2. This includes the definition and history of EC2, step-by step instructions on creating EC2 instances through the AWS Console, SDK, and CloudFormation. We will take the user through practical, hands-on guidance for setting up and managing EC2 instances, emphasizing best practices for security and data management. We will also introduce

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the key concepts and related AWS services that integrate with EC2, providing a solid foundation for readers to build upon in their cloud computing journey.

Chapter 3: Amazon Virtual Private Cloud - This chapter explores **Amazon Virtual Private Cloud** (**Amazon VPC**), a fundamental AWS service that allows users to create and manage their own virtual networks within the cloud. It emphasizes the core aspects of VPC, such as security, scalability, and customization, enabling users to build isolated, controlled network environments. The key topics covered include the configuration of IP address ranges, the creation of subnets, routing tables, and network gateways, alongside an exploration of the tools provided by AWS to secure and optimize cloud deployments. This chapter is essential for understanding how to maintain robust and flexible network architectures while leveraging the cloud's vast resources.

Chapter 4: Amazon S3: Simple Storage Service – In this chapter, we will explore Amazon S3, a fundamental AWS service that offers users object storage, a type of data storage. Here, the reader will understand the key concepts of S3, which include storage classes, S3 versioning, S3's high level of durability, scalability, and security, alongside the integration of S3 with other AWS services. Learning about these key topics will help the reader gain the necessary skills to fully utilize S3 as a storage service.

Chapter 5: Amazon API Gateway – This chapter provides the reader with a comprehensive overview of Amazon API Gateway. This also includes and covers API Gateway integration with Lambda functions. The key concepts covered include passing API keys to API Gateway, integrating Lambda functions with API Gateway, and deploying and invoking API endpoints. The readers will get to learn and understand with real-life scenarios the deploying and invoking of REST API endpoints and building serverless applications using API Gateway.

Chapter 6: AWS Database Services – This chapter provides a high-level understanding of the various AWS Database Services and explores the key concepts of database administration and monitoring. The readers will learn about the numerous advantages of AWS RDS, a fully managed relational database service that simplifies the process of setting up, operating, and scaling relational databases in the AWS cloud. This chapter also allows the user to learn about DynamoDB, a fully managed, highly scalable, and high-performance NoSQL database service that provides consistent, single-digit millisecond latency at any scale. The readers will also learn about Amazon Aurora, a fully managed, high-performance, and cost-effective relational database service compatible with MySQL and PostgreSQL.

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Chapter 7: Elastic Load Balancing and Auto Scaling – In this chapter, the readers will explore two powerful services provided by AWS that are essential for building scalable and highly available applications: **Elastic Load Balancing** (**ELB**) and Auto Scaling. We will cover key concepts for each service, which for ELB include features and benefits (scaling, load distribution, health checks, sticky sessions, and more) and configuring ELB (defining listener rules, creating target groups, and configuring routing). For Auto Scaling, the readers will learn about automatically adjusting the capacity of infrastructure based on application demand and how this helps with optimal performance.

Chapter 8: Amazon Route 53 - The readers will learn about the fundamental AWS service known as Route53. This is a highly scalable and reliable **Domain Name System** (**DNS**) service offered by AWS. The readers will learn about the Route53 services, which is more than just translating domain names to IP addresses. They will also learn and understand the advanced routing policies, traffic management options, implementing health checks and failover configurations, managing domain registration and settings, integrating Route 53 with other AWS services, and many more.

Chapter 9: Decouple Applications – This chapter will provide a fundamental approach to designing and building modern, scalable, and flexible systems. It involves separating components and minimizing dependencies to achieve a loosely coupled architecture. The readers will explore the AWS services, which include AWS Lambda, Amazon SQS, Amazon SNS, Amazon Kinesis, and others. They will learn how data can be managed independently from application logic, providing the freedom to scale and evolve data-intensive applications.

Chapter 10: CloudFormation – In this chapter, we will explore the capabilities and the benefits of AWS CloudFormation, a service that allows users to automate and manage their AWS infrastructure in a scalable and efficient manner. The readers will learn key concepts that take them through fundamental concepts such as templates, stacks, resources, and parameters. Templates are the JSON or YAML files that define the desired state of the users' AWS resources. We will also take the readers through the various methods of deploying CloudFormation templates. Additionally, this chapter will provide hands-on examples and walkthroughs to demonstrate the practical application of CloudFormation.

Chapter 11: AWS Monitoring – This chapter will explore the critical AWS services used for monitoring. We will focus primarily on Amazon CloudWatch, which is the central monitoring. Additionally, we will explore other essential monitoring services like AWS CloudTrail and AWS Config, which offer visibility into API activity and resource

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configuration changes. We will also look into the key features of these products, practical examples, and step-by-step instructions to help readers effectively leverage the AWS monitoring services

Chapter 12: AWS Security and Encryption – Security is paramount in the cloud, and at AWS, security is one of the highest priority topics when it comes to services offered. In this chapter, the readers will cover AWS Security and Encryption, focusing on various objectives that are pivotal in securing AWS environments. The key security concepts covered in this chapter include IAM, KMS, SSM, Secrets Manager, CloudHSM, Shield, WAF, GaurdDuty, Inspector, and Macie.

Chapter 13: AWS Containers – In this chapter, we will explore the concept of AWS Container Service. The readers will learn about Amazon ECS and Amazon EKS. We will uncover how these services empower organizations to orchestrate and deploy containers at scale. The readers will also discover AppRunner, a service catered to accelerate code to scalable web applications. By the end of this chapter, they will gain the knowledge and insights needed to embrace the container revolution and harness the full potential of this transformative technology.

Chapter 14: Automating Deployments with CI/CD in AWS – This chapter looks into the world of DevOps and is designed to help the reader gain insights into the rise of agile methodologies. We will start by exploring core CI/CD concepts more deeply, including the differences between continuous integration vs. delivery vs. deployment. The readers will also learn about CI/CD in the context of Kubernetes and containerized applications, followed by demonstration patterns leveraging Docker, Kubernetes concepts, and AWS container tools. We will provide guidelines, best practices, and troubleshooting advice gleaned from real-world experience with CI/CD in AWS across various applications and teams.

Chapter 15: AWS Cloud Migrations – In this chapter, we will discover the various fundamental AWS Services that play a major role in migration to the cloud. These services include but not limited to AWS **Database Migration Service** (**DMS**), a specialized tool for replicating on-premises databases to AWS with minimal downtime. We will explore AWS DataSync, a software-based transfer acceleration tool optimized for Nas, filesystems, and S3. The readers will learn about the methodical cloud migration components, which include components, dependencies, waves, and landing zones. They will also gain comprehensive technical knowledge and strategies required to migrate organizations to the AWS cloud successfully.

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