

# **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

Component	Details
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@sri-lanka-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@sri-lanka-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@sri-lanka-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@sri-lanka-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:fe51:1d0a/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

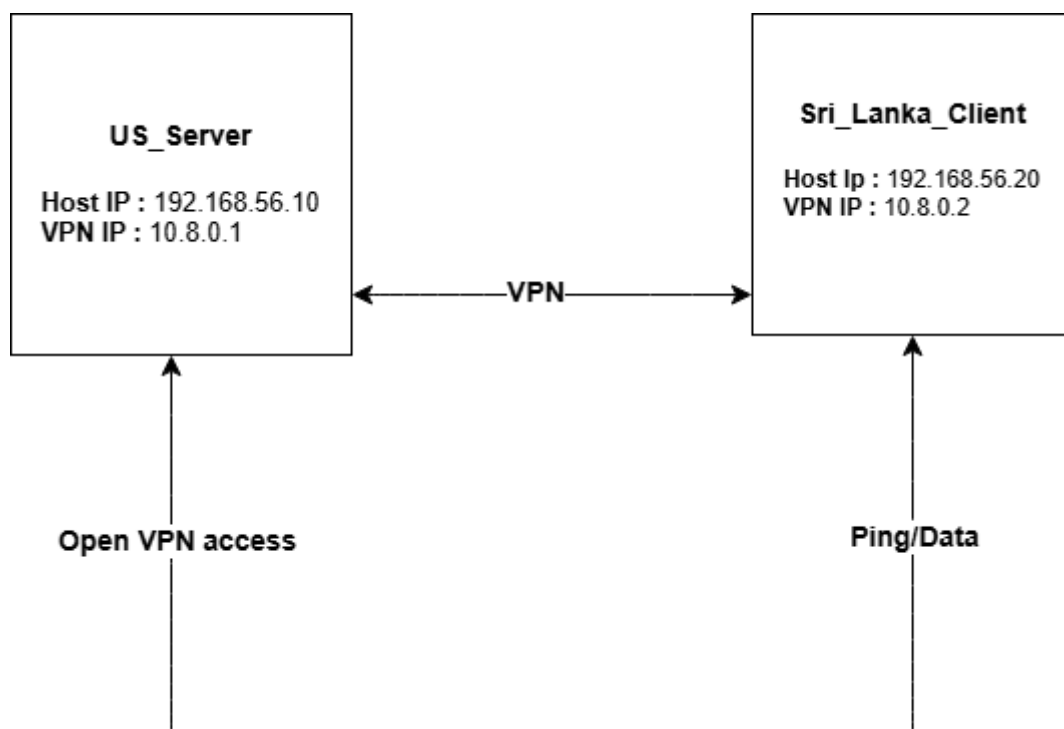
- VPN IP: 10.8.0.

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 libpcsclite1:amd64 (2.0.3-1build1) ...
Setting up libpkcs11-helper1t64: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

[illegible]

## 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$ ./easysrsa 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-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$
```

## 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-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$
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\x2dservice.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.
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

[illegible]

## 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 A
uthentication
2025-12-13 07:24:48 VERIFY ECU 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 TLSv1.3 TLS_AES_256_GCM_SHA384, peer certificate: 2
048 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 10.8.0.0 255.255.2
55.0,topology net30,ping 10,ping-restart 120,ifconfig 10.8.0.6 10.8.0.5,peer-id 0,cipher AES-256-GCM,pro
tocol-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 *Retye\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/ldapw.so to provide /etc/cifs-utils/ldapw.so
map-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  


|                  |   |    |                          |
|------------------|---|----|--------------------------|
| .                | D | 0  | Sat Dec 13 07:51:47 2025 |
| ..               | D | 0  | Sat Dec 13 07:51:47 2025 |
| project-data.txt | 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:~$
```

## 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
.                D           0   Sat Dec 13 07:51:47 2025
..               D           0   Sat Dec 13 07:51:47 2025
project-data.txt 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 ..
-rwxr-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:~$
```

## 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  
  
          D      0 Sat Dec 13 07:51:47 2025  
          D      0 Sat Dec 13 07:51:47 2025  
project-data.txt      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 ..  
-rwxr-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 ..  
-rwxr-xr-x 1 root root  45 Dec 13 07:51 project-data.txt  
-rwxr-xr-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 ..
-rwxr-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/sri
lanka-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 ..
-rwxr-xr-x 1 root root  45 Dec 13 07:51 project-data.txt
-rwxr-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 q
len 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: ~
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 ..
-rwxr-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/sri
lanka-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 ..
-rwxr-xr-x 1 root root  45 Dec 13 07:51 project-data.txt
-rwxr-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 q
len 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 ..
-rwxr-xr-x 1 root root  45 Dec 13 07:51 project-data.txt
-rwxr-xr-x 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 ..
-rwxr-xr-x 1 root root  45 Dec 13 07:51 project-data.txt
-rwxr-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 ..
-rwxr-xr-x 1 root root  45 Dec 13 07:51 project-data.txt
-rwxr-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  
-rwxr--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  
-rwxr--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

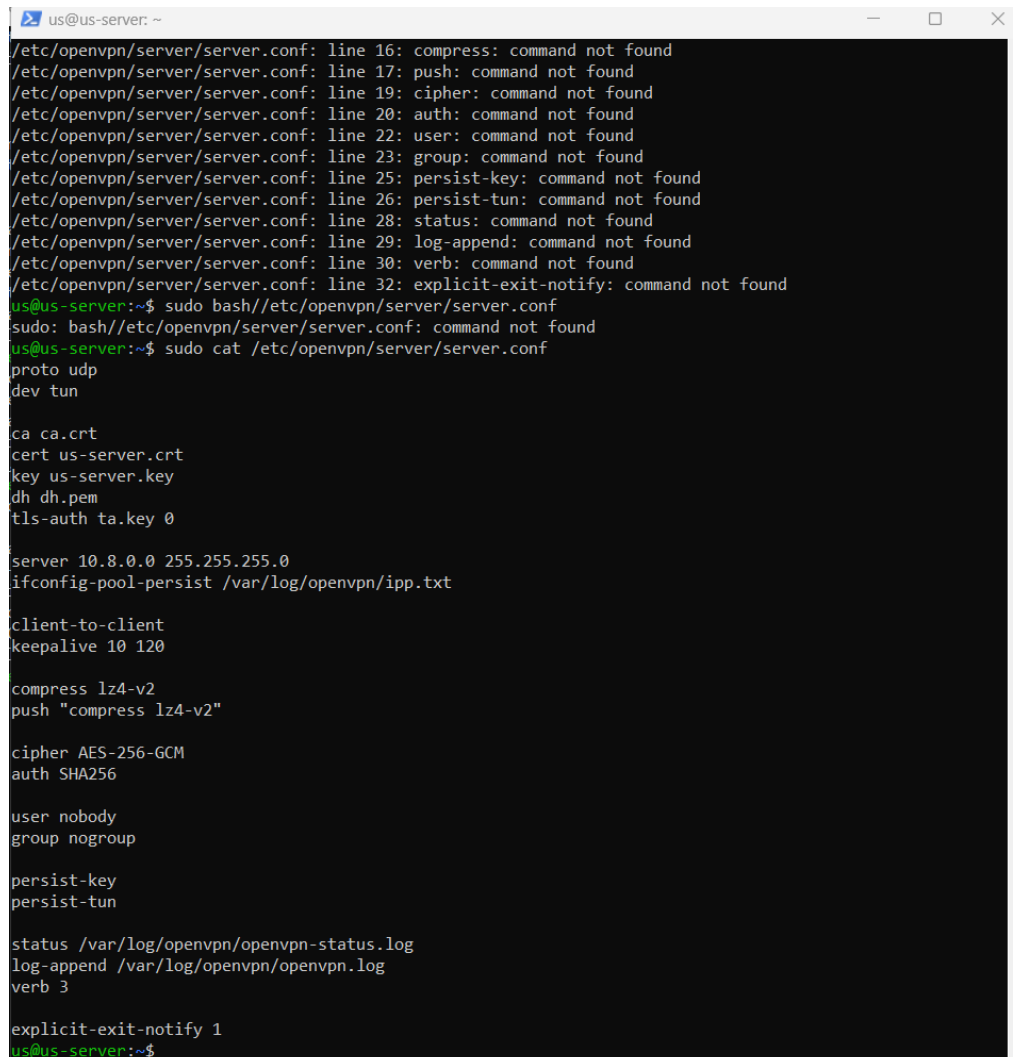
## 12 Conclusion

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

A terminal window titled 'us@us-server: ~' displays the contents of the file /etc/openvpn/server/server.conf. The output shows several lines of configuration, many of which are marked as 'command not found' because the commands are not installed on the system. The configuration includes settings for protocol, device, certificates, server IP, client-to-client communication, compression, cipher, authentication, user/group, persistence, status logging, and explicit-exit-notify.

```
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:~$
```

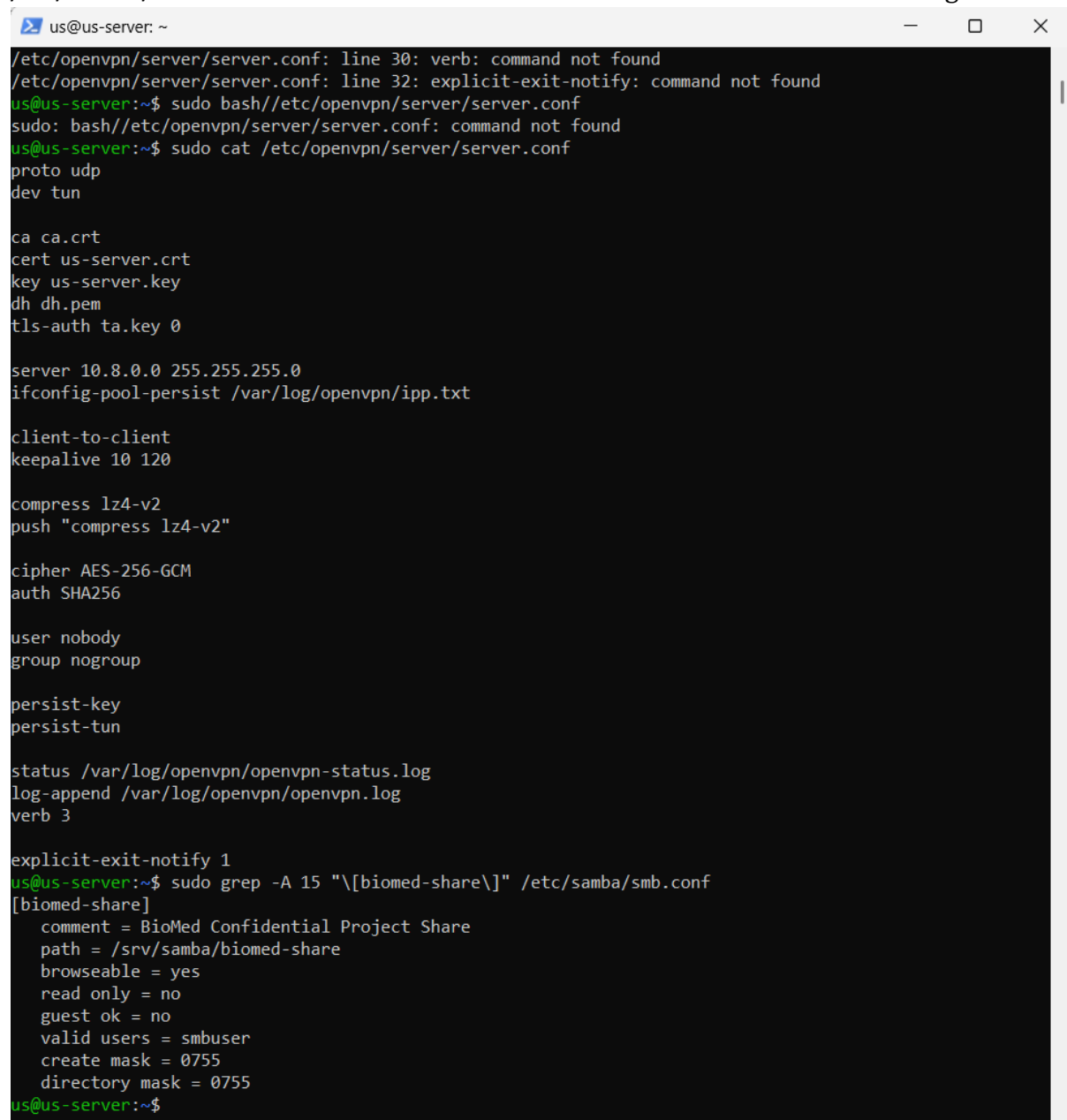
## 13.2 Client Configuration File

/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/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:~$
```