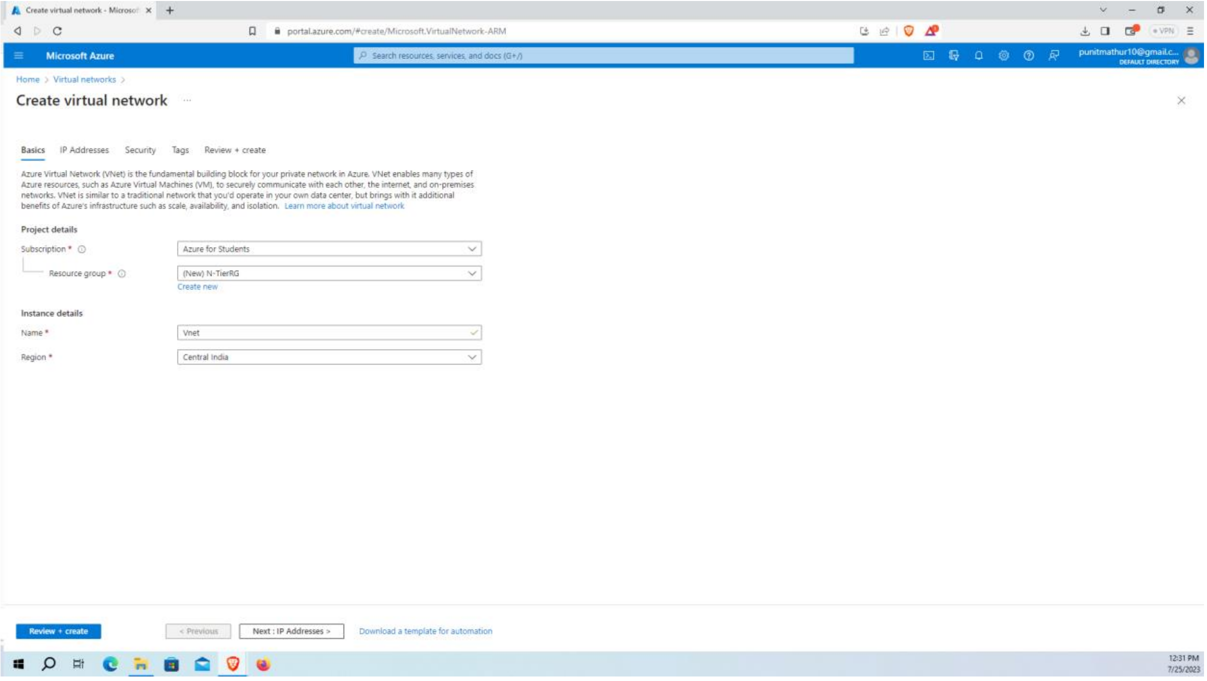
N-Tier Architecture

Our task is to implement an N-Tier architecture on azure portal.
Follow the following instructions to make it.

Create a virtual network named Vnet on a new resource group named N-TierRG with 3 different subnets named WebVN, AppVN and DatabaseVN : -



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portal.azure.com/#create/Microsoft.VirtualNetwork-ARM
Microsoft Azure
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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 * : Azure for Students

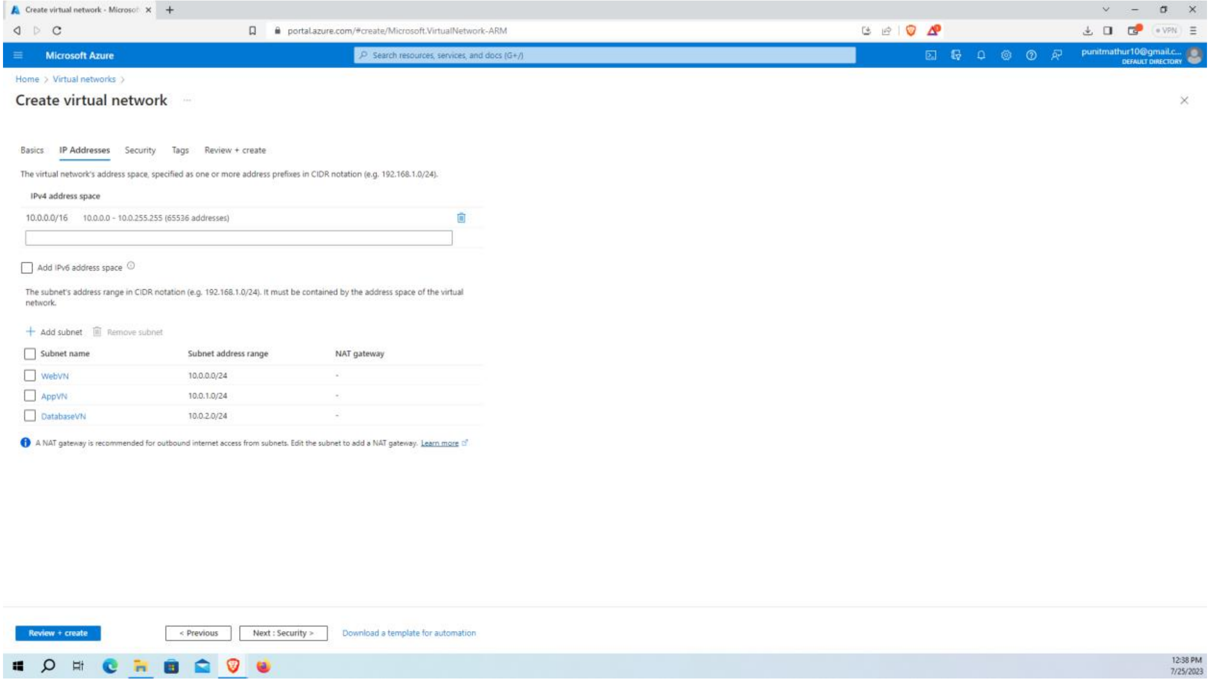
Resource group * : (New) N-TierRG

Create new

Instance details

Name * : Vnet

Region * : Central India



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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

10.0.0.0/16 10.0.0.0 - 10.0.255.255 (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
□ WebVN	10.0.0.0/24	-
□ AppVN	10.0.1.0/24	-
□ DatabaseVN	10.0.2.0/24	-

A NAT gateway is recommended for outbound internet access from subnets. Edit the subnet to add a NAT gateway. Learn more

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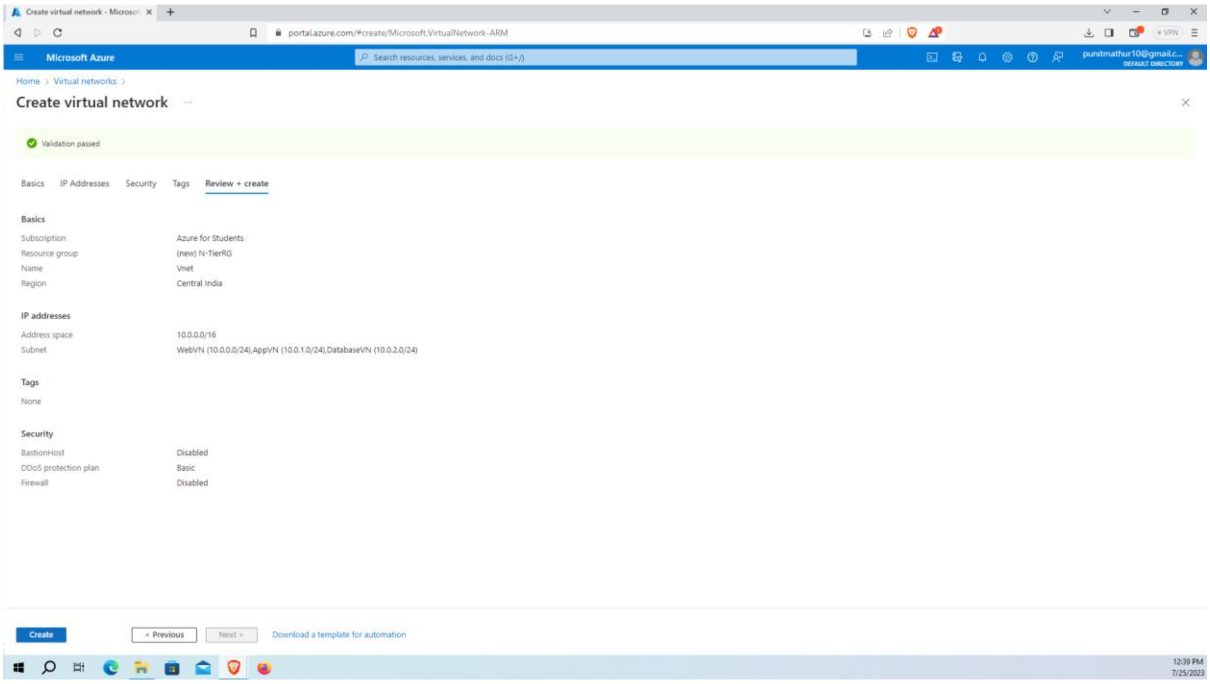

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Create virtual network

Validation passed

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Basics

Subscription	Azure for Students
Resource group	(new) N-TierRG
Name	Vnet
Region	Central India

IP addresses

Address space	10.0.0.0/16
Subnet	WebVN (10.0.0.0/24),AppVN (10.0.1.0/24),DatabaseVN (10.0.2.0/24)

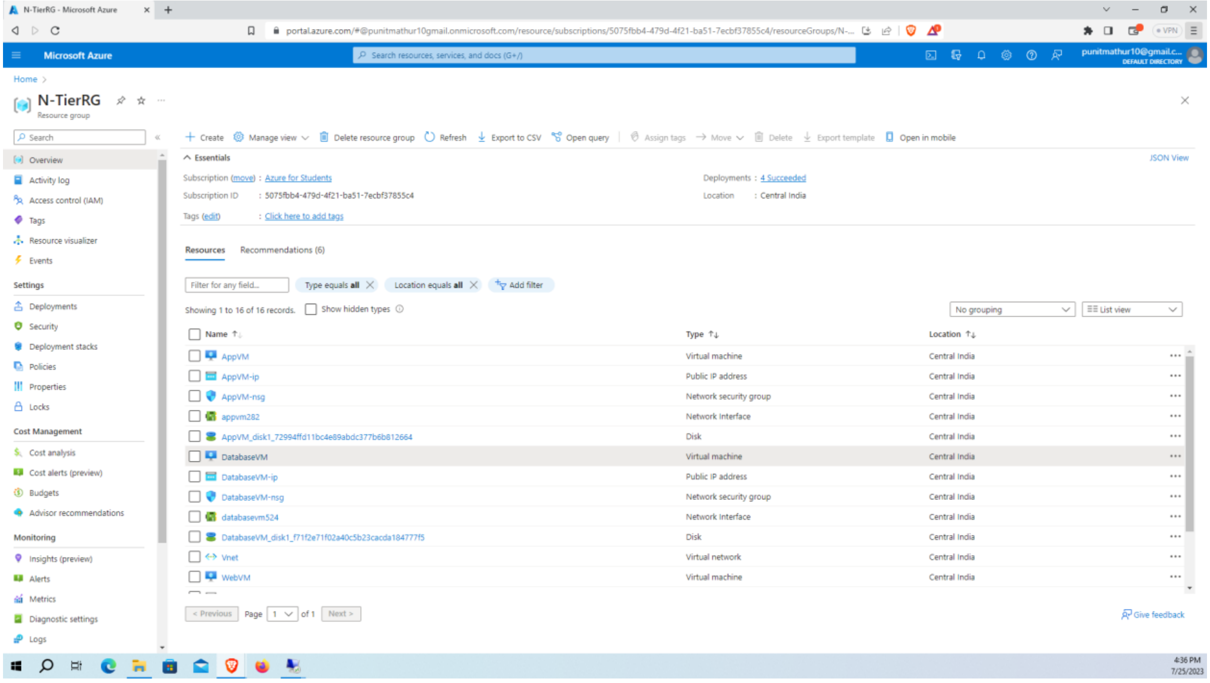
Tags

None

Security

BastionHost	Disabled
DDoS protection plan	Basic
Firewall	Disabled

Now we will create 3 VMs named WebVM, AppVM and DatabaseVM on the same resource group N-TierRG. Attributes of all three will remain the same such as image will be Windows Server 2016 Datacenter, size as Standard_DS1_v2. The difference between all the three machines will be their virtual networks since WebVM will be connected to WebVN, AppVM will be connected to AppVN and likewise DatabaseVM will be connected to DatabaseVN.



N-TierRG
Resource group

Essentials

Subscription (move) : Azure for Students

Subscription ID : 5075fbb4-479d-4f21-ba51-7ecbf37855c4

Tags (edit) : Click here to add tags

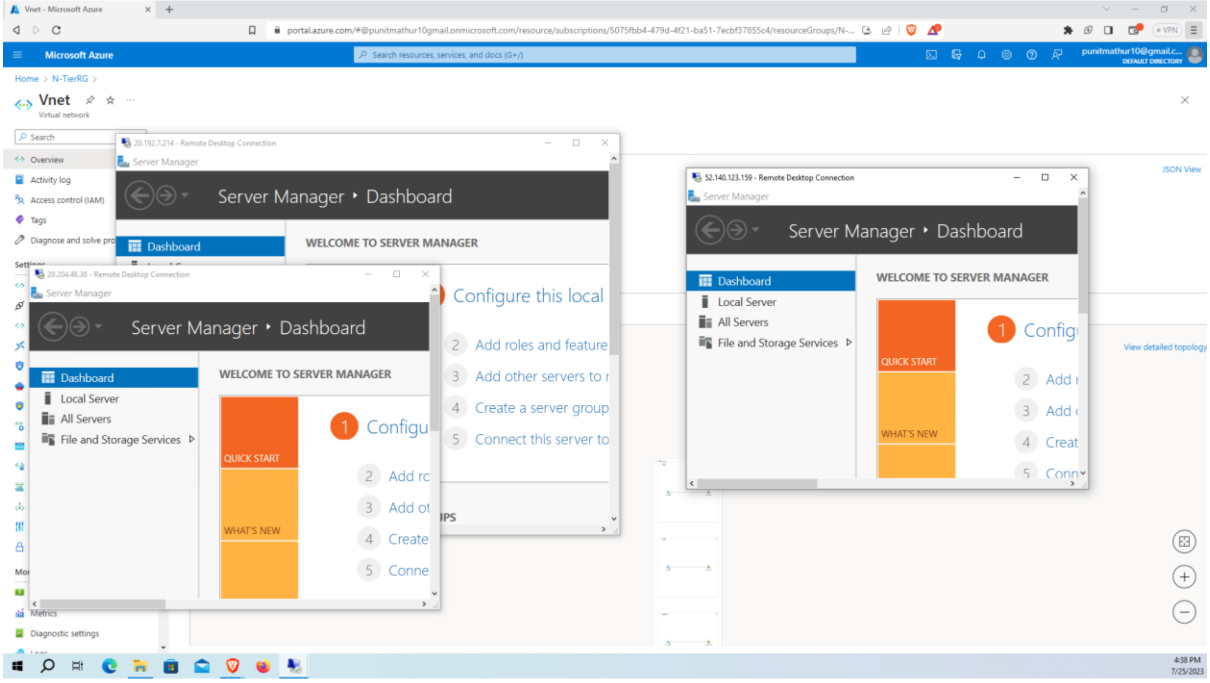
Deployments : 4 Succeeded

Location : Central India

Showing 1 to 16 of 16 records. □ Show hidden types

□ Name	Type	Location
□ AppVM	Virtual machine	Central India
□ AppVM-ip	Public IP address	Central India
□ AppVM-nsg	Network security group	Central India
□ appvm282	Network Interface	Central India
□ AppVM_disk1_72994ffd11bc4e89abdc377b6b812664	Disk	Central India
□ DatabaseVM	Virtual machine	Central India
□ DatabaseVM-ip	Public IP address	Central India
□ DatabaseVM-nsg	Network security group	Central India
□ databasevm524	Network Interface	Central India
□ DatabaseVM_disk1_f71f2e71f02a40c5b23cacda184777f5	Disk	Central India
□ Vnet	Virtual network	Central India
□ WebVM	Virtual machine	Central India

Now open them simultaneously using RDP.


Vnet - Microsoft Azure
portal.azure.com/#@punitmathur10gmail.onmicrosoft.com/resource/subscriptions/5075fbb4-479d-4f21-ba51-7ecbf37855c4/resourceGroups/N-...
Microsoft Azure
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Home > N-TierRG >
Vnet
Virtual network
20.192.7.214 - Remote Desktop Connection
20.204.46.38 - Remote Desktop Connection
52.140.123.159 - Remote Desktop Connection
Server Manager • Dashboard
WELCOME TO SERVER MANAGER
Dashboard
Local Server
All Servers
File and Storage Services
QUICK START
WHAT'S NEW
1 Configure this local
2 Add roles and features
3 Add other servers to
4 Create a server group
5 Connect this server to
JSON View
View detailed topology
4:38 PM
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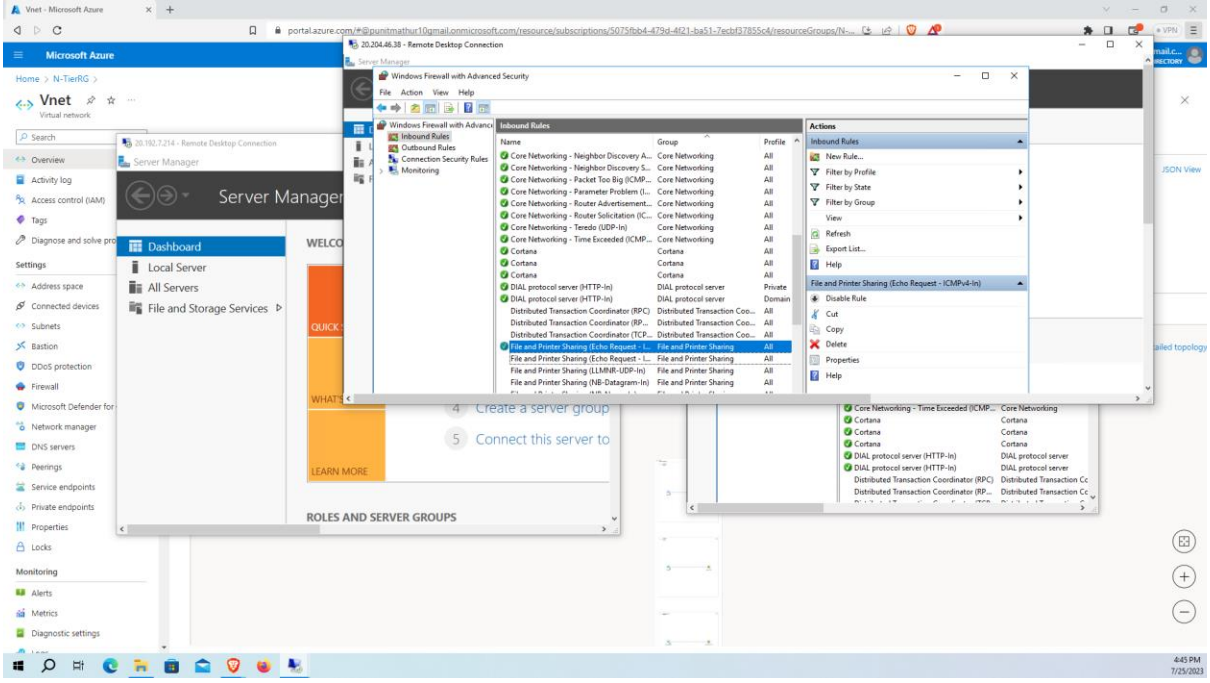
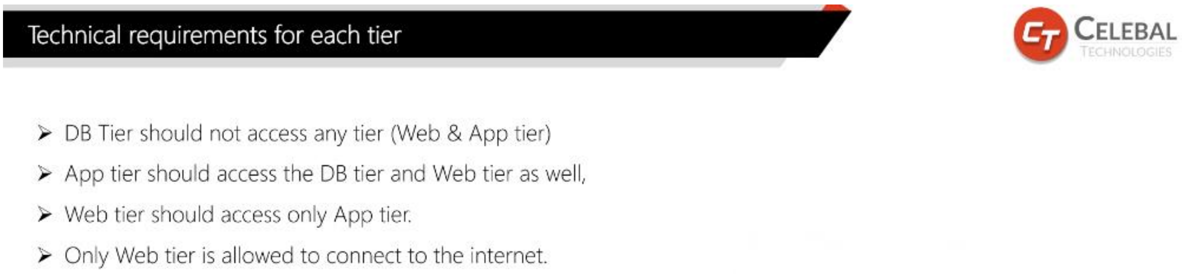
Now, to enable connectivity among the VMs, enable the ICMP protocol in all the VMs. To enable the ICMP protocol, go to the Windows Firewall with Advanced Security then in this pop-up go to the Inbound port rules and then in this search ICMP (IPv4) then on the right side click on Enable rule.



Inbound Rules

Name	Group	Profile
Core Networking - Neighbor Discovery A...	Core Networking	All
Core Networking - Neighbor Discovery S...	Core Networking	All
Core Networking - Packet Too Big (ICMP...	Core Networking	All
Core Networking - Parameter Problem (I...	Core Networking	All
Core Networking - Router Advertisement...	Core Networking	All
Core Networking - Router Solicitation (IC...	Core Networking	All
Core Networking - Teredo (UDP-In)	Core Networking	All
Core Networking - Time Exceeded (ICMP...	Core Networking	All
Cortana	Cortana	All
Cortana	Cortana	All
Cortana	Cortana	All
DIAL protocol server (HTTP-In)	DIAL protocol server	Private
DIAL protocol server (HTTP-In)	DIAL protocol server	Domain
Distributed Transaction Coordinator (RPC)	Distributed Transaction Coo...	All
Distributed Transaction Coordinator (RP...	Distributed Transaction Coo...	All
Distributed Transaction Coordinator (TCP...	Distributed Transaction Coo...	All
File and Printer Sharing (Echo Request - I...	File and Printer Sharing	All
File and Printer Sharing (Echo Request - I...	File and Printer Sharing	All
File and Printer Sharing (LLMNR-UDP-In)	File and Printer Sharing	All
File and Printer Sharing (NB-Datagram-In)	File and Printer Sharing	All

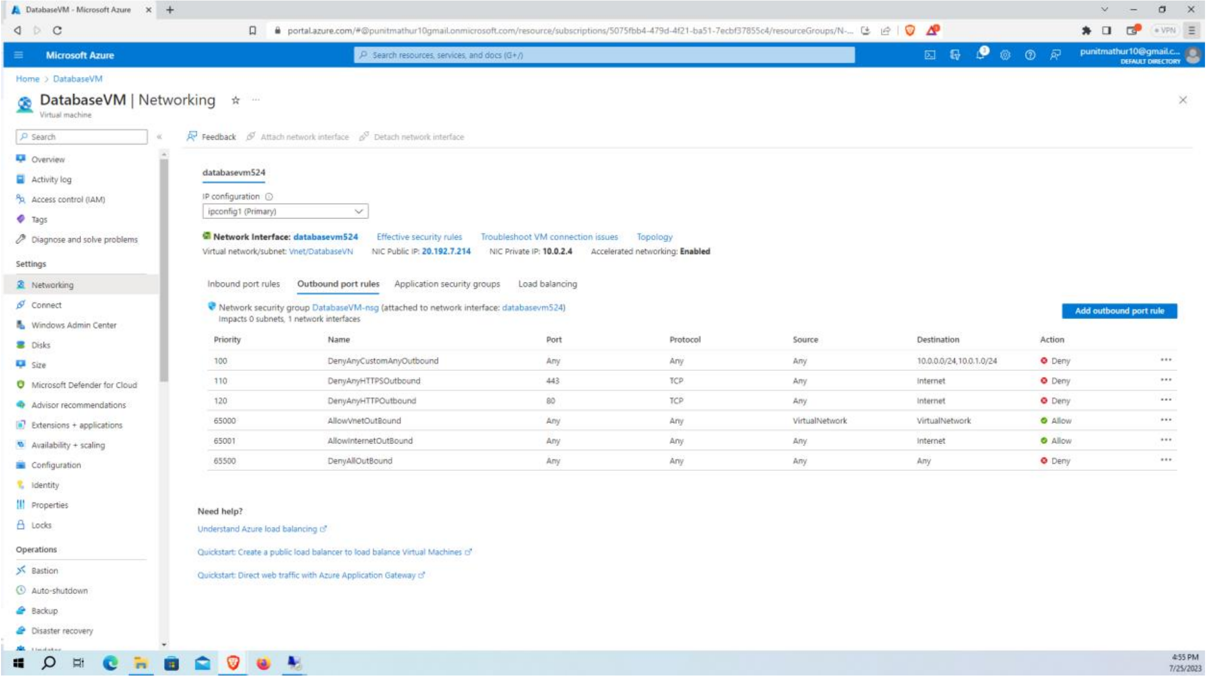


Technical requirements for each tier

- DB Tier should not access any tier (Web & App tier)
- App tier should access the DB tier and Web tier as well,
- Web tier should access only App tier.
- Only Web tier is allowed to connect to the internet.

Now as we can see the first technical requirement is DB Tier should not access any other tier. To do so we need to add outbound rules in the DatabaseVM. Now, go to the outbound port rule and click on the add outbound port rule and then in the add outbound security rule window, select the Destination as IP Address and write down the IP Address subnet of the other two VMs (i.e., AppVM and WebVM) then in the destination port ranges type * and then in the action, select Deny and then click on Add.

Now as per the fourth requirement (Only Web Tier is allowed to connect to the internet). So, to stop the internet service on DatabaseVM, again click on Add Outbound port rule and in the security rule window, select Service Tag in the destination and then in the Destination Service Tag, select Internet.
Now, in the service select Https and, in the action, select Deny and then click on Add. Similarly, do the above step for the service HTTP and then click on Add to add the outbound security rule.



DatabaseVM | Networking

Virtual machine

databasevm524

IP configuration: ipconfig1 (Primary)

Network Interface: databasevm524 · Effective security rules · Troubleshoot VM connection issues · Topology

Virtual network/subnet: Vnet/DatabaseVN · NIC Public IP: 20.192.7.214 · NIC Private IP: 10.0.2.4 · Accelerated networking: Enabled

Inbound port rules · **Outbound port rules** · Application security groups · Load balancing

Network security group DatabaseVM-nsg (attached to network interface: databasevm524)
Impacts 0 subnets, 1 network interfaces

Add outbound port rule

Priority	Name	Port	Protocol	Source	Destination	Action
100	DenyAnyCustomAnyOutbound	Any	Any	Any	10.0.0.0/24,10.0.1.0/24	Deny
110	DenyAnyHTTPSOutbound	443	TCP	Any	Internet	Deny
120	DenyAnyHTTPOutbound	80	TCP	Any	Internet	Deny
65000	AllowVnetOutBound	Any	Any	VirtualNetwork	VirtualNetwork	Allow
65001	AllowInternetOutBound	Any	Any	Any	Internet	Allow
65500	DenyAllOutBound	Any	Any	Any	Any	Deny

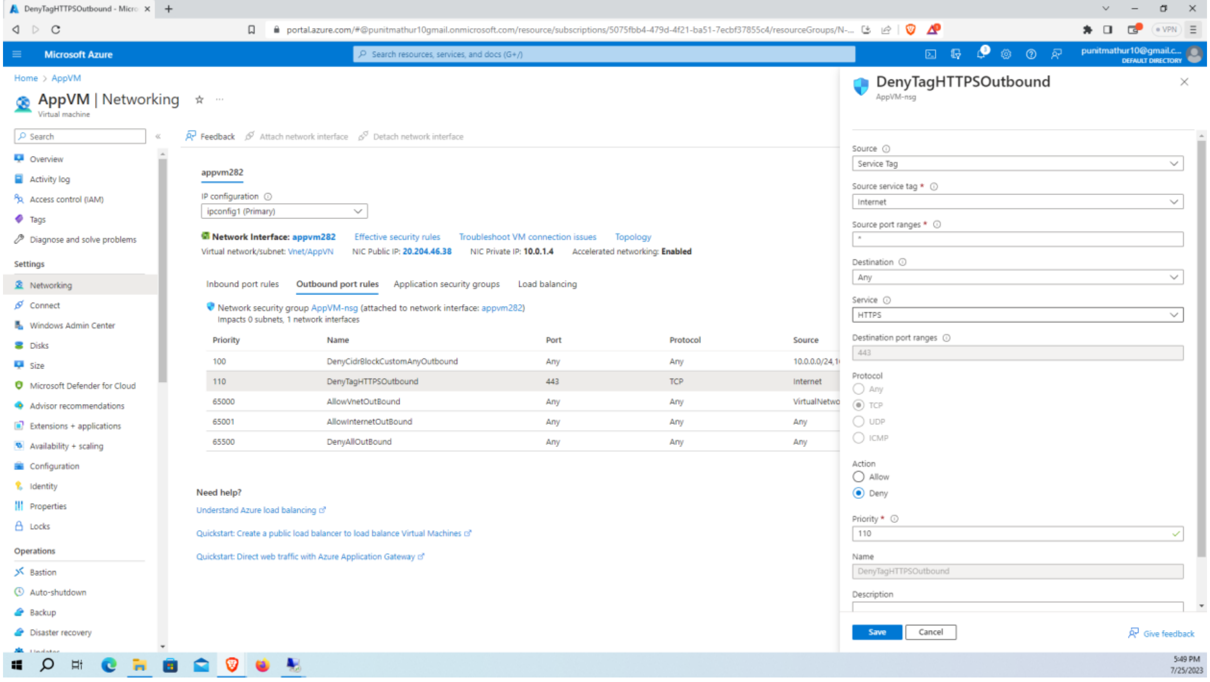
Need help?

Understand Azure load balancing

Quickstart: Create a public load balancer to load balance Virtual Machines

Quickstart: Direct web traffic with Azure Application Gateway

Similarly do this for AppVM too :-



AppVM | Networking

Virtual machine

appvm282

IP configuration: ipconfig1 (Primary)

Network Interface: appvm282 · Effective security rules · Troubleshoot VM connection issues · Topology

Virtual network/subnet: Vnet/AppVN · NIC Public IP: 20.204.46.38 · NIC Private IP: 10.0.1.4 · Accelerated networking: Enabled

Inbound port rules · **Outbound port rules** · Application security groups · Load balancing

Network security group AppVM-nsg (attached to network interface: appvm282)
Impacts 0 subnets, 1 network interfaces

Priority	Name	Port	Protocol	Source
100	DenyCidrBlockCustomAnyOutbound	Any	Any	10.0.0.0/24,1
110	DenyTagHTTPSOutbound	443	TCP	Internet
65000	AllowVnetOutBound	Any	Any	VirtualNetwo
65001	AllowInternetOutBound	Any	Any	Any
65500	DenyAllOutBound	Any	Any	Any

Need help?

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Quickstart: Direct web traffic with Azure Application Gateway

DenyTagHTTPSOutbound

AppVM-nsg

Source: Service Tag

Source service tag *: Internet

Source port ranges *: *

Destination: Any

Service: HTTPS

Destination port ranges: 443

Protocol
○ Any
● TCP
○ UDP
○ ICMP

Action
○ Allow
● Deny

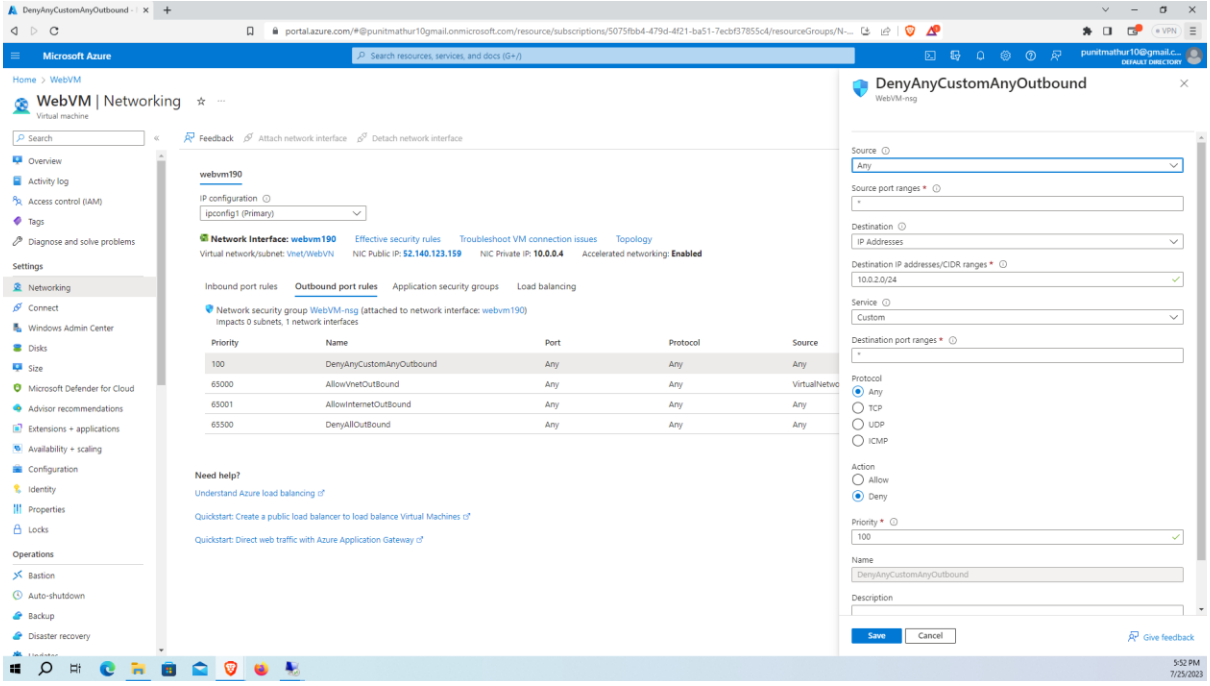
Priority *: 110

Name: DenyTagHTTPSOutbound

Description:

Save · Cancel

Now, as per the third requirement (Web Tier should access only the App Tier/VM). To complete this requirement, go to the WebVM -> Networking -> Outbound port rules and then click on Add Outbound Port rules and in the Outbound Security Rule window, select the destination as IP Address and in the destination IP address, write the Subnet of the DatabaseVM and in the destination port rules, write down the * and then in the Action, select the Deny and then click on Add.



portal.azure.com/#@punitmathur10gmail.onmicrosoft.com/resource/subscriptions/5075fbb4-479d-4f21-ba51-7ecbf37855c4/resourceGroups/N-...

WebVM | Networking

webvm190

IP configuration: ipconfig1 (Primary)

Network Interface: webvm190 Effective security rules Troubleshoot VM connection issues Topology

Virtual network/subnet: Vnet/WebVN NIC Public IP: 52.140.123.159 NIC Private IP: 10.0.0.4 Accelerated networking: Enabled

Network security group WebVM-nsg (attached to network interface: webvm190)
Impacts 0 subnets, 1 network interfaces

Priority	Name	Port	Protocol	Source
100	DenyAnyCustomAnyOutbound	Any	Any	Any
65000	AllowVnetOutBound	Any	Any	VirtualNetwo
65001	AllowInternetOutBound	Any	Any	Any
65500	DenyAllOutBound	Any	Any	Any

DenyAnyCustomAnyOutbound
WebVM-nsg

Source: Any

Source port ranges *: *

Destination: IP Addresses

Destination IP addresses/CIDR ranges *: 10.0.2.0/24

Service: Custom

Destination port ranges *: *

Protocol: ● Any ○ TCP ○ UDP ○ ICMP

Action: ○ Allow ● Deny

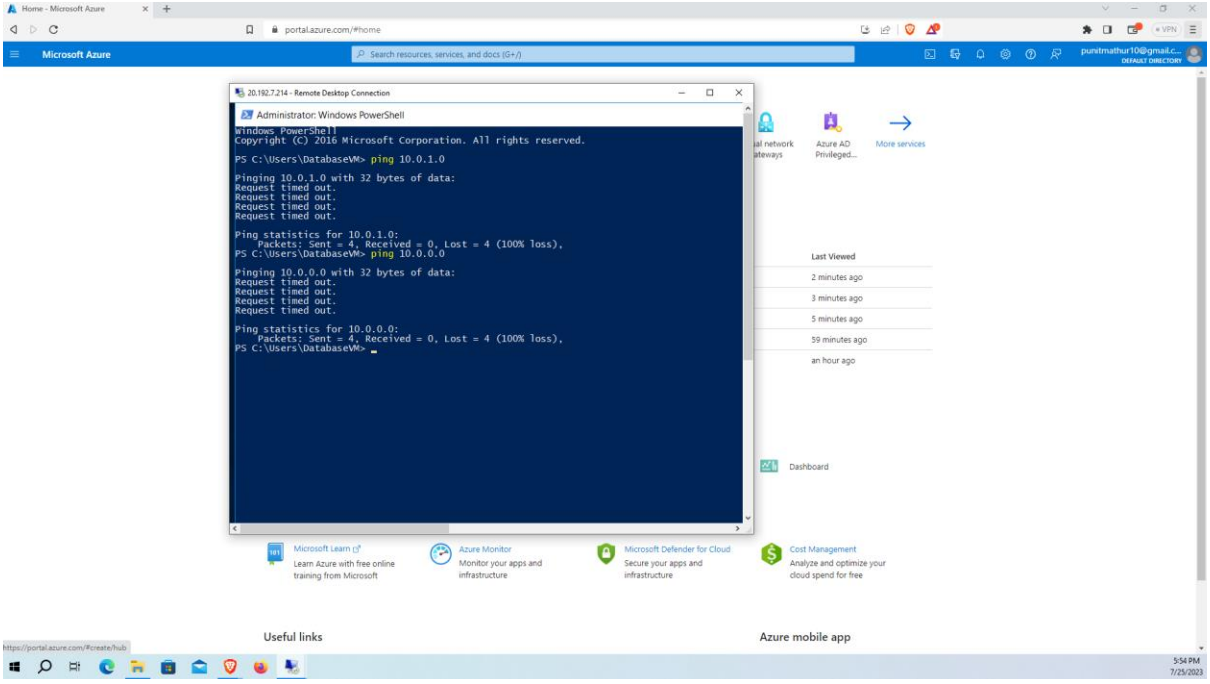
Priority *: 100

Name: DenyAnyCustomAnyOutbound

Description:

Now we will test the configuration of N-Tier technical requirement :-

Now in DatabaseVM open the powershell and Ping 10.0.1.0 and Ping 10.0.0.0, you will receive request time out. Also open internet explorer to check the internet connection.


Home - Microsoft Azure
portal.azure.com/#home
Microsoft Azure
Search resources, services, and docs (G+/)
punitmathur10@gmail.c...
DEFAULT DIRECTORY
20.192.7.214 - Remote Desktop Connection
Administrator: Windows PowerShell
Azure AD Privileged...
More services
Last Viewed
2 minutes ago
3 minutes ago
5 minutes ago
59 minutes ago
an hour ago
Dashboard
Microsoft Learn
Learn Azure with free online training from Microsoft
Azure Monitor
Monitor your apps and infrastructure
Microsoft Defender for Cloud
Secure your apps and infrastructure
Cost Management
Analyze and optimize your cloud spend for free
Useful links
Azure mobile app
5:54 PM
7/25/2023

```
Windows PowerShell
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PS C:\Users\DatabaseVM> ping 10.0.1.0

Pinging 10.0.1.0 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 10.0.1.0:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
PS C:\Users\DatabaseVM> ping 10.0.0.0

Pinging 10.0.0.0 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 10.0.0.0:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
PS C:\Users\DatabaseVM> _
```
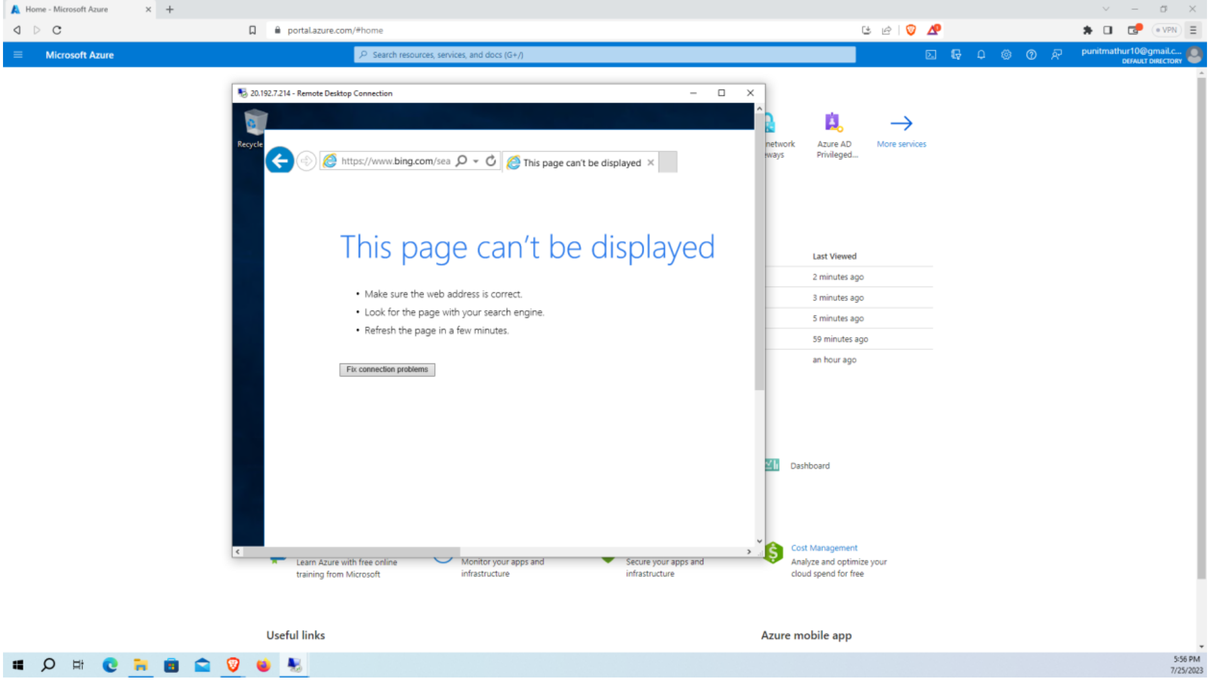
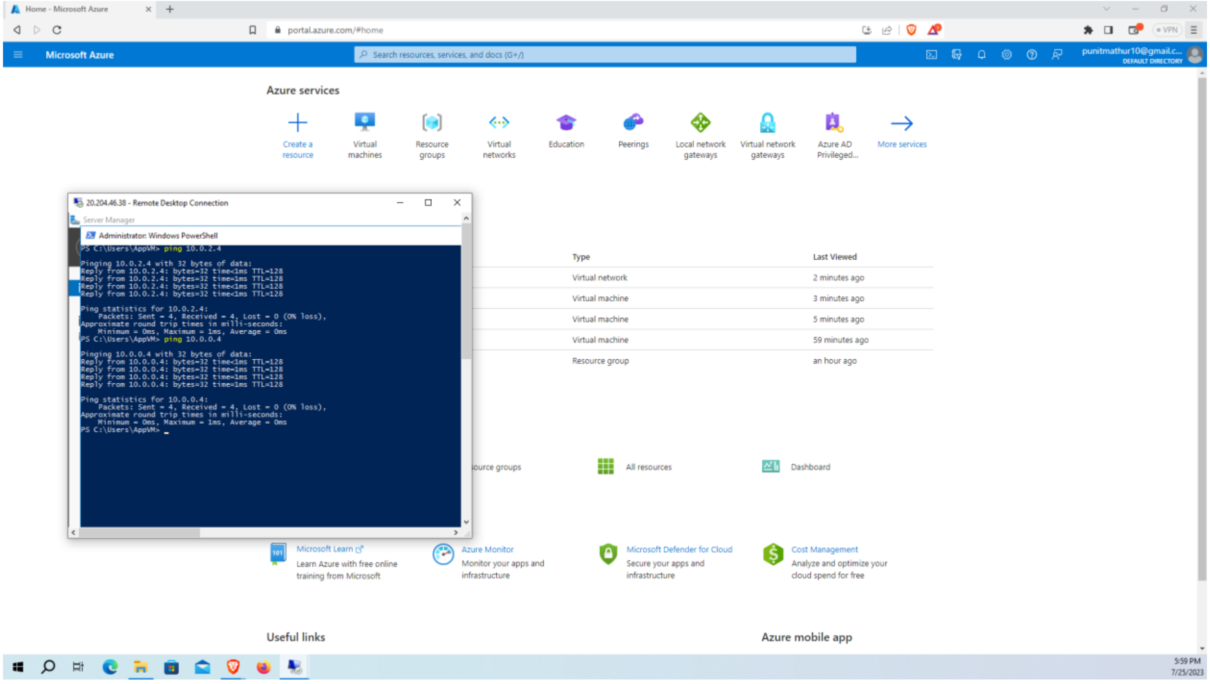



This page can't be displayed

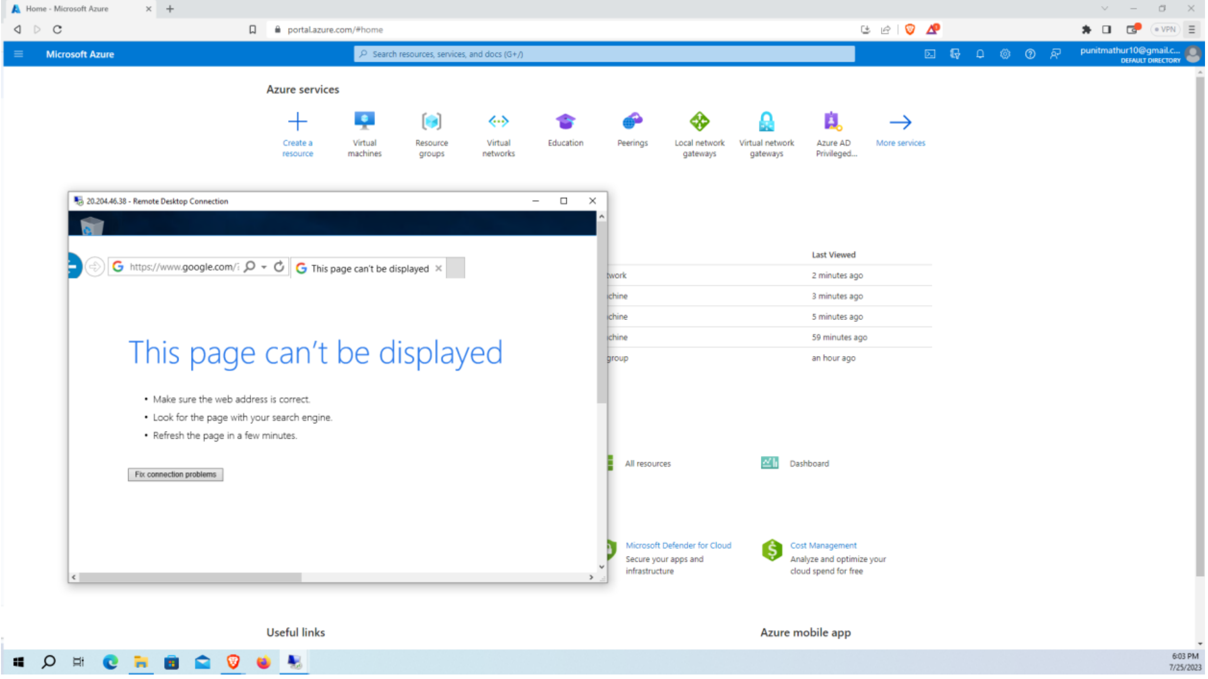
- Make sure the web address is correct.
- Look for the page with your search engine.
- Refresh the page in a few minutes.

Do the same for AppVM and WebVM as well : -



```
PS C:\Users\AppVM> ping 10.0.2.4

Pinging 10.0.2.4 with 32 bytes of data:
Reply from 10.0.2.4: bytes=32 time<1ms TTL=128
Reply from 10.0.2.4: bytes=32 time=1ms TTL=128
Reply from 10.0.2.4: bytes=32 time<1ms TTL=128
Reply from 10.0.2.4: bytes=32 time<1ms TTL=128

Ping statistics for 10.0.2.4:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
PS C:\Users\AppVM> ping 10.0.0.4

Pinging 10.0.0.4 with 32 bytes of data:
Reply from 10.0.0.4: bytes=32 time<1ms TTL=128
Reply from 10.0.0.4: bytes=32 time=1ms TTL=128
Reply from 10.0.0.4: bytes=32 time=1ms TTL=128
Reply from 10.0.0.4: bytes=32 time=1ms TTL=128

Ping statistics for 10.0.0.4:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
PS C:\Users\AppVM> _
```

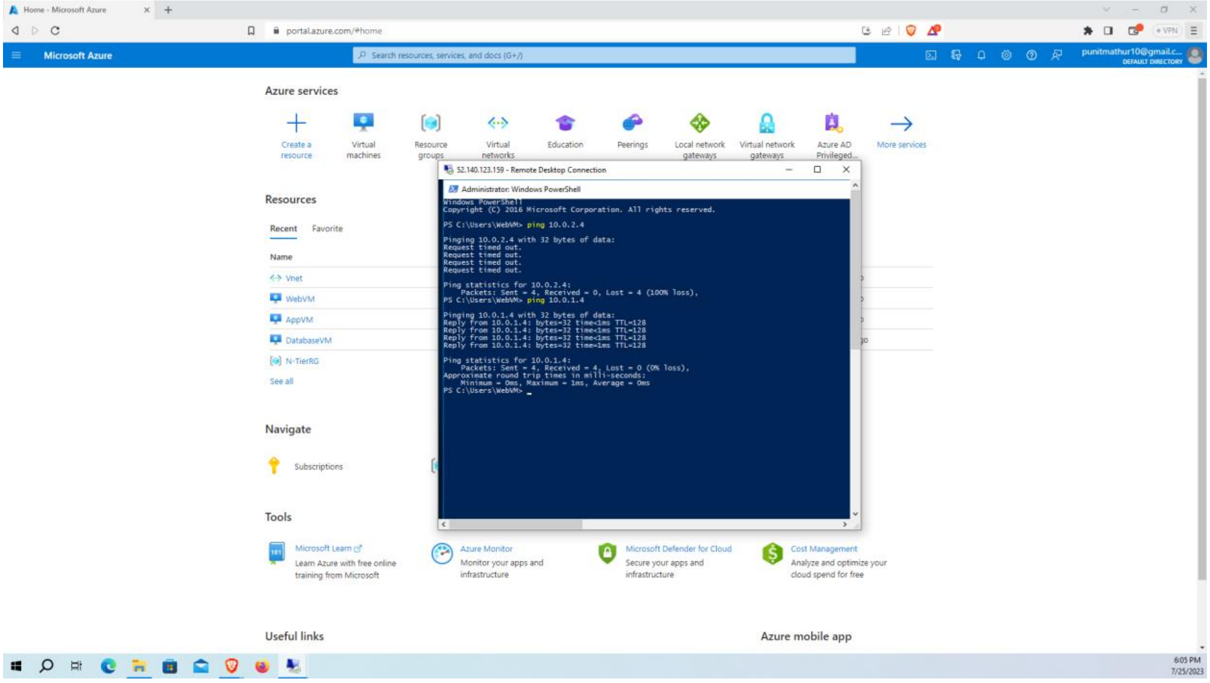
Type	Last Viewed
Virtual network	2 minutes ago
Virtual machine	3 minutes ago
Virtual machine	5 minutes ago
Virtual machine	59 minutes ago
Resource group	an hour ago



This page can't be displayed

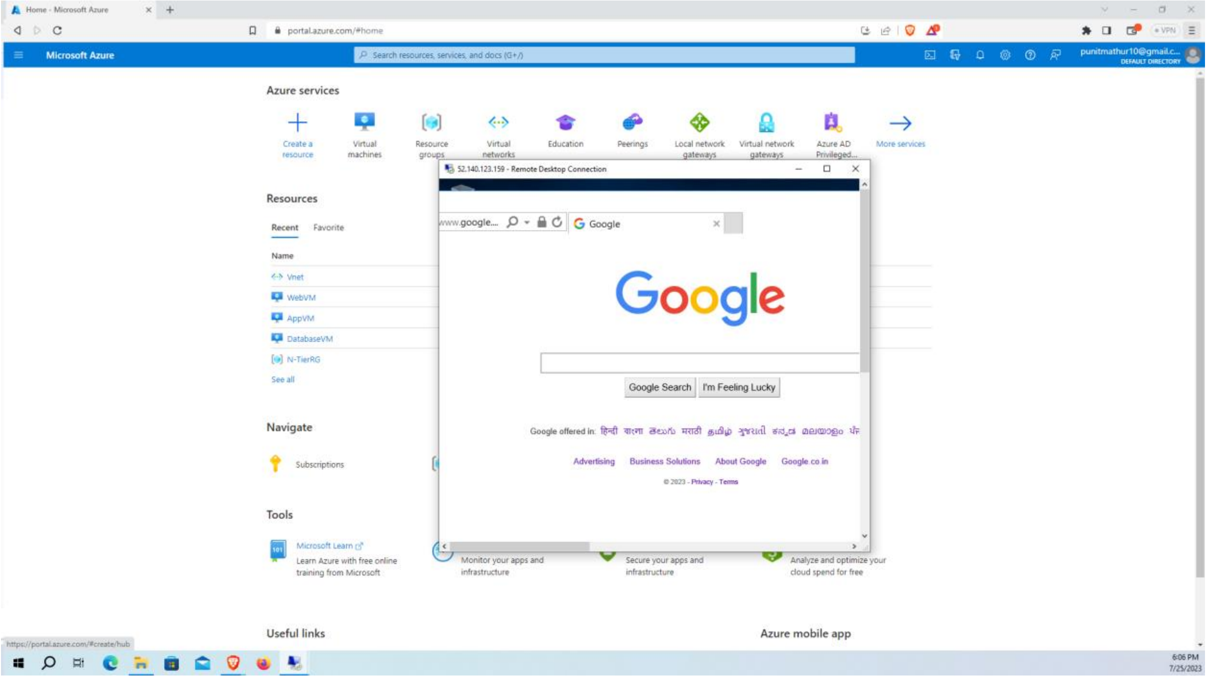
- Make sure the web address is correct.
- Look for the page with your search engine.
- Refresh the page in a few minutes.

Fix connection problems



```
Windows PowerShell
Copyright (C) 2016 Microsoft Corporation. All rights reserved.

PS C:\Users\WebVM> ping 10.0.2.4

Pinging 10.0.2.4 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 10.0.2.4:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
PS C:\Users\WebVM> ping 10.0.1.4

Pinging 10.0.1.4 with 32 bytes of data:
Reply from 10.0.1.4: bytes=32 time<1ms TTL=128
Reply from 10.0.1.4: bytes=32 time<1ms TTL=128
Reply from 10.0.1.4: bytes=32 time<1ms TTL=128
Reply from 10.0.1.4: bytes=32 time=1ms TTL=128

Ping statistics for 10.0.1.4:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
PS C:\Users\WebVM> _
```

Here we can see that internet connection is working as per our requirements.



Task is Completed.