



<https://linkedin.com/in/prafulpatel16>

<https://github.com/prafulpatel16>



AZURE PROJECT

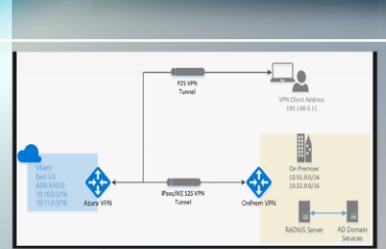
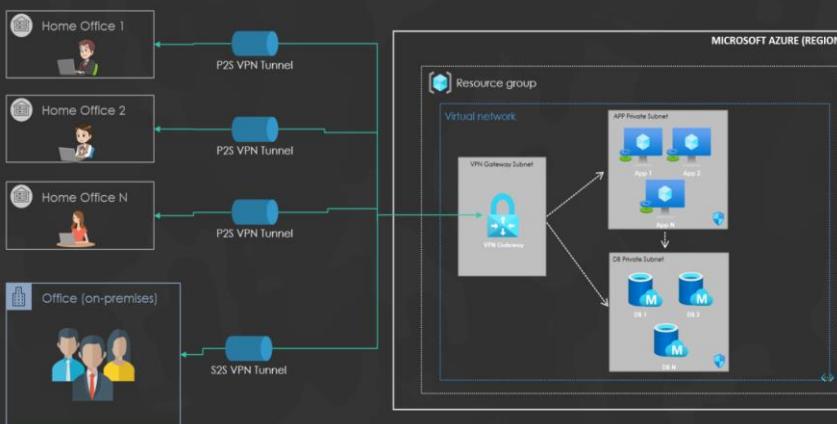
PROJECT-4: HOME OFFICE SOLUTION DURING COVID-19 PANDEMIC

WITH MICROSOFT AZURE VPN GATEWAY

IMPLEMENTED BY: PRAFUL PATEL



Home Office Solution during COVID-19 Pandemic with Microsoft Azure VPN Gateway



Date: MAY 25, 2022

➤ **Project Definition:**

HOME OFFICE SOLUTION DURING COVID-19 PANDEMIC WITH MICROSOFT AZURE VPN GATEWAY

➤ **Project Description:**

Web Application Name: Portfolio web application

VPN Solution: Point-to-Site VPN

An IT services Provider Company **PRAfect Systems Inc.** is engaged into providing Cloud/DevOps & software development solutions. Recently, the company had to run into some work challenges after pandemic hit and they have decided to shift the employee to start working from home model. In order to work from home model there was a challenge to access company's internal web portal "**Portfolio web Application**" within the private environment on which the employee were working on that project. The management people decided to move their entire workload to the Microsoft Azure, hence the home-office solution should be within the Azure cloud. The requirement was generated by the management to the Cloud infrastructure team to find out the proposed relevant solution from the Microsoft Azure and come up with the project implementation plan.

After few day's research and analysis an infrastructure team has approached with the proposed solution of this challenge. The solution would be to implement **P2S VPN** so that home-office workers will use their computers to close and encrypted tunnel between their environments with Azure.

This way when the connection VPN is closed, the employee who is connected, for example, to Home Office 1, will be able to access the resources if he is a member of the cloud team.

This project demonstrates an experience of deploying P2S (Point-to-site configuration) and configuring a remote office-home work solution through which workers can access the company's web portal privately.

➤ **Solution:**

A Point-to-Site (P2S) VPN gateway connection lets you create a secure connection to your virtual network from an individual client computer. A P2S connection is established by starting it from the client computer. This solution is useful for telecommuters who want to connect to Azure VNets from a remote location, such as from home or a conference. P2S VPN is also a useful solution to use instead of S2S VPN when you have only a few clients that need to connect to a VNet.

- Protocols P2S use:

1. Secure Socket Tunneling Protocol (SSTP): TCP 443
 2. OpenVPN: TCP 443
 3. IKEv2 VPN: TCP 443
- P2S VPN Clients authentication method:
 1. Authenticate using native Azure certificate authentication
 2. Authenticate using native Azure Active Directory authentication

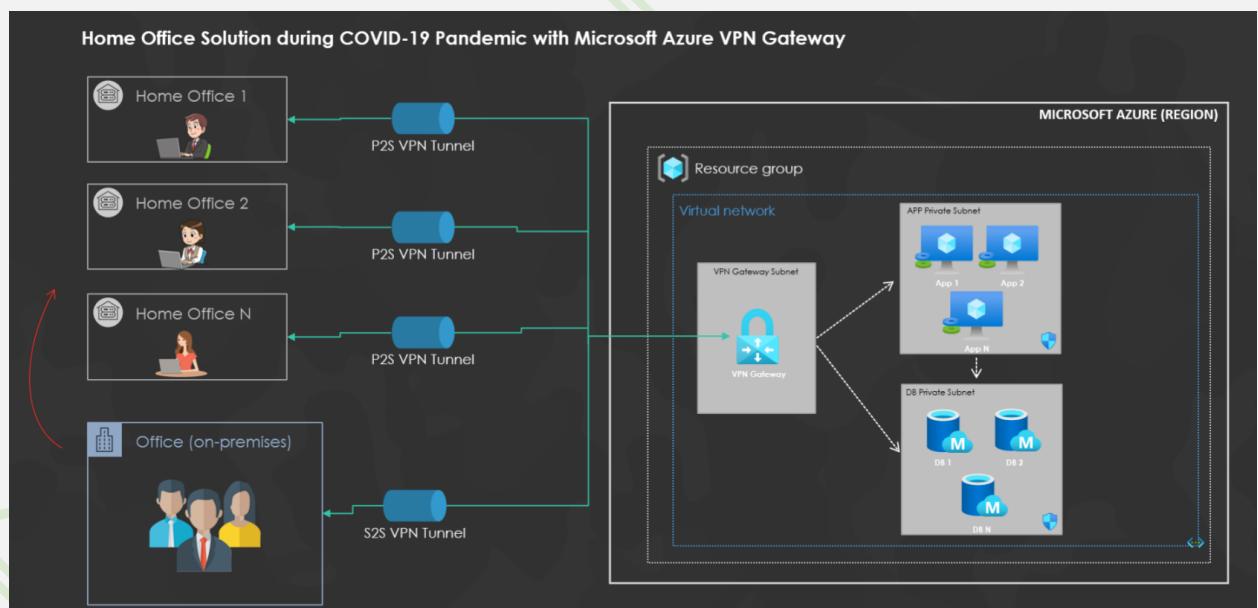
➤ **Project Cost Estimation:**

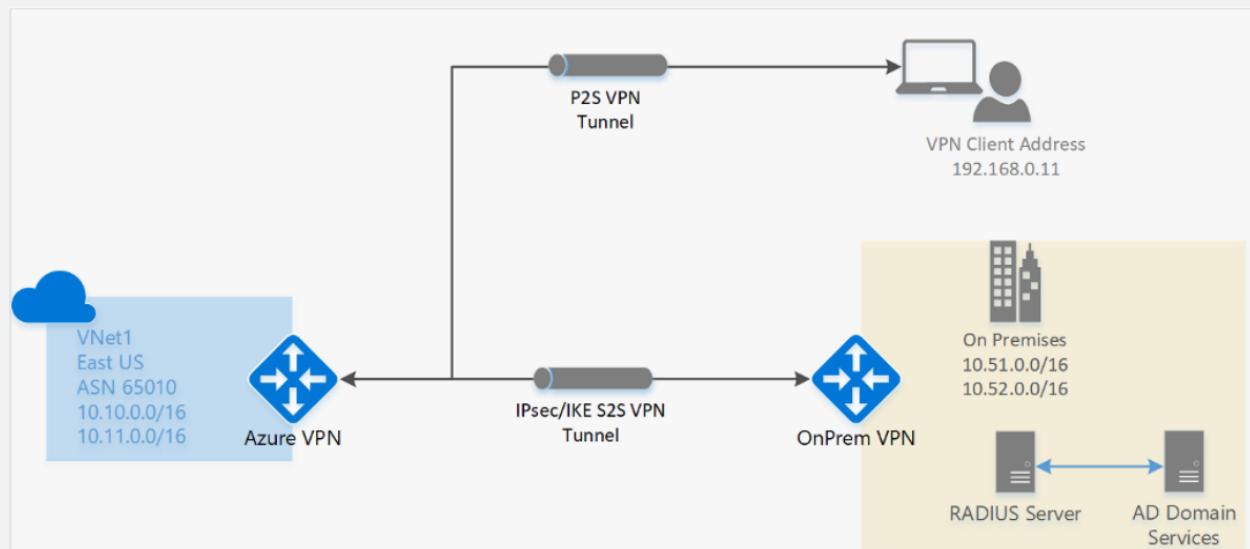
(Note: This cost is Not any actual cost, it's just an estimation based on high level requirement. Price may be vary based on adding and removing services based on requirement.)

➤ **Tools & Technologies covered:**

- Azure VNet
- Azure VM
- Azure VPN Gateway
- Azure VPN

➤ **Solution Architecture:**





This project will be completed in 6 implementation phases.

➤ **Project implementation Phase:**

- Phase 1: Deploy networking components
- Phase 2: Deploy Virtual Machine
- Phase 3: Deploy VPN gateway
- Phase 4: Deploy Azure VPN
- Phase 5: Install and configure web application server
- Phase 6: Test web application accessibility within internal private connection.

➤ **Implementation:**

- Phase 1: Deploy networking components
 1. Go to Azure Virtual Networks
 2. Create a Azure vNet
- Phase 2: Deploy Virtual Machine
 1. Go to Virtual machines
 2. Create Virtual machine
- Phase 3: Deploy VPN gateway
 1. Go to Virtual network gateway
 2. Select gateway type: VPN
 3. Select VPN Type: Route-based
 4. Configure P2S (Point-to-site configuration)
- Phase 4: Deploy Azure VPN
 1. Download Azure VPN client
 2. Install certificate on azure vpn
 3. Establish the VPN connection from local laptop
- Phase 5: Install and configure web application server

1. Create a small bash script to configure apache application server
2. Provide web application source code within the bash script
3. Go to vm and run the bash script to install the web application

➤ **Phase 6: Test web application accessibility within internal private connection**

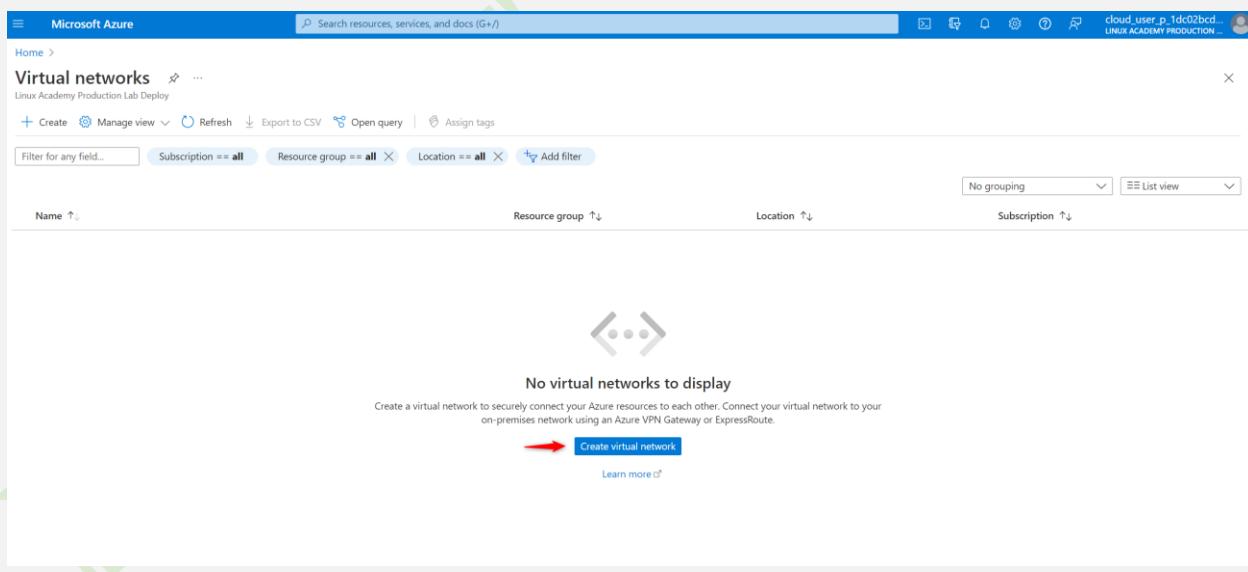
1. Access local terminal from on-premise
2. Copy the private ip of the VM
3. Ping the private ip, it should be successful
4. Go to Browser and hit the private ip
5. Verify that 'Portfolio web application' is accessible from browser

➤ **Implementation in an Action:**

Home Office Solution during COVID-19 Pandemic with Microsoft Azure VPN Gateway

➤ **Phase 1: Deploy networking components**

- Creating VNetprp



Basics

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 * ① P2-Real Hands-On Labs

Resource group * ② 1-zaf11377-playground-sandbox
Create new

Instance details

Name * ③ VNetprp

Region * ④ West US

Review + create < Previous Next : IP Addresses > Download a template for automation

IP Addresses

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

① 10.0.0.0/16 10.0.0 - 10.255.255 (65536 addresses)

Add IPv6 address space

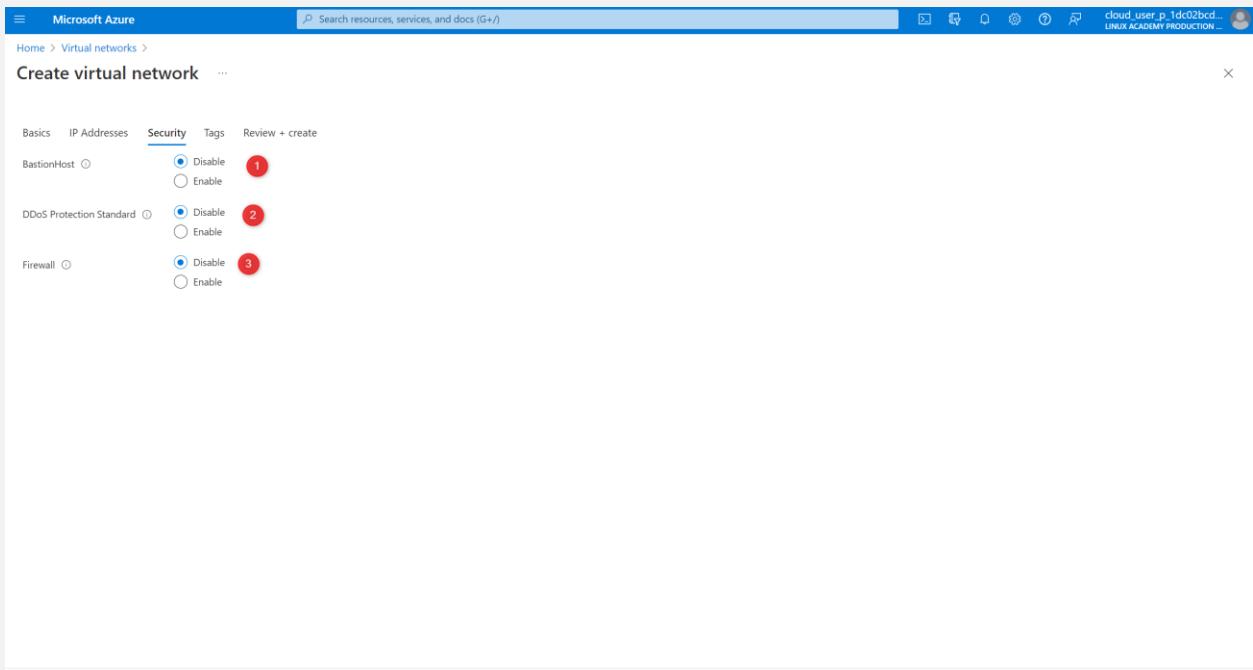
The subnet's address range in CIDR notation (e.g. 192.168.1.0/24). It must be contained by the address space of the virtual network.

+ Add subnet Remove subnet

Subnet name	Subnet address range	NAT gateway
② default	10.0.0.0/24	-

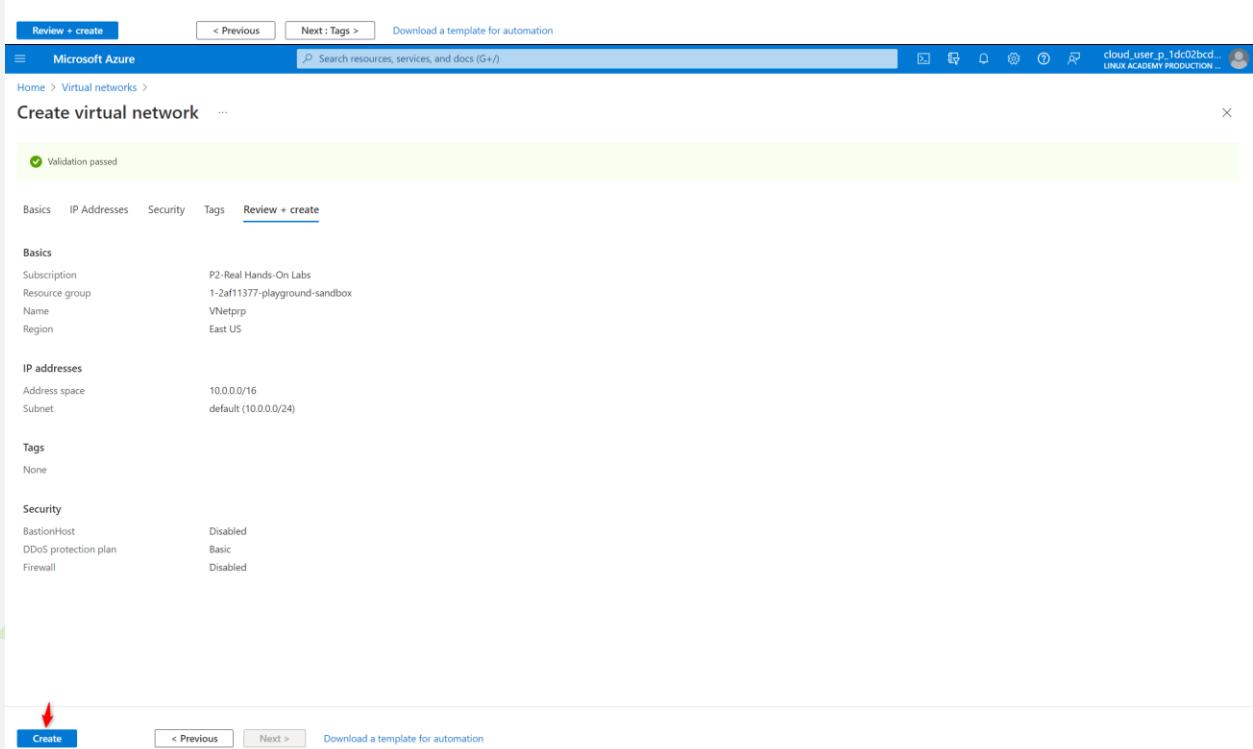
① Use of a NAT gateway is recommended for outbound internet access from a subnet. You can deploy a NAT gateway and assign it to a subnet after you create the virtual network. [Learn more](#)

Review + create < Previous Next : Security > Download a template for automation



The screenshot shows the 'Create virtual network' wizard on the 'Security' tab. Three specific settings are highlighted with red circles and numbers:

- BastionHost: Radio button selected for 'Disable' (numbered 1)
- DDoS Protection Standard: Radio button selected for 'Disable' (numbered 2)
- Firewall: Radio button selected for 'Disable' (numbered 3)



The screenshot shows the 'Create virtual network' wizard on the 'Review + create' tab. A green validation message 'Validation passed' is displayed. The 'Create' button at the bottom left is highlighted with a red arrow.

The screenshot shows the Microsoft Azure Deployment Overview page. At the top right, a green success message states: "Deployment succeeded. Deployment 'Microsoft.VirtualNetwork-20220524173431' to resource group '1-2af11377-playground-sandbox' was successful." Below this, the deployment name is listed as "Microsoft.VirtualNetwork-20220524173431". The deployment status is "Complete". The deployment details section shows the start time as 5/24/2022, 5:38:57 PM, and the correlation ID as 3fcfe302-a498-4e5f-a77b-f49c9fb34e8f. The resource group is "1-2af11377-playground-sandbox". There are links for "Go to resource" and "Pin to dashboard". On the right side, there are sections for "Cost Management" and "Microsoft Defender for Cloud".

The screenshot shows the Microsoft Azure Virtual Network (VNet) settings page for "VNetprp". The left sidebar lists various settings such as Overview, Activity log, Access control (IAM), Tags, and Diagnose and solve problems. The main area displays the "Essentials" section with details about the resource group, location, subscription, and address space. It also shows the "Capabilities" section with five cards: DDoS protection (Not configured), Azure Firewall (Not configured), Peering (Not configured), Private endpoints (Not configured), and Security (Not configured). A "JSON View" link is located at the top right.

Phase 2: Deploy Virtual Machine

The screenshot shows the Microsoft Azure Virtual machines creation page. The left sidebar lists "Virtual machines" and "Linux Academy Production Lab Deploy". The main area shows a list of creation options: "Azure virtual machine" (selected, indicated by a red circle with a '1'), "Azure virtual machine with preset configuration", "Azure Arc virtual machine", and "Azure VMware Solution virtual machine". The search bar at the top is set to "Type == all". The results table includes columns for Subscription, Resource group, Location, Status, Operating system, Size, Public IP address, and Disks. A message at the bottom states: "No virtual machines to display. Create a virtual machine that runs Linux or Windows. Select an image from the marketplace or use your own customized image."

[Home](#) > [Virtual machines](#) > [Create a virtual machine](#)

[Basics](#) [Disk](#) [Networking](#) [Management](#) [Advanced](#) [Tags](#) [Review + create](#)

Create a virtual machine that runs Linux or Windows. Select an image from Azure marketplace or use your own customized image. Choose the Basics tab to review + create to provision a virtual machine with default parameters or review each tab for full customization. [Learn more ↗](#)

Project details

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

Subscription * [R2-Real Hands-On Labs](#) 1
 Resource group * [1-2ef11377-playground-sandbox](#) 2 [Create new](#)

Instance details

Virtual machine name * [app01](#) 3
 Region * [\(US\) East US](#) 4
 Availability options: [No infrastructure redundancy required](#) 5
 Security type: [Standard](#) 6
 Image * [Ubuntu Server 20.04 LTS - Gen2](#) 7 [See in image](#) | [Configure VM generation](#)
 Azure Spot instance:
 Size * [Standard_D2v3 - 2 vcpus, 8 GB memory \(\\$70.00/month\)](#) 8 [See all sizes](#)
(8) [View availability based on policy assignment\(s\) for the selected sizes](#) [Azure-Sized-Units/Microsoft.Authorization/44770f27944eb3d214fc2 \(Policy details\)](#)

Administrator account

Authentication type: SSH public key Password 9

1 Azure now automatically generates an SSH key pair for you and allows you to store it for future use. It is a fast, simple, and secure way to connect to your virtual machine.

Username: [azureuser](#) 10
 SSH public key source: [Generate new key pair](#)
 Key pair name: [app01.key](#) 11

Inbound port rules

Select which virtual machine network ports are accessible from the public internet. You can specify more limited or granular network access on the Networking tab.

Public inbound ports *: None 10 Allow selected ports
 Select inbound ports: [Select one or more ports](#)
(10) All traffic from the internet will be blocked by default. You will be able to change inbound port rules in the VM > Networking page.

[Review + create](#) [< Previous](#) [Next : Disks >](#) 11

[Microsoft Azure](#) [Search resources, services, and docs \(G+\)](#) cloud user p-1dc02b0d...
LINUX ACADEMY PRODUCTION ...

[Home](#) > [Virtual machines](#) > [Create a virtual machine](#)

[Learn more ↗](#)

Network interface

When creating a virtual machine, a network interface will be created for you.

Virtual network * [VNetppr](#) 1 [Create new](#)
 Subnet * [default \(10.0.0.0/24\)](#) 2 [Manage subnet configuration](#)
 Public IP: [None](#) 3 [Create new](#)

NIC network security group: None Basic Advanced

Public inbound ports *: None 10 Allow selected ports
 Select inbound ports: [Select one or more ports](#)
(10) All traffic from the internet will be blocked by default. You will be able to change inbound port rules in the VM > Networking page.

Delete NIC when VM is deleted:
 Accelerated networking:

Load balancing

You can place this virtual machine in the backend pool of an existing Azure load balancing solution. [Learn more ↗](#)

Load balancing options: None 11
 Azure load balancer
Supports all TCP/UDP network traffic, port-forwarding, and outbound flows.
 Application gateway
Web traffic load balancer for HTTP/HTTPS with URL-based routing, SSL termination, session persistence, and web application firewall.

[Review + create](#) [< Previous](#) [Next : Management >](#) 4

Validation passed

Billing information is collected and aggregated by Microsoft to provide context, usage and transactional information with the provider(s) of the offering(s) for support, billing and other transactional activities. Microsoft does not provide rights for third-party offerings. See the [Azure Marketplace Terms](#) for additional details.

Basics

Subscription	P2-Real Hands-On Labs
Resource group	1-2af11377-playground-sandbox
Virtual machine name	app01
Region	East US
Availability options	No infrastructure redundancy required
Security type	Standard
Image	Ubuntu Server 20.04 LTS - Gen2
Size	Standard D2s v3 (2 vcpus, 8 GiB memory)
Authentication type	SSH public key
Username	azuseruser
Key pair name	app01_key
Public inbound ports	None
Azure Spot	No

Disks

OS disk type	Premium SSD LRS
Use managed disks	Yes
Delete OS disk with VM	Enabled
Ephemeral OS disk	No

Networking

Virtual network	VNetppr
Subnet	default (10.0.0.0/24)
Public IP	None
Accelerated networking	On
Place this virtual machine behind an existing load balancing solution?	No
Delete NIC when VM is deleted	Disabled

Management

Microsoft Defender for Cloud	None
Boot diagnostics	On
Enable OS guest diagnostics	Off

Create < Previous Next > Download a template for automation

Activity log

Essentials

Resource group (move)	: 1-2af11377-playground-sandbox
Status	: Running
Location	: East US
Subscription (move)	: P2-Real Hands-On Labs
Subscription ID	: 964df7ca-3ba4-48b6-a695-1ed9db5723f8
Tags (edit)	: Click here to add tags

Properties JSON View

Virtual machine

Computer name	app01
Health state	-
Operating system	Linux
Publisher	canonical
Offer	0001-com-ubuntu-server-focal
Plan	20.04-lts-gen2
VM generation	V2
Agent status	Not Ready
Agent version	Unknown
Host group	None
Host	-
Proximity placement group	-
Colocation status	N/A
Capacity reservation group	-

Networking

Public IP address	-
Private IP address (IPv6)	-
Private IP address (IPv4)	10.0.0.4
Virtual network/subnet	VNetppr/default
DNS name	-

Size

Size	Standard D2s v3
vCPUs	2
RAM	8 GiB

Disk

OS disk	app01_disk1_fd92400b9b87461b936113c787263bf4
Encryption at host	Disabled
Azure disk encryption	Not enabled

Create Virtual Private Gateway

The screenshot shows the Microsoft Azure portal interface. In the search bar at the top, the text 'virtual' has been typed. Below the search bar, there is a navigation bar with tabs: All, Services (27), Marketplace (20), Documentation (28), Resources (0), and Resource Groups (0). The 'Services' tab is selected. Under the 'Services' heading, there is a list of items: Virtual machines, Virtual WANs, Virtual network gateways (with a red arrow pointing to it), Virtual networks, Virtual networks (classic), and Virtual machine scale sets. To the right of the list, there is a preview pane showing a virtual machine configuration with 8 GiB memory.

Phase 3: Deploy VPN gateway

The screenshot shows the 'Virtual network gateways' blade in the Microsoft Azure portal. At the top, there is a header with the title 'Virtual network gateways' and a 'Create' button. Below the header, there are filter options: 'Subscription == all', 'Resource group == all', and 'Location == all'. There is also a 'No grouping' dropdown and a 'List view' dropdown. The main area displays a message: 'No virtual network gateways to display'. Below this message, there is a brief description of Azure VPN Gateway and a 'Create virtual network gateway' button, which is highlighted with a red arrow. A small note below the button says 'Learn more about Virtual network gateway'.

Basics

Subscription: P2-Real Hands-On Labs (1)

Resource group: 1-2af11377-playground-sandbox (2)

Name: vpngrp (2)

Region: East US (3)

Gateway type: VPN (4) (selected)

VPN type: Route-based (5) (selected)

SKU: VpnGw1 (6)

Generation: Generation1 (7)

Virtual network: VNetgrp (8)

Gateway subnet address range: 10.0.1.0/24 (9)

Public IP Address Type: Standard (10)

Public IP address: Create new (11)

Validation passed (12)

Create

Microsoft.VirtualNetworkGateway-20220524175132 | Overview

Deployment is in progress

Deployment name: Microsoft.VirtualNetworkGateway-2022052417... Start time: 5/24/2022, 5:55:53 PM
Subscription: P2-Real Hands-On Labs Correlation ID: d0e3e541-851a-435f-98dc-40aa98feba1

Resource	Type	Status	Operation details
vpnprp	Microsoft.Network/virtualNetworkGateways	Created	Operation details
VNetprp/GatewaySubnet	Microsoft.Network/virtualNetworks/subnets	OK	Operation details
vpnprppip	Microsoft.Network/publicIPAddresses	OK	Operation details

Your deployment is complete

Deployment name: Microsoft.VirtualNetworkGateway-2022052417... Start time: 5/24/2022, 5:55:53 PM
Subscription: P2-Real Hands-On Labs Correlation ID: d0e3e541-851a-435f-98dc-40aa98feba1

Next steps

[Go to resource](#)

Cost Management
Get notified to stay within your budget and prevent unexpected charges on your bill.
[Set up cost alerts >](#)

Microsoft Defender for Cloud
Secure your apps and infrastructure
[Go to Microsoft Defender for Cloud >](#)

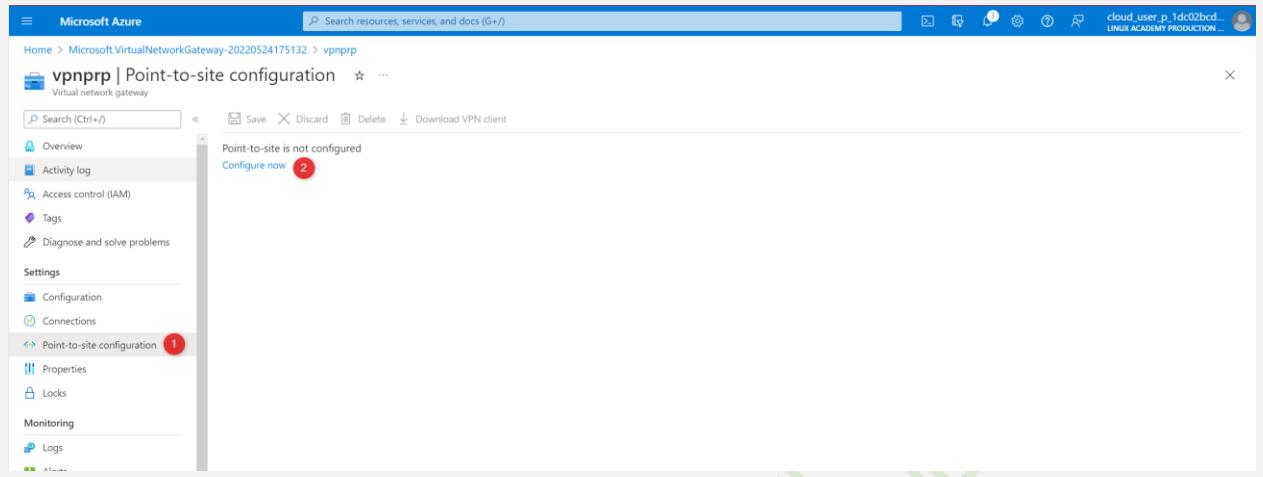
Free Microsoft tutorials
[Start learning today >](#)

Work with an expert
Azure experts are service provider partners who can help manage your assets on Azure and be your first line of support.
[Find an Azure expert >](#)

- Downloading the certificates (see the attachment from the solution video page)

Name	Date modified	Type	Size
clientcert.pfx	10/25/2021 6:17 PM	Personal Information ...	4 KB
rootcertificate.cer	10/25/2021 6:24 PM	Security Certificate	2 KB
rootcertificate.txt	10/25/2021 6:25 PM	Text Document	2 KB

Configuring P2S VPN



Copy certificate

```
-----BEGIN CERTIFICATE-----
MIIC5zCCAc+gAwIBAgIQSUvcreu4ir5IqdUgmDd9fjANBgkqhkiG9w0BAQsFADAW
MRQwEgYDVQQDDATQM1NSb290Q2VydDAeFw0yMTEwMjUyMzQ5MzdaFw0yMjEwMjYw
MDA5MzdaMBYxFDASBqNVBAMMC1AyU1Jvb3RDZXJ0MIIBIjANBgkqhkiG9w0BAQEFA
AOCAQ8AMIIBCgKCAQEAY11RX/m3VU778d7nr2BygarpoT6B1DN3/72UXSv5kE8z
gt2XgORVoqiZ2CQ7okyI4UtMinU5ch3O8qMikryJ/oNq2k7pim1iuOGBNAEmyxPg
5u27JmiXtuYD0mDvdpXw8iJvZ4DuK890XViUX2i5VcCS6ZkN3WK0ORLD1BDSvIr
6FM4GBphQQA1fz9eyB4ED1xBJrOkJ0QKTTZBp0Se1gKLB2Dv21YY5w8rgsKz8I1
7I2WWmbSRV++pZp54ybJMRHiqF2606qICOZT9KLQjpZwWSC0qEW4CaCQk1+yG6Bq
ZdEX+QbroqaYoiCN02R7W1tZkuw2ltMM2mphDM9F2QIDAQABoZewLzACBqNVHQ8B
Af8EBAMCAgQwHQYDVR0OBYEFLYOCYlaalpw10wMay/qkIYsiuMMA0GCSqGSIb3
DQEBCwUAAC1IBAQC2PUYcma6kVASK9NoLUPD61YWgHtdPe0d1Whxh9TUztK3bsQLH
y82aQNSwXpOiiWW211jQsmnaL2PAUoplJm6g1W5CdEZTDiWU+uoSMQywtMikTG7o
NI6h/guv3fx3vI8BBhtPgUlgsVwlRUJ0OV74Hxmaw4TprUkE4zUkPoEpG+ynZo4a
OR9SwD2zUlbR8PkJtwlFKkn6Zx1+rfb2Q1d/zvZk5qLChanUnA1iJB0cVfc/aDxQ
t7xccyRH1YAXWxNOirTF6RIWPt4BD+WZwcJ0nNXwF1sAAuqxLXEd0Gg+YoUUHngQ
V+NXLdu6hMCZOyKKHLEXk0DRgogjAgsmakkz
-----END CERTIFICATE-----
```

- Adding a pool of IPs (range): 172.16.0.0/24

Microsoft Azure

Home > Microsoft.VirtualNetworkGateway-20220524175132 > vpnprrp

vpnprrp | Point-to-site configuration

Virtual network gateway

Search (Ctrl+F) Save Discard Delete Download VPN client

Address pool * 172.16.0.0/24

Tunnel type IKEv2 and SSTP (SSL)

Authentication type Azure certificate

Root certificates
Name: P2SRootCert
Public certificate data: MIIC5zCCAc+gAwIBAgIQSUvcreu4irSlqdUgmDdf9fANBqkjhkiG9w0BAQsfADAW MRQwEgYDVQQDDA...
Revoked certificates
Name: Thumbprint:

Additional routes to advertise:

Wait till the SAVE is complete and “Download VPN Client” option gets enabled

- Generating and installing VPN Azure

Microsoft Azure

Home > Microsoft.VirtualNetworkGateway-20220524175132 > vpnprrp

vpnprrp | Point-to-site configuration

Virtual network gateway

Search (Ctrl+F) Save Discard Delete Download VPN client

Address pool * 172.16.0.0/24

Tunnel type IKEv2 and SSTP (SSL)

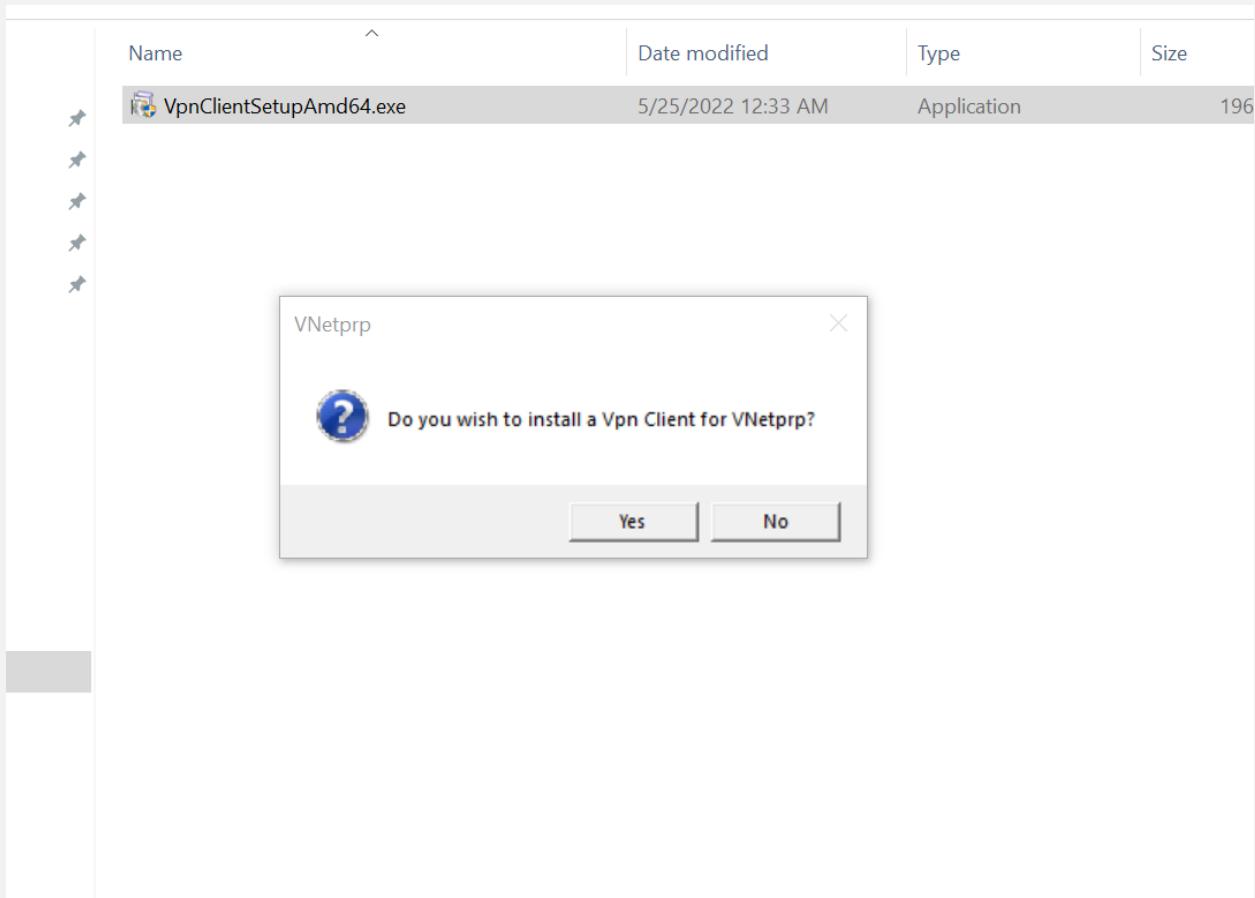
Authentication type Azure certificate

Root certificates
Name: P2SRootCert
Public certificate data: MIIC5zCCAc+gAwIBAgIQSUvcreu4irSlqdUgmDdf9fANBqkjhkiG9w0BAQsfADAW MRQwEgYDVQQDDA...
Revoked certificates
Name: Thumbprint:

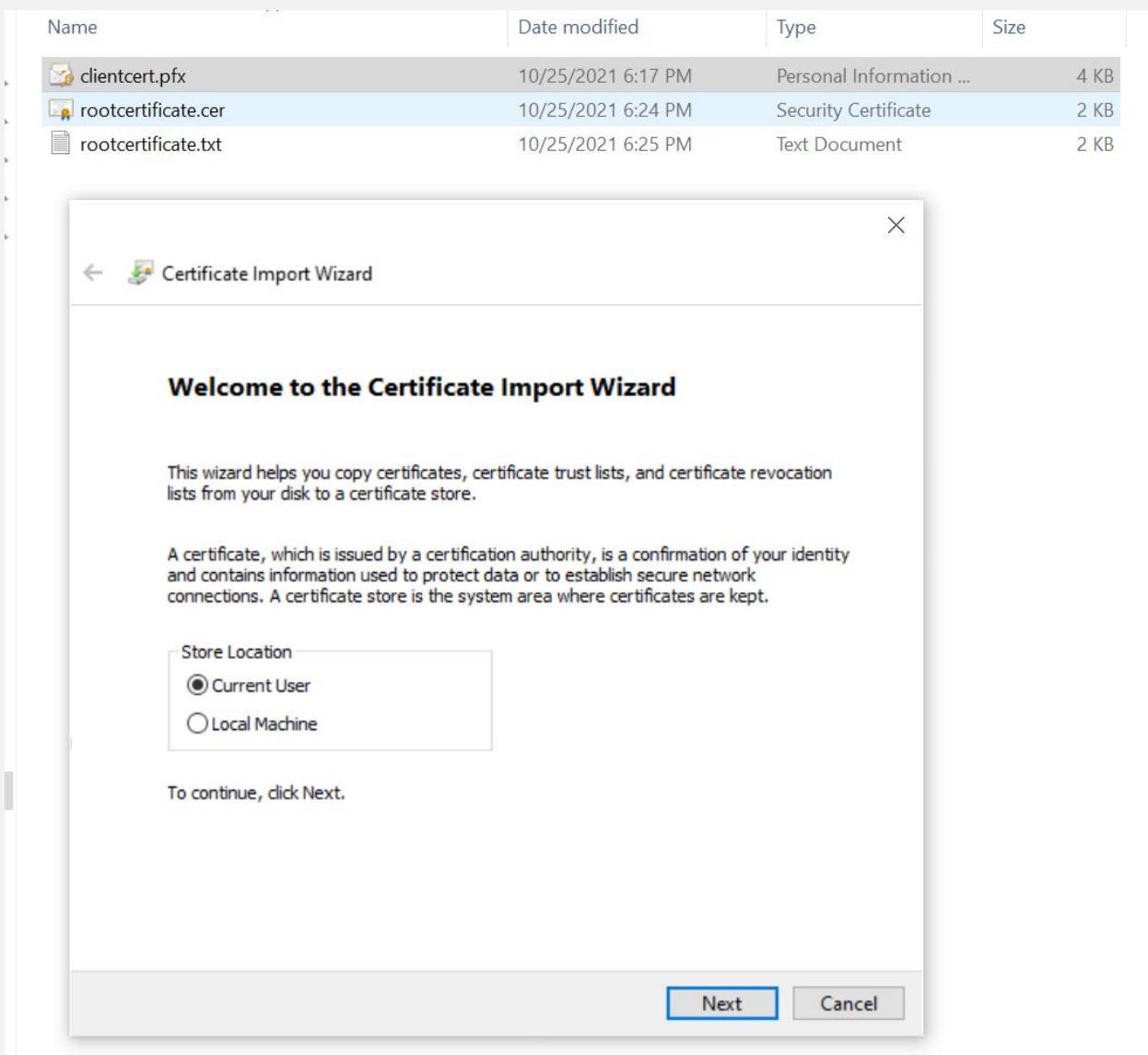
Additional routes to advertise:

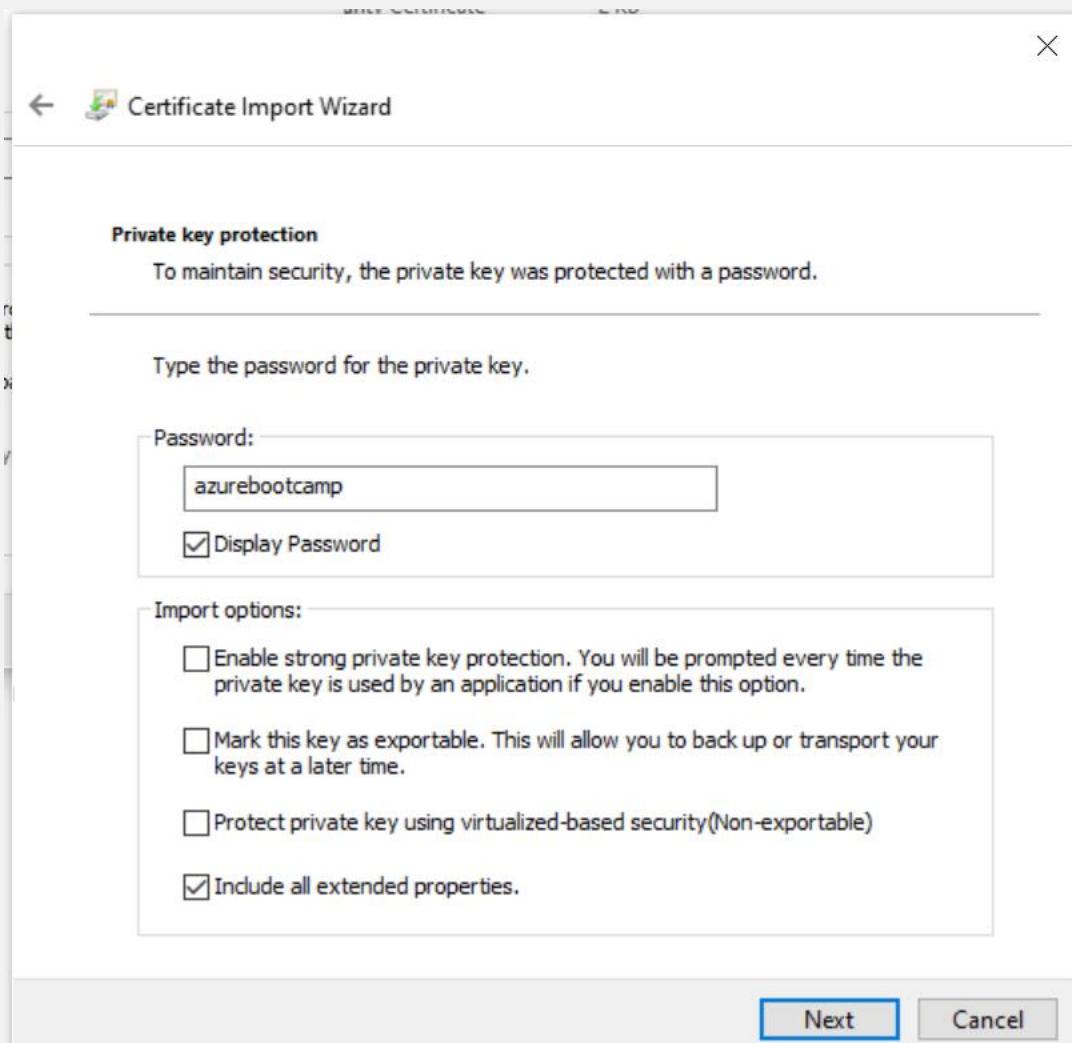
Remote connection via VPN:

- Installing the certificate
- Password: azurebootcamp
- Unzip the vpn and install

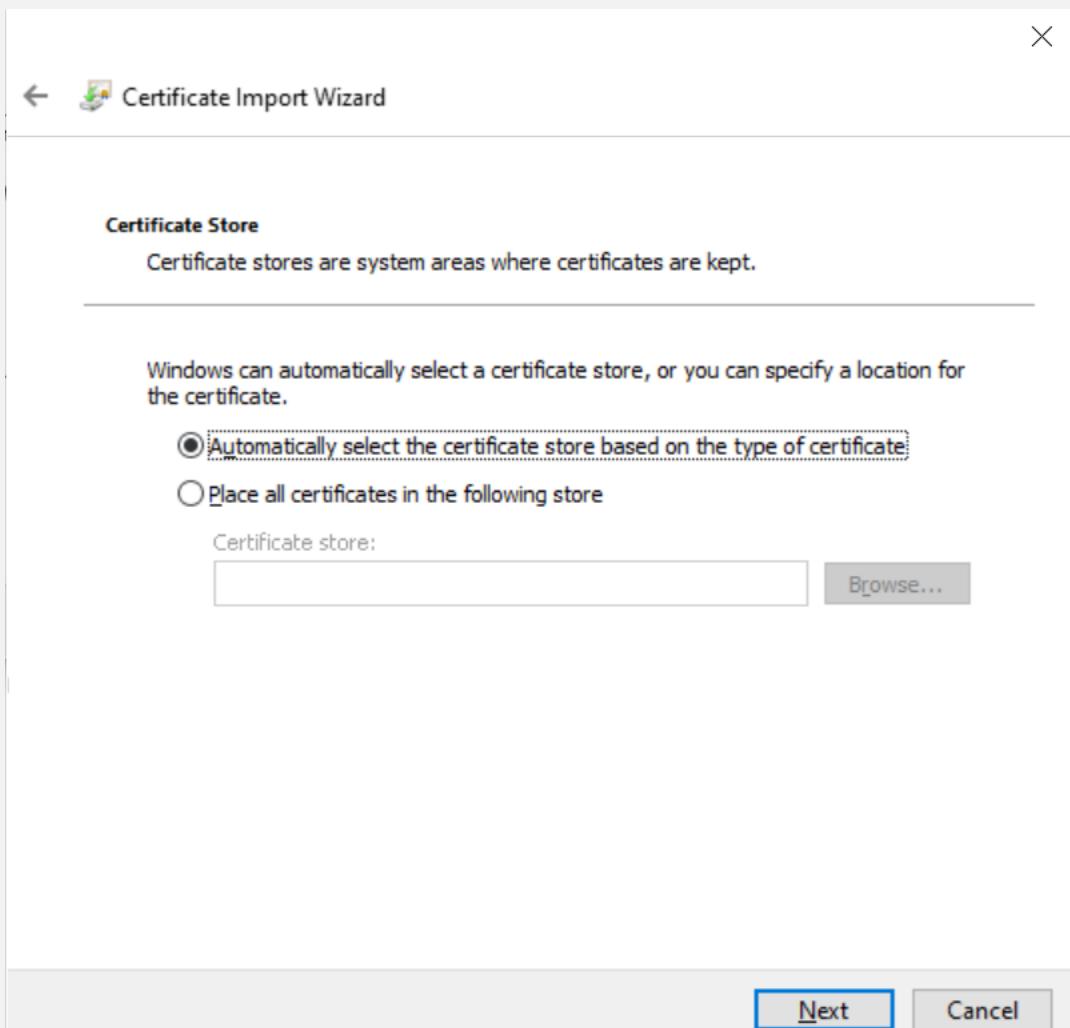


PRAFUL

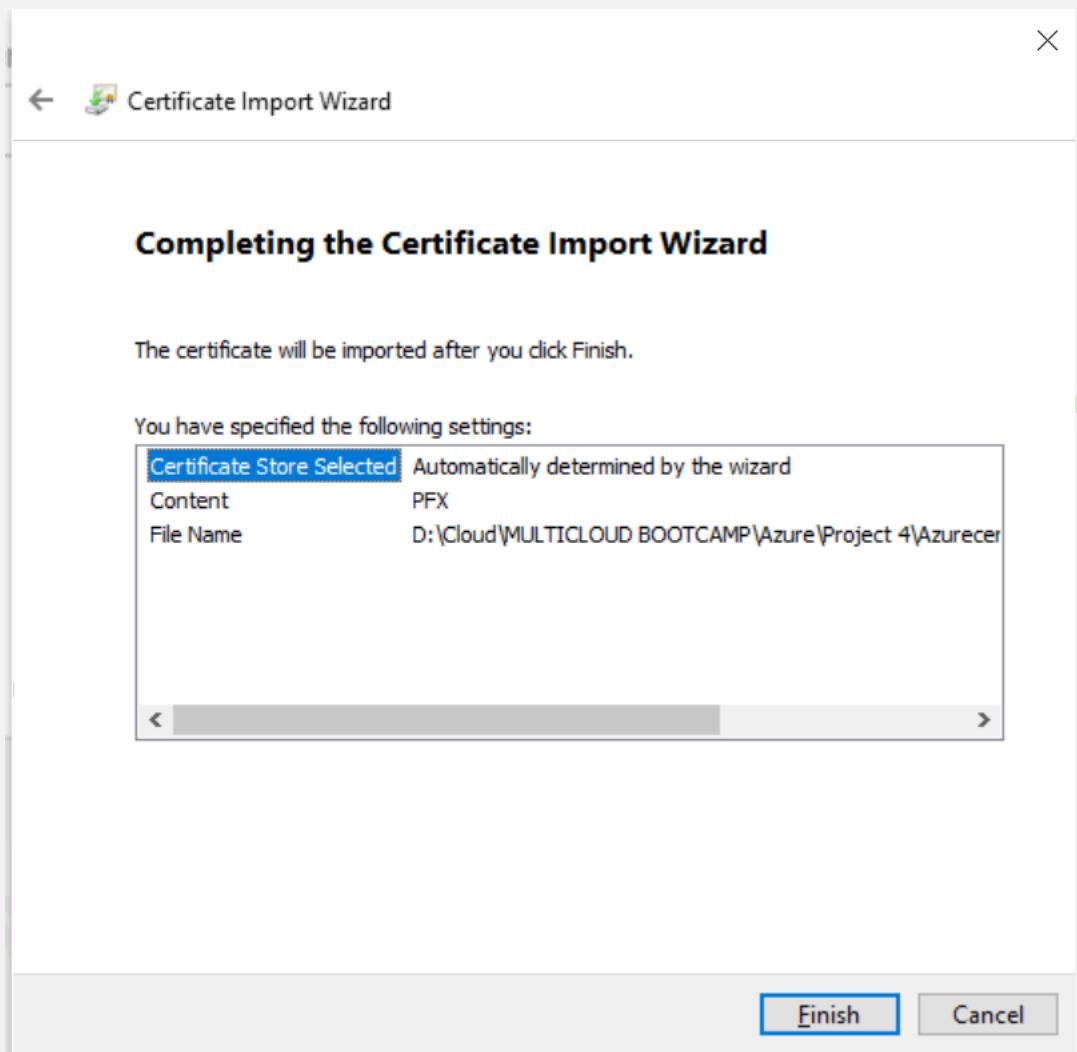


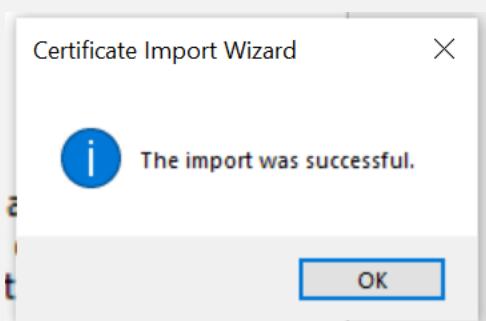
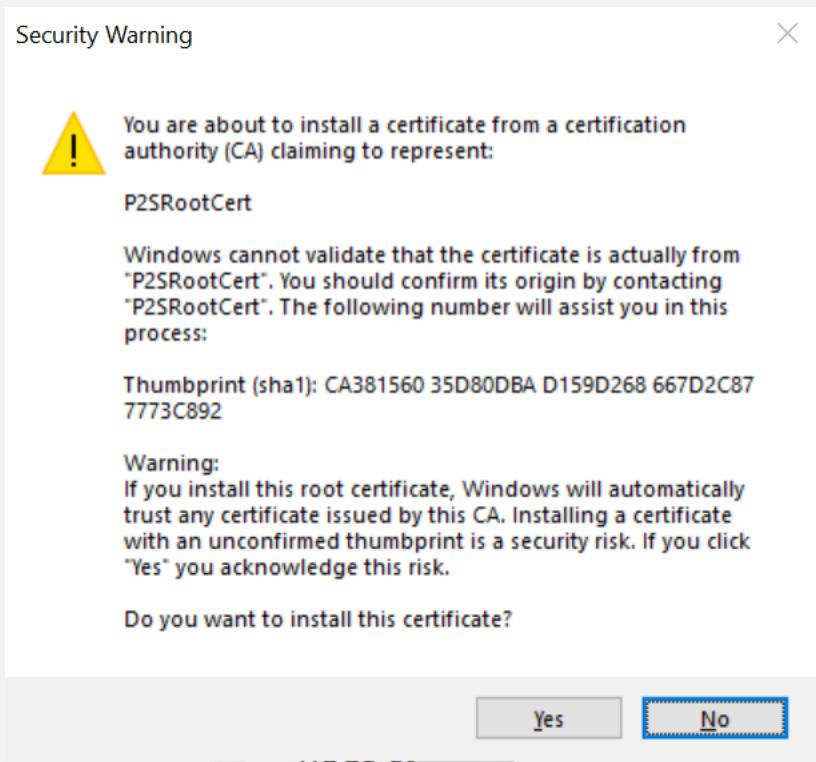


PRAFUL

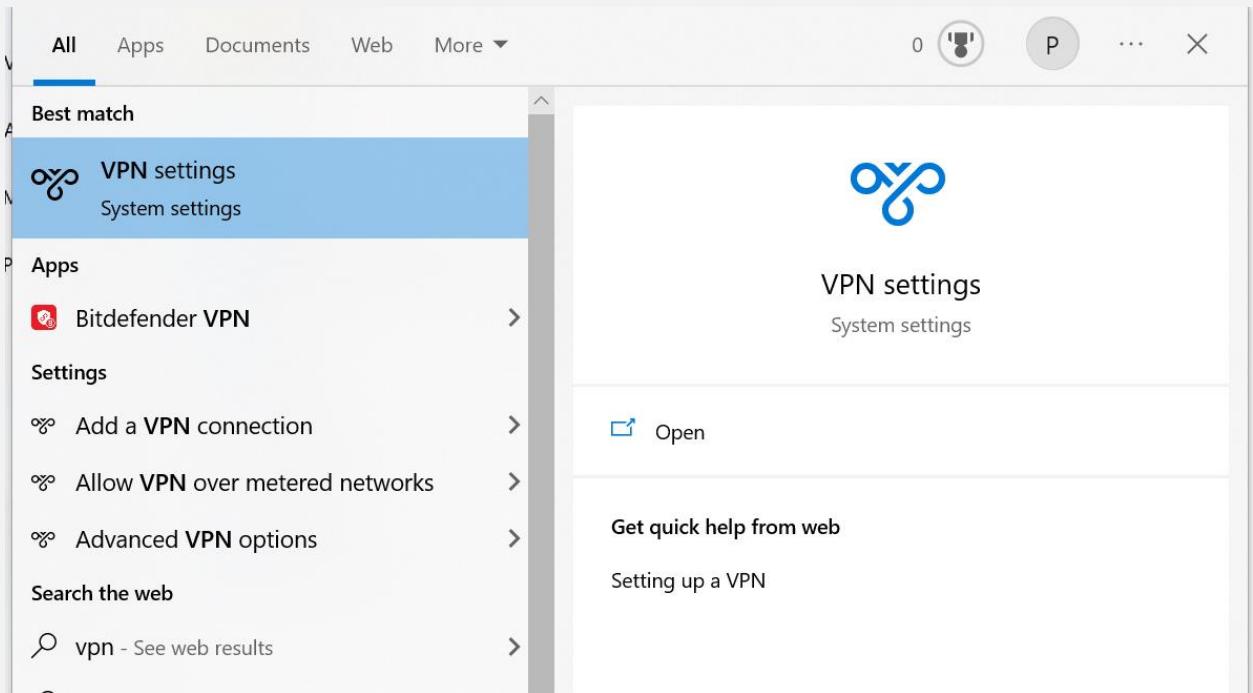


PRAFUL

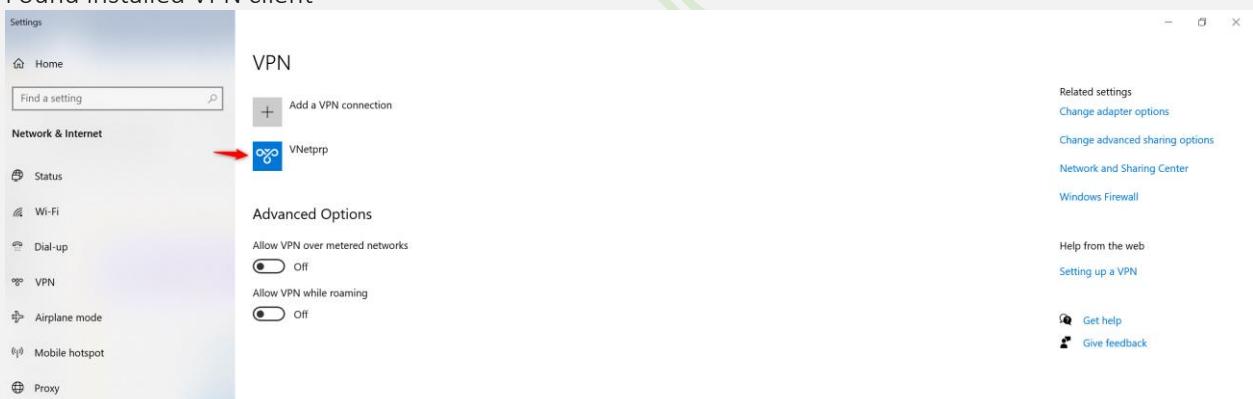




Now Search for installed VPN



Found installed VPN client



VPN



Add a VPN connection

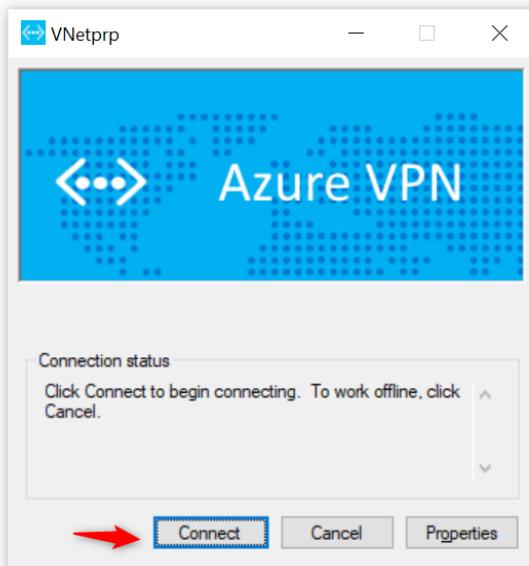


VNetprp

Connect

Advanced options

Remove



Advanced Options

Allow VPN over metered networks



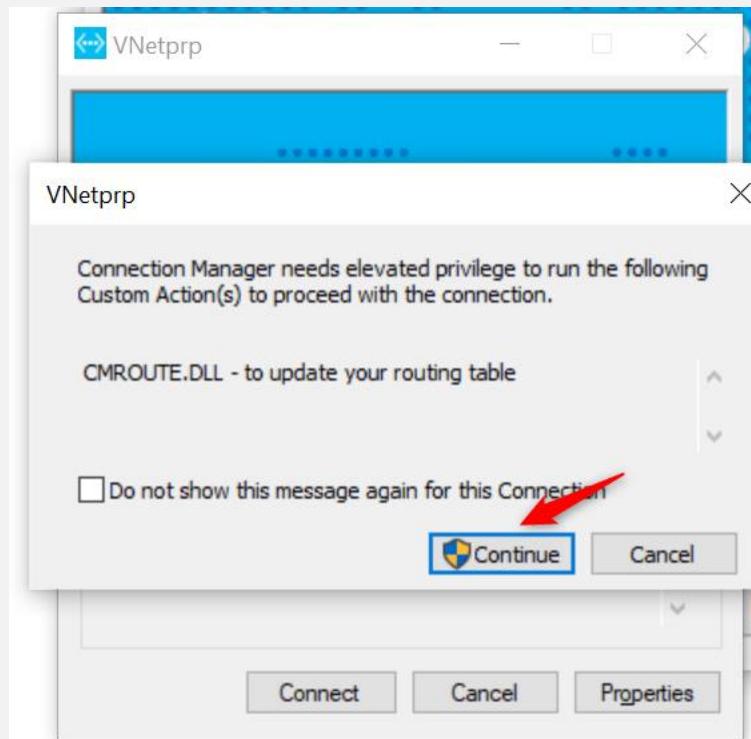
Off

Allow VPN while roaming



Off

PRAFUL



Test the connection from vm

Microsoft Azure

Home > Virtual machines >

Virtual machines

app01

Search resources, services, and docs (G+)

Overview

Activity log

Access control (IAM)

Tags

Diagnose and solve problems

Settings

Networking

Connect

Disk

Size

Microsoft Defender for Cloud

Advisor recommendations

Extensions + applications

Continuous delivery

Availability + scaling

Configuration

Identity

Properties

Locks

Operations

Resource group (move) : 1-2af11377-playground-sandbox

Status : Running

Location : East US

Subscription (move) : P2-Real Hands-On Labs

Subscription ID : 964df7ca-3ba4-48b6-a695-1ed9db5723fb

Tags (edit) : Click here to add tags

Properties Monitoring Capabilities (7) Recommendations Tutorials

Virtual machine

Computer name : app01

Health state : -

Operating system : Linux (ubuntu 20.04)

Publisher : canonical

Offer : 0001-com-ubuntu-server-focal

Plan : 20.04-lts-gen2

VM generation : V2

Agent status : Ready

Agent version : 2.7.1.0

Host group : None

Host : -

Proximity placement group : -

Networking

Public IP address : -

Public IP address (IPv6) : -

Private IP address : 10.0.0.4

Private IP address (IPv6) : -

Virtual network/subnet : VNetprp/default

DNS name : -

Size

Standard D2s v3

vCPUs : 2

RAM : 8 GiB

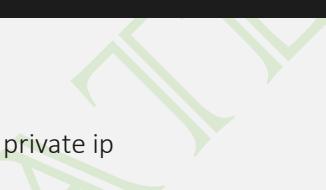
Disk

OS disk : app01_disk1_fd92400b9b87461b936113c787263b4f

Copy private ip

10.0.0.4

Open local terminal from the laptop and ping to private ip of vm



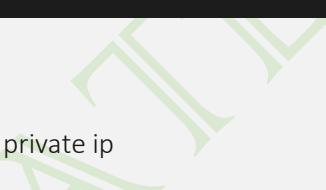
```
2 Terminal
24/05/2022 18:52.46 /home/mobaxterm ping 10.0.0.4
Pinging 10.0.0.4 with 32 bytes of data:
Reply from 10.0.0.4: bytes=32 time=338ms TTL=64
Reply from 10.0.0.4: bytes=32 time=49ms TTL=64
Reply from 10.0.0.4: bytes=32 time=50ms TTL=64
Reply from 10.0.0.4: bytes=32 time=51ms TTL=64

Ping statistics for 10.0.0.4:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 49ms, Maximum = 338ms, Average = 122ms

24/05/2022 18:52.54 /home/mobaxterm
```

The connection is successful

Let's SSH to the VM inside Azure from on premise site using private ip



```
MINGW64:/c/Users/Praful/Downloads
Praful@DESKTOP-M660IAH MINGW64 ~/Downloads
$ ssh azureuser@10.0.0.4 -i app01_key.pem
```

```
L Select azureuser@app01: ~

Praful@DESKTOP-M660IAH MINGW64 ~/Downloads
$ ssh azureuser@10.0.0.4 -i app01_key.pem
The authenticity of host '10.0.0.4 (10.0.0.4)' can't be established.
ED25519 key fingerprint is SHA256:e+jf1jmG3hKduW7VL9YHhlnLZGMWsLYmYyXUHFVEhmE.
This key is not known by any other names
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '10.0.0.4' (ED25519) to the list of known hosts.
Welcome to Ubuntu 20.04.4 LTS (GNU/Linux 5.13.0-1023-azure x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage

System information as of Wed May 25 00:58:02 UTC 2022

System load: 0.0          Processes:           118
Usage of /:   4.9% of 28.90GB  Users logged in:    0
Memory usage: 3%          IPv4 address for eth0: 10.0.0.4
Swap usage:   0%

* Super-optimized for small spaces - read how we shrank the memory
  footprint of MicroK8s to make it the smallest full K8s around.

https://ubuntu.com/blog/microk8s-memory-optimisation

1 update can be applied immediately.
To see these additional updates run: apt list --upgradable

The list of available updates is more than a week old.
To check for new updates run: sudo apt update

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

Select azureuser@app01: ~

The list of available updates is more than a week old.
To check for new updates run: sudo apt update

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.

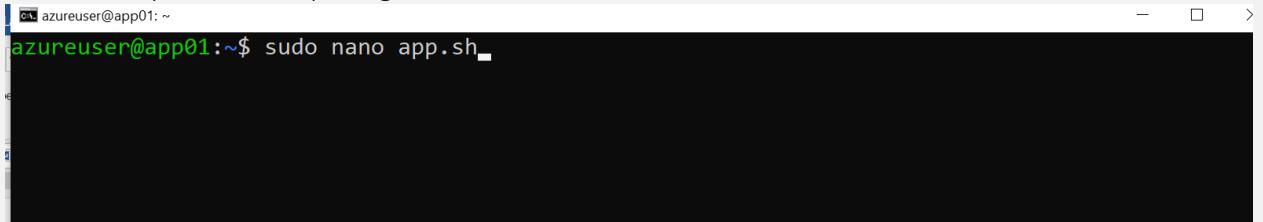
To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

azureuser@app01:~$
```

 Phase 5: Install and configure web application server

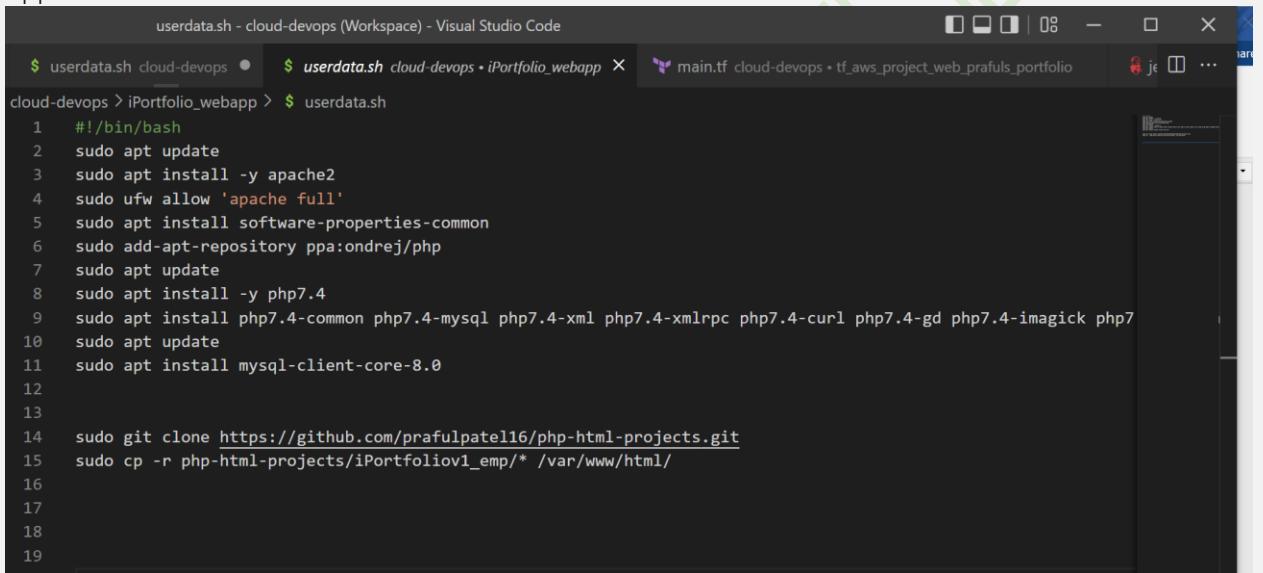
Install application server and deploy a web application

Create a script to install a packages

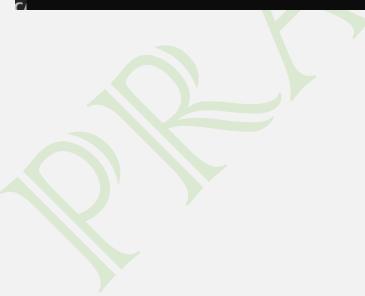


```
azureuser@app01:~$ sudo nano app.sh
```

Application user data



```
userdata.sh - cloud-devops (Workspace) - Visual Studio Code
$ userdata.sh cloud-devops • $ userdata.sh cloud-devops • iPortfolio_webapp X main.tf cloud-devops • tf_aws_project_web_prafuls_portfolio
cloud-devops > iPortfolio_webapp > $ userdata.sh
1  #!/bin/bash
2  sudo apt update
3  sudo apt install -y apache2
4  sudo ufw allow 'apache full'
5  sudo apt install software-properties-common
6  sudo add-apt-repository ppa:ondrej/php
7  sudo apt update
8  sudo apt install -y php7.4
9  sudo apt install php7.4-common php7.4-mysql php7.4-xml php7.4-xmlrpc php7.4-curl php7.4-gd php7.4-imagick php7
10 sudo apt update
11 sudo apt install mysql-client-core-8.0
12
13
14 sudo git clone https://github.com/prafulpatel16/php-html-projects.git
15 sudo cp -r php-html-projects/iPortfoliov1_emp/* /var/www/html/
16
17
18
19
```



```
View Go Run Terminal Help
azuser@app01: ~
GNU nano 4.8
app.sh
Modified
#!/bin/bash
sudo apt update
sudo apt install -y apache2
sudo ufw allow 'apache full'
sudo apt install software-properties-common
sudo add-apt-repository ppa:ondrej/php
sudo apt update
sudo apt install -y php7.4
sudo apt install php7.4-common php7.4-mysql php7.4-xml php7.4-xmlrpc php7.4-curl php7.4-gd p>
sudo apt update
sudo apt install mysql-client-core-8.0

sudo git clone https://github.com/prafulpatel16/php-html-projects.git
rsudo cp -r php-html-projects/iPortfolioV1_emp/* /var/www/html/
y
o

^G Get Help ^O Write Out ^W Where Is ^K Cut Text ^J Justify ^C Cur Pos
^X Exit ^R Read File ^\ Replace ^U Paste Text ^T To Spell ^_ Go To Line
```

Allow +x permission to script

Sudo chmod +x app.sh

```
azureuser@app01:~$ sudo nano app.sh
azureuser@app01:~$ ls -la
total 32
drwxr-xr-x 4 azureuser azureuser 4096 May 25 01:09 .
drwxr-xr-x 3 root      root     4096 May 24 23:49 ..
-rw-r--r-- 1 azureuser azureuser 220 Feb 25 2020 .bash_logout
-rw-r--r-- 1 azureuser azureuser 3771 Feb 25 2020 .bashrc
-rwx----- 2 azureuser azureuser 4096 May 25 00:58 .cache
-rw-r--r-- 1 azureuser azureuser 807 Feb 25 2020 .profile
-rwx----- 2 azureuser azureuser 4096 May 24 23:49 .ssh
-rw-r--r-- 1 azureuser azureuser    0 May 25 01:06 .sudo_as_admin_successful
-rw-r--r-- 1 root      root     613 May 25 01:09 app.sh
azureuser@app01:~$ chmod +x app.sh
```

Run the script file

./app.sh

```
azureuser@app01:~$ ./app.sh
```



```
total 32
drwxr-xr-x 4 azureuser azureuser 4096 May 25 01:09 .
drwxr-xr-x 3 root      root     4096 May 24 23:49 ..
-rw-r--r-- 1 azureuser azureuser 220 Feb 25 2020 .bash_logout
-rw-r--r-- 1 azureuser azureuser 3771 Feb 25 2020 .bashrc
drwx----- 2 azureuser azureuser 4096 May 25 00:58 .cache
-rw-r--r-- 1 azureuser azureuser 807 Feb 25 2020 .profile
drwx----- 2 azureuser azureuser 4096 May 24 23:49 .ssh
-rw-r--r-- 1 azureuser azureuser    0 May 25 01:06 .sudo_as_admin_successful
-rw-r--r-- 1 root      root     613 May 25 01:09 app.sh
```

Installation complete and web application source code copied to apache root directory

Let's verify the web application is running

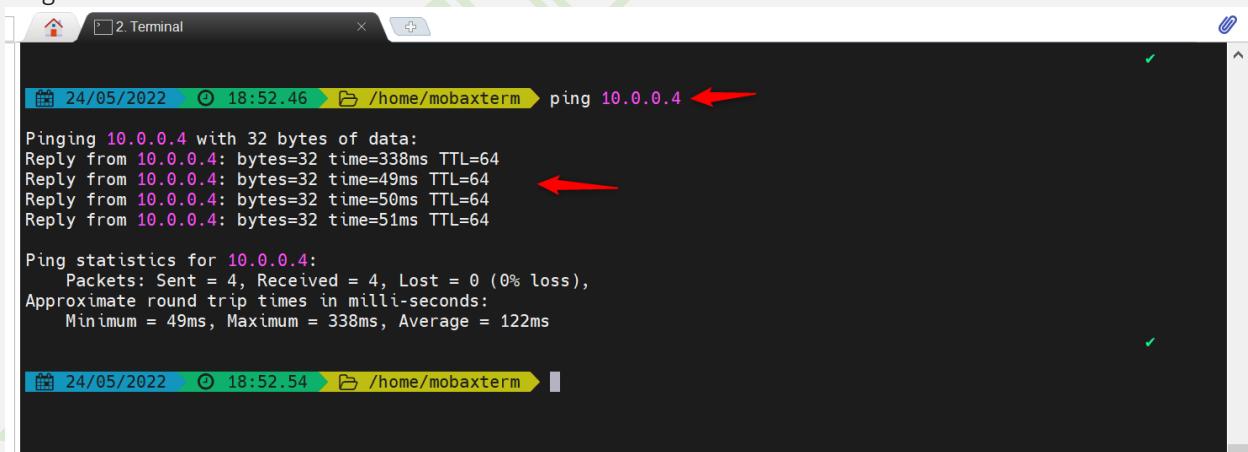
```
azureuser@app01:~$ systemctl status apache2
● apache2.service - The Apache HTTP Server
  Loaded: loaded (/lib/systemd/system/apache2.service; enabled; vendor preset: enabled)
  Active: active (running) since Wed 2022-05-25 01:12:42 UTC; 2min 51s ago
    Docs: https://httpd.apache.org/docs/2.4/
 Process: 22675 ExecStart=/usr/sbin/apachectl start (code=exited, status=0/SUCCESS)
 Main PID: 22679 (apache2)
   Tasks: 6 (limit: 9536)
  Memory: 12.0M
 CGroup: /system.slice/apache2.service
         └─22679 /usr/sbin/apache2 -k start
             ├─22684 /usr/sbin/apache2 -k start
             ├─22685 /usr/sbin/apache2 -k start
             ├─22686 /usr/sbin/apache2 -k start
             ├─22687 /usr/sbin/apache2 -k start
             └─22688 /usr/sbin/apache2 -k start

May 25 01:12:42 app01 systemd[1]: Starting The Apache HTTP Server...
May 25 01:12:42 app01 systemd[1]: Started The Apache HTTP Server.
azureuser@app01:~$
```

Phase 6: Test web application accessibility within internal private connection

Verify if the private connectivity is established from on-premise location

Ping 10.0.0.4



```
24/05/2022 18:52.46 /home/mobaxterm ping 10.0.0.4
Pinging 10.0.0.4 with 32 bytes of data:
Reply from 10.0.0.4: bytes=32 time=338ms TTL=64
Reply from 10.0.0.4: bytes=32 time=49ms TTL=64
Reply from 10.0.0.4: bytes=32 time=50ms TTL=64
Reply from 10.0.0.4: bytes=32 time=51ms TTL=64

Ping statistics for 10.0.0.4:
  Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
  Approximate round trip times in milli-seconds:
    Minimum = 49ms, Maximum = 338ms, Average = 122ms
```

Access web application from the browser using VM's private ip: 10.0.0.4

app01 Virtual machine

Essentials

Resource group (move) : 1-2af11377-playground-sandbox	Operating system : Linux (ubuntu 20.04)
Status : Running	Size : Standard D2s v3 (2 vcpus, 8 GiB memory)
Location : East US	Public IP address : -
Subscription (move) : P2-Real Hands-On Labs	Virtual network/subnet : VNetprp/default
Subscription ID : 964df7ca-3ba4-48b6-a695-1ed9db5723f8	DNS name : -
Tags (edit) : Click here to add tags	

Properties Monitoring Capabilities (7) Recommendations Tutorials

Virtual machine

Computer name : app01	Networking
Health state : -	Public IP address : -
Operating system : Linux (ubuntu 20.04)	Private IP address : 10.0.0.4
Publisher : canonical	Private IP address (IPv6) : -
Offer : 0001-com-ubuntu-server-focal	Virtual network/subnet : VNetprp/default
Plan : 20_04-lts-gen2	DNS name : -
VM generation : V2	
Agent status : Ready	

Networking

Public IP address : -
Private IP address : 10.0.0.4
Private IP address (IPv6) : -
Virtual network/subnet : VNetprp/default
DNS name : -

Size

<http://10.0.0.4>

Not secure | 10.0.0.4

PRAFUL PATEL

I'm Cloud Engineer!

Web application is successfully accessed from on-premise location using private ip



Congratulations!!!! 🎉