

# **VPN Setup and Samba Access Between Two Linux Virtual Machines**

ITC3013 System Administration

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# **1 Objective**

The objective of this assignment is to establish a secure Virtual Private Network (VPN) between two Linux virtual machines named Sri Lanka Client and US Server using an opensource VPN solution (OpenVPN). The VPN ensures confidential communication between the two locations. In addition, a Samba file server is configured on the US virtual machine and securely accessed from the Sri Lanka virtual machine only through the VPN tunnel.

## **1.1 Key Goals**

- Create a secure OpenVPN tunnel between two Linux VMs
- Verify VPN connectivity with 100% successful ping
- Configure a Samba server on the US VM
- Access and transfer files from the Sri Lanka VM through the VPN

## **2 Environment / Platforms Used**

<b>Component</b>	<b>Details</b>
Virtualization	Oracle VirtualBox
Operating System	Ubuntu 22.04 LTS
VPN Software	OpenVPN (Easy-RSA)
File Sharing	Samba
Networking Mode	NAT + Host-Only Adapter
VPN Subnet	10.8.0.0/24
Server VM Name	US Server
Client VM Name	Sri Lanka Client

Host-only IP addresses are used for initial connectivity, SSH access, and VPN endpoint communication. All secure communication and file sharing occur over the VPN subnet (10.8.0.0/24).

## 2.1 Sri Lanka Client Server Configuration

```
sl@srilanka-client: ~
IPv6 address for enp0s3: fd17:625c:f037:2:a00:27ff:feb1:224d

* Strictly confined Kubernetes makes edge and IoT secure. Learn how MicroK8s
just raised the bar for easy, resilient and secure K8s cluster deployment.

https://ubuntu.com/engage/secure-kubernetes-at-the-edge

Expanded Security Maintenance for Applications is not enabled.

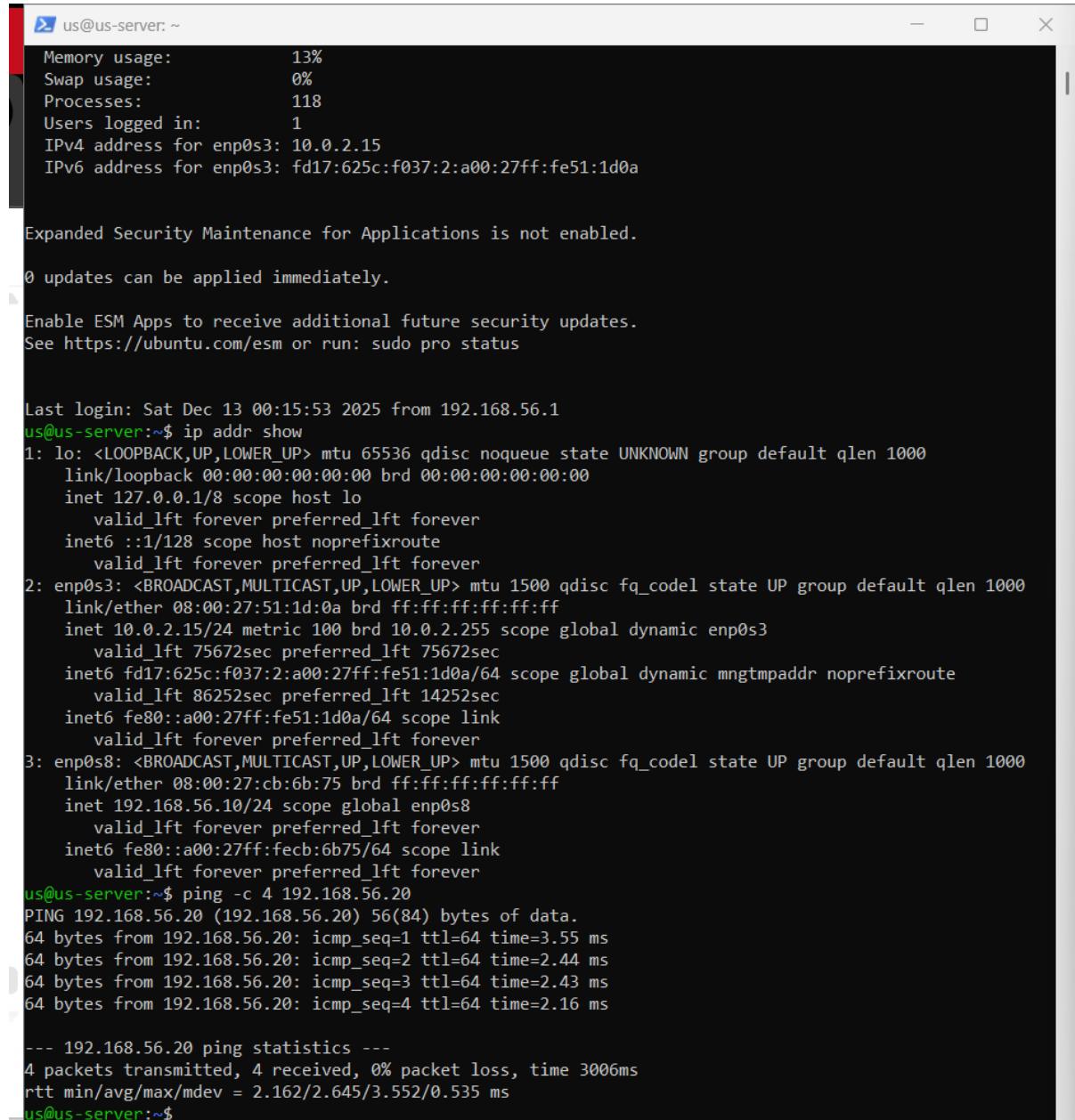
44 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

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

Last login: Sat Dec 13 00:24:23 2025 from 192.168.56.1
sl@srilanka-client:~$ ip addr show
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host noprefixroute
        valid_lft forever preferred_lft forever
2: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 08:00:27:b1:22:4d brd ff:ff:ff:ff:ff:ff
    inet 10.0.2.15/24 metric 100 brd 10.0.2.255 scope global dynamic enp0s3
        valid_lft 75165sec preferred_lft 75165sec
    inet6 fd17:625c:f037:2:a00:27ff:feb1:224d/64 scope global dynamic mngtmpaddr noprefixroute
        valid_lft 86372sec preferred_lft 14372sec
    inet6 fe80::a00:27ff:feb1:224d/64 scope link
        valid_lft forever preferred_lft forever
3: enp0s8: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 08:00:27:83:95:86 brd ff:ff:ff:ff:ff:ff
    inet 192.168.56.20/24 scope global enp0s8
        valid_lft forever preferred_lft forever
    inet6 fe80::a00:27ff:fe83:9586/64 scope link
        valid_lft forever preferred_lft forever
sl@srilanka-client:~$ ping -c 4 192.168.56.10
PING 192.168.56.10 (192.168.56.10) 56(84) bytes of data.
64 bytes from 192.168.56.10: icmp_seq=1 ttl=64 time=1.27 ms
64 bytes from 192.168.56.10: icmp_seq=2 ttl=64 time=2.06 ms
64 bytes from 192.168.56.10: icmp_seq=3 ttl=64 time=2.04 ms
64 bytes from 192.168.56.10: icmp_seq=4 ttl=64 time=1.95 ms

--- 192.168.56.10 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3005ms
rtt min/avg/max/mdev = 1.272/1.830/2.060/0.324 ms
sl@srilanka-client:~$
```

## 2.2 US Server Configuration



```
us@us-server: ~
Memory usage:      13%
Swap usage:        0%
Processes:         118
Users logged in:   1
IPv4 address for enp0s3: 10.0.2.15
IPv6 address for enp0s3: fd17:625c:f037:2:a00:27ff:fe51:1d0a

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

Last login: Sat Dec 13 00:15:53 2025 from 192.168.56.1
us@us-server:~$ ip addr show
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host noprefixroute
        valid_lft forever preferred_lft forever
2: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 08:00:27:51:1d:0a brd ff:ff:ff:ff:ff:ff
    inet 10.0.2.15/24 metric 100 brd 10.0.2.255 scope global dynamic enp0s3
        valid_lft 75672sec preferred_lft 75672sec
    inet6 fd17:625c:f037:2:a00:27ff:fe51:1d0a/64 scope global dynamic mngtmpaddr noprefixroute
        valid_lft 86252sec preferred_lft 14252sec
    inet6 fe80::a00:27ff:fe51:1d0a/64 scope link
        valid_lft forever preferred_lft forever
3: enp0s8: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 08:00:27:cb:6b:75 brd ff:ff:ff:ff:ff:ff
    inet 192.168.56.10/24 scope global enp0s8
        valid_lft forever preferred_lft forever
    inet6 fe80::a00:27ff:fecb:6b75/64 scope link
        valid_lft forever preferred_lft forever
us@us-server:~$ ping -c 4 192.168.56.20
PING 192.168.56.20 (192.168.56.20) 56(84) bytes of data.
64 bytes from 192.168.56.20: icmp_seq=1 ttl=64 time=3.55 ms
64 bytes from 192.168.56.20: icmp_seq=2 ttl=64 time=2.44 ms
64 bytes from 192.168.56.20: icmp_seq=3 ttl=64 time=2.43 ms
64 bytes from 192.168.56.20: icmp_seq=4 ttl=64 time=2.16 ms

--- 192.168.56.20 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3006ms
rtt min/avg/max/mdev = 2.162/2.645/3.552/0.535 ms
us@us-server:~$
```

## 3 Network Configuration

### 3.1 Static IP Assignment

**US-Server:**

- Host-only IP: 192.168.56.10/24
- VPN IP: 10.8.0.1

**SriLanka Client:**

- Host-only IP: 192.168.56.20/24

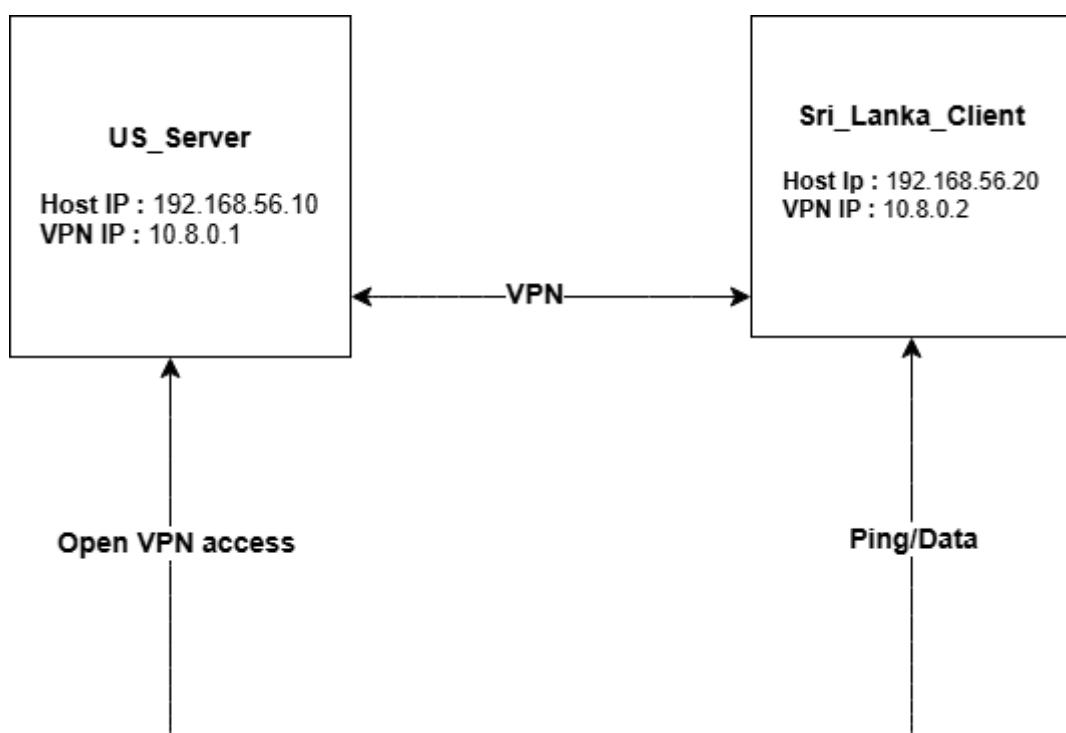
- VPN IP: 10.8.0.

Static IPs were configured using Netplan on both virtual machines to ensure consistent addressing.

## 4 Network Diagram

The following diagram illustrates the complete setup:

- VM names (SriLanka-Client, US-Server)
- Host-only IP addresses
- VPN IP addresses
- OpenVPN tunnel
- Samba service location on US-Server



## 5 OpenVPN Setup

### 5.1 Installing OpenVPN

OpenVPN and Easy-RSA were installed on the US-Server to act as the VPN server and certificate authority. The OpenVPN client package was installed on the SriLanka-Client.

```
Selecting previously unselected package opensc-pkcs11:amd64.
Preparing to unpack .../5-opensc-pkcs11_0.25.0~rc1-1build2_amd64.deb ...
Unpacking opensc-pkcs11:amd64 (0.25.0~rc1-1build2) ...
Selecting previously unselected package opensc.
Preparing to unpack .../6-opensc_0.25.0~rc1-1build2_amd64.deb ...
Unpacking opensc (0.25.0~rc1-1build2) ...
Selecting previously unselected package openvpn.
Preparing to unpack .../7-openvpn_2.6.14-0ubuntu0.24.04.3_amd64.deb ...
Unpacking openvpn (2.6.14-0ubuntu0.24.04.3) ...
Selecting previously unselected package easy-rsa.
Preparing to unpack .../8-easy-rsa_3.1.7-2_all.deb ...
Unpacking easy-rsa (3.1.7-2) ...
Setting up libccid (1.5.5-1) ...
Setting up libeac3:amd64 (1.1.2-ds+git20220117+453c3d6b03a0-1.1build2) ...
Setting up opensc-pkcs11:amd64 (0.25.0~rc1-1build2) ...
Setting up libpcslite1:amd64 (2.0.3-1build1) ...
Setting up libpkcs11-helper1:amd64 (1.29.0-2.1build2) ...
Setting up easy-rsa (3.1.7-2) ...
Setting up openvpn (2.6.14-0ubuntu0.24.04.3) ...
Created symlink /etc/systemd/system/multi-user.target.wants/openvpn.service → /usr/lib/systemd/system/openvpn.service.
Setting up opensc (0.25.0~rc1-1build2) ...
Setting up pcscd (2.0.3-1build1) ...
Created symlink /etc/systemd/system/sockets.target.wants/pcscd.socket → /usr/lib/systemd/system/pcscd.socket.
pcscd.service is a disabled or a static unit, not starting it.
Processing triggers for libc-bin (2.39-0ubuntu8.6) ...
Processing triggers for man-db (2.12.0-4build2) ...
Scanning processes...
Scanning candidates...
Scanning linux images...

Running kernel seems to be up-to-date.

Restarting services...

Service restarts being deferred:
/etc/needrestart/restart.d/dbus.service
systemctl restart systemd-logind.service
systemctl restart unattended-upgrades.service

No containers need to be restarted.

User sessions running outdated binaries:
us @ session #1: login[929]
us @ user manager service: systemd[1144]

No VM guests are running outdated hypervisor (qemu) binaries on this host.
us@us-server:~$ make-cadir ~/easy-rsa
```

### 5.2 Certificate Authority and Key Management

Easy-RSA was used to create a Public Key Infrastructure (PKI). A Certificate Authority (CA) was initialized, followed by the generation and signing of:

- Server certificate (us-server)
- Client certificate (srilanka-client)

- Diffie-Hellman parameters
  - TLS authentication key

Private keys were securely stored with restricted permissions, and only public certificates were exchanged.

### 5.2.1 CA Creation

### 5.2.2 Server and Client Certificates

```
What you are about to enter is what is called a Distinguished Name or a DN.  
There are quite a few fields but you can leave some blank  
For some fields there will be a default value,  
If you enter '.', the field will be left blank.  
-----  
Common Name (eg: your user, host, or server name) [srilanka-client]:  
  
Notice  
-----  
Private-Key and Public-Certificate-Request files created.  
Your files are:  
* req: /home/us/easy-rsa/pki/reqs/srilanka-client.req  
* key: /home/us/easy-rsa/pki/private/srilanka-client.key  
  
us@us-server:~/easy-rsa$ ./easyrsa sign-req client srilanka-client  
Using Easy-RSA 'vars' configuration:  
* /home/us/easy-rsa/vars  
  
Using SSL:  
* openssl OpenSSL 3.0.13 30 Jan 2024 (Library: OpenSSL 3.0.13 30 Jan 2024)  
You are about to sign the following certificate:  
Please check over the details shown below for accuracy. Note that this request  
has not been cryptographically verified. Please be sure it came from a trusted  
source or that you have verified the request checksum with the sender.  
Request subject, to be signed as a client certificate  
for '825' days:  
  
subject=  
    commonName          = srilanka-client  
  
Type the word 'yes' to continue, or any other input to abort.  
Confirm request details: yes  
  
Using configuration from /home/us/easy-rsa/pki/openssl-easyrsa.cnf  
Check that the request matches the signature  
Signature ok  
The Subject's Distinguished Name is as follows  
commonName :ASN.1 12:'srilanka-client'  
Certificate is to be certified until Mar 17 06:26:32 2028 GMT (825 days)  
  
Write out database with 1 new entries  
Database updated  
  
Notice  
-----  
Certificate created at:  
* /home/us/easy-rsa/pki/issued/srilanka-client.crt  
  
us@us-server:~/easy-rsa$
```

## 5.3 OpenVPN Server Configuration (US-Server)

The OpenVPN server configuration file (/etc/openvpn/server/server.conf) defines:

- UDP port 1194
- TUN virtual interface
- VPN subnet 10.8.0.0/24
- Encryption algorithms (AES-256-GCM, SHA256)
- TLS authentication

IP forwarding was enabled to allow VPN traffic routing.

### 5.3.1 IP Forwarding Configuration

```
You are about to sign the following certificate:  
Please check over the details shown below for accuracy. Note that this request  
has not been cryptographically verified. Please be sure it came from a trusted  
source or that you have verified the request checksum with the sender.  
Request subject, to be signed as a client certificate  
for '825' days:  
  
subject=  
    commonName          = srilanka-client  
  
Type the word 'yes' to continue, or any other input to abort.  
Confirm request details: yes  
  
Using configuration from /home/us/easy-rsa/pki/openssl-easysrsa.cnf  
Check that the request matches the signature  
Signature ok  
The Subject's Distinguished Name is as follows  
commonName      :ASN.1 12:'srilanka-client'  
Certificate is to be certified until Mar 17 06:26:32 2028 GMT (825 days)  
  
Write out database with 1 new entries  
Database updated  
  
Notice  
-----  
Certificate created at:  
* /home/us/easy-rsa/pki/issued/srilanka-client.crt  
  
us@us-server:~/easy-rsa$  
us@us-server:~/easy-rsa$  
us@us-server:~/easy-rsa$ sudo mkdir -p /etc/openvpn/server  
us@us-server:~/easy-rsa$ sudo cp ~/easy-rsa/pki/ca.crt /etc/openvpn/server/  
us@us-server:~/easy-rsa$ sudo cp ~/easy-rsa/pki/issued/us-server.crt /etc/openvpn/server/  
us@us-server:~/easy-rsa$ sudo cp ~/easy-rsa/pki/private/us-server.key /etc/openvpn/server/  
us@us-server:~/easy-rsa$ sudo cp ~/easy-rsa/pki/dh.pem /etc/openvpn/server/  
us@us-server:~/easy-rsa$ sudo cp ~/easy-rsa/pki/ta.key /etc/openvpn/server/  
us@us-server:~/easy-rsa$ sudo chmod 600 /etc/openvpn/server/us-server.key  
us@us-server:~/easy-rsa$ ls -l /etc/openvpn/server/  
total 24  
-rw----- 1 root root 1204 Dec 13 06:29 ca.crt  
-rw----- 1 root root  424 Dec 13 06:29 dh.pem  
-rw----- 1 root root  636 Dec 13 06:30 ta.key  
-rw----- 1 root root 4623 Dec 13 06:29 us-server.crt  
-rw----- 1 root root 1704 Dec 13 06:29 us-server.key  
us@us-server:~/easy-rsa$ sudo nano /etc/openvpn/server/server.conf  
us@us-server:~/easy-rsa$ sudo nano /etc/sysctl.conf  
us@us-server:~/easy-rsa$ sudo sysctl -p  
net.ipv4.ip_forward = 1  
us@us-server:~/easy-rsa$
```

### 5.3.2 Firewall Configuration (UFW)

```
Write out database with 1 new entries
Database updated

Notice
-----
Certificate created at:
* /home/us/easy-rsa/pki/issued/srilanka-client.crt

us@us-server:~/easy-rsa$ 
us@us-server:~/easy-rsa$ 
us@us-server:~/easy-rsa$ sudo mkdir -p /etc/openvpn/server
us@us-server:~/easy-rsa$ sudo cp ~/easy-rsa/pki/ca.crt /etc/openvpn/server/
us@us-server:~/easy-rsa$ sudo cp ~/easy-rsa/pki/issued/us-server.crt /etc/openvpn/server/
us@us-server:~/easy-rsa$ sudo cp ~/easy-rsa/pki/private/us-server.key /etc/openvpn/server/
us@us-server:~/easy-rsa$ sudo cp ~/easy-rsa/pki/dh.pem /etc/openvpn/server/
us@us-server:~/easy-rsa$ sudo cp ~/easy-rsa/pki/ta.key /etc/openvpn/server/
us@us-server:~/easy-rsa$ sudo chmod 600 /etc/openvpn/server/us-server.key
us@us-server:~/easy-rsa$ ls -l /etc/openvpn/server/
total 24
-rw----- 1 root root 1204 Dec 13 06:29 ca.crt
-rw----- 1 root root 424 Dec 13 06:29 dh.pem
-rw----- 1 root root 636 Dec 13 06:30 ta.key
-rw----- 1 root root 4623 Dec 13 06:29 us-server.crt
-rw----- 1 root root 1704 Dec 13 06:29 us-server.key
us@us-server:~/easy-rsa$ sudo nano /etc/openvpn/server/server.conf
us@us-server:~/easy-rsa$ sudo nano /etc/sysctl.conf
us@us-server:~/easy-rsa$ sudo sysctl -p
net.ipv4.ip_forward = 1
us@us-server:~/easy-rsa$ sudo ufw allow 1194/udp
Rules updated
Rules updated (v6)
us@us-server:~/easy-rsa$ sudo ufw allow 22/tcp
Rules updated
Rules updated (v6)
us@us-server:~/easy-rsa$ sudo ufw enable
Command may disrupt existing ssh connections. Proceed with operation (y|n)? y
Firewall is active and enabled on system startup
us@us-server:~/easy-rsa$ sudo ufw status
Status: active

To                         Action      From
--                         -----      ---
1194/udp                   ALLOW       Anywhere
22/tcp                      ALLOW       Anywhere
1194/udp (v6)               ALLOW       Anywhere (v6)
22/tcp (v6)                 ALLOW       Anywhere (v6)

us@us-server:~/easy-rsa$
```

### 5.3.3 OpenVPN Server Service Running

```
-rw----- 1 root root 4623 Dec 13 06:29 us-server.crt
-rw----- 1 root root 1704 Dec 13 06:29 us-server.key
us@us-server:~/easy-rsa$ sudo nano /etc/openvpn/server/server.conf
us@us-server:~/easy-rsa$ sudo nano /etc/sysctl.conf
us@us-server:~/easy-rsa$ sudo sysctl -p
net.ipv4.ip_forward = 1
us@us-server:~/easy-rsa$ sudo ufw allow 1194/udp
Rules updated
Rules updated (v6)
us@us-server:~/easy-rsa$ sudo ufw allow 22/tcp
Rules updated
Rules updated (v6)
us@us-server:~/easy-rsa$ sudo ufw enable
Command may disrupt existing ssh connections. Proceed with operation (y|n)? y
Firewall is active and enabled on system startup
us@us-server:~/easy-rsa$ sudo ufw status
Status: active

To           Action      From
--           ----       ---
1194/udp     ALLOW      Anywhere
22/tcp       ALLOW      Anywhere
1194/udp (v6) ALLOW      Anywhere (v6)
22/tcp (v6)  ALLOW      Anywhere (v6)

us@us-server:~/easy-rsa$ sudo mkdir -p /var/log/openvpn
us@us-server:~/easy-rsa$ sudo systemctl enable openvpn-server@server
Created symlink /etc/systemd/system/multi-user.target.wants/openvpn-server@server.service → /usr/lib/systemd/system/openvpn-server@.service.
us@us-server:~/easy-rsa$ sudo systemctl start openvpn-server@server
us@us-server:~/easy-rsa$ sudo systemctl status openvpn-server@server
● openvpn-server@server.service - OpenVPN service for server
   Loaded: loaded (/usr/lib/systemd/system/openvpn-server@.service; enabled; preset: enabled)
   Active: active (running) since Sat 2025-12-13 06:43:26 UTC; 11s ago
     Docs: man:openvpn(8)
           https://openvpn.net/community-resources/reference-manual-for-openvpn-2-6/
           https://community.openvpn.net/openvpn/wiki/HOWTO
   Main PID: 12051 (openvpn)
   Status: "Initialization Sequence Completed"
   Tasks: 1 (limit: 2267)
  Memory: 1.4M (peak: 1.6M)
    CPU: 63ms
   CGroup: /system.slice/system-openvpn\x2dserver.slice/openvpn-server@server.service
           └─12051 /usr/sbin/openvpn --status /run/openvpn-server/status-server.log --status-version 2

Dec 13 06:43:26 us-server systemd[1]: Starting openvpn-server@server.service - OpenVPN service for server
Dec 13 06:43:26 us-server openvpn[12051]: WARNING: Compression for receiving enabled. Compression has been disabled by default for security reasons.
Dec 13 06:43:26 us-server systemd[1]: Started openvpn-server@server.service - OpenVPN service for server.
lines 1-17/17 (END)
```

### **5.3.4 TUN0 Interface with IP 10.8.0.1**

## 5.4 OpenVPN Client Configuration (SriLanka-Client)

The client configuration file includes:

- Server endpoint 192.168.56.10:1194
  - Client certificates and keys
  - Encryption and authentication settings

The VPN connection was established using the OpenVPN client command.

```
sl@sri-lanka-client: ~
2025-12-13 07:24:48 Note: '--allow-compression' is not set to 'no', disabling data channel offload.
2025-12-13 07:24:48 OpenVPN 2.6.14 x86_64-pc-linux-gnu [SSL (OpenSSL)] [LZO] [LZ4] [EPOLL] [PKCS11] [MH/PKTINFO] [AEAD] [DCO]
2025-12-13 07:24:48 library versions: OpenSSL 3.0.13 30 Jan 2024, LZO 2.10
2025-12-13 07:24:48 DCO version: N/A
2025-12-13 07:24:48 TCP/UDP: Preserving recently used remote address: [AF_INET]192.168.56.10:1194
2025-12-13 07:24:48 Socket Buffers: R=[212992->212992] S=[212992->212992]
2025-12-13 07:24:48 UDPv4 link local: (not bound)
2025-12-13 07:24:48 UDPv4 link remote: [AF_INET]192.168.56.10:1194
2025-12-13 07:24:48 NOTE: UID/GID downgrade will be delayed because of --client, --pull, or --up-delay
2025-12-13 07:24:48 TLS: Initial packet from [AF_INET]192.168.56.10:1194, sid=62fac489 3f81ca43
2025-12-13 07:24:48 VERIFY OK: depth=1, CN=Easy-RSA CA
2025-12-13 07:24:48 VERIFY KU OK
2025-12-13 07:24:48 Validating certificate extended key usage
2025-12-13 07:24:48 ++ Certificate has EKU (str) TLS Web Server Authentication, expects TLS Web Server Authentication
2025-12-13 07:24:48 VERIFY EKU OK
2025-12-13 07:24:48 VERIFY OK: depth=0, CN=us-server
2025-12-13 07:24:48 Control Channel: TLSv1.3, cipher TLS_AES_256_GCM_SHA384, peer certificate: 2048 bits RSA, signature: RSA-SHA256, peer temporary key: 253 bits X25519
2025-12-13 07:24:48 [us-server] Peer Connection Initiated with [AF_INET]192.168.56.10:1194
2025-12-13 07:24:48 TLS: move_session: dest=TM_ACTIVE src=TM_INITIAL reinit_src=1
2025-12-13 07:24:48 TLS: tls_multi_process: initial untrusted session promoted to trusted
2025-12-13 07:24:48 PUSH: Received control message: 'PUSH_REPLY,compress lz4-v2,route 10.8.0.0 255.255.255.0,topology net30,ping 10,ping-restart 120,ifconfig 10.8.0.6 10.8.0.5,peer-id 0,cipher AES-256-GCM,protocol-flags cc-exit tls-ekm dyn-tls-crypt,tun-mtu 1500'
2025-12-13 07:24:48 WARNING: Compression for receiving enabled. Compression has been used in the past to break encryption. Sent packets are not compressed unless "allow-compression yes" is also set.
2025-12-13 07:24:48 OPTIONS IMPORT: --ifconfig/up options modified
2025-12-13 07:24:48 OPTIONS IMPORT: route options modified
2025-12-13 07:24:48 OPTIONS IMPORT: tun-mtu set to 1500
2025-12-13 07:24:48 net_route_v4_best_gw query: dst 0.0.0.0
2025-12-13 07:24:48 net_route_v4_best_gw result: via 10.0.2.2 dev enp0s3
2025-12-13 07:24:48 ROUTE_GATEWAY 10.0.2.2/255.255.255.0 IFACE=enp0s3 HWADDR=08:00:27:b1:22:4d
2025-12-13 07:24:48 TUN/TAP device tun0 opened
2025-12-13 07:24:48 net_iface_mtu_set: mtu 1500 for tun0
2025-12-13 07:24:48 net_iface_up: set tun0 up
2025-12-13 07:24:48 net_addr_ptp_v4_add: 10.8.0.6 peer 10.8.0.5 dev tun0
2025-12-13 07:24:48 net_route_v4_add: 10.8.0.0/24 via 10.8.0.5 dev [NULL] table 0 metric -1
2025-12-13 07:24:48 UID set to nobody
2025-12-13 07:24:48 GID set to nogroup
2025-12-13 07:24:48 Capabilities retained: CAP_NET_ADMIN
2025-12-13 07:24:48 Initialization Sequence Completed
2025-12-13 07:24:48 Data Channel: cipher 'AES-256-GCM', peer-id: 0, compression: 'lz4v2'
2025-12-13 07:24:48 Timers: ping 10, ping-restart 120
2025-12-13 07:24:48 Protocol options: protocol-flags cc-exit tls-ekm dyn-tls-crypt
```

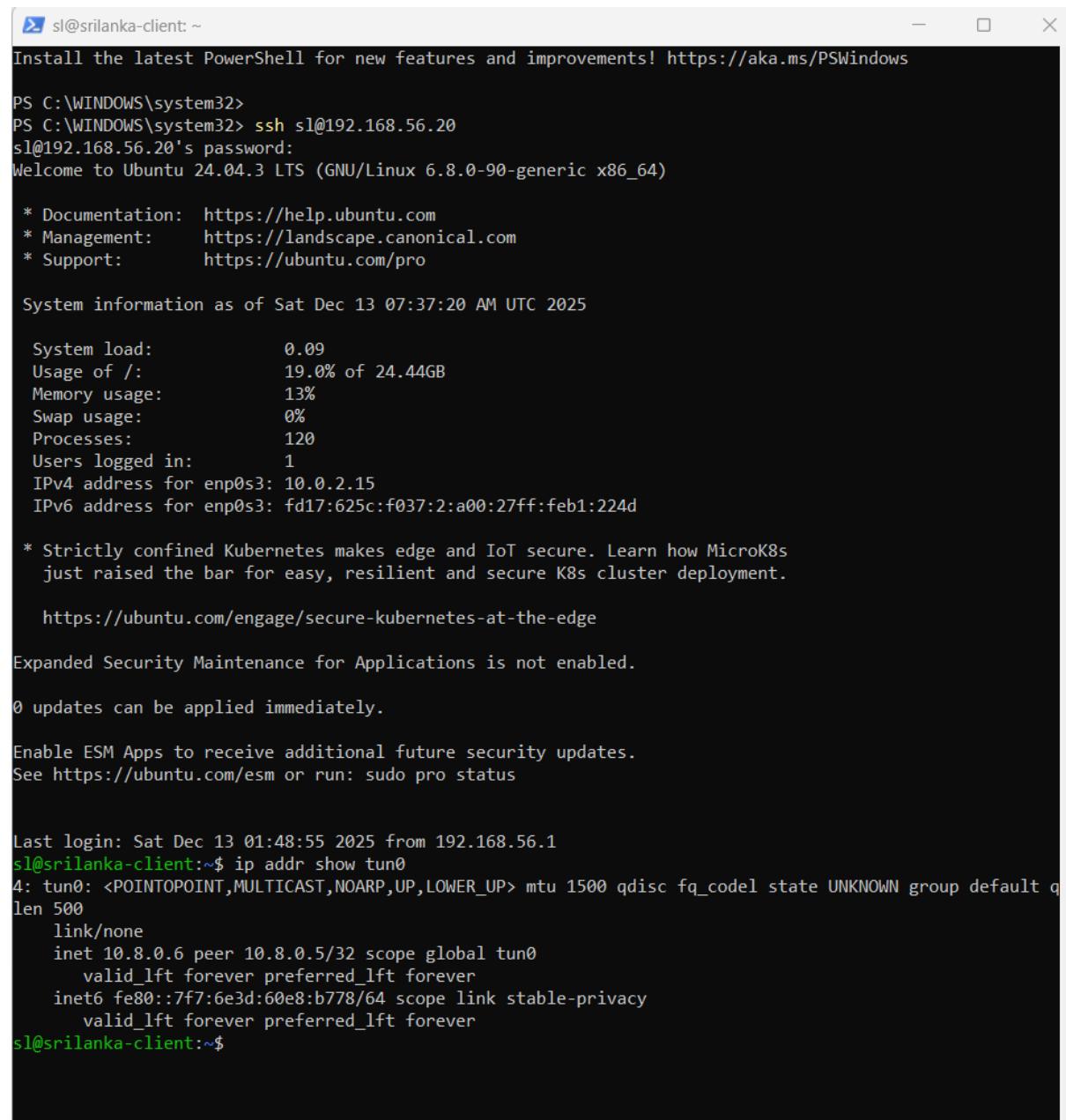
## 6 VPN Verification

VPN connectivity was verified using the following tests:

- ip addr show tun0 to confirm VPN interface
- ping 10.8.0.1 from SriLanka-Client

All ping tests showed 0% packet loss, confirming a stable and secure VPN tunnel.

## 6.1 TUN0 Interface on Client



```
sl@srilanka-client: ~
Install the latest PowerShell for new features and improvements! https://aka.ms/PSWindows

PS C:\WINDOWS\system32>
PS C:\WINDOWS\system32> ssh sl@192.168.56.20
sl@192.168.56.20's password:
Welcome to Ubuntu 24.04.3 LTS (GNU/Linux 6.8.0-90-generic x86_64)

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

System information as of Sat Dec 13 07:37:20 AM UTC 2025

System load:          0.09
Usage of /:           19.0% of 24.44GB
Memory usage:         13%
Swap usage:           0%
Processes:            120
Users logged in:     1
IPv4 address for enp0s3: 10.0.2.15
IPv6 address for enp0s3: fd17:625c:f037:2:a00:27ff:feb1:224d

* Strictly confined Kubernetes makes edge and IoT secure. Learn how MicroK8s just raised the bar for easy, resilient and secure K8s cluster deployment.

https://ubuntu.com/engage/secure-kubernetes-at-the-edge

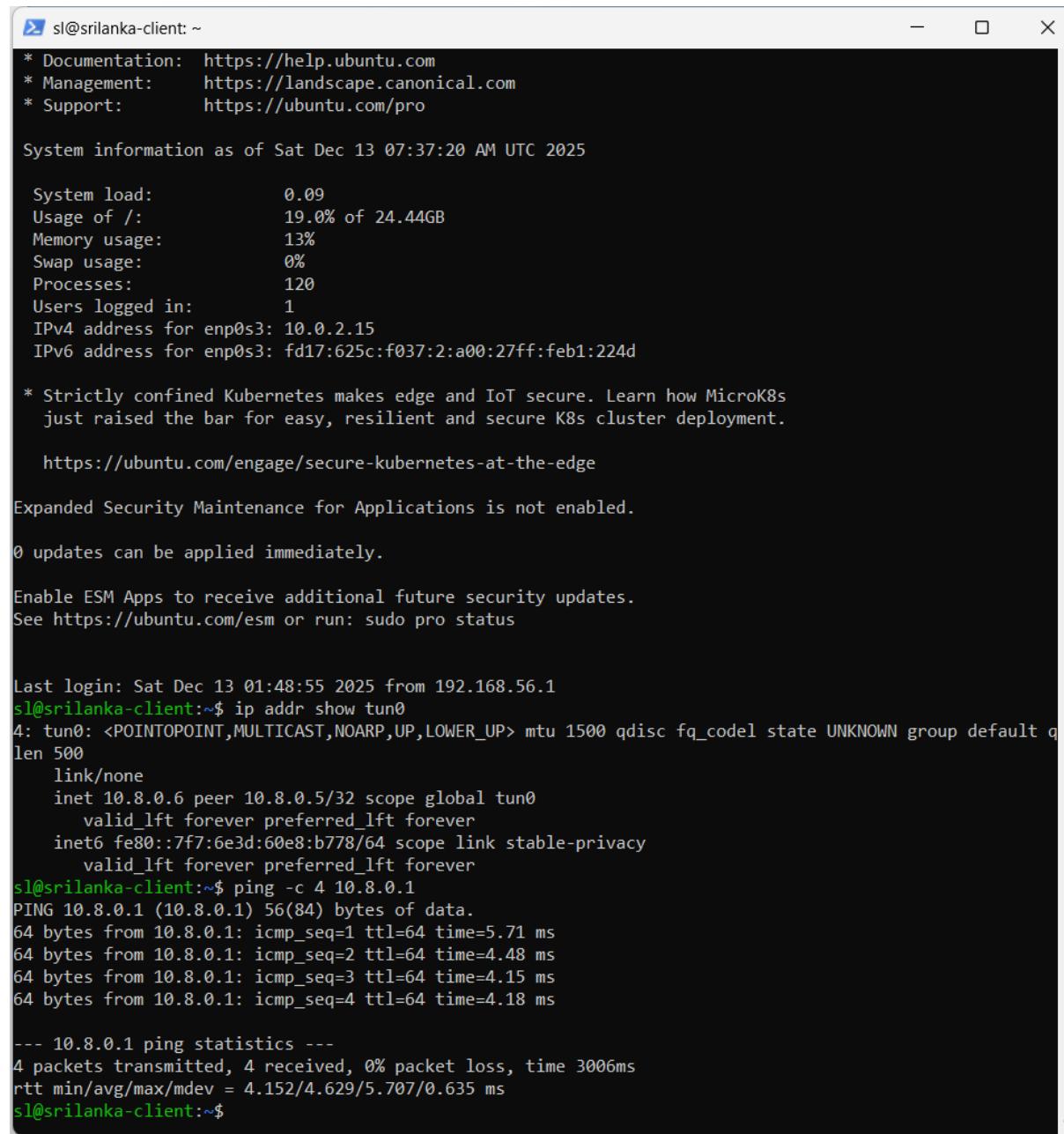
Expanded Security Maintenance for Applications is not enabled.

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

Last login: Sat Dec 13 01:48:55 2025 from 192.168.56.1
sl@srilanka-client:~$ ip addr show tun0
4: tun0: <POINTOPOINT,MULTICAST,NOARP,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UNKNOWN group default qlen 500
    link/none
    inet 10.8.0.6 peer 10.8.0.5/32 scope global tun0
        valid_lft forever preferred_lft forever
    inet6 fe80::7f7:6e3d:60e8:b778/64 scope link stable-privacy
        valid_lft forever preferred_lft forever
sl@srilanka-client:~$
```

## 6.2 Successful Ping to 10.8.0.1



sl@srilanka-client: ~

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

System information as of Sat Dec 13 07:37:20 AM UTC 2025

System load: 0.09
Usage of /: 19.0% of 24.44GB
Memory usage: 13%
Swap usage: 0%
Processes: 120
Users logged in: 1
IPv4 address for enp0s3: 10.0.2.15
IPv6 address for enp0s3: fd17:625c:f037:2:a00:27ff:feb1:224d

* Strictly confined Kubernetes makes edge and IoT secure. Learn how MicroK8s just raised the bar for easy, resilient and secure K8s cluster deployment.

https://ubuntu.com/engage/secure-kubernetes-at-the-edge

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

Last login: Sat Dec 13 01:48:55 2025 from 192.168.56.1
sl@srilanka-client:~$ ip addr show tun0
4: tun0: <POINTOPOINT,MULTICAST,NOARP,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UNKNOWN group default qlen 500
    link/none
    inet 10.8.0.6 peer 10.8.0.5/32 scope global tun0
        valid_lft forever preferred_lft forever
    inet6 fe80::7f7:6e3d:60e8:b778/64 scope link stable-privacy
        valid_lft forever preferred_lft forever
sl@srilanka-client:~$ ping -c 4 10.8.0.1
PING 10.8.0.1 (10.8.0.1) 56(84) bytes of data.
64 bytes from 10.8.0.1: icmp_seq=1 ttl=64 time=5.71 ms
64 bytes from 10.8.0.1: icmp_seq=2 ttl=64 time=4.48 ms
64 bytes from 10.8.0.1: icmp_seq=3 ttl=64 time=4.15 ms
64 bytes from 10.8.0.1: icmp_seq=4 ttl=64 time=4.18 ms

--- 10.8.0.1 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3006ms
rtt min/avg/max/mdev = 4.152/4.629/5.707/0.635 ms
sl@srilanka-client:~$
```

## 7 Samba Server Setup (US-Server)

### 7.1 Installing Samba

Samba was installed to provide a network file-sharing service for the project data.

### 7.2 Creating Shared Directory

A directory `/srv/samba/biomed-share` was created and configured with appropriate permissions. A test file was added to verify access.

## 7.3 Samba Configuration

A secure Samba share named biomed-share was configured with:

- Authenticated user access only
- Read and write permissions
- Restricted to the Samba user smbuser

The Samba service was restarted and verified to be running.

### 7.3.1 Samba Service Active

```
info: Adding new user `smbuser' to supplemental / extra groups `users' ...
info: Adding user `smbuser' to group `users' ...
us@us-server:~/easy-rsa$ sudo smbpasswd -a smbuser
New SMB password:
Retype new SMB password:
Added user smbuser.
us@us-server:~/easy-rsa$ sudo smbpasswd -e smbuser
Enabled user smbuser.
us@us-server:~/easy-rsa$ sudo ufw allow Samba
Rule added
Rule added (v6)
us@us-server:~/easy-rsa$ sudo ufw status
Status: active

To                         Action      From
--                         --          --
1194/udp                   ALLOW       Anywhere
22/tcp                      ALLOW       Anywhere
Samba                      ALLOW       Anywhere
1194/udp (v6)               ALLOW       Anywhere (v6)
22/tcp (v6)                 ALLOW       Anywhere (v6)
Samba (v6)                  ALLOW       Anywhere (v6)

us@us-server:~/easy-rsa$ sudo systemctl restart smbd
us@us-server:~/easy-rsa$ sudo systemctl enable smbd
Synchronizing state of smbd.service with SysV service script with /usr/lib/systemd/systemd-sysv-install.
Executing: /usr/lib/systemd/systemd-sysv-install enable smbd
us@us-server:~/easy-rsa$ sudo systemctl status smbd
● smbd.service - Samba SMB Daemon
   Loaded: loaded (/usr/lib/systemd/system/smbd.service; enabled; preset: enabled)
   Active: active (running) since Sat 2025-12-13 07:58:49 UTC; 25s ago
     Docs: man:smbd(8)
           man:samba(7)
           man:smb.conf(5)
 Main PID: 13793 (smbd)
   Status: "smbd: ready to serve connections..."
    Tasks: 3 (limit: 2267)
   Memory: 7.5M (peak: 7.8M)
      CPU: 182ms
    CGroup: /system.slice/smbd.service
              └─13793 /usr/sbin/smbd --foreground --no-process-group
                  ├─13796 "smbd: notifyd" .
                  └─13798 "smbd: cleanupd" 

Dec 13 07:58:49 us-server systemd[1]: Starting smbd.service - Samba SMB Daemon...
Dec 13 07:58:49 us-server (smbd)[13793]: smbd.service: Referenced but unset environment variable evaluat>
Dec 13 07:58:49 us-server systemd[1]: Started smbd.service - Samba SMB Daemon.
lines 1-19/19 (END)
```

### 7.3.2 Testparm Output

```
SMB1 disabled -- no workgroup available
us@us-server:~/easy-rsa$ testparm
Load smb config files from /etc/samba/smb.conf
Loaded services file OK.
Weak crypto is allowed by GnuTLS (e.g. NTLM as a compatibility fallback)

Server role: ROLE_STANDALONE

Press enter to see a dump of your service definitions

# Global parameters
[global]
    log file = /var/log/samba/log.%m
    logging = file
    map to guest = Bad User
    max log size = 1000
    obey pam restrictions = Yes
    pam password change = Yes
    panic action = /usr/share/samba/panic-action %d
    passwd chat = *Enter\snew\s*\spassword:*\ %n\n *Retype\snew\s*\spassword:*\ %n\n *password\supdated
\ssuccessfully* .
    passwd program = /usr/bin/passwd %u
    server role = standalone server
    server string = %h server (Samba, Ubuntu)
    unix password sync = Yes
    usershare allow guests = Yes
    idmap config * : backend = tdb

[printers]
    browseable = No
    comment = All Printers
    create mask = 0700
    path = /var/tmp
    printable = Yes

[print$]
    comment = Printer Drivers
    path = /var/lib/samba/printers

[biomed-share]
    comment = BioMed Confidential Project Share
    create mask = 0755
    path = /srv/samba/biomed-share
    read only = No
    valid users = smbuser
us@us-server:~/easy-rsa$ sudo apt install smbclient -y
```

### 7.3.3 Local Share Listing

```
panic action = /usr/share/samba/panic-action %d
passwd chat = *Enter\snew\s*\spassword:*\ %n\n *Retype\snew\s*\spassword:*\ %n\n *password\supdated
\ssuccessfully* .
passwd program = /usr/bin/passwd %u
server role = standalone server
server string = %h server (Samba, Ubuntu)
unix password sync = Yes
usershare allow guests = Yes
idmap config * : backend = tdb

[printers]
browseable = No
comment = All Printers
create mask = 0700
path = /var/tmp
printable = Yes

[print$]
comment = Printer Drivers
path = /var/lib/samba/printers

[biomed-share]
comment = BioMed Confidential Project Share
create mask = 0755
path = /srv/samba/biomed-share
read only = No
valid users = smbuser
us@us-server:~/easy-rsa$ sudo apt install smbclient -y
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
smbclient is already the newest version (2:4.19.5+dfsg-4ubuntu9.4).
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
us@us-server:~/easy-rsa$ smbclient -L localhost -U smbuser
Password for [WORKGROUP\smbuser]:
      Sharename      Type      Comment
-----  -----
print$        Disk      Printer Drivers
biomed-share   Disk      BioMed Confidential Project Share
IPC$          IPC       IPC Service (us-server server (Samba, Ubuntu))
SMB1 disabled -- no workgroup available
us@us-server:~/easy-rsa$
```

## 8 Accessing Samba from SriLanka-Client via VPN

Samba client tools were installed on the SriLanka-Client. The Samba share was accessed using the VPN IP address (10.8.0.1) to ensure all traffic passed through the encrypted tunnel.

The share was:

- Listed using smbclient
- Accessed interactively
- Mounted locally using CIFS

File read and write operations were tested successfully.

## 8.1 Samba Shares Listed Over VPN

```
sl@srilanka-client: ~
Setting up python3-talloc:amd64 (2.4.2-1build2) ...
Setting up cifs-utils (2:7.0-2ubuntu0.2) ...
update-alternatives: using /usr/lib/x86_64-linux-gnu/cifs-utils/idmapwbs.so to provide /etc/cifs-utils/idmap-plugin (idmap-plugin) in auto mode
Setting up libavahi-common3:amd64 (0.8-13ubuntu6) ...
Setting up libldb2:amd64 (2:2.8.0+samba4.19.5+dfsg-4ubuntu9.4) ...
Setting up libavahi-client3:amd64 (0.8-13ubuntu6) ...
Setting up samba-libs:amd64 (2:4.19.5+dfsg-4ubuntu9.4) ...
Setting up python3-ldb (2:2.8.0+samba4.19.5+dfsg-4ubuntu9.4) ...
Setting up samba-dsdb-modules:amd64 (2:4.19.5+dfsg-4ubuntu9.4) ...
Setting up libsmbclient0:amd64 (2:4.19.5+dfsg-4ubuntu9.4) ...
Setting up libcups2t64:amd64 (2.4.7-1.2ubuntu7.9) ...
Setting up python3-samba (2:4.19.5+dfsg-4ubuntu9.4) ...
Setting up smbclient (2:4.19.5+dfsg-4ubuntu9.4) ...
Setting up samba-common-bin (2:4.19.5+dfsg-4ubuntu9.4) ...
Processing triggers for man-db (2.12.0-4build2) ...
Processing triggers for libc-bin (2.39-0ubuntu8.6) ...
Scanning processes...
Scanning candidates...
Scanning linux images...

Running kernel seems to be up-to-date.

Restarting services...

Service restarts being deferred:
/etc/needrestart/restart.d/dbus.service
systemctl restart systemd-logind.service
systemctl restart unattended-upgrades.service

No containers need to be restarted.

User sessions running outdated binaries:
sl @ session #1: login[942]
sl @ session #23: sshd[2628]
sl @ user manager service: systemd[1165]

No VM guests are running outdated hypervisor (qemu) binaries on this host.
sl@srilanka-client:~$ smbclient -L 10.8.0.1 -U smbuser
Password for [WORKGROUP\smbuser]:
      Sharename          Type      Comment
      -----          ----      -----
      print$            Disk      Printer Drivers
      biomed-share      Disk      BioMed Confidential Project Share
      IPC$              IPC       IPC Service (us-server server (Samba, Ubuntu))
SMB1 disabled -- no workgroup available
sl@srilanka-client:~$
```

## 8.2 File Listing Inside Share

```
sl@srilanka-client: ~
Processing triggers for man-db (2.12.0-4build2) ...
Processing triggers for libc-bin (2.39-0ubuntu8.6) ...
Scanning processes...
Scanning candidates...
Scanning linux images...

Running kernel seems to be up-to-date.

Restarting services...

Service restarts being deferred:
/etc/needrestart/restart.d/dbus.service
systemctl restart systemd-logind.service
systemctl restart unattended-upgrades.service

No containers need to be restarted.

User sessions running outdated binaries:
sl @ session #1: login[942]
sl @ session #23: sshd[2628]
sl @ user manager service: systemd[1165]

No VM guests are running outdated hypervisor (qemu) binaries on this host.
sl@srilanka-client:~$ smbclient -L 10.8.0.1 -U smbuser
Password for [WORKGROUP\smbuser]:
      Sharename      Type      Comment
      -----      ----
      print$        Disk      Printer Drivers
      biomed-share   Disk      BioMed Confidential Project Share
      IPC$          IPC       IPC Service (us-server server (Samba, Ubuntu))
SMB1 disabled -- no workgroup available
sl@srilanka-client:~$ smbclient //10.8.0.1/biomed-share -U smbuser
Password for [WORKGROUP\smbuser]:
Try "help" to get a list of possible commands.
smb: \> ls
.
..
project-data.txt
      Sharename      Type      Comment
      -----      ----
      print$        Disk      Printer Drivers
      biomed-share   Disk      BioMed Confidential Project Share
      IPC$          IPC       IPC Service (us-server server (Samba, Ubuntu))
SMB1 disabled -- no workgroup available
smb: \> get project-data.txt
getting file \project-data.txt of size 45 as project-data.txt (1.5 KiloBytes/sec) (average 1.5 KiloBytes/sec)
smb: \> !ls
client-configs  project-data.txt  vpn-config
smb: \> exit
sl@srilanka-client:~$
```

### 8.3 Mounted Share with Files

```
sl@srilanka-client: ~
Service restarts being deferred:
/etc/needrestart/restart.d/dbus.service
systemctl restart systemd-logind.service
systemctl restart unattended-upgrades.service

No containers need to be restarted.

User sessions running outdated binaries:
sl @ session #1: login[942]
sl @ session #23: sshd[2628]
sl @ user manager service: systemd[1165]

No VM guests are running outdated hypervisor (qemu) binaries on this host.
sl@srilanka-client:~$ smbclient -L 10.8.0.1 -U smbuser
Password for [WORKGROUP\smbuser]:
      Sharename      Type      Comment
      -----      ----      -----
      print$        Disk      Printer Drivers
      biomed-share  Disk      BioMed Confidential Project Share
      IPC$          IPC       IPC Service (us-server server (Samba, Ubuntu))
SMB1 disabled -- no workgroup available
sl@srilanka-client:~$ smbclient //10.8.0.1/biomed-share -U smbuser
Password for [WORKGROUP\smbuser]:
Try "help" to get a list of possible commands.
smb: \> ls
.
..
project-data.txt
               D      0  Sat Dec 13 07:51:47 2025
               D      0  Sat Dec 13 07:51:47 2025
               N     45  Sat Dec 13 07:51:47 2025

      25623780 blocks of size 1024. 19292684 blocks available
smb: \> get project-data.txt
getting file \project-data.txt of size 45 as project-data.txt (1.5 KiloBytes/sec) (average 1.5 KiloBytes/sec)
smb: \> !ls
client-configs  project-data.txt  vpn-config
smb: \> exit
sl@srilanka-client:~$ sudo mkdir -p /mnt/us-biomed-share
sl@srilanka-client:~$ sudo mount -t cifs //10.8.0.1/biomed-share /mnt/us-biomed-share \
-o username=smbuser,password=1234
sl@srilanka-client:~$ ls -la /mnt/us-biomed-share/
total 8
drwxr-xr-x 2 root root    0 Dec 13 07:51 .
drwxr-xr-x 3 root root 4096 Dec 13 09:09 ..
-rw-rxr-x 1 root root   45 Dec 13 07:51 project-data.txt
sl@srilanka-client:~$ cat /mnt/us-biomed-share/project-data.txt
Confidential BioMed Project Data - US Office
sl@srilanka-client:~$
```

## 8.4 File Created on Client Visible on Server

```
sl@srilanka-client: ~
sl @ session #23: sshd[2628]
sl @ user manager service: systemd[1165]

No VM guests are running outdated hypervisor (qemu) binaries on this host.
sl@srilanka-client:~$ smbclient -L 10.8.0.1 -U smbuser
Password for [WORKGROUP\smbuser]:  

  
Sharename      Type      Comment
-----        ----
print$         Disk      Printer Drivers
biomed-share   Disk      BioMed Confidential Project Share
IPC$          IPC       IPC Service (us-server server (Samba, Ubuntu))
SMB1 disabled -- no workgroup available
sl@srilanka-client:~$ smbclient //10.8.0.1/biomed-share -U smbuser
Password for [WORKGROUP\smbuser]:  

Try "help" to get a list of possible commands.
smb: \> ls
.
..
project-data.txt          D      0  Sat Dec 13 07:51:47 2025
                           D      0  Sat Dec 13 07:51:47 2025
                           N     45  Sat Dec 13 07:51:47 2025

25623780 blocks of size 1024. 19292684 blocks available
smb: \> get project-data.txt
getting file \project-data.txt of size 45 as project-data.txt (1.5 KiloBytes/sec) (average 1.5 KiloBytes/sec)
smb: \> !ls
client-configs  project-data.txt  vpn-config
smb: \> exit
sl@srilanka-client:~$ sudo mkdir -p /mnt/us-biomed-share
sl@srilanka-client:~$ sudo mount -t cifs //10.8.0.1/biomed-share /mnt/us-biomed-share \
-o username=smbuser,password=1234
sl@srilanka-client:~$ ls -la /mnt/us-biomed-share/
total 8
drwxr-xr-x 2 root root    0 Dec 13 07:51 .
drwxr-xr-x 3 root root 4096 Dec 13 09:09 ..
-rw-rxr-x 1 root root    45 Dec 13 07:51 project-data.txt
sl@srilanka-client:~$ cat /mnt/us-biomed-share/project-data.txt
Confidential BioMed Project Data - US Office
sl@srilanka-client:~$ echo "AI/ML Algorithm Data - Sri Lanka Office" | sudo tee /mnt/us-biomed-share/srilanka-data.txt
AI/ML Algorithm Data - Sri Lanka Office
sl@srilanka-client:~$ ls -la /mnt/us-biomed-share/
total 12
drwxr-xr-x 2 root root    0 Dec 13 09:14 .
drwxr-xr-x 3 root root 4096 Dec 13 09:09 ..
-rw-rxr-x 1 root root    45 Dec 13 07:51 project-data.txt
-rw-rxr-x 1 root root    40 Dec 13 09:14 srilanka-data.txt
sl@srilanka-client:~$
```

## 9 Final Verification and Testing

This phase verifies that the VPN tunnel between the US Server and the Sri Lanka Client is successfully established and that secure file sharing via Samba is functioning correctly over the VPN.

### 9.1 VPN Tunnel Verification (Sri Lanka Client)

#### Commands executed:

```
ip addr show tun0 ping -c 4 10.8.0.1
```

### Expected Outcome:

- tun0 interface is active with an IP address in the 10.8.0.0/24 range
- Successful ping responses confirm VPN connectivity with the US Server

```
sl@srilanka-client: ~
getting file \project-data.txt of size 45 as project-data.txt (1.5 KiloBytes/sec) (average 1.5 KiloBytes/sec)
smb: \> !ls
client-configs  project-data.txt  vpn-config
smb: \> exit
sl@srilanka-client:~$ sudo mkdir -p /mnt/us-biomed-share
sl@srilanka-client:~$ sudo mount -t cifs //10.8.0.1/biomed-share /mnt/us-biomed-share \
-o username=smbuser,password=1234
sl@srilanka-client:~$ ls -la /mnt/us-biomed-share/
total 8
drwxr-xr-x 2 root root    0 Dec 13 07:51 .
drwxr-xr-x 3 root root 4096 Dec 13 09:09 ..
-rw-r-xr-x 1 root root   45 Dec 13 07:51 project-data.txt
sl@srilanka-client:~$ cat /mnt/us-biomed-share/project-data.txt
Confidential BioMed Project Data - US Office
sl@srilanka-client:~$ echo "AI/ML Algorithm Data - Sri Lanka Office" | sudo tee /mnt/us-biomed-share/srilanka-data.txt
AI/ML Algorithm Data - Sri Lanka Office
sl@srilanka-client:~$ ls -la /mnt/us-biomed-share/
total 12
drwxr-xr-x 2 root root    0 Dec 13 09:14 .
drwxr-xr-x 3 root root 4096 Dec 13 09:09 ..
-rw-r-xr-x 1 root root   45 Dec 13 07:51 project-data.txt
-rw-r-xr-x 1 root root   40 Dec 13 09:14 srilanka-data.txt
sl@srilanka-client:~$ ls -la /srv/samba/biomed-share/
ls: cannot access '/srv/samba/biomed-share/': No such file or directory
sl@srilanka-client:~$ ip addr show tun0
4: tun0: <POINTOPOINT,MULTICAST,NOARP,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UNKNOWN group default qlen 500
    link/none
    inet 10.8.0.6 peer 10.8.0.5/32 scope global tun0
        valid_lft forever preferred_lft forever
        inet6 fe80::7f7:6e3d:60e8:b778/64 scope link stable-privacy
            valid_lft forever preferred_lft forever
sl@srilanka-client:~$ ping -c 4 10.8.0.1
PING 10.8.0.1 (10.8.0.1) 56(84) bytes of data.
64 bytes from 10.8.0.1: icmp_seq=1 ttl=64 time=5.38 ms
64 bytes from 10.8.0.1: icmp_seq=2 ttl=64 time=4.02 ms
64 bytes from 10.8.0.1: icmp_seq=3 ttl=64 time=3.77 ms
64 bytes from 10.8.0.1: icmp_seq=4 ttl=64 time=4.25 ms

--- 10.8.0.1 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3012ms
rtt min/avg/max/mdev = 3.772/4.354/5.379/0.615 ms
sl@srilanka-client:~$
```

## 9.2 Samba Share Mount Verification

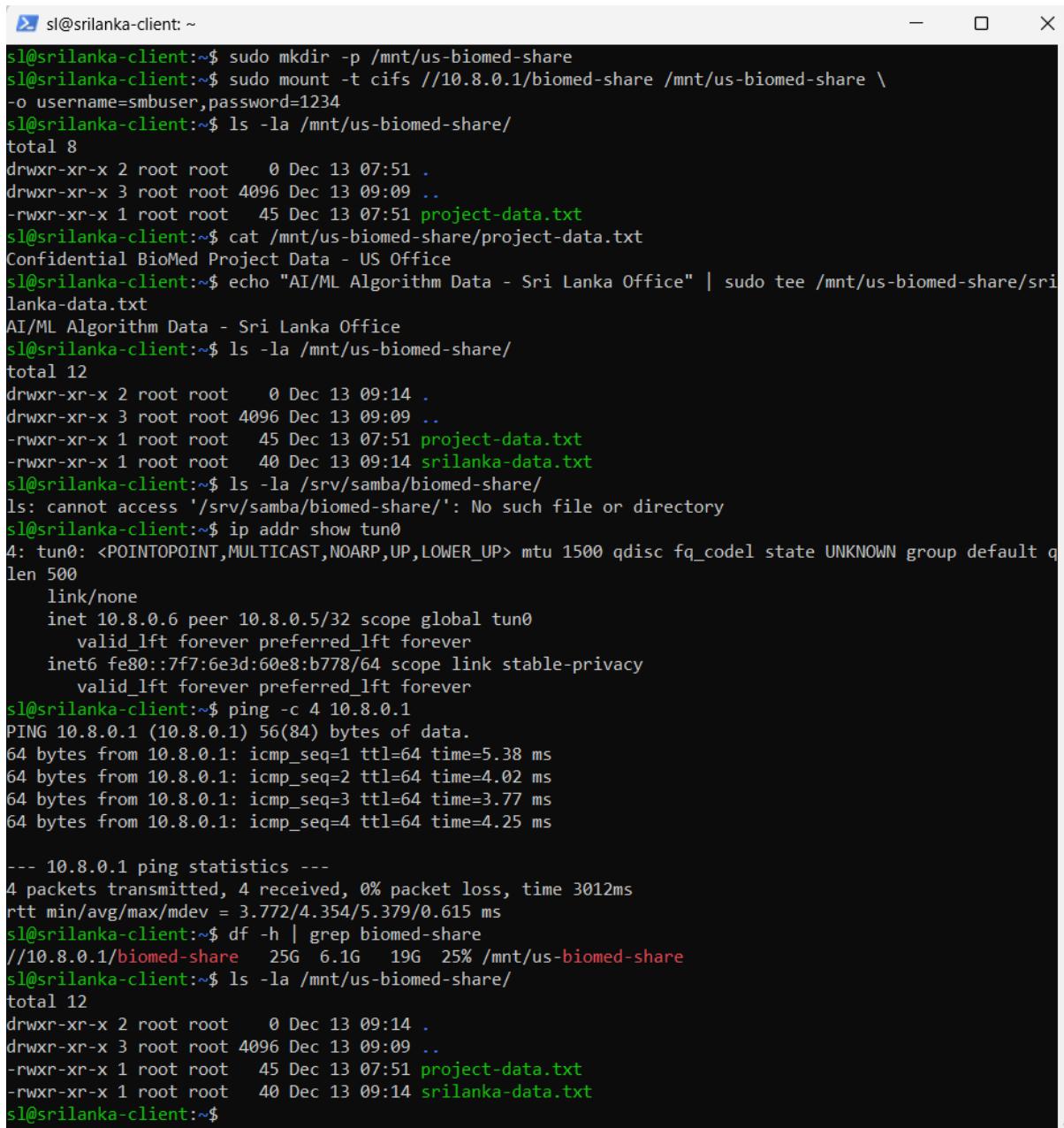
### Commands executed:

```
df -h | grep biomed-share
ls -la /mnt/us-
biomed-share/
```

### Expected Outcome:

- Samba share is mounted successfully

- Files inside the shared directory are visible



```

sl@srilanka-client:~$ sudo mkdir -p /mnt/us-biomed-share
sl@srilanka-client:~$ sudo mount -t cifs //10.8.0.1/biomed-share /mnt/us-biomed-share \
-o username=smbuser,password=1234
sl@srilanka-client:~$ ls -la /mnt/us-biomed-share/
total 8
drwxr-xr-x 2 root root 0 Dec 13 07:51 .
drwxr-xr-x 3 root root 4096 Dec 13 09:09 ..
-rw-r--r-- 1 root root 45 Dec 13 07:51 project-data.txt
sl@srilanka-client:~$ cat /mnt/us-biomed-share/project-data.txt
Confidential BioMed Project Data - US Office
sl@srilanka-client:~$ echo "AI/ML Algorithm Data - Sri Lanka Office" | sudo tee /mnt/us-biomed-share/srilanka-data.txt
AI/ML Algorithm Data - Sri Lanka Office
sl@srilanka-client:~$ ls -la /mnt/us-biomed-share/
total 12
drwxr-xr-x 2 root root 0 Dec 13 09:14 .
drwxr-xr-x 3 root root 4096 Dec 13 09:09 ..
-rw-r--r-- 1 root root 45 Dec 13 07:51 project-data.txt
-rw-r--r-- 1 root root 40 Dec 13 09:14 srilanka-data.txt
sl@srilanka-client:~$ ls -la /srv/samba/biomed-share/
ls: cannot access '/srv/samba/biomed-share/': No such file or directory
sl@srilanka-client:~$ ip addr show tun0
4: tun0: <POINTOPOINT,MULTICAST,NOARP,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UNKNOWN group default qlen 500
    link/none
    inet 10.8.0.6 peer 10.8.0.5/32 scope global tun0
        valid_lft forever preferred_lft forever
    inet6 fe80::7f7:6e3d:60e8:b778/64 scope link stable-privacy
        valid_lft forever preferred_lft forever
sl@srilanka-client:~$ ping -c 4 10.8.0.1
PING 10.8.0.1 (10.8.0.1) 56(84) bytes of data.
64 bytes from 10.8.0.1: icmp_seq=1 ttl=64 time=5.38 ms
64 bytes from 10.8.0.1: icmp_seq=2 ttl=64 time=4.02 ms
64 bytes from 10.8.0.1: icmp_seq=3 ttl=64 time=3.77 ms
64 bytes from 10.8.0.1: icmp_seq=4 ttl=64 time=4.25 ms

--- 10.8.0.1 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3012ms
rtt min/avg/max/mdev = 3.772/4.354/5.379/0.615 ms
sl@srilanka-client:~$ df -h | grep biomed-share
//10.8.0.1/biomed-share 25G 6.1G 19G 25% /mnt/us-biomed-share
sl@srilanka-client:~$ ls -la /mnt/us-biomed-share/
total 12
drwxr-xr-x 2 root root 0 Dec 13 09:14 .
drwxr-xr-x 3 root root 4096 Dec 13 09:09 ..
-rw-r--r-- 1 root root 45 Dec 13 07:51 project-data.txt
-rw-r--r-- 1 root root 40 Dec 13 09:14 srilanka-data.txt
sl@srilanka-client:~$
```

## 9.3 Samba Server Accessibility Test

### Command executed:

```
smbclient -L 10.8.0.1 -U smbuser
```

### Expected Outcome:

- Samba shares hosted on the US Server are listed successfully
- Confirms Samba access over VPN

```

sl@srilanka-client: ~
Confidential BioMed Project Data - US Office
sl@srilanka-client:~$ echo "AI/ML Algorithm Data - Sri Lanka Office" | sudo tee /mnt/us-biomed-share/srilanka-data.txt
AI/ML Algorithm Data - Sri Lanka Office
sl@srilanka-client:~$ ls -la /mnt/us-biomed-share/
total 12
drwxr-xr-x 2 root root 0 Dec 13 09:14 .
drwxr-xr-x 3 root root 4096 Dec 13 09:09 ..
-rw-rxr-xr-x 1 root root 45 Dec 13 07:51 project-data.txt
-rw-rxr-xr-x 1 root root 40 Dec 13 09:14 srilanka-data.txt
sl@srilanka-client:~$ ls -la /srv/samba/biomed-share/
ls: cannot access '/srv/samba/biomed-share/': No such file or directory
sl@srilanka-client:~$ ip addr show tun0
4: tun0: <POINTOPOINT,MULTICAST,NOARP,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UNKNOWN group default qlen 500
    link/none
    inet 10.8.0.6 peer 10.8.0.5/32 scope global tun0
        valid_lft forever preferred_lft forever
        inet6 fe80::7f7:6e3d:60e8:b778/64 scope link stable-privacy
            valid_lft forever preferred_lft forever
sl@srilanka-client:~$ ping -c 4 10.8.0.1
PING 10.8.0.1 (10.8.0.1) 56(84) bytes of data.
64 bytes from 10.8.0.1: icmp_seq=1 ttl=64 time=5.38 ms
64 bytes from 10.8.0.1: icmp_seq=2 ttl=64 time=4.02 ms
64 bytes from 10.8.0.1: icmp_seq=3 ttl=64 time=3.77 ms
64 bytes from 10.8.0.1: icmp_seq=4 ttl=64 time=4.25 ms

--- 10.8.0.1 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3012ms
rtt min/avg/max/mdev = 3.772/4.354/5.379/0.615 ms
sl@srilanka-client:~$ df -h | grep biomed-share
//10.8.0.1/biomed-share 25G 6.1G 19G 25% /mnt/us-biomed-share
sl@srilanka-client:~$ ls -la /mnt/us-biomed-share/
total 12
drwxr-xr-x 2 root root 0 Dec 13 09:14 .
drwxr-xr-x 3 root root 4096 Dec 13 09:09 ..
-rw-rxr-xr-x 1 root root 45 Dec 13 07:51 project-data.txt
-rw-rxr-xr-x 1 root root 40 Dec 13 09:14 srilanka-data.txt
sl@srilanka-client:~$ smbclient -L 10.8.0.1 -U smbuser
Password for [WORKGROUP\smbuser]:
      Sharename          Type      Comment
      -----
      print$            Disk      Printer Drivers
      biomed-share      Disk      BioMed Confidential Project Share
      IPC$              IPC       IPC Service (us-server server (Samba, Ubuntu))
SMB1 disabled -- no workgroup available
sl@srilanka-client:~$
```

## 9.4 Two-Way File Sharing Confirmation

To confirm bidirectional file sharing, the US Server was used to verify files created from the Sri Lanka Client.

```

ls -la /srv/samba/biomed-share/
cat /srv/samba/biomed-share/srilanka-data.txt

```

### Expected Outcome:

- Files created on the Sri Lanka Client are visible on the US Server
- File contents can be read successfully

```
us@us-server: ~
Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

Install the latest PowerShell for new features and improvements! https://aka.ms/PSWindows

PS C:\WINDOWS\system32> ssh us@192.168.56.10
us@192.168.56.10's password:
Welcome to Ubuntu 24.04.3 LTS (GNU/Linux 6.8.0-90-generic x86_64)

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

System information as of Sat Dec 13 09:17:18 AM UTC 2025

System load:          0.0
Usage of /:           19.5% of 24.44GB
Memory usage:         15%
Swap usage:          0%
Processes:            122
Users logged in:     1
IPv4 address for enp0s3: 10.0.2.15
IPv6 address for enp0s3: fd17:625c:f037:2:a00:27ff:fe51:1d0a

Expanded Security Maintenance for Applications is not enabled.

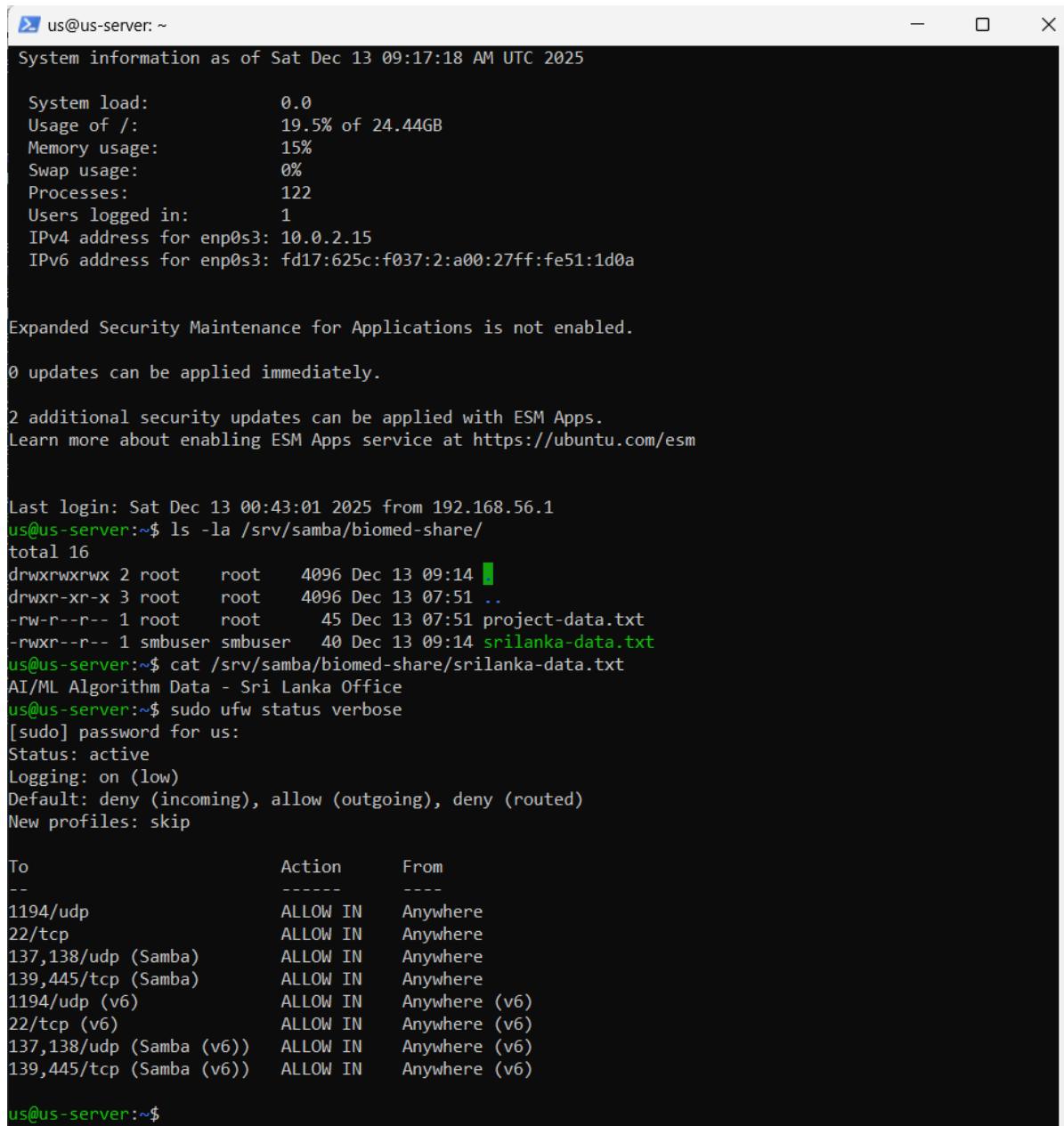
0 updates can be applied immediately.

2 additional security updates can be applied with ESM Apps.
Learn more about enabling ESM Apps service at https://ubuntu.com/esm

Last login: Sat Dec 13 00:43:01 2025 from 192.168.56.1
us@us-server:~$ ls -la /srv/samba/biomed-share/
total 16
drwxrwxrwx 2 root      root      4096 Dec 13 09:14 .
drwxr-xr-x 3 root      root      4096 Dec 13 07:51 ..
-rw-r--r-- 1 root      root      45 Dec 13 07:51 project-data.txt
-rw-r--r-- 1 smbuser   smbuser   40 Dec 13 09:14 srilanka-data.txt
us@us-server:~$ cat /srv/samba/biomed-share/srilanka-data.txt
AI/ML Algorithm Data - Sri Lanka Office
us@us-server:~$
```

## 10 Security Considerations

- OpenVPN encrypts all traffic between Sri Lanka and US
- Samba is accessible only through the VPN subnet
- UFW firewall allows only required services (OpenVPN, SSH, Samba)
- Private keys are masked in screenshots



```
us@us-server: ~
System information as of Sat Dec 13 09:17:18 AM UTC 2025

System load:          0.0
Usage of /:           19.5% of 24.44GB
Memory usage:         15%
Swap usage:           0%
Processes:            122
Users logged in:     1
IPv4 address for enp0s3: 10.0.2.15
IPv6 address for enp0s3: fd17:625c:f037:2:a00:27ff:fe51:1d0a

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

2 additional security updates can be applied with ESM Apps.
Learn more about enabling ESM Apps service at https://ubuntu.com/esm

Last login: Sat Dec 13 00:43:01 2025 from 192.168.56.1
us@us-server:~$ ls -la /srv/samba/biomed-share/
total 16
drwxrwxrwx 2 root      root    4096 Dec 13 09:14 .
drwxr-xr-x 3 root      root    4096 Dec 13 07:51 ..
-rw-r--r-- 1 root      root     45 Dec 13 07:51 project-data.txt
-rw-r--r-- 1 smbuser   smbuser   40 Dec 13 09:14 srilanka-data.txt
us@us-server:~$ cat /srv/samba/biomed-share/srilanka-data.txt
AI/ML Algorithm Data - Sri Lanka Office
us@us-server:~$ sudo ufw status verbose
[sudo] password for us:
Status: active
Logging: on (low)
Default: deny (incoming), allow (outgoing), deny (routed)
New profiles: skip

To                  Action     From
--                  ----      ---
1194/udp           ALLOW IN  Anywhere
22/tcp              ALLOW IN  Anywhere
137,138/udp (Samba) ALLOW IN  Anywhere
139,445/tcp (Samba) ALLOW IN  Anywhere
1194/udp (v6)       ALLOW IN  Anywhere (v6)
22/tcp (v6)         ALLOW IN  Anywhere (v6)
137,138/udp (Samba (v6)) ALLOW IN  Anywhere (v6)
139,445/tcp (Samba (v6)) ALLOW IN  Anywhere (v6)

us@us-server:~$
```

## 11 Troubleshooting

- **VPN connection issues:** Check OpenVPN logs and firewall rules
- **Ping failure:** Verify IP forwarding and VPN interface
- **Samba access issues:** Verify service status and user credentials

## 12 Conclusion

A secure OpenVPN tunnel was successfully established between SriLanka-Client and USServer. VPN connectivity was verified with 100% successful ping tests. A Samba server hosted on the US-Server was securely accessed from the SriLanka-Client through the VPN, demonstrating confidential file sharing in a Linux environment.

## 13 Appendix

### 13.1 Server Configuration File

/etc/openvpn/server/server.conf - Shows how the VPN server was configured on the US Server

```
us@us-server: ~
/etc/openvpn/server/server.conf: line 16: compress: command not found
/etc/openvpn/server/server.conf: line 17: push: command not found
/etc/openvpn/server/server.conf: line 19: cipher: command not found
/etc/openvpn/server/server.conf: line 20: auth: command not found
/etc/openvpn/server/server.conf: line 22: user: command not found
/etc/openvpn/server/server.conf: line 23: group: command not found
/etc/openvpn/server/server.conf: line 25: persist-key: command not found
/etc/openvpn/server/server.conf: line 26: persist-tun: command not found
/etc/openvpn/server/server.conf: line 28: status: command not found
/etc/openvpn/server/server.conf: line 29: log-append: command not found
/etc/openvpn/server/server.conf: line 30: verb: command not found
/etc/openvpn/server/server.conf: line 32: explicit-exit-notify: command not found
us@us-server:~$ sudo bash//etc/openvpn/server/server.conf
sudo: bash//etc/openvpn/server/server.conf: command not found
us@us-server:~$ sudo cat /etc/openvpn/server/server.conf
proto udp
dev tun

ca ca.crt
cert us-server.crt
key us-server.key
dh dh.pem
tls-auth ta.key 0

server 10.8.0.0 255.255.255.0
ifconfig-pool-persist /var/log/openvpn/ipp.txt

client-to-client
keepalive 10 120

compress lz4-v2
push "compress lz4-v2"

cipher AES-256-GCM
auth SHA256

user nobody
group nogroup

persist-key
persist-tun

status /var/log/openvpn/openvpn-status.log
log-append /var/log/openvpn/openvpn.log
verb 3

explicit-exit-notify 1
us@us-server:~$
```

## 13.2 Client Configuration File

/etc/openvpn/client/client.conf - Shows how the Sri Lanka client connects securely to the VPN server

```
us@us-server: ~
/etc/openvpn/server/server.conf: line 30: verb: command not found
/etc/openvpn/server/server.conf: line 32: explicit-exit-notify: command not found
us@us-server:~$ sudo bash//etc/openvpn/server/server.conf
sudo: bash//etc/openvpn/server/server.conf: command not found
us@us-server:~$ sudo cat /etc/openvpn/server/server.conf
proto udp
dev tun

ca ca.crt
cert us-server.crt
key us-server.key
dh dh.pem
tls-auth ta.key 0

server 10.8.0.0 255.255.255.0
ifconfig-pool-persist /var/log/openvpn/ipp.txt

client-to-client
keepalive 10 120

compress lz4-v2
push "compress lz4-v2"

cipher AES-256-GCM
auth SHA256

user nobody
group nogroup

persist-key
persist-tun

status /var/log/openvpn/openvpn-status.log
log-append /var/log/openvpn/openvpn.log
verb 3

explicit-exit-notify 1
us@us-server:~$ sudo grep -A 15 "\[biomed-share\]" /etc/samba/smb.conf
[biomed-share]
comment = BioMed Confidential Project Share
path = /srv/samba/biomed-share
browseable = yes
read only = no
guest ok = no
valid users = smbuser
create mask = 0755
directory mask = 0755
us@us-server:~$
```

### 13.3 Samba Configuration File

/etc/samba/smb.conf - Shows the Samba share used for confidential file sharing

```
us@us-server: ~
/etc/openvpn/server.conf: line 30: verb: command not found
/etc/openvpn/server.conf: line 32: explicit-exit-notify: command not found
us@us-server:~$ sudo bash//etc/openvpn/server/server.conf
sudo: bash//etc/openvpn/server/server.conf: command not found
us@us-server:~$ sudo cat /etc/openvpn/server/server.conf
proto udp
dev tun

ca ca.crt
cert us-server.crt
key us-server.key
dh dh.pem
tls-auth ta.key 0

server 10.8.0.0 255.255.255.0
ifconfig-pool-persist /var/log/openvpn/ipp.txt

client-to-client
keepalive 10 120

compress lz4-v2
push "compress lz4-v2"

cipher AES-256-GCM
auth SHA256

user nobody
group nogroup

persist-key
persist-tun

status /var/log/openvpn/openvpn-status.log
log-append /var/log/openvpn/openvpn.log
verb 3

explicit-exit-notify 1
us@us-server:~$ sudo grep -A 15 "[biomed-share]" /etc/samba/smb.conf
[biomed-share]
comment = BioMed Confidential Project Share
path = /srv/samba/biomed-share
browseable = yes
read only = no
guest ok = no
valid users = smbuser
create mask = 0755
directory mask = 0755
us@us-server:~$
```