

SRE Intern Assignment - Week 2

Networking Fundamentals on Multipass

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Objective

This assignment aims to assess your foundational understanding of networking concepts, your ability to apply them in a virtualized Linux environment, and your practical skills in configuring and troubleshooting basic network services using Multipass on macOS.

Prerequisites

- macOS System with Multipass installed: <https://multipass.run/>
- Two VM instances (example):

```
multipass launch --name router-vm --memory 1G --disk 10G  
multipass launch --name host-a --memory 1G --disk 10G
```

Chapter 1

IP Addressing and Subnetting Fundamentals

1.1 Network Planning

Given Network: 192.168.10.0/24

Subnet into two equal-sized subnets.

Deliverables: Calculated details for both subnets.

- Subnet 1:
 - Network Address: 192.168.10.0
 - First Usable Host IP: 192.168.10.1
 - Last Usable Host IP: 192.168.10.126
 - Broadcast Address: 192.168.10.127
 - Subnet Mask: 255.255.255.128(/25)
- Subnet 2:
 - Network Address: 192.168.10.128
 - First Usable Host IP: 192.168.10.129
 - Last Usable Host IP: 192.168.10.254
 - Broadcast Address: 192.168.10.255
 - Subnet Mask: 255.255.255.128(/25)

1.2 Basic IP Configuration on VMs

host-a (Subnet 1):

```
#1 ip addr add 192.168.10.15/25 dev enp0s1
```

Explanation

#1 Command:

```
ip addr add <ip> dev enp0s1 -> attach ip to enp0s1 interface
```

router-vm (Subnet 2):

```
ip addr add 192.168.10.130/25 dev enp0s1
```

Verification host-a:

```
#1 ip addr show
```

Explanation

#1 Command:

```
ip addr show-> show ip addresses
```

```
root@host-a:~# ip a
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
        valid_lft forever preferred_lft forever
2: enp0s1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 52:54:00:e0:94:8e brd ff:ff:ff:ff:ff:ff
    inet 192.168.64.21/24 metric 100 brd 192.168.64.255 scope global dynamic enp0s1
        valid_lft 3402sec preferred_lft 3402sec
    inet 192.168.10.15/25 scope global enp0s1
        valid_lft forever preferred_lft forever
    inet6 fdd1:c079:7aa8:366d:5054:ff:fee0:948e/64 scope global dynamic mngtmpaddr noprefixroute
        valid_lft 2591990sec preferred_lft 604790sec
    inet6 fe80::5054:ff:fee0:948e/64 scope link
        valid_lft forever preferred_lft forever
```

Verification router-vm:

```
ip addr show
```

```
root@router-vm:~# 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
        valid_lft forever preferred_lft forever
2: enp0s1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 52:54:00:f7:c3:c7 brd ff:ff:ff:ff:ff:ff
    inet 192.168.64.22/24 metric 100 brd 192.168.64.255 scope global dynamic enp0s1
        valid_lft 3452sec preferred_lft 3452sec
    inet 192.168.10.130/25 scope global enp0s1
        valid_lft forever preferred_lft forever
    inet6 fdd1:c079:7aa8:366d:5054:ff:fef7:c3c7/64 scope global dynamic mngtmpaddr noprefixroute
        valid_lft 2591938sec preferred_lft 604738sec
    inet6 fe80::5054:ff:fef7:c3c7/64 scope link
        valid_lft forever preferred_lft forever
root@router-vm:~#
```

1.3 Connectivity Testing

Failure:

```
ping 192.168.10.130
```

Explanation of failure: they both are in same subnet, but not in same layer 2

```
root@host-a:~# ping 192.168.10.130
PING 192.168.10.130 (192.168.10.130) 56(84) bytes of data.
^C
--- 192.168.10.130 ping statistics ---
7 packets transmitted, 0 received, 100% packet loss, time 6244ms

root@host-a:~#
```

success:

```
ip route add 192.168.10.128/25 dev enp0s1
ping 192.168.10.130
```

Explanation of success: After adding route via enp0s1, they are in same layer 2 and therefore ping is working.

```
root@host-a:~# ip route add 192.168.10.128/25 dev enp0s1
root@host-a:~# ping 192.168.10.130
PING 192.168.10.130 (192.168.10.130) 56(84) bytes of data.
64 bytes from 192.168.10.130: icmp_seq=1 ttl=64 time=7.59 ms
64 bytes from 192.168.10.130: icmp_seq=2 ttl=64 time=4.13 ms
64 bytes from 192.168.10.130: icmp_seq=3 ttl=64 time=1.74 ms
64 bytes from 192.168.10.130: icmp_seq=4 ttl=64 time=4.27 ms
64 bytes from 192.168.10.130: icmp_seq=5 ttl=64 time=0.942 ms
^C
--- 192.168.10.130 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4154ms
rtt min/avg/max/mdev = 0.942/3.735/7.590/2.328 ms
root@host-a:~#
```

Chapter 2

Routing Concepts (Static Routing)

2.1 Simulating a Multi-Network Router

router-vm:

```
#1 ip link add dummy0 type dummy
ip addr add 172.16.1.1/24 dev dummy0
#2 ip link set dummy0 up
#3 echo 1 > /proc/sys/net/ipv4/ip_forward
```

Explanation

#1 Command:

ip link add dummy0 type dummy -> add a dummy interface

#2 Command:

ip link set dummy0 up -> make interface dummy active

#3 Command:

echo 1 > /proc/sys/net/ipv4/ip_forward -> ip forwarding between interfaces

```
root@router-vm:~# ip link add dummy0 type dummy
root@router-vm:~# ip addr add 172.16.1.1/24 dev dummy0
root@router-vm:~# ip link set dummy0 up
root@router-vm:~# ip a
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
        valid_lft forever preferred_lft forever
2: enp0s1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 52:54:00:f7:c3:c7 brd ff:ff:ff:ff:ff:ff
    inet 192.168.64.22/24 metric 100 brd 192.168.64.255 scope global dynamic enp0s1
        valid_lft 2691sec preferred_lft 2691sec
    inet 192.168.10.130/25 scope global enp0s1
        valid_lft forever preferred_lft forever
    inet6 fdd1:c079:7aa8:366d:5054:ff:fef7:c3c7/64 scope global dynamic mngtmpaddr noprefixroute
        valid_lft 2591937sec preferred_lft 604737sec
    inet6 fe80::5054:ff:fef7:c3c7/64 scope link
        valid_lft forever preferred_lft forever
3: dummy0: <BROADCAST,NOARP,UP,LOWER_UP> mtu 1500 qdisc noqueue state UNKNOWN group default qlen 1000
    link/ether d2:4e:78:be:fb:4b brd ff:ff:ff:ff:ff:ff
    inet 172.16.1.1/24 scope global dummy0
        valid_lft forever preferred_lft forever
    inet6 fe80::d04e:78ff:febe:fb4b/64 scope link
        valid_lft forever preferred_lft forever
```

host-a:

```
#1 ip route del default via 192.168.64.1
#2 ip route add default via 192.168.10.130
```

Explanation

#1 Command:

```
ip route del default via 192.168.64.1 -> delete default route
```

#2 Command:

```
ip route add default via 192.168.10.130 -> add default route
```

```
root@host-a:~# ip route
default via 192.168.10.130 dev enp0s1
192.168.10.0/25 dev enp0s1 proto kernel scope link src 192.168.10.15
192.168.10.128/25 dev enp0s1 scope link
192.168.64.0/24 dev enp0s1 proto kernel scope link src 192.168.64.21 metric 100
192.168.64.1 dev enp0s1 proto dhcp scope link src 192.168.64.21 metric 100
root@host-a:~# ping 172.16.1.1
PING 172.16.1.1 (172.16.1.1) 56(84) bytes of data.
64 bytes from 172.16.1.1: icmp_seq=1 ttl=64 time=3.05 ms
64 bytes from 172.16.1.1: icmp_seq=2 ttl=64 time=10.9 ms
64 bytes from 172.16.1.1: icmp_seq=3 ttl=64 time=7.19 ms
64 bytes from 172.16.1.1: icmp_seq=4 ttl=64 time=5.86 ms
64 bytes from 172.16.1.1: icmp_seq=5 ttl=64 time=5.13 ms
^Z
[1]+  Stopped                  ping 172.16.1.1
root@host-a:~#
```

2.2 Configuring Static Routes

router-vm:

```
ip route add 10.0.0.0/24 via 172.16.1.2
ip route
```

```
root@host-a:~# ip route add 172.16.1.0/24 via 192.168.10.130
root@host-a:~# ip route
default via 192.168.10.130 dev enp0s1
default via 192.168.64.1 dev enp0s1 proto dhcp src 192.168.64.21 metric 100
172.16.1.0/24 via 192.168.10.130 dev enp0s1
192.168.10.0/25 dev enp0s1 proto kernel scope link src 192.168.10.15
192.168.10.128/25 dev enp0s1 scope link
192.168.64.0/24 dev enp0s1 proto kernel scope link src 192.168.64.21 metric 100
192.168.64.1 dev enp0s1 proto dhcp scope link src 192.168.64.21 metric 100
root@host-a:~#
```

host-a:

```
ip route add 172.16.1.0/24 via 192.168.10.130
ip route
```

```
root@router-vm:~# ip route add 10.0.0.0/24 via 172.16.1.2
root@router-vm:~# ip route
default via 192.168.64.1 dev enp0s1 proto dhcp src 192.168.64.22 metric 100
10.0.0.0/24 via 172.16.1.2 dev dummy0
172.16.1.0/24 dev dummy0 proto kernel scope link src 172.16.1.1
192.168.10.128/25 dev enp0s1 proto kernel scope link src 192.168.10.130
192.168.64.0/24 dev enp0s1 proto kernel scope link src 192.168.64.22 metric 100
192.168.64.1 dev enp0s1 proto dhcp scope link src 192.168.64.22 metric 100
root@router-vm:~# ip a
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
        valid_lft forever preferred_lft forever
2: enp0s1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 52:54:00:f7:c3:c7 brd ff:ff:ff:ff:ff:ff
    inet 192.168.64.22/24 metric 100 brd 192.168.64.255 scope global dynamic enp0s1
        valid_lft 3549sec preferred_lft 3549sec
    inet 192.168.10.130/25 scope global enp0s1
        valid_lft forever preferred_lft forever
    inet6 fdd1:c079:7aa8:366d:5054:ff:fef7:c3c7/64 scope global dynamic mngtmpaddr noprefixroute
        valid_lft 2591928sec preferred_lft 604728sec
    inet6 fe80::5054:ff:fef7:c3c7/64 scope link
        valid_lft forever preferred_lft forever
3: dummy0: <BROADCAST,NOARP,UP,LOWER_UP> mtu 1500 qdisc noqueue state UNKNOWN group default qlen 1000
    link/ether d2:4e:78:be:fb:4b brd ff:ff:ff:ff:ff:ff
    inet 172.16.1.1/24 scope global dummy0
        valid_lft forever preferred_lft forever
    inet6 fe80::d04e:78ff:febe:fb4b/64 scope link
        valid_lft forever preferred_lft forever
```

Chapter 3

Network Services

3.1 DHCP Server Configuration

MAC Terminal:

```
multipass set local.bridged-network=en0
```

router-vm:

```
#1 ip addr flush dev enp0s2
#2 ip addr add 192.168.20.1/24 dev enp0s2
#3 ip link set enp0s2 up
#4 apt update
#5 apt install isc-dhcp-server -y

#6 vim /etc/default/isc-dhcp-server
#7 INTERFACESv4="enp0s2"

#8 vim /etc/dhcp/dhcpd.conf
#9 subnet 192.168.20.0 netmask 255.255.255.0 {
    range 192.168.20.100 192.168.20.150;
    option routers 192.168.20.1;
    option domain-name-servers 8.8.8.8;
    default-lease-time 600;
    max-lease-time 7200;
}

#10 systemctl restart isc-dhcp-server
#11 systemctl enable isc-dhcp-server
#12 systemctl status isc-dhcp-server
```

Explanation

#1 Command:

```
ip addr flush dev enp0s2 – clear existing IP config on enp0s2
```

#2 Command:

```
ip addr add 192.168.20.1/24 dev enp0s2 – assign static IP to enp0s2
```

#3 Command:

```
ip link set enp0s2 up – bring up the interface
```

#4 Command:

```
apt update – update package list
```

#5 Command:

```
apt install isc-dhcp-server -y – install DHCP server
```

#6 Command:

```
vim /etc/default/isc-dhcp-server – configure DHCP interface
```

#7 Command:

```
INTERFACESv4="enp0s2" – bind DHCP to enp0s2
```

#8 Command:

```
vim /etc/dhcp/dhcpd.conf – edit DHCP IP pool settings
```

#9 Config Block:

```
subnet 192.168.20.0 ... – define subnet, IP range, gateway, DNS, and lease time
```

#10 Command:

```
systemctl restart isc-dhcp-server – apply changes by restarting service
```

#11 Command:

```
systemctl enable isc-dhcp-server – start DHCP server at boot
```

#12 Command:

```
systemctl status isc-dhcp-server – check if DHCP service is running
```

host-a:

```
ip addr flush dev enp0s2  
ip link set enp0s2 up  
dhclient -v enp0s2
```

host-a:

```
root@host-a:~# dhclient -v enp0s2
Internet Systems Consortium DHCP Client 4.4.1
Copyright 2004-2018 Internet Systems Consortium.
All rights reserved.
For info, please visit https://www.isc.org/software/dhcp/

Listening on LPF/enp0s2/52:54:00:c0:dc:fe
Sending on LPF/enp0s2/52:54:00:c0:dc:fe
Sending on Socket/fallback
DHCPREQUEST for 10.151.18.3 on enp0s2 to 255.255.255.255 port 67 (xid=0x7e719bd1)
DHCPREQUEST for 10.151.18.3 on enp0s2 to 255.255.255.255 port 67 (xid=0x7e719bd1)
DHCPREQUEST for 10.151.18.3 on enp0s2 to 255.255.255.255 port 67 (xid=0x7e719bd1)
DHCPDISCOVER on enp0s2 to 255.255.255.255 port 67 interval 3 (xid=0xad14a561)
DHCPOFFER of 192.168.20.100 from 192.168.20.1
DHCPREQUEST for 192.168.20.100 on enp0s2 to 255.255.255.255 port 67 (xid=0x61a514ad)
DHCPACK of 192.168.20.100 from 192.168.20.1 (xid=0xad14a561)
bound to 192.168.20.100 -- renewal in 250 seconds.
root@host-a:~# ip a
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
            valid_lft forever preferred_lft forever
2: enp0s1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 52:54:00:6d:82:d2 brd ff:ff:ff:ff:ff:ff
        inet 192.168.64.24/24 metric 100 brd 192.168.64.255 scope global dynamic enp0s1
            valid_lft 3259sec preferred_lft 3259sec
        inet6 fdd1:c079:7aa8:366d:5054:ff:fe6d:82d2/64 scope global dynamic mngtmpaddr noprefixroute
            valid_lft 2591918sec preferred_lft 604718sec
        inet6 fe80::5054:ff:fe6d:82d2/64 scope link
            valid_lft forever preferred_lft forever
3: enp0s2: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 52:54:00:c0:dc:fe brd ff:ff:ff:ff:ff:ff
        inet 192.168.20.100/24 brd 192.168.20.255 scope global dynamic enp0s2
            valid_lft 593sec preferred_lft 593sec
```

router-vm:

```
root@router-vm:~# systemctl status isc-dhcp-server
● isc-dhcp-server.service - ISC DHCP IPv4 server
  Loaded: loaded (/lib/systemd/system/isc-dhcp-server.service; enabled; vendor preset: enabled)
  Active: active (running) since Mon 2025-08-04 04:55:28 UTC; 21s ago
    Docs: man:dhcpd(8)
 Main PID: 6348 (dhcpd)
   Tasks: 4 (limit: 1069)
     Memory: 6.0M
      CPU: 8ms
     CGroup: /system.slice/isc-dhcp-server.service
             └─6348 dhcpd -user dhcpd -group dhcpd -f -4 -pf /run/dhcp-server/dhcpd.pid -cf /etc/dhcp/dhcpd.conf enp0s2

Aug 04 04:55:28 router-vm sh[6348]: PID file: /run/dhcp-server/dhcpd.pid
Aug 04 04:55:28 router-vm dhcpd[6348]: Wrote 0 leases to leases file.
Aug 04 04:55:28 router-vm sh[6348]: Wrote 0 leases to leases file.
Aug 04 04:55:28 router-vm dhcpd[6348]: Listening on LPF/enp0s2/52:54:00:83:ca:19/192.168.20.0/24
Aug 04 04:55:28 router-vm sh[6348]: Listening on LPF/enp0s2/52:54:00:83:ca:19/192.168.20.0/24
Aug 04 04:55:28 router-vm dhcpd[6348]: Sending on  LPF/enp0s2/52:54:00:83:ca:19/192.168.20.0/24
Aug 04 04:55:28 router-vm sh[6348]: Sending on  LPF/enp0s2/52:54:00:83:ca:19/192.168.20.0/24
Aug 04 04:55:28 router-vm dhcpd[6348]: Sending on  Socket/fallback/fallback-net
Aug 04 04:55:28 router-vm sh[6348]: Sending on  Socket/fallback/fallback-net
Aug 04 04:55:28 router-vm dhcpd[6348]: Server starting service.
root@router-vm:~# █
```

3.2 DNS Client Configuration

host-a:

```
ip route del default via <BY LAN>
ip addr del <BY LAN> dev enp0s2
ip route add default via 192.168.20.1 dev enp0s2
vim /etc/resolv.conf
    nameserver 8.8.8.8
dig google.com
```

router-vm:

```
#1 echo 1 > /proc/sys/net/ipv4/ip_forward
#2 iptables -t nat -A POSTROUTING -o enp0s1 -s
    ↳ 192.168.20.0/24 -j MASQUERADE
```

Explanation

#1 Command:

`echo 1 > /proc/sys/net/ipv4/ip_forward` – enables IP forwarding in the kernel

#2 Command:

`iptables -t nat -A POSTROUTING -o enp0s1 -s 192.168.20.0/24 -j MASQUERADE`
– sets up NAT so traffic from 192.168.20.0/24 can go through enp0s1

```
root@host-a:~# dig google.com
; <>> DiG 9.18.30-0ubuntu0.22.04.2-Ubuntu <>> google.com
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 37681
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags: udp: 512
;; QUESTION SECTION:
;google.com.           IN      A

;; ANSWER SECTION:
google.com.        186     IN      A      172.217.24.142

;; Query time: 32 msec
;; SERVER: 8.8.8.8#53(8.8.8.8) (UDP)
;; WHEN: Mon Aug 04 05:34:00 UTC 2025
;; MSG SIZE  rcvd: 55

root@host-a:~# traceroute google.com
traceroute to google.com (172.217.24.142), 30 hops max, 60 byte packets
 1  192.168.20.1 (192.168.20.1)  0.512 ms  0.441 ms  0.654 ms
 2  * * 192.168.64.1 (192.168.64.1)  0.848 ms
 3  10.151.16.3 (10.151.16.3)  6.036 ms  6.029 ms  5.894 ms
 4  10.151.76.10 (10.151.76.10)  5.635 ms  5.615 ms  5.607 ms
 5  125.16.141.157 (125.16.141.157)  5.600 ms  5.593 ms  5.603 ms
 6  * 116.119.161.149 (116.119.161.149)  11.052 ms *
 7  72.14.197.10 (72.14.197.10)  14.246 ms  14.216 ms  14.206 ms
 8  * *
 9  142.251.55.68 (142.251.55.68)  13.887 ms  142.250.236.156 (142.250.236.156)  13.873 ms  142.251.55.60 (142.251.55.60)  13.862 ms
10  142.251.55.91 (142.251.55.91)  13.804 ms  172.253.71.132 (172.253.71.132)  32.299 ms  142.251.230.52 (142.251.230.52)  13.766 ms
11  * nrt20s01-in-f14.1e100.net (172.217.24.142)  13.367 ms  142.250.239.229 (142.250.239.229)  13.488 ms
root@host-a:~#
```

Chapter 4

Basic Network Security and Troubleshooting

4.1 Firewall Configuration (firewalld)

router-vm:

```
#1 systemctl start firewalld  
#2 firewall-cmd --add-service=ssh --permanent  
#3 firewall-cmd --add-service=http --permanent  
#4 firewall-cmd --reload  
#5 firewall-cmd --list-all
```

Explanation

#1 Command:

systemctl start firewalld – starts the firewalld service

#2 Command:

firewall-cmd --add-service=ssh --permanent – allows SSH access permanently

#3 Command:

firewall-cmd --add-service=http --permanent – allows HTTP traffic permanently

#4 Command:

firewall-cmd --reload – reloads the firewall rules to apply changes

#5 Command:

firewall-cmd --list-all – lists all active firewall rules and zones

http enabled:

```
root@router-vm:/# firewall-cmd --list-all
public
  target: default
  icmp-block-inversion: no
  interfaces:
  sources:
  services: dhcpcv6-client http ssh
  ports:
  protocols:
  forward: yes
  masquerade: no
  forward-ports:
  source-ports:
  icmp-blocks:
  rich rules:
root@router-vm:/# █
root@host-a:# curl http://192.168.20.1
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<!--
  Modified from the Debian original for Ubuntu
  Last updated: 2022-03-22
  See: https://Launchpad.net/bugs/1966004
-->
<head>
<meta http-equiv="Content-Type" content="text/html; charset=UTF-8" />
<title>Apache2 Ubuntu Default Page: It works</title>
<style type="text/css" media="screen">
*
{
  margin: 0px 0px 0px 0px;
  padding: 0px 0px 0px 0px;
}

body, html {
  padding: 3px 3px 3px 3px;
  background-color: #D8DBE2;

  font-family: Ubuntu, Verdana, sans-serif;
  font-size: 11pt;
  text-align: center;
}

div.main_page {
  position: relative;
  display: table;

  width: 800px;

  margin-bottom: 3px;
  margin-left: auto;
  margin-right: auto;
  padding: 0px 0px 0px 0px;

  border-width: 2px;
  border-color: #212738;
  border-style: solid;
}
```

http disabled:

```
#1 firewall-cmd --remove-service=http --permanent  
#2 firewall-cmd --reload  
#3 firewall-cmd --list-all
```

Explanation

#1 Command:

firewall-cmd --remove-service=http --permanent – removes HTTP from allowed services

#2 Command:

firewall-cmd --reload – reloads firewall to apply new rules

#3 Command:

firewall-cmd --list-all – confirms removal of HTTP service

```
root@router-vm:/# firewall-cmd --permanent --remove-service=http  
success  
root@router-vm:/# firewall-cmd --reload  
success  
root@router-vm:/# firewall-cmd --list-all  
public  
target: default  
icmp-block-inversion: no  
interfaces:  
sources:  
services: dhcpcv6-client ssh  
ports:  
protocols:  
forward: yes  
masquerade: no  
forward-ports:  
source-ports:  
icmp-blocks:  
rich rules:  
root@router-vm:/#  
  
root@host-a:~# curl http://192.168.20.1  
curl: (7) Failed to connect to 192.168.20.1 port 80 after 5 ms: No route to host  
root@host-a:~#
```

4.2 Packet Tracing with tcpdump

```
#1 tcpdump -i enp0s1 icmp
# From host-a:
#2 ping 192.168.10.130
```

Explanation

#1 Command:

tcpdump -i enp0s1 icmp – captures ICMP packets on interface enp0s1

#2 Command:

ping 192.168.10.130 – sends ping packets to test network connectivity

```
root@host-a:~# ping 192.168.20.1
PING 192.168.20.1 (192.168.20.1) 56(84) bytes of data.
64 bytes from 192.168.20.1: icmp_seq=1 ttl=64 time=11.5 ms
64 bytes from 192.168.20.1: icmp_seq=2 ttl=64 time=1.84 ms
64 bytes from 192.168.20.1: icmp_seq=3 ttl=64 time=4.60 ms
64 bytes from 192.168.20.1: icmp_seq=4 ttl=64 time=3.05 ms
64 bytes from 192.168.20.1: icmp_seq=5 ttl=64 time=1.63 ms
64 bytes from 192.168.20.1: icmp_seq=6 ttl=64 time=8.16 ms
64 bytes from 192.168.20.1: icmp_seq=7 ttl=64 time=3.33 ms
64 bytes from 192.168.20.1: icmp_seq=8 ttl=64 time=1.55 ms
64 bytes from 192.168.20.1: icmp_seq=9 ttl=64 time=0.857 ms
64 bytes from 192.168.20.1: icmp_seq=10 ttl=64 time=0.902 ms
64 bytes from 192.168.20.1: icmp_seq=11 ttl=64 time=24.1 ms
64 bytes from 192.168.20.1: icmp_seq=12 ttl=64 time=2.60 ms
64 bytes from 192.168.20.1: icmp_seq=13 ttl=64 time=1.42 ms
64 bytes from 192.168.20.1: icmp_seq=14 ttl=64 time=1.47 ms
```

```
root@router-vm:/# tcpdump -i enp0s2 icmp
tcpdump: verbose output suppressed, use -v[v]... for full protocol decode
listening on enp0s2, link-type EN10MB (Ethernet), snapshot length 262144 bytes
06:35:21.939294 IP 192.168.20.100 > 192.168.20.1: ICMP echo request, id 8, seq 1, length 64
06:35:21.939563 IP 192.168.20.1 > 192.168.20.100: ICMP echo reply, id 8, seq 1, length 64
06:35:22.958429 IP 192.168.20.100 > 192.168.20.1: ICMP echo request, id 8, seq 2, length 64
06:35:22.958633 IP 192.168.20.1 > 192.168.20.100: ICMP echo reply, id 8, seq 2, length 64
06:35:23.977246 IP 192.168.20.100 > 192.168.20.1: ICMP echo request, id 8, seq 3, length 64
06:35:23.977422 IP 192.168.20.1 > 192.168.20.100: ICMP echo reply, id 8, seq 3, length 64
06:35:25.024781 IP 192.168.20.100 > 192.168.20.1: ICMP echo request, id 8, seq 4, length 64
06:35:25.024861 IP 192.168.20.1 > 192.168.20.100: ICMP echo reply, id 8, seq 4, length 64
06:35:26.048844 IP 192.168.20.100 > 192.168.20.1: ICMP echo request, id 8, seq 5, length 64
06:35:26.048930 IP 192.168.20.1 > 192.168.20.100: ICMP echo reply, id 8, seq 5, length 64
06:35:27.064432 IP 192.168.20.100 > 192.168.20.1: ICMP echo request, id 8, seq 6, length 64
06:35:27.064710 IP 192.168.20.1 > 192.168.20.100: ICMP echo reply, id 8, seq 6, length 64
06:35:28.104994 IP 192.168.20.100 > 192.168.20.1: ICMP echo request, id 8, seq 7, length 64
06:35:28.105113 IP 192.168.20.1 > 192.168.20.100: ICMP echo reply, id 8, seq 7, length 64
06:35:29.105480 IP 192.168.20.100 > 192.168.20.1: ICMP echo request, id 8, seq 8, length 64
06:35:29.105592 IP 192.168.20.1 > 192.168.20.100: ICMP echo reply, id 8, seq 8, length 64
```

4.3 Network Utilities

```
#1 firewall-cmd --permanent --add-masquerade
#2 firewall-cmd --zone=public --add-interface=enp0s1 --
    ↪ permanent
#3 firewall-cmd --zone=public --add-interface=enp0s2 --
    ↪ permanent
#4 firewall-cmd --reload
#5 traceroute google.com
```

Explanation

#1 Command:

--add-masquerade – enables NAT masquerading

#2-3 Commands:

--add-interface – adds interfaces to the public zone

#4 Command:

--reload – reloads firewalld with new rules

#5 Command:

traceroute google.com – traces route to Google's servers

```
root@host-a:~# traceroute google.com
traceroute to google.com (172.217.24.142), 30 hops max, 60 byte packets
 1 _gateway (192.168.20.1)  4.641 ms  4.627 ms  4.617 ms
 2 _gateway (192.168.64.1)  4.606 ms  4.595 ms  4.585 ms
 3 10.151.16.3 (10.151.16.3)  12.821 ms  12.811 ms  12.800 ms
 4 10.151.76.10 (10.151.76.10)  12.790 ms  12.780 ms  12.771 ms
 5 125.16.141.157 (125.16.141.157)  16.666 ms  16.654 ms  16.643 ms
 6 * 182.79.198.2 (182.79.198.2)  35.000 ms 116.119.161.149 (116.119.161.149)  34.920 ms
 7 72.14.197.10 (72.14.197.10)  34.906 ms  34.896 ms  34.885 ms
 8 * * *
 9 142.251.60.186 (142.251.60.186)  29.543 ms 108.170.231.128 (108.170.231.128)  21.877 ms 142.251.55.230 (142.251.55.230)  29.511 ms
10 142.251.55.89 (142.251.55.89)  29.494 ms 142.251.229.250 (142.251.229.250)  29.475 ms 142.251.55.91 (142.251.55.91)  21.813 ms
11 142.251.50.59 (142.251.50.59)  29.446 ms 142.250.208.231 (142.250.208.231)  12.342 ms 142.250.62.67 (142.250.62.67)  12.313 ms
12 142.251.55.89 (142.251.55.89)  11.031 ms nrt20s01-in-f14.1e100.net (172.217.24.142)  10.554 ms 142.251.55.91 (142.251.55.91)  11.015 ms
```

```
#host -a
netstat -tuln
```

Explanation: Lists TCP and UDP ports listening on host-a.

```
root@host-a:~# netstat -tuln
Active Internet connections (only servers)
Proto Recv-Q Send-Q Local Address          Foreign Address        State
tcp      0      0 127.0.0.53:53            0.0.0.0:*
                                         LISTEN
tcp      0      0 0.0.0.0:22              0.0.0.0:*
                                         LISTEN
tcp6     0      0 :::22                  :::*
                                         LISTEN
udp      0      0 127.0.0.53:53            0.0.0.0:*
                                         LISTEN
udp      0      0 192.168.64.24:68          0.0.0.0:*
                                         LISTEN
udp      0      0 0.0.0.0:68              0.0.0.0:*
                                         LISTEN
udp      0      0 10.151.18.3:68            0.0.0.0:*
```

```
#router-vm  
netstat -tuln
```

Explanation: Lists TCP and UDP ports listening on router-vm.

```
root@router-vm:/# netstat -tuln  
Active Internet connections (only servers)  
Proto Recv-Q Send-Q Local Address          Foreign Address        State  
tcp      0      0 0.0.0.0:22              0.0.0.0:*              LISTEN  
tcp      0      0 127.0.0.53:53            0.0.0.0:*              LISTEN  
tcp6     0      0 :::80                  :::*                  LISTEN  
tcp6     0      0 :::22                  :::*                  LISTEN  
udp      0      0 127.0.0.53:53            0.0.0.0:*              LISTEN  
udp      0      0 0.0.0.0:67              0.0.0.0:*              LISTEN  
udp      0      0 192.168.64.23:68          0.0.0.0:*              LISTEN  
udp      0      0 10.151.26.39:68          0.0.0.0:*
```

Conclusion

This document demonstrates the execution and understanding of essential computer network tasks on a UBUNTU-like environment using Multipass.