

Hub and Spoke

Our task here is to establish a connection between hub and spoke.

Before moving forward we will first study them conceptually.

A hub and spoke network is a common transportation or communication system design that involves a central hub connecting to multiple spoke locations. It is widely used in various industries, including transportation, logistics, telecommunications, and airline industries. The concept of a hub and spoke network is also applicable to other fields, such as data distribution and organizational structures.

In a transportation context, the hub and spoke network consists of a central hub (usually a major transportation centre, such as an airport, seaport, or distribution centre) that serves as a focal point for routing and coordinating traffic to and from various spoke locations. The spoke locations are typically smaller regional destinations or distribution points that are connected directly to the hub.

Key characteristics of a hub and spoke network:

1. **Central Hub:** The central hub is the primary point of consolidation and distribution in the network. It handles a significant volume of traffic and serves as a transfer point for passengers, cargo, or data.
2. **Spoke Locations:** Spoke locations are connected to the central hub but not directly to each other. They act as feeder points, gathering and distributing traffic to and from the hub.
3. **Efficient Routing:** The hub and spoke model allows for efficient routing and connectivity between multiple spoke locations and the central hub. It reduces the number of direct connections required, making the system more manageable and cost-effective.

4. **Concentration of Resources:** By centralizing operations at the hub, resources such as personnel, equipment, and infrastructure can be concentrated, leading to potential cost savings and increased operational efficiency.

5. **Flexibility and Scalability:** The hub and spoke network provides a scalable structure that can be adapted to changes in demand and operational requirements. It allows for the addition or removal of spoke locations with minimal disruption to the overall network.

6. **Improved Connectivity:** Spoke locations may have limited direct connections to other spokes, but they gain increased connectivity through the central hub, enabling access to a wider network.

Examples of hub and spoke networks include:

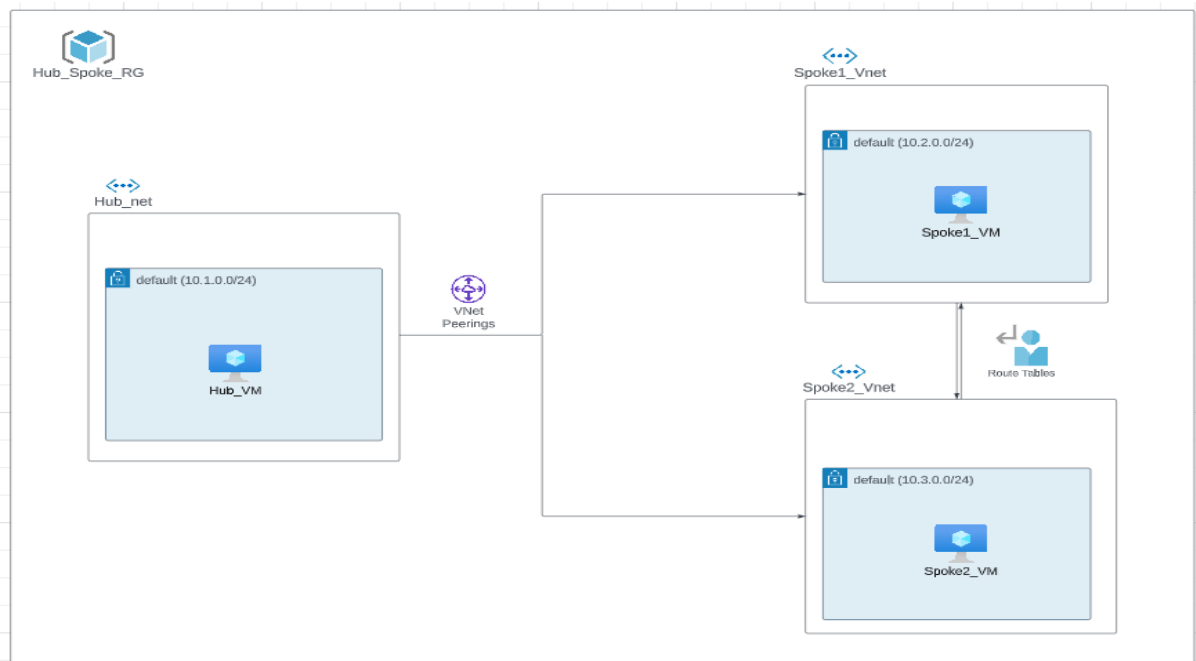
- **Airline Routes:** Many airlines use hub and spoke networks, with major airports acting as hubs that connect to numerous regional and international destinations.

- **Package Delivery:** Courier and package delivery companies often use hub and spoke networks to efficiently distribute packages from central sorting centers to regional distribution centers and then to local delivery routes.

- **Telecommunications:** Telecommunication companies may employ hub and spoke networks to manage data traffic efficiently, with major data centers serving as hubs connected to smaller regional data centers.

Overall, the hub and spoke network design is a widely adopted approach that offers advantages in terms of efficiency, cost-effectiveness, and scalability in various industries.

Architecture : -



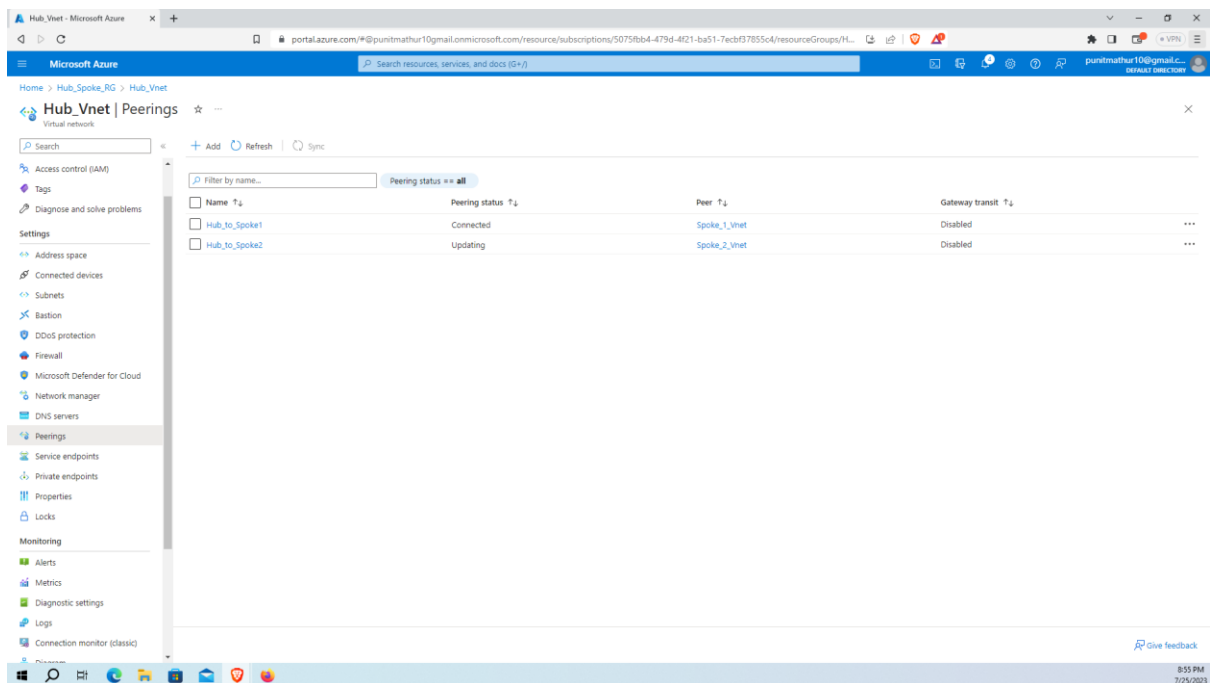
Now we will follow the following instructions to complete the task.

We will first create a Resource Group as Hub_Spoke_RG and in it we will create 3 virtual networks named Hub_Vnet, Spoke_1_Vnet and Spoke_2_Vnet.

The screenshot shows the Microsoft Azure portal interface for a resource group named 'Hub_Spoke_RG'. The page is titled 'Hub_Spoke_RG' and shows the 'Overview' tab. The 'Essentials' section displays the subscription ID '5075fbb4-479d-4f21-ba51-7ecbf37855c4' and the location 'Central India'. Below this, the 'Resources' section shows a list of three virtual networks: 'Hub_Vnet', 'Spoke_1_Vnet', and 'Spoke_2_Vnet'. The left-hand navigation menu includes sections like 'Settings', 'Cost Management', and 'Monitoring'. The bottom of the page shows the Windows taskbar with the time '8:52 PM' and date '7/25/2023'.

Name	Type	Location
Hub_Vnet	Virtual network	Central India
Spoke_1_Vnet	Virtual network	Central India
Spoke_2_Vnet	Virtual network	Central India

Now we will create VNetPeering. Now, go to the Hub_Vnet and then go to Peerings on the left side and then click on Add. Now in the Add Peering window, write the peering link name as Hub_to_Spoke1 for creating VNet Peering between Hub_Vnet and Spoke_1_Vnet. Now in the Remote Virtual network section, write the peering link name as Spoke1_to_Hub and in the virtual network, select the Spoke_1_Vnet and then click on Add. Now similarly create another VNet Peering named as Hub_to_Spoke2 and in the remote virtual network, write the peering link name as Spoke2_to_Hub and select the virtual network as Spoke_2_Vnet and then click on Add.



Now we will create 3 virtual machines named Hub-VM , Spoke1-VM and Spoke2-VM in the same resource group named Hub_Spoke_RG and image will be Windows-Server 2019 datacenter and size will be Standard_B2s.

Create a virtual machine - Microsoft Azure

Resource group: Hub_Spoke_RG

Instance details

Virtual machine name: Hub-VM

Region: (Asia Pacific) Central India

Availability options: No infrastructure redundancy required

Security type: Trusted launch virtual machines

Image: Windows Server 2019 Datacenter - x64 Gen2

VM architecture: x64

Run with Azure Spot discount: ☐

Size: Standard_B2s - 2 vcpus, 4 GiB memory

Administrator account

Username: Hub-VM

Password:

Confirm password:

Inbound port rules

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

Review + create

Create a virtual machine - Microsoft Azure

Validation passed

Basics Disks Networking Management Monitoring Advanced Tags Review + create

Cost given below is an estimate and not the final price. Please use [Pricing calculator](#) for all your pricing needs.

Price

1 X Standard B2s

Subscription credits apply

4,1466 INR/hr

TERMS

By clicking "Create", I (a) agree to the legal terms and privacy statement(s) associated with the Marketplace offering(s) listed above; (b) authorize Microsoft to bill my current payment method for the fees associated with the offering(s), with the same billing frequency as my Azure subscription; and (c) agree that Microsoft may share my contact, 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.

You have set RDP port(s) open to the Internet. This is only recommended for testing. If you want to change this setting, go back to Basics tab.

Basics

Subscription: Azure for Students

Resource group: Hub_Spoke_RG

Virtual machine name: Hub-VM

Region: Central India

Availability options: No infrastructure redundancy required

Create

CreateVm-MicrosoftWindowsServer-201-20230725205642 | Overview

Deployment

Search resources, services, and docs (Ctrl+J)

Home >

Deployment

Deployment name: CreateVm-MicrosoftWindowsServer.WindowsSe... Start time: 7/25/2023, 8:59:23 PM
Subscription: Azure for Students Correlation ID: 739ef78a-b225-4c2c-a18d-5a6826c490ed

Resource group: Hub_Spoke_RG

Deployment details

Resource	Type	Status	Operation details
Hub-VM	Microsoft.Compute/virtualMachines	Created	Operation details
hub-vm705	Microsoft.Network/networkInterfaces	Created	Operation details
Hub-VM-nsg	Microsoft.Network/networkSecurityGroups	OK	Operation details
Hub-VM-ip	Microsoft.Network/publicIPAddresses	OK	Operation details

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8:59 PM
7/25/2023

Create a virtual machine - Microsoft Azure

portal.azure.com/#create/Microsoft.VirtualMachine-ARM

Home > Virtual machines >

Create a virtual machine

Validation passed

Basics Disks Networking Management Monitoring Advanced Tags Review + create

Cost given below is an estimate and not the final price. Please use [pricing calculator](#) for all your pricing needs.

Price

1 X Standard B2s
by Microsoft
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Subscription credits apply
4.1466 INR/hr
[Pricing for other VM sizes](#)

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By clicking "Create", I (a) agree to the legal terms and privacy statement(s) associated with the Marketplace offering(s) listed above; (b) authorize Microsoft to bill my current payment method for the fees associated with the offering(s), with the same billing frequency as my Azure subscription; and (c) agree that Microsoft may share my contact, 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.

You have set RDP (port3389) open to the internet. This is only recommended for testing. If you want to change this setting, go back to Basics tab.

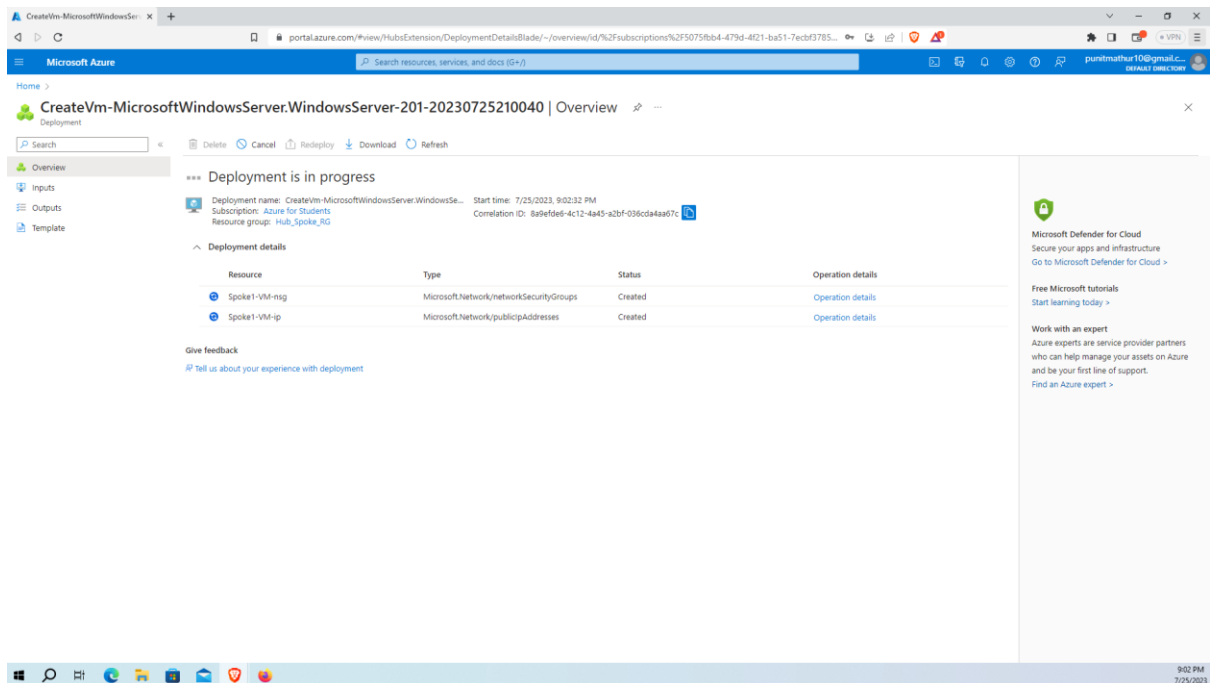
Basics

Subscription: Azure for Students
Resource group: Hub_Spoke_RG
Virtual machine name: Spoke1-VM
Region: Central India
Availability options: No infrastructure redundancy required

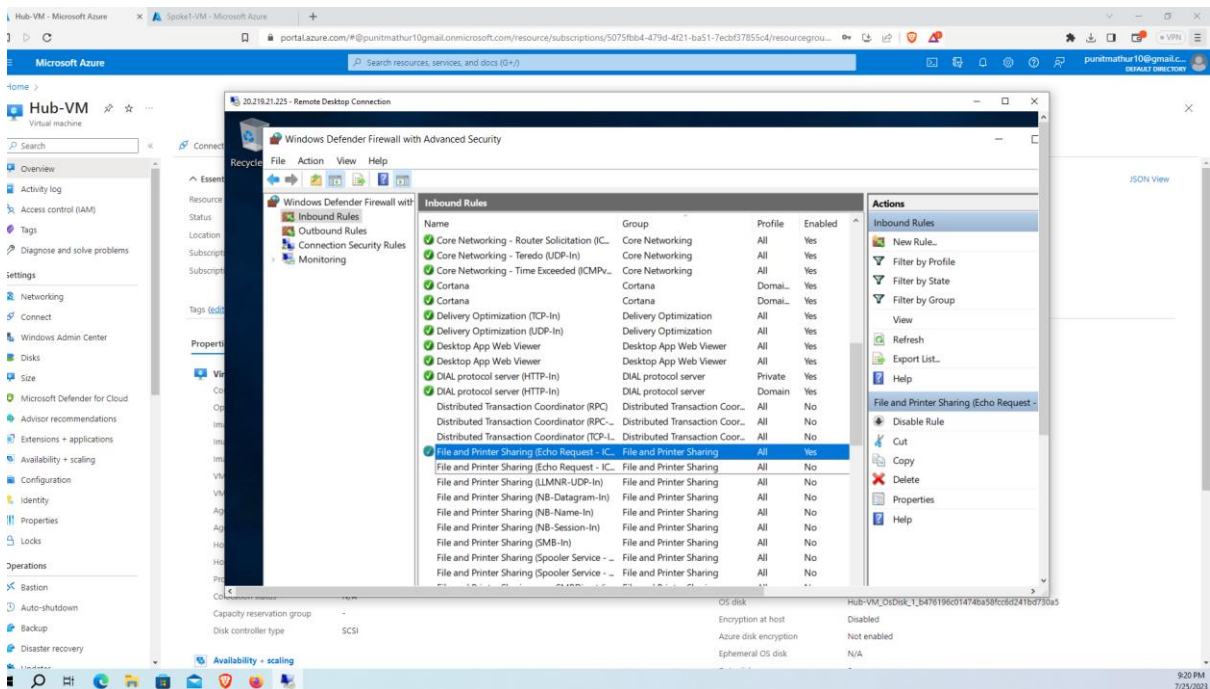
Create < Previous Next > Download a template for automation

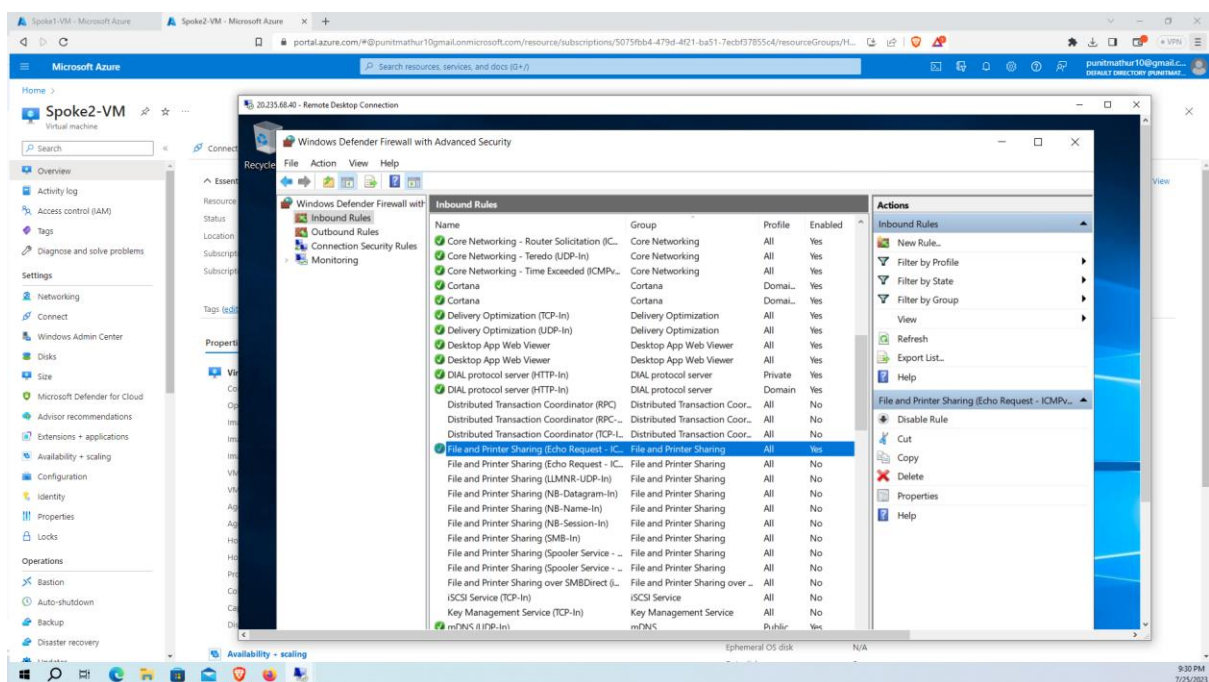
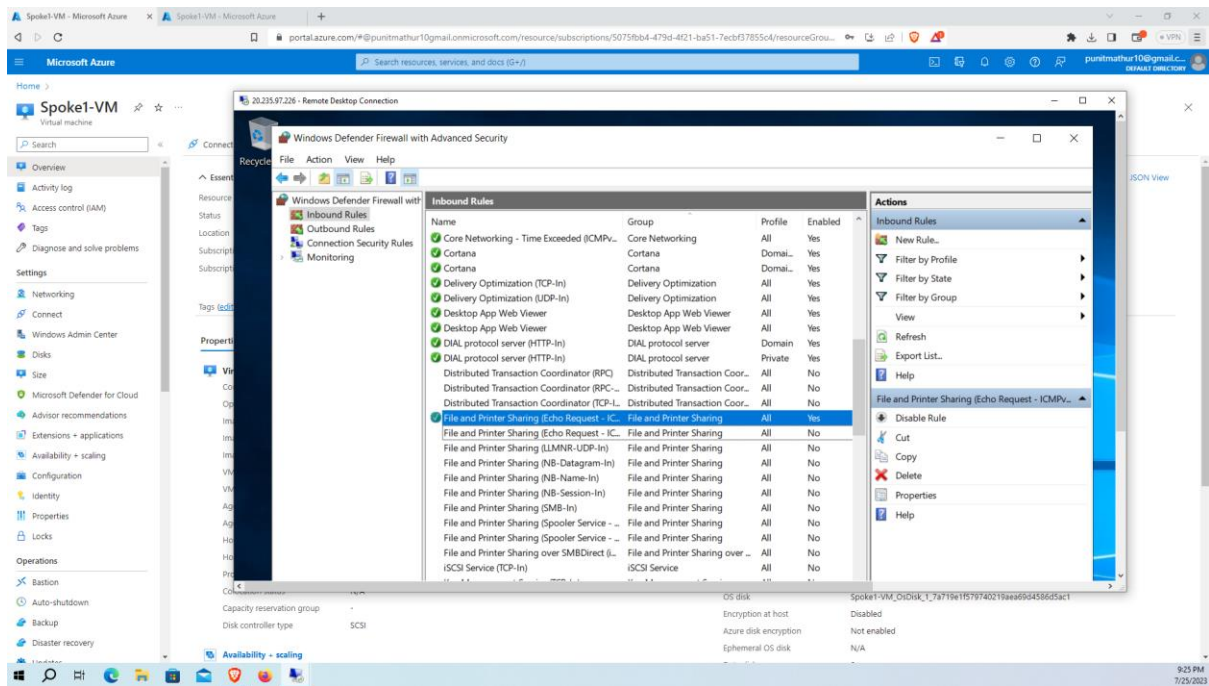
Give feedback

9:02 PM
7/25/2023



Now to test connectivity login to all 3 VMs using RDP and then enable ICMP inbound rule in all 3 VMs.



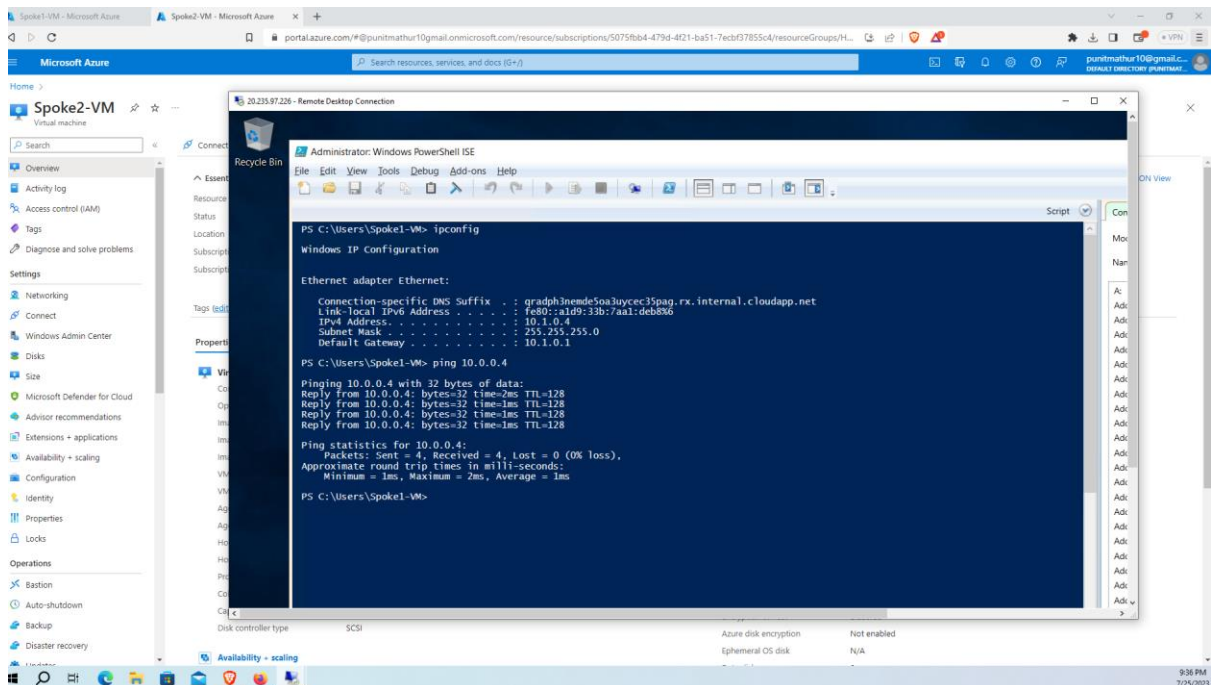
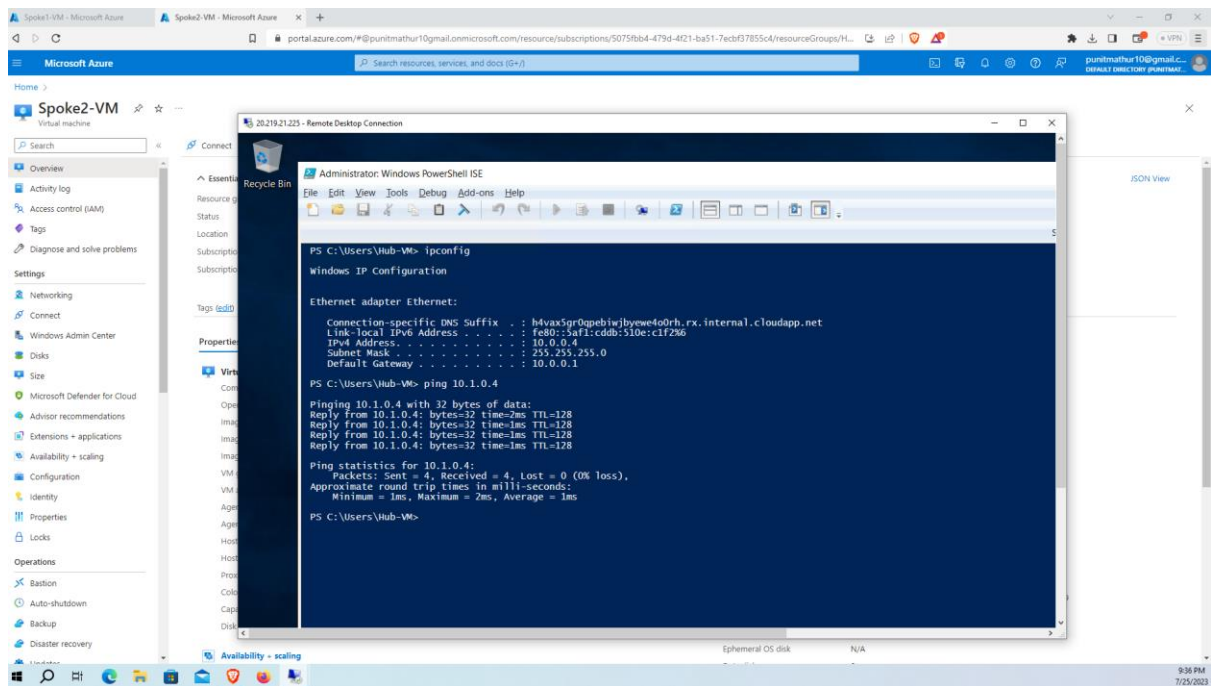


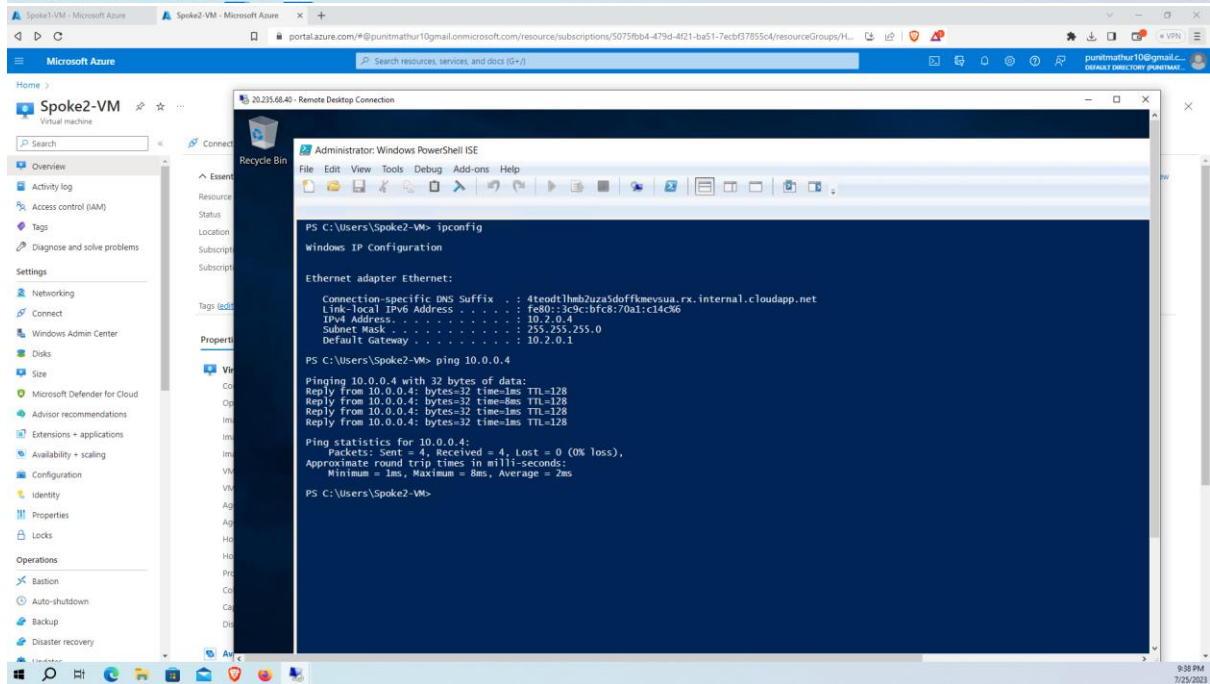
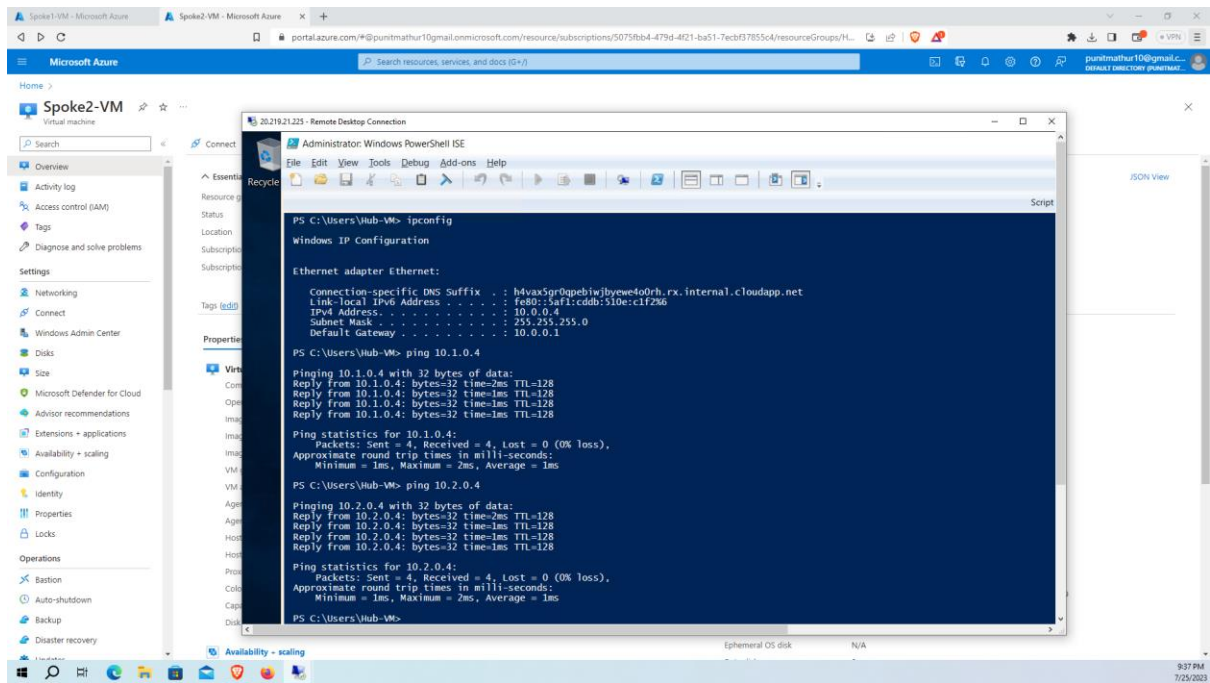
Now open the command prompt in all the VMs and then write the command **ipconfig** to know the IP address of all three VMs.

From this we get the result as:

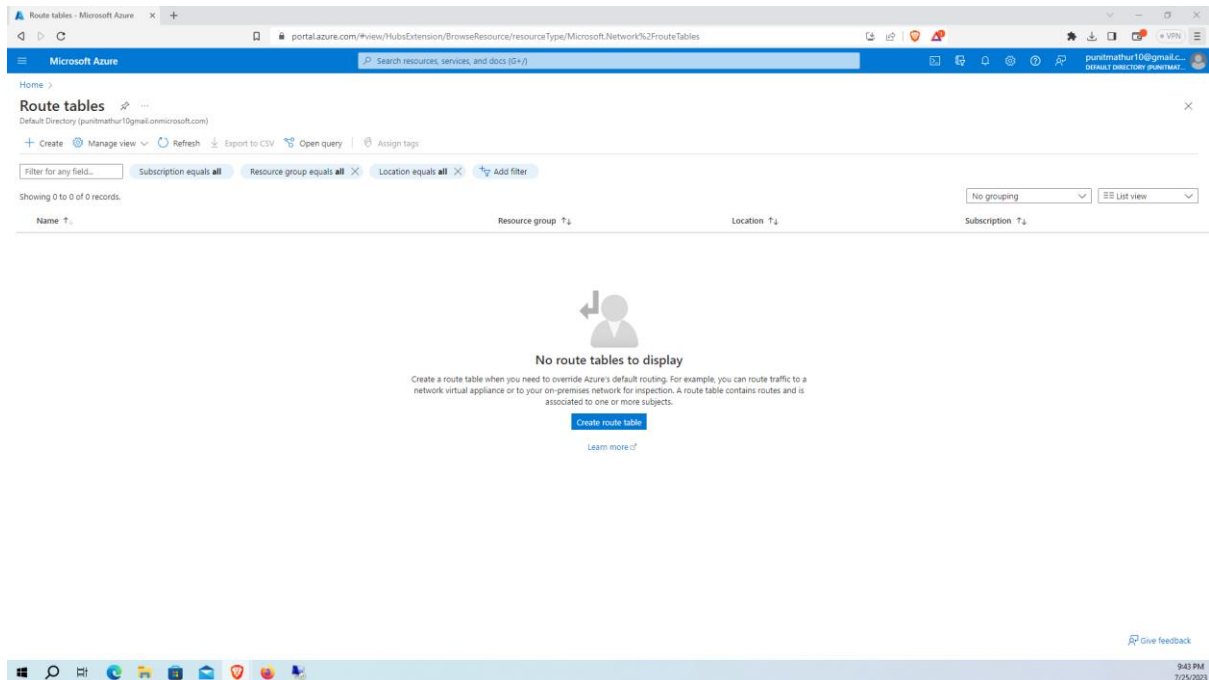
- **HubVM – IP = 10.0.0.4,**
- **Spoke1-VM-IP = 10.1.0.4,**
- **Spoke2-VM-IP = 10.2.0.4**

Now use Ping command in three VMs to see the connectivity.

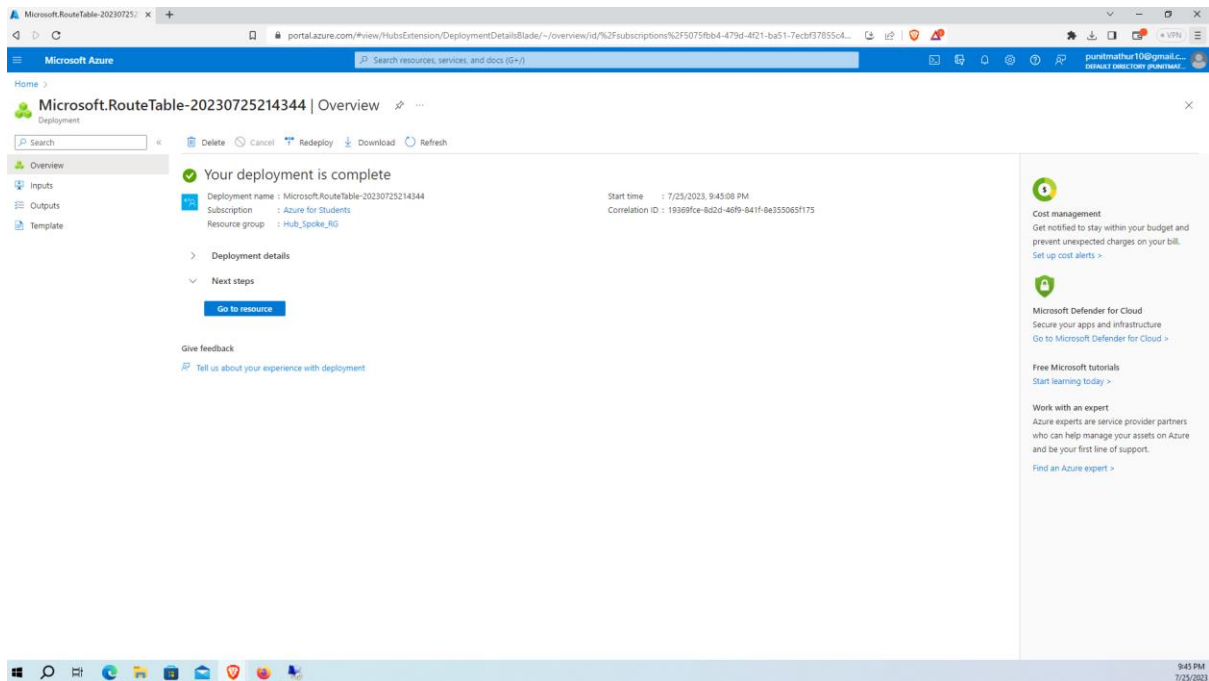




Now we will Create and Configure the route table. For that just search the route table.



Now in the create route table wizard, select the resource group in which we created the VMs and then select the region as Central India and also write the name of the route table as Hub_to_Spoke_RT and also select No option for Propagate gateway routes and then click on Review + Create. Now after reviewing all the details, click on Create. This will create the route table.



Now in the Hub_to_Spoke_RT, go to routes on the left side and then click on Add. Now in the Add route wizard write the route name as Spoke1_to_Spoke2 and select the destination type as IP Address and in the destination IP addresses write the IP Address space of the Spoke2_VNet (i.e 10.2.0.0/16), in the Next hop type, select the Virtual Appliance option and in the hop address, write the private address of the Hub (i.e., 10.0.0.4) and then click on Add.

Hub to Spoke_RT - Microsoft Azure

portal.azure.com/#@punimathur10@gmail.onmicrosoft.com/resource/subscriptions/5075fbb4-479d-4021-ba51-7ecbf37855c4/resourceGroups/H...

Microsoft Azure

Home > Microsoft.RouteTable-20230725214344 | Overview >

Hub_to_Spoke_RT

Route table

Search

Move Delete Refresh Give feedback

Essentials

Resource group (mvp) : [Hub_Spoke_RG](#)

Location : Central India

Subscription (mvp) : [Azure for Students](#)

Subscription ID : 5075fbb4-479d-4021-ba51-7ecbf37855c4

Tags (edit) : [Click here to add tags](#)

Associations : 0 subnet associations

JSON View

Routes

Search routes

Name	Address prefix	Next hop type	Next hop IP address
No results.			

Subnets

Search subnets

Name	Address range	Virtual network	Security group
No results.			

Settings

- Configuration
- Routes
- Subnets
- Properties
- Locks

Monitoring

- Alerts

Automation

- Tasks (preview)
- Export template

Support + troubleshooting

- Effective routes
- New Support Request

9:48 PM 7/25/2023

Add route - Microsoft Azure

portal.azure.com/#@punimathur10@gmail.onmicrosoft.com/resource/subscriptions/5075fbb4-479d-4021-ba51-7ecbf37855c4/resourceGroups/H...

Microsoft Azure

Home > Microsoft.RouteTable-20230725214344 | Overview > Hub_to_Spoke_RT

Hub_to_Spoke_RT | Routes

Route table

Search

Add Refresh Give feedback

Essentials

Resource group (mvp) : [Hub_Spoke_RG](#)

Location : Central India

Subscription (mvp) : [Azure for Students](#)

Subscription ID : 5075fbb4-479d-4021-ba51-7ecbf37855c4

Tags (edit) : [Click here to add tags](#)

Associations : 0 subnet associations

JSON View

Routes

Search routes

Name	Address prefix	Next hop type
No results.		

Subnets

Search subnets

Name	Address range	Virtual network	Security group
No results.			

Settings

- Configuration
- Routes
- Subnets
- Properties
- Locks

Monitoring

- Alerts

Automation

- Tasks (preview)
- Export template

Support + troubleshooting

- Effective routes
- New Support Request

Add route

Hub_to_Spoke_RT

A user defined route (UDR) is a static route that overrides Azure's default system routes, or adds a route to a subnet's route table. [Learn more](#)

Route name *

Spoke1_to_Spoke2

Destination type *

IP Addresses

Destination IP addresses/CIDR ranges *

10.2.0.0/16

Next hop type *

Virtual appliance

Next hop address *

10.0.0.4

Ensure you have IP forwarding enabled on your virtual appliance. You can enable this by navigating to the respective network interface's IP address settings.

Add

9:48 PM 7/25/2023

Now similarly create another route by clicking on Add button. In the add route wizard write the route name as Spoke2_to_Spoke1 and then select the destination type as IP Address and in the destination IP addresses write the IP Address space of the Spoke1_VNet (i.e., 10.2.0.0/16), in the Next hop type, select the Virtual Appliance option and in the hop address, write the private address of the Hub (i.e., 10.1.0.4) and then click on Add.

The screenshot shows the 'Add route' wizard in the Microsoft Azure portal. The wizard is for the 'Hub_to_Spoke_RT' route table. The configuration is as follows:

Field	Value
Route name	Spoke2_to_Spoke1
Destination type	IP Addresses
Destination IP addresses/CIDR ranges	10.1.0.0/16
Next hop type	Virtual appliance
Next hop address	10.0.0.4

A confirmation message at the bottom states: "Ensure you have IP forwarding enabled on your virtual appliance. You can enable this by navigating to the respective network interface's IP address settings." The 'Add' button is visible at the bottom right of the wizard.

Now as both of them are added :

The screenshot shows the 'Subnets' page in the Microsoft Azure portal. The page displays a table with two subnets:

Name	Address range	Virtual network	Security group
default	10.1.0.0/24	Spoke1_Vnet	-
Spoke1_Vnet	10.2.0.0/24	Spoke2_Vnet	-

A notification message at the top right states: "Saved route table for subnet. Successfully saved route table for subnet 'default'."

Now we will enable IP Forwarding so follow the below screenshots very carefully.

The screenshot shows the 'Networking' page for the virtual machine 'hub-vm705'. The left sidebar contains navigation options like Overview, Activity log, Access control (IAM), Tags, Diagnose and solve problems, Settings, Networking, Connect, Windows Admin Center, Disks, Size, Microsoft Defender for Cloud, Advisor recommendations, Extensions + applications, Availability + scaling, Configuration, Identity, Properties, Locks, Operations, Bastion, Auto-shutdown, Backup, and Disaster recovery. The main content area shows the 'Network Interface: hub-vm705' with details: Effective security rules, Troubleshoot VM connection issues, Topology, Virtual network/subnet: hub_vnet/default, NIC Public IP: 20.219.21.225, NIC private IP: 10.0.0.4, and Accelerated networking: Disabled. Below this, there are tabs for Inbound port rules, Outbound port rules, Application security groups, and Load balancing. The 'Inbound port rules' tab is active, showing a table of rules. A 'Need help?' section with links to 'Understand Azure load balancing of', 'Quickstart: Create a public load balancer to load balance Virtual Machines of', and 'Quickstart: Direct web traffic with Azure Application Gateway of' is also visible.

Priority	Name	Port	Protocol	Source	Destination	Action
300	RDP	3389	TCP	Any	Any	Allow
65000	AllowVnetInBound	Any	Any	VirtualNetwork	VirtualNetwork	Allow
65001	AllowAzureLoadBalancerInBound	Any	Any	AzureLoadBalancer	Any	Allow
65500	DenyAllInBound	Any	Any	Any	Any	Deny

The screenshot shows the 'IP configurations' page for the network interface of 'hub-vm705'. The left sidebar is similar to the previous screenshot but includes 'IP configurations', 'DNS servers', 'Network security group', 'Monitoring', 'Insights', 'Alerts', 'Metrics', 'Diagnostic settings', 'Automation', 'Tasks (preview)', 'Export template', 'Support + troubleshooting', 'Effective security rules', 'Effective routes', and 'New Support Request'. The main content area shows 'IP Settings' with 'Enable IP forwarding' checked. Below this, 'Virtual network' is set to 'Hub_Vnet', 'Gateway load balancer' is 'None', and 'Subnet' is 'default (10.0.0.0/24) 250 free IP addresses'. A note states: 'Private and public IP addresses can be assigned to a virtual machine's network interface controller. You can add as many private and public IPv4 addresses as necessary to a network interface, within the limits listed in the Azure limits article. Learn more of'. Below the note, there are buttons for '+ Add', 'Make primary', and 'Delete'. A table lists the IP configurations:

Name	IP Version	Type	Private IP Address	Public IP Address
ipconfig1	IPv4	Primary	10.0.0.4 (Dynamic)	20.219.21.225 (Hub-VM-IP)

At the bottom, there are 'Apply' and 'Discard changes' buttons.

Now connect the Hub_VM using RDP and then open the powershell and then run the following command:

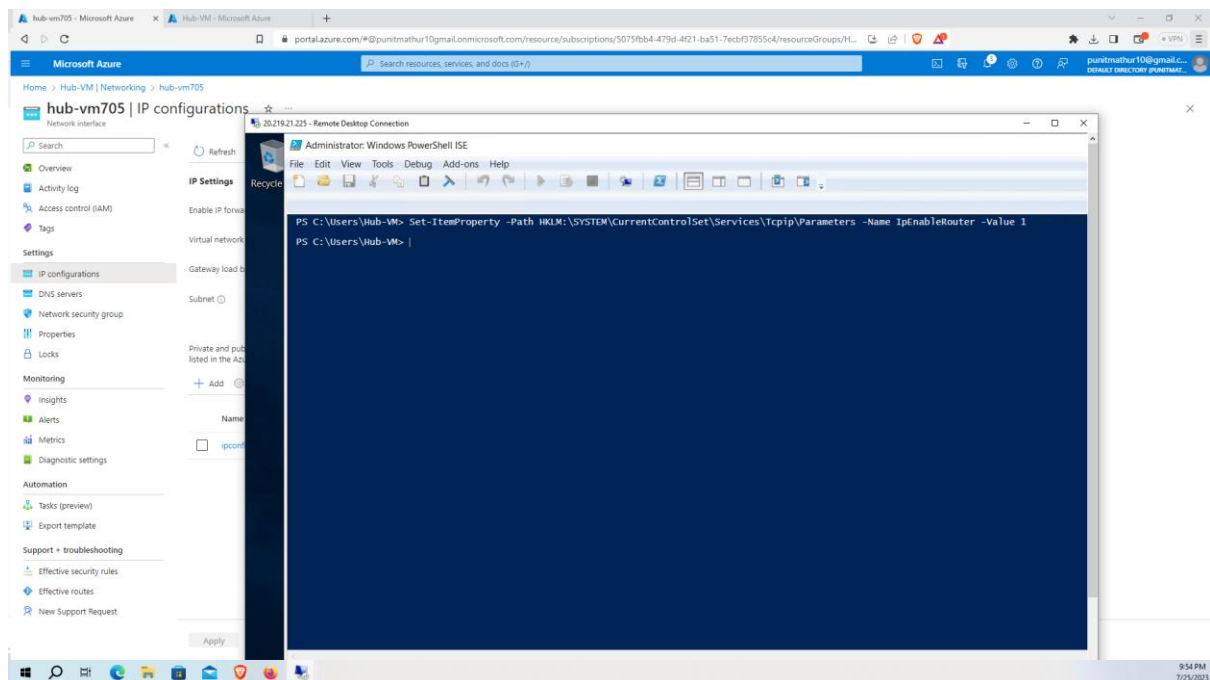
**Set-ItemProperty -Path
HKLM:\SYSTEM\CurrentControlSet\Services\Tcpip\Parameters
-Name IpEnableRouter -Value 1.**

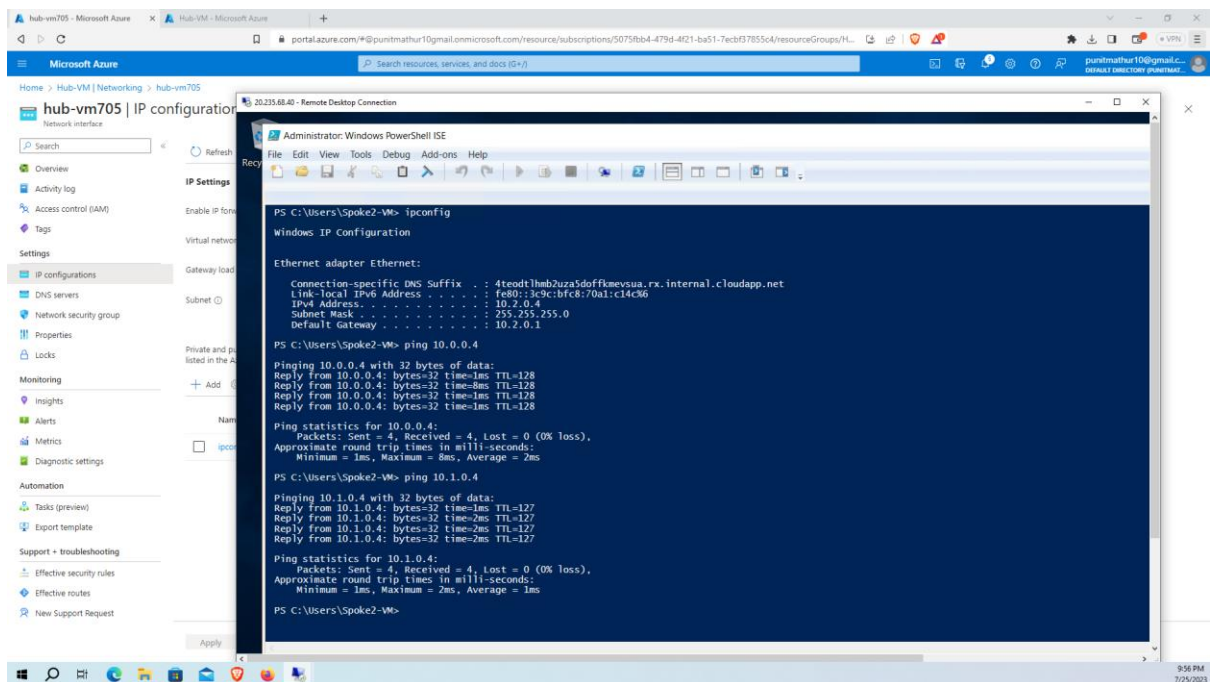
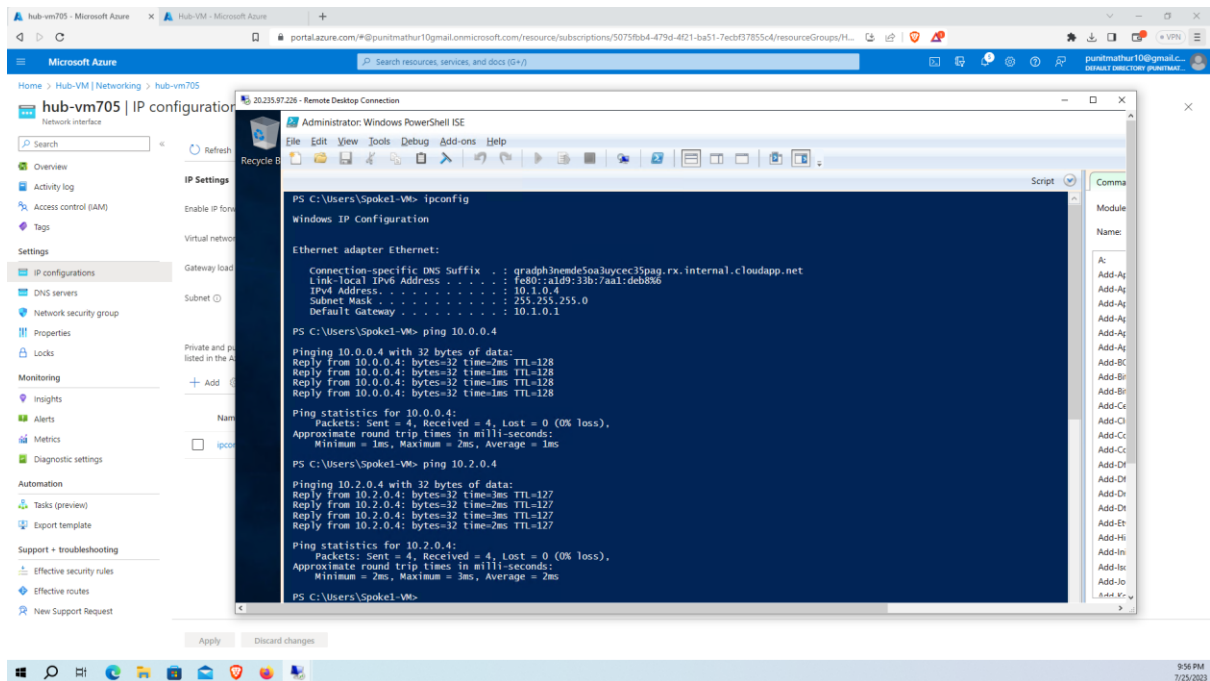
This command enables IP routing on the Windows system by setting the "IpEnableRouter" registry entry to 1.

After enabling the IP routing, restart the virtual machine.

Also ping each other to know the connectivity.

Follow the steps in screenshots carefully.





Task is Completed.