

3 TIER ARCHITECTURE

DEPLOYMENT ON AZURE CLOUD

Sabitha Devarapalli

PROJECT OVERVIEW

This project demonstrates the manual implementation of a Three-Tier Architecture on a cloud platform. The architecture is designed to separate concerns by dividing the application into three independent layers: Web, Application, and Database. Each tier is deployed on a separate virtual machine within a private virtual network to ensure security, scalability, and better performance.

The Web Tier is responsible for handling client requests and serving web content. The Application Tier processes business logic and acts as a bridge between the web server and the database. The Database Tier securely stores and manages application data and is isolated from direct public access.

This project focuses on:

- Creating cloud infrastructure manually (Virtual Network, Subnets, Virtual Machines)
- Implementing secure communication between tiers using Network Security Groups
 - Restricting direct access to the database layer
 - Verifying connectivity between tiers using internal network communication
- Following real-world cloud architecture best practices

By completing this project, hands-on experience is gained in cloud networking, virtual machine management, security configuration, and troubleshooting common deployment issues. This architecture reflects a real-time enterprise application setup commonly used in production environments.

What is 3-Tier Architecture?

3-Tier Architecture is a software design pattern where an application is divided into three separate layers (tiers). Each tier has a specific responsibility and is usually deployed independently to improve security, scalability, and maintainability.

1. Web Tier (Presentation Layer)

- This is the front-end layer
- It interacts directly with users through a browser
- Handles HTTP requests and responses
- Examples: Nginx, Apache, IIS

2. Application Tier (Business Logic Layer)

- This layer processes business logic
- Acts as an intermediary between the web tier and database tier
- Ensures that the web tier does not directly access the database
- Examples: Application servers, backend services

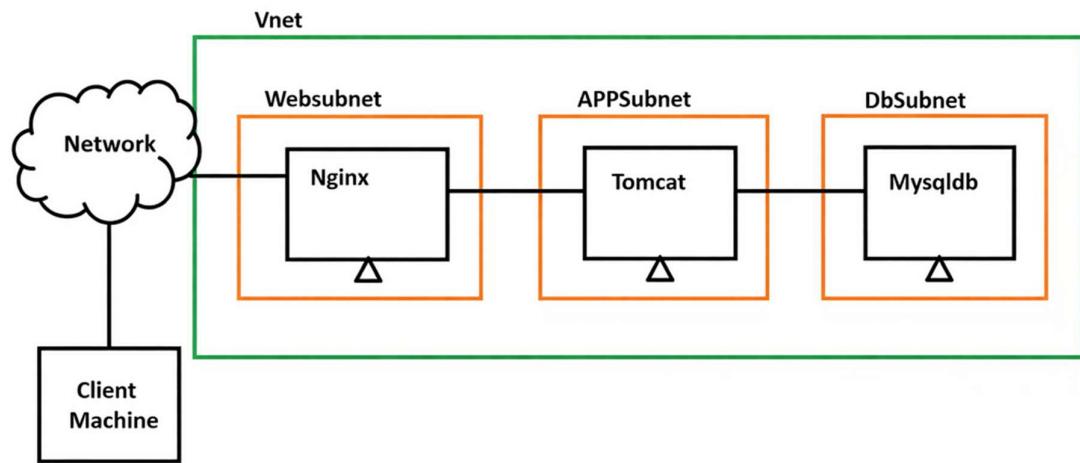
3. Database Tier (Data Layer)

- This layer stores and manages application data
- It is not exposed to the internet
- Only the application tier is allowed to communicate with it
- Examples: MySQL, PostgreSQL, Oracle

Why 3-Tier Architecture is Used?

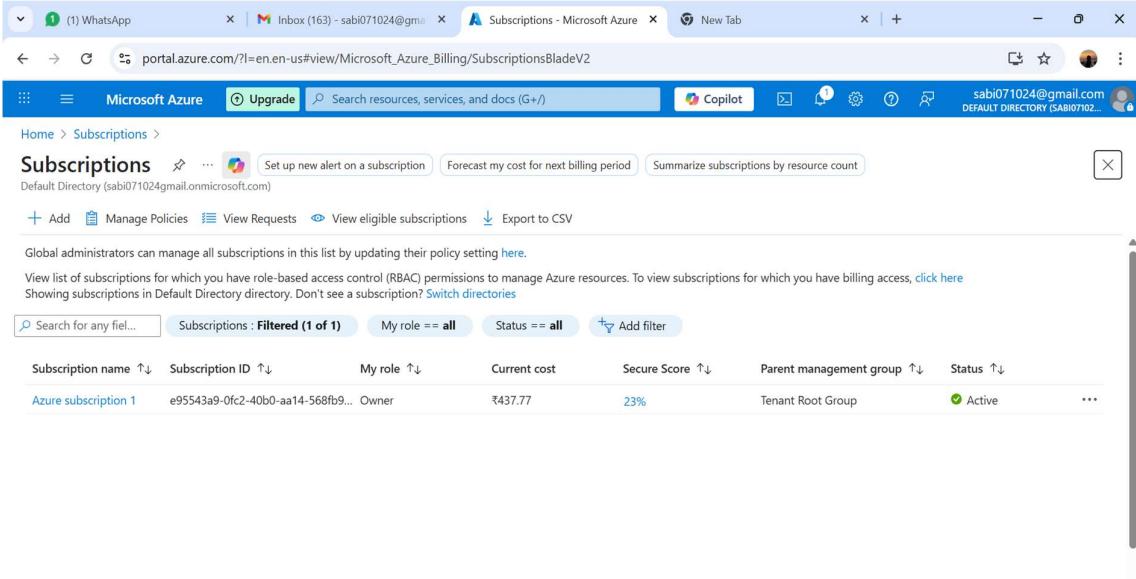
- Improved Security: Database is isolated from public access
- Scalability: Each tier can be scaled independently
- High Availability: Failure in one tier does not affect others directly
- Better Maintenance: Easier to manage and update components
- Real-World Usage: Commonly used in enterprise and cloud applications

This architecture is widely used in cloud environments and enterprise applications because it provides a clear separation of responsibilities and strong security control.



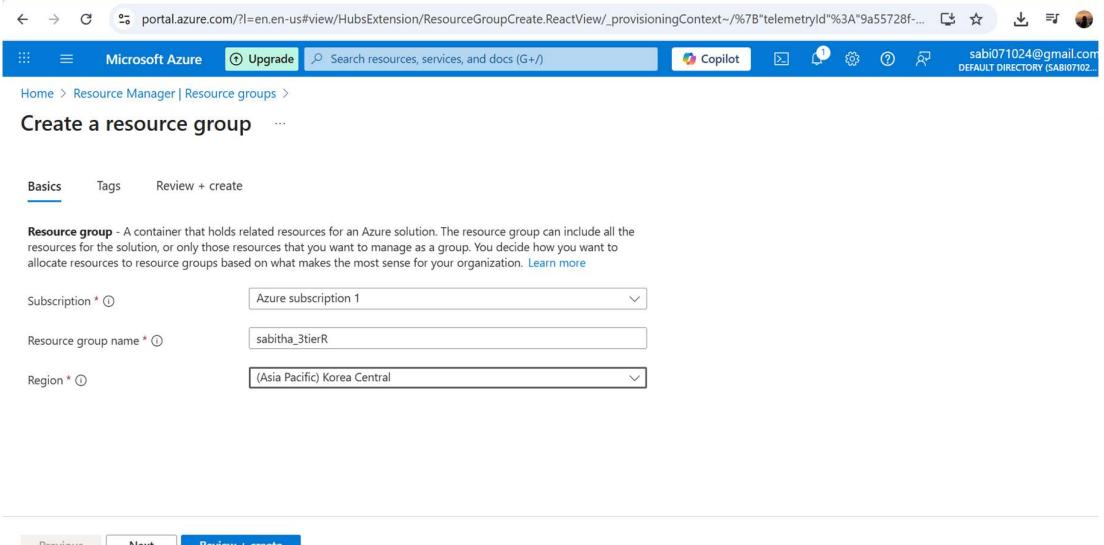
3-Tier Architecture Deployment – Step by Step

- Create Azure Cloud Account by using
<https://portal.azure.com>



The screenshot shows the Microsoft Azure Subscriptions blade. At the top, there are tabs for 'Home' and 'Subscriptions'. Below the tabs, there are buttons for '+ Add', 'Manage Policies', 'View Requests', 'View eligible subscriptions', and 'Export to CSV'. A search bar says 'Search for any field...'. A filter bar shows 'Subscriptions : Filtered (1 of 1)', 'My role == all', 'Status == all', and an 'Add filter' button. The main table lists one subscription: 'Azure subscription 1' with ID 'e95543a9-0fc2-40b0-aa14-568fb9...', owner 'Owner', current cost '\$437.77', secure score '23%', parent management group 'Tenant Root Group', and status 'Active'.

- Create Resource Group



The screenshot shows the 'Create a resource group' blade. At the top, there are tabs for 'Basics', 'Tags', and 'Review + create'. A description of a 'Resource group' is provided: '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.' Below the description, there are three input fields: 'Subscription *' with 'Azure subscription 1' selected, 'Resource group name *' with 'sabitha_3tierR' entered, and 'Region *' with '(Asia Pacific) Korea Central' selected. At the bottom, there are buttons for 'Previous', 'Next', and 'Review + create'.

Select a region of your choice and assign a name to your Resource Group (RG) and then click on **Review + Create**.

➤ Create VIRTUAL NETWORK

Search for a “Virtual Network” and click on create.

The screenshot shows the 'Create virtual network' wizard in the Microsoft Azure portal. The 'Basics' tab is selected. In the 'Subscription' section, 'Azure subscription 1' is chosen. In the 'Resource group' section, 'sabitha_3tierRG' is selected. Under 'Instance details', the 'Virtual network name' is set to 'sabitha-VNET' and the 'Region' is set to '(Asia Pacific) Korea Central'. At the bottom, there are 'Previous', 'Next', and 'Review + create' buttons, with 'Review + create' being the active button.

Select a Resource Group, where the VNet should be deployed and give a name to the Virtual Network and select a region and click next and move to IP Address section.

Note: The region of Resource Group and VNet can be different as it is not mandatory to be same, and it does not effect our architecture.

Also We should create another VNet in different region because, Azure Free trail doesn't provide **1vcpu** service (Total of 4vcpu's). And here we need three Servers so we use two different VNets in two different regions.

screenshot in windows laptop - Microsoft Azure

portal.azure.com/?l=en.en-us#@sabi071024gmail.onmicrosoft.com/resource/subscriptions/e95543a9-0fc2-40b0-aa14-568fb968f789/resourceGroups/sab... Copilot Search resources, services, and docs (G+) Copilot Search resources, services, and docs (G+) Copilot

Home > Network foundation | Virtual networks >

sabitha-VNET Virtual network

Search Overview Activity log Access control (IAM) Tags Diagnose and solve problems Resource visualizer Settings Address space Connected devices Subnets Bastion DDoS protection

Analyze connectivity for my Virtual Network Evaluate routing for this virtual network Suggest connectivity model for this network

Move Delete Refresh Give feedback

Essentials

Resource group (move)	sabitha_3tierRG
Location (move)	Korea Central
Subscription (move)	Azure subscription 1
Subscription ID	e95543a9-0fc2-40b0-aa14-568fb968f789
Address space	10.0.0.0/16
Subnets	2 subnets
DNS servers	Azure provided DNS service
BGP community string	Configure
Virtual network ID	0b65168a-ce04-4498-913c-005353852986
Tags (edit)	Add tags

Add or remove favorites by pressing Ctrl+L+Shift+F

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screenshot in windows laptop - Microsoft Azure

portal.azure.com/?l=en.en-us#@sabi071024gmail.onmicrosoft.com/resource/subscriptions/e95543a9-0fc2-40b0-aa14-568fb968f789/resourceGroups/sab... Copilot Search resources, services, and docs (G+) Copilot

Home > Network foundation | Virtual networks >

SabiVNET-DB Virtual network

Search Overview Activity log Access control (IAM) Tags Diagnose and solve problems Resource visualizer Settings Address space Connected devices Subnets Bastion DDoS protection

Analyze connectivity for my Virtual Network Diagnose issues with this virtual network Retrieve detailed routing information for troubleshooting

Move Delete Refresh Give feedback

Essentials

Resource group (move)	sabitha_3tierRG
Location (move)	North Europe
Subscription (move)	Azure subscription 1
Subscription ID	e95543a9-0fc2-40b0-aa14-568fb968f789
Address space	172.16.0.0/16
Subnets	1 subnet
DNS servers	Azure provided DNS service
BGP community string	Configure
Virtual network ID	b4529423-56cf-459b-b5a2-85330c5254c1
Tags (edit)	Add tags

Add or remove favorites by pressing Ctrl+L+Shift+F

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➤ Create Subnets for each Tier

The screenshot shows the Microsoft Azure portal interface. The left sidebar navigation includes Home, Network foundation, Virtual networks, and sabitha-VNET. Under sabitha-VNET, the Subnets option is selected. The main content area displays a table of subnets:

Name	IPv4	IPv6	Available IPs	Delegated to	Security group	Route table
sabiweb-su...	10.0.1.0/24	-	250	-	sabiweb-0...	-
sabiapp-su...	10.0.2.0/24	-	250	-	SABI-APPS...	-

The screenshot shows the Microsoft Azure portal interface. The left sidebar navigation includes Home, Network foundation, Virtual networks, and SabiVNET-DB. Under SabiVNET-DB, the Subnets option is selected. The main content area displays a table of subnets:

Name	IPv4	IPv6	Available IPs	Delegated to	Security group	Route table
SUBNETDB	172.16.1.0/24	-	250	-	SABI-DBSE...	-

➤ Create Virtual Machines/servers

Showing 1 - 3 of 3 results.

Name	Type	Status	Resource Group	Location	Source	Maintenance sta...	Subscription
SABI-APPSERVER	Virtual machine	Running	sabitha_3tierRG	Korea Central	Marketplace	-	Azure subscripti...
SABI-DBSERVER	Virtual machine	Running	sabitha_3tierRG	North Europe	Marketplace	-	Azure subscripti...
sabiweb-01	Virtual machine	Running	sabitha_3tierRG	Korea Central	Marketplace	-	Azure subscripti...

You are viewing a new version of Browse experience. Click here to access the old experience.

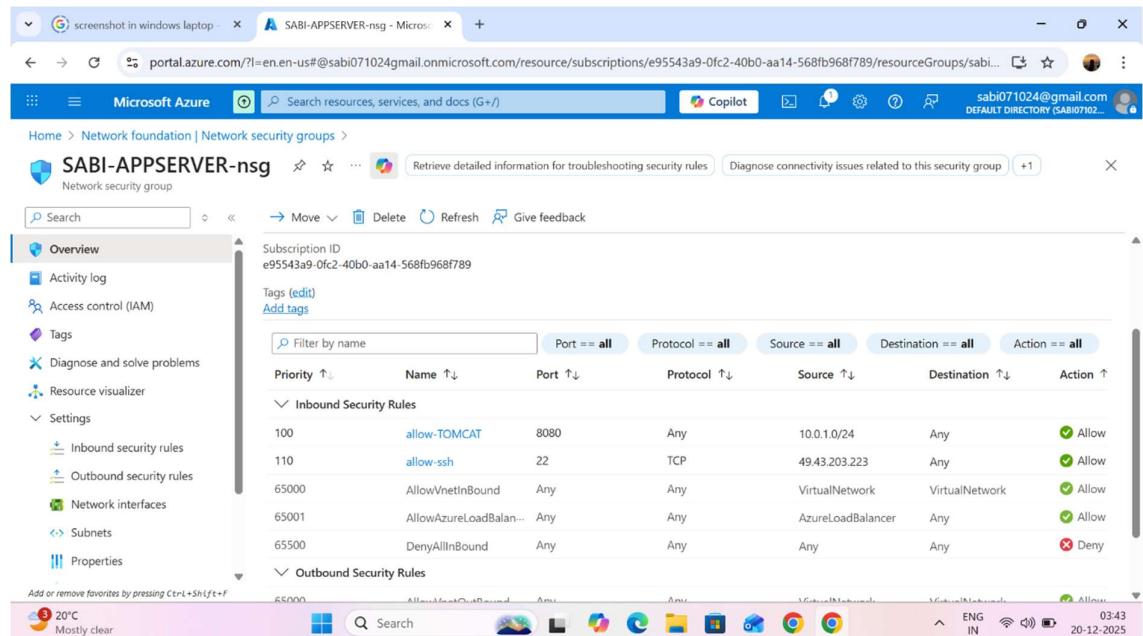
Resource Group	Location	Status	Operating syst...	Size	Public IP addre...	Private IP addr...	Update status
sabitha_3tierRG	Korea Central	Running	Linux	Standard_B2ts_v2	4.217.198.232	10.0.2.4	Enable periodic...
sabitha_3tierRG	North Europe	Running	Linux	Standard_B2ts_v2	20.238.77.132	172.16.1.4	Enable periodic...
sabitha_3tierRG	Korea Central	Running	Linux	Standard_B2ats...	4.217.238.202	10.0.1.4	Enable periodic...

➤ Configure Security Rules (NSGs):

- Set a rule so anyone can access the Web Server on Port 80.
- Set a rule so only the Web Server can talk to the App Server on Port 8080.
- Set a rule so only the App Server can talk to the DB Server on Port 3306.
- Security Restriction: Create a rule to Deny all traffic coming directly from the Web Server to the DB Server to ensure the database remains protected.

4. Verification:

- Log into the Web VM and use the telnet command to check if you can reach the App VM on Port 8080. It must say "Connected".
- Log into the App VM and telnet the DB VM on Port 3306. It must say "Connected".



screenshot in windows laptop - sabiweb-01-nsg - Microsoft Azure

portal.azure.com/?l=en.en-us#sabi071024@gmail.com.onmicrosoft.com/resource/subscriptions/e95543a9-0fc2-40b0-aa14-568fb968f789/resourceGroups/sabi... +

Microsoft Azure Search resources, services, and docs (G+/-) Copilot Settings Diagnose connectivity issues related to this security group +1 sabi071024@gmail.com DEFAULT DIRECTORY (SABI07102... X

Home > Network foundation | Network security groups >

sabiweb-01-nsg Network security group

Search Move Delete Refresh Give feedback

Tags (edit) Add tags

Filter by name Port == all Protocol == all Source == all Destination == all Action == all

Priority ↑ Name ↑ Port ↑ Protocol ↑ Source ↑ Destination ↑ Action ↑

Inbound Security Rules

Priority	Name	Port	Protocol	Source	Destination	Action
300	HTTP	80	TCP	Any	Any	Allow
310	SSH	22	Any	Any	Any	Allow
65000	AllowVnetInBound	Any	Any	VirtualNetwork	VirtualNetwork	Allow
65001	AllowAzureLoadBalanc...	Any	Any	AzureLoadBalancer	Any	Allow
65500	DenyAllInBound	Any	Any	Any	Any	Deny

Outbound Security Rules

Priority	Name	Port	Protocol	Source	Destination	Action
65000	AllowVnetOutBound	Any	Any	VirtualNetwork	VirtualNetwork	Allow
65001	AllowInternetOutBound	Any	Any	Any	Internet	Allow

Add or remove favorites by pressing Ctrl+Shift+F

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screenshot in windows laptop - SABI-DBSERVER-nsg - Microsoft Azure

portal.azure.com/?l=en.en-us#sabi071024@gmail.com.onmicrosoft.com/resource/subscriptions/e95543a9-0fc2-40b0-aa14-568fb968f789/resourceGroups/sabi... +

Microsoft Azure Search resources, services, and docs (G+/-) Copilot Settings Diagnose connectivity issues related to this security group +1 sabi071024@gmail.com DEFAULT DIRECTORY (SABI07102... X

Home > Network foundation | Network security groups >

SABI-DBSERVER-nsg Network security group

Search Move Delete Refresh Give feedback

Analyze security rules for this network security group Diagnose connectivity issues related to this security group +1

Tags (edit) Add tags

Filter by name Port == all Protocol == all Source == all Destination == all Action == all

Priority ↑ Name ↑ Port ↑ Protocol ↑ Source ↑ Destination ↑ Action ↑

Inbound Security Rules

Priority	Name	Port	Protocol	Source	Destination	Action
110	ALLOW-MYSQL	3306	Any	10.0.2.4	172.16.1.4	Allow
118	DENY-WEB-TO-DB	Any	Any	10.1.1.4	172.16.1.4	Deny
65000	AllowVnetInBound	Any	Any	VirtualNetwork	VirtualNetwork	Allow
65001	AllowAzureLoadBalanc...	Any	Any	AzureLoadBalancer	Any	Allow
65500	DenyAllInBound	Any	Any	Any	Any	Deny

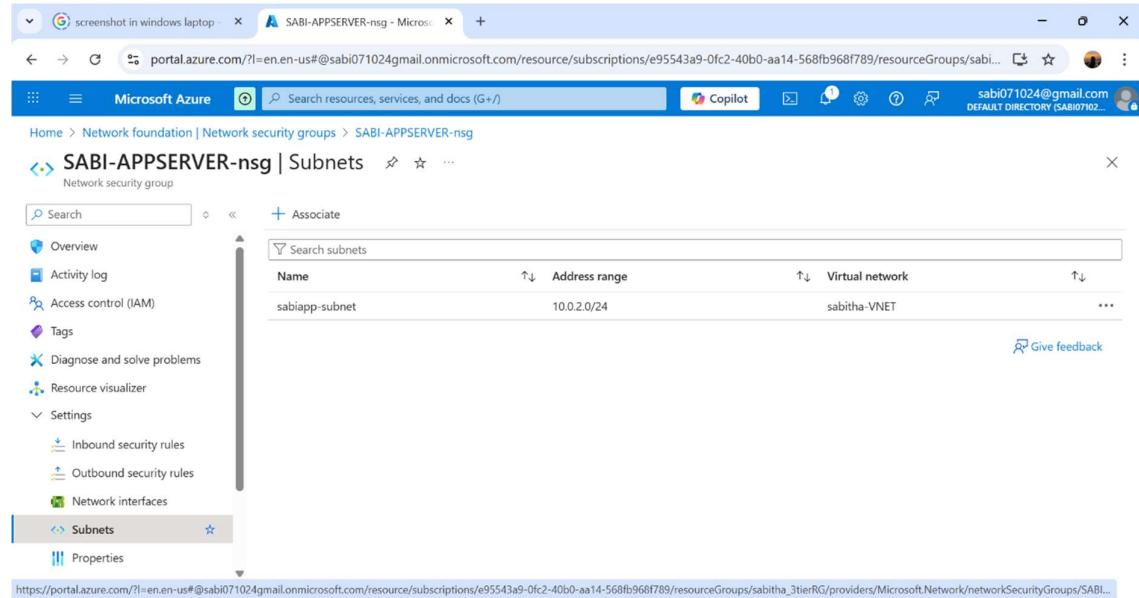
Outbound Security Rules

Priority	Name	Port	Protocol	Source	Destination	Action
65000	AllowVnetOutBound	Any	Any	VirtualNetwork	VirtualNetwork	Allow
65001	AllowInternetOutBound	Any	Any	Any	Internet	Allow
65500	DenyAllOutBound	Any	Any	Any	Any	Deny

Add or remove favorites by pressing Ctrl+Shift+F

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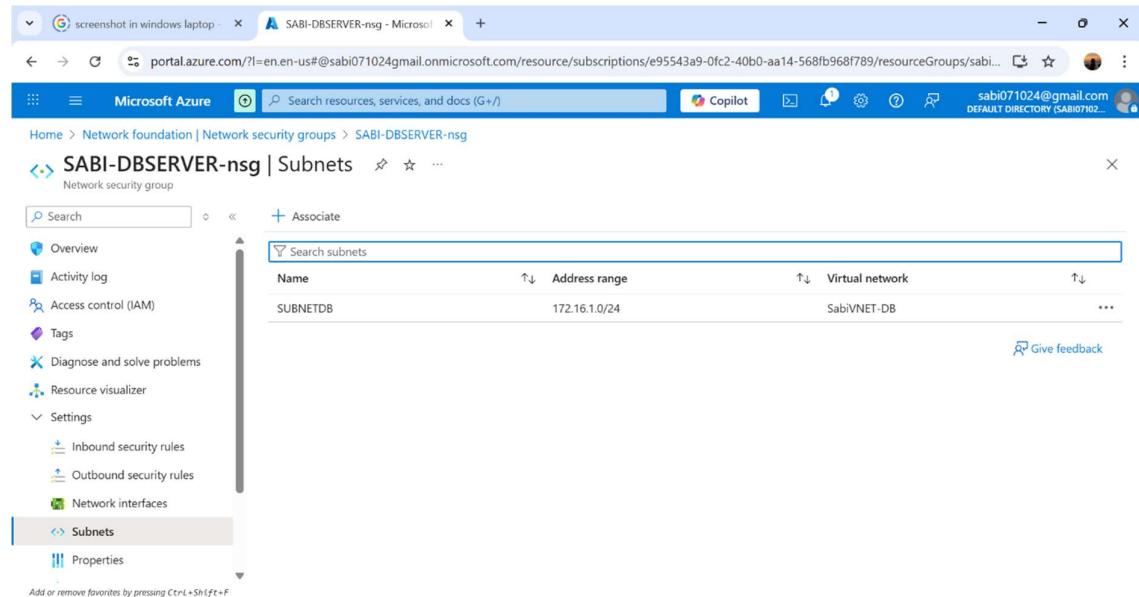
➤ We must associate NSG to respective subnets.



The screenshot shows the Microsoft Azure portal interface. The top navigation bar includes the Microsoft logo, a search bar, and various icons. The main title is "SABI-APPSERVER-nsg | Subnets". On the left, a sidebar menu lists "Overview", "Activity log", "Access control (IAM)", "Tags", "Diagnose and solve problems", "Resource visualizer", "Settings" (with "Inbound security rules" and "Outbound security rules" listed), "Network interfaces", and "Subnets" (which is selected and highlighted in blue). Below the sidebar is a search bar with the placeholder "Search subnets". A table displays the association between subnets and virtual networks:

Name	Address range	Virtual network
sabiapp-subnet	10.0.2.0/24	sabitha-VNET

At the bottom right of the table, there is a "Give feedback" link.



This screenshot shows the Microsoft Azure portal interface, similar to the one above. The title is "SABI-DBSERVER-nsg | Subnets". The left sidebar menu is identical, showing "Subnets" as the selected item. The search bar at the top has the placeholder "Search subnets". A table displays the association between subnets and virtual networks:

Name	Address range	Virtual network
SUBNETDB	172.16.1.0/24	SabiVNET-DB

At the bottom right of the table, there is a "Give feedback" link.

The screenshot shows the Microsoft Azure portal interface. The URL in the address bar is <https://portal.azure.com/?l=en.en-us#sabio71024@gmail.onmicrosoft.com/resource/subscriptions/e95543a9-0fc2-40b0-aa14-568fb968f789/resourceGroups/sabi...>. The user's email is sabi071024@gmail.com and the default directory is SABIO71024. The page title is "sabiweb-01-nsg - Microsoft Azure". The left sidebar shows the navigation path: Home > Network foundation | Network security groups > sabiweb-01-nsg. The main content area is titled "sabiweb-01-nsg | Subnets" and shows a table with one row:

Name	Address range	Virtual network
sabiweb-subnet	10.0.1.0/24	sabitha-VNET

A "Give feedback" link is located at the bottom right of the table.

➤ Install the Software:

- Web VM: Install Nginx.
- App VM: Install Tomcat (Search Google or ChatGPT for installation steps).
- DB VM: Install MySQL DB (Search Google or ChatGPT for installation steps).

Here we will face an issue of Network connection failure, because our WEB VM and APP VM Is in one Region and DB VM is in another Region. They are in two different Vnets too.. So here we use Vnet Peering concept.

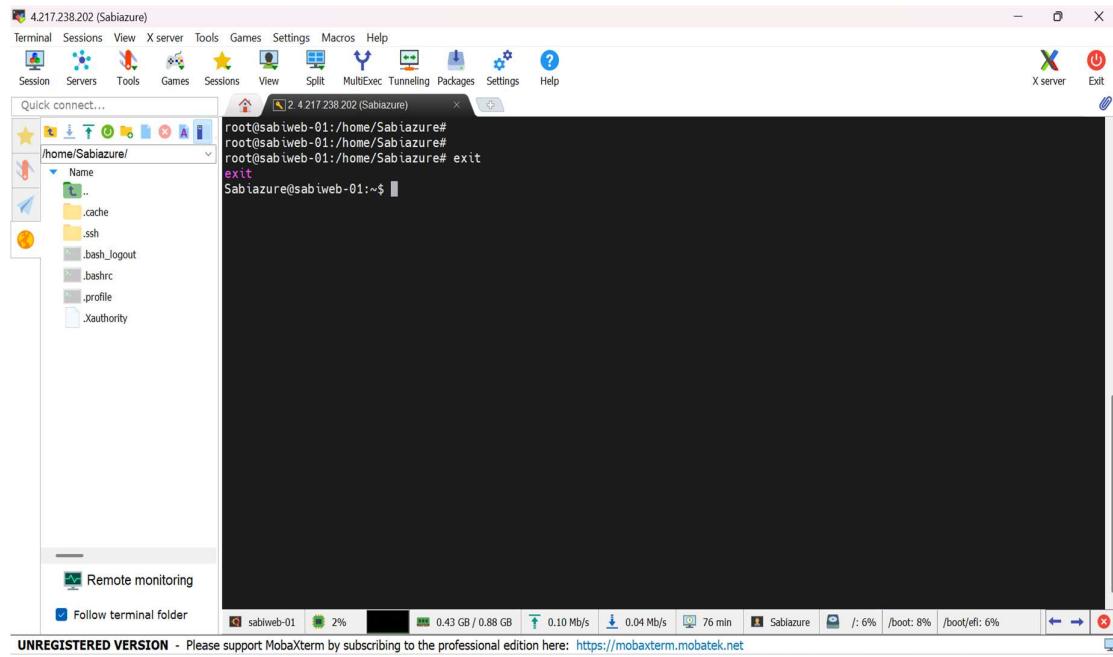
The Purpose of VNET PEERING is to build communication possible between two different Vnets with in same region,with in different region and different Subscriptions as well.

Name	Peering sync status	Peer IP	Remote IP	Virtual network	Cross-tenant
peer-app-to-db	Fully Synchronized	Connected	sabitha...	Disabled	No

Here I made peering between APPVnet TO DBVnet.

➤ Now its Time for Verifying our Machines with given Nsg rules.

- Firstly Login into Webserver and Install Nginx by writing below commands. Here I used MOBAXTERM Tool to connect to my remote machines.
 1. Open MOBAXTERM – SESSIONS-NEW-Copy the publicIP of webserver VM and paste in the Remote host – specify username-ok-password.
Your server will be opened like this



2. Now Install Nginx

- Update system packages

```
sudo apt update
```

- Install Nginx

```
sudo apt install nginx -y
```

- Start nginx service

```
sudo systemctl start nginx
```

- Enable nginx to start on boot

```
sudo systemctl enable nginx
```

- Check nginx status

```
sudo systemctl status nginx
```

- Verify nginx is running ..open browser and access.

<http://<webvm publicip>>

we should see welcome to nginx page

The screenshot shows a MobaXterm window titled "4.217.238.202 (Sabiazure)". The terminal session displays the following output:

```
Scanning processes...
Scanning linux images...
Running kernel seems to be up-to-date.
No services need to be restarted.
No containers need to be restarted.
No user sessions are running outdated binaries.

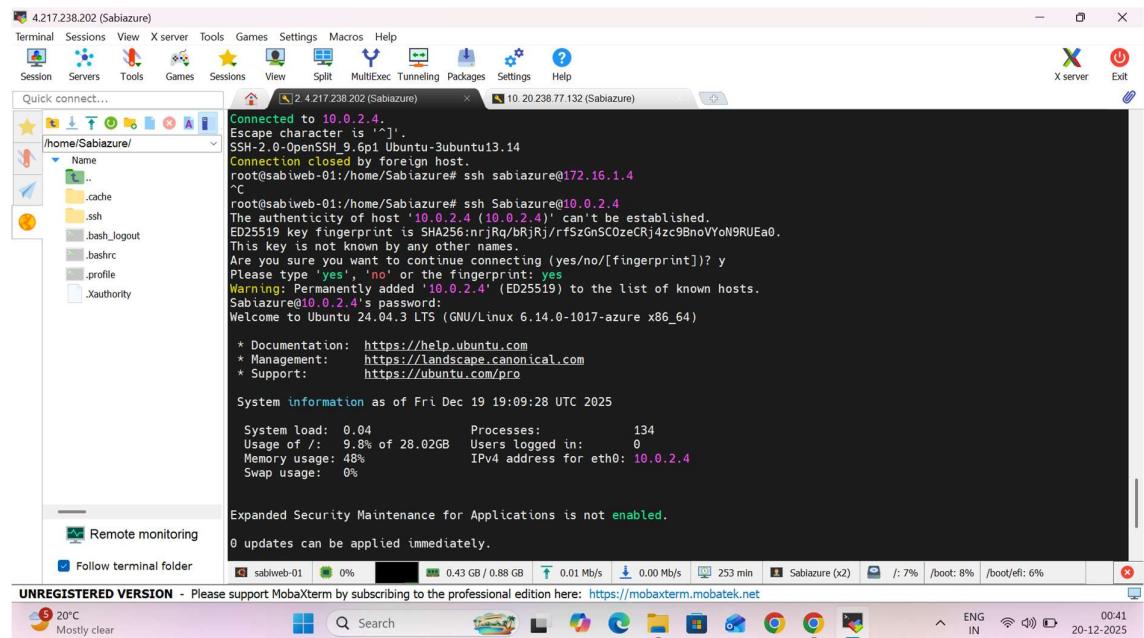
No VM guests are running outdated hypervisor (qemu) binaries on this host.
root@sabiweb-01:/home/Sabiazure# systemctl status nginx
● nginx.service - A high performance web server and a reverse proxy server
  Loaded: loaded (/usr/lib/systemd/system/nginx.service; enabled; preset: enabled)
  Active: active (running) since Fri 2025-12-19 16:16:30 UTC; 26s ago
    Docs: man:nginx(8)
   Process: 3792 ExecStartPre=/usr/sbin/nginx -t -q -g daemon on; master_process on; (code=exited, status=0/SUCCESS)
   Process: 3799 ExecStart=/usr/sbin/nginx -g daemon on; master_process on; (code=exited, status=0/SUCCESS)
 Main PID: 3829 (nginx)
   Tasks: 3 (limit: 1050)
  Memory: 2.4M (peak: 5.3M)
     CPU: 22ms
    CGroup: /system.slice/nginx.service
            └─3829 "nginx: master process /usr/sbin/nginx -g daemon on; master_process on;"

Dec 19 16:16:30 sabiweb-01 systemd[1]: Starting nginx.service - A high performance web server and a reverse proxy server...
Dec 19 16:16:30 sabiweb-01 systemd[1]: Started nginx.service - A high performance web server and a reverse proxy server.
root@sabiweb-01:/home/Sabiazure#
```

At the bottom of the terminal window, there is a status bar with the text "UNREGISTERED VERSION - Please support MobaXterm by subscribing to the professional edition here: <https://mobaxterm.mobatek.net>".



- Now from the webserver VM we can move to appserver VM by using ssh command
Ssh username@privateipof appserver VM
It asks for password ,enter it ..app server VM will open like this



For installing Tomcat in App server VM .Follow below steps..

STEP 1: Install Java
sudo apt update
sudo apt install openjdk-17-jdk -y
check java -version

STEP 2: Install Tomcat 10
sudo apt install tomcat10 -y

STEP 3: Check Tomcat status

sudo systemctl status tomcat10

STEP 4: Check port 8080

```
ss -tulnp | grep 8080
```

STEP 5 :Telnet Verification (do in webserver VM)

telnet <APP_VM_PRIVATE_IP> 8080

The screenshot shows a MobaXterm window with multiple sessions open. Session 2 (4.217.238.202) is active and displays the following output:

```
No services need to be restarted.  
No containers need to be restarted.  
No user sessions are running outdated binaries.  
No VM guests are running outdated hypervisor (gemu) binaries on this host.  
root@sabweb-01:~/home/Sabiazure# systemctl status nginx  
● nginx.service - A high performance web server and a reverse proxy server  
   Loaded: loaded (/usr/lib/systemd/system/nginx.service; enabled; preset: enabled)  
   Active: active (running) since Fri 2025-12-19 16:10:30 UTC; 26s ago  
     Docs: man:nginx(8)  
    Process: 3792 ExecStartPre=/usr/sbin/nginx -t -q -g daemon on; master_process on; (code=exited, status=0/SUCCESS)  
   Process: 3799 ExecStart=/usr/sbin/nginx -g daemon on; master_process on; (code=exited, status=0/SUCCESS)  
 Main PID: 3829 (nginx)  
    Tasks: 3 (limit: 1050)  
   Memory: 2.4M (peak: 5.3M)  
    CPU: 22ms  
   CGroup: /system.slice/nginx.service  
           ├─3829 nginx: master process /usr/sbin/nginx -g daemon on; master_process on;"  
           ├─3831 nginx: worker process"  
           ├─3832 nginx: worker process"  
           └─3832 nginx: worker process"  
  
Dec 19 16:16:30 sabiweb-01 systemd[1]: Starting nginx.service - A high performance web server and a reverse proxy server...  
Dec 19 16:16:30 sabiweb-01 systemd[1]: Started nginx.service - A high performance web server and a reverse proxy server.  
root@sabweb-01:~/home/Sabiazure# telnet 10.0.2.4 8080  
Trying 10.0.2.4...  
Connected to 10.0.2.4.  
Escape character is '^]'.
```

The terminal also shows a 'Remote monitoring' icon and a 'Follow terminal folder' checkbox at the bottom. The status bar at the bottom right indicates network usage (0.42 GB / 88.88 GB), download speed (0.09 Mb/s), upload speed (0.03 Mb/s), and disk usage (Sabiazure (x2): 167 min, /boot: 8%, /boot/efi: 6%).

SABIAZURE Help

Icons View Split MultiExec Tunneling Packages Settings Help

2.4.217.238.202 (Sabiazure) 5.4.217.198.232 (Sabiazure) 6.4.217.198.232 (Sabiazure) 7.4.217.198.232 (Sabiazure)

```
Building dependency tree... Done
Reading state information... Done
The following NEW packages will be installed:
  net-tools
0 upgraded, 1 newly installed, 0 to remove and 0 not upgraded.
Need to get 204 kB of archives.
After this operation, 811 kB of additional disk space will be used.
Get:1 http://azure.archive.ubuntu.com/ubuntu noble-updates/main amd64 net-tools amd64 2.10-0.1ubuntu4.4 [204 kB]
Fetched 204 kB in 0s (11.3 MB/s)
Selecting previously unselected package net-tools.
(Reading database ... 84919 files and directories currently installed.)
Preparing to unpack .../net-tools_2.10-0.1ubuntu4.4_amd64.deb ...
Unpacking net-tools (2.10-0.1ubuntu4.4) ...
Setting up net-tools (2.10-0.1ubuntu4.4) ...
Processing triggers for man-db (2.12.0-4build2) ...
Scanning processes...
Scanning linux images...

Running kernel seems to be up-to-date.

No services need to be restarted.

No containers need to be restarted.

No user sessions are running outdated binaries.

No VM guests are running outdated hypervisor (qemu) binaries on this host.
root@SABI-APPSERVER:/home/Sabiazure# netstat -tulnp | grep 8080
tcp6      0      0 :::8080          ;;;*                  LISTEN      13108/java
root@SABI-APPSERVER:/home/Sabiazure# systemctl start tomcat10
root@SABI-APPSERVER:/home/Sabiazure#
```

SABI-APPSERVER 0% 0.50 GB / 0.87 GB 0.01 Mb/s 0.00 Mb/s 31 min Sabiazure (x2) /: 10% /boot: 8% /boot/efi: 6%

We support MobaXterm by subscribing to the professional edition here: <https://mobaxterm.mobatek.net>

Search ENG IN 19

- Now we have to move to DB server VM from APP VM By using SSH command
- MYSQL Installation should be done inside DB VM by following these steps
 1. Update system
sudo apt update
 2. Install MySQL Server
sudo apt install mysql-server -y
 3. Check MySQL service status
sudo systemctl status mysql
 4. Allow MySQL to listen on private IP
sudo nano /etc/mysql/mysql.conf.d/mysqld.cnf
Find code : bind-address = 127.0.0.1
Change to : bind-address = 0.0.0.0

Save:

- CTRL + O
- Enter
- CTRL + X

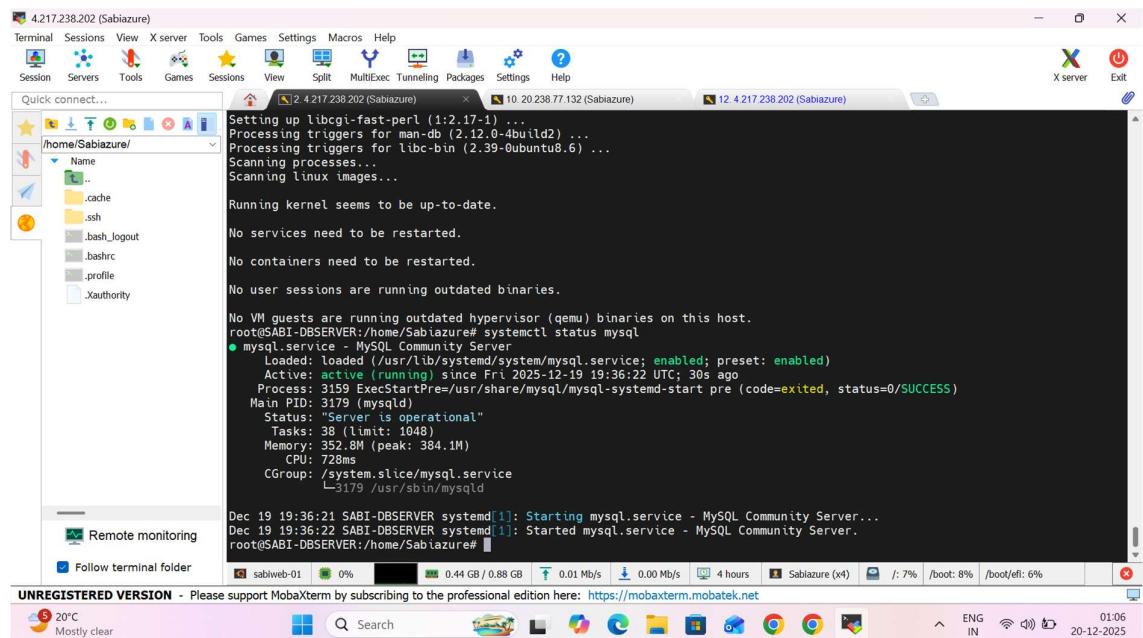
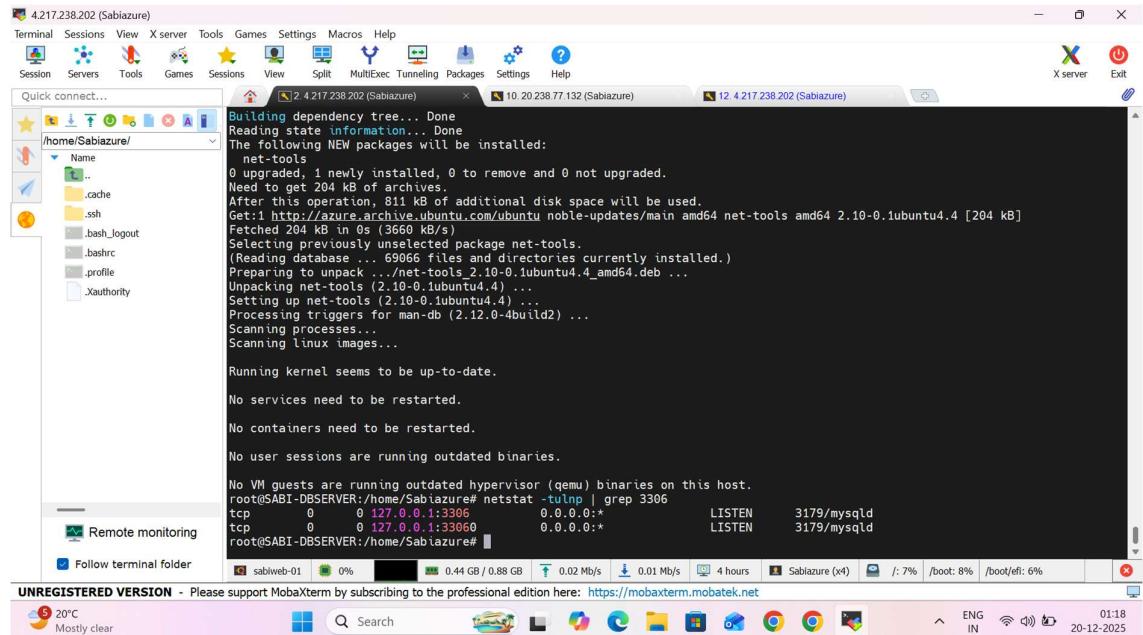
Restart MySQL:sudo systemctl restart mysql

5. MySQL port 3306 listening or not check
sudo netstat -tulnp | grep 3306
Expected output: tcp 0 0 0.0.0.0:3306 LISTEN
mysqld

6. Test from APP VM (IMPORTANT)
Login into APP VM (not Web, not DB)
telnet <DB_PRIVATE_IP> 3306.

Here I faced issue as it is 127.0.0.1 because we know that this IP address is reserved for loopback.

We have to change it to 0.0.0.0



```
4.217.238.202 (Sabiazure)
Terminal Sessions View X server Tools Games Settings Macros Help
Session Servers Tools Games Sessions View Split MultiExec Tunneling Packages Settings Help
X server Exit
Quick connect...
/home/Sabiazure/
Name .. cache .ssh bash_logout bashrc profile .xauthority
Last login: Fri Dec 19 18:07:29 2025 from 49.43.203.223
Sabiazure@SABI-APPSERVER:~$ sudo su
root@SABI-APPSERVER:/home/Sabiazure# ssh Sabiazure@172.16.1.4
^q
exit
ssh: connect to host 172.16.1.4 port 22: Connection timed out
root@SABI-APPSERVER:/home/Sabiazure#
root@SABI-APPSERVER:/home/Sabiazure#
root@SABI-APPSERVER:/home/Sabiazure# exit
exit
Sabiazure@SABI-APPSERVER:~$ sudo su
root@SABI-APPSERVER:/home/Sabiazure# telnet 172.16.1.4 22
Trying 172.16.1.4...
telnet: Unable to connect to remote host: Connection timed out
root@SABI-APPSERVER:/home/Sabiazure#
root@SABI-APPSERVER:/home/Sabiazure# telnet ^C
root@SABI-APPSERVER:/home/Sabiazure# telnet 172.16.1.4 3306
Trying 172.16.1.4...
telnet: Unable to connect to remote host: Connection timed out
root@SABI-APPSERVER:/home/Sabiazure# ssh Sabiazure@172.16.1.4
The authenticity of host '172.16.1.4 (172.16.1.4)' can't be established.
ED25519 key fingerprint is SHA256:33oEkvv+6IHkm80xNLzeeQ9UIZ8mg1hMeXQJrZ5mWw.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '172.16.1.4' (ED25519) to the list of known hosts.
Sabiazure@172.16.1.4's password: 
Remote monitoring
Follow terminal folder
sabiweb-01 0% 0.45 GB / 0.88 GB 0.01 Mb/s 0.00 Mb/s 4 hours Sabiazure (x4) /: 7% /boot: 8% /boot/efi: 6%
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4.217.238.202 (Sabiazure)
Terminal Sessions View X server Tools Games Settings Macros Help
Session Servers Tools Games Sessions View Split MultiExec Tunneling Packages Settings Help
X server Exit
Quick connect...
/home/Sabiazure/
Name .. cache .ssh bash_history bash_logout bashrc profile .sudo_as_admin_successful .xauthority
Executing: /usr/lib/systemd/systemd-sysv-install enable mysql
Created symlink /etc/systemd/system/multi-user.target.wants/mysql.service → /usr/lib/systemd/system/mysql.service.
Sabiazure@SABI-DBSERVER:~$ sudo systemctl start mysql
Sabiazure@SABI-DBSERVER:~$ sudo ss -tulpn | grep 3306
tcp LISTEN 0 151 127.0.0.1:3306 0.0.0.0:* users:(("mysqld",pid=5322,fd=23))
tcp LISTEN 0 70 127.0.0.1:33060 0.0.0.0:* users:(("mysqld",pid=5322,fd=21))
Sabiazure@SABI-DBSERVER:~$ sudo grep -R "bind-address" /etc/mysql
/etc/mysql/mysql.conf.d/mysqld.cnf:bind-address = 0.0.0.0
/etc/mysql/mysql.conf.d/mysqld.cnf:bind-address = 127.0.0.1
/etc/mysql/mysql.conf.d/mysqld.cnf:mysql-bind-address = 127.0.0.1
Sabiazure@SABI-DBSERVER:~$ sudo nano /etc/mysql/my.cnf
Sabiazure@SABI-DBSERVER:~$ sudo systemctl restart mysql
Sabiazure@SABI-DBSERVER:~$ sudo ss -tulpn | grep 3306
tcp LISTEN 0 151 0.0.0.0:3306 0.0.0.0:* users:(("mysqld",pid=5402,fd=23))
tcp LISTEN 0 70 127.0.0.1:33060 0.0.0.0:* users:(("mysqld",pid=5402,fd=21))
Sabiazure@SABI-DBSERVER:~$ sudo ufw allow 3306
Rules updated
Rules updated (v6)
Sabiazure@SABI-DBSERVER:~$ sudo ufw reload
Firewall not enabled (skipping reload)
Sabiazure@SABI-DBSERVER:~$ sudo ufw status
Status: inactive
Sabiazure@SABI-DBSERVER:~$ exit
logout
Connection to 172.16.1.4 closed.
Sabiazure@SABI-APPSERVER:~$ telnet 172.16.1.4 3306
Trying 172.16.1.4...
Connected to 172.16.1.4.
Escape character is '^['.
Ahost '10.0.2.4' is not allowed to connect to this MySQL serverConnection closed by foreign host.
Sabiazure@SABI-APPSERVER:~$ 
sabiweb-01 0% 0.45 GB / 0.88 GB 0.02 Mb/s 0.00 Mb/s 6 hours Sabiazure (x4) /: 7% /boot: 8% /boot/efi: 6%
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Sabiazure@SABI-DBSERVER:~$ sudo systemctl disable mysql
Synchronizing state of mysql.service with SysV service script with /usr/lib/systemd/systemd-sysv-install.
Executing: /usr/lib/systemd/systemd-sysv-install disable mysql
Removed "/etc/systemd/system/multi-user.target.wants/mysql.service".
Sabiazure@SABI-DBSERVER:~$ systemctl is-enabled mysql
disabled
Sabiazure@SABI-DBSERVER:~$ sudo pkill -9 mysqld
Sabiazure@SABI-DBSERVER:~$ sudo pkill -9 mysql
Sabiazure@SABI-DBSERVER:~$ ps -ef | grep mysql
Sabiazu+ 5056 3905 0 21:17 pts/2 00:00:00 grep --color=auto mysql
Sabiazure@SABI-DBSERVER:~$ sudo nano /etc/mysql/mysql.conf.d/mysqld.cnf
Sabiazure@SABI-DBSERVER:~$ sudo systemctl daemon-reexec
Sabiazure@SABI-DBSERVER:~$ sudo systemctl daemon-reload
Synchronizing state of mysql.service with SysV service script with /usr/lib/systemd/systemd-sysv-install.
Executing: /usr/lib/systemd/systemd-sysv-install enable mysql
Created symlink /etc/systemd/system/multi-user.target.wants/mysql.service → /usr/lib/systemd/system/mysql.service.
Sabiazure@SABI-DBSERVER:~$ sudo systemctl start mysql
Sabiazure@SABI-DBSERVER:~$ sudo ss -tulnp | grep 3306
tcp LISTEN 0 151 127.0.0.1:3306 0.0.0.0:* users:(("mysqld",pid=5322,fd=23))
tcp LISTEN 0 70 127.0.0.1:33060 0.0.0.0:* users:(("mysqld",pid=5322,fd=21))
Sabiazure@SABI-DBSERVER:~$ sudo grep -R "bind-address" /etc/mysql
/etc/mysql/mysql.conf.d/mysqld.cnf:bind-address = 0.0.0
/etc/mysql/mysql.conf.d/mysqld.cnf:bind-address = 127.0.0.1
/etc/mysql/mysql.conf.d/mysqld.cnf:mysqld-bind-address I= 127.0.0.1
Sabiazure@SABI-DBSERVER:~$ sudo nano /etc/mysql/my.cnf
Sabiazure@SABI-DBSERVER:~$ sudo systemctl restart mysql
Sabiazure@SABI-DBSERVER:~$ sudo ss -tulnp | grep 3306
tcp LISTEN 0 151 0.0.0.0:3306 0.0.0.0:* users:(("mysqld",pid=5402,fd=23))
tcp LISTEN 0 70 127.0.0.1:33060 0.0.0.0:* users:(("mysqld",pid=5402,fd=21))
Sabiazure@SABI-DBSERVER:~$
```

sabiweb-01 1% 0.45 GB / 0.88 GB 0.10 Mb/s 0.04 Mb/s 6 hours Sabiazure (x4) /: 7% /boot: 8% /boot/efi: 6%

CONCLUSION

In this project, a Three-Tier Architecture was successfully designed and implemented on a cloud platform using separate virtual machines for the Web, Application, and Database tiers. Each tier was deployed in its own network segment to ensure proper isolation and secure communication.

The project demonstrated how layered architecture improves security, scalability, and maintainability by preventing direct access to the database and enforcing controlled communication between tiers using network security rules. Real-world challenges such as service configuration, connectivity issues, and access restrictions were identified and resolved through systematic troubleshooting.

By completing this project, hands-on experience was gained in cloud infrastructure setup, virtual networking, security configuration, Linux server management, and database connectivity. This implementation reflects a real-time enterprise architecture model commonly used in production environments.

Overall, the project strengthened practical understanding of cloud-based application deployment and highlighted the importance of proper architectural design in building secure and reliable systems.