

# Lab 02

## Creating an Azure Network

### Overview

This assignment sets up a software-defined network for Azure.

### Deliverables / What to Submit

1. Take a screenshot of the web page to submit for credit.
2. From the Azure Portal choose Home then VM2. Take a screenshot of the vm2 configuration. Include your username on the right side of the screen.
3. Examine the code to create the rule to allow HTTP traffic through webnsg in Part 2 step 10.

### Getting Started

1. Login to <https://portal.azure.com>. From the Home screen choose All Resources.



2. Note the names of your existing resources. Your resources may look different from the image below.

**All resources** ...  
Default Directory (bigosstcc.onmicrosoft.com)

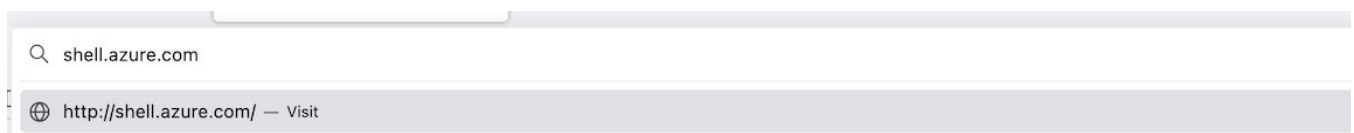
+ Create Manage view Refresh Export to CSV Open query Assign tags Delete

Filter for any field... Subscription equals **all** Resource group equals **all** × Type equals **all** × Location equals **all** × Add filter

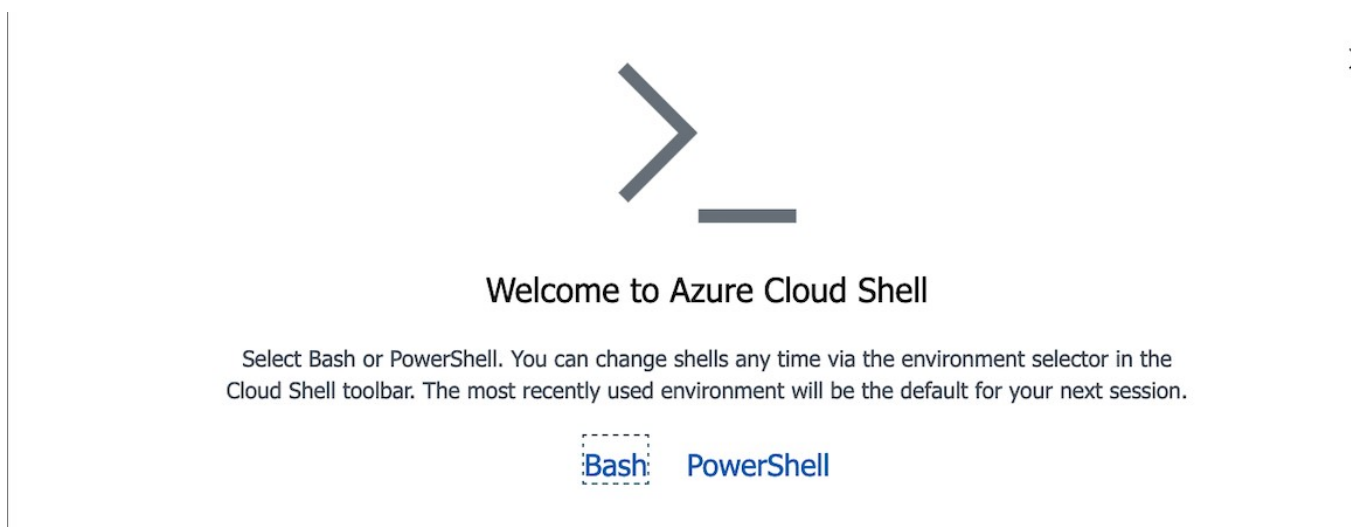
0 Unsecure resources 1 Recommendations No grouping

<input type="checkbox"/> Name ↑↓	Type ↑↓	Resource group ↑↓	Location ↑↓	Subscription ↑↓
<input type="checkbox"/> cs7100320028c9b5126	Storage account	cloud-shell-storage-southcentralus	South Central US	Azure for Students
<input type="checkbox"/> FirstVM-nsg	Network security group	vm1	East US	Azure for Students
<input type="checkbox"/> FirstVM-vnet	Virtual network	vm1	East US	Azure for Students
<input type="checkbox"/> NetworkWatcher_eastus	Network Watcher	NetworkWatcherRG	East US	Azure for Students
<input type="checkbox"/> Windows2016a-nsg	Network security group	vm1	East US	Azure for Students

- Choose Export to CSV. Save the file for later use.
- Create a new tab on the browser. Open <https://shell.azure.com> on this new tab. This step opens an Azure shell command line interface (CLI).



- Select Bash Shell.



- Choose *Create Storage*. This creates permanent storage for the CLI shell operations.

## You have no storage mounted

Azure Cloud Shell requires an Azure file share to persist files. [Learn more](#)  
This will create a new storage account for you and this will incur a small monthly cost. [View pricing](#)  
Azure Cloud Shell will register your subscription with Microsoft.CloudShell resource provider.

\* Subscription

Azure for Students

[Show advanced settings](#)

Create storage

Close

7. The storage may take several minutes to create. Wait until it is complete.

## You have no storage mounted

Azure Cloud Shell requires an Azure file share to persist files. [Learn more](#)  
This will create a new storage account for you and this will incur a small monthly cost. [View pricing](#)  
Azure Cloud Shell will register your subscription with Microsoft.CloudShell resource provider.

\* Subscription

Azure for Students

[Show advanced settings](#)

Creating...

Close

8. On completion, the Bash shell will appear.

```
Microsoft Azure Search resources, services, and docs (G+/  
Bash | [power icon] [help icon] [gear icon] [upload icon] [download icon] [copy icon] [paste icon]  
Requesting a Cloud Shell.Succeeded.  
Connecting terminal...  
  
Welcome to Azure Cloud Shell  
  
Type "az" to use Azure CLI  
Type "help" to learn about Cloud Shell  
  
edward [ ~ ]$
```

9. Create SSH keys for the CLI using the *ssh-keygen* command.

```
Microsoft Azure Search resources, services, and docs (G+/  
Bash | [power icon] [help icon] [gear icon] [upload icon] [download icon] [copy icon] [paste icon]  
Requesting a Cloud Shell.Succeeded.  
Connecting terminal...  
  
Welcome to Azure Cloud Shell  
  
Type "az" to use Azure CLI  
Type "help" to learn about Cloud Shell  
  
edward [ ~ ]$ ssh-keygen  
Generating public/private rsa key pair.  
Enter file in which to save the key (/home/edward/.ssh/id_rsa):  
Created directory '/home/edward/.ssh'.  
Enter passphrase (empty for no passphrase):  
Enter same passphrase again:  
Your identification has been saved in /home/edward/.ssh/id_rsa  
Your public key has been saved in /home/edward/.ssh/id_rsa.pub  
The key fingerprint is:  
SHA256:eJoW6z8ENv1Hxd4lFT3eSs/DrKxGgZKv/7aaX8wa/jI edward@cc-c9c2859c-58c96f7cb4-1d  
The key's randomart image is:  
+---[RSA 3072]---+  
|                 .  o+  
|                  o ..o  
| .. .o ..oo  
|=+ ..... o..  
|.o+S.  ..o+  
|*o...o .+o  
|=.....+. .  
| o .. oE+o  
| ..o=*B*.  
+---[SHA256]-----+  
edward [ ~ ]$
```

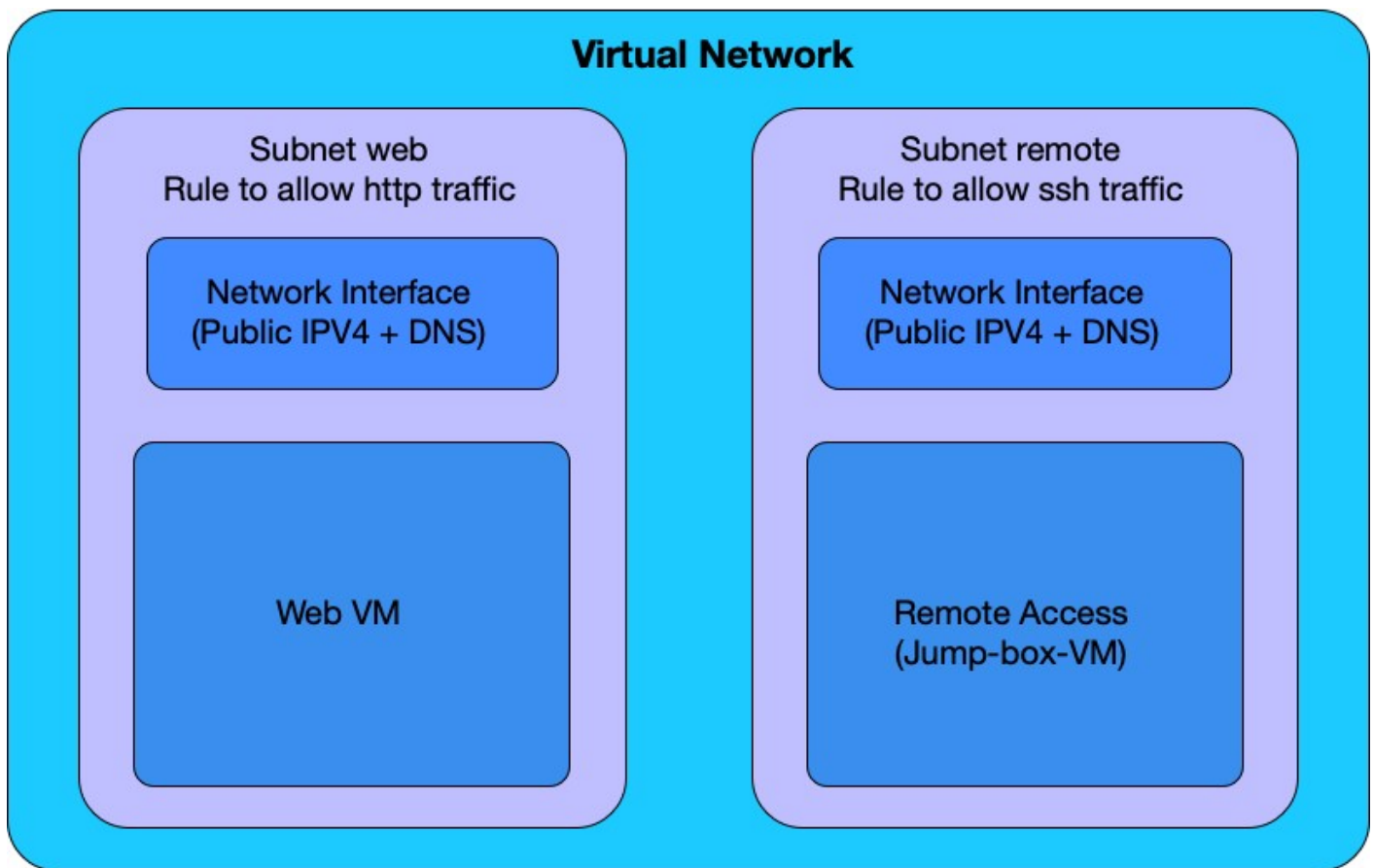
10. List the directory using `ls -la`. The keys are stored in the `.ssh` directory. Use `ls -la .ssh` to display the key files `id_rsa` and `id_rsa.pub`.

```
edward [ ~ ]$ ls -la
total 60
drwxr-xr-x 4 edward edward 4096 Apr 27 23:50 .
drwxrwxrwx 3 root   root   4096 Apr 27 23:49 ..
drwx----- 5 edward edward 4096 Apr 27 23:49 .azure
-rw----- 1 edward edward   11 Apr 27 23:50 .bash_history
-rw-r--r-- 1 edward edward  178 Apr 23  2022 .bash_logout
-rw-r--r-- 1 edward edward  645 Apr 23  2022 .bash_profile
-rw-r--r-- 1 edward edward  741 Apr 27 23:49 .bashrc
lrwxrwxrwx 1 edward edward   22 Apr 27 23:49 clouddrive -> /usr/csuser/clouddrive
drwx----- 2 edward edward 4096 Apr 27 23:50 .ssh
-rw-r--r-- 1 edward edward   42 Apr 27 23:49 .tmux.conf
-rw-r--r-- 1 edward edward 22287 Jun 17  2022 .zshrc
edward [ ~ ]$ ls -la .ssh
total 16
drwx----- 2 edward edward 4096 Apr 27 23:50 .
drwxr-xr-x 4 edward edward 4096 Apr 27 23:50 ..
-rw----- 1 edward edward 2635 Apr 27 23:50 id_rsa
-rw-r--r-- 1 edward edward  589 Apr 27 23:50 id_rsa.pub
edward [ ~ ]$
```

Use the `cat` commands to display the contents of the public key.

## Creating a Software Defined Network (SDN)

Azure uses a software-defined network (SDN) to provide network services to virtual machines (VMs). This set of steps will create an SDN for the next set of VMs. It helps to visualize the parts of the SDN.



- The SDN is composed of virtual networks and subnets (including IP address pools). We will create two subnets.
- Virtual network interface cards.
- One or more public IP addresses.
- Internal DNS name and optional public DNS names for external name resolution
- Network security groups and rules are used to secure and control the flow of network traffic. This function works the same way a regular firewall controls the flow of packets.

## Part 1 - Setting up the network

1. Create a Network Interface. Select the Home page on the Azure Portal. Choose *Create resource*. In the search box enter *Network*. Select *Network interface*.



[Home](#) >

## Create a resource ...

Get Started

Recently created

### Categories

AI + Machine Learning

Analytics

Blockchain

Compute

Containers

Databases

Network

network security group

network interface

network security network interface

network monitoring

Virtual network

Local network gateway

Virtual network gateway



Function App

2. Select Network interface and then Create.

[Home](#) > [Create a resource](#) >

# Marketplace

## Get Started

[Service Providers](#)

## Management

[Private Marketplace](#)[Private Offer Management](#)

## My Marketplace

[Favorites](#)[Recently created](#)[Private products](#)

## Categories

[IT & Management Tools \(57\)](#)[Networking \(46\)](#)[Security \(44\)](#)☐ Azure services onlyShowing 1 to 20 of 177 results for 'network interface'. [Clear search](#)

### Network interface

Microsoft

Azure Service

Create a Microsoft Azure Network Interface that allows you to connect a Virtual Machine to a Virtual Network.

Create ▾



Create



### Network security group

Microsoft

Azure Service

A virtual firewall to control inbound and outbound traffic for virtual machines and subnets.

Create ▾

**Resource group:** vm2**Name:** webvnic**Region:** East US**Virtual network:** virtualNetwork1



Microsoft Azure

Search resources, services, and

Home

>

Create a resource

>

Marketplace

>

Create network interface

Basics

Tags

Review + create

Create a network interface and attach it to a virtual machine. A network interface enables a virtual machine to communicate with Internet, Azure, and on-premises resources. [Learn more about network interface](#)

Project details

Subscription \*

Azure for Students

Resource group \*

vm2

Create new

Instance details

Name \*

webvnic

Region \*

East US

Virtual network \* ⓘ

(New) virtualNetwork1 (vm2)

Edit virtual network

Subnet \* ⓘ

(New) subnet1

Edit subnet

10.1.0.0 - 10.1.255.255 (65,536 addresses)

IP version

☒ IPv4
 ☐ IPv4 and IPv6

Private IP address assignment

☒ Dynamic
 ☐ Static

- Examine the subnet addresses. The 10.1.1.0/16 class B is reduced to 10.1.1.0/24. Select Edit subnet.

Microsoft Azure

Search resources, services, and docs (G+I)

Home

>

Create a resource

>

Marketplace

>

Create network interface

Basics

Tags

Review + create

Create a network interface and attach it to a virtual machine. A network interface enables a virtual machine to communicate with Internet, Azure, and on-premises resources. [Learn more about network interface](#)

Project details

Subscription \*

Azure for Students

Resource group \*

vm2

Create new

Instance details

Name \*

webvnic

Region \*

East US

Virtual network \* ⓘ

(New) virtualNetwork1 (vm2)

Edit virtual network

Subnet \* ⓘ

(New) subnet1

Edit subnet

10.1.0.0 - 10.1.255.255 (65,536 addresses)

IP version

☒ IPv4
 ☐ IPv4 and IPv6

Private IP address assignment

☒ Dynamic
 ☐ Static

Edit subnet

Select an address space and configure your subnet. You can customize a default subnet or select from subnet templates if you plan select services later. [Learn more](#)

IP address space ⓘ

10.1.0.0/16

10.1.0.0 - 10.1.255.255 (65,536 addresses)

Subnet details

Subnet template ⓘ

Default

Name \* ⓘ

websubnet

Starting address \* ⓘ

10.1.1.0

Subnet size ⓘ

/24 (256 addresses)

IP address space ⓘ

10.1.1.0 - 10.1.1.255 (256 addresses)

Security

Simplify internet access for virtual machines by using a network address translation gateway. Filter subnet traffic using a network se group. [Learn more](#)

NAT gateway ⓘ

None

Create new

Network security group ⓘ

None

Create new

Route table

None

Select Edit subnet.

## Edit subnet



Select an address space and configure your subnet. You can customize a default subnet or select from subnet templates if you plan to add select services later. [Learn more](#)

IP address space ① 10.1.0.0/16   
10.1.0.0 - 10.1.255.255 (65536 addresses)

### Subnet details

Subnet template ① Default 

Name \* ① websubnet  

Starting address \* ① 10.1.1.0

Subnet size ① /24 (256 addresses) 

IP address space ① 10.1.1.0 - 10.1.1.255 (256 addresses)

### Security

Simplify internet access for virtual machines by using a network address translation gateway. Filter subnet traffic using a network security group. [Learn more](#)

NAT gateway ① None   
[Create new](#)

Network security group ① None   
[Create new](#)

Route table None 

Use the following values.

**Name:** websubnet

**Starting address:** 10.1.1.0

**Subnet size:** /24 (256)

Save the subnet changes.

Select the Static IP radio button.

Home > Create a resource > Marketplace >

## Create network interface

Basics Tags Review + create

Create a network interface and attach it to a virtual machine. A network interface enables a virtual machine to communicate with Internet, Azure, and on-premises resources. [Learn more about network interface](#)

### Project details

Subscription *	Azure for Students
Resource group *	vm2

[Create new](#)

### Instance details

Name *	webvnic
Region *	East US
Virtual network * ⓘ	(New) virtualNetwork1 (vm2)
	<a href="#">Edit virtual network</a>
Subnet * ⓘ	(New) websubnet
	<a href="#">Edit subnet</a> 10.1.1.0 - 10.1.1.255 (256 addresses)
IP version	<input checked="" type="radio"/> IPv4 <input type="radio"/> IPv4 and IPv6
Private IP address assignment	<input type="radio"/> Dynamic <input checked="" type="radio"/> Static
Private IPv4 address *	10.1.1.4

**Private IP address assignment:** static

**Private IPv4 address:** 10.1.1.4

Save the interface configuration. After validation choose Create.

Microsoft Azure

Home > Create a resource > Marketplace >

## Create network interface

Validation passed

Basics Tags Review + create

### Basics

Subscription	Azure for Students
Resource group	vm2
Region	East US
Name	webvnic
Virtual network	(New) virtualNetwork1 (vm2)
Subnet	(New) websubnet
IP version	IPv4
Private IP address assignment	Static
Private IPv4 address	10.1.1.4

### Tags

None

View the webvnic configuration.

Microsoft Azure

Search resources, services, and docs (G+ /)

Home >

### webvnic

Network Interface

Search

Move Delete Refresh Edit accelerated networking

Overview

Activity log

Access control (IAM)

Tags

Settings

IP configurations

DNS servers

Network security groups

Essentials

Resource group (move)	: vm2	Private IPv4 address	: 10.1.1.4
Location (move)	: East US	Public IPv4 address	: -
Subscription (move)	: Azure for Students	Private IPv6 address	: -
Subscription ID	: 64a25757-e10c-4ce1-bac2-342ce0c30f45	Public IPv6 address	: -
Accelerated networking	: Disabled	Attached to	: -
Virtual network/subnet	: virtualNetwork1/websubnet	Type	: Regular
Tags (edit)	: Click here to add tags		

Notice there is no public IPv4 address listed on the interface.

From the Home screen choose Create, Network, Public IP address.

[Home](#) >

## Create a resource ...

Get Started

Recently created

### Categories

AI + Machine Learning

Analytics

Blockchain

Compute

Containers

Databases

Developer Tools

DevOps

Identity

Integration

Internet of Things

IT & Management Tools

Media

Migration

Mixed Reality

Monitoring & Diagnostics



### Popular Azure services [See more in All services](#)

	Public IP address <a href="#">Create</a>   <a href="#">Docs</a>
	Virtual Network <a href="#">Create</a>   <a href="#">Docs</a>   <a href="#">MS Learn</a>
	Local network gateway <a href="#">Create</a>   <a href="#">Docs</a>
	Connection <a href="#">Create</a>   <a href="#">Docs</a>
	Front Door and CDN profiles <a href="#">Create</a>   <a href="#">Docs</a>
	Traffic Manager profile <a href="#">Create</a>   <a href="#">Docs</a>   <a href="#">MS Learn</a>
	Network security group <a href="#">Create</a>   <a href="#">Docs</a>   <a href="#">MS Learn</a>
	Virtual network gateway <a href="#">Create</a>   <a href="#">Docs</a>   <a href="#">MS Learn</a>

Enter the following values.

**Resource group:** vm2

**Name:** webPublicIP

[Home](#) > [Create a resource](#) >

## Create public IP address ...

Basics   Tags   Review + create

-----

Subscription ⓘ \*

Azure for Students



Resource group ⓘ \*

vm2



[Create new](#)

### Instance details

Region \*

(US) East US



### Configuration details

Name \*

The name must not be empty.

IP Version \* ⓘ

☒ IPv4

☐ IPv6

SKU \* ⓘ

☐ Basic

☒ Standard

Availability zone \* ⓘ

Zone-redundant



Tier \* ⓘ

☐ Global

Save the public IP address. Validate and create the IP address.

Associate the public IP address with the network interface. Note: the screens use the name webPublicIP2 but you will be using webPublicIP.

Examine the webPublicIP configuration.

Microsoft Azure

Search resources, services, and docs (G+)

Home >

webPublicIP2  
Public IP address

Search

Associate Dissociate Delete Move Refresh Open in mobile

Overview

Activity log

Access control (IAM)

Tags

Settings

Configuration

Properties

Locks

Monitoring

Essentials

Resource group (move) : vm2

Location (move) : East US

Subscription (move) : Azure for Students

Subscription ID : 64a25757-e10c-4ce1-bac2-342ce0c30f45

SKU : Standard

Tier : Regional

IP address : 20.84.15.126

DNS name : -

Associated to : -

Virtual machine : -

Routing preference : Microsoft network

Tags (edit) : Click here to add tags

Choose the Associate button.

Home >

webPublicIP2  
Public IP address

Search

Associate Dissociate Delete Move Refresh Open in mobile

Overview

Activity log

Access control (IAM)

Tags

Settings

Configuration

Properties

Locks

Monitoring

Insights

Essentials

Resource group (move) : vm2

Location (move) : East US

Subscription (move) : Azure for Students

Subscription ID : 64a25757-e10c-4ce1-bac2-342ce0c30f45

SKU : Standard

Tier : Regional

IP address : 20.84.15.126

DNS name : -

Associated to : -

Virtual machine : -

Routing preference : Microsoft network

Tags (edit) : Click here to add tags

Get Started Properties Tutorials

Associate public IP address

webPublicIP2

Choose the resource to which you want to associate this public IP address.

Resource type

Load balancer

Load balancer

Network interface

Load balancer \*

Select Interface from the Resource drop-down.

Home >

webPublicIP2  
Public IP address

Search

Associate Dissociate Delete Move Refresh Open in mobile

Overview

Activity log

Access control (IAM)

Tags

Settings

Configuration

Properties

Locks

Monitoring

Insights

Essentials

Resource group (move) : vm2

Location (move) : East US

Subscription (move) : Azure for Students

Subscription ID : 64a25757-e10c-4ce1-bac2-342ce0c30f45

SKU : Standard

Tier : Regional

IP address : 20.84.15.126

DNS name : -

Associated to : -

Virtual machine : -

Routing preference : Microsoft network

Tags (edit) : Click here to add tags

Get Started Properties Tutorials

Associate public IP address

webPublicIP2

Choose the resource to which you want to associate this public IP address.

Resource type

Network interface

Network interface \*

Cannot be associated with this network interface

remotevmVMNIC

resource group: vm2

webvmnic

resource group: vm2

Choose the webvnic interface.

View the webvnic configuration. Note the public IP address.

## Part 2 - Configuration with the CLI

Now that we have setup our first network manually, we will now add the rest of our networks and VM to the configuration. To speed up this process, we will use the Azure CLI to mass create networks and VM's for our networks.

Open a new tab on the browser to <https://shell.azure.com>

1. Create the remote security group remotensg.

```
az network nsg create --resource-group vm2 --name remotensg
```

2. Create the remote network security group rules. Paste the code below into the Bash shell.

```
az network nsg rule create --resource-group vm2 --nsg-name remotensg --name allowssh --protocol  
tcp --priority 100 --destination-port-range 22 --access allow
```

3. Create the remote subnet 10.1.2.0/24 with the subnet name remotesubnet and security group remotensg.

```
az network vnet subnet create --resource-group vm2 --vnet-name vnet-eastus-1 --name remotesubnet  
--address-prefix 10.1.2.0/24 --network-security-group remotensg
```

4. Create the Ubuntu 22.04 Linux web server.

```
az vm create --resource-group vm2 --name webvm --nics webvnic --image Ubuntu2204 --size  
Standard_B1ms --admin-username azuremol --generate-ssh-keys
```

5. Create the Ubuntu 22.04 Linux JumpBox server.

```
az vm create --resource-group vm2 --name remotevm --vnet-name vnet-eastus-1 --subnet  
remotesubnet --nsg remotensg --public-ip-address remotepublicip --image Ubuntu2204 --size  
Standard_B1ms --admin-username azuremol --generate-ssh-keys
```

6. Test the connection to the jump box. Commands are in bold (use your IP address, the one below is an example).



```
edward [ ~ ]$ eval $(ssh-agent) Agent pid 301
edward [ ~ ]$ ssh-add
Identity added: /home/edward/.ssh/id_rsa (edward@cc-c9c2859c-
58c96f7cb4-ldm8p)
edward [ ~ ]$ ssh -A azuremol@74.235.35.186
The authenticity of host '74.235.35.186 (74.235.35.186)' can't be established.
ED25519 key fingerprint is
SHA256:+lbhwT+eEeB9LXHoOKwRJ3fav5OtSvaHXB1C6yeREzA.
This key is not known by any other names
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '74.235.35.186' (ED25519) to the list of known hosts.
Welcome to Ubuntu 22.04.2 LTS (GNU/Linux 5.15.0-1037-azure x86_64)
```

- Documentation: <https://help.ubuntu.com>
- Management: <https://landscape.canonical.com>
- Support: <https://ubuntu.com/advantage>

System information as of Tue May 2 03:17:47 UTC 2023

System load: 0.0732421875 Processes: 101  
Usage of /: 5.0% of 28.89GB Users logged in: 0  
Memory usage: 13% IPv4 address for eth0: 10.1.2.4  
Swap usage: 0%

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.  
See <https://ubuntu.com/esm> or run: `sudo pro status`

The programs included with the Ubuntu system are free software; the exact distribution terms for each program are described in the individual files in `/usr/share/doc/*/copyright`.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by applicable law.  
To run a command as administrator (user "root"), use "sudo <command>". See "man sudo\_root" for details.

azuremol@remotevm:~\$

## 7. Connect to the webvm server.

```
azuremol@remotevm:~$ ssh 10.1.1.4
The authenticity of host '10.1.1.4 (10.1.1.4)' can't be established.
ED25519 key fingerprint is
SHA256:1pFU2M0so/8idcudTOHBV0ZDnaQ4trDEwdIeBtTkUDI.
This key is not known by any other names
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '10.1.1.4' (ED25519) to the list of known hosts.
Welcome to Ubuntu 22.04.2 LTS (GNU/Linux 5.15.0-1037-azure x86_64)
```

- Documentation: <https://help.ubuntu.com>
- Management: <https://landscape.canonical.com>
- Support: <https://ubuntu.com/advantage>

System information as of Tue May 2 03:19:18 UTC 2023

System load: 0.0 Processes: 95  
Usage of /: 5.0% of 28.89GB Users logged in: 0  
Memory usage: 13% IPv4 address for eth0: 10.1.1.4  
Swap usage: 0%

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.  
See <https://ubuntu.com/esm> or run: `sudo pro status`

The programs included with the Ubuntu system are free software; the exact distribution terms for each program are described in the individual files in `/usr/share/doc/*/copyright`.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by applicable law.  
To run a command as administrator (user "root"), use "`sudo <command>`". See "`man sudo_root`" for details.

```
azuremol@webvm:~$ ls azuremol@webvm:~$ uname -a
Linux webvm 5.15.0-1037-azure #44-Ubuntu SMP Thu Apr 20 13:19:31 UTC
2023 x86_64 x86_64 x86_64 GNU/Linux azuremol@webvm:~$
```

## 8. Install the webserver on webvm.

```
sudo apt update && sudo apt install -y apache2
```

**Open port 80 for the web server. Log out from Linux server webvm. Log out from Linux server remotevm. Enter the commands from the Azure CLI shell.**

## 9. Create the web network security group webnsg

```
az network nsg create --resource-group vm2 --name webnsg
```

10. Create the webnsg rules for the HTTP port 80.

```
az network nsg rule create --resource-group vm2 --nsg-name webnsg --name allowhttp --protocol tcp  
--priority 100 --destination-port-range 80 --access allow
```

11. Associate the webnsg rule with the webvnic.

```
az network nic update --name webvnic --resource-group vm2 --network-security-group webnsg
```

12. Test the web server by opening a connection to your public IP address. The syntax is <http://publicipaddress>, where *publicipaddress* is your server's public Ip address which can be found on your VM's information tab. In my case, it would be <http://20.81.63.106>.

**Be sure to use http and not https!**

**STOP. Take a screen snapshot of this screen for the lab submission.**

Refer to deliverables 2 & 3 at the top of the lab for the other two lab requirements.