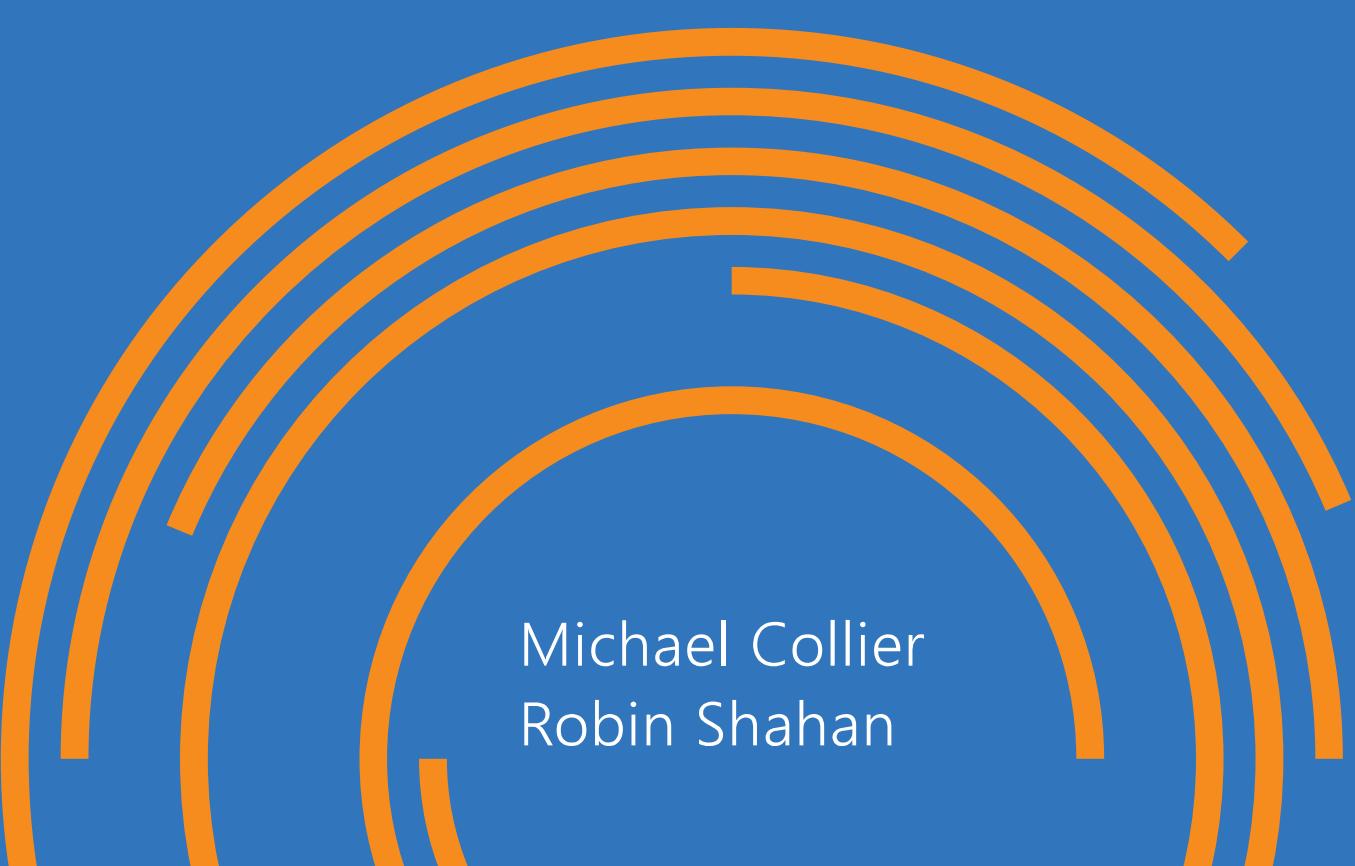




Fundamentals of Azure

Second Edition

Microsoft Azure Essentials



A large, stylized graphic element in the background consists of several concentric arcs. The outer arcs are orange, and the inner arcs are blue. The arcs are slightly broken, creating a sense of motion or depth. The entire graphic is set against a solid blue rectangular background.

Michael Collier
Robin Shahan

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To my wife, Sonja, and sons, Aidan and Logan; I love you more than words can express. I could not have written this book without your immense support and patience.

—Michael S. Collier

I dedicate this book to the many people who helped make this the best book possible by reviewing, discussing, and sharing their technical wisdom. I especially want to mention Neil Mackenzie, who is always willing to share his encyclopedic knowledge of Azure with me, and whose tech reviews were incredibly helpful. I'd also like to mention Jennelle Crothers, without whom networking would be a complete mystery to me.

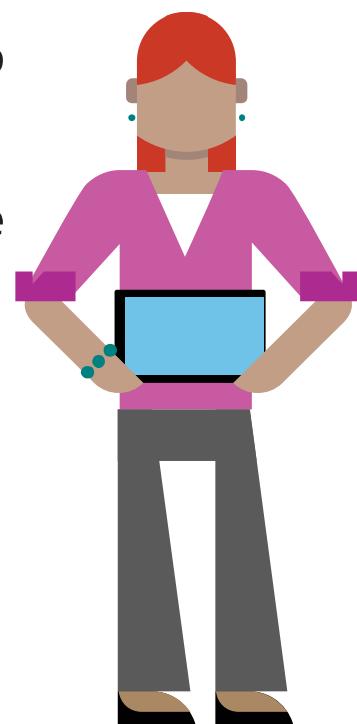
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Introduction

Microsoft Azure is Microsoft's cloud computing platform, providing a wide variety of services you can use without purchasing and provisioning your own hardware. Azure enables the rapid development of solutions and provides the resources to accomplish tasks that may not be feasible in an on-premises environment. Azure's compute, storage, network, and application services allow you to focus on building great solutions without the need to worry about how the physical infrastructure is assembled.

This book covers the fundamentals of Azure you need to start developing solutions right away. It concentrates on the features of the Azure platform that you are most likely to need to know rather than on every feature and service available on the platform. This book also provides several walkthroughs you can follow to learn how to create VMs and virtual networks, websites and storage accounts, and so on. In many cases, real-world tips are included to help you get the most out of your Azure experience.

In addition to its coverage of core Azure services, the book discusses common tools useful in

creating and managing Azure-based solutions. The book wraps up by providing details on a few common business scenarios where Azure can provide compelling and valuable solutions, as well as a chapter providing overviews of some of the commonly used services not covered in the book.

Who should read this book

This book focuses on providing essential information about the key services of Azure for developers and IT professionals who are new to cloud computing. Detailed, step-by-step demonstrations are included to help the reader understand how to get started with each of the key services. This material is useful not only for those who have no prior experience with Azure, but also for those who need a refresher and those who may be familiar with one area but not others. Each chapter is standalone; there is no requirement that you perform the hands-on demonstrations from previous chapters to understand any particular chapter.

Assumptions

We expect that you have at least a minimal understanding of virtualized environments and virtual machines. There are no specific skills required overall for this book, but having some knowledge of the topic of each chapter will help you gain a deeper understanding. For example, the chapter on virtual networks will make more sense if you have some understanding of networking, and the chapter on databases will be more useful if you understand what a database is and why you might use one. Web development skills will provide a good background for understanding Azure Web Apps, and some understanding of identity will be helpful when studying the chapter on Active Directory.

This book might not be for you if...

This book might not be for you if you are looking for an in-depth developer or architecture-focused discussion on a wide range of Azure features, or if you are looking for details on other public or private cloud platforms.

Organization of this book

This book explores six foundational features of the Microsoft Azure platform, along with insights on getting started with Azure, management tools, and common business scenarios. This book also includes a chapter with overviews of some of the more commonly used services, such as HDInsight (Azure's Hadoop service) and Service Bus, but there are many services in the Azure platform that are not in the scope of this book, such as Azure Batch, Data Lake Analytics, and Azure DNS, just to mention a few. To learn about all of the services available in the Azure platform, start your journey at <http://azure.microsoft.com>. Also, there is a web application that shows the many services of Azure and allows you to drill down to learn more. See <http://aka.ms/azposterapp>.

The topics explored in this book include:

- **Getting started with Azure:** Understand what cloud computing is, learn about Azure Resource Manager and Role-Based Access Control, visit the management portals, learn about billing, find out how you can

contribute to the Azure documentation and code samples.

- **Azure App Service and Web Apps:** Learn about the Azure App Service, consisting of Web Apps, Logic Apps, Mobile Apps, API Apps, and Function Apps. We will focus on Web Apps and how they work with the App Service and App Service plans, covering the topic from deployment to monitoring and scaling.
- **Virtual Machines:** Explore the basic features of Azure Virtual Machines, including how to create, configure, and manage them.
- **Storage:** Read about the basics of Azure Storage, including blobs, tables, queues, and file shares, as well as some of the options available such as Premium Storage and Cool Storage.
- **Virtual Networks:** Learn the basics of virtual networks, including how to create one, and why a virtual network might be necessary. This also covers site-to-site and point-to-site networking, as well as ExpressRoute.
- **Databases:** Explore two relational database options available in Azure: Azure SQL

Database and SQL Server in Azure Virtual Machines.

- **Azure Active Directory:** Explore basic features of Azure AD, including creating a directory, users and groups, and using the application gallery.
- **Management Tools:** Explore three common tools for working with Azure: Visual Studio 2015 and the Azure SDK, Azure PowerShell cmdlets, and the Cross-Platform Command-Line Interface
- **Additional Azure services:** Get an overview about Azure services not covered in the book that may be fundamental to you now or in the future, such as Azure Service Fabric and Azure Container Service.
- **Business Scenarios:** Explore five common scenarios for utilizing Azure features: development and test, hybrid, application and infrastructure modernization, and Azure Mobile Apps, and Machine Learning.

Conventions and features in this book

This book presents information using conventions designed to make the information readable and easy to follow:

- To create specific Azure resources, follow the numbered steps listing each action you must take to complete the exercise.
- There are currently two management portals for Azure: the Azure portal at <https://portal.azure.com> and the Azure classic portal at <http://manage.windowsazure.com>. In most cases, the book uses the Azure portal, but the Azure classic portal may be used for those features that have not been migrated to the newer portal yet, such as Azure Active Directory.
- Boxed elements with labels such as “Note” or “See Also” provide additional information.
- A plus sign (+) between two key names means that you must press those keys at the same time. For example, “Press Alt+Tab” means that you hold down the Alt key while you press Tab.

- A right angle bracket between two or more menu items (e.g., File Browse > Virtual Machines) means that you should select the first menu or menu item, then the next, and so on.

System requirements

For many of the examples in this book, you need only Internet access and a browser (Internet Explorer 10 or higher) to access the Azure portals.

Chapter 2, "Azure App Service and Web Apps," and Chapter 4, "Azure Storage," use Visual Studio to show concepts used in developing applications for Azure. For these examples, you will need Visual Studio. The system requirements are:

- Windows 7 Service Pack 1, Windows 8, Windows 8.1, Windows 10, Windows Server 2008 R2 SP1, Windows Server 2012, or Windows Server 2012 R2
- Computer that has a 1.6GHz or faster processor (2GHz recommended)
- 1 GB (32 Bit) or 2 GB (64 Bit) RAM (Add 512 MB if running in a virtual machine)

- 4 GB of available hard disk space
- 5400 RPM hard disk drive
- DirectX 9 capable video card running at 1024 x 768 or higher-resolution display
- DVD-ROM drive (if installing Visual Studio from DVD)
- Internet connection

After installing Visual Studio, you must also install the Azure Tools and SDK for the language of your choice from
<https://azure.microsoft.com/tools/>.

The system requirements for the Azure SDK that are not included in the Visual Studio system requirements are as follows:

- IIS7 with ASP.NET and WCF HTTP Activation, Static Content, IIS Management Console, and HTTP Redirection
- Web Deployment Tools 2.1 or up
- Internet Explorer 10 or higher

Depending on your Windows configuration, you might require Local Administrator rights to install or configure Visual Studio 2015.

Downloads

Some of the chapters in this book include exercises that let you interactively try out new material learned in the main text. Chapter 4, “Azure Storage,” has PowerShell scripts; Chapter 5, “Virtual Networks,” has PowerShell scripts and a Resource Manager template. These can be downloaded from the following page:

<https://aka.ms/FundAzure2e/downloads>

Follow the instructions on the target page to download the code sample files.

Note To use the PowerShell scripts, you need to have Azure PowerShell installed. This article explains how to install and configure Azure PowerShell:

<https://azure.microsoft.com/documentation/articles/powershell-install-configure/>.

Using the code samples

The code samples are stored within a unique .ZIP file, “FundAzure2E.ZIP,” which can be downloaded to your computer and unzipped so that you can use them with the exercises in this book.

- Samples for Chapter 4, "Azure Storage," are in the Chapter4_PowerShellScripts folder in the ZIP file. This includes the PowerShell scripts for both Blob storage and File Storage. You can open, edit, and run these using the PowerShell ISE.
- Samples for Chapter 5, "Azure Virtual Networks," are in the folder "Chapter5_PowerShellScripts_And_Templates." This includes both the Resource Manager templates used to create and modify a virtual network and the PowerShell script used to create a point-to-site VPN Network. To use the Resource Manager templates, please follow the instructions provided in the chapter. You can open, edit, and run the PowerShell script with PowerShell ISE.

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The Azure community is made up of many people bound together by this one technology. We are honored to be members of this community, and we thank you for your help and support. We would like to especially thank Neil Mackenzie, Mike Wood, and Mike Martin, as well as Byron Tardif, Ashwin Kamath, and Rajesh

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Errata, updates, & support

We've made every effort to ensure the accuracy of this book. You can access updates to this book—in the form of a list of submitted errata and their related corrections—at:

<http://aka.ms/FundAzure2e/errata>

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Getting started with Microsoft Azure

The purpose of this ebook is to help you understand the fundamentals of Microsoft Azure so you can hit the ground running when you start using it.

With an Azure account, you can work through the demos in this book and use them as hands-on labs. If you don't have an Azure account, you can sign up for a free trial at azure.microsoft.com. If you have an MSDN subscription, you

can activate the included Azure benefits and use the associated monthly credit. You can also check out Purchase Options at <https://azure.microsoft.com/pricing/purchase-options/> and Member Offers at <https://azure.microsoft.com/pricing/member-offers/> (for members of MSDN, the Microsoft Partner Network, BizSpark, and other Microsoft programs).

What is Azure?

The following will give an overview of Azure, which is Microsoft's cloud computing platform.

Overview of cloud computing

Cloud computing provides a modern alternative to the traditional on-premises datacenter. A public cloud vendor is completely responsible for hardware purchase and maintenance and provides a wide variety of platform services that you can use. You lease whatever hardware and software services you require on an as-needed basis, thereby converting what had been a capital expense for hardware purchase into an operational expense. It also allows you to lease access to hardware and software resources that would be too expensive to purchase. Although you are limited to the hardware provided by the cloud vendor, you only have to pay for it when you use it.

Cloud environments provide an online portal experience, making it easy for users to manage compute, storage, network, and application resources. For example, in the Azure portal, a user can create a virtual machine (VM) configuration specifying the following: the VM size (with regard to CPU, RAM, and local disks), the operating system, any predeployed software, the network configuration, and the location of the VM. The user then can deploy the VM based on that configuration and within a few minutes access the deployed VM. This quick deployment

compares favorably with the previous mechanism for deploying a physical machine, which could take weeks just for the procurement cycle.

In addition to the public cloud just described, there are private and hybrid clouds. In a private cloud, you create a cloud environment in your own datacenter and provide self-service access to compute resources to users in your organization. This offers a simulation of a public cloud to your users, but you remain completely responsible for the purchase and maintenance of the hardware and software services you provide. A hybrid cloud integrates public and private clouds, allowing you to host workloads in the most appropriate location. For example, you could host a high-scale website in the public cloud and link it to a highly secure database hosted in your private cloud (or on-premises datacenter).

Microsoft provides support for public, private, and hybrid clouds. Microsoft Azure, the focus of this book, is a public cloud. Microsoft Azure Stack is an add-on to Windows Server 2016 that allows you to deploy many core Azure services in your own datacenter and provides a self-service portal experience to your users. You can

integrate these into a hybrid cloud through the use of a virtual private network.

Comparison of on-premises versus Azure

With an on-premises infrastructure, you have complete control over the hardware and software that you deploy. Historically, this has led to hardware procurement decisions focused on scaling up; that is, purchasing a server with more cores to satisfy a performance need. With Azure, you can deploy only the hardware provided by Microsoft. This leads to a focus on scale-out through the deployment of additional compute nodes to satisfy a performance need. Although this has consequences for the design of an appropriate software architecture, there is now ample proof that the scale-out of commodity hardware is significantly more cost-effective than scale-up through expensive hardware.

Microsoft has deployed Azure datacenters in over 22 regions around the globe from Melbourne to Amsterdam and Sao Paulo to Singapore. Additionally, Microsoft has an arrangement with 21Vianet, making Azure available in two regions in China. Microsoft has also announced the deployment of Azure to

another eight regions. Only the largest global enterprises are able to deploy datacenters in this manner, so using Azure makes it easy for enterprises of any size to deploy their services close to their customers, wherever they are in the world. And you can do that without ever leaving your office.

For startups, Azure allows you to start with very low cost and scale rapidly as you gain customers. You would not face a large up-front capital investment to create a new VM—or even several new VMs. The use of cloud computing fits well with the scale fast, fail fast model of startup growth.

Azure provides the flexibility to set up development and test configurations quickly. These deployments can be scripted, giving you the ability to spin up a development or test environment, do the testing, and spin it back down. This keeps the cost very low, and maintenance is almost nonexistent.

Another advantage of Azure is that you can try new versions of software without having to upgrade on-premises equipment. For example, if you want to see the ramifications of running your application against Microsoft SQL Server 2016 instead of Microsoft SQL Server 2014, you can create a SQL Server 2016 instance and run a

copy of your services against the new database, all without having to allocate hardware and run wires. Or you can run on a VM with Microsoft Windows Server 2012 R2 instead of Microsoft Windows Server 2008 R2.

Cloud offering

Cloud computing usually is classified in three categories: SaaS, PaaS, and IaaS. However, as the cloud matures, the distinction among these is being eroded.

SaaS: Software as a service

SaaS is software that is centrally hosted and managed for the end customer. It usually is based on a multitenant architecture—a single version of the application is used for all customers. It can be scaled out to multiple instances to ensure the best performance in all locations. SaaS software typically is licensed through a monthly or annual subscription.

Microsoft Office 365 is a prototypical model of a SaaS offering. Subscribers pay a monthly or annual subscription fee, and they get Exchange as a Service (online and/or desktop Outlook), Storage as a Service (OneDrive), and the rest of the Microsoft Office Suite (online, the desktop version, or both). Subscribers are always

provided the most recent version. This essentially allows you to have a Microsoft Exchange server without having to purchase a server and install and support Exchange—the Exchange server is managed for you, including software patches and updates. Compared to installing and upgrading Office every year, this is much less expensive and requires much less effort to keep updated.

Other examples of SaaS include Dropbox, WordPress, and Amazon Kindle.

PaaS: Platform as a service

With PaaS, you deploy your application into an application-hosting environment provided by the cloud service vendor. The developer provides the application, and the PaaS vendor provides the ability to deploy and run it. This frees developers from infrastructure management, allowing them to focus strictly on development.

Azure provides several PaaS compute offerings, including the Web Apps feature in Azure App Service and Azure Cloud Services (web and worker roles). In either case, developers have multiple ways to deploy their application without knowing anything about the nuts and bolts supporting it. Developers don't have to create VMs, use Remote Desktop Protocol (RDP) to log

into each one, and install the application. They just hit a button (or pretty close to it), and the tools provided by Microsoft provision the VMs and then deploy and install the application on them.

IaaS: Infrastructure as a service

An IaaS cloud vendor runs and manages server farms running virtualization software, enabling you to create VMs that run on the vendor's infrastructure. Depending on the vendor, you can create a VM running Windows or Linux and install anything you want on it. Azure provides the ability to set up virtual networks, load balancers, and storage and to use many other services that run on its infrastructure. You don't have control over the hardware or virtualization software, but you do have control over almost everything else. In fact, unlike PaaS, you are completely responsible for it.

Azure Virtual Machines, the Azure IaaS offering, is a popular choice when migrating services to Azure because it enables the "lift and shift" model for migration. You can configure a VM similar to the infrastructure currently running your services in your datacenter and migrate your software to the new VM. You might need to make tweaks, such as URLs to other services or

storage, but many applications can be migrated in this manner.

Azure VM Scale Sets (VMSS) is built on top of Azure Virtual Machines and provides an easy way to deploy clusters of identical VMs. VMSS also supports autoscaling so that new VMs can be deployed automatically when required. This makes VMSS an ideal platform to host higher-level microservice compute clusters such as for Azure Service Fabric and the Azure Container Service.

Azure services

Azure includes many services in its cloud computing platform. Let's talk about a few of them.

- **Compute services** This includes the Azure Virtual Machines—both Linux and Windows, Cloud Services, App Services (Web Apps, Mobile Apps, Logic Apps, API Apps, and Function Apps), Batch (for large-scale parallel and batch compute jobs), RemoteApp, Service Fabric, and the Azure Container Service.
- **Data services** This includes Microsoft Azure Storage (comprised of the Blob, Queue, Table, and Azure Files services),

Azure SQL Database, DocumentDB, StorSimple, and the Redis Cache.

- **Application services** This includes services that you can use to help build and operate your applications, such as Azure Active Directory (Azure AD), Service Bus for connecting distributed systems, HDInsight for processing big data, Azure Scheduler, and Azure Media Services.
- **Network services** This includes Azure features such as Virtual Networks, ExpressRoute, Azure DNS, Azure Traffic Manager, and the Azure Content Delivery Network.

When migrating an application, it is worthwhile to have some understanding of the different services available in Azure because you might be able to use them to simplify the migration of your application and improve its robustness. It is impossible for us to cover everything in this book, but there are some services we felt you should know about. Chapter 9, “Additional Azure services,” provides a list of these services and a brief description of each of them.

The new world: Azure Resource Manager

The Azure Resource Manager is the new methodology for deploying resources.

What is it?

Since it went into public preview, the Azure Service Management (ASM) deployment model has been used to deploy services. In the Azure portal, services managed with ASM are referred to as *classic*. In 2015, Microsoft introduced the Resource Manager deployment model as a modern, more functional replacement for ASM. The Resource Manager deployment model is recommended for all new Azure workloads.

These deployment models are often referred to as *control planes* because they are used to control services, not just to deploy them. This is different from a data plane, which manages the data used by a service.

Typically, your running Azure infrastructure will contain many resources, but some of the resources will be related to one another in some way, such as all being the component services required to run a web application. For example,

you might have two VMs running the web application, using a database to store data, and residing in the same virtual network. With Resource Manager, you deploy these assets into the same resource group and manage and monitor them together. You can deploy, update, or delete all of the resources in a resource group in one operation.

In this example, the resource group would contain the following:

- VM1
- VM2
- Virtual network
- Storage account
- Azure SQL Database

You can also create a template that precisely defines all the Resource Manager resources in a deployment. You can then deploy this Resource Manager template into a resource group as a single control-plane operation, with Resource Manager in Azure ensuring that resources are deployed correctly. After deployment, Resource Manager provides security, auditing, and tagging features to help you manage your resources.

Why use Resource Manager?

There are several advantages to using Resource Manager. The deployment is faster because resources can be deployed in parallel rather than sequentially as they are in ASM. The Resource Manager model enables each service to have its own service provider, and they can update it as needed independently of the other services.

Azure Storage has its own service provider, VMs have their own service provider, and so on. With the ASM model, all services had to be updated at one time, so if one service was finished and the rest were not, the one that was ready had to wait on the others before it could be released. Here are some of the other major advantages to the Resource Manager model:

- Deployment using templates
 - You can create a reusable (JSON) template that can be used to deploy all of the resources for a specific solution in one fell swoop. You no longer have to create a VM in the portal, wait for it to finish, then create the next VM, and so on.
 - You can use the template to redeploy the same resources repeatedly. For example, you may set up the resources

in a test environment and find that it doesn't fit your needs. You can delete the resource group, which removes all of the resources for you, then tweak your template and try again. If you only want to make changes to the resources deployed, you can just change the template and deploy it again, and Resource Manager will change the resources to conform to the new template.

- You can take that template and easily re-create multiple versions of your infrastructure, such as staging and production. You can parameterize fields such as the VM name, network name, storage account name, etc., and load the template repeatedly, using different parameters.
- Resource Manager can identify dependencies in a template but allows you to specify additional dependencies if necessary. For example, you wouldn't want to deploy a virtual machine before creating the storage account for the VHD files that are used for the OS and data disks.
- Security

- You can use the new Role-Based Access Control (RBAC) to control access to the resources in the group. For example, you can assign the Owner role to a user, giving that user full administrative privileges to those resources in the group but not to other resources in the subscription. Other roles include Reader (you can read anything except secrets) and Contributor (you can do most anything except add or revoke access).
- Billing
 - To help organize all of the resources in a subscription for billing purposes, you can assign tags to each resource and then retrieve all of the billing information for a specific tag.

For example, if one department owns a web application and several related components, you can assign the same tag to all of those resources. Then, you can retrieve the billing for that department by retrieving the billing for that tag.

Note If you apply a tag to a resource group, the resources in the group do not inherit that

tag. You have to apply the tag to each individual resource.

Maximize the benefits of using Resource Manager

Microsoft has several suggestions to help you maximize the use of the Resource Manager model when working with your applications and components.

- Use templates rather than using scripting like PowerShell or the Azure Command-Line Interface (CLI). Using a template allows resources to be deployed in parallel, making it much faster than using a script executed sequentially.
- Automate as much as possible by leveraging templates. You can include configurations for various extensions like PowerShell DSC and Web Deploy. This way, you don't need any manual steps to create and configure the resources.
- Use PowerShell or the Azure CLI to manage the resources, such as to start or stop a virtual machine or application.

- Put resources with the same lifecycle in the same resource group. In our example above, what if the database is used by multiple applications? If that's true, or if the database is going to live on even after the application is retired or removed, you don't want to re-create the database every time you redeploy the application and its components. In that case, put the database in its own resource group.

Resource group tips

You can decide how to allocate your resources to resource groups based on what makes sense for you and your organization. A resource group is a logical container to hold related resources for an application or group of applications. These tips should be considered when making decisions about your resource group:

- As noted before, all of the resources in a group should have the same lifecycle.
- A resource can only be assigned to one group at a time.
- A resource can be added to or removed from a resource group at any time. Note that every resource must belong to a resource

group, so if you remove it from one group, you have to add it to another.

- Most types of resource can be moved to a different resource group at any time.
- The resources in a resource group can be in different regions.
- You can use a resource group to control access for the resources therein.

Tips for using Resource Manager templates

Resource Manager templates define the deployment and configuration of your application. They are used to deploy an application and all of its component resources repeatedly.

You can divide the deployments in a set of templates and create a master template that links in all of the required templates.

Templates can be modified and redeployed with updates. For example, you can add a new resource or update configuration information about a resource in a template. When deployed again, Resource Manager will create any new

resources it finds and perform updates for any that have been changed. You will see this in Chapter 5, “Azure Virtual Networks,” where you deploy a template defining a VNet with two subnets. Then, you add a third subnet and redeploy the template, and you can see the third subnet appear in the Azure portal.

Templates can be parameterized to allow you more flexibility in deployment. This is what allows you to use the same template repeatedly but with different values, such as VM name, virtual network name, storage account name, region, and so on.

You can export the current state of the resources in a resource group to a template. This can then be used as a pattern for other deployments, or it can be edited and redeployed to make changes and additions to the current resource group’s resources.

Here is an example of a JSON template. Deploying this template will create a storage account in West US called mystorage. This is parameterized; you can include a parameter file that provides the values for newStorageAccountName and location. Otherwise, it will use the defaults.

```
{  
  
    "$schema":  
    "http://schema.management.azure.com/schemas/201  
    5-01-01/deploymentTemplate.json#",  
  
    "contentVersion": "1.0.0.0",  
  
    "parameters": {  
  
        "newStorageAccountName": {  
  
            "type": "string",  
  
            "defaultValue": "mystorage",  
  
            "metadata": {  
  
                "description": "Unique DNS Name for the  
                Storage Account where the Virtual Machine's  
                disks will be placed."  
  
            }  
  
        },  
  
        "location": {  
  
            "type": "string",  
  
            "defaultValue": "West US",  
  
            "allowedValues": [  
  
                "West US",  
  
                "East US"  
  
            ],  
  
            "metadata": {  
  
                "description": "The location where the virtual machine will be created."  
            }  
        }  
    }  
}
```

```
        "description": "Restricts choices to  
where premium storage is located in the US."  
    }  
}  
,  
  
"resources": [  
{  
    "type":  
"Microsoft.Storage/storageAccounts",  
    "name":  
"[parameters('newStorageAccountName')]",  
    "apiVersion": "2015-06-15",  
    "location": "[parameters('location')]",  
    "properties": {  
        "accountType": "Standard_LRS"  
    }  
}  
,  
]  
}
```

The classic deployment model

Let's talk a bit about what came before Resource Manager. These resources are now referred to as *classic*. For example, you can have storage accounts, virtual machines, and virtual networks that use the classic deployment model. The classic and Resource Manager models are not compatible with each other. The classic resources cannot be seen by the Resource Manager resources, and vice versa. For example, the PaaS Cloud Services feature of Azure is a classic feature, so you can only use it with storage accounts that are classic storage accounts. The exception to that rule is that you can use classic storage accounts to host Resource Manager VMs. This will make it easier to migrate your VMs from the classic deployment model to the Resource Manager deployment model.

Note that this means you may log into the classic Azure portal and see classic resources but not see Resource Manager resources, and vice versa.

Note There are two versions of the portal. The production portal is the Azure portal at <https://portal.azure.com>. Most features have

been moved to the Azure portal, with some exceptions such as Azure Active Directory (Azure AD). The previous portal is called the classic Azure portal (<https://manage.windowsazure.com>), and it can still be used to manage Azure AD and to configure and scale classic resources such as Cloud Services.

You can migrate your assets from the classic to the Resource Manager deployment model.

- For storage accounts, you can use AzCopy to copy blobs, files, and tables to a new Resource Manager storage account. Note that tables must be exported from the classic account and then imported into the Resource Manager account.
- For virtual machines, you can shut them down and copy their VHD file to a new Resource Manager storage account and then use the VHD file to re-create the VM.
- For virtual networks, you can re-create them as Resource Manager VNets.
- There is also a migration service that is in public preview. Microsoft recommends using this only for nonproduction workloads at this time. For more information, check out this article:

<https://azure.microsoft.com/documentation/articles/virtual-machines-windows-migration-classic-resource-manager/>

PowerShell changes for the Resource Manager and classic deployment models

Chapter 8, “Management tools,” talks about some of the tools available to use with Azure, including the Azure PowerShell cmdlets and the Azure CLI.

One of the other changes made when the Azure team created the Resource Manager model was to create PowerShell cmdlets that work just for the Resource Manager model. They did this by appending “Rm” to “Azure” in the name of the cmdlets. For example, to create a classic storage account, you would use the *New-AzureStorageAccount* cmdlet. To create a Resource Manager storage account, you would use the *New-AzureRmStorageAccount* cmdlet.

Microsoft did this so you could easily tell which kind of resource you were creating. Also, this

ensures that scripts that are currently being used will continue to work. Each time you deploy a Resource Manager resource, you have to specify the resource group into which it should be placed. Also, some of the cmdlets for Resource Manager (such as creating a VM) have more details than their counterparts in the classic model.

One last note: for storage accounts, the only PowerShell cmdlets impacted are on the control plane, such as those for creating a storage account, listing storage accounts, removing a storage account, and so on. All of the PowerShell cmdlets used to access the actual objects in storage—blobs, tables, queues, and files—remain unchanged. So once you are pointed to the right storage account, you're good to go.

Role-Based Access Control

In this section, we'll take a look at Role-Based Access Control (RBAC) to understand how you can use it to manage the security for your Resource Manager resources.

What is it?

In addition to the Resource Manager deployment model that allows you to group and manage your related resources, Microsoft introduced RBAC, providing fine-grained control over the operations and scope with which a user can perform a control-plane action. The previous methodology (classic) only allows you to grant either full administrative privileges to everything in a subscription or no access at all.

With Resource Manager, you can grant permissions at a specified scope: subscription, resource group, or resource. This means you can deploy a set of resources into a resource group and then grant permissions to one or more specific users, groups, or service principal. Those users will only have the permissions granted to those resources in that resource group. This access does not allow them to modify resources in other resource groups. You can also give a user permission to manage a single VM, and that's all that user will be able to access and administer.

In addition to users, Azure RBAC also supports service principals that formally are identities representing applications, but informally are used by RBAC to allow automated processes to

