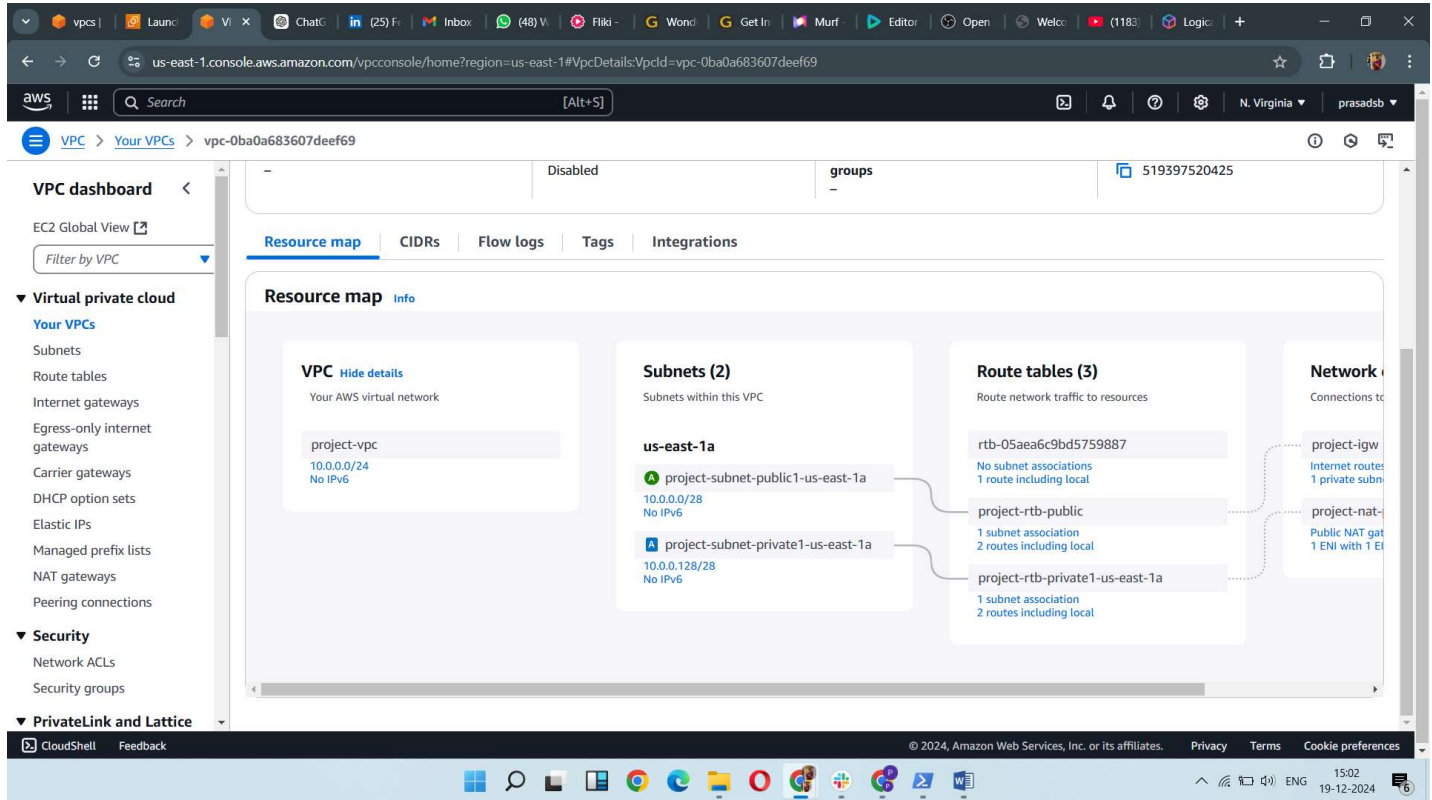


Basic Networking Topology Implementation

Design and implement a basic networking topology:

- Set up two VMs with private IPs.
- Configure one VM as a web server and the other as a client.
- Use SSH to securely transfer files between them.

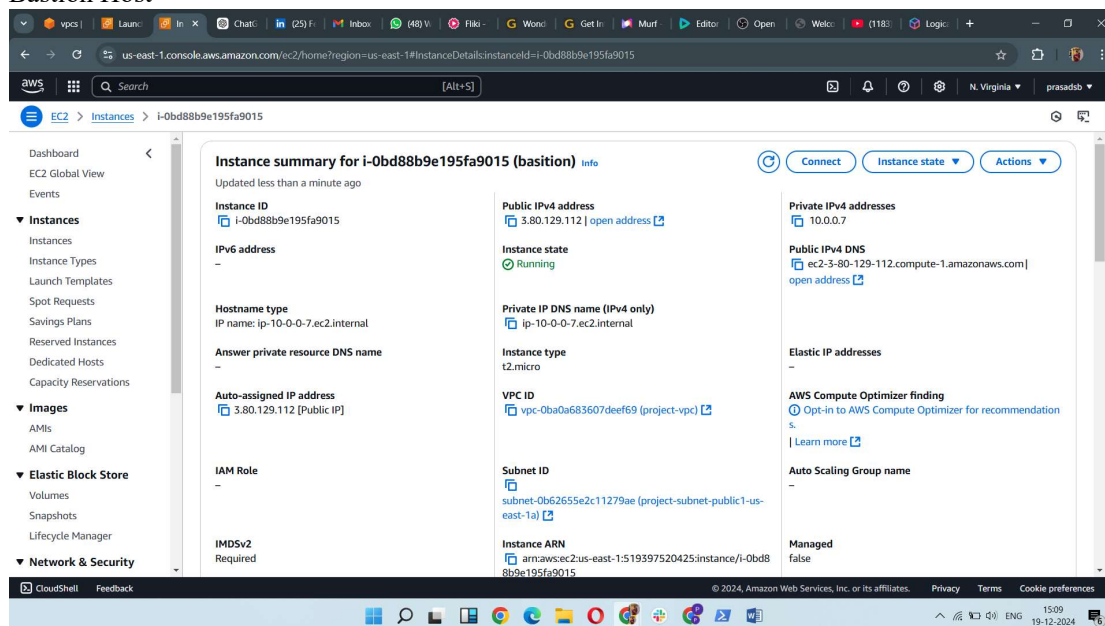
I created the Virtual private cloud (VPC) with 1 public subnet and 1 private subnet to ensure network isolation and secure communication between the instances.



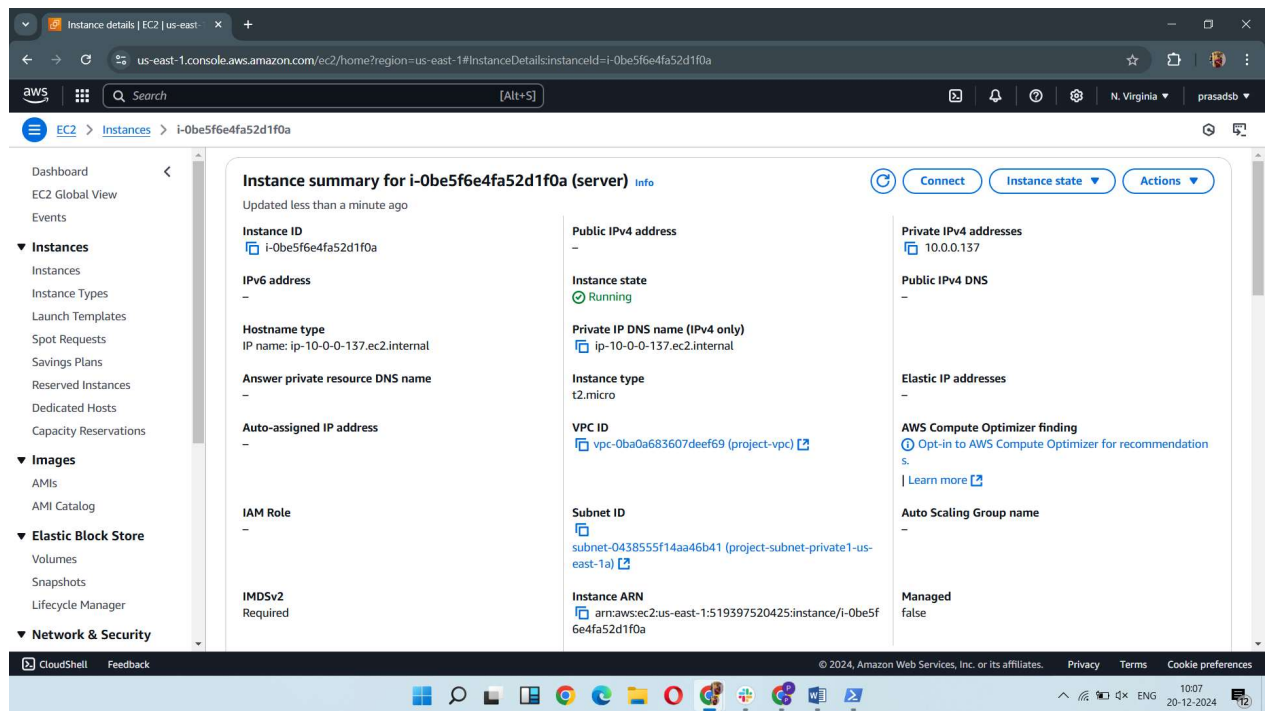
Three EC2 instances were created:

- **Bastion Host (Public IP):** An EC2 instance created in the public subnet, with a public IP for access.
- **Web Server (Private IP):** An EC2 instance created in the private subnet, configured as a web server.
- **Client (Private IP):** Another EC2 instance created in the private subnet, configured as the client.

- Bastion Host



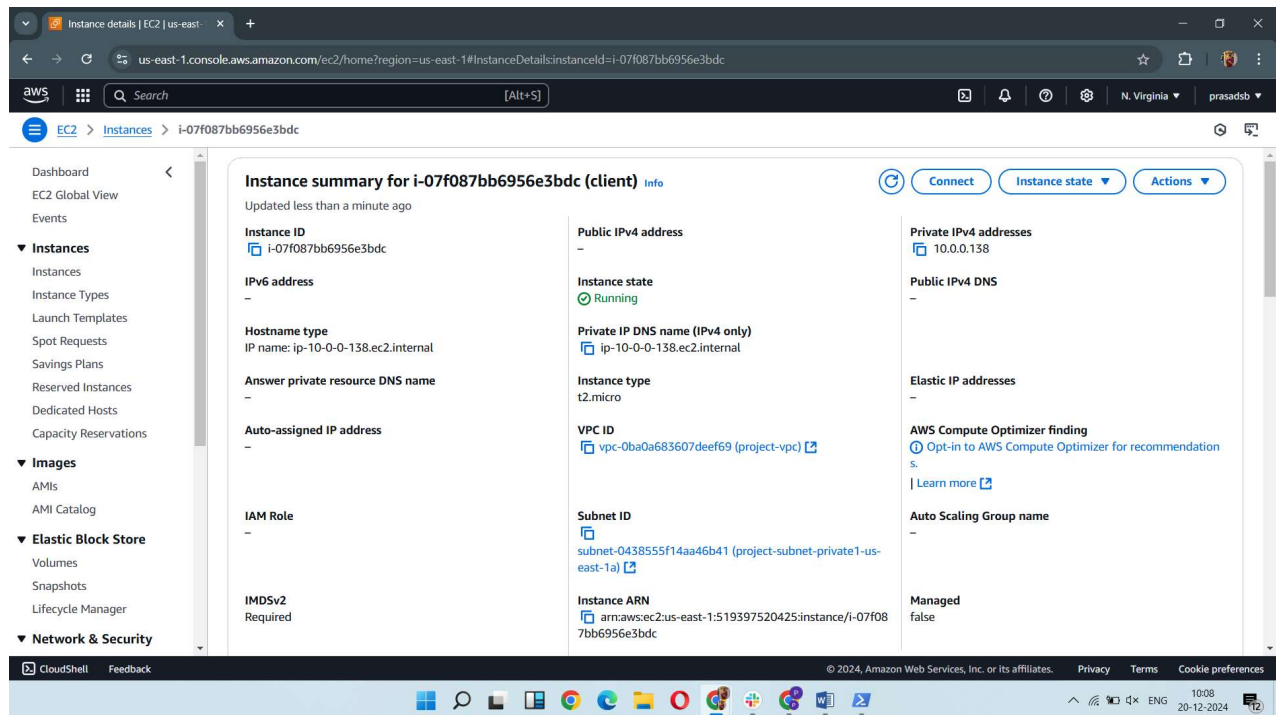
- Web server



The screenshot displays the AWS Management Console interface for an EC2 instance. The browser address bar shows the URL: `us-east-1.console.aws.amazon.com/ec2/home?region=us-east-1#InstanceDetails:instanceId=i-0be5f6e4fa52d1f0a`. The console header includes the AWS logo, a search bar, and navigation links for EC2, Instances, and the specific instance ID `i-0be5f6e4fa52d1f0a`. The left-hand navigation pane lists various AWS services, with 'Instances' and 'Network & Security' expanded. The main content area, titled 'Instance summary for i-0be5f6e4fa52d1f0a (server)', provides a comprehensive overview of the instance's configuration. It includes fields for Instance ID, IP addresses, Hostname type, DNS names, VPC ID, Subnet ID, IAM Role, and Instance ARN. The instance is currently in a 'Running' state. A sidebar on the right offers additional details such as Private IPv4 addresses, Public IPv4 DNS, Elastic IP addresses, and an AWS Compute Optimizer finding. The bottom of the console features a footer with copyright information, privacy terms, and a system tray with taskbar icons and a clock showing 10:07 on 20-12-2024.

Instance summary for i-0be5f6e4fa52d1f0a (server)		
Instance ID i-0be5f6e4fa52d1f0a	Public IPv4 address -	Private IPv4 addresses 10.0.0.137
IPv6 address -	Instance state Running	Public IPv4 DNS -
Hostname type IP name: ip-10-0-0-137.ec2.internal	Private IP DNS name (IPv4 only) ip-10-0-0-137.ec2.internal	Elastic IP addresses -
Answer private resource DNS name -	Instance type t2.micro	AWS Compute Optimizer finding Opt-in to AWS Compute Optimizer for recommendation s. Learn more
Auto-assigned IP address -	VPC ID vpc-0ba0a683607deef69 (project-vpc)	Auto Scaling Group name -
IAM Role -	Subnet ID subnet-0438555f14aa46b41 (project-subnet-private1-us-east-1a)	Managed false
IMDSv2 Required	Instance ARN arn:aws:ec2:us-east-1:519397520425:instance/i-0be5f6e4fa52d1f0a	

- Client



This screenshot shows the AWS Management Console for a different EC2 instance, identified by ID `i-07f087bb6956e3bdc`. The browser address bar URL is `us-east-1.console.aws.amazon.com/ec2/home?region=us-east-1#InstanceDetails:instanceId=i-07f087bb6956e3bdc`. The console layout is consistent with the previous screenshot, showing the instance summary for a 'client' instance. The instance is also in a 'Running' state. The configuration details, including VPC ID, Subnet ID, and Instance ARN, are similar to the server instance. The right-hand sidebar provides the same supplementary information as the first screenshot. The footer and system tray at the bottom of the console show a clock time of 10:08 on 20-12-2024.

Instance summary for i-07f087bb6956e3bdc (client)		
Instance ID i-07f087bb6956e3bdc	Public IPv4 address -	Private IPv4 addresses 10.0.0.138
IPv6 address -	Instance state Running	Public IPv4 DNS -
Hostname type IP name: ip-10-0-0-138.ec2.internal	Private IP DNS name (IPv4 only) ip-10-0-0-138.ec2.internal	Elastic IP addresses -
Answer private resource DNS name -	Instance type t2.micro	AWS Compute Optimizer finding Opt-in to AWS Compute Optimizer for recommendation s. Learn more
Auto-assigned IP address -	VPC ID vpc-0ba0a683607deef69 (project-vpc)	Auto Scaling Group name -
IAM Role -	Subnet ID subnet-0438555f14aa46b41 (project-subnet-private1-us-east-1a)	Managed false
IMDSv2 Required	Instance ARN arn:aws:ec2:us-east-1:519397520425:instance/i-07f087bb6956e3bdc	

- SSH keys were securely transferred from the local machine to the bastion host using SCP.
- The bastion host used as an intermediary to access the private instances (web server and client), bypassing the lack of public IPs on those machines.

Windows PowerShell

```
PS C:\Users\hp\downloads> scp -i "C:/Users/hp/downloads/nginx.pem" "C:/Users/hp/downloads/nginx.pem" ubuntu@3.86.178.239:/home/ubuntu/.ssh/
>>
nginx.pem
PS C:\Users\hp\downloads> █
```

ubuntu@ip-10-0-0-7: ~\$ ssh

```
Get:22 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates/multiverse amd64 Components [948 B]
Get:30 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates/multiverse amd64 c-n-f Metadata [552 B]
Get:31 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-backports/main amd64 Components [208 B]
Get:32 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-backports/main amd64 c-n-f Metadata [112 B]
Get:33 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-backports/universe amd64 Packages [10.7 kB]
Get:34 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-backports/universe Translation-en [10.8 kB]
Get:35 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-backports/universe amd64 Components [11.7 kB]
Get:36 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-backports/universe amd64 c-n-f Metadata [1104 B]
Get:37 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-backports/restricted amd64 Components [216 B]
Get:38 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-backports/restricted amd64 c-n-f Metadata [116 B]
Get:39 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-backports/multiverse amd64 Components [212 B]
Get:40 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-backports/multiverse amd64 c-n-f Metadata [116 B]
Get:41 http://security.ubuntu.com/ubuntu noble-security/universe Translation-en [162 kB]
Get:42 http://security.ubuntu.com/ubuntu noble-security/universe amd64 Components [52.0 kB]
Get:43 http://security.ubuntu.com/ubuntu noble-security/universe amd64 c-n-f Metadata [13.5 kB]
Get:44 http://security.ubuntu.com/ubuntu noble-security/restricted amd64 Packages [560 kB]
Get:45 http://security.ubuntu.com/ubuntu noble-security/restricted Translation-en [108 kB]
Get:46 http://security.ubuntu.com/ubuntu noble-security/restricted amd64 Components [212 B]
Get:47 http://security.ubuntu.com/ubuntu noble-security/multiverse amd64 Packages [12.2 kB]
Get:48 http://security.ubuntu.com/ubuntu noble-security/multiverse Translation-en [2940 B]
Get:49 http://security.ubuntu.com/ubuntu noble-security/multiverse amd64 Components [212 B]
Get:50 http://security.ubuntu.com/ubuntu noble-security/multiverse amd64 c-n-f Metadata [356 B]
Fetched 31.7 MB in 6s (5454 kB/s)
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
58 packages can be upgraded. Run 'apt list --upgradable' to see them.
ubuntu@ip-10-0-0-7:~$ ls
ubuntu@ip-10-0-0-7:~$ ll
total 20
drwxr-xr-x 4 ubuntu ubuntu 4096 Dec 19 06:52 /
drwxr-xr-x 3 root root 4096 Dec 19 06:43 /
-rw-r--r-- 1 ubuntu ubuntu 220 Mar 31 2024 .bash_logout
-rw-r--r-- 1 ubuntu ubuntu 3771 Mar 31 2024 .bashrc
drwxr-xr-x 2 ubuntu ubuntu 4096 Dec 19 06:44 /
-rw-r--r-- 1 ubuntu ubuntu 807 Mar 31 2024 .profile
drwxr-xr-x 2 ubuntu ubuntu 4096 Dec 19 06:43 /
-rw-r--r-- 1 ubuntu ubuntu 0 Dec 19 06:52 .sudo_as_admin_successful
ubuntu@ip-10-0-0-7:~$ cd .ssh
-bash: cd: .ssh: No such file or directory
ubuntu@ip-10-0-0-7:~$ cd /.ssh
-bash: cd: /.ssh: No such file or directory
ubuntu@ip-10-0-0-7:~$ cd .ssh
ubuntu@ip-10-0-0-7:~$ ll
total 12
drwxr-xr-x 2 ubuntu ubuntu 4096 Dec 19 06:43 /
drwxr-xr-x 4 ubuntu ubuntu 4096 Dec 19 06:52 /
-rw-r--r-- 1 ubuntu ubuntu 387 Dec 19 06:43 authorized_keys
ubuntu@ip-10-0-0-7:~$ ll
total 16
drwxr-xr-x 2 ubuntu ubuntu 4096 Dec 19 06:54 /
drwxr-xr-x 4 ubuntu ubuntu 4096 Dec 19 06:52 /
-rw-r--r-- 1 ubuntu ubuntu 387 Dec 19 06:43 authorized_keys
-rw-r--r-- 1 ubuntu ubuntu 1674 Dec 19 06:54 nginx.pem
ubuntu@ip-10-0-0-7:~$
```

ubuntu@ip-10-0-0-137: ~\$

```
ubuntu@ip-10-0-0-7:~$ ssh -i "nginx.pem" ubuntu@10.0.0.137
The authenticity of host '10.0.0.137 (10.0.0.137)' can't be established.
ED25519 key fingerprint is SHA256:SrJVl4r5rUjuu456FIxuG7gwgeGT8YfA0vblhGX3yQ.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '10.0.0.137' (ED25519) to the list of known hosts.
Welcome to Ubuntu 24.04.1 LTS (GNU/Linux 6.8.0-1018-aws x86_64)

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

System information as of Thu Dec 19 06:59:08 UTC 2024

System load:  0.29           Processes:      107
Usage of /:   24.7% of 6.71GB Users logged in:      0
Memory usage: 22%           IPv4 address for enX0: 10.0.0.137
Swap usage:   0%

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

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

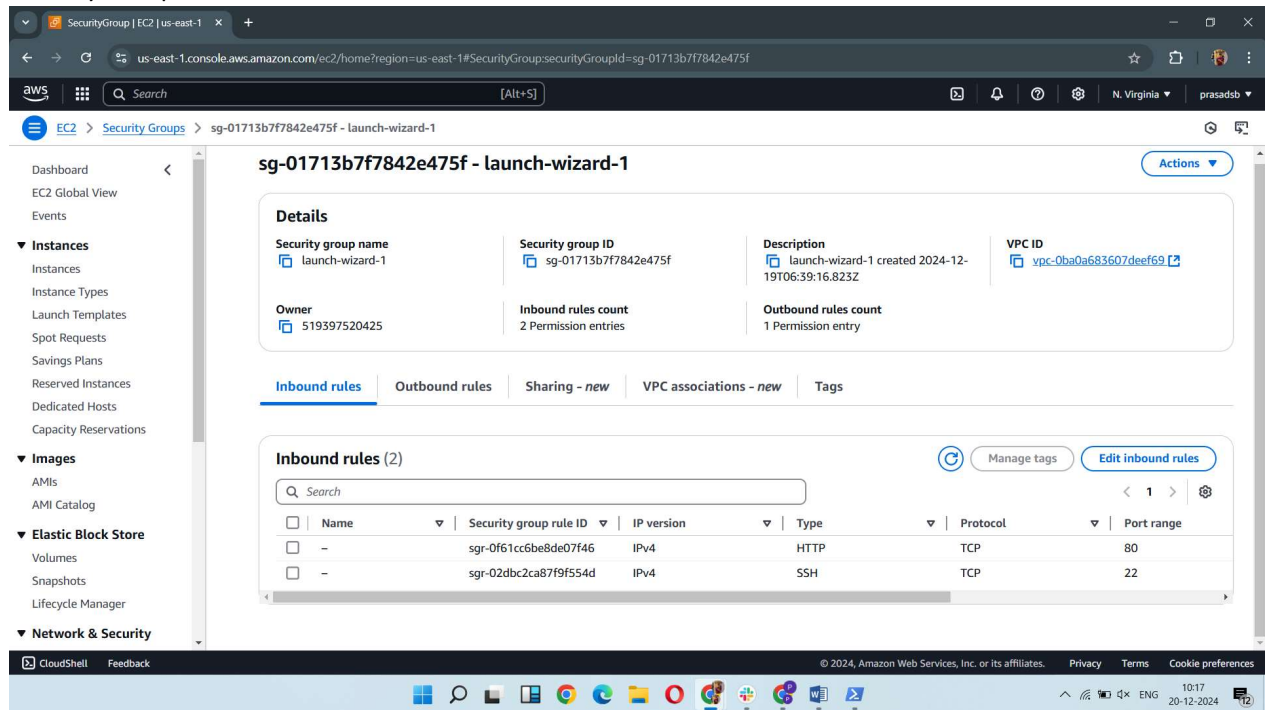
The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

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

ubuntu@ip-10-0-0-137:~$ sudo apt update
```

- Nginx was installed on the web server, and the appropriate firewall rules (HTTP/80) were added to the security group, enabling the client to access the web page hosted on the server.
- Security Groups



- Web server virtual machine

```
ubuntu@ip-10-0-0-137: ~
ubuntu@ip-10-0-0-137: $ nginx -v
nginx version: nginx/1.24.0 (Ubuntu)
ubuntu@ip-10-0-0-137: $ curl 10.0.0.137
<!DOCTYPE html>
<html>
<head>
<title>Welcome to nginx!</title>
<style>
html { color-scheme: light dark; }
body { width: 35em; margin: 0 auto;
font-family: Tahoma, Verdana, Arial, sans-serif; }
</style>
</head>
<body>
<h1>Welcome to nginx!</h1>
<p>If you see this page, the nginx web server is successfully installed and
working. Further configuration is required.</p>

<p>For online documentation and support please refer to
<a href="http://nginx.org/">nginx.org</a>.<br/>
Commercial support is available at
<a href="http://nginx.com/">nginx.com</a>.</p>

<p><em>Thank you for using nginx.</em></p>
</body>
</html>
ubuntu@ip-10-0-0-137: $
```


- Client virtual machine.

```
ubuntu@ip-10-0-0-138: ~
ubuntu@ip-10-0-0-138: $ curl 10.0.0.137
<!DOCTYPE html>
<html>
<head>
<title>Welcome to nginx</title>
<style>
html { color-scheme: light dark; }
body { width: 35em; margin: 0 auto;
font-family: Tahoma, Verdana, Arial, sans-serif; }
</style>
</head>
<body>
<h1>Welcome to nginx!</h1>
<p>If you see this page, the nginx web server is successfully installed and
working. Further configuration is required.</p>

<p>For online documentation and support please refer to
<a href="http://nginx.org/">nginx.org</a>.<br>
Commercial support is available at
<a href="http://nginx.com/">nginx.com</a>.</p>

<p><em>Thank you for using nginx.</em></p>
</body>
</html>
ubuntu@ip-10-0-0-138: $
```

- The file transfer process was carried out using SCP, both from the client to the server and vice versa. This demonstrated the use of secure file transfer over SSH.

```
ubuntu@ip-10-0-0-137: ~
ubuntu@ip-10-0-0-137: $ cat authorized_keys
ssh-rsa AAAAB3NzaC1yc2EAAAADAQABAAQCAu0KX67CY/Bu1dJVzCMdpZGv500183W40wPazroKCI/udM1q/nxC2u35p8VlydpCQSL19QqghYckGrT3IS10pAgWkHc24uXbTpAVFuzl+2HmeaP7/rHLrITL32TxV7Fm+A1uR/4P4V848Toln05YtX00n2rQE31t6b95aevgk0nqNt53aV6C2
jXwX/XS2/U1M0u8IM7IIEIY9L8C8OUVf/giGxAvQd5Fg3viy1055j4l7puoKAE+cas8oEc3uclusesI08TYBFupLVH06da6jzjg39yx/nGrNappoglw140IXgtzv5uIP+2X3tXcyp nginx
ubuntu@ip-10-0-0-137: ~
ubuntu@ip-10-0-0-137: ~
ubuntu@ip-10-0-0-137: ~
ubuntu@ip-10-0-0-137: ~
total 20
drwxr-xr-x 2 ubuntu ubuntu 4096 Dec 19 07:25 /
drwxr-xr-x 4 ubuntu ubuntu 4096 Dec 19 09:01 /
-rw-r--r-- 1 ubuntu ubuntu 387 Dec 19 06:58 authorized_keys
-rw-r--r-- 1 ubuntu ubuntu 284 Dec 19 07:29 known_hosts
-rw-r--r-- 1 ubuntu ubuntu 1674 Dec 19 07:25 nginx.pem
ubuntu@ip-10-0-0-137: ~
ubuntu@ip-10-0-0-137: ~
ubuntu@ip-10-0-0-137: ~
Warning: Identity file /path/to/nginx.pem not accessible: No such file or directory.
ubuntu@10.0.0.138: Permission denied (publickey).
scp: Connection closed.
ubuntu@ip-10-0-0-137: ~
total 20
drwxr-xr-x 2 ubuntu ubuntu 4096 Dec 19 07:25 /
drwxr-xr-x 4 ubuntu ubuntu 4096 Dec 19 09:01 /
-rw-r--r-- 1 ubuntu ubuntu 387 Dec 19 06:58 authorized_keys
-rw-r--r-- 1 ubuntu ubuntu 284 Dec 19 07:29 known_hosts
-rw-r--r-- 1 ubuntu ubuntu 1674 Dec 19 07:25 nginx.pem
ubuntu@ip-10-0-0-137: ~
ubuntu@ip-10-0-0-137: ~
total 32
drwxr-xr-x 4 ubuntu ubuntu 4096 Dec 19 09:01 /
drwxr-xr-x 3 root root 4096 Dec 19 06:58 /
-rw-r--r-- 1 ubuntu ubuntu 771 Dec 19 07:37 .bash_history
-rw-r--r-- 1 ubuntu ubuntu 220 Mar 31 2024 .bash_logout
-rw-r--r-- 1 ubuntu ubuntu 3771 Mar 31 2024 .bashrc
drwxr-xr-x 2 ubuntu ubuntu 4096 Dec 19 06:59 /
-rw-r--r-- 1 ubuntu ubuntu 807 Mar 31 2024 .profile
drwxr-xr-x 2 ubuntu ubuntu 4096 Dec 19 07:25 /
-rw-r--r-- 1 ubuntu ubuntu 0 Dec 19 06:59 .sudo_as_admin_successful
-rw-r--r-- 1 ubuntu ubuntu 0 Dec 19 07:13 file.txt
ubuntu@ip-10-0-0-137: ~
Warning: Identity file /ssh/nginx.pem not accessible: No such file or directory.
ubuntu@10.0.0.138: Permission denied (publickey).
scp: Connection closed.
ubuntu@ip-10-0-0-137: ~
file.txt
100% 0 0.0KB/s 00:00
ubuntu@ip-10-0-0-137: $
```

```
ubuntu@ip-10-0-0-138: ~
ubuntu@ip-10-0-0-138: ~
total 32
drwxr-xr-x 4 ubuntu ubuntu 4096 Dec 19 09:21 /
drwxr-xr-x 3 root root 4096 Dec 19 06:58 /
-rw-r--r-- 1 ubuntu ubuntu 371 Dec 19 07:37 .bash_history
-rw-r--r-- 1 ubuntu ubuntu 220 Mar 31 2024 .bash_logout
-rw-r--r-- 1 ubuntu ubuntu 3771 Mar 31 2024 .bashrc
drwxr-xr-x 2 ubuntu ubuntu 4096 Dec 19 07:06 /
-rw-r--r-- 1 ubuntu ubuntu 807 Mar 31 2024 .profile
drwxr-xr-x 2 ubuntu ubuntu 4096 Dec 19 09:14 /
-rw-r--r-- 1 ubuntu ubuntu 0 Dec 19 07:08 .sudo_as_admin_successful
-rw-r--r-- 1 ubuntu ubuntu 0 Dec 19 09:20 file.txt
ubuntu@ip-10-0-0-138: ~
touch prasad.txt
ubuntu@ip-10-0-0-138: ~
total 32
drwxr-xr-x 4 ubuntu ubuntu 4096 Dec 19 09:22 /
drwxr-xr-x 3 root root 4096 Dec 19 06:58 /
-rw-r--r-- 1 ubuntu ubuntu 371 Dec 19 07:37 .bash_history
-rw-r--r-- 1 ubuntu ubuntu 220 Mar 31 2024 .bash_logout
-rw-r--r-- 1 ubuntu ubuntu 3771 Mar 31 2024 .bashrc
drwxr-xr-x 2 ubuntu ubuntu 4096 Dec 19 07:06 /
-rw-r--r-- 1 ubuntu ubuntu 807 Mar 31 2024 .profile
drwxr-xr-x 2 ubuntu ubuntu 4096 Dec 19 09:14 /
-rw-r--r-- 1 ubuntu ubuntu 0 Dec 19 07:08 .sudo_as_admin_successful
-rw-r--r-- 1 ubuntu ubuntu 0 Dec 19 09:20 file.txt
-rw-r--r-- 1 ubuntu ubuntu 0 Dec 19 09:22 prasad.txt
ubuntu@ip-10-0-0-138: ~
Warning: Identity file /ssh/nginx.pem not accessible: No such file or directory.
The authenticity of host '10.0.0.137 (10.0.0.137)' can't be established.
ED25519 key fingerprint is SHA256:5rJVL4r5rJuu456FIxUG7gaageT8YfABvLhGK3yQ.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '10.0.0.137' (ED25519) to the list of known hosts.
prasad.txt
100% 0 0.0KB/s 00:00
ubuntu@ip-10-0-0-138: $
```

Basic Architecture

