Microsoft

Microsoft Azure Compute

The Definitive Guide

Avinash Valiramani

FREE SAMPLE CHAPTER

Microsoft

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Published with the authorization of Microsoft Corporation by:
Pearson Education, Inc.

ISBN-13: 978-0-13-756444-6
ISBN-10: 0-13-756444-9

Library of Congress Control Number: 2022935534

ScoutAutomatedPrintCode

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About the Author

Avinash Valiramani is an IT Infrastructure and Cloud Architect with more than 15 years of expertise in areas of Microsoft Technologies such as Microsoft Azure, Microsoft 365, Office365, Windows Server, Microsoft Exchange, SCCM, Intune, Hyper-V, and others. He is a certified Architect on Azure and Microsoft365 and primarily helps enterprises globally in their Cloud Roadmap Architecture and Onboarding/Migration Strategies & Implementation. Avinash is publishing four books on Microsoft Azure Best Practices series including this current one, collating real-world experiences to deliver a comprehensive and concise experience for new and budding technologists. Avinash also holds certifications in Barracuda, AWS, Citrix, VMware, and many other IT/Security industry certifications to complement his Microsoft expertise. He has authored a course of Azure Virtual Desktop for Oreilly Media and is planning many others in the coming months. You can follow Avinash on Twitter at @avaliramani.

Acknowledgments

I would like to thank Loretta Yates for trusting me with this huge responsibility. These books would not have been possible without your confidence in me and I will be forever grateful for that. I would like to thank Charvi Arora and the entire Microsoft Press/Pearson team for their constant support and guidance on this project. I would especially like to thank Kate Shoup for editing and reviewing this book and for all her guidance and attention to detail throughout these series of books. Kate, it has been a wonderful experience writing these four books with you and I could not have asked for a better collaborator. Thanks to Thomas Palathra for his thoughtful technical edits, Sarah Kearns for the amazing copy editing and Tracey Croom for adding the final touches to bring this to fruition. This book is the fruit of all our labor, and I am extremely happy we worked together on it.

I would also like to thank my family with gratitude, especially my brother Junaid and uncle Chandru on this effort. Your assistance in helping me organize my life and ensuring I could stay on track while wearing multiple hats was invaluable. This has been the biggest reason I managed to get this mammoth series of books out and it would not have been possible without all your support during this process. I would like to thank my mom for all her strength and belief throughout the years even when things were not going well and for believing in me throughout. Love you all.

Introduction to Azure compute services

Welcome to *Azure Compute: The Definitive Guide*. This book was developed to provide in-depth information about the different Azure services that provide computing capabilities and best practices based on real-life experiences with the product in use in different environments. *Azure Compute: The Definitive Guide* is the first in a series of what will eventually include three additional titles: *Azure Monitoring and Management: The Definitive Guide; Azure Networking: The Definitive Guide*; and *Azure Storage: The Definitive Guide*.

This book is largely based on the version of Azure compute services generally available during 2021, taking into account the development work done on these services over the years. At the time of this writing, a few features and functionalities were under preview and could potentially change before they are generally available. Most of these will be covered in subsequent editions of this book.

Overview

Over the years, Microsoft has introduced different services related to Azure compute. It started with Azure virtual machines (VMs) before introducing additional platform-as-a-service solutions like Azure App Service, Azure Container Service, Azure Functions, and Azure Virtual Desktop.

Following is a brief timeline of the announcement of each of these services in public preview:

- **Azure VMs** June 2012
- **Azure App Service** March 2015
- **Azure Container Service** September 2015
- **Azure virtual machine scale sets (VMSS)** November 2015
- **Azure Functions** March 2016
- **Azure Virtual Desktop** March 2019

Each service added new dimensions and capabilities to Azure's compute stack that have provided customers with more varied options to leverage compute services depending on their requirements. Over time, each service has helped increase scalability and reliability while reducing the cost and complexity of managing cloud infrastructure workloads.

As you go through each service in more detail in this book, you will find that every service, if used correctly, has the potential to transform an organization's infrastructure and business applications environment. In subsequent chapters, you will dive into each compute service to better understand how each one works and associated best practices. You will initially focus on factors to consider when selecting and designing each workload. Thereafter, you will focus on deployment considerations and strategies, with step-by-step walkthroughs for a better understanding of deployment methods, followed by some best practices.

Cloud service categories

Let's start by defining the different types of cloud service categories:

- **Infrastructure as a service (IaaS)** Using VMs with storage and networking is generally referred to as infrastructure as a service (IaaS). This is a traditional approach to using cloud services in line with on-premises workloads. Most on-premises environments use virtualization technologies such as Hyper-V to virtualize Windows and Linux workloads. Migrating to IaaS from such an environment is considered to be a much easier first step than migrating to PaaS or FaaS (defined next). Over time, as an organization's understanding of various other types of cloud services grows, it can migrate to PaaS or FaaS.
- **Platform as a service (PaaS)** One of the biggest benefits of using a cloud service is the capability to offload the management of back-end infrastructure to the service provider. This model is called platform as a service (PaaS). Examples of back-end infrastructure include different layers of the application, such as the compute layer, storage layer, networking layer, security layer, and monitoring layer. Organizations can use PaaS to free up their IT staff to focus on higher-level tasks and core organizational needs instead of on routine infrastructure monitoring, upgrade, and maintenance activities. Azure App Service and Azure Container Service are examples of Azure PaaS offerings.
- **Function as a service (FaaS)** Function as a service (FaaS) offerings go one step beyond PaaS to enable organizations to focus only on their application code, leaving the entire back-end infrastructure deployment and management to the cloud service provider. This provides developers with a great way to deploy their code without worrying about the back-end

infrastructure deployment, scaling, and management. It also enables the use of microservices architectures for applications. An example of an Azure FaaS offering is Azure Functions.

NOTE In addition to IaaS, PaaS, and FaaS, there is software as a service (SaaS). This is another type of cloud service category. However, because it is not applicable in the context of Microsoft Azure, this book will not delve into it further.

Not all services fall cleanly within the scope of one of these cloud service categories. For example:

- Azure Virtual Desktop, a virtualized Windows desktop hosting service, combines IaaS and PaaS to provide a cohesive solution.
- Azure VMSS, an automated VM scaling service, combines IaaS and PaaS to provide auto-scaling features.

Each of these cloud service categories has various features and limitations. Limitations might relate to the application, technological know-how, and costs for redevelopment, among others. As a result, most organizations use some combination of different types of services to maximize their cloud investments.

Each service provides a different level of control and ease of management. For example:

- IaaS provides maximum control and flexibility in migration and use.
- FaaS provides maximum automation for workload deployment, management, and use.
- PaaS provides a mix of both at varying levels, depending on the PaaS service used.

Each service also offers varying levels of scalability. For example:

- IaaS requires the use of additional services to achieve true scalability and load balancing—for example, VMSS or Azure Load Balancer.
- PaaS and FaaS services are generally designed with built-in scalability and load-balancing features.

Cost-wise, each service provides varying levels of efficiency. For example:

- FaaS offerings charge for compute based only on the usage hours for compute services, making it extremely cost-effective.
- IaaS products charge for compute services regardless of usage once the compute service (for example, a VM) is online.

- PaaS offerings are a mixed bag depending on how the services are configured. Some PaaS products charge for compute resources regardless of usage, while others, if configured correctly, charge based on usage alone.

Migration factors and strategies

Along with these features and limitations, there are certain migration factors to consider when deciding which category of cloud service might be the best solution in an organization's cloud journey. (See Figure I-1.) Of course, organizations can always start with one category (IaaS) and migrate to a second category (PaaS or FaaS) over time as their understanding of the cloud matures.

Let's examine the flow chart shown in Figure I-1 in more detail:

- **Lift-and-shift migration strategy** In a lift-and-shift migration, the organization migrates its existing on-premises environment as-is to the cloud, without redeveloping or redesigning the application stack. This is a preferred migration approach for organizations in which:
  - A hardware refresh or procurement is planned.
  - Scaling or security limitations require the organization to migrate to the cloud as quickly as possible, with the least amount of disruption.
  - A lift-and-shift migration strategy generally involves less effort because no code changes are necessary. Application components remain as-is and are migrated in their current state to the cloud. This is generally the preferred approach for organizations that want to mainly use IaaS to host their application and database workloads.
- **Cloud-optimized strategy** With cloud-optimized migrations, the organization redesigns or recodes its application as necessary to use PaaS and FaaS services. This enables the organization to use microservice architectures, enabling it to truly benefit from the scalability and cost benefits that a cloud service like Azure provides.

Organizations can use a lift-and-shift migration strategy, a cloud-optimized migration strategy, or a combination of the two. For example, an organization might use the flexibility provided by cloud services to start its migration using a lift-and-shift approach to quickly benefit from the scaling and global availability of Azure. Then, over time, the organization could migrate to more cloud-optimized PaaS and FaaS services.

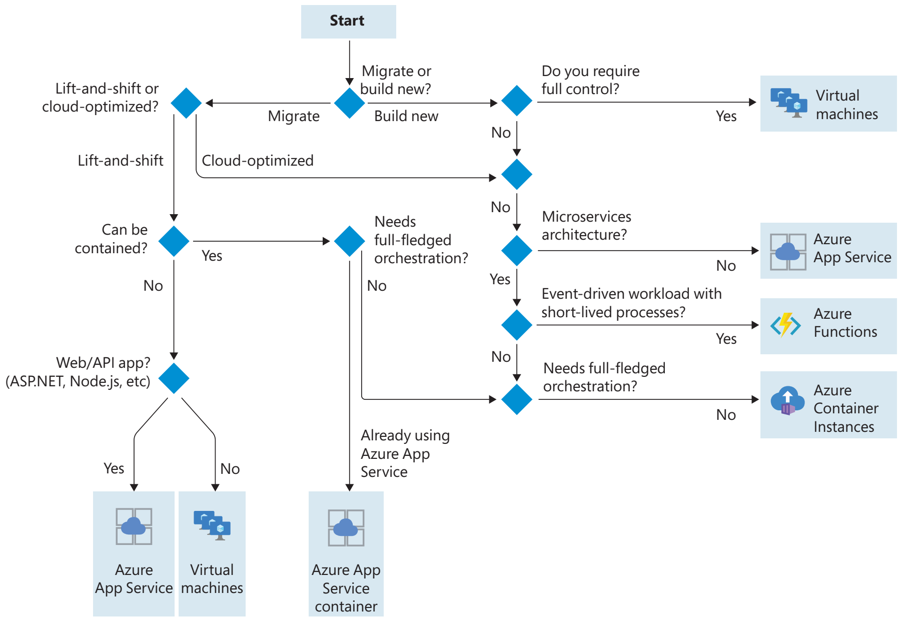
Start
Migrate or build new?
Migrate
Build new
Lift-and-shift or cloud-optimized?
Lift-and-shift
Cloud-optimized
Do you require full control?
Yes
No
Virtual machines
No
Microservices architecture?
No
Azure App Service
Yes
Event-driven workload with short-lived processes?
Yes
Azure Functions
No
Needs full-fledged orchestration?
No
Azure Container Instances
Can be contained?
Yes
No
Needs full-fledged orchestration?
No
Already using Azure App Service
Web/API app? (ASP.NET, Node.js, etc)
Yes
No
Azure App Service
Virtual machines
Azure App Service container

FIGURE I-1 Cloud-migration considerations. Please refer to *https://docs.microsoft.com/en-us/azure/architecture/guide/technology-choices/compute-decision-tree* for more information on Figure I-01.

Who this book is for

Microsoft Azure Compute: The Definitive Guide is for anyone interested in Azure infrastructure solutions: IT and cloud administrators, security professionals, developers, and engineers.

This book is designed to be useful for the entire spectrum of Azure users. Whether you have basic experience on Azure or other on-premises or cloud virtualization technologies, or you are an expert, my hope is that you will still derive value from this book. This book provides introductory, intermediate, and advanced coverage on each compute service.

The book especially targets those who are working in medium to large enterprise organizations and have at least one year of experience in administering, deploying, managing, monitoring, upgrading, migrating, and designing infrastructure services such as virtual machines, as well as related infrastructure such as storage, networking, and backups.

How this book is organized

This book is organized into six chapters:

Chapter 1: Azure virtual machines

Chapter 2: Azure virtual machine scale sets

Chapter 3: Azure App Service

Chapter 4: Azure Virtual Desktop

Chapter 5: Azure Container Instances

Chapter 6: Azure Functions

Each chapter focuses on a specific Azure compute service and includes in-depth coverage of the inner workings of each service, walkthroughs to guide you on how to build and test the service, and real-world best practices to help you maximize your Azure investments.

The approach adopted for the book is a unique mix of didactic, narrative, and experiential instruction. Didactic instruction is used to introduce to you the core aspects of each service. Narrative instruction leverages what you already understand to help you grasp new concepts. Finally, the experiential instruction conveys real-world experiences and challenges of small and large environments and the factors to consider while designing and implementing your own workloads. This includes step-by-step guided walkthroughs on how to configure each Azure compute service and its related features and options to gain all the benefits each service has to offer.

System requirements

To follow along with this book, you'll need an Azure subscription. At the time of this writing, Microsoft provides a 30-day, $200 trial subscription, which you can use to explore most of the services discussed in this book. Some services, however, such as dedicated hosts, are not supported by this trial subscription; these require a paid subscription.

The following list details the minimum system requirements needed to run the content in the book's companion website (*MicrosoftPressStore.com/AzureComputeTDG/detail*):

- Windows 10/11, with the latest updates from Microsoft Update Service
- Azure PowerShell (*https://docs.microsoft.com/en-us/powershell/azure/install-az-ps*)
- Azure CLI (*https://docs.microsoft.com/en-us/cli/azure/install-azure-cli*)
- Display monitor capable of 1024 x 768 resolution
- Microsoft mouse or compatible pointing device

About the companion content

The companion content for this book can be downloaded from the following page:

MicrosoftPressStore.com/AzureComputeTDG/downloads

The companion content includes the following:

- PowerShell code for each walkthrough in the book (where applicable)
- CLI code for each walkthrough in the book (where applicable)

Errata, updates, & book support

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

MicrosoftPressStore.com/AzureComputeTDG/errata

If you discover an error that is not already listed, please submit it to us at the same page.

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Let's keep the conversation going! We're on Twitter: *http://twitter.com/MicrosoftPress*.

Chapter 3

Azure App Service

Overview

Azure App Service is a compute service within Azure that enables you to host web applications, mobile application back ends, and REST APIs. Some key features of Azure App Service include the following:

- It provides DevOps integration capabilities to allow for continuous deployment of code using Azure DevOps, Docker Hub, GitHub, and other third-party solutions.
- It allows for development in different programming languages like .NET Core, .NET, Node.js, PHP, Python, Java, and others.
- It allows for both Windows- and Linux-based applications to run at scale.

Although App Service can help address the requirements of most app deployments, there are a few key points to consider when deciding it is the best service for hosting an app. Some primary reasons to use Azure App Service are as follows:

- **Automated management** OS management activities, including patching and maintenance, are automated. This applies even to the language frameworks supported by the service. This frees development and engineering resources from the burden of managing the back-end platform so they can focus on more business-critical application-development activities.
- **Support for multiple frameworks** In addition to the different programming languages that can be used by App Service, it can also leverage PowerShell scripts and other types of executables for background services.
- **Robust scaling** Both manual and automated scaling operations are supported—including scaling up, down, in, and out. This can help organizations of all sizes embarking on their cloud journey obtain the maximum benefit from their cloud spends.
- **Global deployment** App Service deployments are supported across Microsoft's globally dispersed regions and datacenters. This allows for app hosting in regions closest to the users.
- **High availability and uptime guarantees** In addition to workloads hosted on the free and shared tiers of services, App Service workloads are guaranteed a 99.95% uptime.

- **Optimized for DevOps builds** Continuous integration and deployment can be achieved by leveraging App Service in conjunction with Azure DevOps, Azure Container Registry, GitHub, Bitbucket, and Docker Hub. This allows for multiple staging and dev/test environments that can be used for testing, validation, and production.
- **Support for PowerShell and CLI management** Apps can be managed using Azure PowerShell, the command-line interface (CLI), or the Azure Portal to help in DevOps and automation activities.
- **Integration with Docker and containers** Apps can be dockerized and hosted as custom containers in App Service. Both Windows- and Linux-based containers are supported. This enables engineers with skills in managing Docker to quickly get up to speed managing Azure App Service.
- **Adherence to global compliance standards** Compliance with ISO, SOC, and PCI standards is built in.
- **Easy to integrate with existing authentication solutions** Various secure authentication solutions can be easily leveraged, enabling users to employ existing Azure Active Directory, Microsoft, Google, Facebook, and Twitter accounts.
- **Built-in support for mobile apps** Mobile app features such as user authentication, notification services, offline data sync, social integration, and automated scaling are all built-in, making it easy to build and deploy apps.
- **Ability to run code and scripts in a serverless architecture** On-demand scripts and code snippets can be executed without deploying back-end servers using serverless computing. This saves time, resources, and money, as compute costs are charged only for actual use.
- **Connectors for enterprise, SaaS, and internet-based services** App Service has ready connectors for integration with enterprise applications, SaaS applications, and internet-based services, making it easy to integrate with the most commonly used platforms and applications.
- **Hybrid connectivity** Support for hybrid connections is available to allow access to on-premises data sources.
- **Built-in application templates** There are numerous application templates available in the Azure Marketplace, including templates for WordPress, Drupal, and Umbraco, to name a few. The list of templates available is quite extensive and is being updated constantly.
- **Visual Studio and Visual Studio Code integration** Deep integration with Visual Studio and Visual Studio Code allows for streamlined app building, deployment, and troubleshooting.
- **Support for Linux languages and frameworks** Linux containers can be run natively or using custom containers (known as Web App for Containers). This allows for the use of built-in Linux images for languages such as .NET Core, Python, Node.js, JRE, PHP, and others. Custom containers help address scenarios not covered by the built-in images.

App Service plans

App Service plans identify the hardware computing resources made available to the App Service to run the required web, API, and mobile apps. Depending on what plan you select, computing resources are dedicated solely to your organization or shared among customers. The App Service plan also defines the specifications of the back-end VM series that is allocated. This, in turn, affects the number of applications that can be hosted using those resources.

NOTE **One App Service plan can be used to deploy and run multiple apps.**

When you create an App Service plan, you must define certain parameters for that plan. These include the following:

- The pricing tier (Free, Shared, Dedicated, Isolated, etc.)
- The region in which the apps will run (Central US, West Europe, East Asia, etc.)
- The size of the VM instances required (small, medium, large)
- The total number of VM instances required

Once the preceding parameters are defined, the resources identified in the plan are created in the selected region. Thereafter, the resources are made available for the hosting of the required apps.

Choosing the right pricing tier is key. Table 3-1 reviews the four pricing tiers.

TABLE 3-1 Pricing tiers

Pricing tier	Description	Key features
Free	Allows you to host one or more web apps without having to pay any associated compute charges.	The underlying hardware is shared between customers. You can run only 10 apps. You can have 10 free plans per region. There are time limits on CPU usage. These make this pricing tier ideal for test/dev workloads, and web APIs generally run quickly. There are limits on memory, storage, bandwidth, scalability, and security features. Uptime SLAs do not apply.
Shared	Similar to the Free tier in that the underlying hardware is shared, but offers more flexibility in terms of CPU usage and so on.	The underlying hardware is shared between customers. You can run 100 apps. You can have 10 plans within a single resource group. You can have unlimited shared plans per region. There are limits on memory, storage, bandwidth, scalability, and security features. However, CPU usage limits apply 240 minutes per day. A per-app charge applies. Uptime SLAs do not apply.

Pricing tier	Description	Key features
Dedicated	Provides compute resources that are dedicated to that customer. There are different levels available in this plan—Basic, Standard, Premium, PremiumV2, and PremiumV3—and each defines the number of VM instances that the apps in the plan get access to.	A per-instance charge applies, regardless of the number of apps running. You can scale out by increasing the number of VM instances available. You can scale up by moving from one dedicated tier to a higher one to increase the size of the VM instances. This tier supports several additional features, including features that relate to backups, security, auto-scaling, and integration with traffic management. An uptime SLA of 99.95% applies.
Isolated	Provides a dedicated set of VMs hosted in an Azure virtual network environment to support compute isolation.	Plans in this tier are deployed into an App Service Environment (ASE), described in more detail later in this chapter. Fixed charges to run the environment apply, as well as variable charges based on the number of instances. This tier provides maximum scale-out capabilities. Fine-grained control over ingress and egress application network traffic is supported. All security and scaling features are available for apps running on this tier. An uptime SLA of 99.95% applies.

NOTE **As you can see, the higher the tier, the more features become available to improve security, scalability, and reliability.**

Single versus multiple App Service plans

You can host multiple apps as part of the same App Service plan, potentially reducing your overall compute costs. Because multiple apps share the underlying resources allocated to the App Service plan, it is important to monitor their use.

Before you add a new app to your App Service plan, make sure its requirements align with available resources in the plan. Take these factors into consideration when deciding whether to host an app in an existing App Service plan or create a new plan for the app:

- **Does the app have the same scaling needs as the rest of the apps in the current plan?**
- **Do the app's resource requirements (current and future) align with the available resources in the current plan?**
- **Does the app have any security or feature requirements that cannot be met by the existing plan?**
- **Does the app need to be isolated from other apps?**

NOTE **Adding an app to an existing App Service plan might seem cost-effective, but if doing so will affect application performance or potentially cause outages, it might not be worth it.**

Azure App Service Environments

Earlier, I mentioned that the Isolated pricing tier deploys apps in an App Service Environments (ASE). An ASE is a dedicated, fully isolated environment provisioned to run apps with high levels of security and scalability. An ASE can host Windows or Linux web apps, mobile apps, function apps, and Docker containers.

Although all application workloads can be hosted in an ASE, considering the cost implications, there are certain workload types that are more appropriate for ASEs than others. When deciding if an ASE is the best choice for an app, consider these factors:

- Does the app require complete isolation and secure access to on-premises resources?
- Does the app have high memory requirements that are not met by the Dedicated tier?
- Does the app require a very high level of scalability?

If the answer to all or most of these questions is yes, then an ASE might be the appropriate choice.

Here is a list of some examples of functionality that is only possible when using an ASE:

- Hosting apps in a single-tenant environment
- Using private or internal Certificate Authority certificates
- Publishing a dedicated outbound IP address for all the apps hosted in the ASE
- Publishing and accessing apps only on a private internal IP address
- Providing the highest level of scaling possible across all App Service plans
- Securing outbound network traffic with additional network controls available with integrations that are not part of the app

An ASE is assigned exclusive access to a dedicated set of compute and network resources and is accessible only from a single subscription. Each subscription supports the deployment of 100 App Service plan instances. These can be deployed in one of three ways:

- A single App Service plan with 100 instances
- 100 App Service plans with single instances in each plan
- A combination of the two

An ASE is composed of two components:

- **Front ends** Front ends provide HTTP and HTTPS endpoints for ingress termination and load-balancing. Front ends are added automatically as scaling operations take place to handle the additional load.
- **Workers** Workers host the apps deployed by a customer. You specify the size of the workers when you select your App Service plan tier.

Both components are managed services and are deployed or removed automatically as the App Service plans are sized. Because of this design, the charges associated with an ASE are fixed every month based on the plan that is selected. Additionally, every vCPU in the plan has an associated cost, which will be levied when resources are consumed.

There are two different ways to provision network access for an ASE, depending on its public access requirements:

- **External ASE** An internet-facing ASE is deployed with a public IP address so the apps hosted on the ASE can be accessed externally.
- **Internal ASE** An internal ASE is deployed using an internal load balancer (ILB) IP address so it is accessible only on internal networks. This would include any networks connected over VPN or ExpressRoute.

The public virtual IP (VIP) or the ILB IP serve as the endpoints for the termination of the different protocols for client connectivity. Because there is no direct access to the VMs running in the ASE, you can create network security groups (NSGs) to manage the network traffic within the subnet where the ASE is housed. If a site-to-site VPN or ExpressRoute connection to the on-premises environment is in place, the apps hosted in the ASE can communicate with on-premises resources.

App Service walkthrough

The following sections step you through the process of creating a basic web app using the Azure Portal, Azure PowerShell, and Azure CLI. You will use sample GitHub code provided by Microsoft to create a static HTML website, which you will use later to create a Hello World web app.

NOTE **You will create the same web app using all three methods. Be sure to adjust the web app's name for each deployment.**

USING THE AZURE PORTAL

To create a sample static HTML website for the Hello World web app using the Azure Portal, follow these steps:

1. Log in to the Azure Portal and type **app services** in the search bar.
2. Under **Services**, click **App Services**. (See Figure 3-1.)

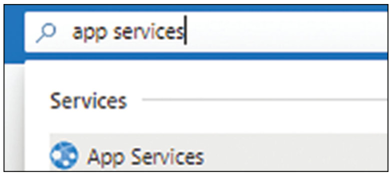


FIGURE 3-1 Selecting the App Services service in the Azure Portal.

3. Click either the **Create** button or the **Create App Service** button to launch the Create Web App wizard. (See Figure 3-2.)

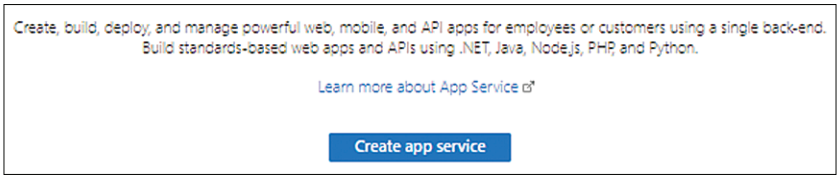
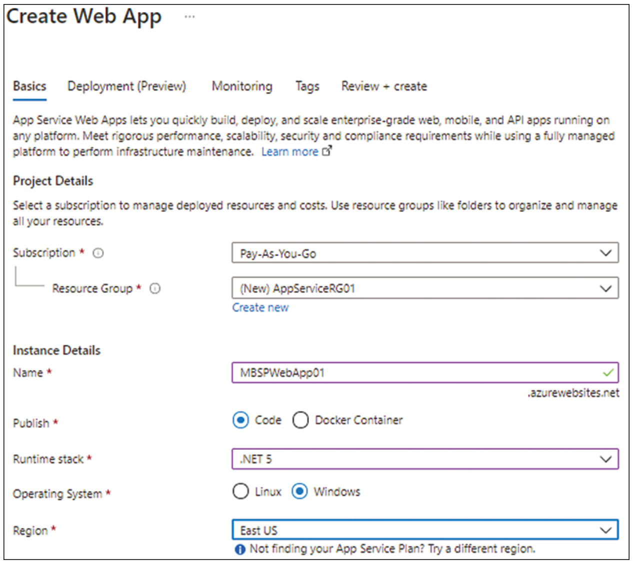

Create, build, deploy, and manage powerful web, mobile, and API apps for employees or customers using a single back-end. Build standards-based web apps and APIs using .NET, Java, Node.js, PHP and Python.

FIGURE 3-2 Creating the first App Service.

4. In the **Basics** tab, enter the following information for the web app (see Figure 3-3):
   - **Subscription** Select the subscription that will host the web app.
   - **Resource Group** Select an existing resource group or create a new one to host the web app.
   - **Name** Enter a unique name for the web app. If the name you enter is already in use, the wizard will prompt you to select another name.
   - **Publish** Select the publishing model for the web app. Your options are Code and Docker Container. In this case, choose **Code**.
   - **Runtime Stack** Choose the runtime stack that corresponds to the app—here, **.NET 5**.
   - **Operating System** Choose an operating system for the app VM—in this case, **Windows**.
   - **Region** Select the Azure region you want to host the app.


Create Web App

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Project Details

Select a subscription to manage deployed resources and costs. Use resource groups like folders to organize and manage all your resources.

Subscription * : Pay-As-You-Go

Resource Group * : (New) AppServiceRG01
Create new

Instance Details

Name * : MBSPWebApp01 .azurewebsites.net

Publish * : [✓ Code] Docker Container

Runtime stack * : .NET 5

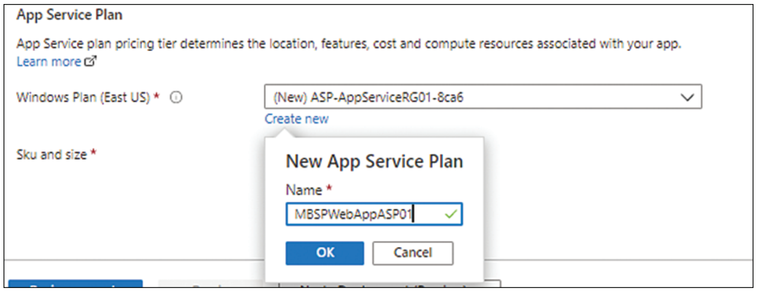
Operating System * : Linux [✓ Windows]

Region * : East US

Not finding your App Service Plan? Try a different region.

FIGURE 3-3 Setting up the basic configuration for the app.

5. Still in the **Basics** tab, under **App Service Plan**, select an existing App Service plan. Alternatively, to create a new plan, click **Create New**, type a name for the new plan, and click **OK**. (See Figure 3-4.)


App Service Plan

App Service plan pricing tier determines the location, features, cost and compute resources associated with your app.
Learn more

Windows Plan (East US) * (New) ASP-AppServiceRG01-8ca6
Create new

Sku and size *

New App Service Plan
Name * MBSPWebAppASP01

FIGURE 3-4 Defining a new App Service plan.

6. In the **Sku and Size** section, click the **Change Size** link. (See Figure 3-5.)

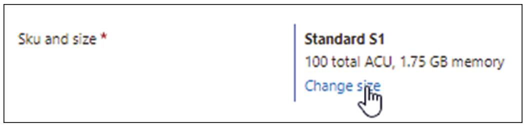
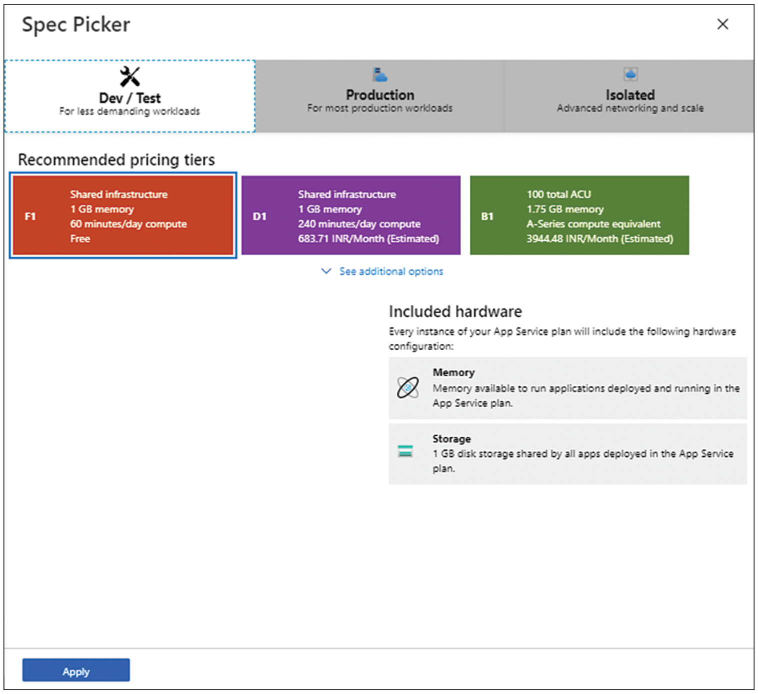

Sku and size * Standard S1
100 total ACU, 1.75 GB memory

FIGURE 3-5 Setting the SKU and size for the App Service plan.

7. In the Spec Picker window, choose an appropriate pricing tier based on your resource and feature requirements. In this case, click **Dev / Test**. Then choose the **F1** plan (the Free pricing tier) and click **Apply**. (See Figure 3-6.)


Spec Picker

Dev / Test
For less demanding workloads
Production
For most production workloads
Isolated
Advanced networking and scale

Recommended pricing tiers

F1: Shared infrastructure, 1 GB memory, 60 minutes/day compute, Free

D1: Shared infrastructure, 1 GB memory, 240 minutes/day compute, 683.71 INR/Month (Estimated)

B1: 100 total ACU, 1.75 GB memory, A-Series compute equivalent, 3944.48 INR/Month (Estimated)

Included hardware

Every instance of your App Service plan will include the following hardware configuration:

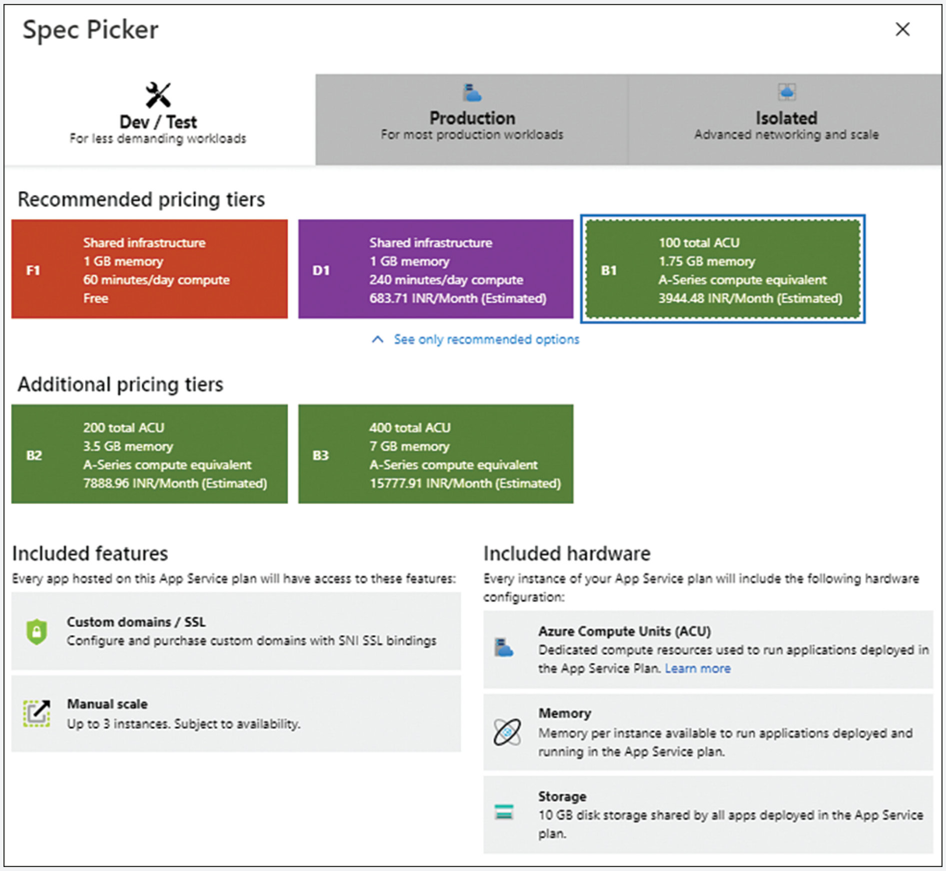
Memory
Memory available to run applications deployed and running in the App Service plan.

Storage
1 GB disk storage shared by all apps deployed in the App Service plan.

FIGURE 3-6 Set the SKU and size.

Choose a pricing tier

As you've learned, there are various pricing tiers available. Figure 3-7 shows additional Dev / Test pricing tiers, with the B1 tier selected; Figure 3-8 shows the recommended pricing tiers for production workloads; and Figure 3-9 shows recommended tiers for isolated workloads.



Spec Picker

Dev / Test — For less demanding workloads
Production — For most production workloads
Isolated — Advanced networking and scale

Recommended pricing tiers

F1 — Shared infrastructure, 1 GB memory, 60 minutes/day compute, Free

D1 — Shared infrastructure, 1 GB memory, 240 minutes/day compute, 683.71 INR/Month (Estimated)

B1 — 100 total ACU, 1.75 GB memory, A-Series compute equivalent, 3944.48 INR/Month (Estimated)

See only recommended options

Additional pricing tiers

B2 — 200 total ACU, 3.5 GB memory, A-Series compute equivalent, 7888.96 INR/Month (Estimated)

B3 — 400 total ACU, 7 GB memory, A-Series compute equivalent, 15777.91 INR/Month (Estimated)

Included features

Every app hosted on this App Service plan will have access to these features:

Custom domains / SSL
Configure and purchase custom domains with SNI SSL bindings

Manual scale
Up to 3 instances. Subject to availability.

Included hardware

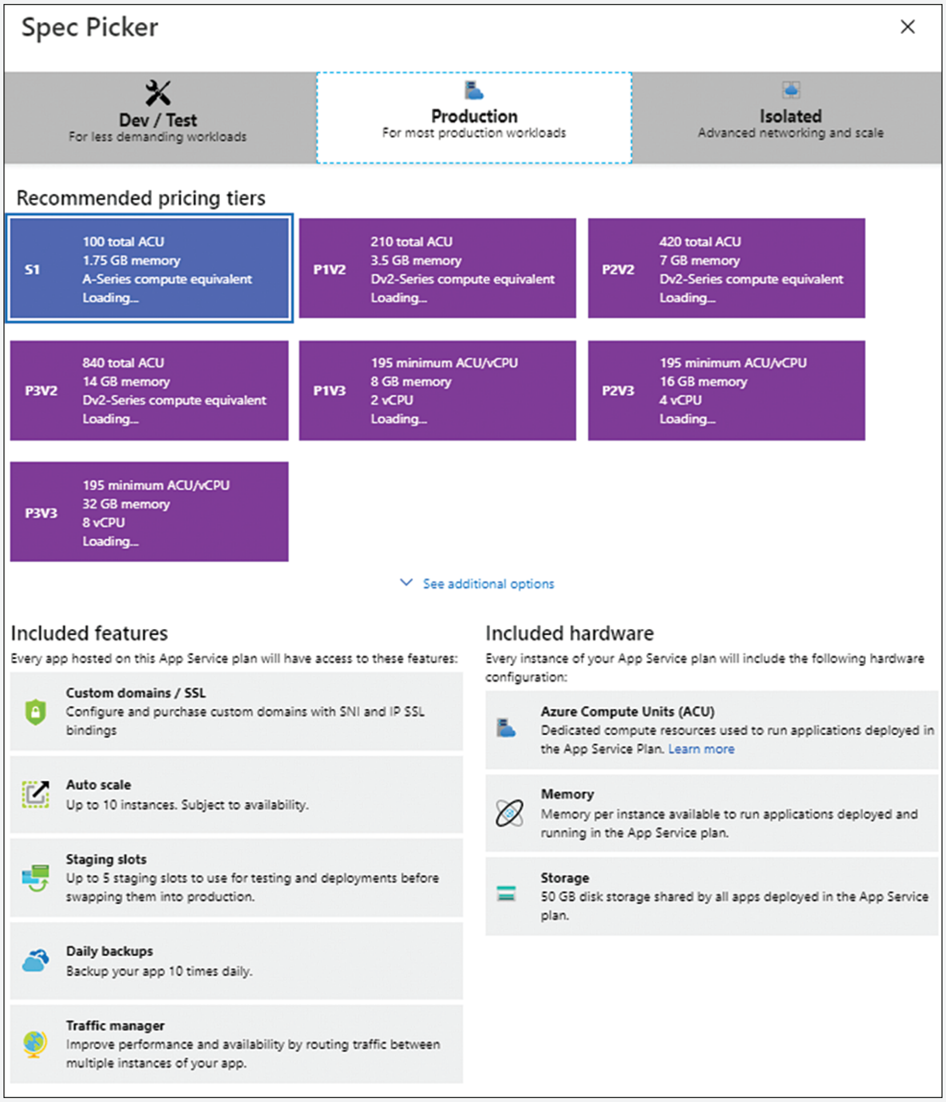
Every instance of your App Service plan will include the following hardware configuration:

Azure Compute Units (ACU)
Dedicated compute resources used to run applications deployed in the App Service Plan. Learn more

Memory
Memory per instance available to run applications deployed and running in the App Service plan.

Storage
10 GB disk storage shared by all apps deployed in the App Service plan.

FIGURE 3-7 Options for the Shared and Basic tiers.


Spec Picker

Dev / Test
For less demanding workloads

Production
For most production workloads

Isolated
Advanced networking and scale

Recommended pricing tiers

S1	100 total ACU 1.75 GB memory A-Series compute equivalent Loading...
P1V2	210 total ACU 3.5 GB memory Dv2-Series compute equivalent Loading...
P2V2	420 total ACU 7 GB memory Dv2-Series compute equivalent Loading...
P3V2	840 total ACU 14 GB memory Dv2-Series compute equivalent Loading...
P1V3	195 minimum ACU/vCPU 8 GB memory 2 vCPU Loading...
P2V3	195 minimum ACU/vCPU 16 GB memory 4 vCPU Loading...
P3V3	195 minimum ACU/vCPU 32 GB memory 8 vCPU Loading...

See additional options

Included features

Every app hosted on this App Service plan will have access to these features:

Custom domains / SSL
Configure and purchase custom domains with SNI and IP SSL bindings

Auto scale
Up to 10 instances. Subject to availability.

Staging slots
Up to 5 staging slots to use for testing and deployments before swapping them into production.

Daily backups
Backup your app 10 times daily.

Traffic manager
Improve performance and availability by routing traffic between multiple instances of your app.

Included hardware

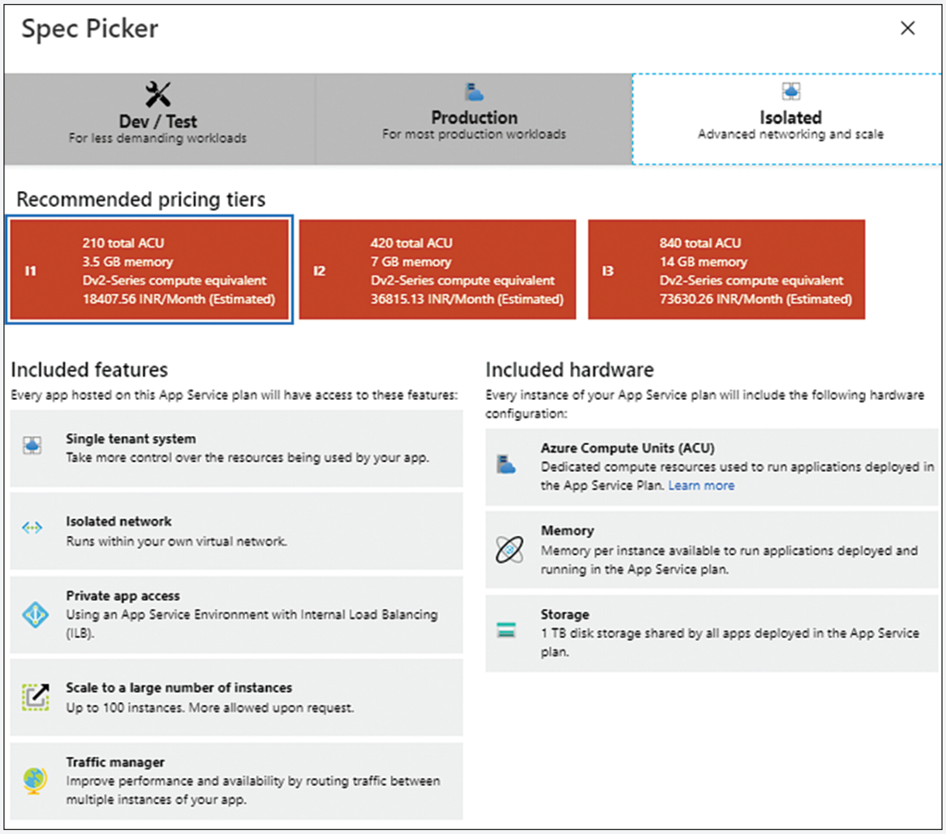
Every instance of your App Service plan will include the following hardware configuration:

Azure Compute Units (ACU)
Dedicated compute resources used to run applications deployed in the App Service Plan. Learn more

Memory
Memory per instance available to run applications deployed and running in the App Service plan.

Storage
50 GB disk storage shared by all apps deployed in the App Service plan.

FIGURE 3-8 Tiers for production workloads.


Spec Picker

Dev / Test
For less demanding workloads
Production
For most production workloads
Isolated
Advanced networking and scale

Recommended pricing tiers

I1	210 total ACU 3.5 GB memory Dv2-Series compute equivalent 18407.56 INR/Month (Estimated)	
I2	420 total ACU 7 GB memory Dv2-Series compute equivalent 36815.13 INR/Month (Estimated)	
I3	840 total ACU 14 GB memory Dv2-Series compute equivalent 73630.26 INR/Month (Estimated)	

Included features

Every app hosted on this App Service plan will have access to these features:

Single tenant system
Take more control over the resources being used by your app.

Isolated network
Runs within your own virtual network.

Private app access
Using an App Service Environment with Internal Load Balancing (ILB).

Scale to a large number of instances
Up to 100 instances. More allowed upon request.

Traffic manager
Improve performance and availability by routing traffic between multiple instances of your app.

Included hardware

Every instance of your App Service plan will include the following hardware configuration:

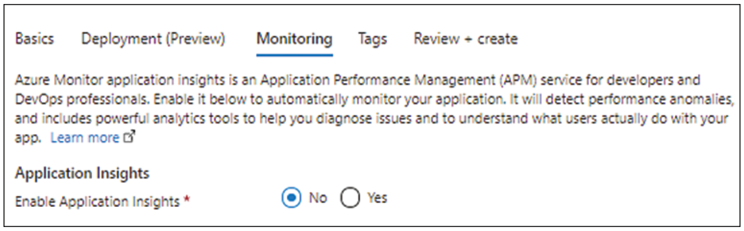
Azure Compute Units (ACU)
Dedicated compute resources used to run applications deployed in the App Service Plan. Learn more

Memory
Memory per instance available to run applications deployed and running in the App Service plan.

Storage
1 TB disk storage shared by all apps deployed in the App Service plan.

FIGURE 3-9 Tiers for isolated workloads.

8. Click **Next** twice. Then, in the **Monitoring** tab, next to **Enable Application Insights**, select the **No** option button and click **Next**. (See Figure 3-10.)



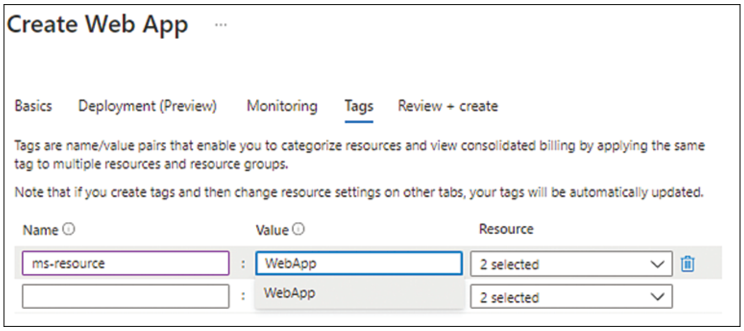
Azure Monitor application insights is an Application Performance Management (APM) service for developers and DevOps professionals. Enable it below to automatically monitor your application. It will detect performance anomalies, and includes powerful analytics tools to help you diagnose issues and to understand what users actually do with your app. Learn more

Application Insights

Enable Application Insights * [✓ No] Yes

FIGURE 3-10 Choosing settings in the Monitoring tab.

9. In the **Tags** tab, enter any tags that you would like to apply to identify the resources for the App Service. For example, type **ms-resource** in the **Name** column and **WebApp** in the **Value** column. (See Figure 3-11.) Then click **Next**.


Create Web App ...

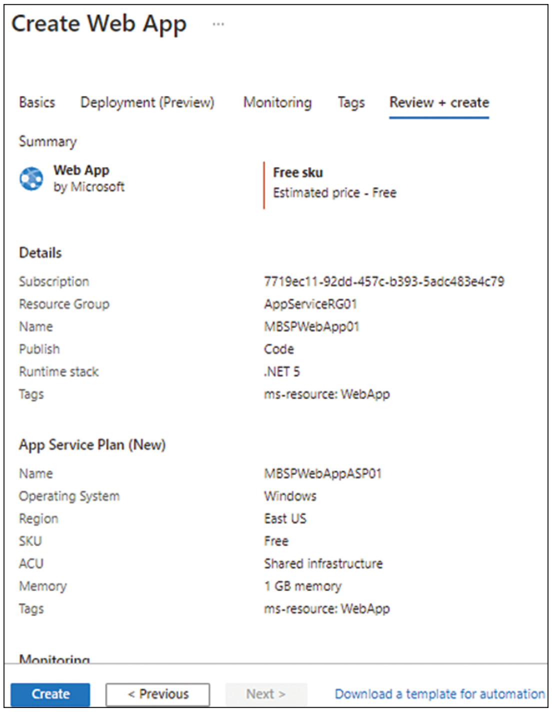
Tags are name/value pairs that enable you to categorize resources and view consolidated billing by applying the same tag to multiple resources and resource groups.

Note that if you create tags and then change resource settings on other tabs, your tags will be automatically updated.

Name		Value	Resource
ms-resource	:	WebApp	2 selected
	:	WebApp	2 selected

FIGURE 3-11 Setting up tags for the web app.

10. In the **Review + Create** tab, review your settings and click **Create** to create the web app. (See Figure 3-12.)


Create Web App ...

Summary

Web App
by Microsoft

Free sku
Estimated price - Free

Details

Subscription	7719ec11-92dd-457c-b393-5adc483e4c79
Resource Group	AppServiceRG01
Name	MBSPWebApp01
Publish	Code
Runtime stack	.NET 5
Tags	ms-resource: WebApp

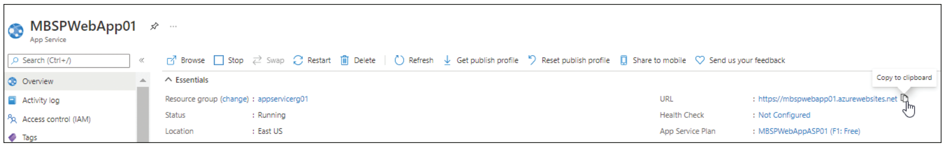
App Service Plan (New)

Name	MBSPWebAppASP01
Operating System	Windows
Region	East US
SKU	Free
ACU	Shared infrastructure
Memory	1 GB memory
Tags	ms-resource: WebApp

Monitoring

FIGURE 3-12 Reviewing the web app settings.

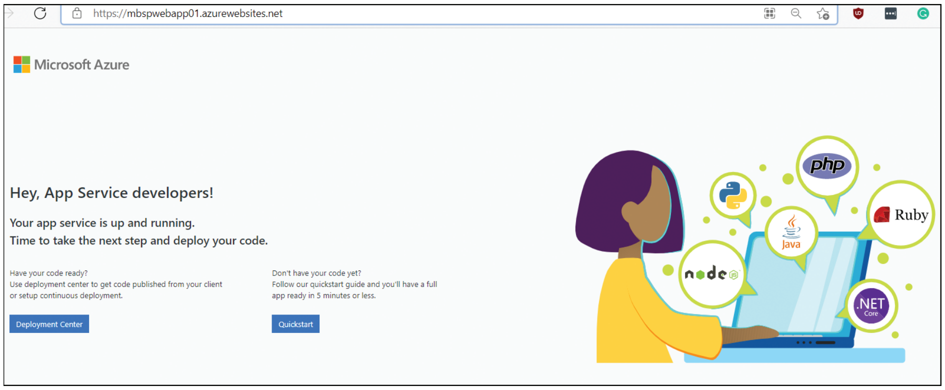
11. After the web app is created, click it. (In this example, it's called **MBSPWebApp01**.) Then, in the **Overview** section of the web app's page in the Azure Portal, copy the URL for the web app (located in the upper-right corner). (See Figure 3-13.)



Resource group (change) : appservicerg01
Status : Running
Location : East US
URL : https://mbspwebapp01.azurewebsites.net
Health Check : Not Configured
App Service Plan : MBSPWebAppASP01 (F1: Free)

FIGURE 3-13 Copying the web app URL.

12. Paste the URL in your web browser's address bar to see the associated website. It will look like the one shown in Figure 3-14.



Hey, App Service developers!

Your app service is up and running.
Time to take the next step and deploy your code.

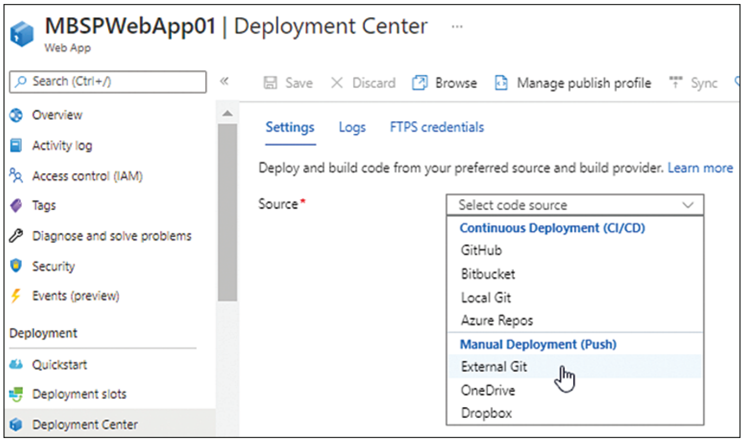
Have your code ready?
Use deployment center to get code published from your client or setup continuous deployment.

Don't have your code yet?
Follow our quickstart guide and you'll have a full app ready in 5 minutes or less.

FIGURE 3-14 The default web app website.

Now you'll build the web app.

13. In the **Deployment** section of the web app's page in the Azure Portal, click **Deployment Center**.
14. In the **Settings** tab, click the **Source** drop-down list and select **External Git**. (See Figure 3-15.)



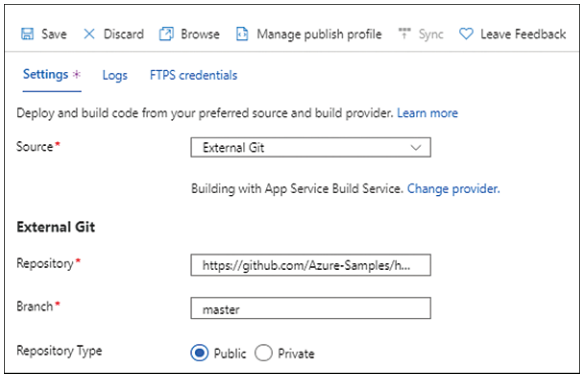
Deploy and build code from your preferred source and build provider. Learn more

Source* Select code source

Continuous Deployment (CI/CD)
GitHub
Bitbucket
Local Git
Azure Repos
Manual Deployment (Push)
External Git
OneDrive
Dropbox

FIGURE 3-15 Setting the deployment source.

15. Under External Git, type https://github.com/Azure-Samples/html-docs-hello-world.git in the Repository box, type master in the **Branch** box, and select the Public option button next to **Repository Type**. (See Figure 3-16.)



Deploy and build code from your preferred source and build provider. Learn more

Source* External Git

Building with App Service Build Service. Change provider.

External Git

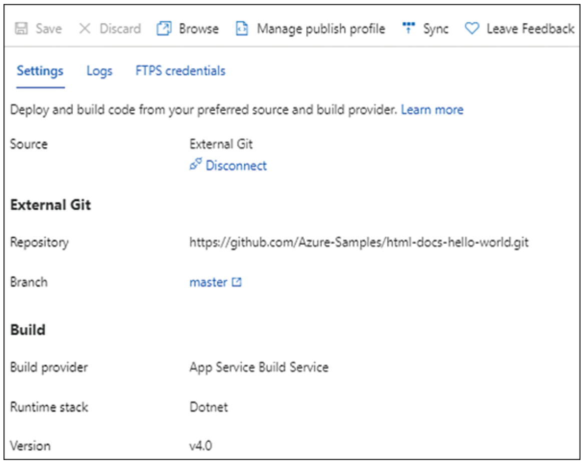
Repository* https://github.com/Azure-Samples/h...

Branch* master

Repository Type [✓ Public] Private

FIGURE 3-16 Setting the External Git configuration.

16. Click **Save** to apply the changes. This will reload the code from the repository and restart the web app.
17. Verify the app details. (See Figure 3-17.)



Deploy and build code from your preferred source and build provider. Learn more

Source External Git

Disconnect

External Git

Repository https://github.com/Azure-Samples/html-docs-hello-world.git

Branch master

Build

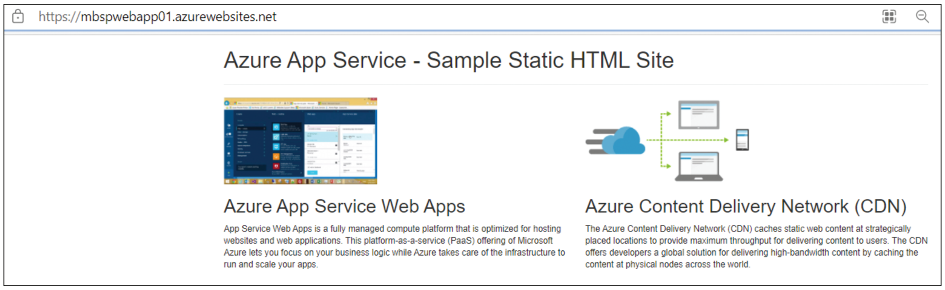
Build provider App Service Build Service

Runtime stack Dotnet

Version v4.0

FIGURE 3-17 The external Git configuration.

18. Click **Browse** to return to the website.
19. The website has changed, as shown in Figure 3-18, indicating that the Git repository was successfully cloned to build your web app.


https://mbspwebapp01.azurewebsites.net

Azure App Service - Sample Static HTML Site

Azure App Service Web Apps

App Service Web Apps is a fully managed compute platform that is optimized for hosting websites and web applications. This platform-as-a-service (PaaS) offering of Microsoft Azure lets you focus on your business logic while Azure takes care of the infrastructure to run and scale your apps.

Azure Content Delivery Network (CDN)

The Azure Content Delivery Network (CDN) caches static web content at strategically placed locations to provide maximum throughput for delivering content to users. The CDN offers developers a global solution for delivering high-bandwidth content by caching the content at physical nodes across the world.

FIGURE 3-18 Sample Azure App Service static HTML site.

USING AZURE POWERSHELL

You can create a sample static HTML website for the Hello World web app with Azure PowerShell using the `New-AzAppServicePlan` and `New-AzWebApp` commands. The following code shows you how. (Note that you need to connect to the Azure subscription using PowerShell first.)

Note that you need to make the following replacements in the code:

- Replace the app name with a unique name or add (`Get-Random`) to the end of the name to randomize it.
- Replace the `Location` variable with the desired Azure region.
- Replace the resource group name with an existing resource group or a different name (optional).

After the script successfully completes, browse to the web app URL to verify the application has been created successfully:

```
# Set the public GitHub repository URL, AppName and Location variables.
$githubrepo="https://github.com/Azure-Samples/html-docs-hello-world.git"
$appname="MBSPWebApp01"
$location="East US"
$resourcegroup="AppServiceRG01"
# Create a resource group to host the App Service.
New-AzResourceGroup -Name $resourcegroup -Location $location
# Create an App Service plan in Free tier.
New-AzAppServicePlan -Name $appname -Location $location -ResourceGroupName $resource-
group -Tier Free
# Create a web app using the App Service Plan.
New-AzWebApp -Name $appname -Location $location -AppServicePlan $appname -ResourceGroup-
Name $resourcegroup
# Configure GitHub deployment from your GitHub repo and deploy once.
$PropertiesObject = @{
    repoUrl = "$githubrepo";
    branch = "master";
    isManualIntegration = "true";
}
```

```
Set-AzResource -Properties $PropertiesObject -ResourceGroupName $resourcegroup
-ResourceType Microsoft.Web/sites/sourcecontrols -ResourceName $appname/web
-ApiVersion 2015-08-01 -Force
```

USING THE AZURE CLI

You can create a sample static HTML website for the Hello World web app with the Azure CLI using the `az appservice plan create` and `az webapp create` commands. The following code shows you how. (Note that you need to connect to the Azure subscription using the Azure CLI first.)

Note that you need to make the following replacements in the code:

- Replace the app name with a unique name or add (`$RANDOM`) to the end of the name to randomize it.
- Replace the `Location` variable with the desired Azure region.
- Replace the resource group name with an existing resource group or a different name (optional).

After the script successfully completes, browse to the web app URL to verify the application has been created successfully:

```
#!/bin/bash
# Set the public GitHub repository URL, AppName and Location variables.
githubrepo=https://github.com/Azure-Samples/html-docs-hello-world.git
appname=MBSPWebApp01
location=EastUS
resourcegroup=AppServiceRG01
# Create a resource group to host the App Service.
az group create --location $location --name $resourcegroup
# Create an App Service plan in Free tier.
az appservice plan create --name $appname --resource-group $resourcegroup --sku FREE
# Create a web app using the App Service Plan.
az webapp create --name $appname --resource-group $resourcegroup --plan $appname
# Configure GitHub deployment from your GitHub repo and deploy once.
az webapp deployment source config --name $appname --resource-group $resourcegroup
--repo-url $githubrepo --branch master --manual-integration
```

Planning deployment and operations

There are three main components to take into consideration when planning a deployment to Azure App Service:

- Deployment sources
- Build pipelines
- Deployment mechanisms

Each of these is used differently in every environment, as each environment has unique use cases and development needs. It is difficult to take a one-size-fits-all approach when planning a deployment, so it will serve you well to understand these three main components. First, though, let's discuss appropriate deployment sources.

Select an appropriate deployment source

One of the first steps in the deployment process is to identify the location where the application code will reside during the development, test, and production phases. There are two main options for this:

- **A single centralized source for all phases** This approach involves using a centralized source such as GitHub, Azure Repos, or Bitbucket, where all the code can reside for deployments as needed.
- **A hybrid approach** This approach involves using a combination of sources: a centralized source for testing and production and a local source on the developer's local storage for development.

The recommended approach for any enterprise environment is to identify a centralized source so that all the code repository structures can be built and maintained centrally, and code backups can be performed on a regular basis. For example, App Service has built-in integration with GitHub, which can be easily set up when the GitHub environment is online.

Deployment source walkthrough

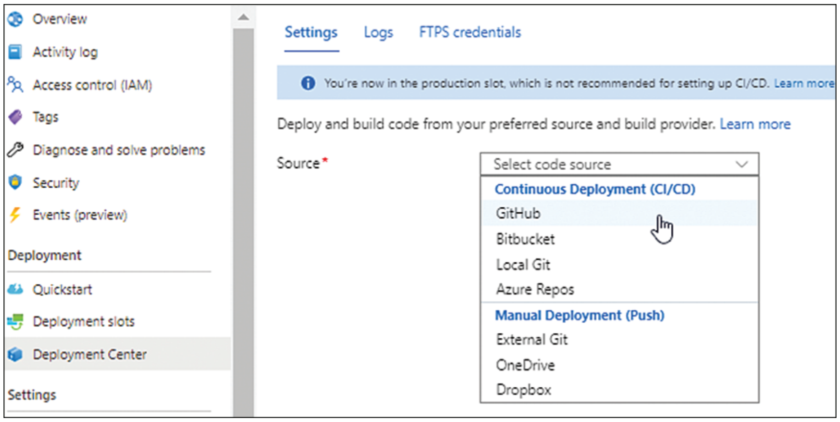
The following sections step you through the process of setting up a different deployment source for the static web app you created earlier using the Azure Portal, Azure PowerShell, and Azure CLI. If you are following along, then make sure to adjust the web app name and variables as needed for each deployment.

NOTE **Be sure to adjust the web app's name for each deployment.**

USING THE AZURE PORTAL

To select a deployment source using the Azure Portal, follow these steps:

1. In the Azure Portal, select the web app you created earlier.
2. In the left pane, under **Deployment**, click **Deployment Center**.
3. In the **Settings** tab, click the **Source** drop-down list and choose **GitHub**. (See Figure 3-19.)



You're now in the production slot, which is not recommended for setting up CI/CD. Learn more

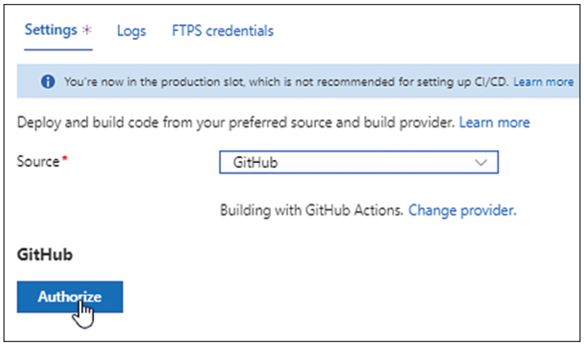
Deploy and build code from your preferred source and build provider. Learn more

Source* Select code source

Continuous Deployment (CI/CD)
GitHub
Bitbucket
Local Git
Azure Repos
Manual Deployment (Push)
External Git
OneDrive
Dropbox

FIGURE 3-19 Selecting a new deployment source.

4. Click the **Authorize** button. (See Figure 3-20.)



You're now in the production slot, which is not recommended for setting up CI/CD. Learn more

Deploy and build code from your preferred source and build provider. Learn more

Source* GitHub

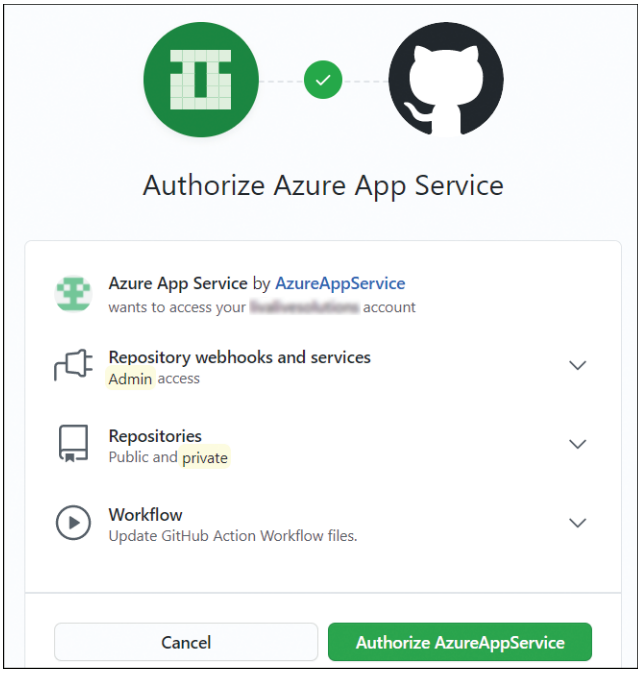
Building with GitHub Actions. Change provider.

GitHub

FIGURE 3-20 Authorizing the deployment source (in this case, GitHub).

5. In the Authorize Azure App Service dialog box, click the **Authorize AzureAppService** button. (See Figure 3-21.)

   In the GitHub login window that opens, enter your login credentials to begin the integration process. This may take a few minutes. When the integration process is complete, you'll see the options shown in Figure 3-22.
6. Open the **Organization** drop-down and choose the appropriate organization.
7. Open the **GitHub Repository** drop-down and choose the desired repository.
8. Open the **Branch** drop-down list and choose the branch you want to connect the app to.
9. Under **Build**, open the **Runtime Stack** drop-down list and choose the appropriate runtime stack based on your environment. Then open the Version drop-down list and select the appropriate version. (See Figure 3-23.) Finally, click **Save**.



Authorize Azure App Service

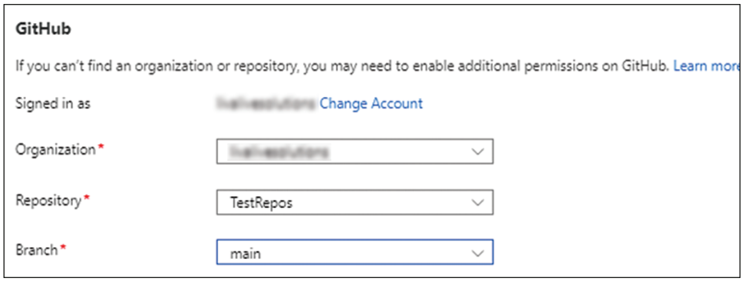
Azure App Service by AzureAppService
wants to access your [redacted] account

Repository webhooks and services
Admin access

Repositories
Public and private

Workflow
Update GitHub Action Workflow files.

FIGURE 3-21 Authorizing the deployment source (GitHub).

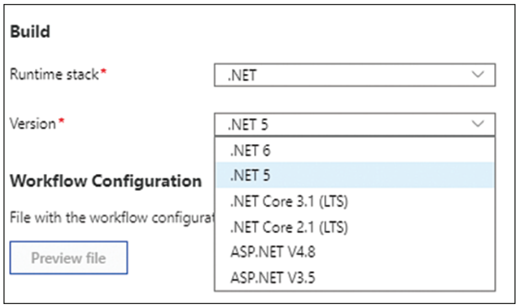


GitHub

If you can't find an organization or repository, you may need to enable additional permissions on GitHub. Learn more

Signed in as	[redacted] Change Account
Organization *	[redacted]
Repository *	TestRepos
Branch *	main

FIGURE 3-22 Setting the organization, repository, and branch under GitHub.



Build

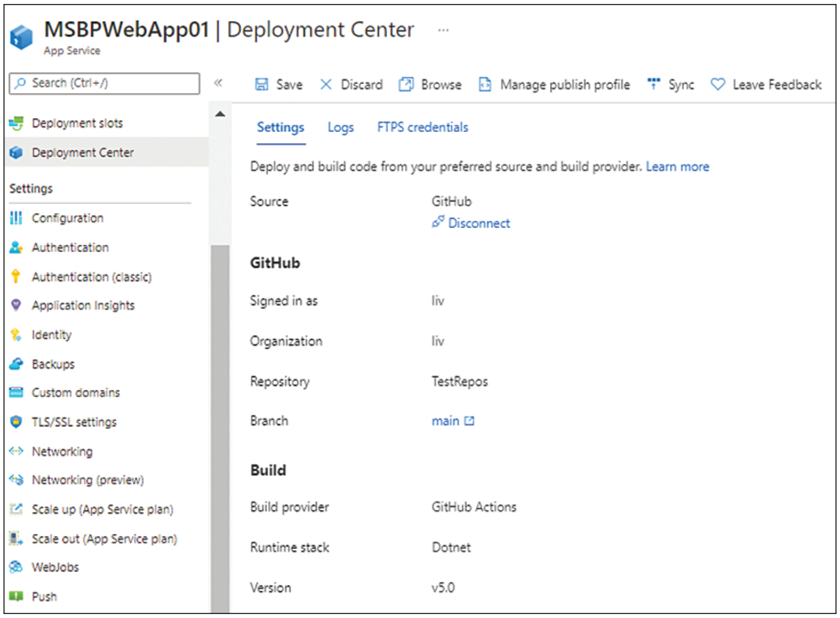
Runtime stack *	.NET
Version *	.NET 5

Workflow Configuration

File with the workflow configurat

FIGURE 3-23 Selecting the runtime stack and version.

Azure shows a summary of the configuration settings. (See Figure 3-24.)


MSBPWebApp01 | Deployment Center
App Service

Save Discard Browse Manage publish profile Sync Leave Feedback

Settings Logs FTPS credentials

Deploy and build code from your preferred source and build provider. Learn more

Source: GitHub
Disconnect

GitHub

Signed in as: liv
Organization: liv
Repository: TestRepos
Branch: main

Build

Build provider: GitHub Actions
Runtime stack: Dotnet
Version: v5.0

FIGURE 3-24 Summary of the final config is shown.

USING AZURE POWERSHELL

You can use Azure PowerShell to select a deployment source, as shown here. (Remember to adjust the value of each variable as needed for your environment.)

```
#Set the Webapp and GitHub variables
$githubrepository="{URL-of-required-GitHub-repo}"
$githubtoken="{GitHub-access-token}"
$webappname="{Name-Of-WebApp}"
$webapplocation="{WebApp-Azure-Region}"
# Setup GitHub token
$PropertyObject = @{token = $githubtoken;}
Set-AzResource -PropertyObject $PropertyObject -ResourceId /providers/Microsoft.Web/
sourcecontrols/GitHub -ApiVersion 2015-08-01 -Force
# Configure GitHub deployment from the required GitHub repo
$PropertyObject = @{
    repoUrl = "$githubrepository";
    branch = "master";
}
# Set the Webapp with the GitHub configuration
```

```
Set-AzResource -PropertyObject $PropertyObject -ResourceGroupName {resource-group-name}
-ResourceType Microsoft.Web/sites/sourcecontrols -ResourceName $webappname/web
-ApiVersion 2015-08-01 -Force
```

USING THE AZURE CLI

You can use the Azure CLI to select a deployment source, as shown here. (Remember to adjust the value of each variable as needed for your environment.)

```
#Set the Webapp and GitHub variables
githubrepos={URL-Of-GitHub-Repository}
githubtoken={GitHub-Access-Token}
WebApp={WebAppName}
ResourceGroup={ResourceGroupName}
# Configure continuous deployment from GitHub.
az webapp deployment source config --name $WebApp --resource-group $ResourceGroup
--repo-url $githubrepos --branch master --git-token $githubtoken
```

Build pipelines

A build pipeline helps automate the process of compiling, testing, and packaging source code for deployment. The pipeline reads the source code data from the deployment source and performs a series of predefined steps to prepare it for deployment.

The programming language used for the app build will determine the commands employed during the build process. This process can be executed using Azure Pipelines, a third-party solution, or locally.

Deployment mechanism

After an application package has been built, it is deployed into the web app. This action is called the *deployment mechanism*. App Service supports multiple deployment mechanisms:

- **Kudu** This open-source engine handles continuous deployments, provides HTTP endpoints, and manages all Git deployments in Azure App Service.
- **FTP** You can use this protocol to upload files from a source website directly to the web app.
- **WebDeploy** This client-server tool, designed by Microsoft, syncs application content and configuration to web apps.

After the selected deployment mechanism copies the code to the web app, every VM instance running the app receives a notification regarding the availability of the new files. Each instance syncs the new files from the shared location in the web app's /wwwroot directory.

Best practices

Following are several best practices that relate to deployment.

Deployment slots

Deployment slots provide an easy way to deploy and manage code rollouts. A deployment slot creates a live App Service inside the App Service plan. You can use this to load code for testing; then, when testing is complete, you can swap the slot so the code moves to staging or production.

In the back end, the deployment slot is already live on worker instances, ready to receive connections. After the swap is performed, all settings applied to the staging or production slot will be applied to the code in the test slot (depending on which slot is selected). This makes it important to use App Service settings and connection strings to store all the required database and unique app settings required for staging or production. If this configuration is stored in the application code, the staging or production application will write to the test database instances.

It is highly recommended to use deployment slots when deploying new code to staging or production because it makes it easier to swap the previous version of the code in case of any issues. This can reduce downtime while also automating the entire DevOps pipeline workflow to build, test, and validate new code before rolling it out into production.

Deployment slots are not supported on the Free, Shared, or Basic tier plans; they are supported, however, on all plans from the Standard plan onward. For enterprise environments in which DevOps processes are in place, this would generally be the minimum plan selected. Each deployment slot has its own unique URL, which you can use to access the code in that slot for testing at no additional cost.

NOTE **If you scale a deployment slot up or out, all the slots on the App Service will be scaled accordingly, as they all share the same App Service plan.**

Along with the codebase is a group of settings that get swapped, as follows:

- General application settings, such as the framework version, web sockets, and so on
- Connection strings (you can configure these to remain with the slot)
- App settings (you can configure these to remain with the slot)
- Public certificates
- WebJobs content
- Handler mappings

There are also settings that are not transferred during a swap. You should take these into consideration and manage the code accordingly to ensure that the right settings are applied at the time of the swap. Following is a list of some of these settings:

- Publishing endpoints
- Custom domain names
- Non-public certificates and TLS/SSL settings
- Scale settings
- WebJobs schedulers
- IP restrictions
- The Always On setting
- Diagnostic settings

Deployment slots walkthrough

The following sections step you through the process of setting up deployment slots for your web app using the Azure Portal, Azure PowerShell, and the Azure CLI.

NOTE **Be sure to adjust the web app's name and variables for each deployment.**

USING THE AZURE PORTAL

To set up deployment slots using the Azure Portal, follow these steps:

1. In the Azure Portal, display the page for the web app you created earlier.
2. In the left pane, under **Deployment**, click **Deployment Slots**. (See Figure 3-25.)

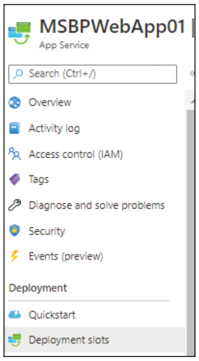
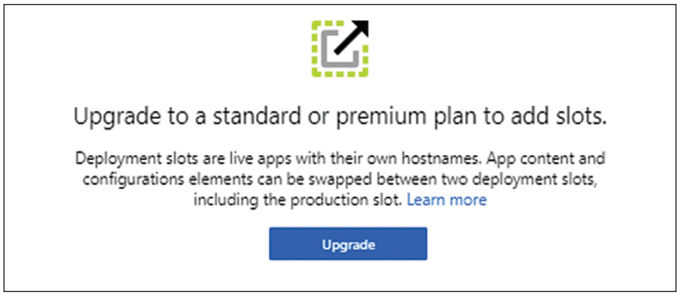


FIGURE 3-25 Setting up deployment slots.

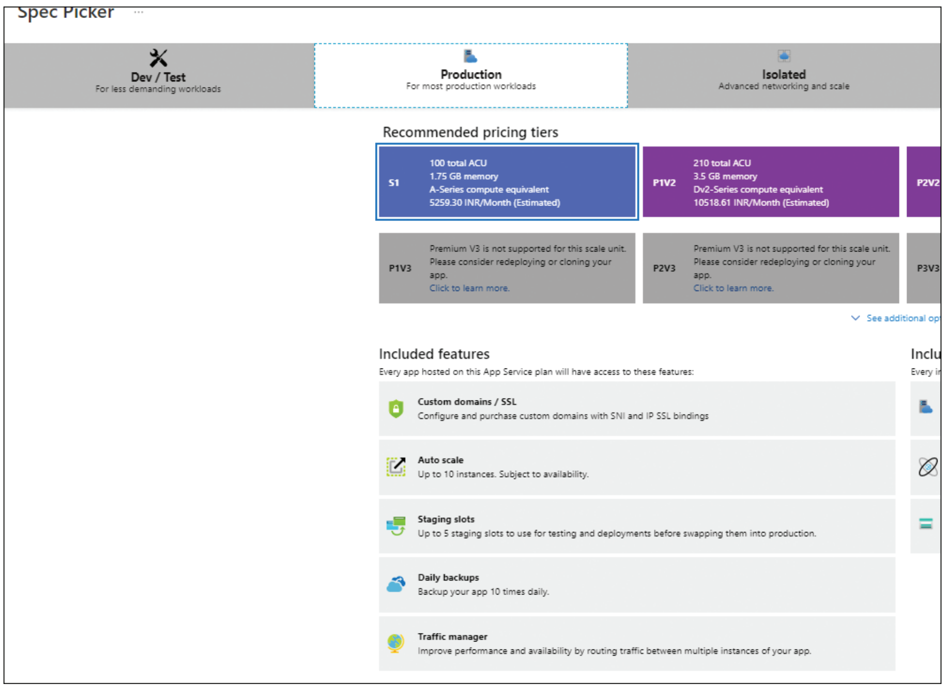
3. If the web app is on the Free, Shared, or Basic tier, you will see the message shown in Figure 3-26. Click **Upgrade** to upgrade to a Standard or Premium plan. Then, in the Spec Picker window (see Figure 3-27), select a Standard or Premium plan that supports deployment slots, and click **Apply**.



Upgrade to a standard or premium plan to add slots.

Deployment slots are live apps with their own hostnames. App content and configurations elements can be swapped between two deployment slots, including the production slot. Learn more

FIGURE 3-26 Upgrading the App Service plan for slot support.



Spec Picker

Dev / Test
For less demanding workloads
Production
For most production workloads
Isolated
Advanced networking and scale

Recommended pricing tiers

S1 — 100 total ACU, 1.75 GB memory, A-Series compute equivalent, 5259.30 INR/Month (Estimated)

P1V2 — 210 total ACU, 3.5 GB memory, Dv2-Series compute equivalent, 10518.61 INR/Month (Estimated)

P2V2

P1V3 — Premium V3 is not supported for this scale unit. Please consider redeploying or cloning your app. Click to learn more.

P2V3 — Premium V3 is not supported for this scale unit. Please consider redeploying or cloning your app. Click to learn more.

P3V3

See additional op

Included features

Every app hosted on this App Service plan will have access to these features:

Custom domains / SSL
Configure and purchase custom domains with SNI and IP SSL bindings

Auto scale
Up to 10 instances. Subject to availability.

Staging slots
Up to 5 staging slots to use for testing and deployments before swapping them into production.

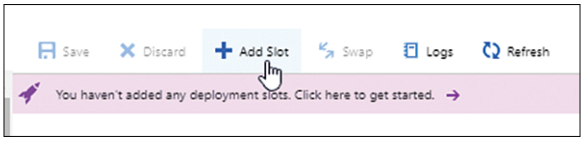
Daily backups
Backup your app 10 times daily.

Traffic manager
Improve performance and availability by routing traffic between multiple instances of your app.

Inclu
Every i

FIGURE 3-27 Selecting a Standard or Premium App Service Plan.

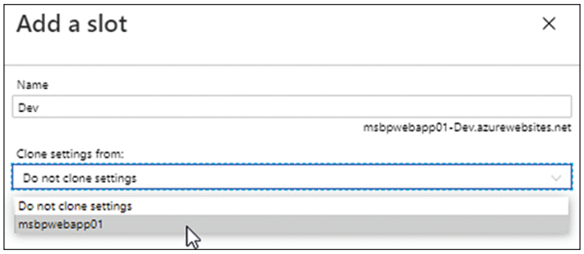
4. Click the **Add Slot** button to start the Add a Slot wizard. (See Figure 3-28.)



You haven't added any deployment slots. Click here to get started. →

FIGURE 3-28 Adding a new slot.

5. In the Add a Slot wizard (see Figure 3-29), enter a unique name for the new slot in the **Name** box. Then open the **Clone Settings From** drop-down list and specify whether the settings for the slot should be cloned from an existing web app or slot, and if so, which one. Finally, click **Add**.



Add a slot

Name: Dev

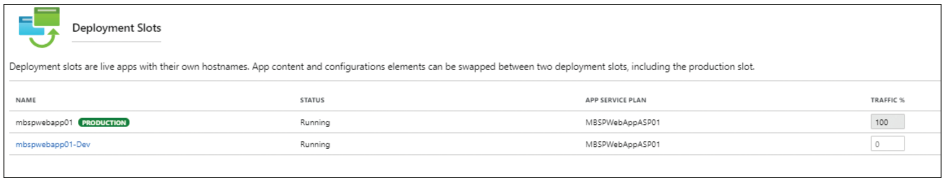
msbpwebapp01-Dev.azurewebsites.net

Clone settings from: Do not clone settings

Do not clone settings
msbpwebapp01

FIGURE 3-29 Selecting the new slot settings.

The new slot appears under the main production slot and any other existing slots for the web app. (See Figure 3-30.)



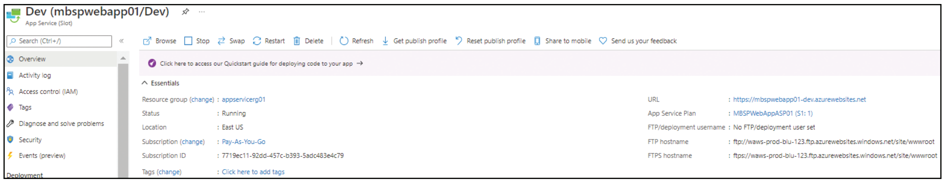
Deployment Slots

Deployment slots are live apps with their own hostnames. App content and configurations elements can be swapped between two deployment slots, including the production slot.

NAME	STATUS	APP SERVICE PLAN	TRAFFIC %
mbspwebapp01 PRODUCTION	Running	MBSPWebAppASP01	100
mbspwebapp01-Dev	Running	MBSPWebAppASP01	0

FIGURE 3-30 Multiple deployment slots.

6. Obtain the slot's URL by clicking the slot's name. The URL is displayed in the upper-right corner of the slot's Overview tab. (See Figure 3-31.)



Dev (mbspwebapp01/Dev)
App Service (Slot)

Click here to access our Quickstart guide for deploying code to your app →

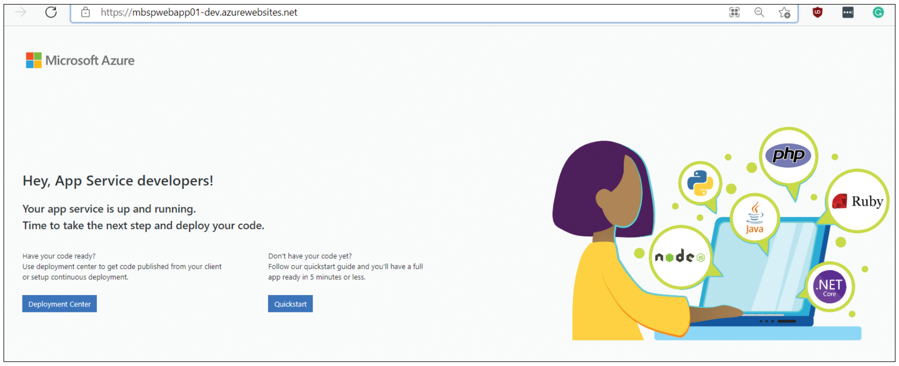
Essentials

Resource group (change)	: appservicerg01
Status	: Running
Location	: East US
Subscription (change)	: Pay-As-You-Go
Subscription ID	: 7719ec11-92dd-457c-b393-5adc483e4c79
Tags (change)	: Click here to add tags

URL	: https://mbspwebapp01-dev.azurewebsites.net
App Service Plan	: MBSPWebAppASP01 (S1: 1)
FTP/deployment username	: No FTP/deployment user set
FTP hostname	: ftp://waws-prod-blu-123.ftp.azurewebsites.windows.net/site/wwwroot
FTPS hostname	: ftps://waws-prod-blu-123.ftp.azurewebsites.windows.net/site/wwwroot

FIGURE 3-31 The new deployment slot's URL.

7. Click the URL to load the default App Service website in your web browser rather than the custom HTML site you built earlier. (See Figure 3-32.)


https://mbspwebapp01-dev.azurewebsites.net

Microsoft Azure

Hey, App Service developers!

Your app service is up and running.
Time to take the next step and deploy your code.

Have your code ready?
Use deployment center to get code published from your client or setup continuous deployment.

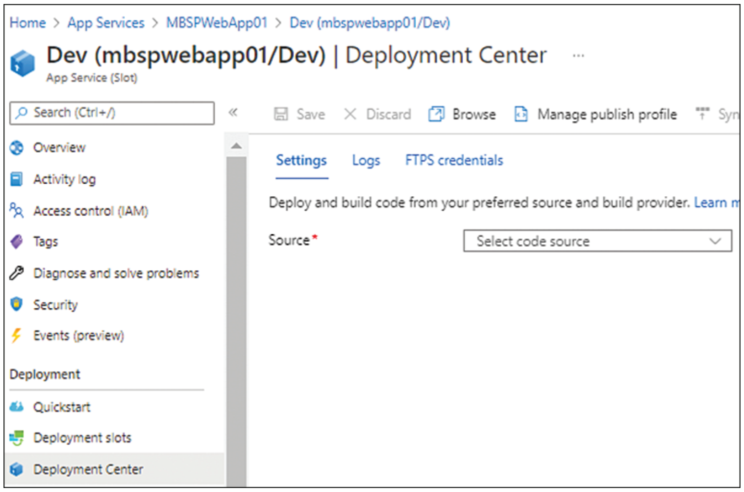
Deployment Center

Don't have your code yet?
Follow our quickstart guide and you'll have a full app ready in 5 minutes or less.

Quickstart

FIGURE 3-32 The website associated with the new deployment slot's URL.

8. Click the **Deployment Center** button on the web page to open the slot's Deployment Center page with the Settings tab displayed. Notice that the Source setting is blank. (See Figure 3-33.)


Home > App Services > MBSPWebApp01 > Dev (mbspwebapp01/Dev)

Dev (mbspwebapp01/Dev) | Deployment Center

App Service (Slot)

Deploy and build code from your preferred source and build provider. Learn m

Source * Select code source

FIGURE 3-33 The slot's Deployment Center page.

9. Open the Source drop-down list and choose the same GitHub account you used earlier, but with a different branch.

USING AZURE POWERSHELL

You can create a deployment slot with Azure PowerShell by using the `New-AzWebAppSlot` command. The following code shows you how to perform this configuration for an existing web app:

```
$ResourceGroup = "AppServiceRG01"
$WebApp = "MBSPWebApp01"
New-AzWebAppSlot -ResourceGroupName $ResourceGroup -name $WebApp -slot dev
```

NOTE You can also use Azure PowerShell to list all available deployment slots (`Get-AzWebAppSlot`), delete a deployment slot (`Remove-AzWebAppSlot`), set up a deployment slot (`Set-AzWebAppSlot`), and swap a deployment slot for a web page (`Switch-AzWebAppSlot`).

USING THE AZURE CLI

You can create a deployment slot with the Azure CLI using the `az webapp deployment slot create` command. The following Bash script shows you how to perform this configuration for an existing web app:

```
az webapp deployment slot create --name MBSPWebapp01 --resource-group AppServiceRG01
--slot Dev
```

NOTE You can also use the Azure CLI to list all available deployment slots (`az webapp deployment slot list`), delete a deployment slot (`az webapp deployment slot delete`), set up a deployment slot (`az webapp deployment slot auto-swap`), and swap a deployment slot for a web page (`az webapp deployment slot swap`).

Deploy code continuously only in staging or testing

You should set up the continuous deployment of code only for staging or testing slots. Setting up continuous deployment for production slots can result in code going live without proper controls.

You should also set up production branch integrations against a dummy slot in the App Service. After the code is deployed in the slot, performing a swap to make the code live is a better approach, as it provides more control over the deployment and allows easy rollback in case of issues.

Use Azure DevOps

Azure DevOps can help with the automated continuous deployment of containers to the App Service. Similarly, you can use the Deployment Center for the continuous delivery of containers to the App Service. After the integration is performed, new commits to the branch will result in the automated building, tagging, and deployment of the updated container.

TIP Follow a similar approach to point a new build to staging to avoid unintended code activations.

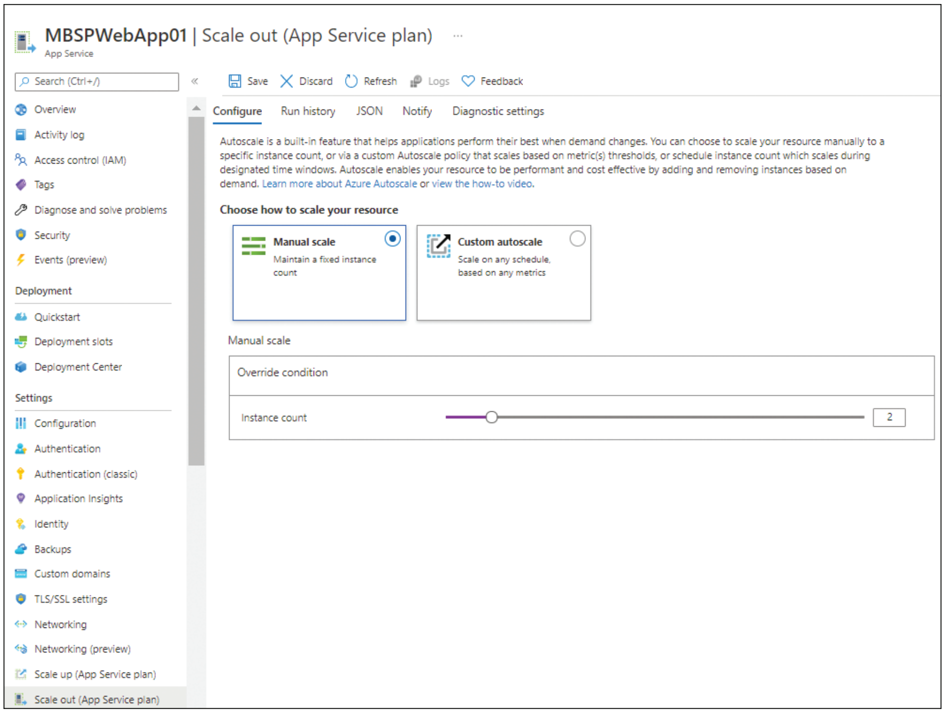
GitHub Actions

GitHub Actions makes it easy to build, test, and deploy code directly from GitHub to App Service. You should employ GitHub Actions if you are using GitHub as a deployment source to help automate code deployments with proper controls and change tracking.

Multiple instances for production applications

For production applications, it is highly recommended that when you design and code the app, you keep in mind that multiple instances of the application will need to run simultaneously. This might require you to code the app to handle multiple VM instances running the app without sync issues when reading or writing data.

Running a production app with one VM instance creates a single point-of-failure. Instead, you should try to run the application with at least two or three instances, splitting your resource requirements across them, instead of one large instance. This will also help you when any upgrades are performed on the underlying VM instances, because the load will be redirected to the other available instances, preventing any downtime. Fortunately, you can easily achieve this by using the scale-out services provided by your App Service plan. (See Figure 3-34.) It is recommended that you set up automated scaling when handling increased resource or load requirements; setting up a minimum number of instances for the app up front can help mitigate a lot of basic issues.



Autoscale is a built-in feature that helps applications perform their best when demand changes. You can choose to scale your resource manually to a specific instance count, or via a custom Autoscale policy that scales based on metric(s) thresholds, or schedule instance count which scales during designated time windows. Autoscale enables your resource to be performant and cost effective by adding and removing instances based on demand. Learn more about Azure Autoscale or view the how-to video.

Choose how to scale your resource

[✓ **Manual scale** Maintain a fixed instance count] **Custom autoscale** Scale on any schedule, based on any metrics

Manual scale

Override condition

Instance count 2

FIGURE 3-34 Scaling for multiple instances.

Collocation

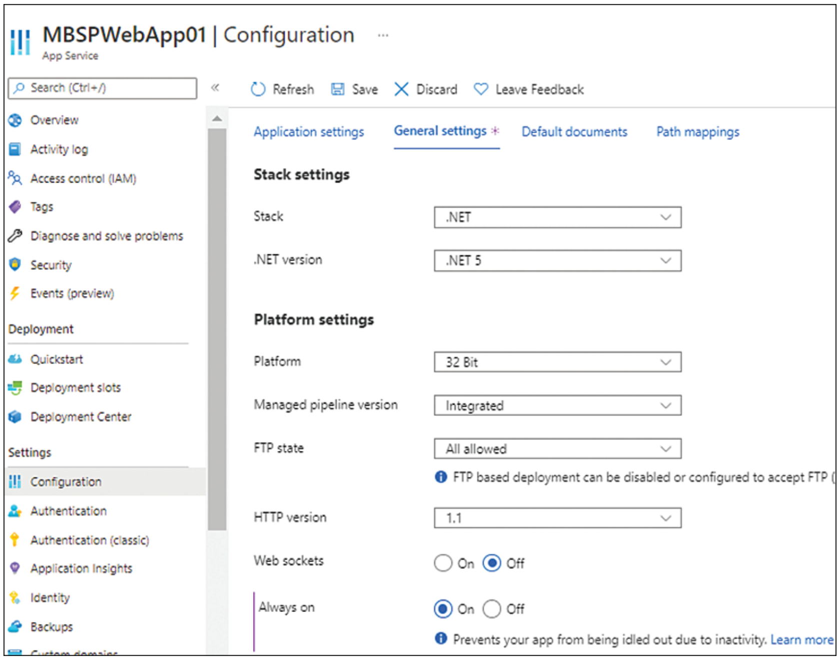
It is a good practice to host all interconnected workloads in the same region—in other words, to collocate them. This helps reduce the following:

- Latency between workloads
- Costs incurred due to data transfer between regions
- Complexity in design and high-availability builds

NOTE **Unless there are business or security reasons for hosting workloads across regions, it is better to collocate them.**

Enable Always On

Always On is an App Service feature that ensures that VM instances are kept alive, even if there are no ingress requests or traffic to the VM instances for more than 20 minutes. This can help prevent the instance from going offline due to an idle timeout, thereby creating a cold-start situation that leads to delayed response times. Always On is disabled by default, but you easily enable it using the Azure Portal (see Figure 3-35), Azure PowerShell, or Azure CLI.


MBSPWebApp01 | Configuration
App Service

Stack settings

Stack: .NET

.NET version: .NET 5

Platform settings

Platform: 32 Bit

Managed pipeline version: Integrated

FTP state: All allowed

FTP based deployment can be disabled or configured to accept FTP (

HTTP version: 1.1

Web sockets: On [✓ Off]

Always on: [✓ On] Off

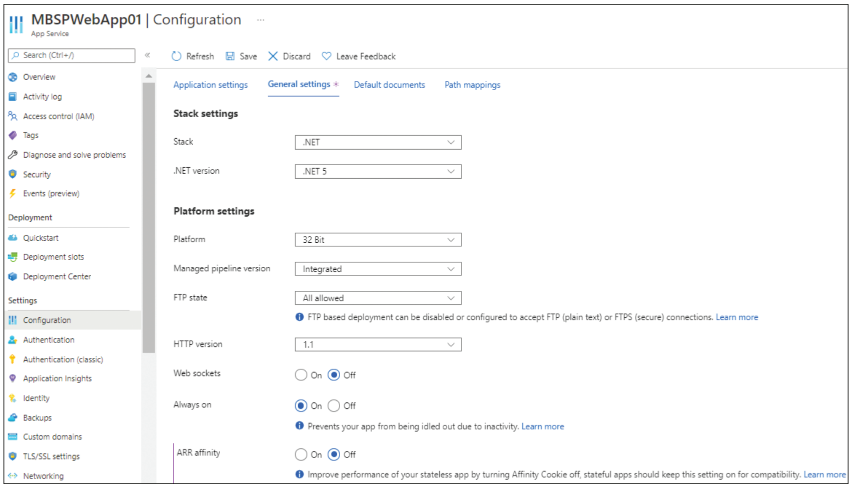
Prevents your app from being idled out due to inactivity. Learn more

FIGURE 3-35 Enabling the Always On setting.

Disable ARR Affinity

When a client session is unexpectedly disconnected from an app, the general practice is to reconnect the user to the same app instance so the previous session can be continued. One way to do this is to enable the Application Request Routing (ARR) Affinity setting. However, when ARR Affinity is enabled, the app uses affinity cookies, which cause some VM instances to become overloaded with sessions and create load-balancing issues.

To avoid this scenario, it is recommended that you either build a stateless application or store the state information in a back-end service like a database or cache. Once that is in place, you can disable the ARR Affinity setting (see Figure 3-36), which should improve app performance.



Stack settings

Stack	.NET
.NET version	.NET 5

Platform settings

Platform	32 Bit
Managed pipeline version	Integrated
FTP state	All allowed
	FTP based deployment can be disabled or configured to accept FTP (plain text) or FTPS (secure) connections. Learn more
HTTP version	1.1
Web sockets	On [✓ Off]
Always on	[✓ On] Off
	Prevents your app from being idled out due to inactivity. Learn more
ARR affinity	On [✓ Off]
	Improve performance of your stateless app by turning Affinity Cookie off, stateful apps should keep this setting on for compatibility. Learn more

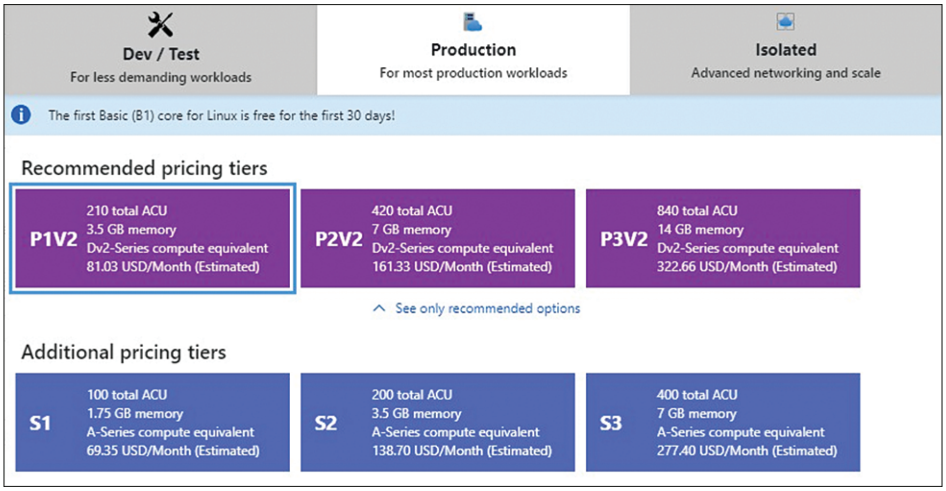
FIGURE 3-36 Disabling ARR Affinity.

Production hardware for production apps

As discussed, there are various App Service tiers available for deployment, and each tier offers specific hardware SKUs to meet different requirements. If the App Service plan is being used for a production application deployment, it is advisable to select hardware in the Production tier. (See Figure 3-37.) This ensures that the hardware resources available to the application are consistent and can be scaled automatically as required.

Define Health Check parameters

App Service has a Health Check feature that monitors the health status of running instances and automatically removes unhealthy instances from the load balancer to avoid disruption in service. This feature is disabled by default; however, it is recommended that you enable it. After you do, define the path that the service should poll on a regular basis to identify unhealthy instances. Be sure the path you select is available on all instances and is critical for the functioning of the application. This will help determine the accurate status of the application. (See Figure 3-38.)


Dev / Test
For less demanding workloads

Production
For most production workloads

Isolated
Advanced networking and scale

The first Basic (B1) core for Linux is free for the first 30 days!

Recommended pricing tiers

P1V2	210 total ACU 3.5 GB memory Dv2-Series compute equivalent 81.03 USD/Month (Estimated)
P2V2	420 total ACU 7 GB memory Dv2-Series compute equivalent 161.33 USD/Month (Estimated)
P3V2	840 total ACU 14 GB memory Dv2-Series compute equivalent 322.66 USD/Month (Estimated)

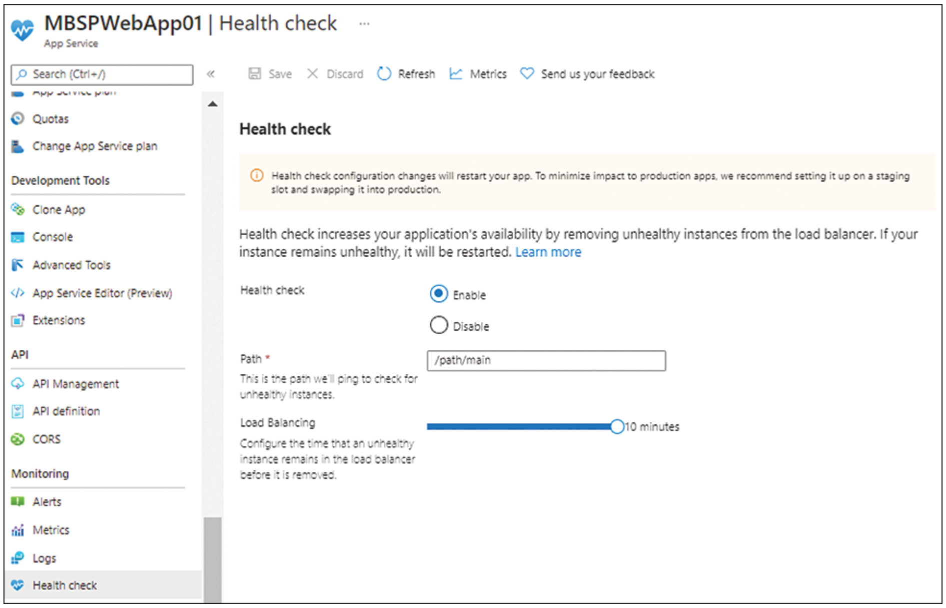
See only recommended options

Additional pricing tiers

S1	100 total ACU 1.75 GB memory A-Series compute equivalent 69.35 USD/Month (Estimated)
S2	200 total ACU 3.5 GB memory A-Series compute equivalent 138.70 USD/Month (Estimated)
S3	400 total ACU 7 GB memory A-Series compute equivalent 277.40 USD/Month (Estimated)

FIGURE 3-37 Selecting the production tier.

NOTE **The Health Check feature works only when there are two or more VM instances running in the app. If the app has only a single instance, traffic will not be blocked, even if that instance is deemed unhealthy, as there is no alternative to failover.**


MBSPWebApp01 | Health check ···
App Service

Health check

Health check configuration changes will restart your app. To minimize impact to production apps, we recommend setting it up on a staging slot and swapping it into production.

Health check increases your application's availability by removing unhealthy instances from the load balancer. If your instance remains unhealthy, it will be restarted. Learn more

Health check: [✓ Enable] Disable

Path *: /path/main
This is the path we'll ping to check for unhealthy instances.

Load Balancing: 10 minutes
Configure the time that an unhealthy instance remains in the load balancer before it is removed.

FIGURE 3-38 Configuring Health Check.

Application Initialization

Application Initialization is a great feature to warm up a new application instance before it is made available to users. You can query a single URL path or multiple URL paths in the application to warm them up or trigger a script to preload cache. If not set, it can result in application instances being put into service at the time of any restart or scale-out operation, without being ready to service clients.

In such cases, the recommended approach is to set App Initialization in the web.config file to define the different custom URL paths that need to be queried to confirm that the application is completely online before the instance is put into service. If multiple URL paths are defined, App Service will wait for all the paths to confirm their status (success or failure) before the instance is made live.

TIP **Set this up if you notice that new app instances are causing timeouts, access failures, or other unexpected behavior when they come online.**

Auto-Heal

Auto-Heal is an App Service feature that enables you to trigger custom actions based on high memory usage, high CPU usage, and so on. The custom actions currently supported include the following:

- Email alerts to admins or stakeholders
- Automated worker process recycling
- Memory dump collection for investigation

This is a great feature, and you can configure it using the web.config tool, the Azure Portal, Azure PowerShell, or the Azure CLI.

Auto-Heal walkthrough

The following section steps you through the process of setting up Auto-Heal using the Azure Portal.

USING THE AZURE PORTAL

To set up Auto-Heal using the Azure Portal, follow these steps:

1. In the left pane of the web app's configuration page, click **Diagnose and Solve Problems**. Then, in the right pane, click **Diagnostic Tools**. (See Figure 3-39.)

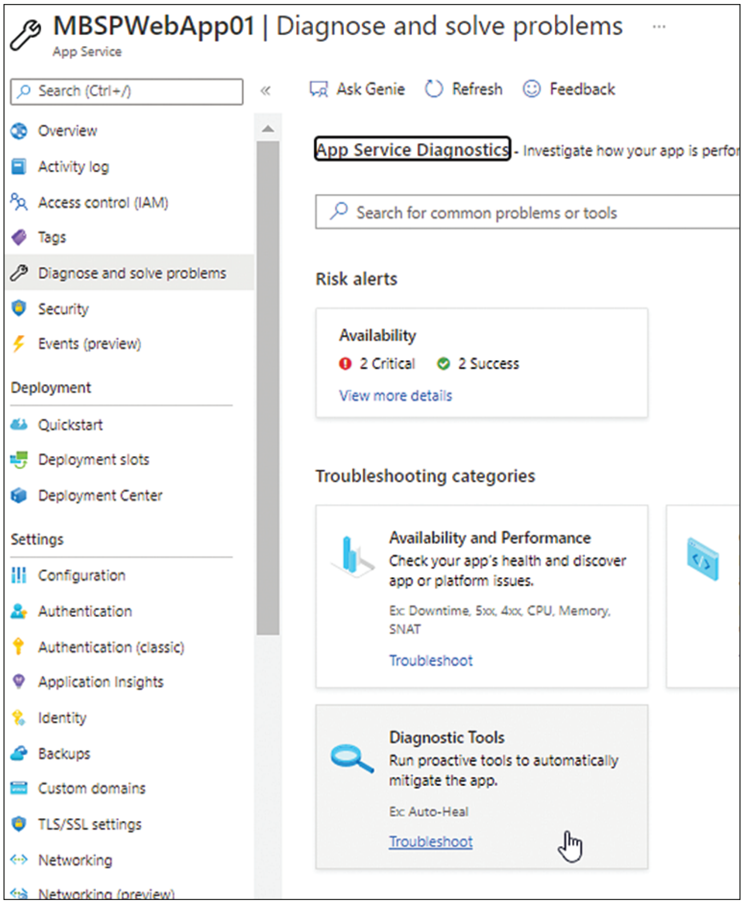
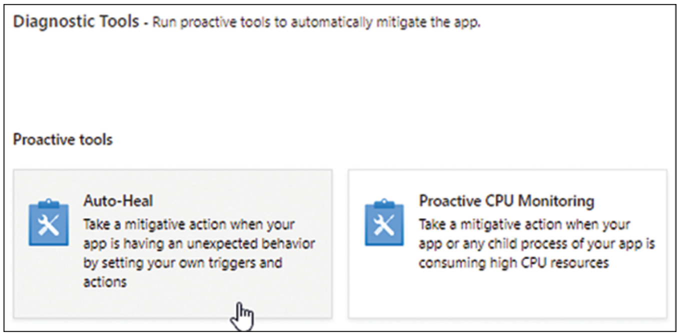


FIGURE 3-39 Selecting the Diagnostic Tools option.

2. Click **Auto-Heal**. (See Figure 3-40.)



Diagnostic Tools - Run proactive tools to automatically mitigate the app.

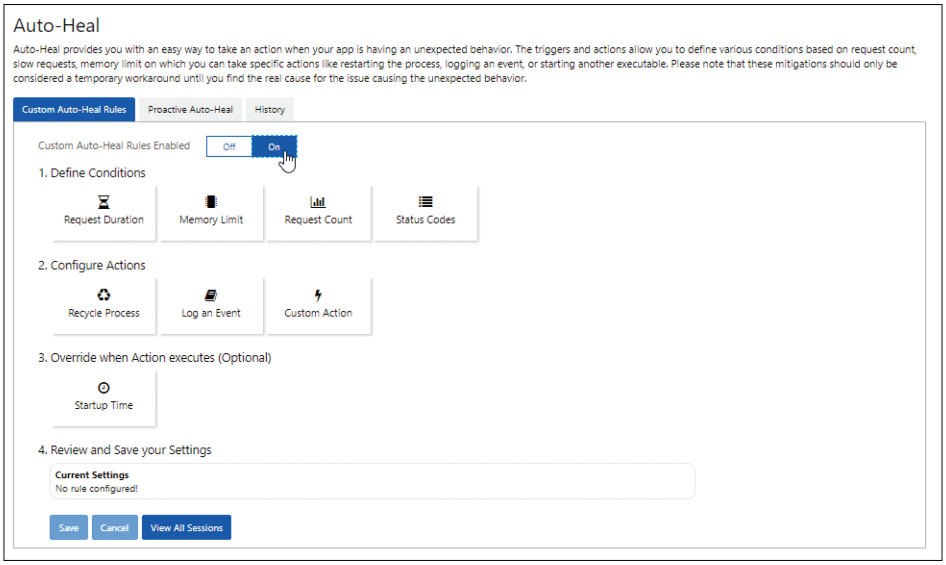
Proactive tools

Auto-Heal
Take a mitigative action when your app is having an unexpected behavior by setting your own triggers and actions

Proactive CPU Monitoring
Take a mitigative action when your app or any child process of your app is consuming high CPU resources

FIGURE 3-40 Selecting Auto-Heal.

3. Next to **Custom Auto-Heal Rules Enabled**, click **On**. Then define the desired conditions, actions, and override options based on your app requirements and click **Save**. (See Figure 3-41.)



Auto-Heal

Auto-Heal provides you with an easy way to take an action when your app is having an unexpected behavior. The triggers and actions allow you to define various conditions based on request count, slow requests, memory limit on which you can take specific actions like restarting the process, logging an event, or starting another executable. Please note that these mitigations should only be considered a temporary workaround until you find the real cause for the issue causing the unexpected behavior.

Custom Auto-Heal Rules Enabled: Off [✓ On]

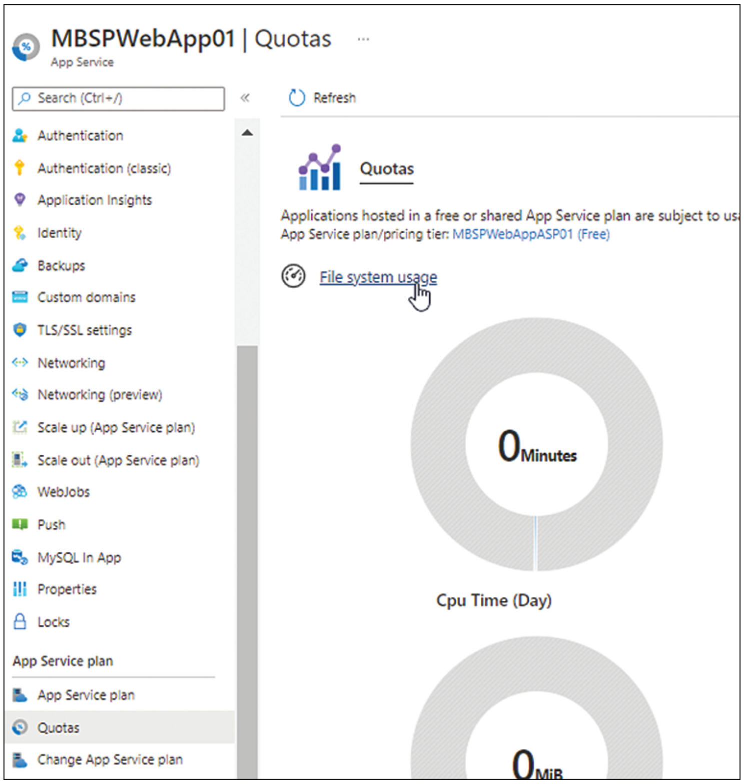
1. Define Conditions
2. Configure Actions
3. Override when Action executes (Optional)
4. Review and Save your Settings

Current Settings
No rule configured!

FIGURE 3-41 Enabling Auto-Heal.

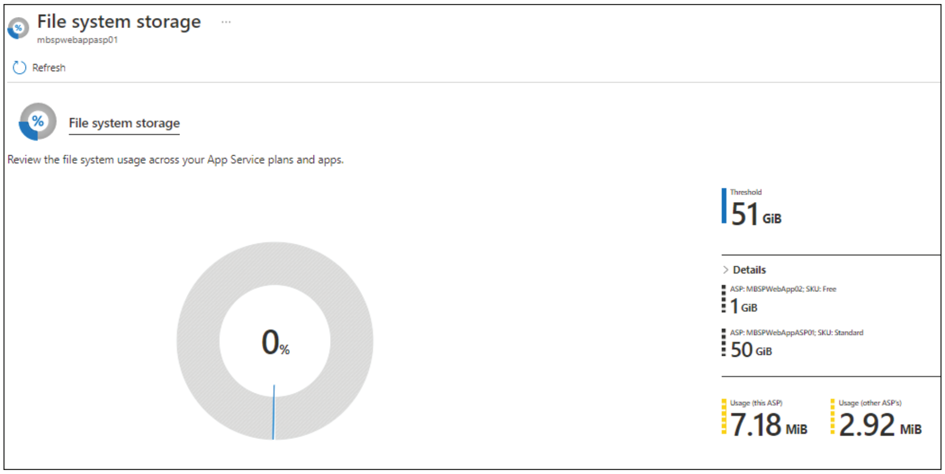
Monitor disk space usage

The Azure Portal has an option to monitor App Service quotas, which you can use to monitor an app's file system usage. For example, you might monitor this to ensure that the web folder has a minimum of 1 GB of free disk space for faster application restarts and scale-outs. (See Figure 3-42 and Figure 3-43.)



Applications hosted in a free or shared App Service plan are subject to us
App Service plan/pricing tier: MBSPWebAppASP01 (Free)

FIGURE 3-42 Quota check.



Review the file system usage across your App Service plans and apps.

Threshold
51 GiB

Details
ASP: MBSPWebApp02; SKU: Free
1 GiB
ASP: MBSPWebAppASP01; SKU: Standard
50 GiB

Usage (this ASP)
7.18 MiB
Usage (other ASP's)
2.92 MiB

FIGURE 3-43 File system storage usage.

Enable Application Insights

Application Insights is an Azure Monitor feature to detect and analyze performance anomalies, debug code errors, and provide a better understanding of user behavior when using the app.

App Insights includes a feature called the Profiler. This feature enables you to capture the performance of the application and obtain detailed traces to identify hot code paths. (A *hot code path* is the one that take the longest to respond when handling a web request.) This can help you identify bottlenecks within an app and any dependencies. It also allows you to target development or troubleshooting efforts more appropriately.

TIP **Profiler works only with .NET applications. If you build an app using .NET, it is highly recommended that you set up Profiler to obtain these deep insights.**

Configure monitoring and alerts

Set up monitoring for important parameters and define alerts based on appropriate thresholds. These alerts can be defined on the App Service or the App Service Plan level. There are a few recommendations for monitoring and alerting that can be configured as follows:

- **Average Working Memory Set** This helps identify the average amount of memory in MiBs used by the app. It's recommended to set this value based on the expected average memory requirements so that any breach is alerted.
- **Average CPU Percentage** This helps identify the average CPU used across all the app instances. It's recommended to set this value high enough that alerts can help either scaling or remediation actions to be taken before any service interruptions.
- **HTTP Server Errors** This helps to monitor specific HTTP status codes to identify errors or issues being encountered in web requests. It's recommended to set the value to monitor and alert for high instances of HTTP status codes greater than or equal to 400 and less than 500.
- **Average Response Time** This helps to monitor app responsiveness. If this value is too high, then it might indicate ongoing or imminent problems with the app. It's recommended to set this value for alerting based on stress testing to identify appropriate thresholds for the hosted app.
- **Average Memory Percentage** This helps to monitor the average memory used in all the instances of the app. It's recommended to set this value high enough that alerts can help either scaling or remediation actions to be taken before any service interruptions.

Deploy in multiple regions

One of the best ways to achieve high availability and ensure disaster recovery for an app is to deploy it across multiple regions. Doing so can help ensure that any regional outage does not impact app availability. This will require various other considerations as we've covered in the Disaster Recovery section later in this chapter.

However, if possible, incorporate this into the application design at the earliest stage possible.

A multi-region design can also help in routing requests to the closest datacenter based on the user's region. This can be achieved using Azure Front Door or Azure Traffic Manager to manage all the ingress traffic and route it appropriately. This can also help load-balance traffic between multiple geographies providing global load-balancing.

Plan new app deployments in existing plans

Generally, when a new workload is deployed, there is a temporary spike in resource requirements while the workload is completely online and servicing requests, at which point things stabilize and return to earlier levels until user traffic hits the new workload. If you are deploying a new workload using an existing App Service plan, you should check the CPU and memory usage to make sure there is enough spare capacity to handle this deployment spike.

If CPU or memory utilization reaches or exceeds 90%, you should bring additional VM instances online so the overall load goes down. Then you can deploy the new workload. After deployment, the App Service plan can be scaled down based on the new average resource requirements.

Scaling

Scaling is critical for applications using App Service. It can provide both performance benefits and cost savings—which can be maximized if the scaling occurs automatically.

You can achieve scaling (up or down) by changing your App Service plan tier. Be aware, however, that while a lower-tier plan will reduce your costs, it could have an impact on performance and feature availability. Therefore, it is important to identify which features you need in order to meet your application performance requirements and use this information when selecting your plan. For example:

- **Dev and test phase** Use the Free tier so no compute charges are levied.
- **General testing/pre-production release** Use the Shared tier to leverage additional features such as custom DNS and various resources.
- **Production release** Use the Basic Dedicated tier to use SSL/TLS with more resources for scaling.

NOTE **As your needs change or your performance metrics indicate a problem with the selected tier, you can choose a different tier—moving to a higher tier or a lower one based on your storage, compute, or memory requirements.**

Scaling up or down by changing plans occurs almost immediately and requires no changes to the code or application configuration. All apps in the App Service plan are affected when scaling occurs; if you update to a higher-tier plan, each app in the plan will be able to use the new features that become available. Generally, scaling up provides access to features including (but not limited to) the following:

- More CPU, memory, and disk space
- Autoscaling
- Custom domains and SSL/TLS certificates
- Deployment slots

NOTE **Of course, this will also increase the cost of the App Service plan.**

In contrast, scaling down by changing plans removes or reduces the feature set, depending on which plan you choose.

In addition to scaling up or down, you can also scale out or in. Scaling out increases the number of VM instances allocated to run your app(s). For example, in the Dedicated tier, with the Premium V2 and V3 plans, you can deploy 30 VM instances, whereas in the Isolated tier, you can scale out to 100 VM instances. Scaling in is the reverse of these scenarios; you might scale in to reduce costs or unused capacity.

NOTE **When you scale out, it applies to all apps running on the App Service plan on all new instances. So, each new instance runs all the apps in the plan.**

All scaling operations can be performed manually or automatically—*if* your App Service plan tier supports this. Autoscaling is available only in the Standard and Premium plans on the Dedicated tier and the ASE hosted on the Isolated tier. You can perform automatic scaling based on schedules and/or metric-based rules that trigger the scaling operation.

Per-app scaling

Per-app scaling enables you to scale each app in an App Service plan independently, meaning you can configure an app to run on only a certain number of instances. For example, if your App Service plan supports 20 instances, but one of your apps requires only five instances to handle peak loads, you can use per-app scaling to set the scaling limit to five for that app. This enables you to make more appropriate use of the resources available in the App Service plan by assigning more resources only to the apps that require this.

Per-app scaling is enabled at the App Service plan level and can be configured thereafter independently for each app. Using this feature well can help you achieve the highest level of app density per App Service plan.

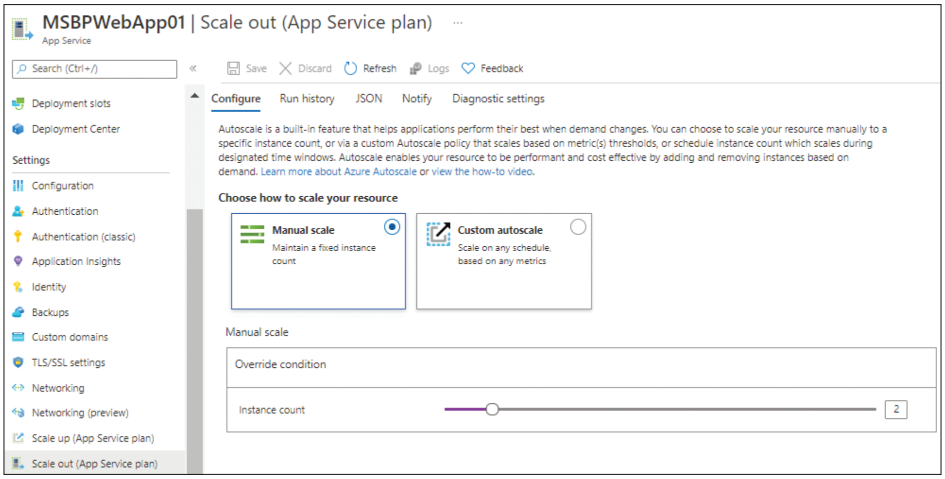
Scaling walkthrough

The following sections step you through the process of setting up scaling for your web app using the Azure Portal, Azure PowerShell, and Azure CLI.

USING THE AZURE PORTAL

To set up scaling using the Azure Portal, follow these steps:

1. In the left pane of the web app's configuration page, under **Settings**, click **Scale Up (App Service Plan)**. Then, in the right pane, do one of the following:
   - Click the **Manual Scale** option button. Then, in the **Manual Scale** settings, drag the **Instance Count** slider to **2**. (See Figure 3-44.)



MSBPWebApp01 | Scale out (App Service plan)

App Service

Autoscale is a built-in feature that helps applications perform their best when demand changes. You can choose to scale your resource manually to a specific instance count, or via a custom Autoscale policy that scales based on metric(s) thresholds, or schedule instance count which scales during designated time windows. Autoscale enables your resource to be performant and cost effective by adding and removing instances based on demand. Learn more about Azure Autoscale or view the how-to video.

Choose how to scale your resource

[✓ Manual scale: Maintain a fixed instance count] Custom autoscale: Scale on any schedule, based on any metrics

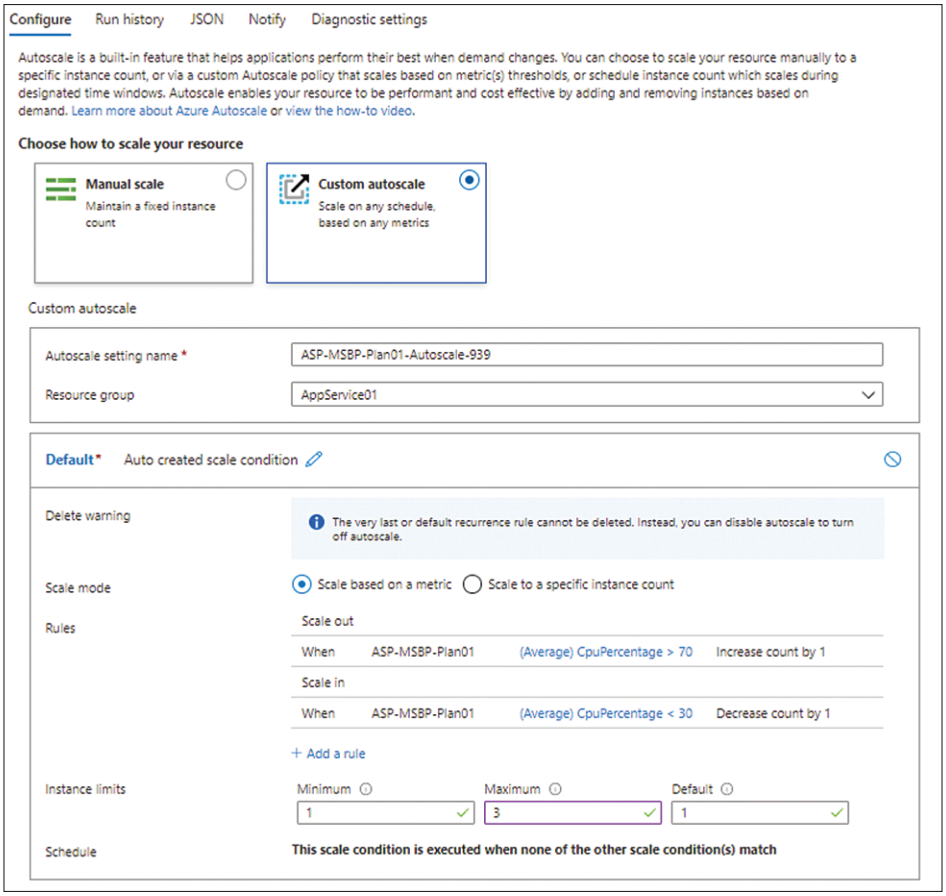
Manual scale

Override condition

Instance count: 2

FIGURE 3-44 Manual scale configuration.

   - If you require a more advanced or custom configuration, select the **Custom Autoscale** option button and specify when you want the custom autoscaling operation to be automatically performed. (See Figure 3-45.)


Configure Run history JSON Notify Diagnostic settings

Autoscale is a built-in feature that helps applications perform their best when demand changes. You can choose to scale your resource manually to a specific instance count, or via a custom Autoscale policy that scales based on metric(s) thresholds, or schedule instance count which scales during designated time windows. Autoscale enables your resource to be performant and cost effective by adding and removing instances based on demand. Learn more about Azure Autoscale or view the how-to video.

Choose how to scale your resource

Manual scale — Maintain a fixed instance count

[✓ Custom autoscale — Scale on any schedule, based on any metrics]

Custom autoscale

Autoscale setting name * ASP-MSBP-Plan01-Autoscale-939

Resource group AppService01

Default* Auto created scale condition

Delete warning: The very last or default recurrence rule cannot be deleted. Instead, you can disable autoscale to turn off autoscale.

Scale mode: [✓ Scale based on a metric] Scale to a specific instance count

Rules

Scale out			
When	ASP-MSBP-Plan01	(Average) CpuPercentage > 70	Increase count by 1
Scale in			
When	ASP-MSBP-Plan01	(Average) CpuPercentage < 30	Decrease count by 1

+ Add a rule

Instance limits: Minimum 1 Maximum 3 Default 1

Schedule: This scale condition is executed when none of the other scale condition(s) match

FIGURE 3-45 Custom autoscale configuration.

USING AZURE POWERSHELL

You can set up scaling with Azure PowerShell when you use the `New-AzAppServicePlan` command to create the App Service plan and employ the `-NumberofWorkers` and `-PerSiteScaling` switches. The following code shows you how:

```
#Define the variables for your environment
$ResourceGroup = "{ResourceGroupName}"
$AppServicePlan = "{Name-Of-AppServicePlan}"
$Location = "{AzureRegionName}"
#Set scaling config during plan creation
New-AzAppServicePlan -ResourceGroupName $ResourceGroup -Name $AppServicePlan
-Location $Location -Tier Standard -WorkerSize Small -NumberofWorkers 3
-PerSiteScaling $true
```

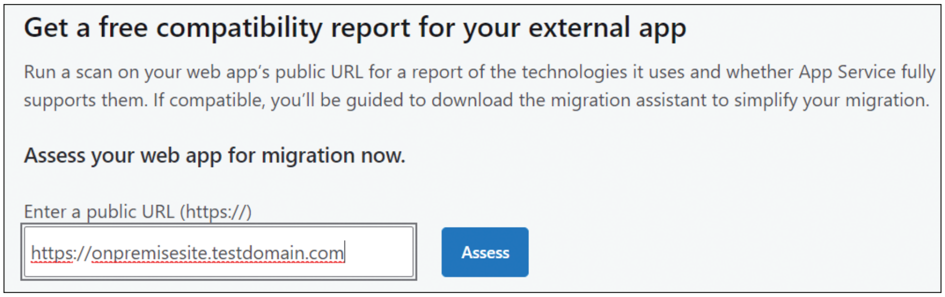
USING THE AZURE CLI

You can set up scaling with the Azure CLI when you use the `az appservice plan create` command to create the App Service plan and employ the `--per-site-scaling` and `--number-of-workers` switches. The following Bash script shows you how:

```
#Set the web app variables
WebappName="AppService$random"
Location="EastUS"
ResourceGroup = “ResourceGroup01”
# Set scaling config during plan creation
az appservice plan create --name $WebAppName --resource-group $ResourceGroup
--location $Location --sku S1 --number-of-workers 3 --per-site-scaling
```

Migrate to Azure App Service

One of the key questions in any environment is how best to migrate an existing on-premises app to App Service. To aid with this, Azure provides a free service called App Service Migration Assistant. (See Figure 3-46.) You can use this service to quickly scan and assess an existing web app to determine if it is suitable for migration. If the Migration Assistant service determines that the app is suitable for migration, you can use it to migrate the app to App Service. It is highly recommended that you use this free service to speed up and streamline app migrations.


Get a free compatibility report for your external app

Run a scan on your web app's public URL for a report of the technologies it uses and whether App Service fully supports them. If compatible, you'll be guided to download the migration assistant to simplify your migration.

Assess your web app for migration now.

Enter a public URL (https://)

https://onpremisesite.testdomain.com

FIGURE 3-46 Azure App Service Migration Assistant.

Networking considerations

As discussed, you must consider numerous deployment and operational issues when deciding on the most appropriate strategy to set up a new App Service in Azure. Similarly, you need to consider various networking solutions. The following sections cover the different networking services that are supported for integration with Azure App Service and some best practices associated with each.

By default, App Service allows all hosted apps to be accessible over the public internet. Although that might be appropriate for a large number of customer-facing apps, numerous internal or protected applications require more granular control over inbound and outbound traffic. You can set up numerous Azure services and App Service features to provide the required level of protection. Each service can help in addressing the requirements in different ways; thus, it is important to understand how each one works to design the right strategy for App Service networking.

Service endpoints and private endpoints

Azure App Service offers two types of deployment scenarios:

- **Free, Shared, Basic, Standard, Premium, PremiumV2, and PremiumV3 pricing SKUs** Apps are hosted on a multi-tenant infrastructure.
- **Isolated SKU App Service plan** A single-tenant ASE hosts all the apps directly in the client's Azure virtual network.

In a multi-tenant scenario, service endpoints enable you to define inbound traffic restrictions, allowing traffic only from a set of trusted subnets to connect to the web app. In this way, you can restrict traffic to only required resources such as VMs, other ASEs, or even other apps that use VNet Integration.

NOTE **You can configure service endpoints using the Azure Portal, Azure PowerShell, and the Azure CLI.**

Private endpoints are available only in the PremiumV2 and PremiumV3 tier App Service plans. They allow apps hosted on the multi-tenant infrastructure to be securely connected to the customer's virtual private network. So, all inbound traffic to the web app from the customer's virtual network flows over a secure and private connection. (See Figure 3-47.)

Some key benefits of using a private endpoint include the following:

- You can restrict inbound app access to resources in a specific virtual network.
- Users and resources within the connected virtual network can access apps using an internal private IP.
- You can use a web application firewall (WAF) used along with a private endpoint for enhanced protection.
- Data leakage and data theft are difficult, as the app is accessible only on a protected network.

Some limitations when using private endpoints include the following:

- A web app can support only 100 private endpoints.
- Remote debugging is not supported.
- FTP access to the web app is not allowed.

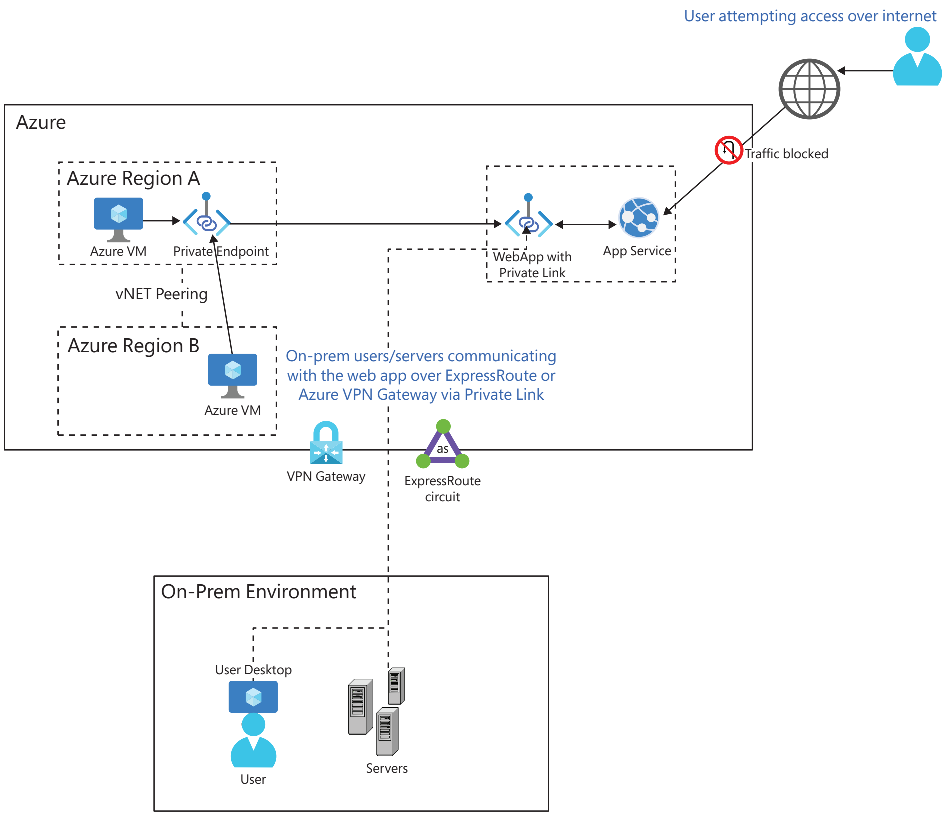


FIGURE 3-47 Private endpoint connections.

VNet integration

VNet integration helps multi-tenant apps access resources in other Azure VNet and interconnected networks. It provides outbound access from the app to the VNet and connected networks. This makes it possible for the app to access any resource located inside those networks.

This feature has two variations:

- **Regional integration** This is when the integration is with a VNet within the same Azure region as the app. Regional integration requires a dedicated subnet in the VNet for integration.
- **Gateway-required integration** This is when the integration is with a VNet in another Azure region or with a classic VNet in the same region. Here, an Azure virtual network gateway is provisioned in the destination VNet for the integration.

NOTE **VNet integration is an advanced feature and available only with the Standard and Premium plans.**

Regional VNet integration

As mentioned, regional VNet integration is when the App Service is integrated with a VNet in the same Azure region as the app. This enables apps to access resources located within:

- The same region as the app
- Any VNet peered with the integrated VNet
- Any networks connected via ExpressRoute to the integrated VNet
- Service-endpoint secured services
- Private endpoint resources

Some restrictions with regional VNet integration include the following:

- The integration subnet must be unused and dedicated to only one App Service plan.
- The integration subnet must be /28 or larger.
- Classic VNet is not supported.
- Only one regional VNet is supported per App Service plan.

Gateway-required VNet integration

Gateway-required VNet integration is useful when an app requires access to resources located in:

- An Azure VNet in a region different from the app
- An Azure classic virtual network in the same or different region

This requires an Azure Virtual Network gateway configured with an SSTP point-to-site VPN for the integration. Once integrated, the apps can get access to resources located within:

- Any VNet peered with the integrated VNet
- Any networks connected via VPN to the integrated VNet

Some restrictions with gateway-required VNet integration include the following:

- No support for Azure ExpressRoute connections.
- Only one VNet at a time can be connected.
- An App Service Plan supports a maximum of five VNet integrations.

Traffic Manager and Azure Front Door

You can use Traffic Manager and Azure Front Door to control and distribute requests from web clients across App Service endpoints. These endpoints, which are geographically dispersed, are set to Active or Passive; based on the routing logic applied, traffic is redirected, taking into account the availability and load on the App Service endpoint.

Azure Traffic Manager is a global DNS-based load-balancing service that distributes traffic among back-end application nodes based on a load-balancing algorithm you select. It provides a public endpoint that diverts incoming client requests to the available application node hosted in Azure or in another external service.

Azure Front Door is great for application acceleration and global HTTP(S) load balancing. It provides more features than Traffic Manager and is highly recommended for use with App Service. It supports SSL offloading, Application layer processing, AnyCast routing, and content caching for faster performance and security against DDoS attacks.

Three primary routing algorithms overlap between Traffic Manager and Front Door:

- **Latency/performance** The closest app is selected based on the lowest network latency to the back ends.
- **Priority** Priority is given to the primary app defined in the configuration. Other locations hosting the same app are set up as backups so that traffic can be failed over if the primary is unavailable.
- **Weighted** Traffic is distributed across a set of apps evenly or based on a weight assigned to each app.

In addition to these three, Traffic Manager provides one additional routing algorithm:

- **Performance** Users are redirected to the closest app region based on their network latency to the app location.

Similarly, Azure Front Door provides one additional routing algorithm:

- **Geographic** Users are redirected to apps that are closest to their geographic location.

Hybrid Connections

The Hybrid Connections feature helps connect an app to on-premises resources over a secure port. It does this by setting up a relay agent, called Hybrid Connection Manager (HCM), that requires access to both the on-premises endpoint and App Service over port 443. Once the relay agent is operational, the app hosted in Azure can access resources on any TCP-enabled host endpoint on any port or application protocol. The connection is secured using TLS 1.2; in addition, shared access signature (SAS) keys authenticate and authorize resource access.

Some of the main benefits of using Hybrid Connections are as follows:

- Secure access to on-premises resources over private or public networks.
- Service-based provisioning, making it fast to set up and configure.
- Works on port 443, making it easier to handle across most firewalls.
- Multiple networks can be accessed using the same relay agent.
- No dependency on application protocol, language, or port requirements, as long as TCP support is available.

However, Hybrid Connections has a few limitations:

- It only supports TCP. It does not support the UDP protocol.
- It cannot be used to mount network-enabled drives remotely to the app.
- It uses dynamic port mapping for app access.

Network security groups

You can use network security groups (NSGs) to block both ingress and egress traffic to all resources in a VNet. For apps that use the regional VNet integration feature:

- Egress traffic can be managed using NSGs.
- Ingress traffic management requires the use of the Access Restrictions feature.

Route tables

Route tables help to set up custom routes required to enforce a specific routing configuration. You can use route tables to route outbound traffic as needed.

Azure DNS private zones

Once an app is integrated into a VNet, the DNS server configured for the VNet is applied to the app as well. If the VNet is set to use Azure DNS private zones, this would cause issues for the app, because by default, it does not support private DNS zones. However, you can enable this support configuring application settings to force all outbound traffic from the app via the VNet and require the use of the Azure DNS private zone.

Backup and restore

Azure App Service has a built-in backup and restore feature available for the Standard, Premium, and Isolated tiers. This feature allows you to create backups manually or on an automated schedule. Backups can be retained indefinitely, which is useful for organizations with long-term data-retention requirements.

The Azure App Service backup feature can currently back up the following:

- File contents
- The application configuration
- Databases interconnected for use with the app, including Azure SQL Database, Azure Database for MySQL, and Azure Database for PostgreSQL

Some key features of this built-in backup service are as follows:

- Each backup is triggered as a full backup rather than an incremental backup. This makes restore operations fast and reliable, as dependencies on earlier backups are reduced.
- Restore operations can restore to the existing app or to a new app. This is useful in scenarios in which you need to create a new test or dev environment from a recent backup.
- You can schedule backups using the Azure Portal, Azure PowerShell, or the Azure CLI.

It’s important to be aware of a few limitations when setting up the backup feature:

- Backups are supported for a maximum of 10 GB of app and database content. In addition, backups of individual databases can have a maximum size of 4 GB. Backups exceeding this size will fail.

- This feature is supported only for the Standard and Premium Dedicated tiers and the Isolated tier.
- If VNet integration is in place, the backup and restore features cannot be used at the same time.
- The Azure storage required to store the backups should be in the same subscription, and preferably the same region, as the App Service.
- The firewall service for the storage account should not be configured or online.
- Backups for in-app MySQL databases are automatic, without the need for any configuration steps. However, if manual configuration settings, such as connection strings, are put in place, automated backups will not work correctly.
- TLS encryption for MySQL or PostgreSQL will cause backups to fail. If that is a requirement for the environment, consider a third-party backup solution.

Backup walkthrough

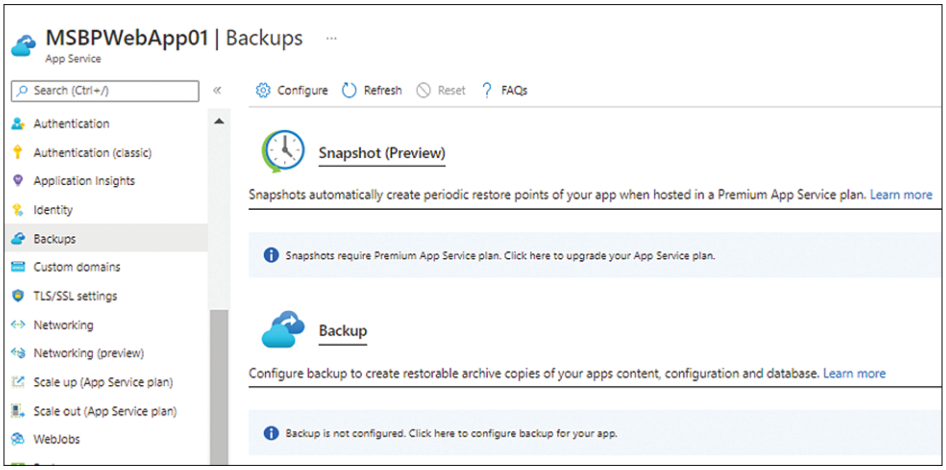
The following sections step you through the process of setting up backups for your web app using the Azure Portal, Azure PowerShell, and the Azure CLI.

NOTE **Adjust the storage names per your requirements.**

USING THE AZURE PORTAL

To set up backups using the Azure Portal, follow these steps:

1. In the left pane of the web app's configuration page, under **Settings**, click **Backup**. (See Figure 3-48.) By default, no backups are configured.



Snapshots automatically create periodic restore points of your app when hosted in a Premium App Service plan. Learn more

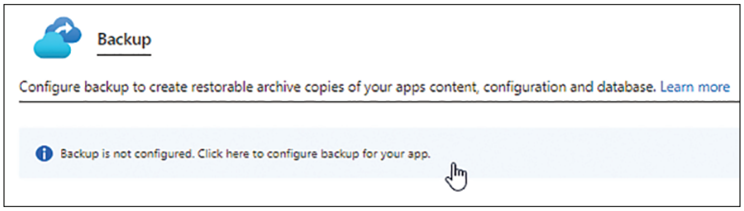
Snapshots require Premium App Service plan. Click here to upgrade your App Service plan.

Configure backup to create restorable archive copies of your apps content, configuration and database. Learn more

Backup is not configured. Click here to configure backup for your app.

FIGURE 3-48 Backup configuration for web apps.

2. Under **Backup**, click the **Backup Is Not Configured. Click Here to Configure Backup for Your App** link. (See Figure 3-49.)



Configure backup to create restorable archive copies of your apps content, configuration and database. Learn more

Backup is not configured. Click here to configure backup for your app.

FIGURE 3-49 Backup is not configured.

3. In the Backup Configuration page, enter the following information (see Figure 3-50):
   - **Backup Storage** Click the container in which you want to store the backup.
   - **Scheduled Backup** Click **On**.
   - **Backup Every** Specify how frequently backups should occur, in days or hours.
   - **Start Backup Schedule From** Specify the date, time, and time zone when the backup schedule should start.
   - **Retention (Days)** Specify how long (in days) the backup should be retained.
   - **Keep At Least One Backup** Click **Yes** to ensure that at least one backup is always retained.

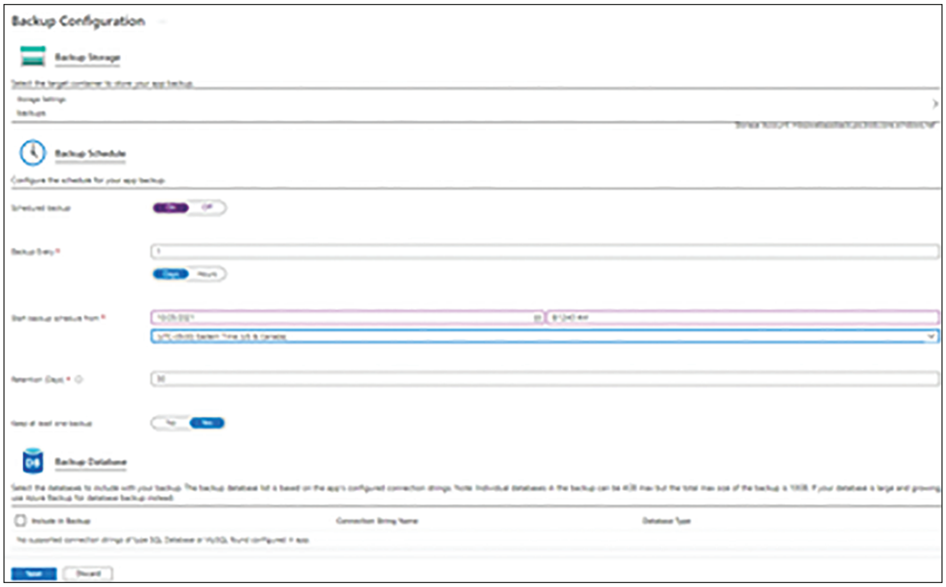


FIGURE 3-50 Configuring backup settings.

USING AZURE POWERSHELL

You can set up backups for a web app with Azure PowerShell using the `New-AzWebAppBackup` command. This command triggers a one-time backup. To schedule a backup, you must use the `Edit-AzWebAppBackupConfiguration` command.

To trigger a one-time backup, use the following code:

```
#Set variables
$resourcegroup="AppServiceRG01"
$appname="mywebapp$(Get-Random -Minimum 100000 -Maximum 999999)"
$storageaccountname="backupsstorage"
$storagecontainer="backups"
$location="East US 2"
$backupname="BackupOnce"
# Generate an SAS token for the storage container, valid for one month.
$sastokenUrl = New-AzStorageContainerSASToken -Name $storagecontainer -Permission rwdl
-Context $storageaccountname.Context -ExpiryTime (Get-Date).AddMonths(1) -FullUri
# Create a one-time backup
New-AzWebAppBackup -ResourceGroupName $resourcegroup -Name $appname -StorageAccountUrl
$sastokenUrl -BackupName $backupname
```

To schedule a backup, use the following code:

```
#Set variables
$resourcegroup="AppServiceRG01"
$appname="MSBPAPP01"
$storageaccountname="backupsstorage"
$storagecontainer="backups"
$location="East US 2"
# Generate an SAS token for the storage container, valid for 1 year.
$sastokenUrl = New-AzStorageContainerSASToken -Name $storagecontainer -Permission rwdl
-Context $storageaccountname.Context -ExpiryTime (Get-Date).AddYears(1) -FullUri
# Schedule a backup every day, beginning in two hours, and retain for 30 days
Edit-AzWebAppBackupConfiguration -ResourceGroupName $resourcegroup -Name $appname
-StorageAccountUrl $sastokenUrl -FrequencyInterval 1 -FrequencyUnit Day
-KeepAtLeastOneBackup -StartTime (Get-Date).AddHours(2) -RetentionPeriodInDays 30
```

USING THE AZURE CLI

You can set up backups for a web app with the Azure CLI using the `az webapp config backup create` command. This command triggers a one-time backup. To schedule a backup, you must use the `az webapp config backup update` command.

To trigger a one-time backup, use the following code:

```
#!/bin/bash
#Set variables
resourcegroupname="AppServiceRG01"
```

```
appname=MSBP-APP01
storagename=backupsstorage
location="EastUS2"
backupcontainer="backups"
backupname="backuponce"
expirydate=$(date -I -d "$(date) + 2 months")
# Generates an SAS token for the storage container, valid for one month.
sastoken=$(az storage container generate-sas --account-name $storagename
--name $backupcontainer --expiry $expirydate --permissions rwdl --output tsv)
# Construct the SAS URL for the container
sastokenurl=https://$storagename.blob.core.windows.net/$backupcontainer?$sastoken
# Create a one-time backup
az webapp config backup create --resource-group $resourcegroupname --webapp-name
$appname --backup-name $backupname --container-url $sastokenurl
```

To schedule a backup, use the following code:

```
#!/bin/bash
#Set variables
resourcegroupname="AppServiceRG01"
appname=MSBP-APP01
storagename=backupsstorage
location="EastUS2"
backupcontainer="appbackup"
expirydate=$(date -I -d "$(date) + 1 month")
# Generate an SAS token for the storage container, valid for one month.
sastoken=$(az storage container generate-sas --account-name $storagename
--name $backupcontainer --expiry $expirydate --permissions rwdl --output tsv)
# Construct the SAS URL for the container
sastokenurl=https://$storagename.blob.core.windows.net/$backupcontainer?$sastoken
# Schedule a backup every day and retain for 10 days
az webapp config backup update --resource-group $resourcegroupname --webapp-name
$appname --container-url $sastokenurl --frequency 1d --retain-one true --retention 10
```

Disaster recovery

In the event of a region-wide failure of the Azure infrastructure, causing App Service and all hosted apps to go offline, you would need to bring App Service back online in another available region and restore your data within that new region. You can achieve this in multiple ways, including the following:

- **Multi-site architecture** You can set up App Service in such a way that the same apps are published across multiple Azure regions and the database is replicated geographically. Moreover, you can set up any interdependent components in a multi-site design or set them up to work with high availability (HA). This type of design is also called an active-active datacenter design.

- **Standby site** You can preconfigure the standby region with all required apps and interconnected services and replicate required data to that site. The standby site can then be brought online in the event of a disaster. This type of design is also called an active-passive with hot standby design.
- **Cold recovery** A cold recovery is where a failover site is identified, and all required services and data are restored and brought online on that site after a disaster, either manually or automatically. This type of design is also called an active-passive with cold standby design.

There are numerous factors to consider when developing a disaster-recovery strategy, especially for cold-recovery scenarios. Be sure to consider the following points in your planning:

- Identify all interconnected components within the App Service and decide on the best strategy to make them either region-independent or restorable in another region when required. These should include (but are not limited to) the following:
  - Deployment slot configurations
  - TLS/SSL certificates
  - Azure Key Vault configuration, including secrets, certificates, and managed identities
  - Integrations with load balancers, Azure Traffic Manager, WAFs, or Azure Firewall
  - Integrations using Hybrid Connections, site-to-site VPNs, or ExpressRoute
  - Integrations with third-party services that must be rebuilt
- Refer to the product documentation or configuration of each service to validate data replication or availability in the desired failover region in the event of a disaster.
- Identify and document the steps to restore each service (and the configuration required to reintegrate it, if needed), and the order in which each service should be restored.
- Test the restoration procedure, if possible, on a regular basis.
- Identify the testing parameters after restoration to validate a successful restore.
- Regularly review procedures and processes in place to ensure any changes in the environment, in product features, or in Microsoft's terms of service are taken into account in the event a restoration operation becomes necessary.

NOTE **Only the Premium tier supports moving an app from one region to another. However, in a disaster scenario, Microsoft enables this functionality for all App Service plans. So, apps can be migrated, restored, or downloaded, regardless of plan.**

Cost considerations

It's relatively easy to set up and scale up Azure App, but you can incur unwanted costs if you don't plan and monitor it. To better gauge and manage your monthly spend, it is therefore important to understand the different elements in the App Service environment that are subject to charge.

The main resource charges are associated with compute resources for VM instances. These charges depend on the App Service plan tier and the number of VM instances deployed. The charges levied are based on the number of times the instances are online. It is highly recommended to monitor the usage of instances and identify areas where you can better manage it. This can help you significantly decrease your spending.

In addition to compute resources, Microsoft charges for some additional resources, including the following:

- App Service domains
- App Service certificates
- IP-based certificate bindings
- Storage for backup and diagnostic logging
- A virtual network for the Isolated tier ASE

NOTE **Your monthly bill will provide a detailed breakdown of the charges associated with each of these different resources.**

There are various ways to optimize costs associated with App Service and related workloads. Here are just a few:

- **Host multiple apps in a single plan** One of the best ways to optimize costs is to collocate multiple apps within the same App Service plan. This will require you to analyze application and API loads to determine which apps to host together. On a related note, you can move apps to different App Service plans within the same region and resource group to optimize usage over time based on load analysis. You'll want to consider this when deciding which plan to use to host your app.

NOTE **Hosting multiple apps on a plan results in higher app density. This can help you reduce the number of plans you need, thereby optimizing costs.**

- **Use the Free or Shared tier to host test and dev workloads** Using the Free or Shared tier for dev and test workloads can help keep costs low during those stages. These tiers are also an excellent choice for most environments for hosting functions, scripts, and code snippets, depending on their runtime and SLA requirements.

- **Use the Standard tier or above to host production workloads** Using the Standard tier or above to host production workloads ensures those workloads are covered by the App Service SLA. This is because the hardware available on these tiers provides much better performance than the hardware resources allocated to the Free and Shared tiers. The Standard and above tiers also offer better memory, storage, security, and scaling features.
- **Use autoscaling** Be aware that the cost of running workloads on the Standard or higher tiers is much higher. Therefore, to optimize costs, you should use autoscaling to remove VM instances when they are inactive. Autoscaling is supported in the Standard Dedicated tiers and can be used both to scale out and to scale in, ensuring that only the compute resources required are online.
- **Reserve instances** The Dedicated PremiumV3 and Isolated tiers enable you to reserve and pre-pay for instances at a discount for use later on. You can reserve between one and three years in advance; the longer the reservation period, the cheaper it is. If you know the minimum number of compute resources you will require for the next one to three years, it would be advisable to reserve them to obtain the significant cost benefit.

NOTE **If you use more compute resources than you reserved, the additional compute resources will be charged at the normal rate rather than the discounted rate. Therefore, you should monitor the usage of the apps hosted in the App Service plan over time to determine if additional reservations are required.**

- **Set up budgets** Setting up a budget can help stakeholders keep better track of their costs and (hopefully) eliminate overspending. You can set up alerts to notify application admins if spending does exceed your budget, enabling them to take immediate action to reduce the spend.
- **Monitor your spending** Once your budget is in place, it is important to monitor your costs on a regular basis to identify unwanted spends and areas that might be ripe for optimization. Trend analysis of this data can also help in forecasting for future planning.
- **Analyze in PowerBI or Excel** You can export the data you collect over time when monitoring costs to Microsoft PowerBI or Microsoft Excel to analyze historical trends across datasets. You can do this on a scheduled basis—daily, weekly, or monthly—making it possible to perform a long-term analysis.
- **Avoid post-deletion charges** Even if you delete all the apps in an App Service plan, charges for that plan, and the number of VM instances deployed, will continue to apply. To avoid incurring these charges, you should delete the plan or scale it down to the Free tier. You can also remove other associated resources manually, such as the following:
  - Virtual networks created for the Isolated tier
  - The Key Vault used to store TLS/SSL certificates

- Log Analytics workspaces for log ingestion and analysis
- Backup and diagnostic logging storage accounts

Security recommendations

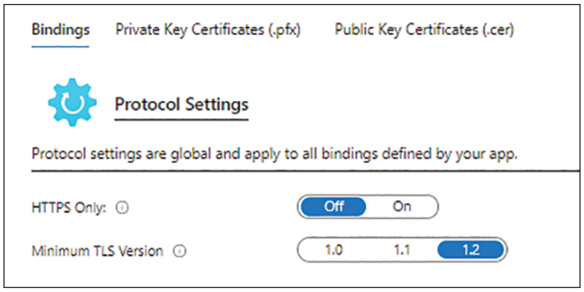
There are numerous security recommendations to consider when hosting apps on App Service. These are some of the most common ones:

- **Use the latest version if possible** Make sure the platforms, frameworks, programming languages, and protocols used by your apps are up to date. This can significantly reduce the attack surface.
- **Turn off anonymous access** Anonymous access is one of the leading causes of data theft. Unless there is a need to allow anonymous requests, it is recommended that you disable it completely. If you absolutely must allow anonymous requests, expose only the app elements that require anonymous access while securing all other APIs or access points.
- **Use the built-in authentication module** Rather than using custom code, employ the built-in authentication module to handle all authentication and authorization requests. This helps reduce coding errors that might pose a security threat—not to mention saving you time and effort.
- **Protect access to back-end resources** Make sure back-end resources are protected by using authentication. This authentication could call for either the user's identity or their managed identity. Managed identity is an identity managed by the Azure platform itself. This makes it easy to maintain because it eliminates the need to rotate secrets manually.
- **Map custom domains and use certificates** It is a good practice to map custom domains for apps. This makes it easier for end-users to access the app. App Service supports several types of certificates, based on security needs:
  - **Free App Service Managed certificate** This is a free certificate issued by DigiCert, which is automatically renewed every six months. Be aware that this certificate has some limitations. For example, it does not allow exports, it is not supported with ASE, and it does not support wildcard certifications. In addition, it does not support client authentication and does not integrate with Traffic Manager. However, if these are acceptable, then it is a great option.
  - **App Service certificate** This is a certificate issued by GoDaddy. There are two types currently available: Standard and Wildcard. The certificate is stored in Azure Key vault and automatically renewed.
  - **Third-party certificate** This is a certificate procured from a trusted third-party certificate provider. These certificates can either be imported into Azure Key Vault and then imported into App Service or imported directly into App Service.

- **Private certificate** This is a certificate created by the customer using an internal PKI infrastructure. This certificate is best for apps used for internal testing or for apps used by internal employees on managed devices. This certificate requires the certificate chain to be deployed on the device. The certificate can be imported into Azure Key Vault and then imported into App Service or imported directly into App Service.

IMPORTANT **Be sure to provision a well-known SSL/TLS certificate so client browsers connect over HTTPS without errors.**

- **Use certificates to limit access** If you need to limit access to the application to specific clients, using a certificate for client authentication is highly recommended, as it blocks connections from clients missing the required certificate.
- **Use HTTPS instead of HTTP** Although App Service allows both HTTP and HTTPS connections, it is highly recommended that all HTTP requests be redirected to HTTPS. This ensures that all connections are secured by default using the SSL/TLS certificate deployed for HTTPS. All authentication and client communication would take place on a secure channel, reducing traffic snooping.
- **Disable TLS 1.0** Industry standards such as PCI DSS have deemed TLS 1.0 as an unsecure protocol. It is highly recommended that you disable TLS 1.0, forcing all apps to use TLS 1.1 or, preferably, TLS 1.2. Figure 3-51 shows the settings to use HTTPS only and to disable TLS 1.0.


Bindings
Private Key Certificates (.pfx)
Public Key Certificates (.cer)
Protocol Settings

Protocol settings are global and apply to all bindings defined by your app.

HTTPS Only: [✓ Off] On

Minimum TLS Version: 1.0 1.1 [✓ 1.2]

FIGURE 3-51 Setting HTTPS only and specifying the minimum TLS version.

- **Encrypt communication** When integrating apps with other Azure services such as Azure Storage, Azure SQL Database, or other database services, all communication between the workloads remains within the Azure back end. However, that traffic is on shared network infrastructure within Azure. Therefore, it is highly recommended that you encrypt this traffic to ensure that all communication is secure at all times.

- **Secure FTP traffic** Use the FTP protocol judiciously, only when required. In addition, use it only over SSL/TLS so that all communication is secure. In short, avoid using FTP unless absolutely necessary.
- **Use Key Vault or environment variables** Use Azure Key Vault and managed identity for secure storage, access, and management of application secrets. This includes API tokens, database credentials, and private keys that are otherwise included in the application code. If you cannot use managed identities, then it is recommended that you use environment variables in app settings and connection strings to store these values. These are stored securely with encryption and are decrypted just before being passed on to the application's process memory. The Azure platform manages the encryption keys and rotates them on a regular basis, making the system very difficult to breach.
- **Define IP restrictions (if necessary)** Depending on your application access requirements, access to the app can be restricted for certain IP addresses or IP ranges only. This can help secure access especially for highly sensitive apps where the users accessing the application are known and access has to be limited to known networks only.
- **Define dynamic access restrictions** For apps hosted on a Windows-based App Service, you can prevent external distributed denial of service (DDoS) attacks defining the following parameters to dynamically restrict access:
  - Deny IP address based on the number of concurrent requests.
  - Deny IP address based on the number of requests over a period of time.
- **Use the Isolated pricing tier for network isolation** The Isolated tier is best used for apps that require all network infrastructure to be isolated and dedicated for use by a single organization only. If your organization has compliance or security needs that require such enforcement, use the Isolated tier.
- **Protect communications when accessing on-premises resources** On-premises resources can be accessed using Hybrid Connections, via site-to-site VPNs, or by connecting the ASE directly to an on-premises environment. Each of these methods provides secure access to resources. Based on the network topology in place, select the best method for your environment, making sure all communication is directed over the selected channel only.
- **Use NSGs for ingress traffic** Use NSGs to protect and manage ingress traffic and network access. Expose only the required endpoints and prevent access to others. Periodically review the NSG configuration to make sure no unwanted endpoints are exposed.
- **Leverage Azure Security Center** You should use the Azure Security Center service to periodically carry out security assessments. You should also implement recommendations issued by Azure Security Center to plug security holes and employ its Integrated Threat Intelligence functionality to prevent traffic from known-malicious IP addresses.

- **Use Azure Policy** Use Azure Policy to define and implement built-in policies for App Service, such as HTTPS enforcement, minimum allowed TLS version, and enforcement of a virtual network service endpoint.
- **Use Azure Activity Log to monitor changes** After policy definitions are in place, you can use Azure Activity Log to monitor configuration changes to network resources, network settings, and any resources related to App Service.
- **Use Azure Monitor for centralized logging** You can store Azure Activity and App Service Diagnostic Logs in Azure storage, Log Analytics, or event hubs. Azure Monitor then uses these to centrally monitor events and changes.
- **Encrypt source data at rest** It is a recommended practice to encrypt application source data at rest. This means encrypting the data stored in Azure storage with platform- or customer-managed encryption keys and using Azure Key Vault to inject application secrets at runtime as part of the application settings.
- **Use WAF for inbound traffic** Secure access to an internet-facing application using the WAF deployed in front of the app. Then use service endpoints and access restrictions on the WAF to secure ingress traffic. A WAF protects internet-facing applications from DDoS attacks, URI filtering, and SQL injection attacks.
- **Use Azure Firewall for outbound traffic** Use the Azure Firewall service to centrally divert all outbound traffic. This allows the enforcement of traffic-management policies and captures and monitors logs for centralized analysis.

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