



Azure Virtual Network

In this very first chapter, we will learn about the basics of Azure networking, including creating Azure virtual networks and designing address spaces and subnets. This will lay the foundation for all future recipes that will be covered in this chapter.

We will cover the following recipes in this chapter:

- Creating a virtual network in the Azure portal
- Creating a virtual network with PowerShell
- Adding a subnet in the Azure portal
- Adding a subnet with PowerShell
- Changing the address space size
- Changing the subnet size

Technical requirements

For this chapter, the following is required:

- An Azure subscription
- Azure PowerShell

The code samples can be found at <https://github.com/PacktPublishing/Azure-Networking-Cookbook-Second-Edition/tree/master/Chapter01>.

Creating a virtual network in the Azure portal

Azure Virtual Network represents your local network in the cloud. It enables other Azure resources to communicate over a secure private network without exposing endpoints over the internet.

Getting ready

Before you start, open a web browser and go to the Azure portal at <https://portal.azure.com>.

How to do it...

In order to create a new virtual network using the Azure portal, take the following steps:

1. In the Azure portal, select **Create a resource** and choose **Virtual network** under **Networking** (or search for **virtual network** in the search bar). A new pane will open, where we need to provide information for the virtual network. First, select the **Subscription** option we want to use and the **Resource group** option for where the virtual network will be deployed. Then, include a name and select a region (of the Azure datacenter) for where the virtual network will be deployed. An example is shown in *Figure 1.1*:

Create virtual network

Basics

IP Addresses

Security

Tags

Review + create

Azure Virtual Network (VNet) is the fundamental building block for your private network in Azure. VNet enables many types of Azure resources, such as Azure Virtual Machines (VM), to securely communicate with each other, the internet, and on-premises networks. VNet is similar to a traditional network that you'd operate in your own data center, but brings with it additional benefits of Azure's infrastructure such as scale, availability, and isolation. [Learn more about virtual network](#)

Project details

Subscription *

Microsoft Azure Sponsorship

Resource group *

(New) Packt-Networking-Portal

Create new

Instance details

Name *

Packt-Portal

Region *

(Europe) West Europe

Figure 1.1: Creating an Azure virtual network

2. In the next pane, we first need to define the address space and define the **Subnet name** and **Subnet address range** values for the first subnet. After the address space is defined, as shown in *Figure 1.2*, we will receive a message stating that **This virtual network doesn't have any subnets**. Therefore, we need to select the **Add subnet** option:

Create virtual network

Basics **IP Addresses** Security Tags Review + create

The virtual network's address space, specified as one or more address prefixes in CIDR notation (e.g. 192.168.1.0/24).

IPv4 address space

10.10.0.0/16 10.10.0.0 - 10.10.255.255 (65536 addresses)



☐ Add IPv6 address space ⓘ

The subnet's address range in CIDR notation (e.g. 192.168.1.0/24). It must be contained by the address space of the virtual network.

[+ Add subnet](#) [🗑 Remove subnet](#)

Subnet name

Subnet address range

This virtual network doesn't have any subnets.

✖ This virtual network doesn't have any subnets.

Figure 1.2: Configuring a virtual network address space and subnet

3. In the **Add subnet** pane, we need to define **Subnet name** and **Subnet address range**. Optionally, we can add service endpoints we want to connect to the virtual network. Service endpoints allow us to connect to Azure services in a secure way, over Azure backbone infrastructure, without needing a public IP address. An example is shown in *Figure 1.3*:

Add subnet ✕

Subnet name *

FrontEnd ✓

Subnet address range * ⓘ

10.10.0.0/24 ✓

10.10.0.0 - 10.10.0.255 (251 + 5 Azure reserved addresses)

SERVICE ENDPOINTS

Create service endpoint policies to allow traffic to specific azure resources from your virtual network over service endpoints. [Learn more](#)

Services ⓘ

0 selected ^

Filter services

- ☐ Select all
- ☐ Microsoft.AzureActiveDirectory
- ☐ Microsoft.AzureCosmosDB
- ☐ Microsoft.CognitiveServices
- ☐ Microsoft.ContainerRegistry
- ☐ Microsoft.EventHub
- ☐ Microsoft.KeyVault
- ☐ Microsoft.ServiceBus
- ☐ Microsoft.Sql
- ☐ Microsoft.Storage
- ☐ Microsoft.Web

Figure 1.3: Adding a subnet


4. After we have added the first subnet, in our case, **FrontEnd**, we can add more subnets to the virtual network or proceed to the **Security** section, as shown in Figure 1.4:

Create virtual network

Basics IP Addresses Security Tags Review + create



The virtual network's address space, specified as one or more address prefixes in CIDR notation (e.g. 192.168.1.0/24).

IPv4 address space

10.10.0.0/16 10.10.0.0 - 10.10.255.255 (65536 addresses) 

☐ Add IPv6 address space ⓘ

The subnet's address range in CIDR notation (e.g. 192.168.1.0/24). It must be contained by the address space of the virtual network.

 Add subnet  Remove subnet

<input type="checkbox"/> Subnet name	Subnet address range
<input type="checkbox"/> FrontEnd	10.10.0.0/24

Figure 1.4: Adding the FrontEnd subnet

5. In the **Security** section, we can choose whether we want to enable **Bastion Host**, **DDoS protection**, and **Firewall**. If any of these options are enabled, we need to provide additional information for that service. Afterward, we can optionally add tags, or skip that and create the service. An example is shown in Figure 1.5:

Create virtual network

Basics IP Addresses Security Tags Review + create

BastionHost ⓘ Disabled Enabled

DDoS protection ⓘ Basic Standard

Firewall ⓘ Disabled Enabled

Figure 1.5: Toggling security options

6. Creating a virtual network usually does not take much time and should be completed in under two minutes. Once the deployment is finished, we can start using the virtual network.

How it works...

We deploy virtual networks to **Resource group** under **Subscription** in the Azure datacenter that we choose. **Region** and **Subscription** are important parameters; we will only be able to attach Azure resources to this virtual network if they are in the same subscription and region as the Azure datacenter. The address space option defines the number of IP addresses that will be available for our network. It uses the **Classless Inter-Domain Routing (CIDR)** format and the largest range we can choose is **/8**. In the portal, we need to create an initial subnet and define the subnet address range. The smallest subnet allowed is **/29** and the largest is **/8** (however, this cannot be larger than the virtual network range). For reference, the range **10.0.0.0/8** (in CIDR format) will create an address range of **167772115** IP addresses (from **10.0.0.0** to **10.255.255.255**) and **10.0.0.0/29** will create a range of **8** IP addresses (from **10.0.0.0** to **10.0.0.7**).

Creating a virtual network with PowerShell

PowerShell is a command-line shell and scripting language based on .NET Framework. It's often used by system administrators to automate tasks and manage operating systems. Azure PowerShell **Az** is a PowerShell module that allows us to automate and manage Azure resources. **Az** is also very often used to automate deployment tasks and can also be used to deploy a new Azure virtual network.

Getting ready

Before we start, we need to make sure that we have the latest **Az** modules installed. To install **Az** modules, we need to run this command in the PowerShell console:

```
Install-Module -Name Az -AllowClobber -Scope CurrentUser
```

For more information, you can visit <https://docs.microsoft.com/powershell/azure/install-az-ps?view=azps-4.5.0>.

Before we start, we need to connect to the Azure subscription from a PowerShell console. Here's the command to do this:

```
Connect-AzAccountAzAccount
```

This will open a pop-up window where we need to input the credentials for the Azure subscription.

Afterward, we need to create a resource group where our virtual network will be deployed:

```
New-AzResourceGroup -name 'Packt-Networking-Script' -Location 'westeurope'
```

The output should be similar to that shown in *Figure 1.6*:

```
ResourceGroupName : Packt-Networking-Script
Location          : westeurope
ProvisioningState : Succeeded
Tags              :
ResourceId        : /subscriptions/12345678-9012-3456-7890-123456789012/resourceGroups/Packt-Networking-Script
```

Figure 1.6: Connecting to an Azure subscription from PowerShell

How to do it...

Deploying an Azure virtual network is done in a single script. We need to define the parameters for the name, resource group, location, and address range. Here is an example script:

```
New-AzVirtualNetwork -ResourceGroupName 'Packt-Networking-Script' -Location
'westeurope' -Name 'Packt-Script' -AddressPrefix 10.11.0.0/16
```

You should receive the following output:

```
Name                : Packt-Script
ResourceGroupName   : Packt-Networking-Script
Location            : westeurope
Id                  : /subscriptions/12345678-9012-3456-7890-123456789012
Etag                : W/"d0c9a5a2-d133-479e-a42d-5e53365d200b"
ResourceGuid        : 2f9b5c37-fefc-4530-9f9e-9ff011d94f8d
ProvisioningState    : Succeeded
Tags                :
AddressSpace         : {
                        "AddressPrefixes": [
                          "10.11.0.0/16"
                        ]
                      }
DhcpOptions          : {}
Subnets             : []
VirtualNetworkPeerings : []
EnableDdosProtection : false
DdosProtectionPlan   : null
```

Figure 1.7: Deploying an Azure virtual network using a script

How it works...

The difference between deploying a virtual network from the portal and using PowerShell is that no subnet needs to be defined in PowerShell. The subnet is deployed in a separate command that can be executed either when you are deploying a virtual network, or later on. We are going to see this command in the *Adding a subnet with PowerShell* recipe later in this chapter.

Adding a subnet in the Azure portal

In addition to adding subnets while creating a virtual network, we can add additional subnets to our network at any time.

Getting ready

Before you start, open a web browser and go to the Azure portal at <https://portal.azure.com>. Here, locate the previously created virtual network.

How to do it...

In order to add a subnet to a virtual network using the Azure portal, we must take the following steps:

1. In the **Virtual network** pane, go to the **Subnets** section.
2. Select the **Add subnet** option.
3. A new pane will open. We need to provide information for the subnet, including the **Name** value and the **Address range** value in CIDR format. The **Address range** value must be in the range limit of the virtual network address range and cannot overlap with the address range of other subnets in the virtual network. Optionally, we can add information for **Network security group**, **Route table**, **Service endpoints**, and **Subnet delegation**. These options will be covered in later recipes:

Add subnet

×

Packet-Portal

Name *
 ✓

Address range (CIDR block) * ⓘ
 ✓
10.10.1.0 - 10.10.1.255 (251 + 5 Azure reserved addresses)

NAT gateway ⓘ
 ▼
☐ Add IPv6 address space

Network security group
 ▼

Route table
 ▼

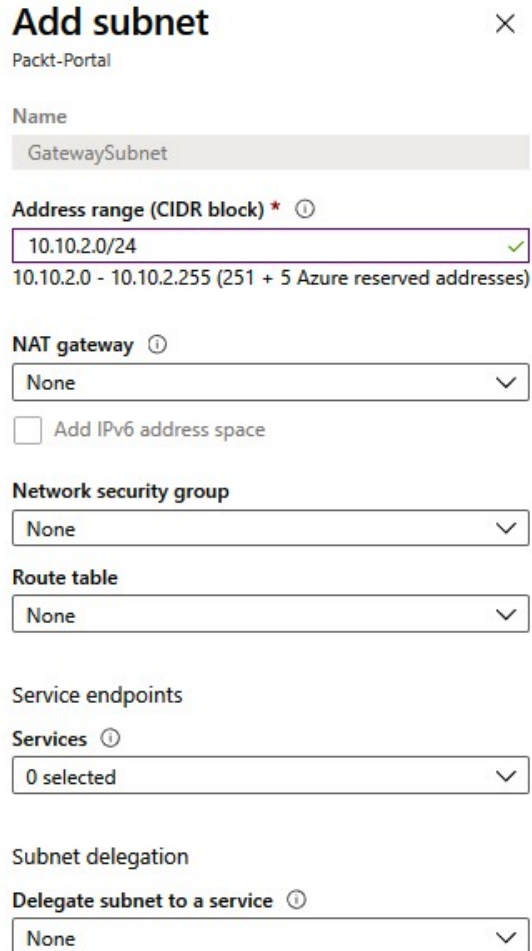
Service endpoints
Services ⓘ
 ▼

Subnet delegation
Delegate subnet to a service ⓘ
 ▼

Figure 1.8: Adding the address range

4. We can also add a gateway subnet in the same pane. To add a gateway subnet, select the **Gateway subnet** option.

For a gateway subnet, the only parameter we need to define is **Address range**. The same rules apply as for adding a regular subnet. This time, we don't have to provide a name, as it's already defined. You can add only one gateway subnet per virtual network. Service endpoints are not allowed in the gateway subnet:



Add subnet ✕

Packit-Portal

Name

GatewaySubnet

Address range (CIDR block) * ⓘ

10.10.2.0/24 ✓

10.10.2.0 - 10.10.2.255 (251 + 5 Azure reserved addresses)

NAT gateway ⓘ

None ▼

☐ Add IPv6 address space

Network security group

None ▼

Route table

None ▼

Service endpoints

Services ⓘ

0 selected ▼

Subnet delegation

Delegate subnet to a service ⓘ

None ▼

Figure 1.9: Adding a gateway subnet for a virtual network

- After the subnets are added, we can see the newly created subnets in the **Subnets** pane under the virtual network:

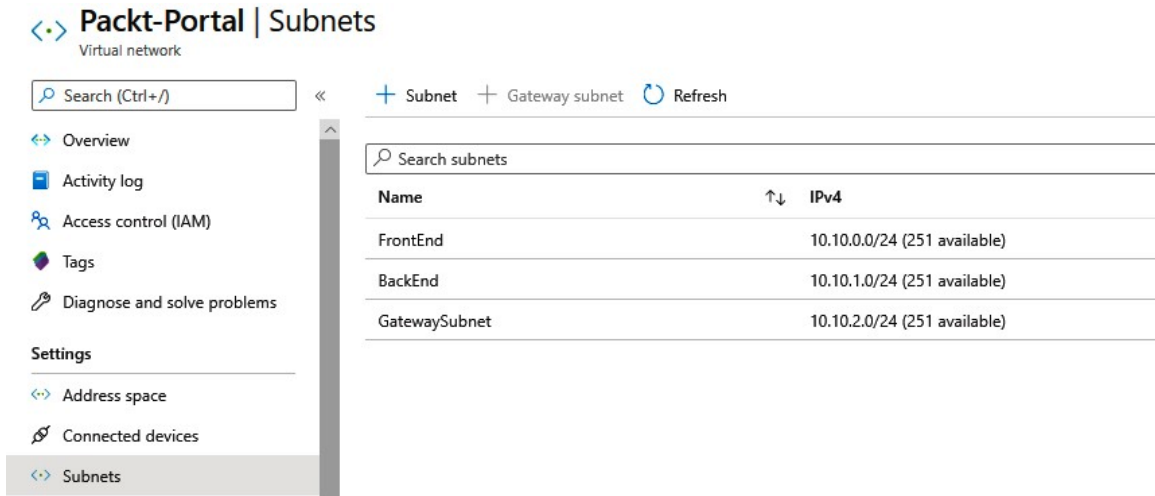


Figure 1.10: Viewing newly created subnets in the Subnets pane

How it works...

A single virtual network can have multiple subnets defined. Subnets cannot overlap and must be in the range of the virtual network address range. For each subnet, four IP addresses are saved for Azure management and cannot be used. Depending on the network settings, we can define the communication rules between subnets in the virtual network. A gateway subnet is used for **Virtual Private Network (VPN)** connections, and this will be covered later in the cookbook.

Now, let's learn how to add a subnet using PowerShell.

Adding a subnet with PowerShell

When creating an Azure virtual network with PowerShell, a subnet is not created in the same step and requires an additional command to be executed separately.

Getting ready

Before creating a subnet, we need to collect information about the virtual network that the new subnet will be associated with. The parameters that need to be provided are the name of the virtual network and the resource group that the virtual network is located in:

```
$VirtualNetwork = Get-AzVirtualNetwork -Name 'Packt-Script'
-ResourceGroupName 'Packt-Networking-Script'
```

How to do it...

1. To add a subnet to the virtual network using PowerShell, we need to execute a command and provide the name and address prefix. The address prefix is again in CIDR format:

```
Add-AzVirtualNetworkSubnetConfig -Name FrontEnd -AddressPrefix 10.11.0.0/24  
-VirtualNetwork $VirtualNetwork
```

2. We need to confirm these changes by executing the following command:

```
$VirtualNetwork | Set-AzVirtualNetwork
```

3. We can add an additional subnet by running all commands in a single step, as follows:

```
$VirtualNetwork = Get-AzVirtualNetwork -Name 'Packt-Script'  
-ResourceGroupName 'Packt-Networking-Script'  
Add-AzVirtualNetworkSubnetConfig -Name BackEnd -AddressPrefix 10.11.1.0/24  
-VirtualNetwork $VirtualNetwork  
$VirtualNetwork | Set-AzVirtualNetwork
```

How it works...

The subnet is created and added to the virtual network, but we need to confirm the changes before they can become effective. When it comes to size, all the rules for creating or adding a subnet using the Azure portal, apply here as well; the subnet must be within the virtual network's address space and cannot overlap with other subnets in the virtual network. The smallest subnet allowed is **/29**, and the largest is **/8**, provided the value is within the virtual network's address space. For example, if you are creating a **/16** network, the largest value for the subnet will be **/16** only, as we cannot include a **/8** subnet in a **/16** address space.

There's more...

We can create and add multiple subnets with a single script, as follows:

```
$VirtualNetwork = Get-AzVirtualNetwork -Name 'Packt-Script'  
-ResourceGroupName 'Packt-Networking-Script'  
  
$FrontEnd = Add-AzVirtualNetworkSubnetConfig -Name FrontEnd -AddressPrefix  
10.11.0.0/24 -VirtualNetwork $VirtualNetwork  
  
$BackEnd = Add-AzVirtualNetworkSubnetConfig -Name BackEnd -AddressPrefix  
10.11.1.0/24 -VirtualNetwork $VirtualNetwork  
  
$VirtualNetwork | Set-AzVirtualNetwork
```

Changing the address space size

After the initial address space is defined during the creation of a virtual network, we can still change the address space size as needed. We can either increase or decrease the size of the address space or change the address space completely by using a new address range.

Getting ready

Before you start, open a web browser and go to the Azure portal at <https://portal.azure.com>.

How to do it...

In order to change the address space size for a virtual network using the Azure portal, we must observe the following steps:

1. In the **Virtual network** pane, locate **Address space** under **Settings**.
2. Next, click on **Address space** and change the value to the desired range. An example is shown in *Figure 1.11*:

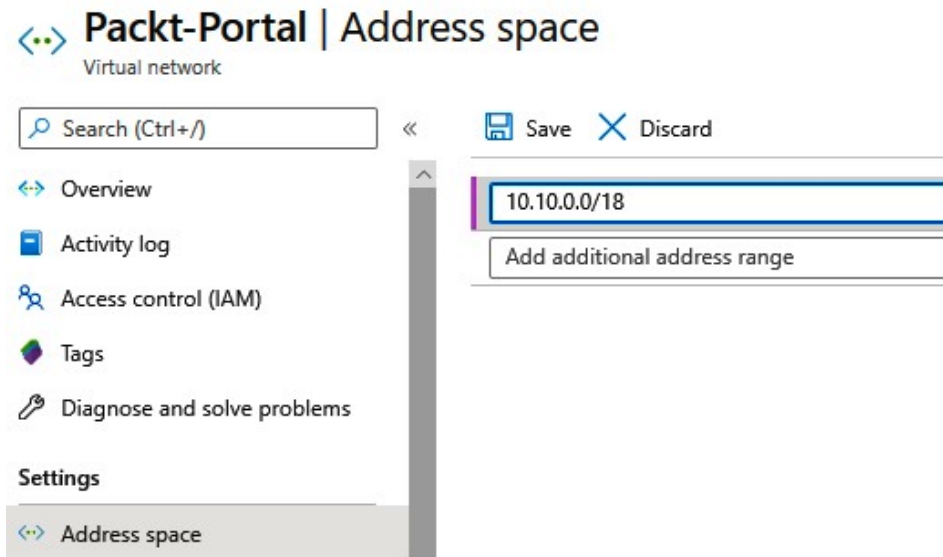


Figure 1.11: Changing the address space range

3. After you have entered a new value for **Address space**, click **Save** to apply the changes.

How it works...

Although you can change the address space at any time, there are some rules that determine what you can and cannot do. The address space cannot be decreased if you have subnets defined in the address space that would not be covered by the new address space. For example, if the address space were in the range of **10.0.0.0/16**, it would cover addresses from **10.0.0.1** to **10.0.255.254**. If one of the subnets was defined as **10.0.255.0/24**, we wouldn't be able to change the virtual network to **10.0.0.0/17**, as this would leave the subnet outside the new space.

The address space can't be changed to a new address space if you have subnets defined. In order to completely change the address space, you need to remove all subnets first. For example, if we had the address space defined as **10.0.0.0/16**, we would not be able to change it to **10.1.0.0/16**, since having any subnets in the old space would leave them in an undefined address range.

Let's see how to change the size of the newly created subnets.

Changing the subnet size

Similar to the virtual network address space, we can change the size of a subnet at any time.


Getting ready





Before you start, open a web browser and go to the Azure portal at <https://portal.azure.com>.

How to do it...

In order to change the subnet size using the Azure portal, we must take the following steps:

1. In the **Virtual network** pane, select the **Subnets** option.
2. Select the subnet you want to change. In the **Subnets** option, enter a new value for the subnet size under **Address range**. An example of how to do this is shown in *Figure 1.12*:

 **FrontEnd**
Packt-Portal

 Save  Discard  Delete  Refresh

Address range (CIDR block) * ⓘ

10.10.0.0/25

✓

10.10.0.0 - 10.10.0.127 (123 + 5 Azure reserved addresses)

Available addresses ⓘ

251

NAT gateway ⓘ

None

▼

☐ Add IPv6 address space

Network security group

None

▼

Route table

None

▼

Users

Manage users

>

Service endpoints

Services ⓘ

0 selected

▼

Subnet delegation

Delegate subnet to a service ⓘ

None

▼

Figure 1.12: Changing the subnet size using the Azure portal

3. After entering a new address range value, click **Save**.
4. In the **Subnets** list, you can see that the changes have been applied and the address space has changed, as shown in *Figure 1.13*:

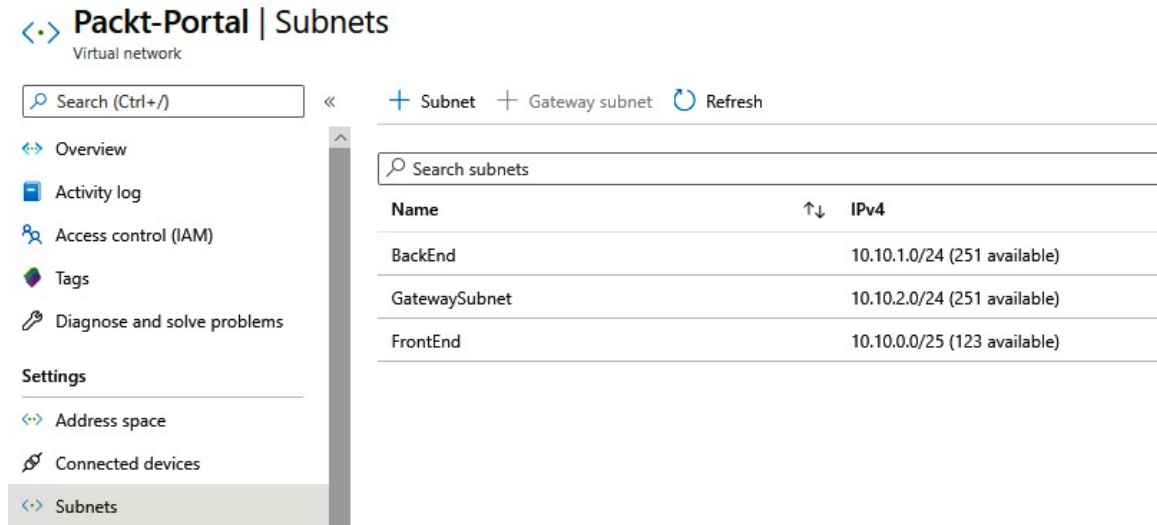


Figure 1.13: Viewing changes made in the subnet address range

How it works...

When changing the subnet size, there are some rules that must be followed. We cannot change the address space if it is not within the virtual network address space range, and the subnet range cannot overlap with other subnets in a virtual network. If devices are assigned to this subnet, we cannot change the subnet to exclude the addresses that these devices are already assigned to.