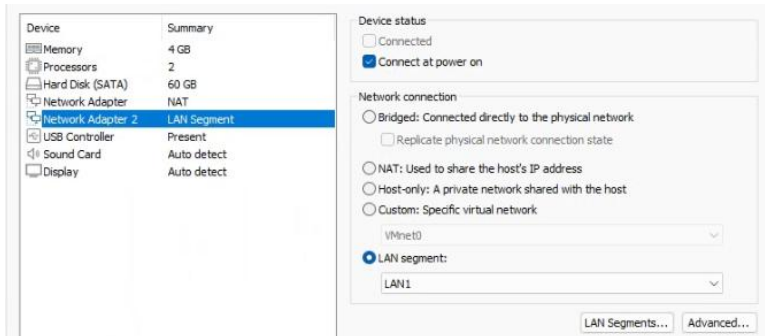


## Exercise 1 – Configuring Network Interfaces on AlmaLinux

### Tasks to Perform on AlmaLinux:

#### Step 1:

1. In your VM configuration, add a **new network interface**, connect it to a new LAN segment, and name it **LAN1**.



#### Step 2:

1. Verify that the **NetworkManager** service is successfully started.

```
gkeymole@server07 ~ $ sudo systemctl status NetworkManager
[sudo] password for gkeymole:
• NetworkManager.service - Network Manager
   Loaded: loaded (/usr/lib/systemd/system/NetworkManager.service; enabled; preset: enabled)
   Active: active (running) since Sat 2025-03-29 18:52:00 EDT; 44s ago
     Docs: man:NetworkManager(8)
   Main PID: 1006 (NetworkManager)
    Tasks: 3 (limit: 22829)
   Memory: 10.2M
      CPU: 79ms
   CGroup: /system.slice/NetworkManager.service
           └─1006 /usr/sbin/NetworkManager --no-daemon

Mar 29 18:52:00 server07 NetworkManager[1006]: <info> [1743288720.7779] policy: set 'ens160' (ens160) as default for
Mar 29 18:52:00 server07 NetworkManager[1006]: <info> [1743288720.7844] device (ens160): state change: ip-config -> >
Mar 29 18:52:00 server07 NetworkManager[1006]: <info> [1743288720.7876] device (ens160): state change: ip-check -> s>
Mar 29 18:52:00 server07 NetworkManager[1006]: <info> [1743288720.7879] device (ens160): state change: secondaries ->
Mar 29 18:52:00 server07 NetworkManager[1006]: <info> [1743288720.7887] manager: NetworkManager state is now CONNECT>
Mar 29 18:52:00 server07 NetworkManager[1006]: <info> [1743288720.7893] device (ens160): Activation: successful, dev>
Mar 29 18:52:00 server07 NetworkManager[1006]: <info> [1743288720.7896] manager: NetworkManager state is now CONNECT>
Mar 29 18:52:00 server07 NetworkManager[1006]: <info> [1743288720.7903] manager: startup complete
Mar 29 18:52:03 server07 NetworkManager[1006]: <info> [1743288723.2225] agent-manager: agent[1cb72489250a9440,:1.24/>
Mar 29 18:52:10 server07 NetworkManager[1006]: <info> [1743288730.9081] agent-manager: agent[43b3950362fb4132,:1.68/>
lines 1-21/21 (END)
```

```
gkeymole@server07 ~ $ nmcli general status
STATE      CONNECTIVITY  WIFI-HW  WIFI    WWAN-HW  WWAN    METERED
connected  full          missing  enabled  missing  enabled  no (guessed)
gkeymole@server07 ~ $
```

#### Using the nmcli tool:

2. List and check the status of all network interfaces on your computer.

```
gkeymole@server07 ~ $ nmcli device status
DEVICE  TYPE      STATE             CONNECTION
ens160  ethernet  connected         ens160
lo       loopback  connected (externally)  lo
ens192  ethernet  disconnected       --
gkeymole@server07 ~ $
```

### 3. List the connections of all network interfaces.

```
gkeymole@server07 ~ $ nmcli connection show
NAME      UUID                                  TYPE      DEVICE
ens160    4f1ea044-afb6-319d-bb0b-7d899f8f71e7 ethernet  ens160
lo        08952192-d29d-4856-9563-1d7a74826648 loopback   lo
gkeymole@server07 ~ $
```

```
gkeymole@server07 ~ $ nmcli
ens160: connected to ens160
"VMware VMXNET3"
ethernet (vmxnet3), 00:0C:29:91:68:21, hw, mtu 1500
ip4 default
inet4 192.168.198.128/24
route4 192.168.198.0/24 metric 100
route4 default via 192.168.198.2 metric 100
inet6 fe80::20c:29ff:fe91:6821/64
route6 fe80::/64 metric 1024

lo: connected (externally) to lo
"lo"
loopback (unknown), 00:00:00:00:00:00, sw, mtu 65536
inet4 127.0.0.1/8
inet6 ::1/128
route6 ::1/128 metric 256

DNS configuration:
servers: 192.168.198.2
domains: localdomain
interface: ens160
```

### 4. List the details of your active connection.

```
gkeymole@server07 ~ $ nmcli connection show ens160
connection.id:          ens160
connection.uuid:        4f1ea044-afb6-319d-bb0b-7d899f8f71e7
connection.stable-id:   --
connection.type:        802-3-ethernet
connection.interface-name: ens160
connection.autoconnect: yes
connection.autoconnect-priority: -999
connection.autoconnect-retries: -1 (default)
connection.multi-connect: 0 (default)
connection.auth-retries: -1
connection.timestamp:    1743288720
connection.permissions:  --
connection.zone:         --
connection.controller:   --
connection.master:       --
connection.slave-type:   --
connection.port-type:    --
connection.autoconnect-slaves: -1 (default)
connection.autoconnect-ports: -1 (default)
connection.down-on-poweroff: -1 (default)
connection.secondaries:   --
connection.gateway-ping-timeout: 0
connection.metered:      unknown
connection.lldp:         default
connection.mdns:         -1 (default)
connection.llmnr:        -1 (default)
connection.dns-over-tls: -1 (default)

gkeymole@server07 ~ $ nmcli connection show ens160 | grep IP
GENERAL.IP-IFACE: ens160
IP4.ADDRESS[1]:   192.168.198.128/24
IP4.GATEWAY:      192.168.198.2
IP4.ROUTE[1]:     dst = 192.168.198.0/24, nh = 0.0.0.0, mt = 100
IP4.ROUTE[2]:     dst = 0.0.0.0/0, nh = 192.168.198.2, mt = 100
IP4.DNS[1]:       192.168.198.2
IP4.DOMAIN[1]:    localdomain
IP6.ADDRESS[1]:   fe80::20c:29ff:fe91:6821/64
IP6.GATEWAY:      --
IP6.ROUTE[1]:     dst = fe80::/64, nh = ::, mt = 1024
gkeymole@server07 ~ $
```

5. Create a new connection for the new interface added in Step 1, with the following details:
  - a. Connection name: **LAN1**
  - b. Manual IP address: **192.168.50.10/24**

```
gkeymole@server07 ~ $ nmcli connection add type ethernet con-name LAN1 ifname ens192 ip4 192.168.50.10/24
Connection 'LAN1' (3b7aa2ad-88a5-475c-8c51-bf6ea4b7c903) successfully added.
gkeymole@server07 ~ $
```

6. List the details of this new **LAN1** network connection (with the new configuration)

```
gkeymole@server07 ~ $ nmcli connection show LAN1 | grep IP
GENERAL.IP-IFACE: ens192
IP4.ADDRESS[1]: 192.168.50.10/24
IP4.GATEWAY: --
IP4.ROUTE[1]: dst = 192.168.50.0/24, nh = 0.0.0.0, mt = 101
IP6.ADDRESS[1]: fe80::7782:9465:7774:23df/64
IP6.GATEWAY: --
IP6.ROUTE[1]: dst = fe80::/64, nh = ::, mt = 1024
gkeymole@server07 ~ $
```

```
gkeymole@server07 ~ $ nmcli connection show LAN1
connection.id: LAN1
connection.uuid: 3b7aa2ad-88a5-475c-8c51-bf6ea4b7c903
connection.stable-id: --
connection.type: 802-3-ethernet
connection.interface-name: ens192
connection.autoconnect: yes
connection.autoconnect-priority: 0
connection.autoconnect-retries: -1 (default)
connection.multi-connect: 0 (default)
connection.auth-retries: -1
connection.timestamp: 1743290772
connection.permissions: --
connection.zone: --
connection.controller: --
connection.master: --
connection.slave-type: --
connection.port-type: --
connection.autoconnect-slaves: -1 (default)
connection.autoconnect-ports: -1 (default)
connection.down-on-poweroff: -1 (default)
connection.secondaries: --
connection.gateway-ping-timeout: 0
connection.metered: unknown
connection.lldp: default
connection.mdns: -1 (default)
connection.lldmnr: -1 (default)
```

**Note : Keep the session open on AlmaLinux and log in on the Ubuntu machine.**

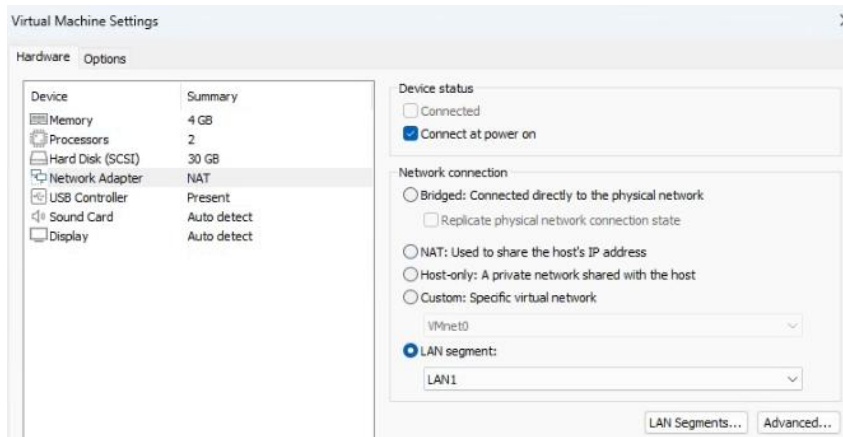
## Exercise 2 – Configuring Network Interfaces on Ubuntu

### Tasks to Perform on Ubuntu:

#### Step 1:

1. In your VM configuration, modify the **NAT network interface** and connect it to the **LAN1 segment**.

## Lab 5 - Linux Network and Routing Configuration



### Step 2:

1. Verify that the **NetworkManager** service is successfully started.

```
gkeymole@client07:~$ sudo systemctl status NetworkManager
[sudo] password for gkeymole:
● NetworkManager.service - Network Manager
   Loaded: loaded (/lib/systemd/system/NetworkManager.service; enabled; vendor preset: enabled)
   Active: active (running) since Sat 2025-03-29 19:39:42 EDT; 1min 14s ago
     Docs: man:NetworkManager(8)
   Main PID: 575 (NetworkManager)
    Tasks: 3 (limit: 4549)
   Memory: 10.6M
      CPU: 113ms
   CGroup: /system.slice/NetworkManager.service
           └─575 /usr/sbin/NetworkManager --no-daemon

Mar 29 19:40:28 client07 NetworkManager[575]: <warn> [1743291628.6143] device (ens33): Activation: failed for connection 'Wired connection 1'
Mar 29 19:40:28 client07 NetworkManager[575]: <info> [1743291628.6143] device (ens33): state change: failed -> disconnected (reason 'disconnected')
Mar 29 19:40:28 client07 NetworkManager[575]: <info> [1743291628.6278] dhcp4 (ens33): canceled DHCP transaction
Mar 29 19:40:28 client07 NetworkManager[575]: <info> [1743291628.6282] policy: auto-activating connection 'Wired connection 1' (eb3c)
Mar 29 19:40:28 client07 NetworkManager[575]: <info> [1743291628.6284] device (ens33): Activation: starting connection 'Wired connection 1' (eb3c)
Mar 29 19:40:28 client07 NetworkManager[575]: <info> [1743291628.6284] device (ens33): state change: disconnected -> prepare (reason 'disconnected')
Mar 29 19:40:28 client07 NetworkManager[575]: <info> [1743291628.6285] manager: NetworkManager state is now CONNECTING
Mar 29 19:40:28 client07 NetworkManager[575]: <info> [1743291628.6286] device (ens33): state change: prepare -> config (reason 'none')
Mar 29 19:40:28 client07 NetworkManager[575]: <info> [1743291628.6325] device (ens33): state change: config -> ip-config (reason 'none')
Mar 29 19:40:28 client07 NetworkManager[575]: <info> [1743291628.6355] dhcp4 (ens33): activation: beginning transaction (timeout in 45s)

gkeymole@client07:~$ nmcli general status
STATE      CONNECTIVITY  WIFI-HW  WIFI    WWAN-HW  WWAN
connecting limited      enabled  enabled  enabled  enabled
gkeymole@client07:~$
```

### Using the **nmcli** tool:

2. List and check the status of all network interfaces on your computer.

```
gkeymole@client07:~$ nmcli device status
DEVICE  TYPE      STATE                                  CONNECTION
ens33   ethernet  connecting (getting IP configuration)  Wired connection 1
lo      loopback  unmanaged                             --
gkeymole@client07:~$
```

3. List the connections of all network interfaces.

```
gkeymole@client07:~$ nmcli connection show
NAME                                UUID                                TYPE      DEVICE
Wired connection 1                  eb3cceb8-a88e-3d95-966f-38a27045b6f5  ethernet  --
gkeymole@client07:~$
```

4. List the details of your active connection.



## Lab 5 - Linux Network and Routing Configuration

```
gkeymole@client07:~$ nmcli
ens33: disconnected
    "Intel 82545EM"
    1 connection available
    ethernet (e1000), 00:0C:29:3A:95:95, hw, mtu 1500

lo: unmanaged
    "lo"
    loopback (unknown), 00:00:00:00:00:00, sw, mtu 65536

Use "nmcli device show" to get complete information about known devices and
"nmcli connection show" to get an overview on active connection profiles.

Consult nmcli(1) and nmcli-examples(7) manual pages for complete usage details.
gkeymole@client07:~$
```

5. Delete the current connection (if any).

```
gkeymole@client07:~$ nmcli connection show
NAME                UUID                                  TYPE      DEVICE
Wired connection 1  eb3cceb8-a88e-3d95-966f-38a27045b6f5 ethernet --
gkeymole@client07:~$ nmcli connection delete Wired\ connection\ 1
Connection 'Wired connection 1' (eb3cceb8-a88e-3d95-966f-38a27045b6f5) successfully deleted.
gkeymole@client07:~$
```

6. Create a new connection with the following details:

- Connection name: **LAN1**
- Manual IP address: **192.168.50.20/24**
- Default Gateway: **192.168.50.10**
- DNS server: **8.8.8.8**

```
gkeymole@client07:~$ nmcli
ens33: disconnected
    "Intel 82545EM"
    ethernet (e1000), 00:0C:29:3A:95:95, hw, mtu 1500

lo: unmanaged
    "lo"
    loopback (unknown), 00:00:00:00:00:00, sw, mtu 65536

Use "nmcli device show" to get complete information about known devices and
"nmcli connection show" to get an overview on active connection profiles.

Consult nmcli(1) and nmcli-examples(7) manual pages for complete usage details.
gkeymole@client07:~$ nmcli connection add con-name LAN1 ifname ens33 type ethernet ip4 192.168.50.20/24 gw4 192.168.50.10
Connection 'LAN1' (e174a1db-50ee-4a6a-98cf-3e747dd07133) successfully added.
gkeymole@client07:~$ nmcli connection modify LAN1 ipv4.dns 8.8.8.8
gkeymole@client07:~$ nmcli connection down LAN1 ; nmcli connection up LAN1
Connection 'LAN1' successfully deactivated (D-Bus active path: /org/freedesktop/NetworkManager/ActiveConnection/13)
Connection successfully activated (D-Bus active path: /org/freedesktop/NetworkManager/ActiveConnection/14)
gkeymole@client07:~$
```

7. List the details of this new network connection (with the new configuration).

```
gkeymole@client07:~$ nmcli
ens33: connected to LAN1
    "Intel 82545EM"
    ethernet (e1000), 00:0C:29:3A:95:95, hw, mtu 1500
    ip4 default
    inet4 192.168.50.20/24
    route4 192.168.50.0/24 metric 100
    route4 default via 192.168.50.10 metric 20100
    route4 169.254.0.0/16 metric 1000
    inet6 fe80::6737:a195:3fb7:2bf1/64
    route6 fe80::/64 metric 1024

lo: unmanaged
    "lo"
    loopback (unknown), 00:00:00:00:00:00, sw, mtu 65536

DNS configuration:
    servers: 8.8.8.8
    interface: ens33

gkeymole@client07:~$ nmcli connection show LAN1 | grep IP
GENERAL.IP-IFACE: ens33
IP4.ADDRESS[1]: 192.168.50.20/24
IP4.GATEWAY: 192.168.50.10
IP4.ROUTE[1]: dst = 192.168.50.0/24, nh = 0.0.0.0, mt = 100
IP4.ROUTE[2]: dst = 0.0.0.0/0, nh = 192.168.50.10, mt = 20100
IP4.ROUTE[3]: dst = 169.254.0.0/16, nh = 0.0.0.0, mt = 1000
IP4.DNS[1]: 8.8.8.8
IP6.ADDRESS[1]: fe80::6737:a195:3fb7:2bf1/64
IP6.GATEWAY: --
IP6.ROUTE[1]: dst = fe80::/64, nh = ::, mt = 1024
gkeymole@client07:~$
```

### Step 3: Testing the connectivity between the two VMs:

1. Use the **ping** command to test the connection with the **AlmaLinux** VM.  
**ping 192.168.50.10**

You must successfully ping the AlmaLinux VM.

```
gkeymole@client07: ~$ ping -c 4 192.168.50.10
PING 192.168.50.10 (192.168.50.10) 56(84) bytes of data.
64 bytes from 192.168.50.10: icmp_seq=1 ttl=64 time=0.329 ms
64 bytes from 192.168.50.10: icmp_seq=2 ttl=64 time=0.229 ms
64 bytes from 192.168.50.10: icmp_seq=3 ttl=64 time=0.219 ms
64 bytes from 192.168.50.10: icmp_seq=4 ttl=64 time=0.265 ms

--- 192.168.50.10 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3081ms
rtt min/avg/max/mdev = 0.219/0.260/0.329/0.043 ms
gkeymole@client07: ~$
```

2. Return to the **AlmaLinux** machine and test the connection with the **Ubuntu** VM.  
**ping 192.168.50.20**

You must also successfully ping the Ubuntu VM.

```
gkeymole@server07 ~$ ping -c 4 192.168.50.20
PING 192.168.50.20 (192.168.50.20) 56(84) bytes of data.
64 bytes from 192.168.50.20: icmp_seq=1 ttl=64 time=6.78 ms
64 bytes from 192.168.50.20: icmp_seq=2 ttl=64 time=0.213 ms
64 bytes from 192.168.50.20: icmp_seq=3 ttl=64 time=0.216 ms
64 bytes from 192.168.50.20: icmp_seq=4 ttl=64 time=0.252 ms

--- 192.168.50.20 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3073ms
rtt min/avg/max/mdev = 0.213/1.864/6.777/2.836 ms
gkeymole@server07 ~$
```

## Exercise 3 – Routing Configuration

### Tasks to Perform on AlmaLinux:

1. Enable **IP forwarding** in the **kernel** settings and ensure it remains active after reboot.

```
[root@server07 ~]# sysctl -w net.ipv4.ip_forward=1
net.ipv4.ip_forward = 1
[root@server07 ~]# echo "net.ipv4.ip_forward=1" >> /etc/sysctl.conf
[root@server07 ~]#
```

2. Assign the network interfaces in the appropriate **Firewall zones**.

```
[root@server07 ~]# firewall-cmd --get-zones
block dmz drop external home internal nm-shared public trusted work
[root@server07 ~]# firewall-cmd --get-active-zones
public
    interfaces: ens160 ens192
[root@server07 ~]#
```

```
[root@server07 ~]# nmcli connection show
NAME      UUID                                  TYPE      DEVICE
ens160    4f1ea044-afb6-319d-bb0b-7d899f8f71e7 ethernet  ens160
LAN1      3b7aa2ad-88a5-475c-8c51-bf6ea4b7c903 ethernet  ens192
lo        57e46995-2bf2-47f6-9a9e-224bc840ad8e loopback   lo
[root@server07 ~]# nmcli connection modify ens160 connection.id NAT
[root@server07 ~]# nmcli connection show
NAME      UUID                                  TYPE      DEVICE
NAT       4f1ea044-afb6-319d-bb0b-7d899f8f71e7 ethernet  ens160
LAN1      3b7aa2ad-88a5-475c-8c51-bf6ea4b7c903 ethernet  ens192
lo        57e46995-2bf2-47f6-9a9e-224bc840ad8e loopback   lo
[root@server07 ~]#
```

## Lab 5 - Linux Network and Routing Configuration

```
[root@server07 ~]# firewall-cmd --get-zones
block dmz drop external home internal nm-shared public trusted work
[root@server07 ~]# nmcli connection modify NAT con.zone external
[root@server07 ~]# nmcli connection down NAT | nmcli connection up NAT
Connection successfully activated (D-Bus active path: /org/freedesktop/NetworkManager/ActiveConnection/7)
[root@server07 ~]# nmcli connection down NAT ; nmcli connection up NAT
Connection 'NAT' successfully deactivated (D-Bus active path: /org/freedesktop/NetworkManager/ActiveConnection/7)
Connection successfully activated (D-Bus active path: /org/freedesktop/NetworkManager/ActiveConnection/8)
[root@server07 ~]#
```

```
[root@server07 ~]# nmcli connection modify LAN1 con.zone nm-shared
[root@server07 ~]# nmcli connection down LAN1 ; nmcli connection up LAN1
Connection 'LAN1' successfully deactivated (D-Bus active path: /org/freedesktop/NetworkManager/ActiveConnection/6)
Connection successfully activated (D-Bus active path: /org/freedesktop/NetworkManager/ActiveConnection/9)
[root@server07 ~]#
```

3. Verify that the interfaces are correctly assigned to their respective Firewall zones.

```
[root@server07 ~]# firewall-cmd --get-active-zones
external
  interfaces: ens160
nm-shared
  interfaces: ens192
[root@server07 ~]#
```

4. List the firewall rules associated with each zone.

```
[root@server07 ~]# firewall-cmd --list-all --zone=external
external (active)
  target: default
  icmp-block-inversion: no
  interfaces: ens160
  sources:
  services: ssh
  ports:
  protocols:
  forward: yes
  masquerade: yes
  forward-ports:
  source-ports:
  icmp-blocks:
  rich rules:
[root@server07 ~]#
```

```
[root@server07 ~]# firewall-cmd --list-all --zone=nm-shared
nm-shared (active)
  target: ACCEPT
  icmp-block-inversion: no
  interfaces: ens192
  sources:
  services: dhcp dns ssh
  ports:
  protocols: icmp ipv6-icmp
  forward: no
  masquerade: no
  forward-ports:
  source-ports:
  icmp-blocks:
  rich rules:
    rule priority="32767" reject
[root@server07 ~]#
```

### Tasks to Perform on Ubuntu:

1. Send three ping requests to any **external website**. This must work. If not, recheck your configuration on the AlmaLinux side.

```
gkeymole@client07:~$ ping -c 3 google.com
PING google.com (142.250.69.78) 56(84) bytes of data:
64 bytes from tzyula-aa-in-f14.1e100.net (142.250.69.78): icmp_seq=1 ttl=127 time=2.06 ms
64 bytes from tzyula-aa-in-f14.1e100.net (142.250.69.78): icmp_seq=2 ttl=127 time=1.93 ms
64 bytes from tzyula-aa-in-f14.1e100.net (142.250.69.78): icmp_seq=3 ttl=127 time=1.76 ms

--- google.com ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2004ms
rtt min/avg/max/mdev = 1.759/1.914/2.059/0.122 ms
gkeymole@client07:~$
```

2. Open **Firefox** and try to connect to the internet. It must work. If not, verify the AlmaLinux settings again.

