CASE STUDY

Implementing a Robust VPN Solution for Secure Remote Access to Cloud Resources

Presented By.

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INTRODUCTION

- Organizations increasingly depend on cloud resources (AWS EC2, RDS, etc.)
- Remote work culture requires employees to access cloud services from anywhere.
- Directly exposing resources to the internet leads to security threats.
- A VPN solution allows secure and private connectivity to AWS VPC resources.
- This project focuses on AWS Client VPN with IAM authentication to provide safe and scalable access.

MOTIVATION

- Protect sensitive business data from cyberattacks and unauthorized access.
- Provide remote teams with seamless and secure connectivity.
- Eliminate risks of public-facing SSH/RDP connections.
- Reduce operational complexity with IAM-based authentication.
- Ensure the solution is robust, scalable, and easy to manage for future needs.

WITHOUT VPN VS WITH VPN

Without VPN:

- Data travels in plaintext over the internet.
- Easy for attackers to sniff/modify traffic.
- No identity verification of users.

With VPN:

- Data is encrypted using protocols (AES, IPsec).
- Private tunnel → only authenticated users connect.
- Cloud resources hidden from direct internet exposure.
- Strong authentication: Certificates, IAM, MFA.

SOLUTION DEVELOPMENT

Our proposed VPN solution integrates modern security protocols and architectures:

- Site-to-Site VPN for organization-to-cloud secure link. (IKEv2 + IPsec)
- Point-to-Site VPN for individual remote user access.
- Robust Authentication & Key Exchange (OpenVPN, Certificates, MFA).

SOLUTION DEVELOPMENT

Site-to-Site VPN Architecture:

Use Case:

Connects an organization's on-premises data center securely with cloud VPC.

How it works:

- A VPN gateway (router/firewall) at each site.
- Tunnels established via Ipsec+IKEv2.
- Encrypted communication between data center and cloud resources.

Advantages:

- Permanent connection.
- Best for multiple users in branch offices.

SOLUTION DEVELOPMENT

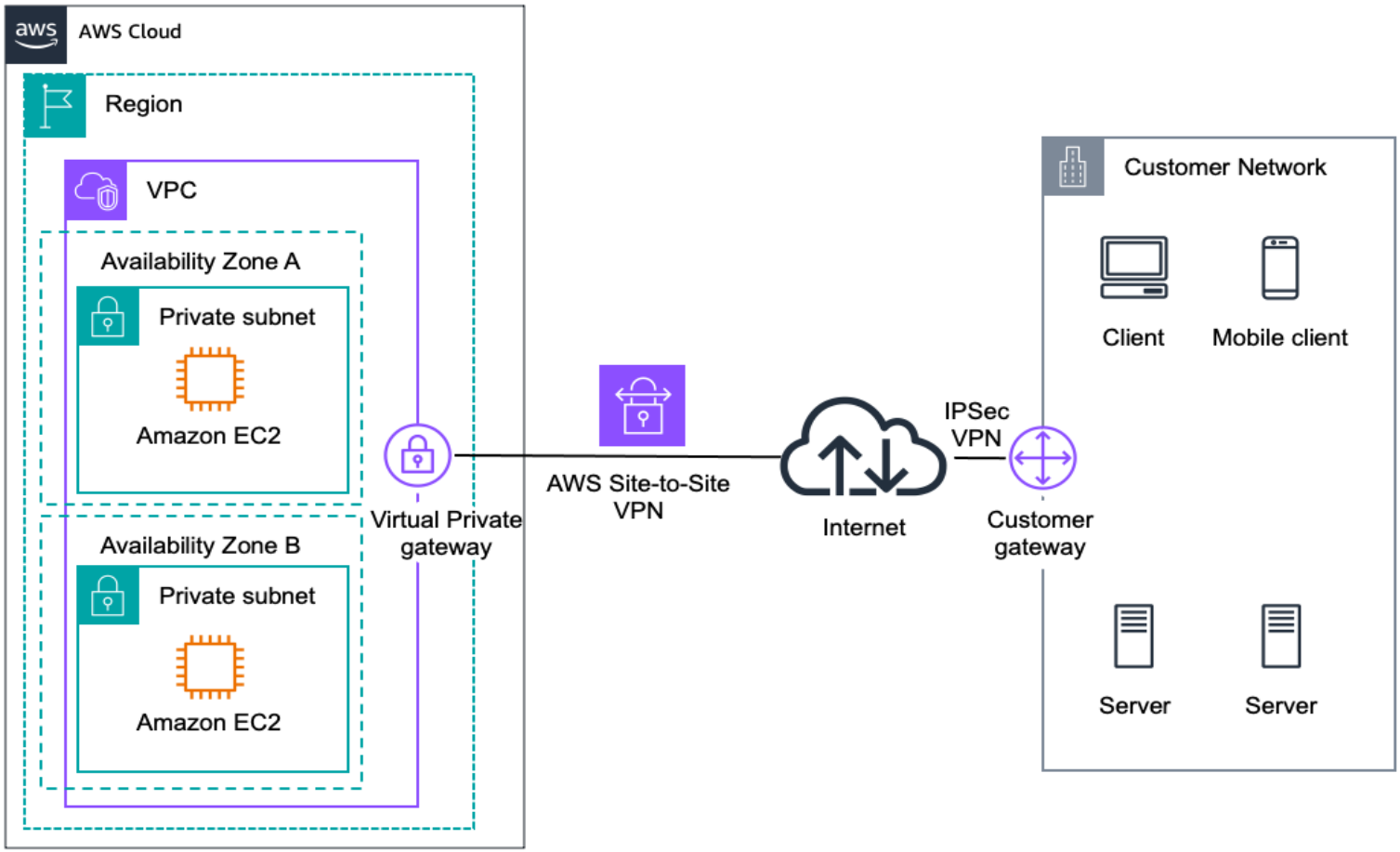


Fig : Site-To-Site VPN Architecture

SOLUTION DEVELOPMENT

Point-to-Site VPN Architecture:

Use Case:

Individual employees working remotely.

How it works:

- User installs VPN client on laptop/phone.
- Client authenticates via certificate / username-password + MFA.
- Secure tunnel established directly to Cloud VPN gateway.

Advantages:

- Flexible – works from anywhere.
- Best for small teams or remote users.

SOLUTION DEVELOPMENT

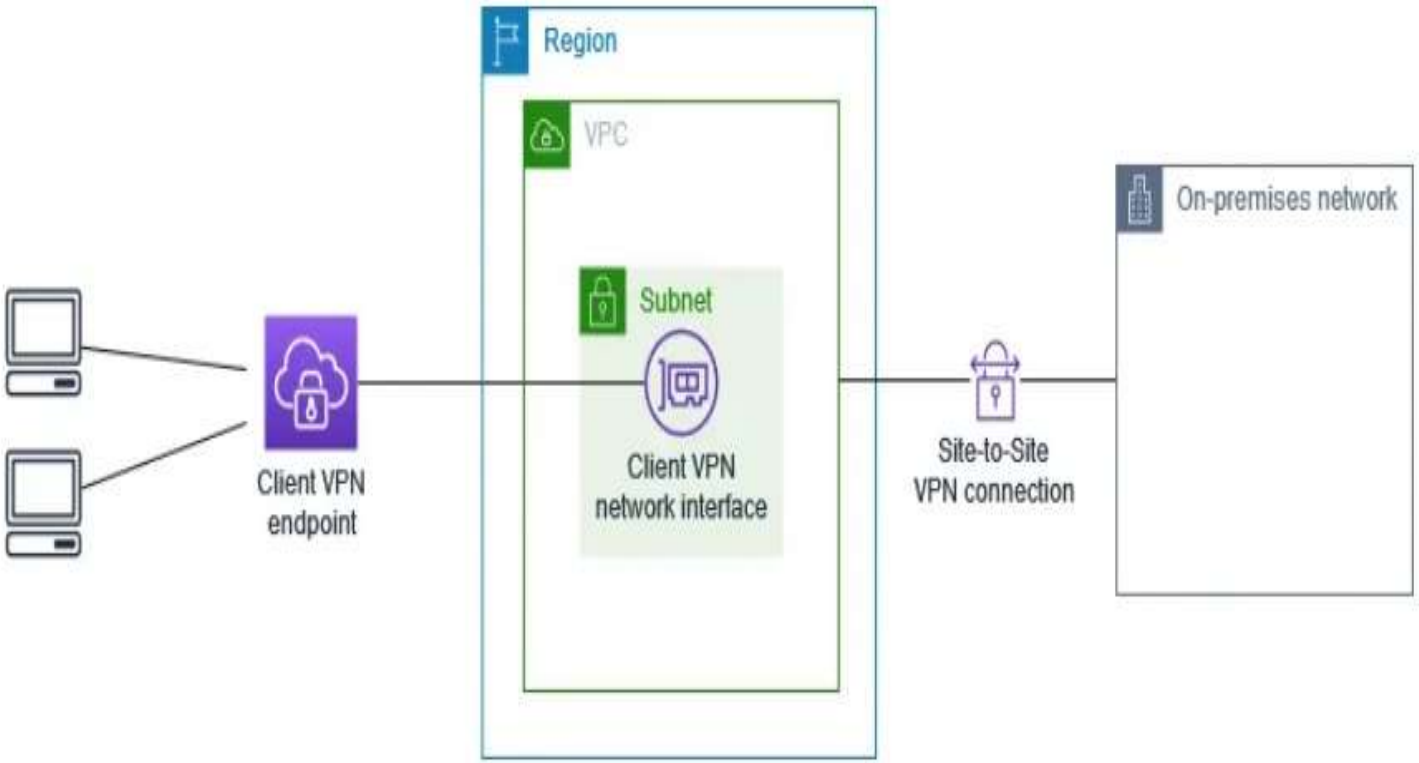


Fig : Point-To-Site VPN Architecture

SOLUTION DEVELOPMENT

Authentication & Key Management :

Key Exchange (TLS Handshake):

- Uses OpenVPN (TLS/SSL) for secure tunneling.
- Diffie–Hellman ensures unique keys per session.

Authentication Mechanisms:

- Using Digital Certificates: Each client and server has its own certificate issued by a trusted CA.
- Certificates validate identities.

Multi-Factor Authentication Integration Session Security:

- Perfect Forward Secrecy (PFS) ensures new keys per session(Uses Diffie–Hellman).
- Even if one session key is compromised, past/future sessions remain safe.

IMPLEMENTATION

Step 1: Set Up VPC, Subnets, and Route Tables.

VPC (VPN): (10.0.0.0/16)

Creating Subnets:-

Public Subnet (PUB): 10.0.1.0/24

Private Subnet (PVT): 10.0.2.0/24

Creating Internet Gateway:-

Internet Gateway (IGW): VPN-IGW

Creating Route Table:-

Public Route Table (PUB-RT)

Private Route Table (PVT-RT)

Creating Associations:-

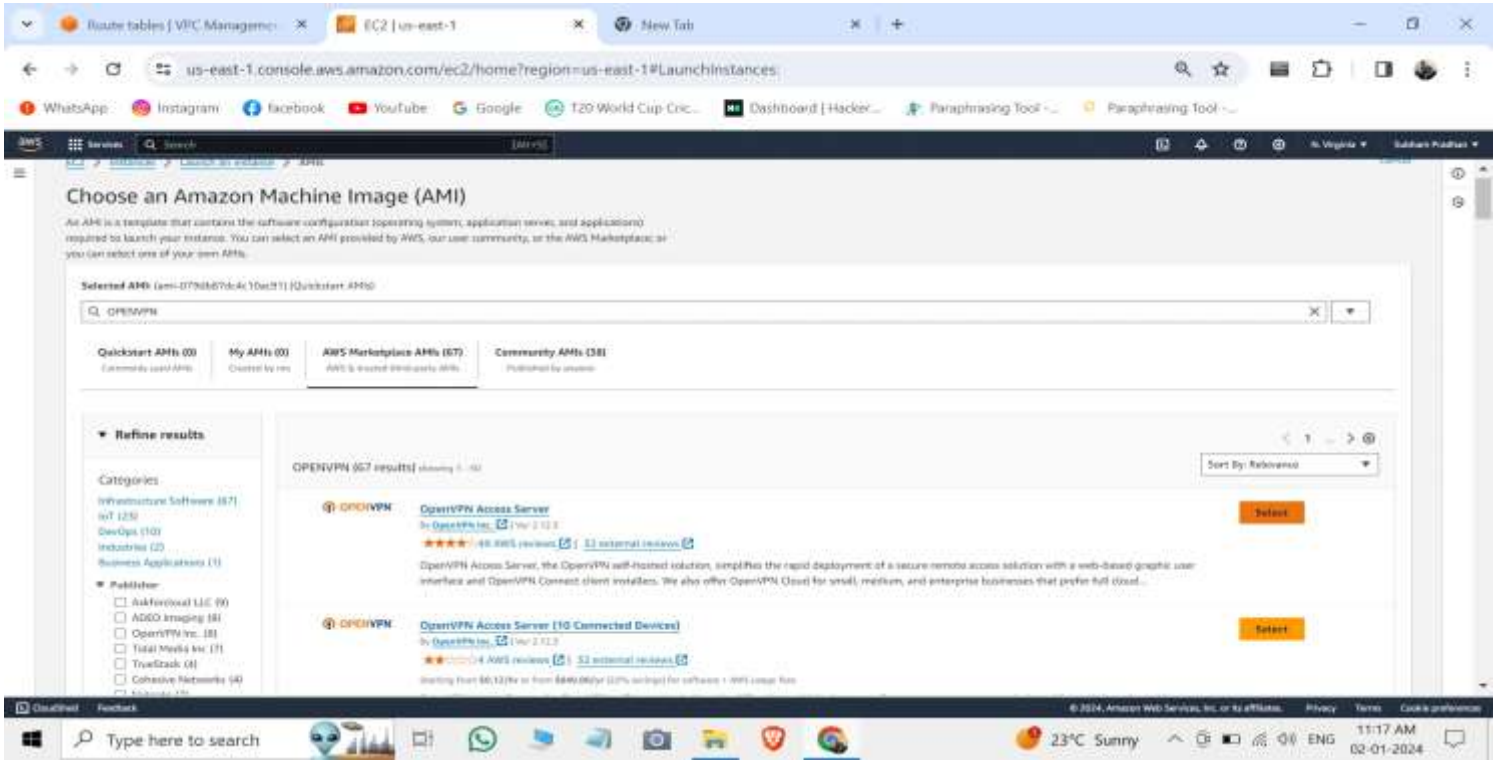
Associate IGW and PUB-RT with the PUB subnet

Associate PVT-RT with the PVT subnet

IMPLEMENTATION

Step 2: Launch OpenVPN Server

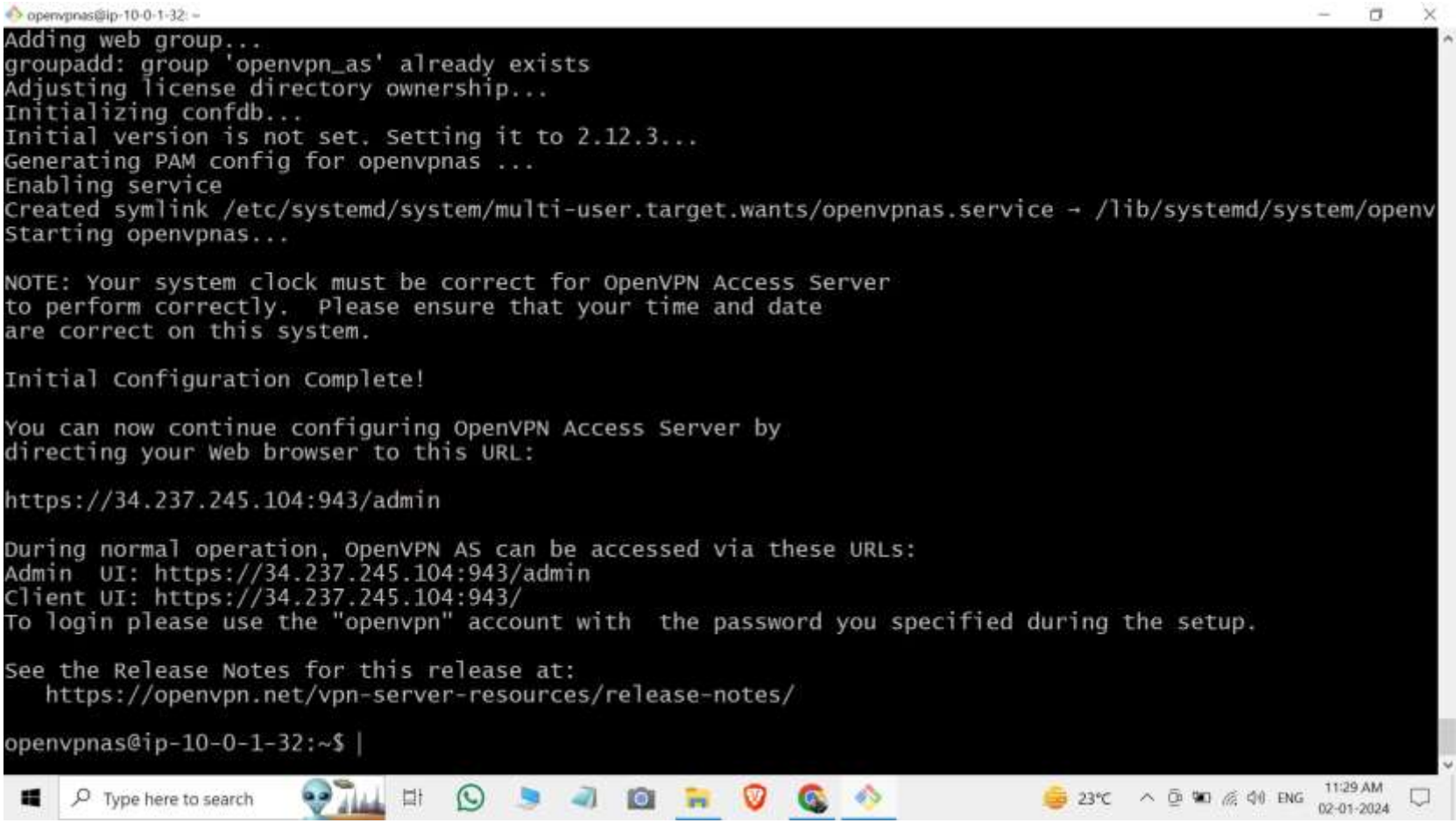
Launch an EC2 instance named “OPENVPN” using the OpenVPN AMI.



- Set a password for the OpenVPN Admin UI and Client UI.
- Copy the Admin UI and Client UI.

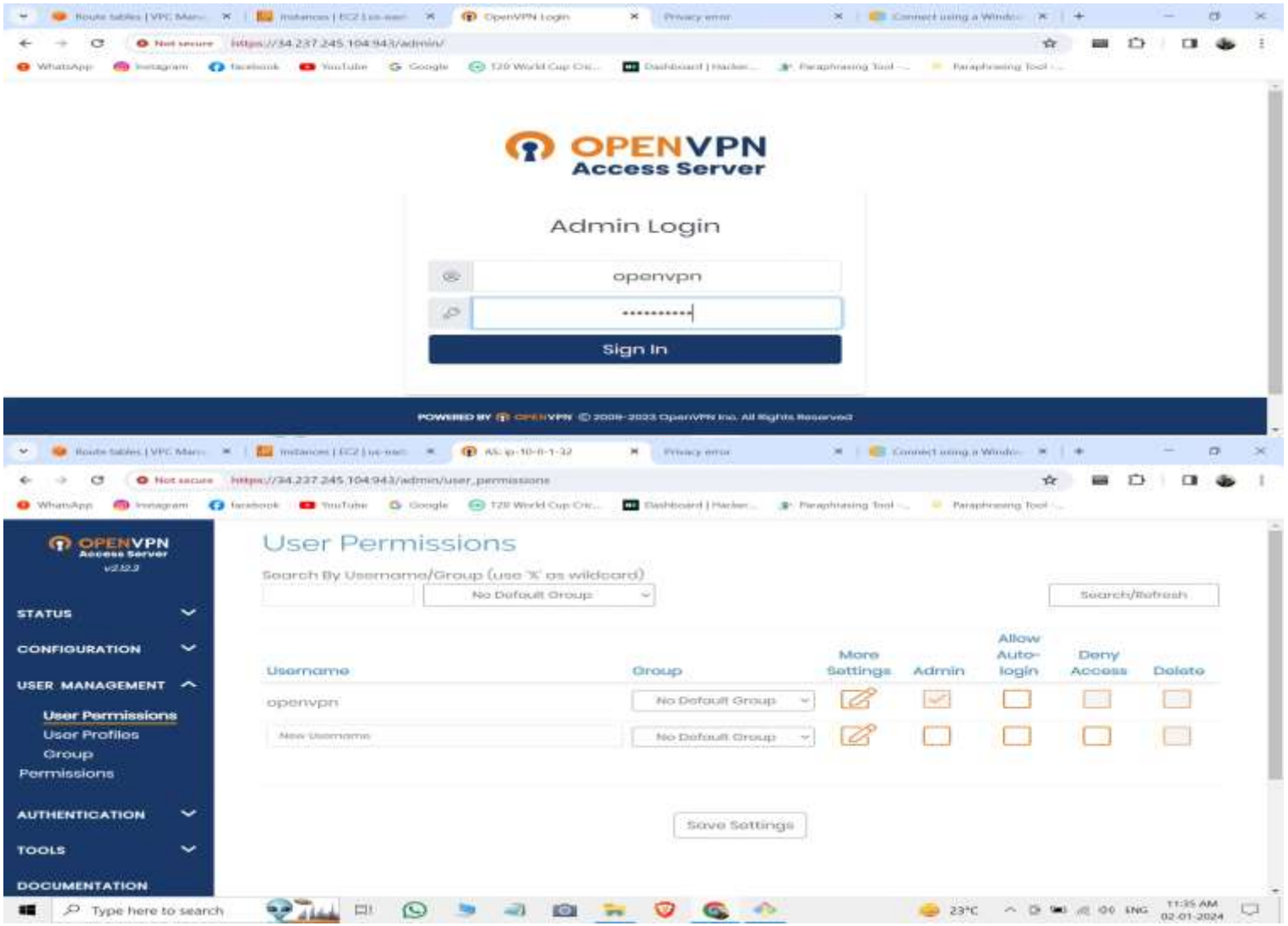
IMPLEMENTATION

Step 2: Launch OpenVPN Server



IMPLEMENTATION

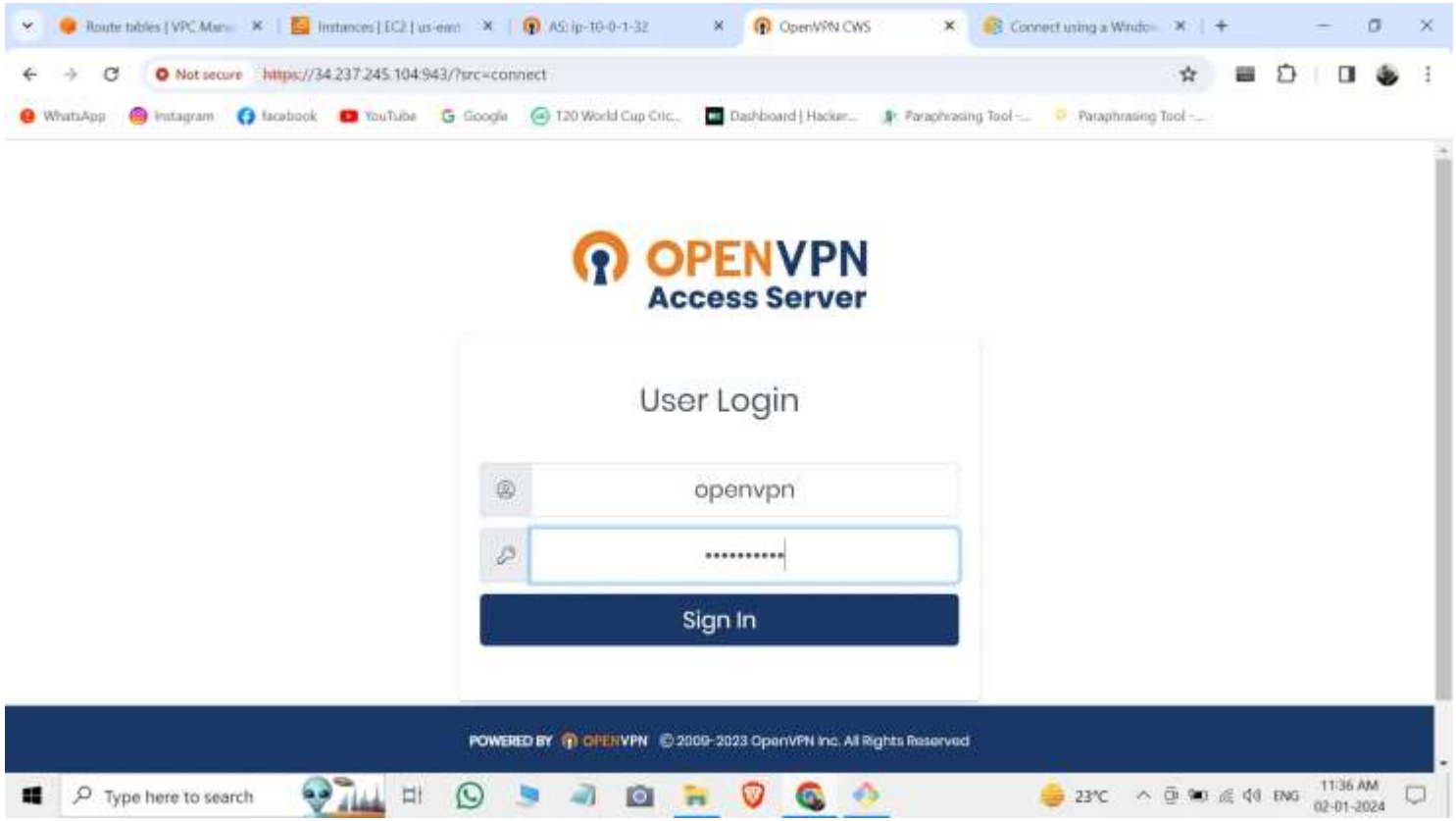
Step 3: Connect to Admin UI



IMPLEMENTATION

Step 4: Connect to Client UI & Download Connection Profile

- Connect to the Client UI.
- Install the OpenVPN client app on your device.
- Download the connection profile from the Client UI.



IMPLEMENTATION

Step 4: Connect to Client UI & Download Connection Profile

IMPLEMENTATION

Step 5: Test VPN Connection

- Ping the Private IP of the OpenVPN server; it will not work.

- Log in using the user ID and password in the OpenVPN client.
- Upload the downloaded profile file then connect.

IMPLEMENTATION

Step 5: Test VPN Connection

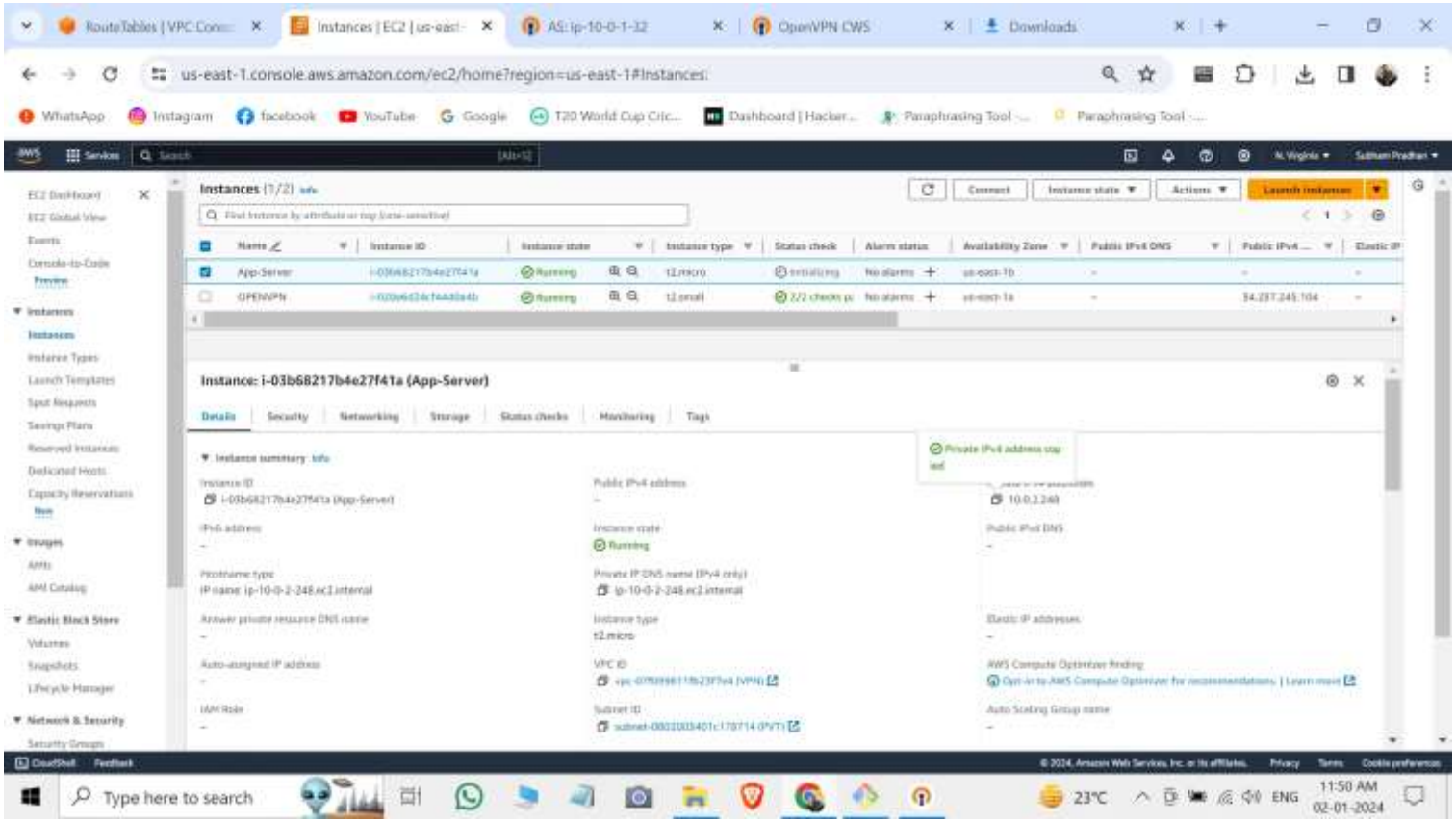
- Ping again

```
ASUS@LAPTOP-Q9QDRNKO MINGW64 ~/Downloads
$ ping 10.0.1.32

Pinging 10.0.1.32 with 32 bytes of data:
Reply from 10.0.1.32: bytes=32 time=272ms TTL=64
Reply from 10.0.1.32: bytes=32 time=322ms TTL=64
Reply from 10.0.1.32: bytes=32 time=394ms TTL=64
Reply from 10.0.1.32: bytes=32 time=424ms TTL=64

Ping statistics for 10.0.1.32:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 272ms, Maximum = 424ms, Average = 353ms
```

IMPLEMENTATION

Step 6: Create Additional Resources

- Create another EC2 instance (APP-SERVER) in the PVT subnet.
- Set up a NAT Gateway in the PUB subnet.
- Route the NAT Gateway in the PVT subnet.



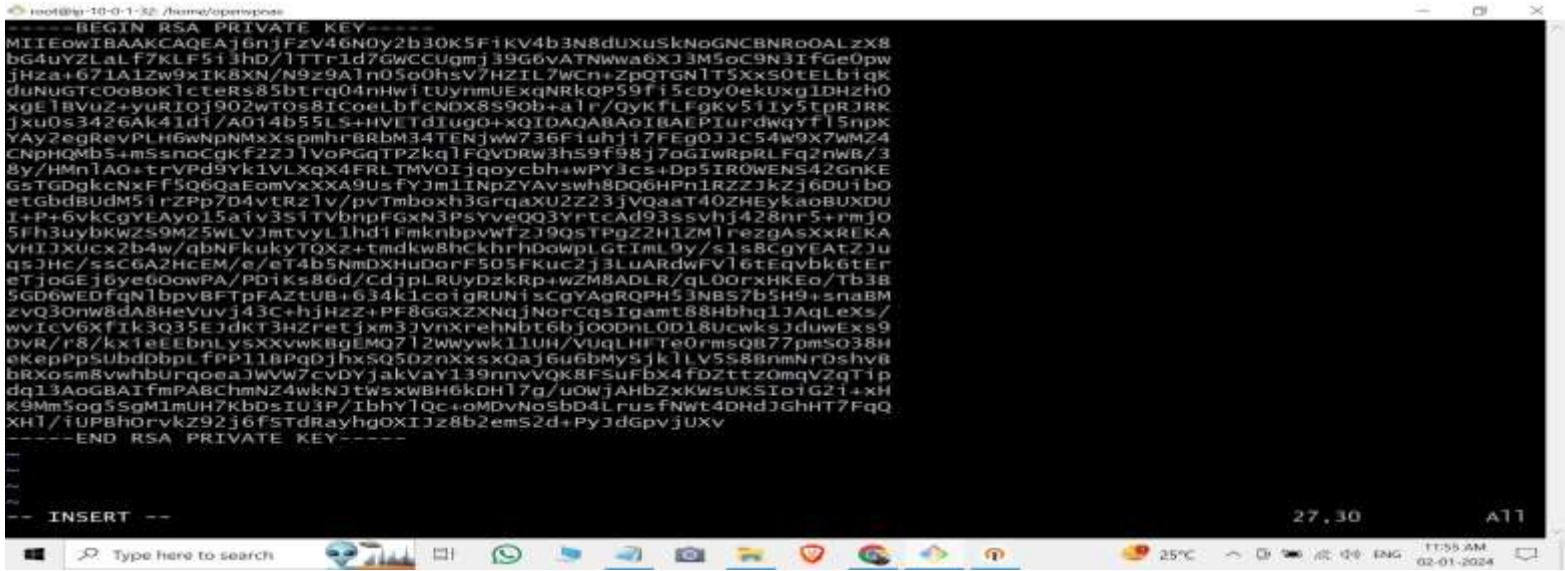
IMPLEMENTATION

Step 7: Test Communication with NAT Gateway

- Reconnect to the OpenVPN server.
- Ping the private IP of the APP-SERVER; it should ping due to the NAT Gateway.

```
openvpnas@ip-10-0-1-32:~$ sudo su
root@ip-10-0-1-32:/home/openvpnas# ping 10.0.1.32
PING 10.0.1.32 (10.0.1.32) 56(84) bytes of data.
64 bytes from 10.0.1.32: icmp_seq=1 ttl=64 time=0.039 ms
64 bytes from 10.0.1.32: icmp_seq=2 ttl=64 time=0.048 ms
64 bytes from 10.0.1.32: icmp_seq=3 ttl=64 time=0.048 ms
64 bytes from 10.0.1.32: icmp_seq=4 ttl=64 time=0.045 ms
64 bytes from 10.0.1.32: icmp_seq=5 ttl=64 time=0.046 ms
64 bytes from 10.0.1.32: icmp_seq=6 ttl=64 time=0.049 ms
64 bytes from 10.0.1.32: icmp_seq=7 ttl=64 time=0.044 ms
```

- Create a test-key on APP-SERVER, change permissions, and perform an SSH connection.

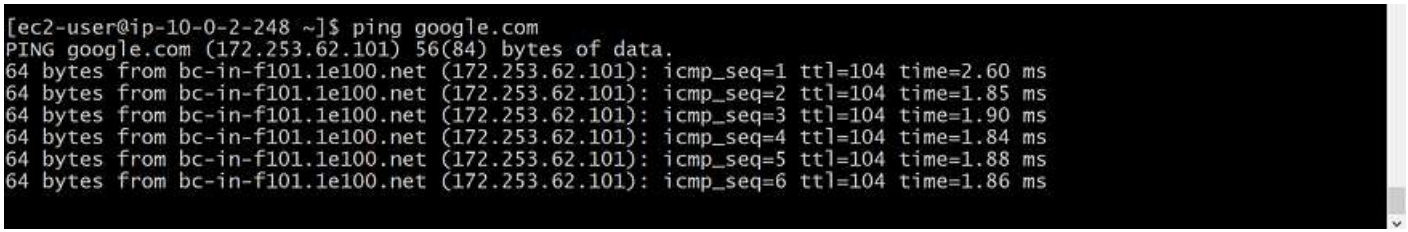


IMPLEMENTATION

Step 8: Install Apache Server on APP-SERVER

- connect to the APP-SERVER.

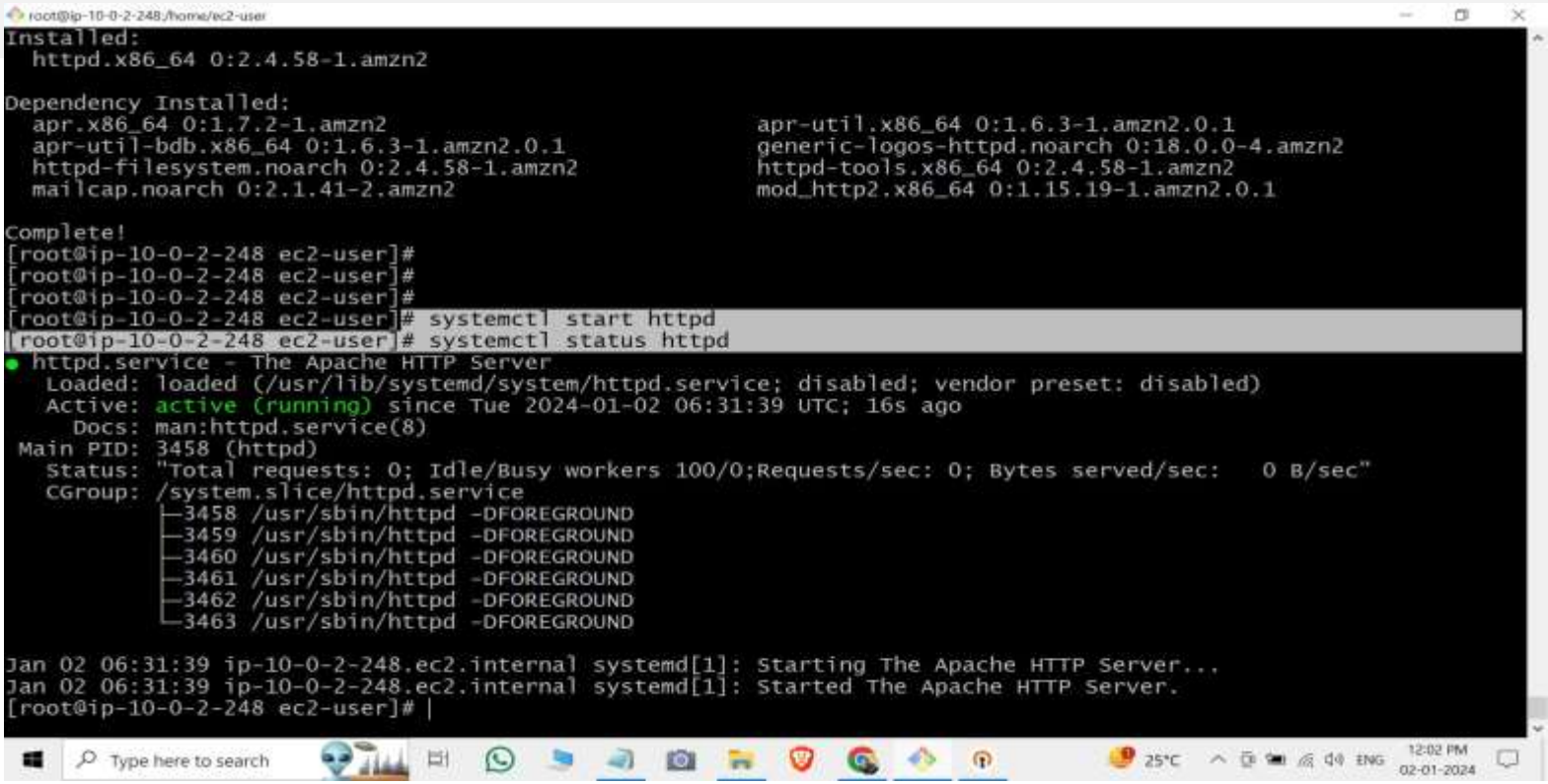
- ping google.com



IMPLEMENTATION

Step 8: Install Apache Server on APP-SERVER

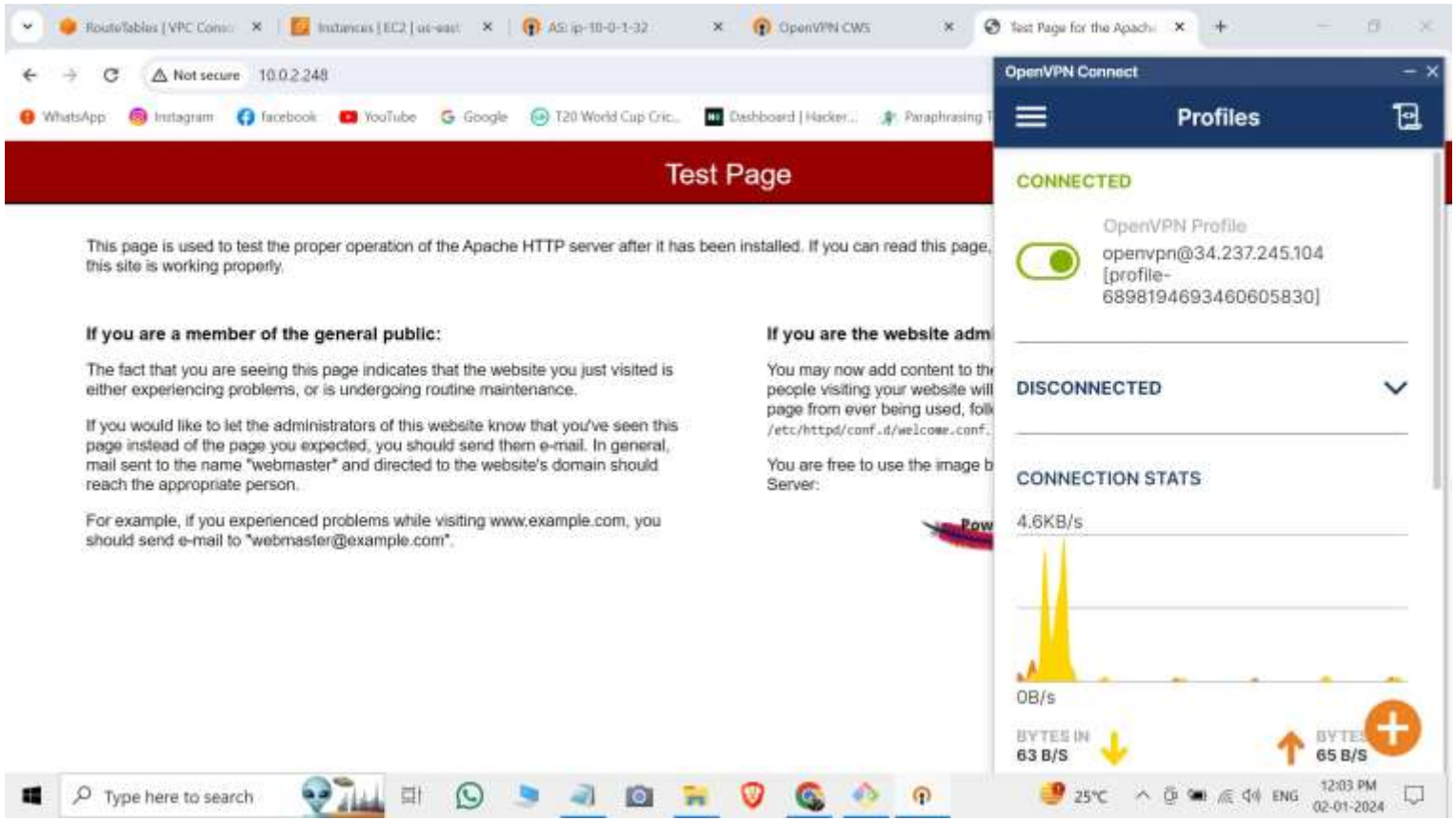
- Switch to sudo su on APP-SERVER.
- Install Apache: yum install httpd -y.
- Start Apache: systemctl start httpd.
- Check status: systemctl status httpd.



RESULT

Access Apache by pasting the private IP of APP-SERVER; it should display the Apache server.

*(**Note**: Ensure that the VPN connection is active during testing.)*



CONCLUSION

•Implemented a secure Point-to-Site VPN using AWS Client VPN service.

•Enabled remote user access to AWS VPC resources via an encrypted, OpenVPN-based tunnel.

•Ensured confidentiality, integrity, and controlled access with mutual TLS authentication and AWS IAM/ACM integration.

•Achieved scalability, flexibility (split-tunnel/full-tunnel), and observability.

•Final outcome: Remote users can securely connect and manage AWS cloud resources as if they were inside the VPC without exposing them directly to the internet.

REFERENCES

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  https://docs.aws.amazon.com/vpn/latest/clientvpn-admin/cvpn-getting-started.html
- **Nord VPN - What is it, and how does it work?**
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