Microsoft Azure

Planning, Deploying, and Managing the Cloud

—

Second Edition

—

Julian Soh
Marshall Copeland
Anthony Puca
Micheleen Harris

Apress®

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Thank you to my family—Priscilla, Jasmine, and Makayla—for their continued support and all the great people I have had the honor to learn from, especially my co-authors and friends—Marshall Copeland, Anthony Puca, and Micheleen Harris. I also dedicate this book to those using technology to make the world a better place.

—Julian

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—Marshall

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—Anthony

Thank you to Rob Callaway, my fiancé, for always providing support and encouragement to keep me going—looking forward to our life together. Thank you to Marie and Steve Harris, my parents, for setting me down the road of science. Thank you to Rachelle Moore, Jessica Faulkner, Jennifer Flannery, and Jeremy Reynolds for your friendship and support. A big thanks to the reviewers, especially Priyanshi Singh, for their excellent work. Thank you to Apress and especially, Shrikant Vishwakarma, for all the tireless guidance and getting us to the finish line. Last, but not least, thank you to my co-authors—Julian Soh, Marshall Copeland, and Anthony Puca—for the partnership and amazing support.

—Micheleen

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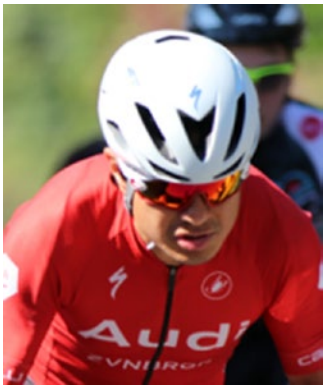
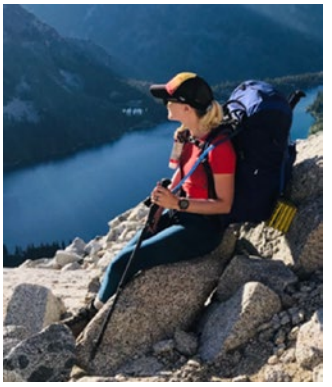
About the Authors



Julian Soh is a solutions engineer and works at Microsoft, where he helps customers incorporate AI into software solutions, adopt modern data strategies, and use advanced analytics. A mechanical engineer by training with a background in information science, his career has primarily been in IT working with public, private, and nonprofit organizations in the United States and Asia. Find him at https://juliansoh.github.io/ and on LinkedIn at www.linkedin.com/in/juliansoh.

Marshall Copeland is a Microsoft Alumni cloud security architect focused on cyber defenses in public cloud architecture using both cloud-native services and third-party risk management solutions. His work focuses on application and network security in hybrid deployments, secure Kubernetes design, and cloud security blueprints for training teams to enhance "blue team hunting" in the cloud. Find him on LinkedIn at www.linkedin.com/in/marshallcopeland/.

Anthony Puca is a director of Azure apps and infrastructure in Microsoft's US Federal Government division. Anthony has been consulting with US federal government departments and agencies on private, public, and hybrid cloud technologies for the last three years.



Micheleen Harris is a data scientist and technical program manager at Microsoft, where she focuses on AI and machine learning. She has been a developer for over ten years and was a bioinformatician before that. With a passion for learning, she has designed and delivered many courses and given workshops and talks at large conferences, such as Microsoft /build and ODSC West. She is the co-founder of the Seattle Artificial Intelligence Workshops meetup. Her personal website is `https://michhar.github.io`, and she can be followed on Twitter at @rheartpython.

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Kurtis Carlson is an independent consultant helping businesses migrate their mission-critical applications to Azure and apply governance across the organization's portfolio of applications. He also helps developers and operations teams modernize applications and practices using Azure DevOps and infrastructure as code. His IT career includes working for San Francisco–based companies like Visa International and First Republic Bank, as well as local government agencies.

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Daren Child is a lifelong data professional with experience as a data architect in Fortune 100 companies, world financial organizations, and research organizations. Daren joined Microsoft as a government data architect in 2016. Since then, he has been involved in data transformation and aiding government organizations with developing a data culture. Daren is a fan of storage-based data access patterns and has taken on a personal initiative to revive enterprise data warehouses across US government organizations.

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Introduction

Since the launch of the first edition of this book in 2015, Microsoft Azure, and cloud computing in general, has come a long way. This second edition is completely rewritten and updated, with more than 70% of the book containing brand-new topics and trends. In the first edition, we focused on managing a data center in the cloud, as reflected by the subtitle we chose at that time. Since then, Microsoft Azure is more than just your data center in the cloud. It is where you adopt advanced technologies like artificial intelligence (AI), Internet of Things (IoT), and machine learning, and handle vast amounts of data to help make data-driven decisions. With the focus on these new capabilities in Microsoft Azure, this second edition is all about adopting the intelligent cloud.

There are many resources online and by other authors that focus on all the topics covered in this book. But we found that there is a lack of updated material that goes into more than just an introduction of all the main technologies in Microsoft Azure. Thus, we wanted a book that ambitiously strives to give readers a strong foundation in all the important aspects of Microsoft Azure. If you are new to Microsoft Azure and cloud computing in general, Parts I and II of this book should give you a solid overview of Azure's capabilities and the business and environmental trends, including planning and adopting strategies. For the more seasoned readers, Parts III through VII cover the different categories of Azure services (IaaS, PaaS, data, cloud-based software development, and AI/ML). Although we tried to build the hands-on exercises in such a way that they are interrelated throughout the book, you can read any part in any order and still gain the benefits of the content without getting lost.

Due to the rapidly changing nature of technology, we have also incorporated a GitHub repository that is dedicated to updating the hands-on exercises and provide more content than we were able to fit within the physical constraints of these pages. We hope that you benefit greatly from this book as much as we enjoyed working on it. We wish you all the best in your quest for knowledge and making a difference in technology.

PART I

Introducing Microsoft Azure

CHAPTER 1

Microsoft Azure and Cloud Computing

Cloud computing as a platform does not require a review; however, the hundreds of new services and updated changes to the Microsoft Azure public cloud can be a great investment for your business. Updated Azure core services and new business services are explained in this book to further your knowledge. This book was written for both technical and business readers to gain greater skills through our guidance.

This book is updated in its second edition. We know that reader commitment goes beyond the cover price; it is spent in the value of your time learning. You cannot afford to waste one hour, so we are dedicated to earning your commitment on every page and in every chapter by providing you the most timely and updated guidance on Microsoft Azure services. We provide guidance and information to help you understand the details and completed code in the book as well as additional examples on the public GitHub location.

Note All the code for the software-defined infrastructure (both Microsoft Azure ARM templates and HashiCorp Terraform) can be downloaded at https://github.com/harris-soh-copeland-puca.

In this chapter, you learn about many new features and best-in-cloud improvements that are integrated and deployed through various methods in the Azure platform. This chapter is written as a high-level introduction to updated features that have been greatly enhanced or are new to the platform. The other chapters provide in-depth information on topics, to provide guidance and configuration.

J. Soh et al., *Microsoft Azure*, https://doi.org/10.1007/978-1-4842-5958-0_1

Where Is Microsoft Azure Today?

One of the challenges for technical readers may be having expertise in other cloud solutions and relating to Microsoft Azure terminology. You are first guided through Azure services and cloud products to identify a cloud service, and then in later chapters, we provide a deeper look at how to create, deploy, and manage that service. Azure services are continuously updated, and you need to understand the details to enable technologies to support your business and leverage updated Azure platform services. The market drives features that benefit business revenue, and cloud computing customers are requesting continuous innovation from Microsoft.

The Microsoft Azure additions have grown out of teams that expand beyond the Redmond campus to include global collaboration with businesses, customers, universities, and governments to expand Microsoft Azure services. The incorporated feedback provides a road map that, like software development, leverages a CI/CD (continuous integration/continuous deployment) pipeline. Azure services and resources change and adapt much more rapidly than traditional on-premises software deployment cycles.

The information provided is written with the intent to eliminate unnecessary acronyms. Some are unavoidable, and many are overused in online documentation. Depending on your business role, some acronyms are indispensable and are used in more than one workflow, and if you are skimming information, it can be confusing. For example, SDLC (software development life cycle) is used in Agile delivery conversations. If the topic also includes cybersecurity, then SDLC means *security development life cycle*.

Agile is a term used in software development conversations; it is not an acronym but a process for delivering software in a short schedule. Another example is continuous integration/continuous deployment (CICD or CI/CD). It is a term that is used in more than software delivery; for example, Azure documentation is updated on GitHub and delivered directly to websites.

Note This chapter provides an overview of many of the fundamental Azure features with additional chapters providing deep dives and guidance.

Azure Availability

Azure has an infrastructure that is geographically identified globally, regionally, and by zone. Azure regions are based on countries and broken into geographies. This is important because specific regions have failover availability and services that are available in a region. Not all services are available in all regions across the globe.

Azure regions are several datacenters deployed within a perimeter. They provide low network latency for communication within those regions and inside those datacenters. Many of the datacenters' physical buildings are aligned together as one location; they are described as a *datacenter campus* in some documentation. An entire datacenter can failover for another datacenter in the Azure region. Some of the Azure regions (in the United States, for example) are identified as Central US or East US in the Azure public cloud.

A Microsoft Azure region supports at least two physically separate locations that preserve data within a specific compliance boundary. *Geographies* allow customers to maintain data inside known locations by geographic boundaries. Geographic boundaries are connected using dedicated low-latency networks and include regions in the United States and around the globe, but it is more apparent when you look at geographic regions in Europe. For example, Azure regions in Europe include North Europe and West Europe, which support each other to provide high availability; likewise, North Germany and West Germany specifically maintain data inside Germany's borders.

Azure availability zones include at least two Azure regions, which are physically separated by hundreds of miles to support more than one location for high availability. The datacenter equipment includes redundant power, redundant cooling, and redundant network connectivity. High availability requires an architecture that considers both *infrastructure as a service* (IaaS) and *platform as a service* (PaaS). High availability does not include backup and recovery, which is included in the architecture for disaster recovery processes.

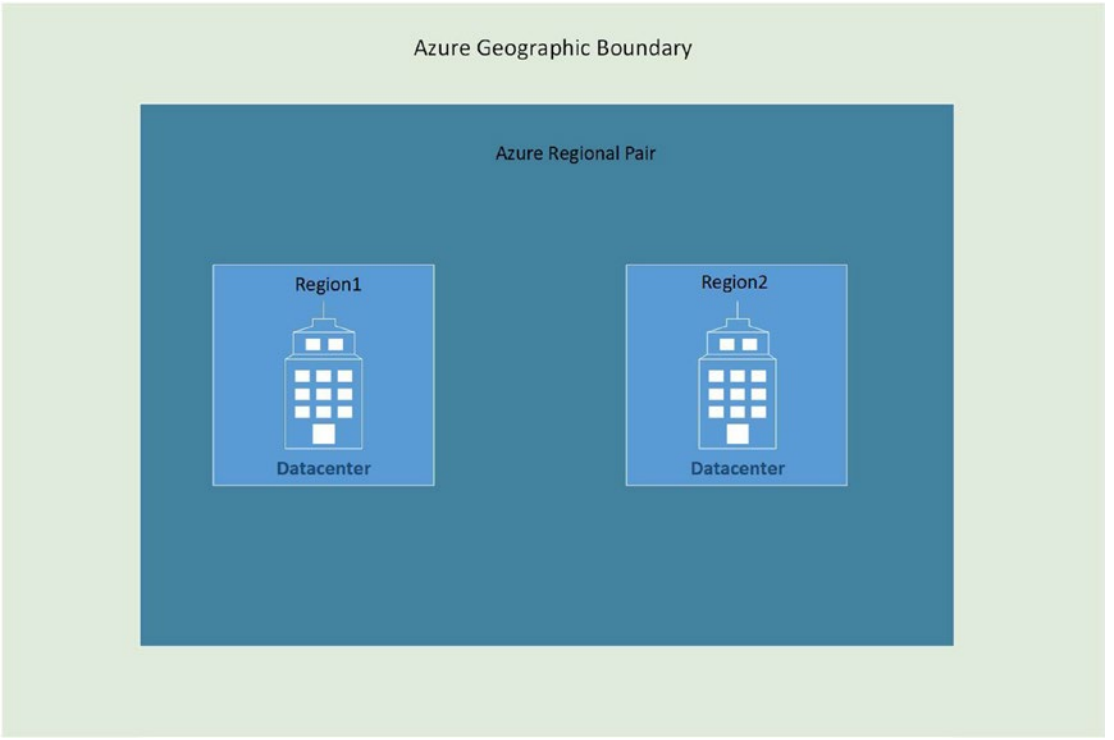

Figure 1-1. *Azure geographic boundary with regional pairs*

For the Azure Government cloud, we use USDOD central or USDODE. Other regions support both the US public cloud and the US Azure Government clouds. To learn more about the Azure regions across the United States, Europe, and Asia, go to `https://azure.microsoft.com/is-is/global-infrastructure/geographies/`.

Azure Government is significantly different from other cloud services providers because it specifically addresses technical and mandatory regulatory requirements, such as

- FedRAMP
- FISMA
- FBI Criminal Justice Information Systems (CJIS)

Often, these government-specific requirements make it difficult for cloud services providers to scale up. Also, special SLAs (service-level agreements) and compliance requirements can cause providers to be penalized for noncompliance. For example, the FBI CJIS requires that a cloud service provider's personnel be background-checked and fingerprinted.

The Azure Government cloud was the first cloud to be consistent with the 13 areas defined in the CJIS security policy.

Note Standards apply to all customers using Azure cloud, Public or Government. Microsoft datacenter personnel are background-checked and fingerprinted, the same personnel are responsible for the service. Standards such as CJIS apply to all customers using Azure Government. Use the contact email cjis@microsoft.com for information on which services are currently available in specific states across the United States.

The Azure SLA for availability Each Microsoft Azure service has an SLA based on the region the service is available in. The most up-to-date SLA information is available at https://azure.microsoft.com/en-us/support/legal/sla/. The Azure SLA for availability zones offers 99.99% virtual machine (VM) uptime.

Azure Compliance

Azure maintains more than 90 compliance certifications, which include ones that specifically support regions and countries. These certifications are built to meet industry standards for IT and cloud-computing services. Azure's industry-recognized certifications are at https://docs.microsoft.com/en-us/microsoft-365/compliance/offering-home?view=o365-worldwide.

Figure 1-2. *Azure compliance offerings*

Certifications govern Azure's suitability for specific industry use, and they form the basis of customer trust. Third-party auditors, who are recognized by certification bodies, independently verify each certification. There is also a requirement for recertification and periodic audits to ensure compliance with all certifications.

Microsoft is a member of the advisory committee for many certification bodies, and it provides feedback and recommendations on proposed changes. Microsoft has visibility in many upcoming changes, which allows them to incorporate changes in the Azure platform in a timely manner.

Microsoft Azure Subscriptions

An Azure subscription is a large collection of services in your Azure account for identifying, controlling, and providing governance of those resources. Azure Active Directory is used in the provisioning of resources through ARM being able to use the role-based access control applied to specific resources. There are several ways to purchase an Azure subscription.

- Free trial
- Pay as you go
- Visual Studio MSDN (testing only)
- Microsoft resellers
- open license platform plus
- Microsoft enterprise account agreements

Azure role-based administration allows user and machine accounts access to resources in your Azure subscription; however, at a high level, there are administrative roles that are limited to the number of roles per subscription. Before we take a deeper dive into administration accounts, a few definitions need to be reviewed.

The term *Azure resource* designates an entity or an intelligent object that is managed by Azure. Simple examples are a virtual network (VNet), a storage account, or a virtual machine (VM). All three are Azure resources; they are not Azure services.

An *Azure service* is an automated deployment of a VM, VNet, or storage account.

An *Azure resource group* allows the grouping of resources that have the same life cycle and security requirements. Like individual services, a resource group can assign privileged access to multiple Azure roles.

Note One Azure account can have multiple Azure subscriptions associated with it.

An Azure subscription name is limited to a maximum of 64 characters, and the name cannot be changed. It is an important planning decision for administrative roles support for your Azure subscription.

Note Be aware the person who completes the Azure subscription sign up wizard is assigned the Global Administrator role.

It is important to realize that a Global Administrator and a Privileged Role Administrator can delegate administrator roles to other users in Azure AD. Table 1-1 provides key roles for Azure subscription users to consider for management and to support security needs, such as separation of duties.

Table 1-1. *Azure Account Roles, Limits, and Descriptions*

Admin Role	Limit	Description
Account Administrator	1/Azure account	Access to the Account Center
Service Administrator	1/Azure subscription	Access all subscriptions through the Azure management portal
Co-Administrator	Unlimited/Azure subscription	Cannot change permissions of Azure subscriptions
Global Administrator	1/Azure account	Read and modify every administrative setting in Azure AD

There is one Account Administrator per Azure subscription; this role authorizes and creates additional accounts for access to a subscription. This account allows you to change billing information and services administration. There is one Service Administrator account per Azure subscription, and it authorizes management access to the management portal for subscriptions. In a subscription, the Co-Administrator account is unlimited.