



AZURE FINAL PROJECT

Submitted by:

Sidharth Panigrahi

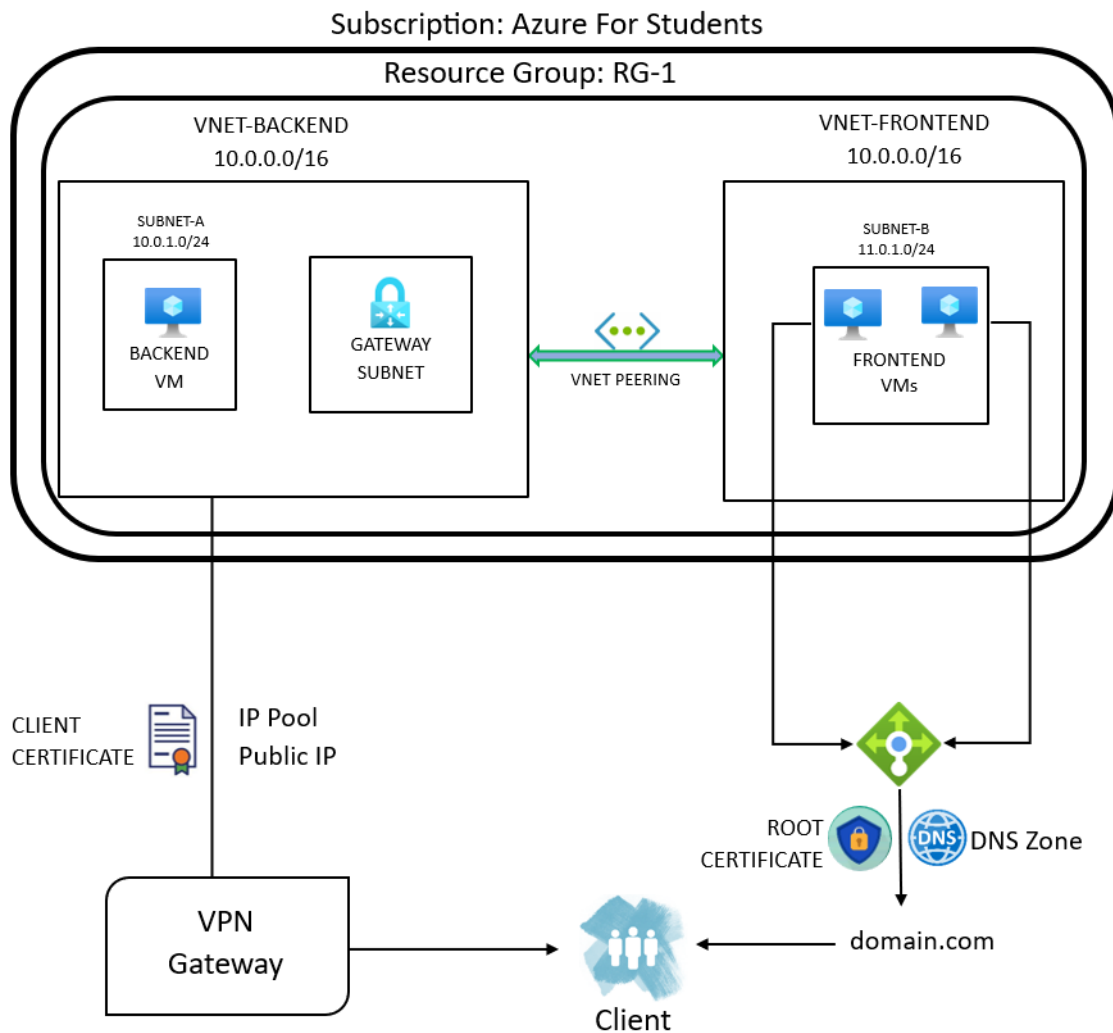
SIC:22BECC43

Batch: 2

Branch: ECE

PROJECT ARCHITECTURE

The following is the architecture to deploy an web-app on Azure cloud:

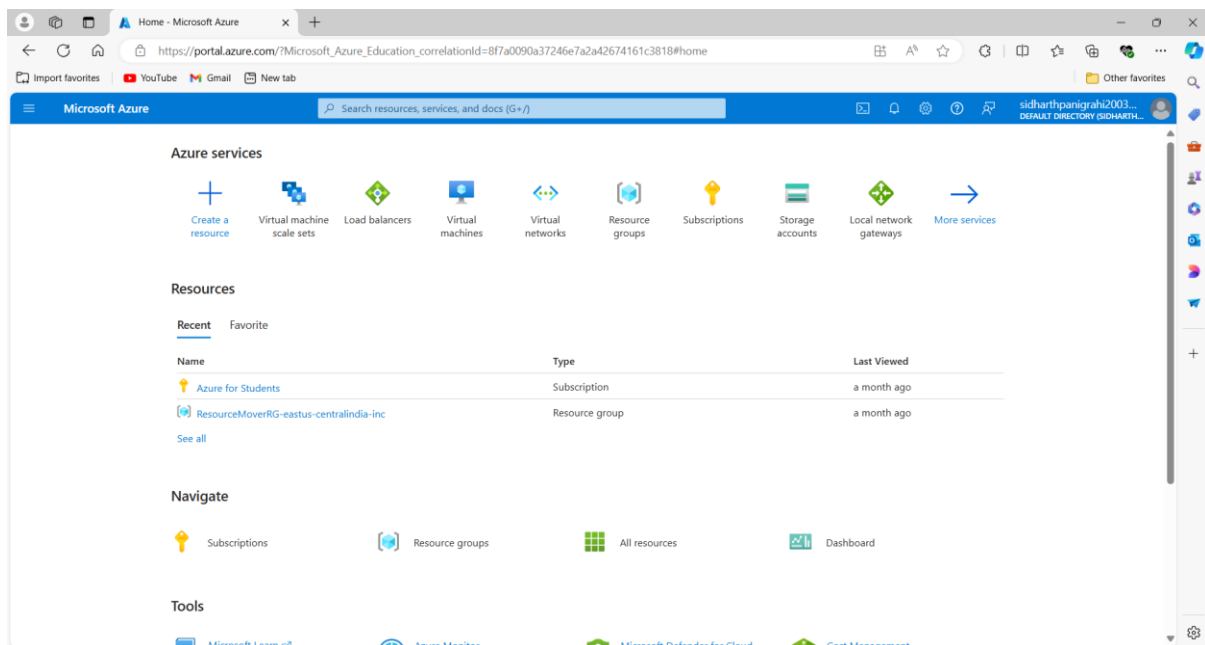


Steps followed for the project

- VNets Established: Distinct Virtual Networks configured for frontend and backend.
- VMs Launched: Frontend and backend running on Virtual Machines; linked via a jump server.
- Load Balancer Implemented: Integrated with frontend VMs; public IP exclusively assigned to the Load Balancer.
- Autoscaling Activated: Traffic distribution managed on frontend VMs.
- Secured Access: VPN utilized for private entry through the jump server.
- Azure Hosting Completed: Application deployed on Azure; domain routed to the Load Balancer's public IP.
- Operations Verified: Frontend operations executed; database outcomes confirmed.
- SSL Certificate Installed: Domain secured with SSL during hosting

Microsoft Azure Cloud services

Microsoft Azure is a cloud computing platform offering a wide range of services, including virtual machines, databases, AI, and IoT, allowing businesses to build, deploy, and manage applications across a global network of data centers. It provides scalability, security, and flexibility to support diverse workloads and business needs.



SERVICES USED OF AZURE

- **Azure Virtual Network:** Enables the creation of isolated networks within Azure, allowing you to segment the infrastructure into frontend and backend networks for security and organization.
- **Azure Virtual Machines:** Provides scalable, on-demand computing resources where the application's frontend and backend (database) will be hosted. A jump VM is also used for secure management access to these resources.
- **Azure Load Balancer:** Distributes incoming network traffic across multiple VMs in the frontend network to ensure high availability and reliability. The load balancer is assigned a public IP address to manage external traffic.
- **Azure VPN Gateway:** Facilitates secure communication between the jump server and other VMs over a private network, allowing administrators to manage the infrastructure without exposing it to the public internet.
- **Azure DNS:** Manages the mapping of the domain name to the public IP of the load balancer, enabling users to access the application via a custom domain.

EXPLANATION ABOUT THE PROJECT:

This project is focused on deploying a web application using Microsoft Azure, emphasizing security, scalability, and efficient traffic management. The setup involves separating the frontend and backend components into different virtual networks (VNets) to enhance security and control.

Virtual Networks: We start by creating two distinct VNets—one for the frontend, which handles user interaction, and another for the backend, where the database is managed. Separating these networks ensures that the backend is not exposed to the public internet, significantly reducing security risks.

Virtual Machines: Within these VNets, Azure Virtual Machines (VMs) are deployed to host the services. The frontend VMs manage user interactions, while the backend VMs handle database operations. To securely access and manage these VMs, a jump VM is set up, connecting through a private path using a VPN. This jump server provides a secure way to manage the infrastructure without exposing it to the internet directly.

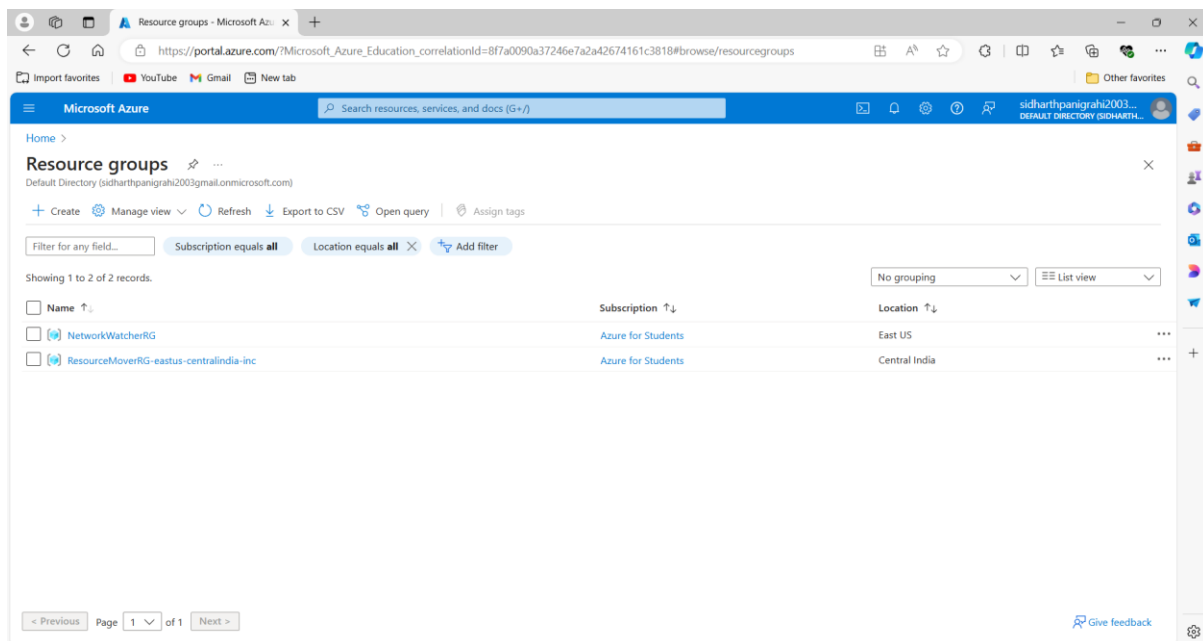
Load Balancer and Autoscaling: To manage traffic efficiently, an Azure Load Balancer is used. This distributes incoming requests across the frontend VMs, ensuring balanced traffic flow. The load balancer is assigned a public IP address, making it the only component accessible from the internet. Autoscaling is enabled to adjust the number of VMs automatically based on demand, ensuring the hosting service remains responsive under varying loads.

Web Hosting and Security: The web hosting is handled by Azure Web Hosting Service, with the public IP of the load balancer mapped to a custom domain name. An SSL certificate is applied to secure the communication, ensuring that all interactions are encrypted and protected.

This setup provides a secure, scalable, and reliable web hosting environment, ready to handle real-world demands.

SCREENSHOTS OF THE PROJECT

- Created a resource group and separate virtual networks for a database (backend) and frontend of the application, respectively.



- Created a Resource group with Region: **east-us2** to deploy everything inside it.

Home > Resource groups >

Create a resource group

Basics Tags Review + create

Resource group - A container that holds related resources for an Azure solution. The resource group can include all the resources for the solution, or only those resources that you want to manage as a group. You decide how you want to allocate resources to resource groups based on what makes the most sense for your organization. [Learn more](#)

Project details

Subscription *

Resource group *

Resource details

Region *

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

Home > RG-1 Resource group

Search

[+ Create](#) [Manage view](#) [Delete resource group](#) [Refresh](#) [Export to CSV](#) [Open query](#) [Assign tags](#) [Move](#) [Delete](#) [Export template](#)

Overview

Activity log Access control (IAM) Tags Resource visualizer Events Settings Cost Management Monitoring Automation Help

Essentials

Resources Recommendations

Filter for any field... [Type equals all](#) [Location equals all](#) [Add filter](#)

Showing 0 to 0 of 0 records. ☐ Show hidden types

No grouping [List view](#)

Name ↑↓ Type ↑↓ Location ↑↓

No resources match your filters

Try changing or clearing your filters.

[Create resources](#) [Clear filters](#) [Give feedback](#)

Virtual networks - Microsoft Azure

https://portal.azure.com/?Microsoft_Azure_Education_correlationId=8f7a0090a37246e7a2a42674161c3818#browse/Microsoft.Network%2Fvirtua...

Microsoft Azure

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

Home >

Virtual networks

Default Directory (sidharthpanigrahi2003@gmail.onmicrosoft.com)

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

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

Showing 0 to 0 of 0 records.

Name ↑↓	Resource group ↑↓	Location ↑↓	Subscription ↑↓
---------	-------------------	-------------	-----------------

No virtual networks to display

Create a virtual network to securely connect your Azure resources to each other. Connect your virtual network to your on-premises network using an Azure VPN Gateway or ExpressRoute.

Create virtual network

Learn more

Give feedback

Create virtual network - Microsoft Azure

https://portal.azure.com/?Microsoft_Azure_Education_correlationId=8f7a0090a37246e7a2a42674161c3818#create/Microsoft.VirtualNetwork-ARM

Microsoft Azure

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

Home > Virtual networks >

Create virtual network

Basics Security IP addresses Tags Review + create

Project details

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

Subscription * Azure for Students

Resource group * RG-1

Create new

Instance details

Virtual network name * VN-ET-BACKEND

Region * (US) East US 2

Deploy to an Azure Extended Zone

Previous Next Review + create

Give feedback

Create virtual network - Microsoft Azure

Home > Virtual networks > Create virtual network

Basics Security IP addresses Tags Review + create

Define the address space of your virtual network with one or more IPv4 or IPv6 address ranges. Create subnets to segment the virtual network address space into smaller ranges for use by your applications. When you deploy resources into a subnet, Azure assigns the resource an IP address from the subnet. [Learn more](#)

Add IPv4 address space

10.0.0.0/16
10.0.0.0 /16
10.0.0.0 - 10.0.255.255 65,536 addresses
+ Add a subnet

Subnets	IP address range	Size	NAT gateway
subnet-A	10.0.1.0 - 10.0.1.255	/24 (256 addresses)	-

Previous Next Review + create

VNET-BACKEND - Microsoft Azure

Home > VNET-BACKEND-1723284575594 | Overview

VNET-BACKEND Virtual network

Deployment succeeded
Deployment "VNET-BACKEND-1723284575594" to resource group "RG-1" was successful.
Go to resource Pin to dashboard

Search

Move Delete Refresh Give feedback

Overview

Activity log Access control (IAM) Tags Diagnose and solve problems Settings Monitoring Automation Help

Essentials

Resource group (move) : RG-1
Location (move) : East US 2
Subscription (move) : Azure for Students
Subscription ID : c915e8bc-bbf0-44d0-b007-5652fa5bd3e5

Tags (edit) : Add tags

Address space : 10.0.0.0/16
DNS servers : Azure provided DNS service
Flow timeout : Configure
BGP community string : Configure
Virtual network ID : 63699485-00e6-44b1-ae9-b824f0e4000

Topology Properties Capabilities (5) Recommendations Tutorials

DDoS protection
Configure additional protection from distributed denial of service attacks.
Not configured

Azure Firewall
Protect your network with a stateful L3-L7 firewall.
Not configured

Peerings
Seamlessly connect two or more virtual networks.
Not configured

Microsoft Defender for Cloud
Strengthen the security posture of your environment.

Private endpoints
Privately access Azure services

Create virtual network - Microsoft | x

https://portal.azure.com/?Microsoft_Azure_Education_correlationId=8f7a0090a37246e7a2a42674161c3818#create/Microsoft.VirtualNetwork-ARM

Import favorites YouTube Gmail New tab

Microsoft Azure Search resources, services, and docs (G+)

Home > Virtual networks >

Create virtual network

Basics Security IP addresses Tags Review + create

Project details

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

Subscription * Azure for Students

Resource group * RG-1

[Create new](#)

Instance details

Virtual network name * VN-1-FRONTEND

Region * (US) East US 2

[Deploy to an Azure Extended Zone](#)

Previous Next Review + create

[Give feedback](#)

Create virtual network - Microsoft | x

https://portal.azure.com/?Microsoft_Azure_Education_correlationId=8f7a0090a37246e7a2a42674161c3818#create/Microsoft.VirtualNetwork-ARM

Import favorites YouTube Gmail New tab

Microsoft Azure Search resources, services, and docs (G+)

Home > Virtual networks >

Create virtual network

Basics Security IP addresses Tags Review + create

virtual network address space into smaller ranges for use by your applications. When you deploy resources into a subnet, Azure assigns the resource an IP address from the subnet. [Learn more](#)

Add IPv4 address space

11.0.0.0/16

11.0.0.0 /16

11.0.0.0 - 11.0.255.255 65,536 addresses

+ Add a subnet

Subnets	IP address range	Size	NAT gateway
Subnet-B	11.0.1.0 - 11.0.1.255	/24 (256 addresses)	-

The entered IPv4 address range may not work correctly. It is recommended to use an address range that is not globally routable, such as 192.168.0.0/16 or a range defined in RFC 1918 and RFC 6598. [Learn more](#)

Previous Next Review + create

[Give feedback](#)

Microsoft Azure portal showing the details of a Virtual Network (VNET-FRONTEND-172356744584) in the Overview tab. The interface includes a left sidebar with navigation options like Overview, Activity log, Access control (IAM), Tags, Diagnose and solve problems, Settings, Address space, Connected devices, Subnets, Bastion, DDoS protection, Firewall, Microsoft Defender for Cloud, Network manager, DNS servers, and Peerings.

Essentials

- Resource group: [RG-1](#)
- Location: [East US 2](#)
- Subscription: [Azure for Students](#)
- Subscription ID: c915e8bc-bbf0-44d0-b007-5652fa5bd3e5
- Address space: 11.0.0.0/16
- DNS servers: [Azure provided DNS service](#)
- Flow timeout: [Configure](#)
- BGP community string: [Configure](#)
- Virtual network ID: 2daafb09-1b14-467c-a645-a87b9c6cd2cf

Capabilities (5)

- DDoS protection**: Configure additional protection from distributed denial of service attacks.
● Not configured
- Azure Firewall**: Protect your network with a stateful L3-L7 firewall.
● Not configured
- Peerings**: Seamlessly connect two or more virtual networks.
● Not configured
- Microsoft Defender for Cloud**: Strengthen the security posture of your environment.
- Private endpoints**: Privately access Azure services.

Microsoft Azure portal showing the list of Virtual Networks. The interface includes a top bar with filters and a table of virtual networks.

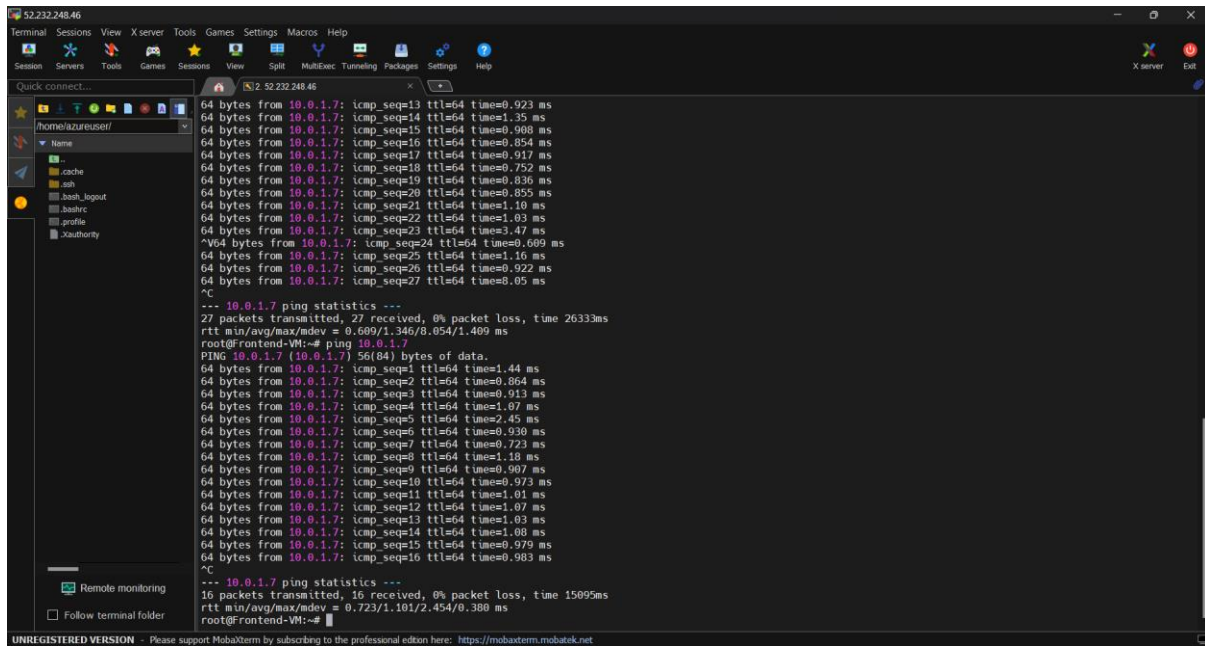
Filter for any field... Subscription equals all Resource group equals all Location equals all Add filter

Showing 1 to 2 of 2 records.

Name	Resource group	Location	Subscription
VNET-BACKEND	RG-1	East US 2	Azure for Students
VNET-FRONTEND	RG-1	East US 2	Azure for Students

< Previous Page 1 of 1 Next >

- Checked the peering status of the virtual networks using MobaXterm application.



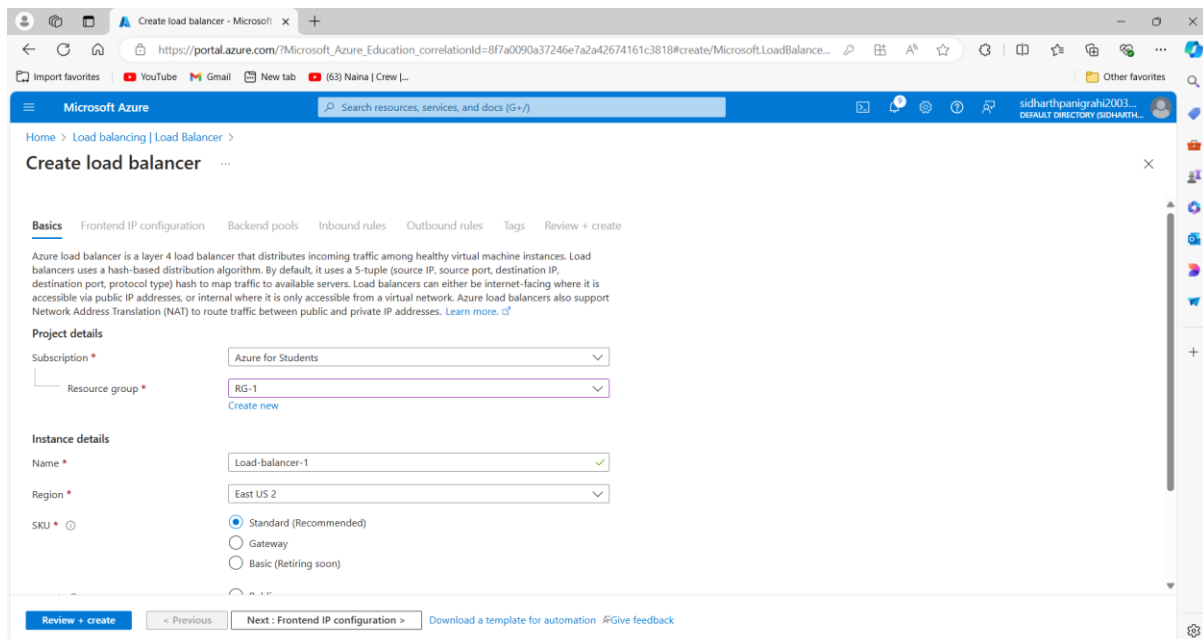
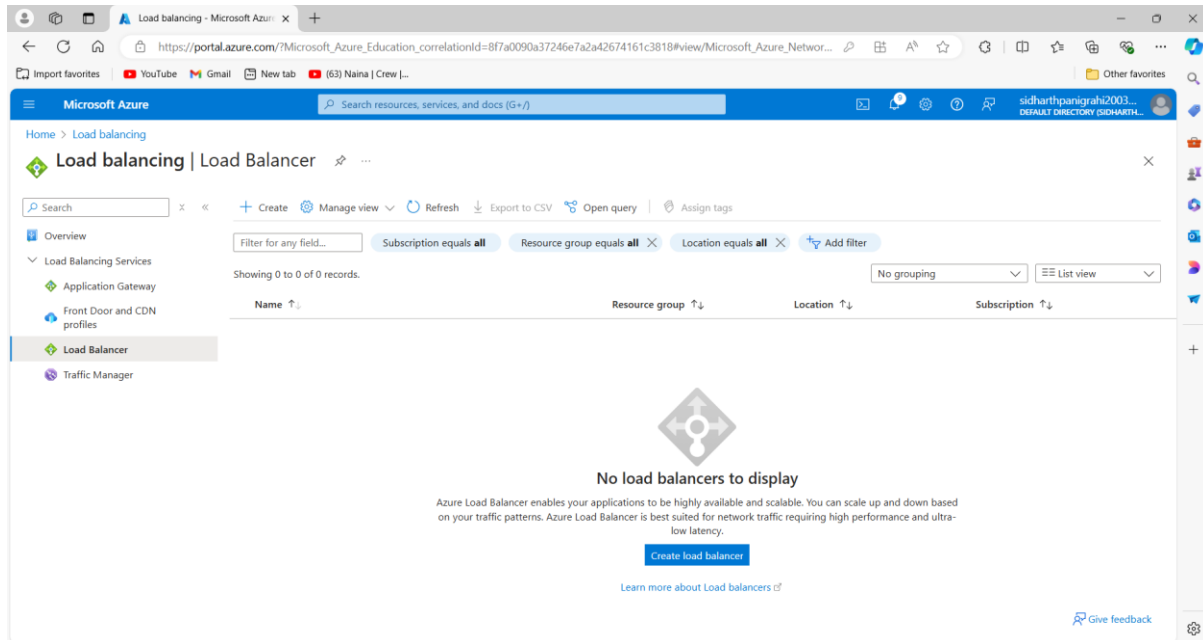
The screenshot shows the MobaXterm application window with a terminal session. The terminal displays the output of a ping command to 10.0.1.7. The output shows 27 packets transmitted, 27 received, 0% packet loss, and a time of 26333ms. The statistics show a round-trip time (rtt) of 0.689/1.346/8.054/1.469 ms. The terminal also shows the output of a second ping command to 10.0.1.7, which shows 16 packets transmitted, 16 received, 0% packet loss, and a time of 15095ms. The statistics show a round-trip time (rtt) of 0.723/1.101/2.454/0.388 ms. The terminal window has a menu bar with options like Terminal, Sessions, View, X server, Tools, Games, Settings, Macros, and Help. The left sidebar shows a file explorer with folders like .cache, .ssh, .bash_logout, .bashrc, .profile, and .xauthority. The bottom status bar indicates the application is an UNREGISTERED VERSION and provides a link to the professional edition.

```
52.232.248.46
Terminal Sessions View X server Tools Games Settings Macros Help
Quick connect...
/home/azureuser/
Name
.cache
.ssh
.bash_logout
.bashrc
.profile
.xauthority
Remote monitoring
Follow terminal folder

64 bytes from 10.0.1.7: icmp_seq=13 ttl=64 time=0.923 ms
64 bytes from 10.0.1.7: icmp_seq=14 ttl=64 time=1.35 ms
64 bytes from 10.0.1.7: icmp_seq=15 ttl=64 time=0.988 ms
64 bytes from 10.0.1.7: icmp_seq=16 ttl=64 time=0.854 ms
64 bytes from 10.0.1.7: icmp_seq=17 ttl=64 time=0.917 ms
64 bytes from 10.0.1.7: icmp_seq=18 ttl=64 time=0.752 ms
64 bytes from 10.0.1.7: icmp_seq=19 ttl=64 time=0.836 ms
64 bytes from 10.0.1.7: icmp_seq=20 ttl=64 time=0.855 ms
64 bytes from 10.0.1.7: icmp_seq=21 ttl=64 time=1.10 ms
64 bytes from 10.0.1.7: icmp_seq=22 ttl=64 time=1.03 ms
64 bytes from 10.0.1.7: icmp_seq=23 ttl=64 time=3.47 ms
^V64 bytes from 10.0.1.7: icmp_seq=24 ttl=64 time=0.609 ms
64 bytes from 10.0.1.7: icmp_seq=25 ttl=64 time=1.16 ms
64 bytes from 10.0.1.7: icmp_seq=26 ttl=64 time=0.922 ms
64 bytes from 10.0.1.7: icmp_seq=27 ttl=64 time=0.85 ms
^C
--- 10.0.1.7 ping statistics ---
27 packets transmitted, 27 received, 0% packet loss, time 26333ms
rtt min/avg/max/mdev = 0.689/1.346/8.054/1.469 ms
root@Frontend-VM:~# ping 10.0.1.7
PING 10.0.1.7 (10.0.1.7) 56(84) bytes of data:
64 bytes from 10.0.1.7: icmp_seq=1 ttl=64 time=1.44 ms
64 bytes from 10.0.1.7: icmp_seq=2 ttl=64 time=0.864 ms
64 bytes from 10.0.1.7: icmp_seq=3 ttl=64 time=0.913 ms
64 bytes from 10.0.1.7: icmp_seq=4 ttl=64 time=1.07 ms
64 bytes from 10.0.1.7: icmp_seq=5 ttl=64 time=2.45 ms
64 bytes from 10.0.1.7: icmp_seq=6 ttl=64 time=0.930 ms
64 bytes from 10.0.1.7: icmp_seq=7 ttl=64 time=0.723 ms
64 bytes from 10.0.1.7: icmp_seq=8 ttl=64 time=1.18 ms
64 bytes from 10.0.1.7: icmp_seq=9 ttl=64 time=0.907 ms
64 bytes from 10.0.1.7: icmp_seq=10 ttl=64 time=0.973 ms
64 bytes from 10.0.1.7: icmp_seq=11 ttl=64 time=1.01 ms
64 bytes from 10.0.1.7: icmp_seq=12 ttl=64 time=1.07 ms
64 bytes from 10.0.1.7: icmp_seq=13 ttl=64 time=1.03 ms
64 bytes from 10.0.1.7: icmp_seq=14 ttl=64 time=1.88 ms
64 bytes from 10.0.1.7: icmp_seq=15 ttl=64 time=0.979 ms
64 bytes from 10.0.1.7: icmp_seq=16 ttl=64 time=0.983 ms
^C
--- 10.0.1.7 ping statistics ---
16 packets transmitted, 16 received, 0% packet loss, time 15095ms
rtt min/avg/max/mdev = 0.723/1.101/2.454/0.388 ms
root@Frontend-VM:~#
```

UNREGISTERED VERSION - Please support MobaXterm by subscribing to the professional edition here: <https://mobaxterm.mobatek.net>

- Applied a load balancer to the frontend servers in the frontend network and attached a public IP to the load balancer only.



Create load balancer - Microsoft

https://portal.azure.com/?Microsoft_Azure_Education_correlationId=8f7a0090a37246e7a2a42674161c3818#create/Microsoft.LoadBalance...

Import favoritesYouTubeGmailNew tab(63) Naina | Crew |...

Microsoft AzureSearch resources, services, and docs (G+)

sidharthpanigraha2003...
DEFAULT DIRECTORY (SIDHARTH...

Home > Load balancing | Load Balancer >

Create load balancer

BasicsFrontend IP configurationBackend poolsInbound rulesOutbound rulesTagsReview + create

A frontend IP configuration is an IP address used for inbound and/or outbound communication as defined within load balancing, inbound NAT, and outbound rules.

+ Add a frontend IP configuration

Name ↑↓	IP address ↑↓	Virtual network ↑↓	Subnet ↑↓
Frontend-pool	Dynamic	VNET-FRONTEND	Subnet-B

Review + create

< Previous

Next : Backend pools >

Download a template for automation

Give feedback

Add backend pool - Microsoft

https://portal.azure.com/?Microsoft_Azure_Education_correlationId=8f7a0090a37246e7a2a42674161c3818#view/Microsoft_Azure_Networ...

Import favoritesYouTubeGmailNew tab(63) Naina | Crew |...

Microsoft AzureSearch resources, services, and docs (G+)

sidharthpanigraha2003...
DEFAULT DIRECTORY (SIDHARTH...

Home > Load balancing | Load Balancer > Create load balancer >

Add backend pool

Name *

Backend-Pool

Virtual network

VNET-FRONTEND

Backend Pool Configuration

NIC

IP address

IP configurations

IP configurations associated to virtual machines and virtual machine scale sets must be in same location as the load balancer and be in the same virtual network.

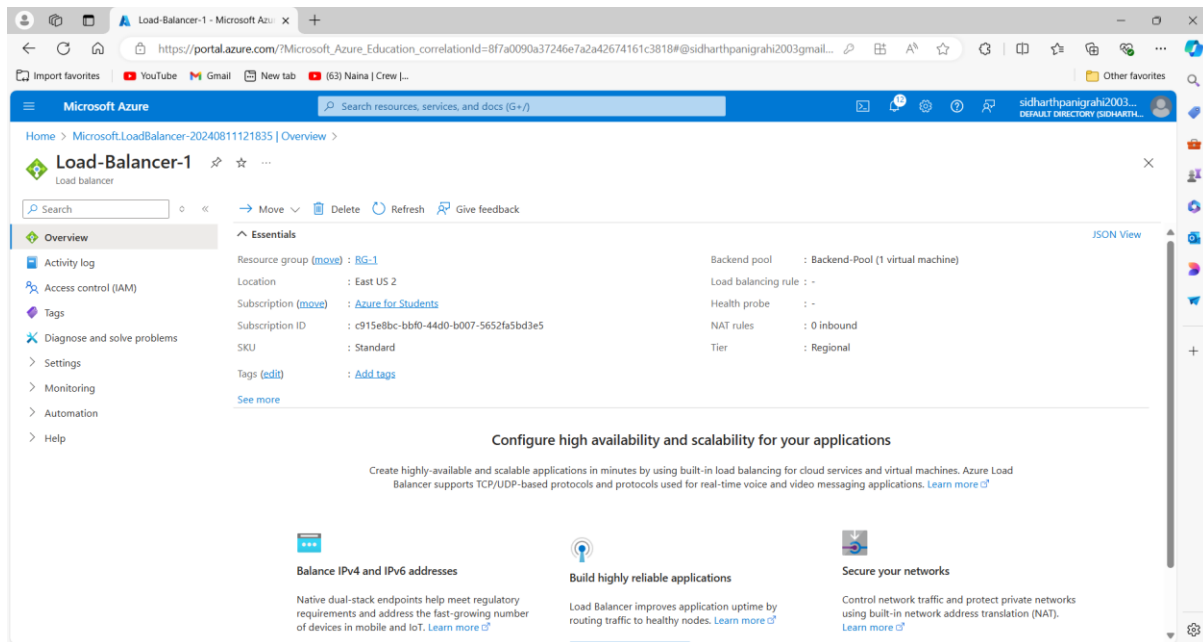
+ Add | X Remove

Resource Name	Resource group	Type	IP configuration	IP Address	Availability set
Frontend-VM	RG-1	Virtual machine	ipconfig1	11.0.1.4	-

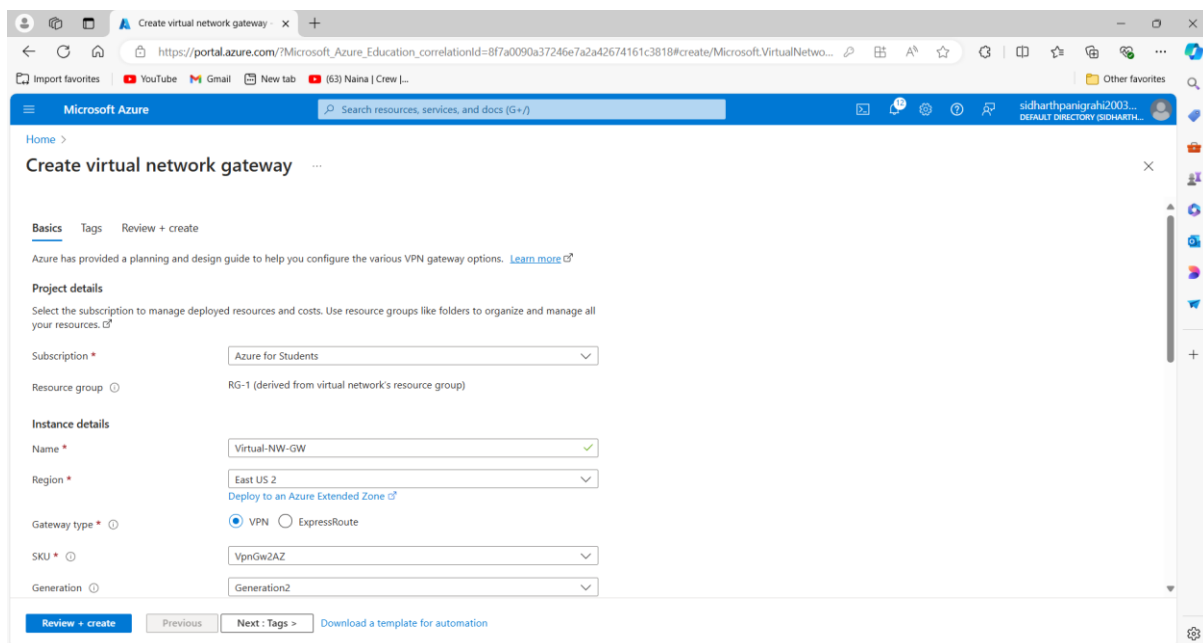
Save

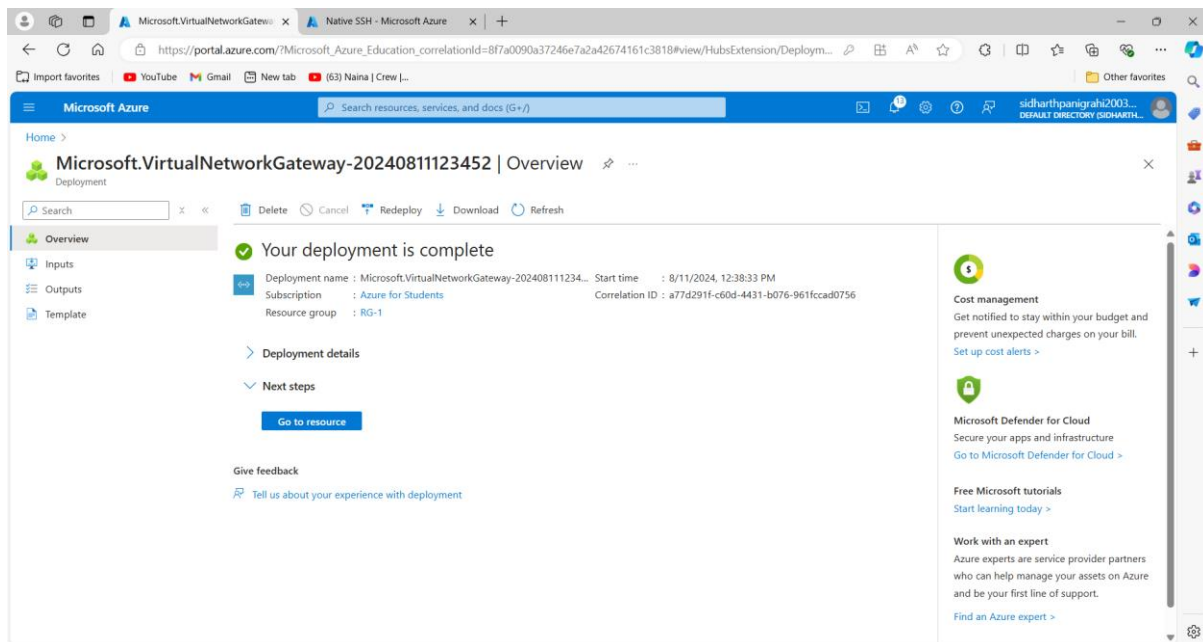
Cancel

Give feedback

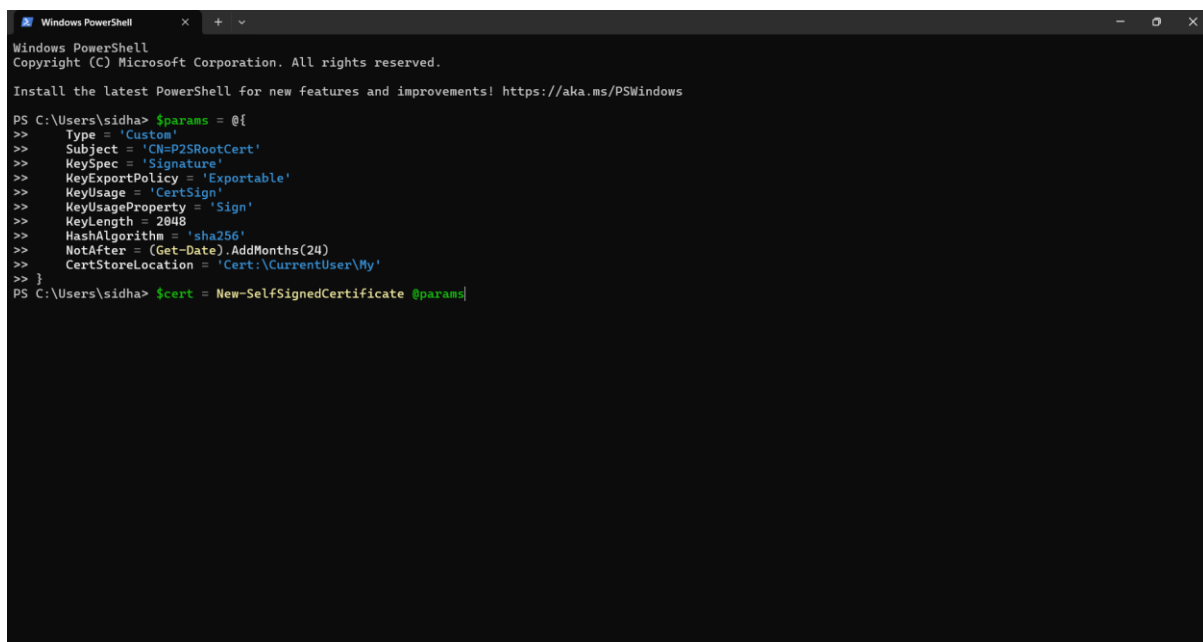


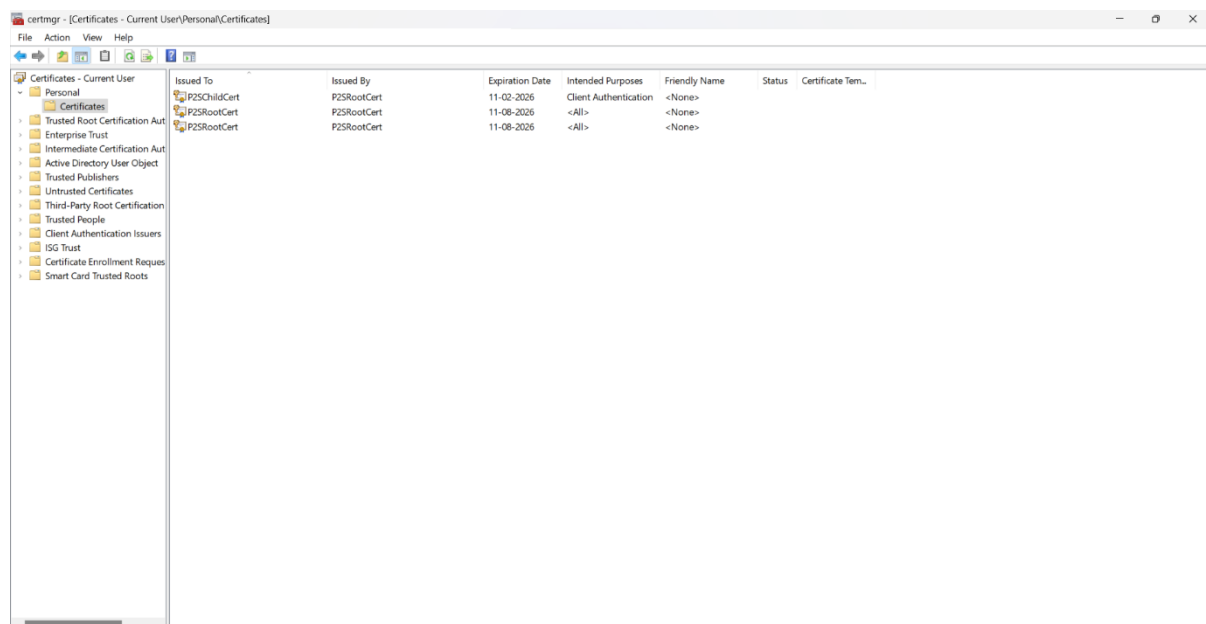
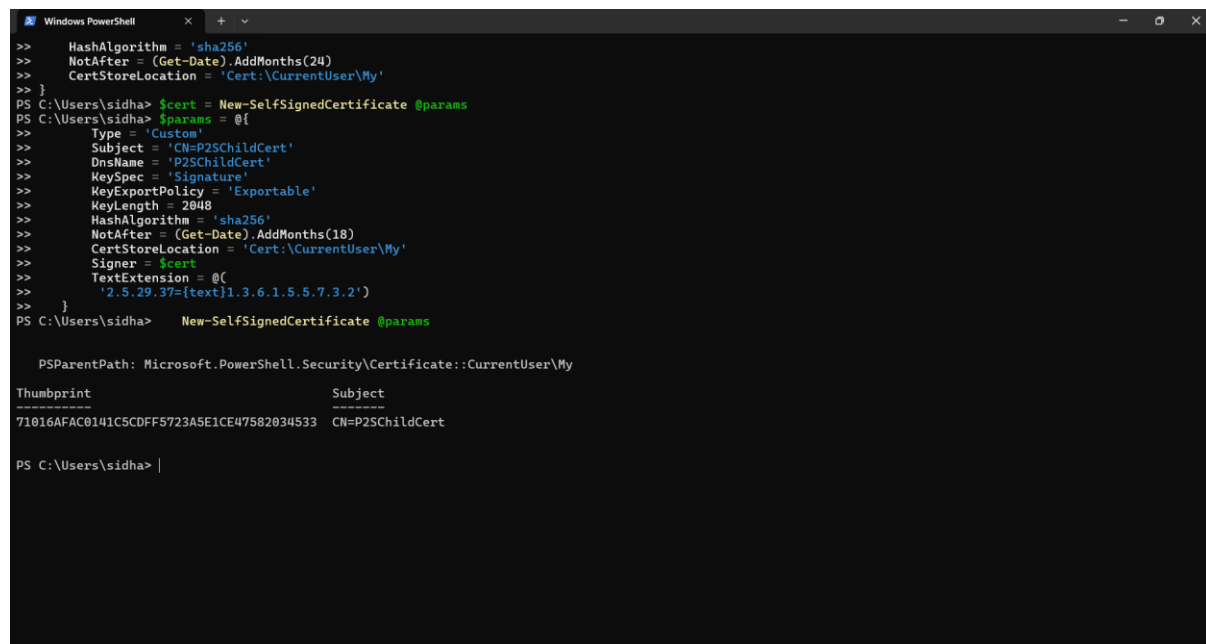
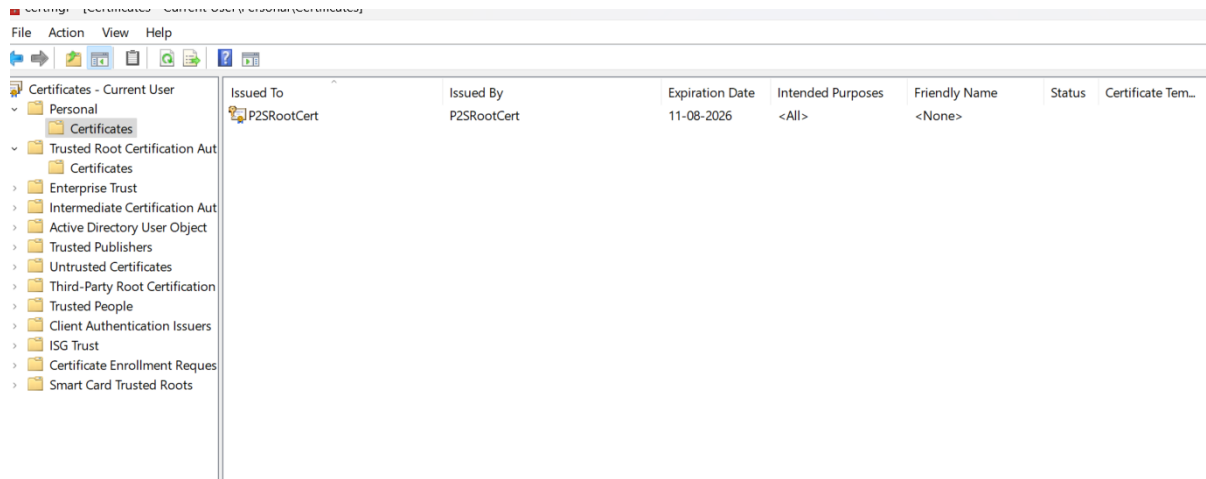
- Created a virtual network gateway



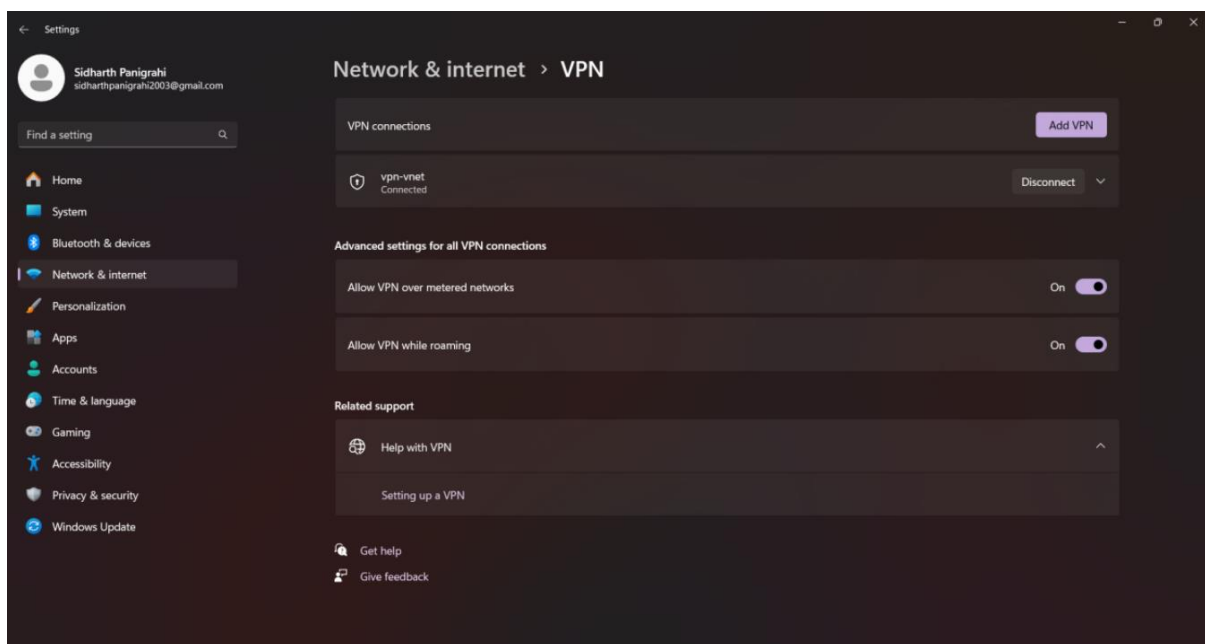
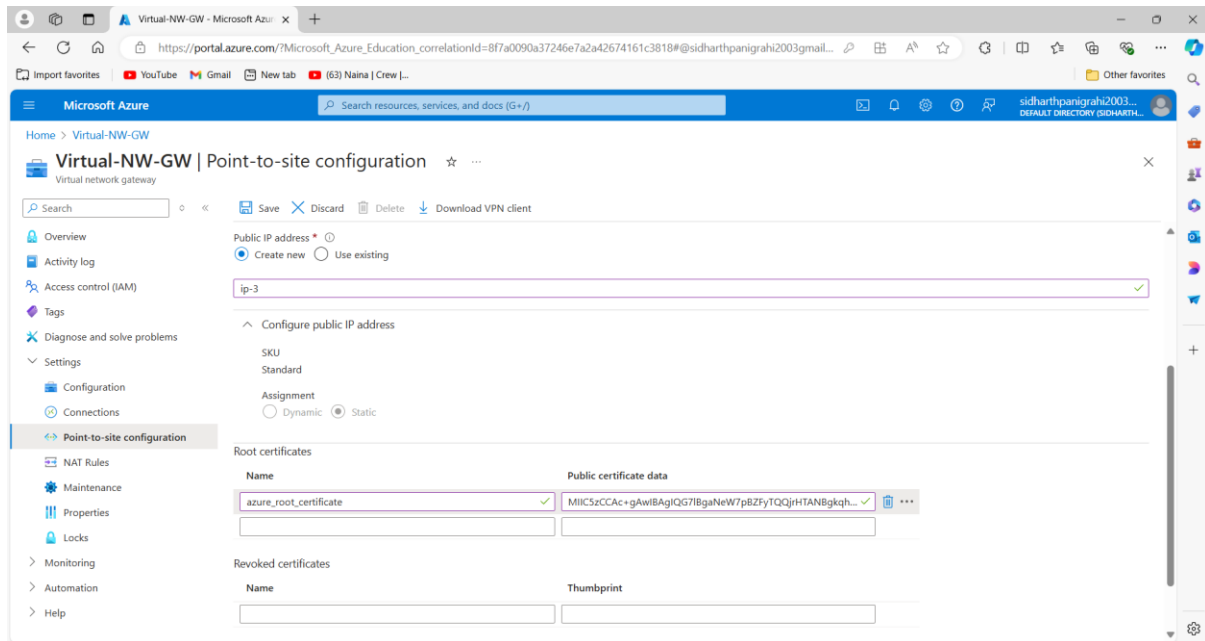


- Created Root certificate and Client certificate using windows powershell.





- Established Point-to-site configuration



- Deployed it with Azure Hosting service and mapped the public IP of the load balancer to the domain name.

Create a DNS Zone

Project details

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

Subscription *

Resource group * [Create new](#)

Instance details

☐ This zone is a child of an existing zone already hosted in Azure DNS

Name *

Resource group location *

[Review + create](#) [< Previous](#) [Next: DNS Zone Editor >](#)

sidharth-dns.in DNS zone

[Child zone](#) [Record sets](#) [Import](#) [Export](#) [Move](#) [Refresh](#) [Delete](#)

Overview

Essentials

Resource group (move) : [RG-1](#)

Location : Global

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

Subscription ID : c915e8bc-bbf0-44d0-b007-5652fa5bd3e5

Recordsets : 2

Tags (edit) : [Add tags](#)

Max number of record ... : 10000

Name server 1 : ns1-03.azure-dns.com.

Name server 2 : ns2-03.azure-dns.net.

Name server 3 : ns3-03.azure-dns.org.

Name server 4 : ns4-03.azure-dns.info.

Get Started Tutorials Tools + SDK

Azure DNS is a hosting service for DNS domains that provides name resolution by using Microsoft Azure infrastructure. By hosting your domains in Azure, you can manage your DNS records by using the same credentials, APIs, tools, and billing as your other Azure services.

Add DNS record sets
Begin hosting your domain in Azure DNS by adding record sets. A record set is a collection of records in a zone that have the same name and are the same type.

Import record sets from file
You have the option to import your zone directly using the import utility. This utility offers a rapid, dependable, and convenient method for transferring DNS zone data into or out of Azure DNS.

Access control
View your level of access to DNS zone. Review the level of access a user, group, service principal, or managed identity has to this DNS zone.

Azure DNS Documentation
For detail understanding of Azure DNS, refer to the documentation.

The screenshot shows the Microsoft Azure portal interface. The browser address bar displays a URL from portal.azure.com. The page title is "sidharth-dns.in | Recordsets". On the left, a navigation pane lists various DNS management options, with "Recordsets" selected. The main content area shows a table of DNS records for the "sidharth-dns.in" DNS zone. The table has columns for Name, Type, TTL, Value, Alias resource type, and Alias target. Two records are listed: an NS record pointing to four Azure DNS servers and a SOA record with detailed metadata.

Name	Type	TTL	Value	Alias resource type	Alias target
@	NS	172800	ns1-03.azure-dns.com, ns2-03.azure-dns.net, ns3-03.azure-dns.org, ns4-03.azure-dns.info.		
@	SOA	3600	Email: azuredns-hostmaster.microsoft.com Host: ns1-03.azure-dns.com. Refresh: 3600 Retry: 300 Expire: 2419200 Minimum TTL: 300 Serial number: 1		

The screenshot shows a domain management dashboard with a modal dialog titled "Nameservers changed!". The dialog informs the user that their nameservers have been changed to a list of four Azure DNS servers. It also includes a note that propagation may take up to 24 hours. The background shows the "Domains" section of the dashboard with a list of domains and a "Change Nameservers" button.

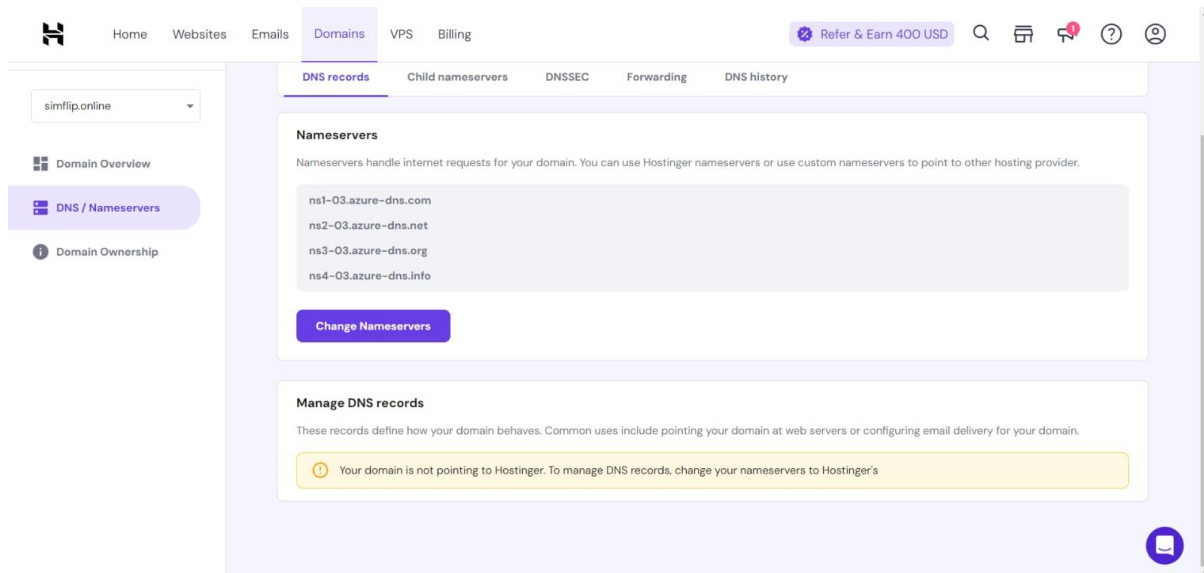
Nameservers changed!

Your nameservers has been changed to:

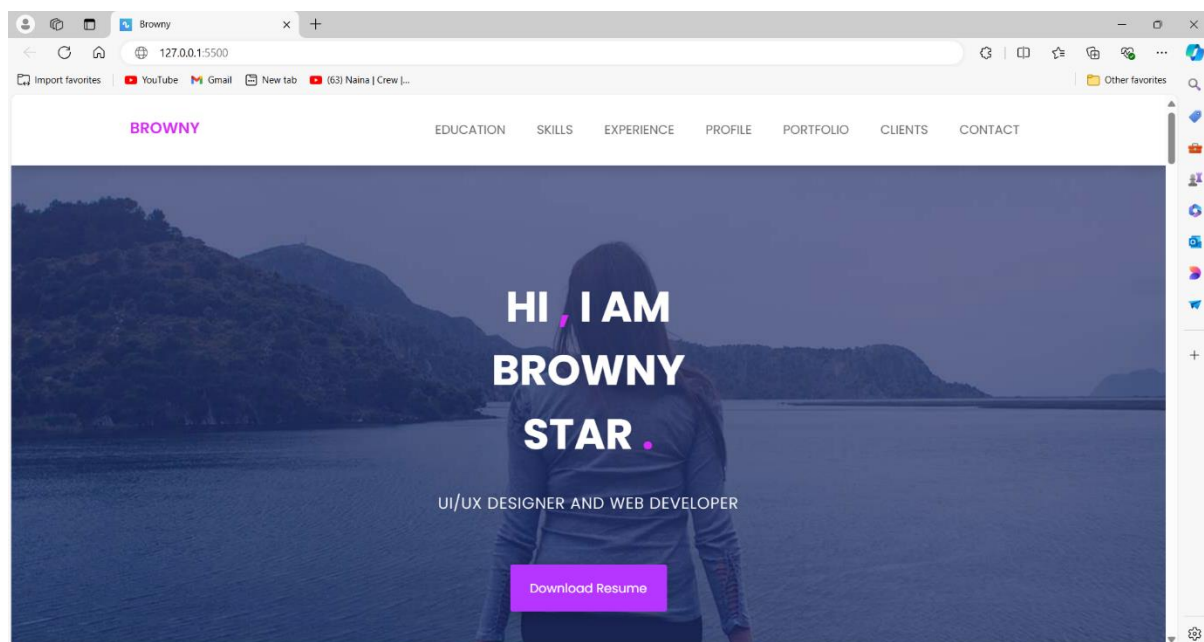
- ns1-03.azure-dns.com
- ns2-03.azure-dns.net
- ns3-03.azure-dns.org
- ns4-03.azure-dns.info

It might take up to 24 hours for the domain to propagate to the new nameservers.

Close



- Applied the SSL certificate to the domain while it was hosted.



Industrial Practices:

- **Security:** Apply the principle of least privilege, utilize a jump server for secure VM access, and ensure data is encrypted both during transmission (using SSL) and when stored.
- **Scalability:** Implement autoscaling to dynamically adjust the number of VM instances based on traffic, ensuring the application handles fluctuating loads effectively.
- **High Availability:** Configure load balancers across different availability zones to maintain service continuity in case of a zone failure.
- **Cost Efficiency:** Optimize resource usage with autoscaling and continuously monitor to prevent over-provisioning, helping to minimize unnecessary expenses.

THANK YOU
