

LAB 4
CONSTRUCT A SIMPLE NETWORK



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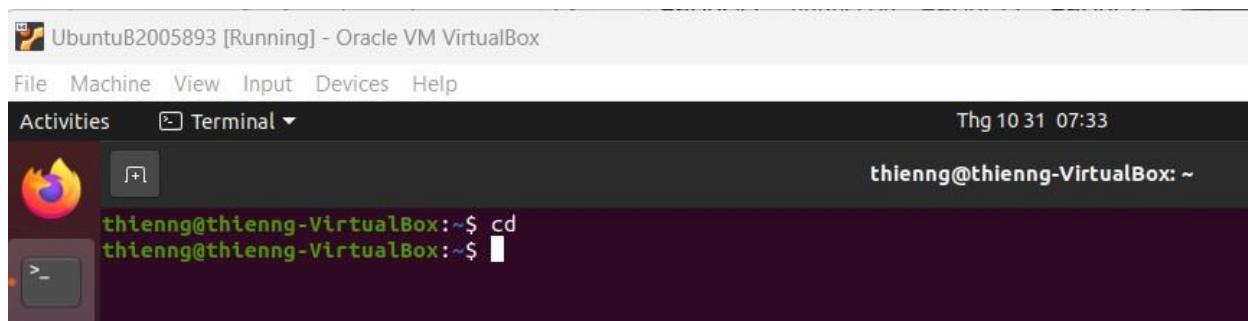
ID: B2005893

Group: M01

Submission: an ID_NAME_Lab04.pdf file describes clearly how did you solve the problem

Exercise 0: change the directory to your home directory

Answer: \$cd



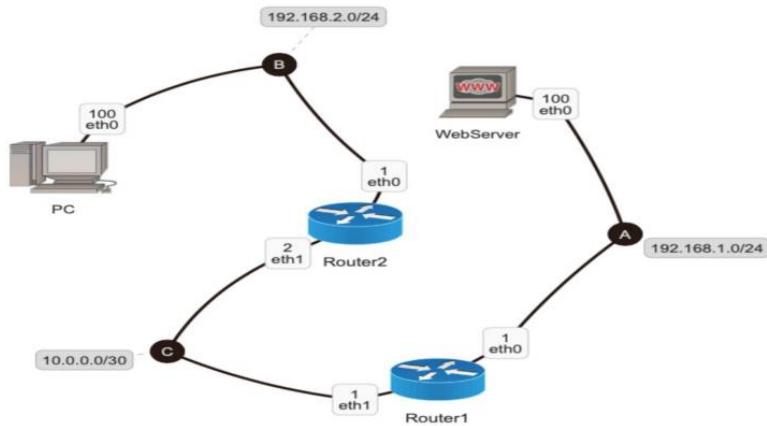
UbuntuB2005893 [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities Terminal Thg 10 31 07:33

thienng@thienng-VirtualBox:~\$ cd
thienng@thienng-VirtualBox:~\$

Exercise 17: Construct the following network



Answer:

1. Files and Folders

```
$ tree
```

```
UbuntuB2005893 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Thg 11 4 22:48
thienng@thienng-VirtualBox:~/LAB4/EX17$ tree
.
├── lab.conf
├── pc
├── pc.startup
├── r1
├── r1.startup
├── r2
├── r2.startup
└── webserver
    └── webserver.startup

4 directories, 5 files
thienng@thienng-VirtualBox:~/LAB4/EX17$
```

2. File configurations

```
$ cat lab.conf  
$ cat pc.startup  
$ cat r1.startup  
$ cat r2.startup  
$ cat webserver.startup
```

The screenshot shows a terminal window titled "UbuntuB2005893 [Running] - Oracle VM VirtualBox". The terminal session is as follows:

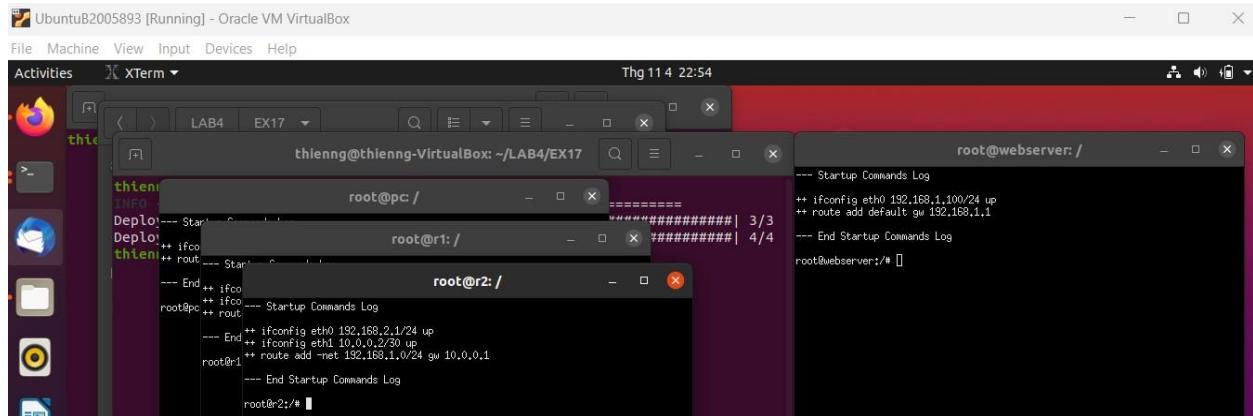
```
thienng@thienng-VirtualBox: ~/LAB4/EX17$ cat lab.conf  
pc[0]=B  
r1[0]=A  
r1[1]=C  
r2[0]=B  
r2[1]=C  
webserver[0]=A  
thienng@thienng-VirtualBox: ~/LAB4/EX17$ cat pc.startup  
ifconfig eth0 192.168.2.100/24 up  
route add default gw 192.168.2.1  
thienng@thienng-VirtualBox: ~/LAB4/EX17$
```

The screenshot shows a terminal window titled "UbuntuB2005893 [Running] - Oracle VM VirtualBox". The terminal session is as follows:

```
thienng@thienng-VirtualBox: ~/LAB4/EX17$ cat r1.startup  
ifconfig eth0 192.168.1.1/24 up  
ifconfig eth1 10.0.0.1/30 up  
route add -net 192.168.2.0/24 gw 10.0.0.2  
thienng@thienng-VirtualBox: ~/LAB4/EX17$ cat r2.startup  
ifconfig eth0 192.168.2.1/24 up  
ifconfig eth1 10.0.0.2/30 up  
route add -net 192.168.1.0/24 gw 10.0.0.1  
thienng@thienng-VirtualBox: ~/LAB4/EX17$ cat webserver.startup  
ifconfig eth0 192.168.1.100/24 up  
route add default gw 192.168.1.1  
thienng@thienng-VirtualBox: ~/LAB4/EX17$
```

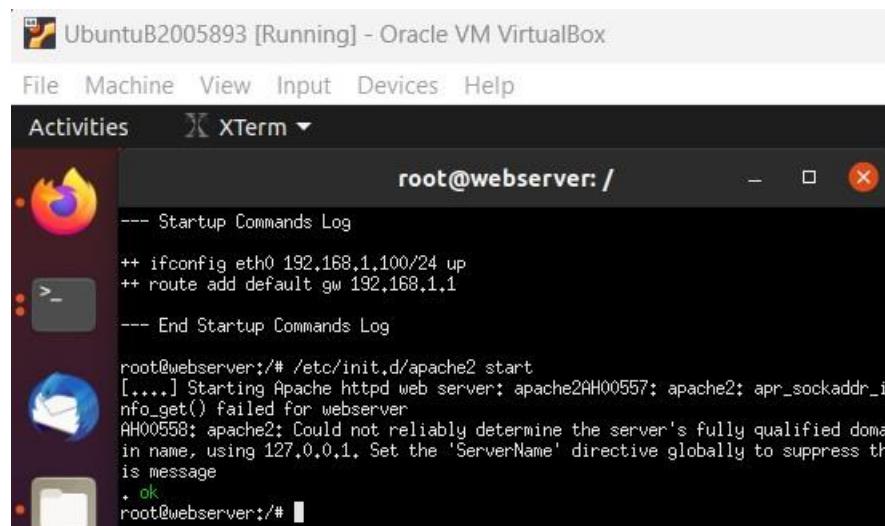
3. Start Kathara

```
$ kathara lstart
```



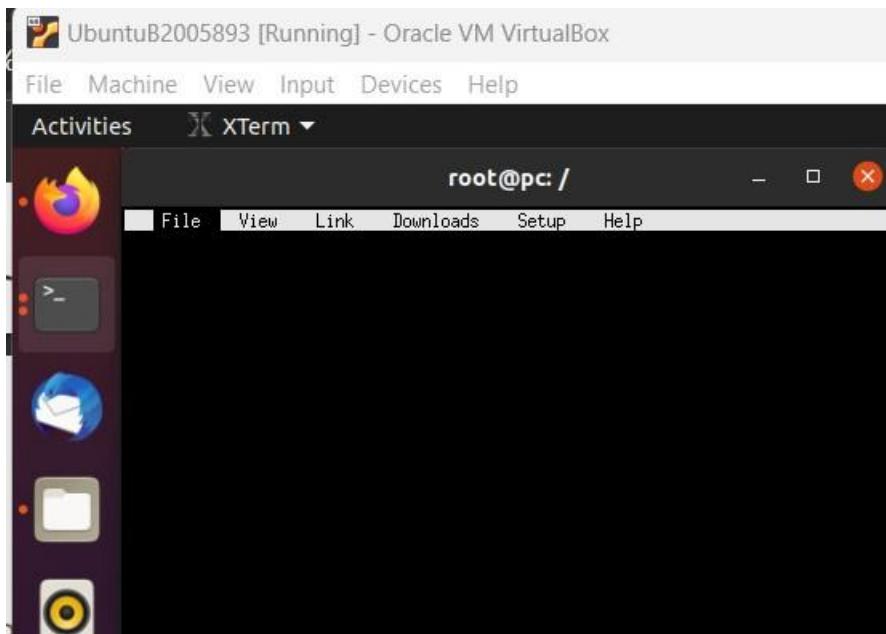
4. On the server, start *apache2* using the following command

```
# /etc/init.d/apache2 start
```



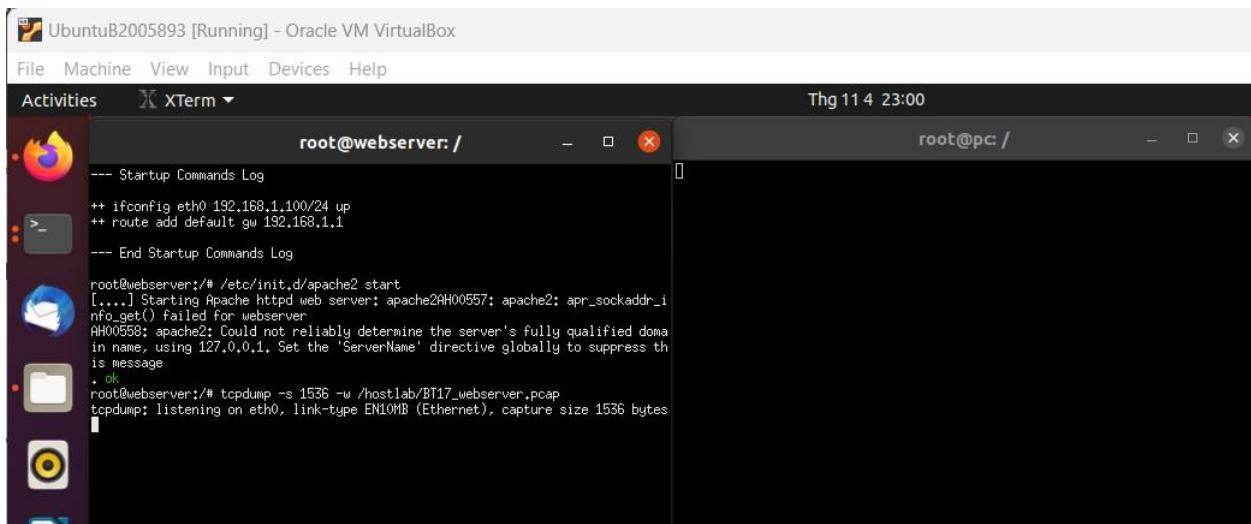
5. On the PC, open a web browser using the *links* command

```
# links
```



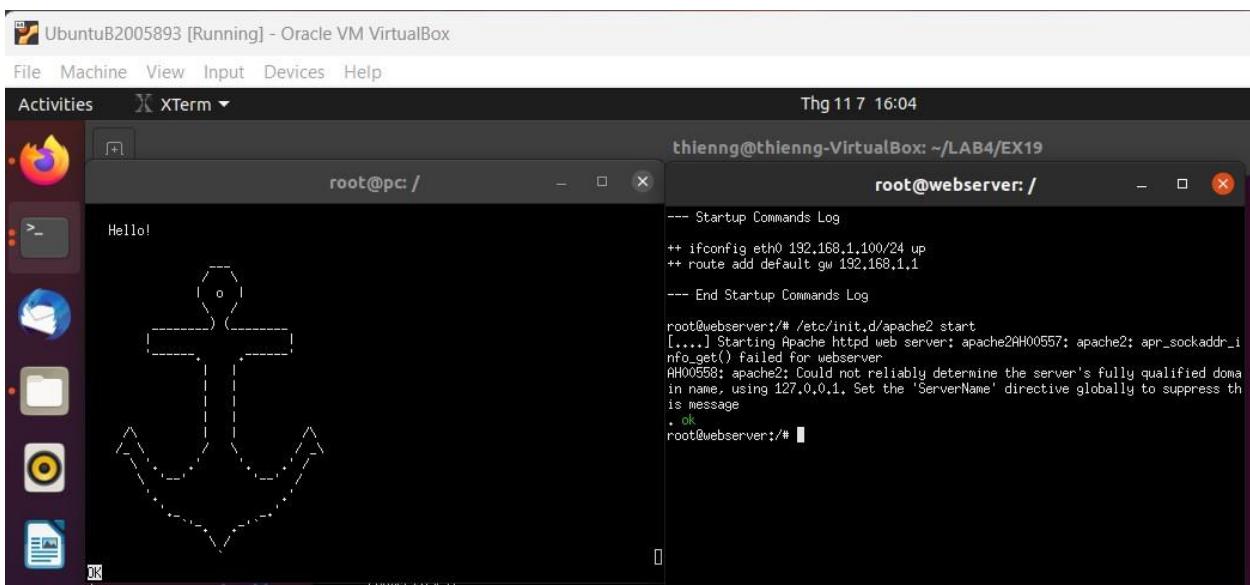
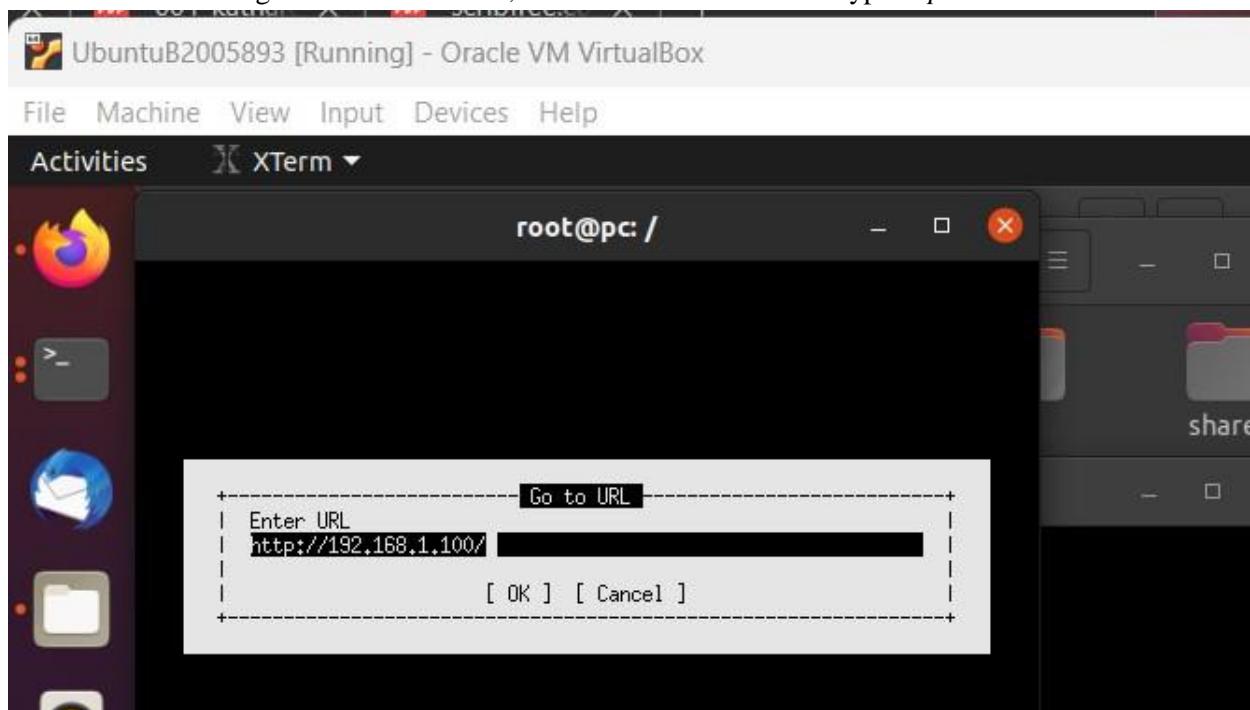
6. On the server, capture the packages sending from the PC

```
# tcpdump -s 1536 -w /hostlab/BT17_webserver.pcap
```

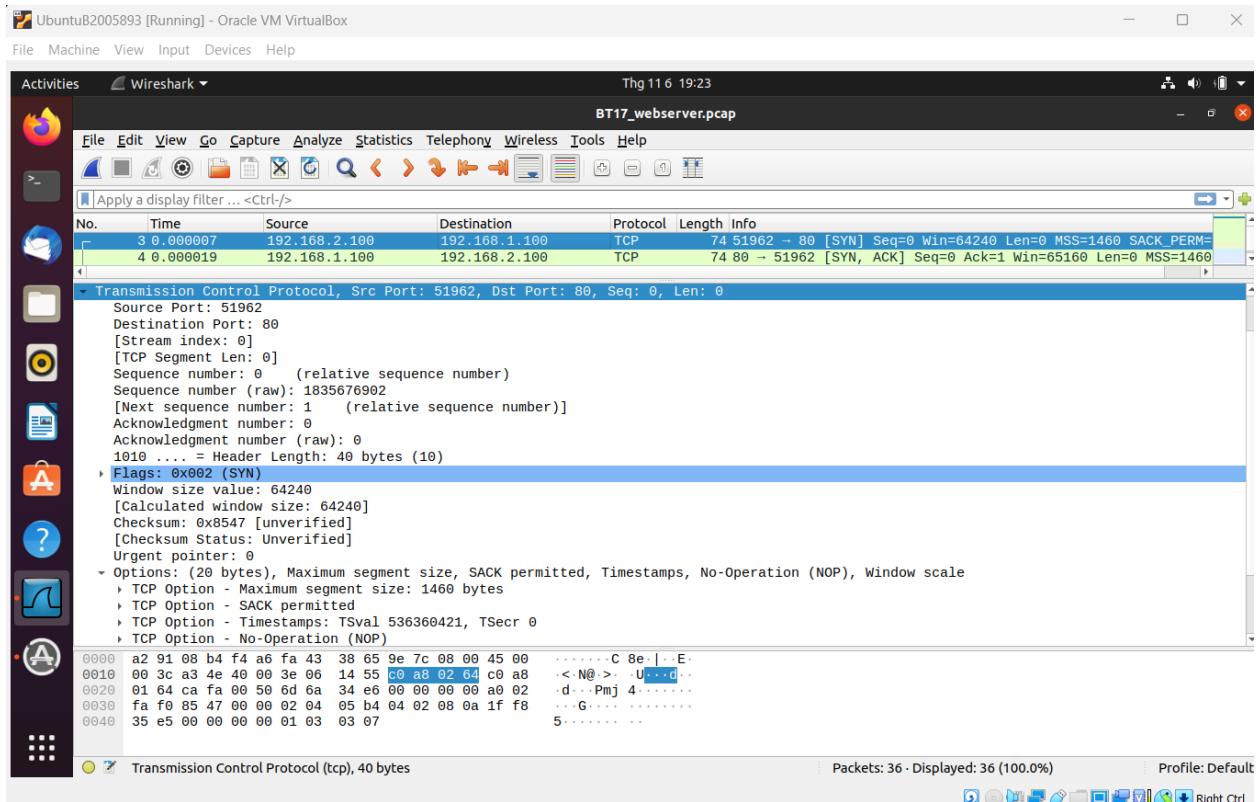


7. On the Pc, access the website provided by the server:

Press *F10* to get into the Menu bar, then select *Go to URL* and type *http://192.168.1.100/*



8. Open the BT17_webserver.pcap using Wireshark. Discover the Transmission Control Protocol Header



- The browser is working on port 51962
- Apache2 of the webserver is working at port 80
- The SYN flag is being turned on. SYN (synchronisation) - Flag used as the first step in establishing a three-way handshake between two servers. Just the first of both the sender and the receiver is allowed to set this flag. Client request to open service gateway by sending a SYN packet (TCP packet) to the server, in this packet, the sequence number parameter is assigned as a random value X

On frame 4:

This Wireshark screenshot displays network traffic captured from a file named BT17_webserver.pcap. The timeline shows the capture was made at 11:16:19.10. The packet list pane shows several TCP segments, with the fourth segment highlighted in green. The details pane provides a detailed breakdown of this selected packet, which is a SYN-ACK segment (TCP flags 0x012). It includes fields such as Source Port (80), Destination Port (51962), Sequence number (0), Acknowledgment number (1), and various TCP options like Maximum segment size (1460), SACK permitted, Timestamps, and Window scale. The bytes pane shows the raw hex and ASCII representation of the packet.

This Wireshark screenshot focuses on the detailed analysis of the fourth packet in the capture, identified as 'Packet 4 · BT17_webserver.pcap'. The analysis pane highlights the SYN-ACK flag and notes that it is an ACK to the segment in frame 3. It also provides timing information: RTT to ACK (0.000012000 seconds) and IRTT (0.000034000 seconds). The bytes pane shows the raw hex and ASCII representation of the packet.

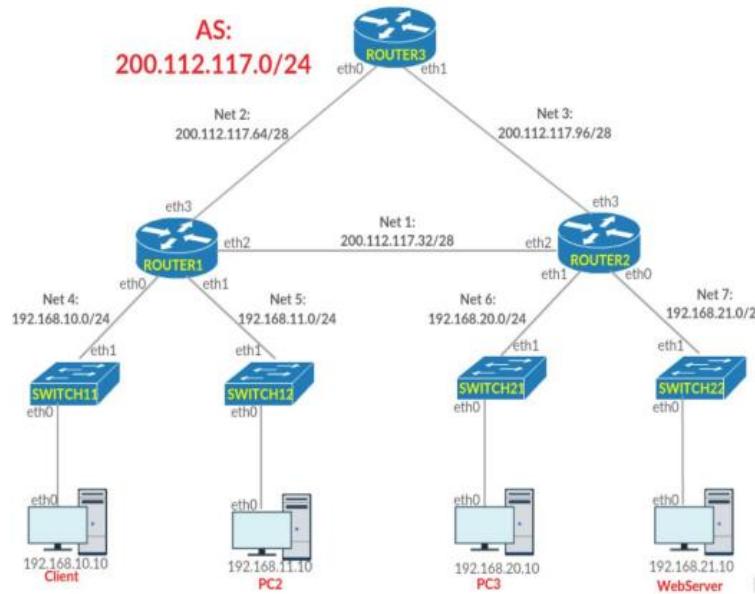
- ➔ Flag SYN and Flag ACK are both being turned on to notice this is the second send. A segment that has both SYN and ACK will be the second segment on the same connection. The server will respond by sending back to the client with SYN-ACK message. In this packet, the parameter acknowledgement number is assigned the value of $x + 1$, the parameter sequence number randomly assigned a value Y

9. Delete VMs

\$ kathara lclean

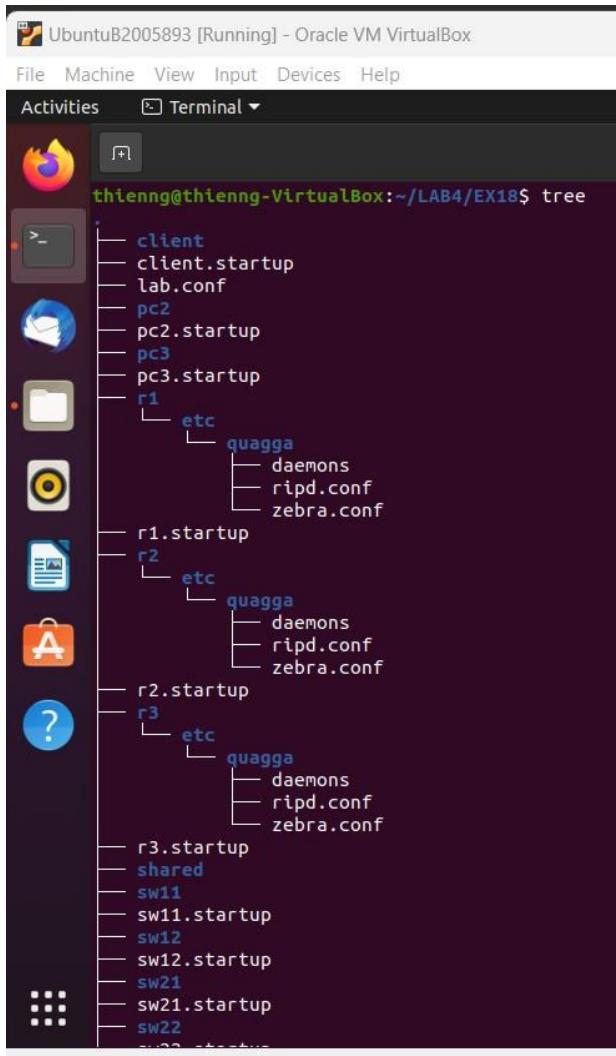
```
Ubuntu82005893 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Thg 11 4 23:06
thienng@thienng-VirtualBox:~/LAB4/EX1$ kathara lclean
INFO - ===== Stopping Network Scenario =====
Deleting devices...|#####
Deleting collision domains...|#####
thienng@thienng-VirtualBox:~/LAB4/EX1$
```

Exercise 18: Construct the following network. All router use the RIPv2 protocol

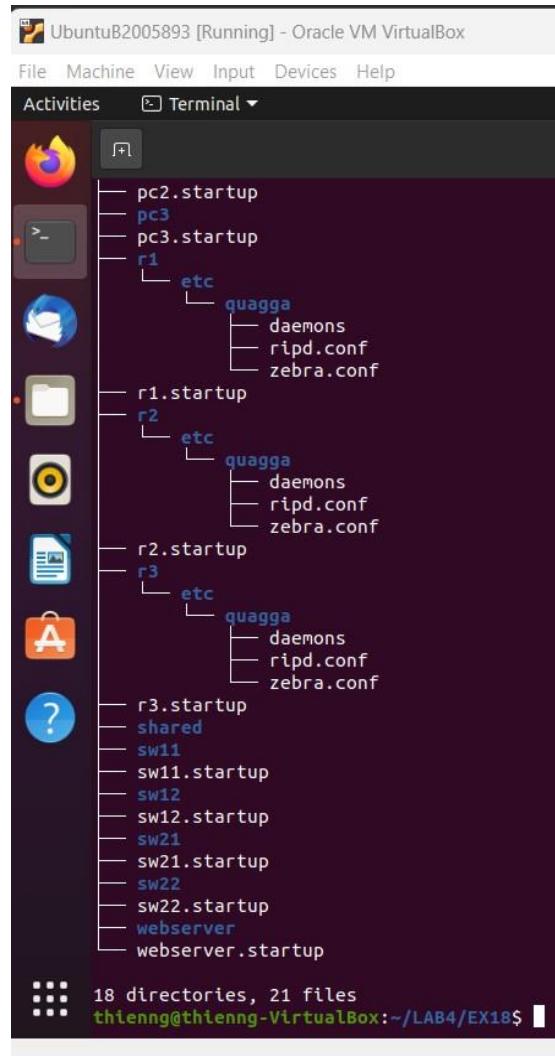


1. Files and Folders

\$ tree



```
thienng@thienng-VirtualBox:~/LAB4/EX18$ tree
.
├── client
│   └── client.startup
├── lab.conf
├── pc2
│   └── pc2.startup
├── pc3
│   └── pc3.startup
└── r1
    ├── etc
    │   └── quagga
    │       ├── daemons
    │       │   └── ripd.conf
    │       └── zebra.conf
    └── r1.startup
        └── etc
            └── quagga
                ├── daemons
                │   └── ripd.conf
                └── zebra.conf
└── r2
    ├── etc
    │   └── quagga
    │       ├── daemons
    │       │   └── ripd.conf
    │       └── zebra.conf
    └── r2.startup
        └── etc
            └── quagga
                ├── daemons
                │   └── ripd.conf
                └── zebra.conf
└── r3
    ├── etc
    │   └── quagga
    │       ├── daemons
    │       │   └── ripd.conf
    │       └── zebra.conf
    └── r3.startup
        ├── shared
        ├── sw11
        └── sw11.startup
        └── sw12
            └── sw12.startup
            └── sw21
                └── sw21.startup
                └── sw22
                    └── sw22.startup
                    └── webserver
                        └── webserver.startup
```



```
thienng@thienng-VirtualBox:~/LAB4/EX18$ tree
.
├── pc2.startup
├── pc3
├── pc3.startup
└── r1
    └── etc
        └── quagga
            ├── daemons
            │   └── ripd.conf
            └── zebra.conf
└── r1.startup
    └── etc
        └── quagga
            ├── daemons
            │   └── ripd.conf
            └── zebra.conf
└── r2
    └── etc
        └── quagga
            ├── daemons
            │   └── ripd.conf
            └── zebra.conf
└── r2.startup
    └── etc
        └── quagga
            ├── daemons
            │   └── ripd.conf
            └── zebra.conf
└── r3
    └── etc
        └── quagga
            ├── daemons
            │   └── ripd.conf
            └── zebra.conf
└── r3.startup
    ├── shared
    ├── sw11
    └── sw11.startup
    └── sw12
        └── sw12.startup
        └── sw21
            └── sw21.startup
            └── sw22
                └── sw22.startup
                └── webserver
                    └── webserver.startup
18 directories, 21 files
thienng@thienng-VirtualBox:~/LAB4/EX18$
```

2. File configurations

\$ cat client.startup	\$ cat r1.startup
\$ cat pc2.startup	\$ cat r2.startup
\$ cat pc3.startup	\$ cat r3.startup
\$ cat webserver.startup	
\$ cat sw11.startup	\$ cat r1/etc/quagga/daemons
\$ cat sw12.startup	\$ cat r1/etc/quagga/ripd.conf
\$ cat sw21.startup	\$ cat r1/etc/quagga/zebra.conf
\$ cat sw22.startup	

The screenshot shows a Linux desktop environment running in a VirtualBox VM. The desktop has a dark theme with icons for various applications like a browser, terminal, file manager, and system tools. A terminal window is open, displaying the output of several 'cat' commands. The commands read configuration files from the user's home directory (~) and print their contents to the terminal. The files contain mappings for network components like clients, switches, and routers.

```
thienng@thienng-VirtualBox:~/LAB4/EX18$ cat lab.conf
client[0]=A
pc2[0]=B
pc3[0]=C
webserver[0]=D

sw11[0]=A
sw11[1]=E

sw12[0]=B
sw12[1]=F

sw21[0]=C
sw21[1]=G

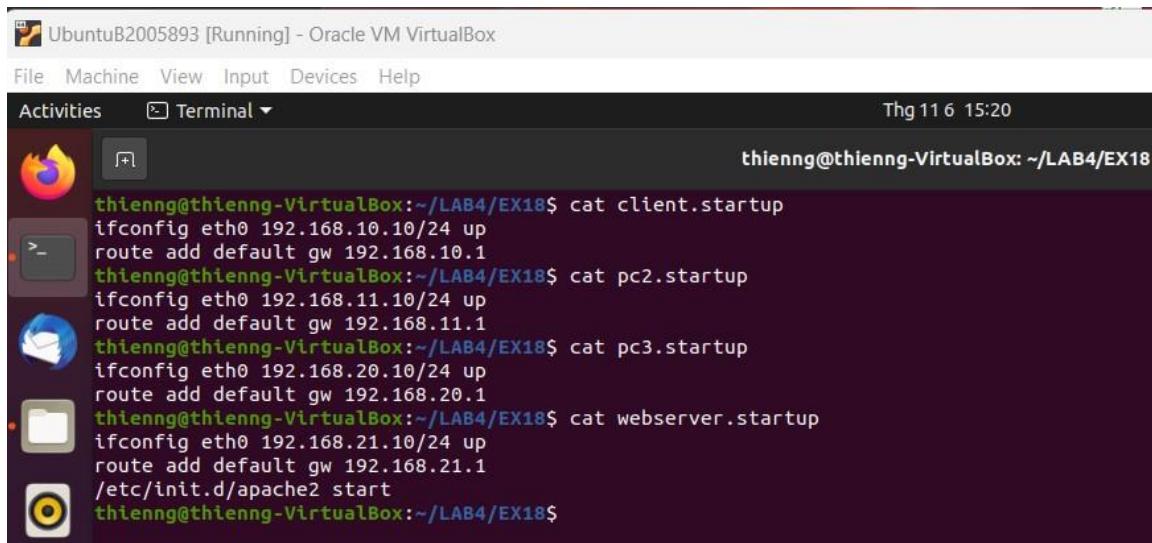
sw22[0]=D
sw22[1]=H

r1[0]=E
r1[1]=F
r1[2]=I
r1[3]=J

r2[0]=G
r2[1]=H
r2[2]=I
r2[3]=K

r3[0]=J
r3[1]=K

thienng@thienng-VirtualBox:~/LAB4/EX18$
```

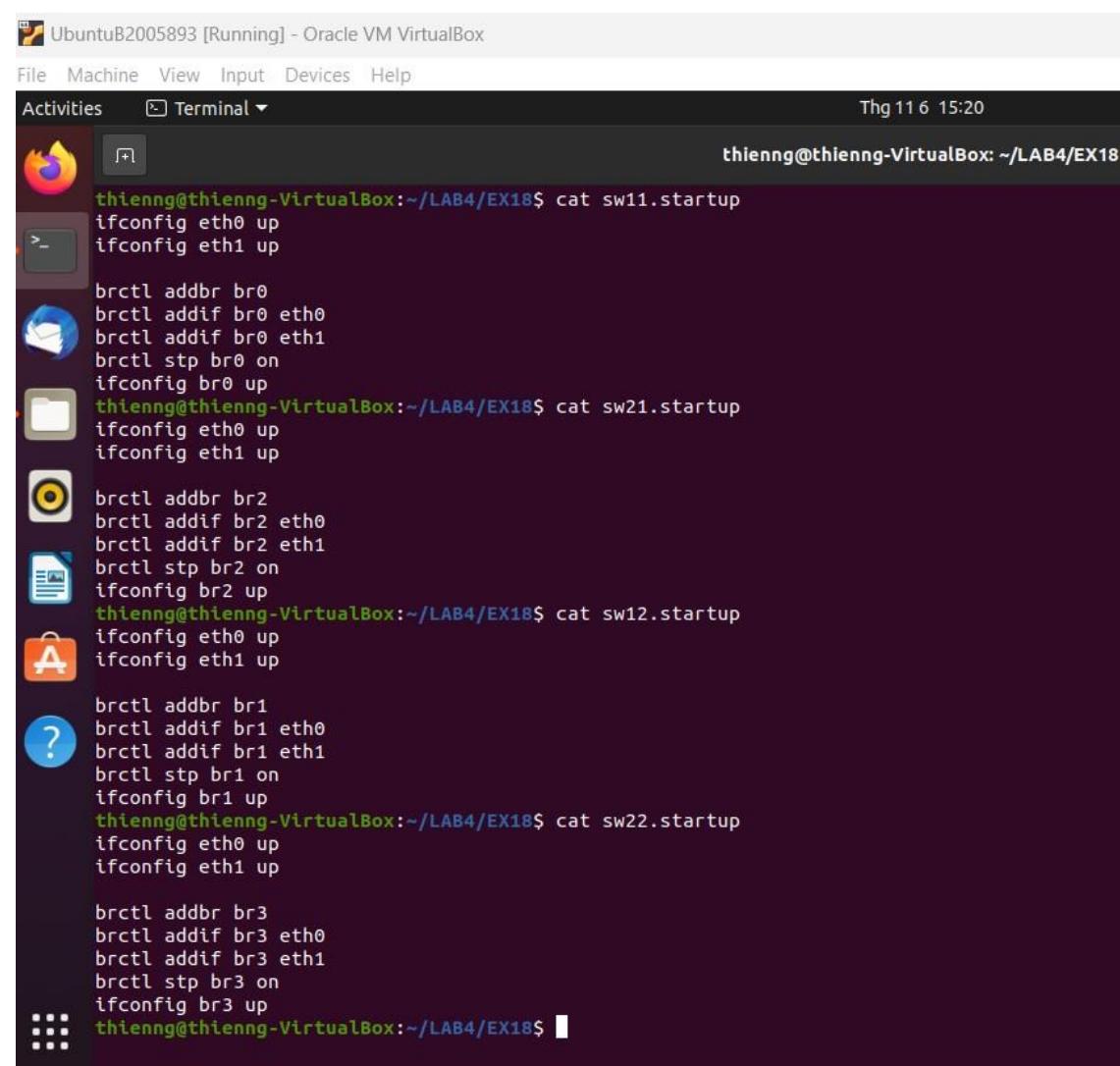


UbuntuB2005893 [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities Terminal Thg 11 6 15:20

```
thienng@thienng-VirtualBox:~/LAB4/EX18$ cat client.startup
ifconfig eth0 192.168.10.10/24 up
route add default gw 192.168.10.1
thienng@thienng-VirtualBox:~/LAB4/EX18$ cat pc2.startup
ifconfig eth0 192.168.11.10/24 up
route add default gw 192.168.11.1
thienng@thienng-VirtualBox:~/LAB4/EX18$ cat pc3.startup
ifconfig eth0 192.168.20.10/24 up
route add default gw 192.168.20.1
thienng@thienng-VirtualBox:~/LAB4/EX18$ cat webserver.startup
ifconfig eth0 192.168.21.10/24 up
route add default gw 192.168.21.1
/etc/init.d/apache2 start
thienng@thienng-VirtualBox:~/LAB4/EX18$
```



UbuntuB2005893 [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities Terminal Thg 11 6 15:20

```
thienng@thienng-VirtualBox:~/LAB4/EX18$ cat sw11.startup
ifconfig eth0 up
ifconfig eth1 up

brctl addbr br0
brctl addif br0 eth0
brctl addif br0 eth1
brctl stp br0 on
ifconfig br0 up
thienng@thienng-VirtualBox:~/LAB4/EX18$ cat sw21.startup
ifconfig eth0 up
ifconfig eth1 up

brctl addbr br2
brctl addif br2 eth0
brctl addif br2 eth1
brctl stp br2 on
ifconfig br2 up
thienng@thienng-VirtualBox:~/LAB4/EX18$ cat sw12.startup
ifconfig eth0 up
ifconfig eth1 up

brctl addbr br1
brctl addif br1 eth0
brctl addif br1 eth1
brctl stp br1 on
ifconfig bri up
thienng@thienng-VirtualBox:~/LAB4/EX18$ cat sw22.startup
ifconfig eth0 up
ifconfig eth1 up

brctl addbr br3
brctl addif br3 eth0
brctl addif br3 eth1
brctl stp br3 on
ifconfig br3 up
thienng@thienng-VirtualBox:~/LAB4/EX18$
```

UbuntuB2005893 [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities Terminal Thg 11 6 15:23

```
thienng@thienng-VirtualBox:~/LAB4/EX18$ cat r1.startup
ifconfig eth0 192.168.10.1/24 up
ifconfig eth1 192.168.11.1/24 up
ifconfig eth2 200.112.117.33/28 up
ifconfig eth3 200.112.117.65/28 up
/etc/init.d/quagga start
thienng@thienng-VirtualBox:~/LAB4/EX18$ cat r2.startup
ifconfig eth0 192.168.20.1/24 up
ifconfig eth1 192.168.21.1/24 up
ifconfig eth2 200.112.117.34/28 up
ifconfig eth3 200.112.117.97/28 up
/etc/init.d/quagga start
thienng@thienng-VirtualBox:~/LAB4/EX18$ cat r3.startup
ifconfig eth0 200.112.117.66/28 up
ifconfig eth1 200.112.117.98/28 up
/etc/init.d/quagga start
thienng@thienng-VirtualBox:~/LAB4/EX18$
```

UbuntuB2005893 [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities Terminal Thg 11 6 15:25

```
thienng@thienng-VirtualBox:~/LAB4/EX18$ cat r1/etc/quagga/daemons
zebra=yes
bgpd=no
ospfd=no
ospf6d=no
ripd=yes
ripngd=no
thienng@thienng-VirtualBox:~/LAB4/EX18$ cat r1/etc/quagga/ripd.conf
hostname ripd
password zebra
enable password zebra

router rip
redistribute connected
network 192.168.0.0/24
network 200.112.117.0/28

log file /var/log/quagga/ripd.log
thienng@thienng-VirtualBox:~/LAB4/EX18$ cat r1/etc/quagga/zebra.conf
hostname zebra
password zebra
enable password zebra

log file /var/log/quagga/zebra.log
thienng@thienng-VirtualBox:~/LAB4/EX18$
```

```

thienng@thienng-VirtualBox:~/LAB4/EX18$ cat r2/etc/quagga/ripd.conf
hostname ripd
password zebra
enable password zebra

router rip
redistribute connected
network 192.168.0.0/24
network 200.112.117.0/28

log file /var/log/quagga/ripd.log
thienng@thienng-VirtualBox:~/LAB4/EX18$ cat r3/etc/quagga/ripd.conf
hostname ripd
password zebra
enable password zebra

router rip
redistribute connected
network 200.112.117.0/28

log file /var/log/quagga/ripd.log
thienng@thienng-VirtualBox:~/LAB4/EX18$ 

```

3. After building up the network, start kathara and open routing table on the routers

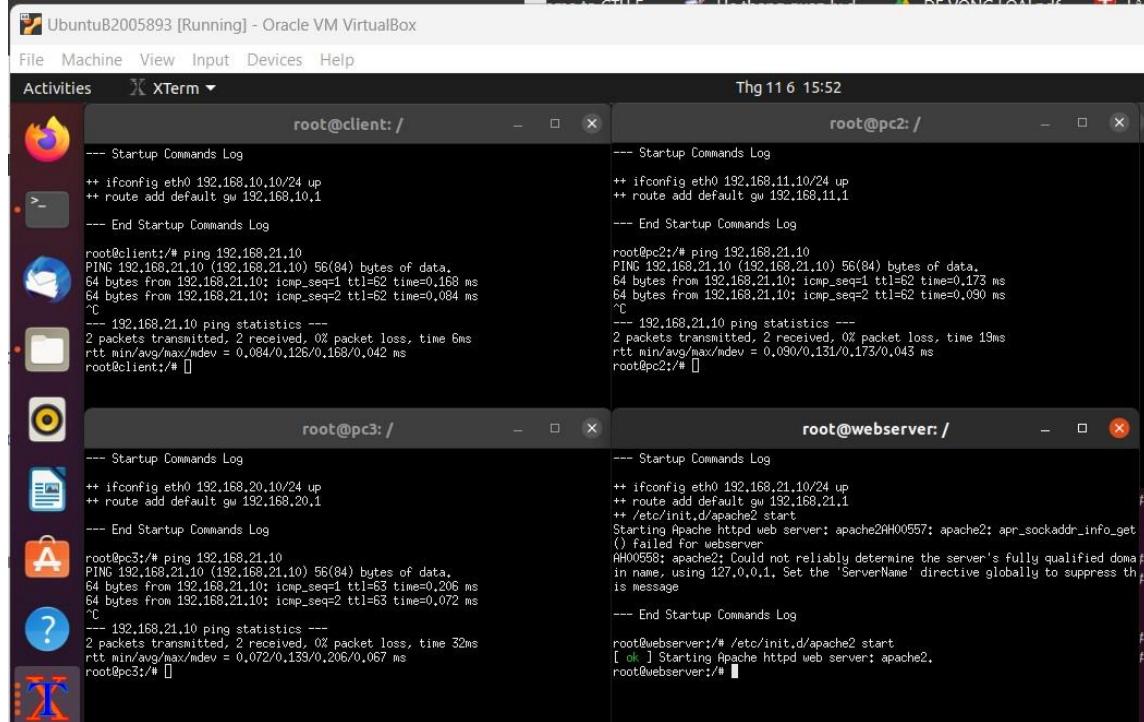
```
# route -n
```

Destination	Gateway	Genmask	Flags	Metric	Ref	Use	Iface
192.168.10.0	0.0.0.0	255.255.255.0	U	0	0	0	eth0
192.168.11.0	0.0.0.0	255.255.255.0	U	0	0	0	eth1
192.168.20.0	200.112.117.34	255.255.255.0	UG	20	0	0	eth2
192.168.21.0	200.112.117.34	255.255.255.0	UG	20	0	0	eth2
200.112.117.32	0.0.0.0	255.255.255.240	U	0	0	0	eth2
200.112.117.64	0.0.0.0	255.255.255.240	U	0	0	0	eth3
200.112.117.96	200.112.117.34	255.255.255.240	UG	20	0	0	eth2

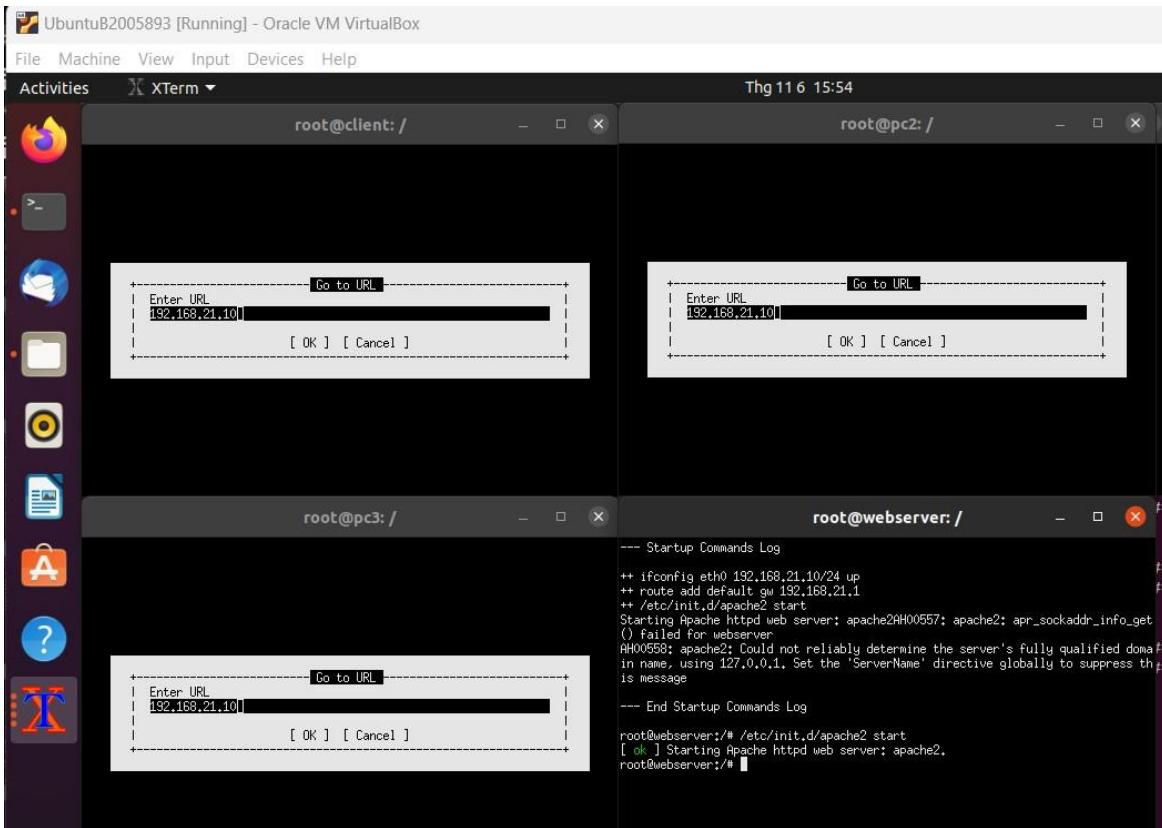
Destination	Gateway	Genmask	Flags	Metric	Ref	Use	Iface
192.168.10.0	200.112.117.33	255.255.255.0	UG	20	0	0	eth2
192.168.11.0	200.112.117.33	255.255.255.0	UG	20	0	0	eth2
192.168.20.0	0.0.0.0	255.255.255.0	U	0	0	0	eth0
192.168.21.0	0.0.0.0	255.255.255.0	U	0	0	0	eth1
200.112.117.32	0.0.0.0	255.255.255.240	U	0	0	0	eth2
200.112.117.64	200.112.117.33	255.255.255.240	UG	20	0	0	eth2
200.112.117.96	0.0.0.0	255.255.255.240	U	0	0	0	eth3

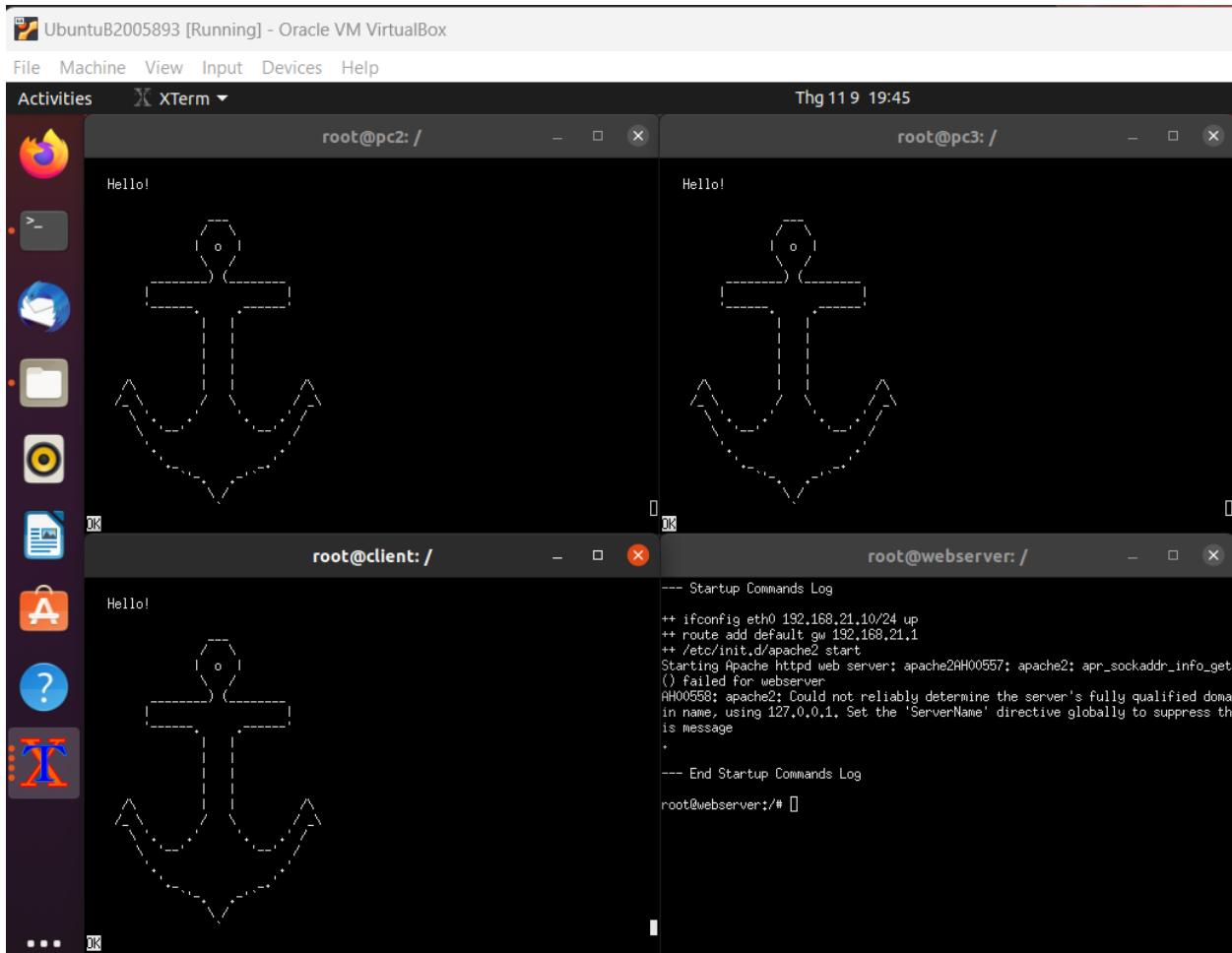
Destination	Gateway	Genmask	Flags	Metric	Ref	Use	Iface
192.168.10.0	200.112.117.65	255.255.255.0	UG	20	0	0	eth0
192.168.11.0	200.112.117.65	255.255.255.0	UG	20	0	0	eth0
192.168.20.0	200.112.117.97	255.255.255.0	UG	20	0	0	eth1
192.168.21.0	200.112.117.97	255.255.255.0	UG	20	0	0	eth1
200.112.117.32	200.112.117.97	255.255.255.240	UG	20	0	0	eth1
200.112.117.64	0.0.0.0	255.255.255.240	U	0	0	0	eth0
200.112.117.96	0.0.0.0	255.255.255.240	U	0	0	0	eth1

- Test connectivity, ping all the pc and client to the webserver and start apache2 on the webserver
- ```
ping 192.168.21.10
/etc/init.d/apache2 start
```



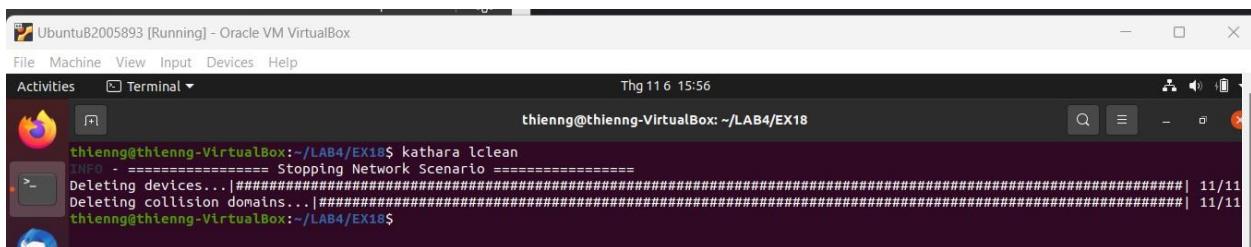
- On the PC and the Client, open a web browser using the *links* command
- ```
# links
```



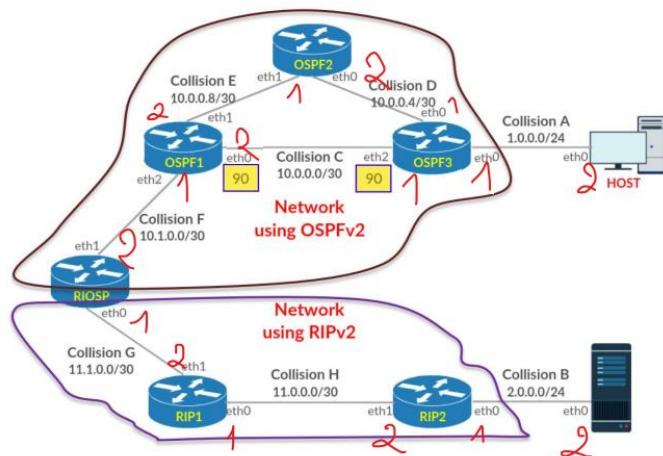


7. Delete VMs

\$ kathara lclean



Exercise 19: Construct the following network.

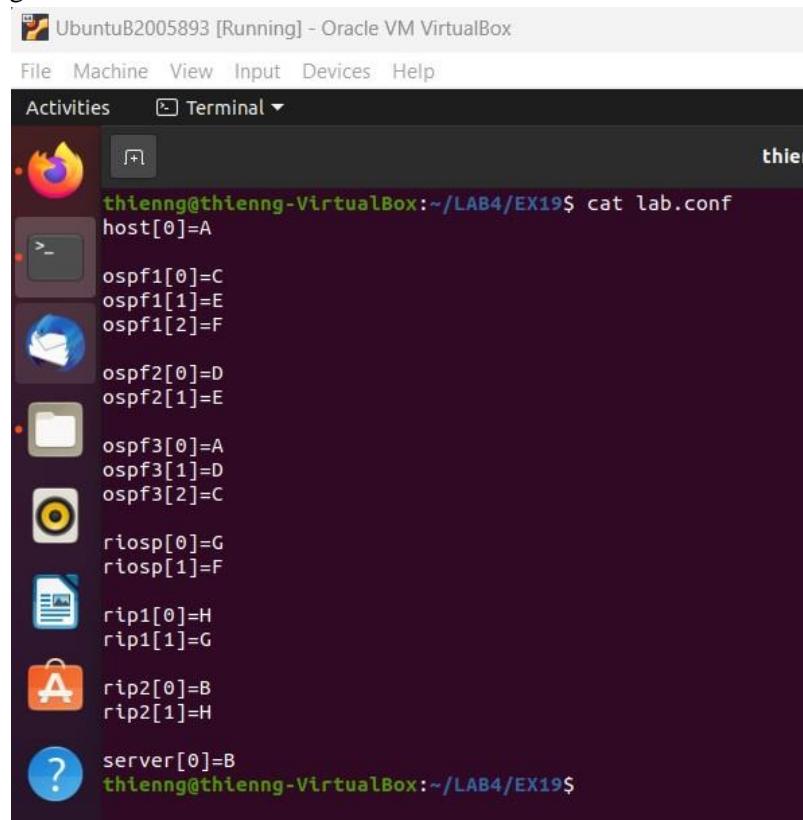


1. Files and Folders

\$ tree

```
thienng@thienng-VirtualBox:~/LAB4/EX19$ tree
.
├── host
├── host.startup
├── lab.conf
└── ospf1
    ├── etc
    │   └── quagga
    │       ├── daemons
    │       └── ospfd.conf
    └── ospf1.startup
        └── ospf1
            └── etc
                └── quagga
                    ├── daemons
                    └── ospfd.conf
    └── ospf2
        ├── etc
        │   └── quagga
        │       ├── daemons
        │       └── ospfd.conf
        └── ospf2.startup
            └── ospf2
                └── etc
                    └── quagga
                        ├── daemons
                        └── ospfd.conf
    └── ospf3
        ├── etc
        │   └── quagga
        │       ├── daemons
        │       └── ospfd.conf
        └── ospf3.startup
            └── ospf3
                └── etc
                    └── quagga
                        ├── daemons
                        └── ospfd.conf
    └── riosp
        ├── etc
        │   └── quagga
        │       ├── daemons
        │       └── ripd.conf
        └── riosp.startup
            └── riosp
                └── etc
                    └── quagga
                        ├── daemons
                        └── ripd.conf
    └── rip1
        ├── etc
        │   └── quagga
        │       ├── daemons
        │       └── ripd.conf
        └── rip1.startup
            └── rip1
                └── etc
                    └── quagga
                        ├── daemons
                        └── ripd.conf
    └── rip2
        ├── etc
        │   └── quagga
        │       ├── daemons
        │       └── ripd.conf
        └── rip2.startup
            └── rip2
                └── etc
                    └── quagga
                        ├── daemons
                        └── ripd.conf
    └── server
        └── var
            └── www
                └── html
                    └── index.html
    └── server.startup
        └── server
            └── shared
24 directories, 23 files
thienng@thienng-VirtualBox:~/LAB4/EX19$
```

2. Files configurations

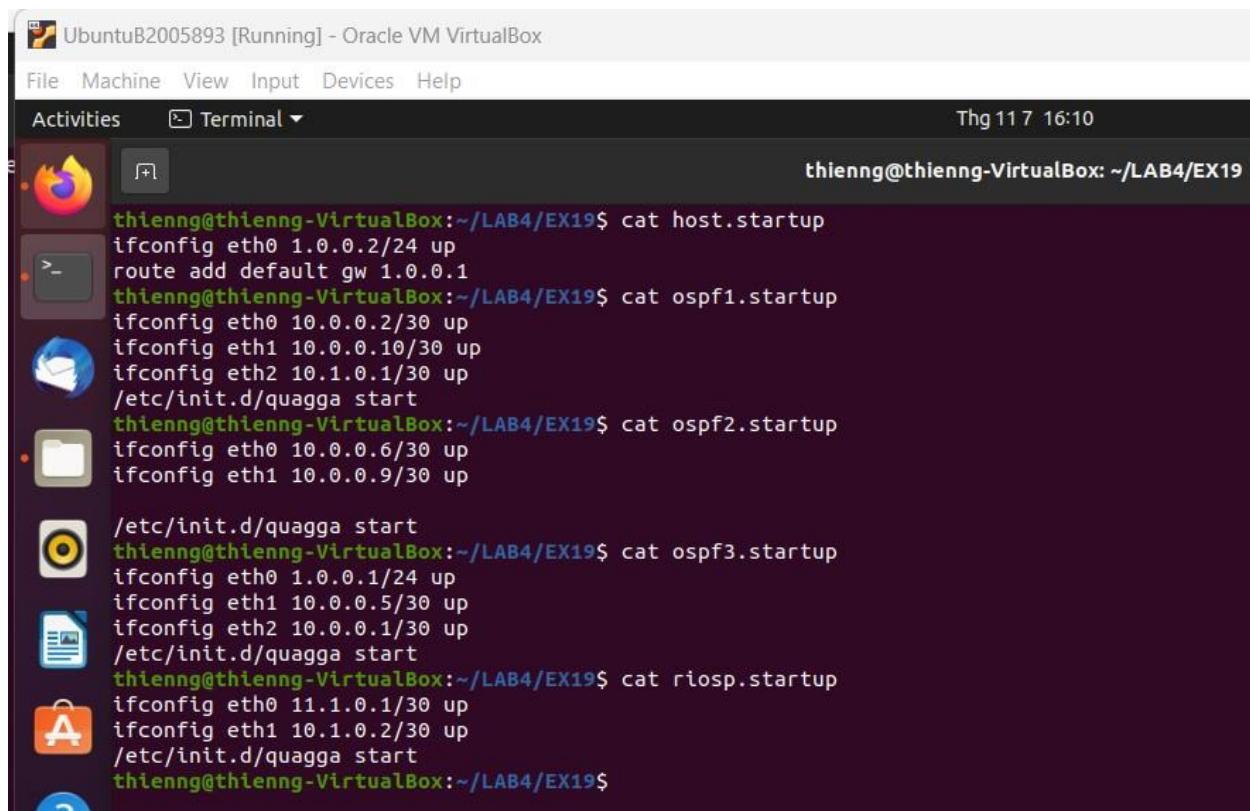


UbuntuB2005893 [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities Terminal

```
thienng@thienng-VirtualBox:~/LAB4/EX19$ cat lab.conf
host[0]=A
ospf1[0]=C
ospf1[1]=E
ospf1[2]=F
ospf2[0]=D
ospf2[1]=E
ospf3[0]=A
ospf3[1]=D
ospf3[2]=C
riosp[0]=G
riosp[1]=F
rip1[0]=H
rip1[1]=G
rip2[0]=B
rip2[1]=H
server[0]=B
thienng@thienng-VirtualBox:~/LAB4/EX19$
```



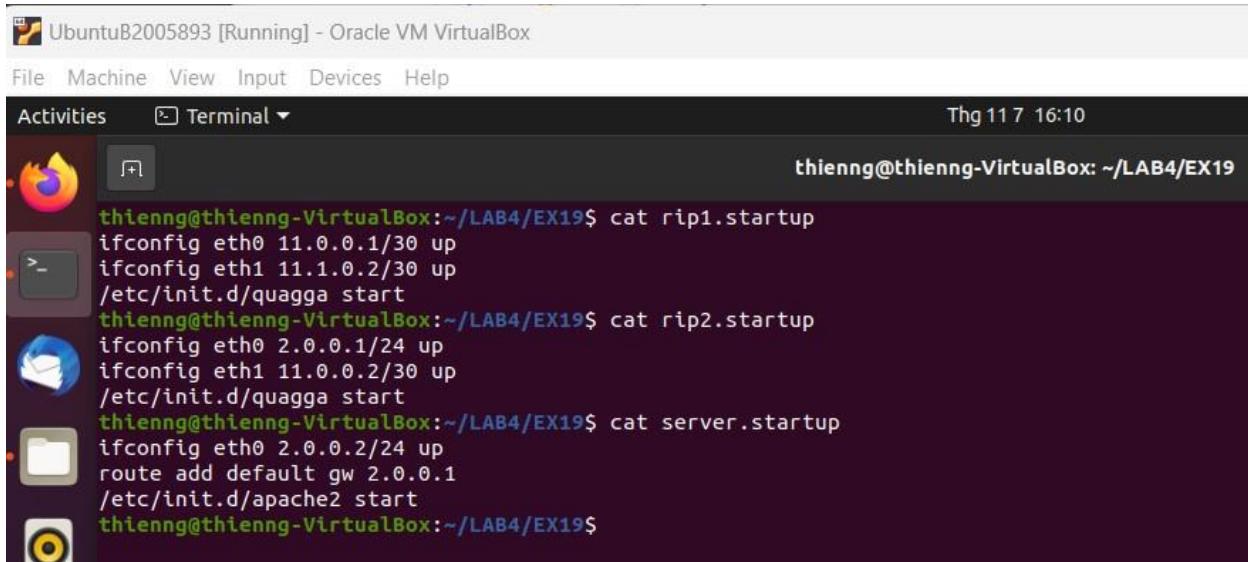
UbuntuB2005893 [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

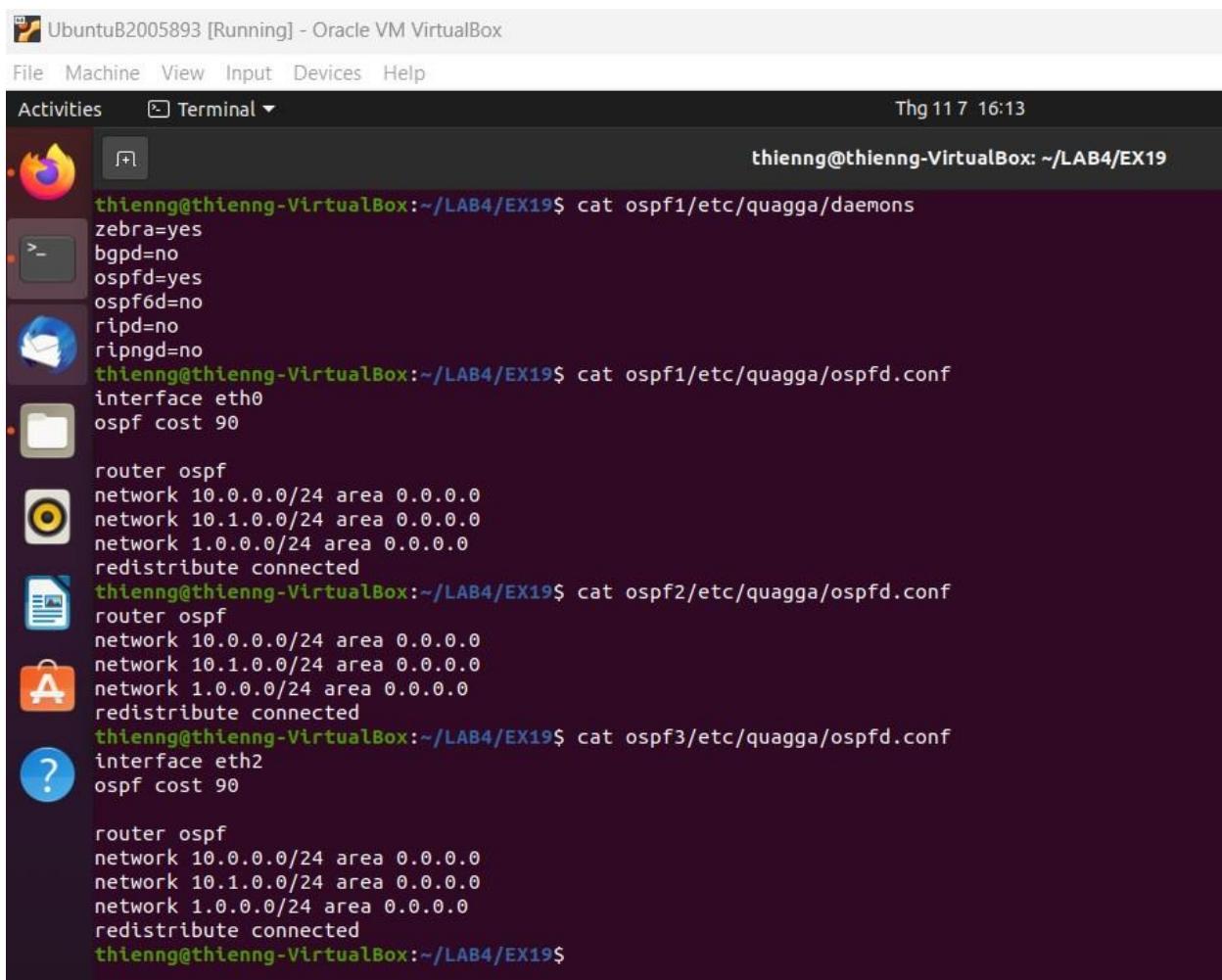
Activities Terminal Thg 11 7 16:10

```
thienng@thienng-VirtualBox:~/LAB4/EX19$ cat host.startup
ifconfig eth0 1.0.0.2/24 up
route add default gw 1.0.0.1
thienng@thienng-VirtualBox:~/LAB4/EX19$ cat ospf1.startup
ifconfig eth0 10.0.0.2/30 up
ifconfig eth1 10.0.0.10/30 up
ifconfig eth2 10.1.0.1/30 up
/etc/init.d/quagga start
thienng@thienng-VirtualBox:~/LAB4/EX19$ cat ospf2.startup
ifconfig eth0 10.0.0.6/30 up
ifconfig eth1 10.0.0.9/30 up

/etc/init.d/quagga start
thienng@thienng-VirtualBox:~/LAB4/EX19$ cat ospf3.startup
ifconfig eth0 1.0.0.1/24 up
ifconfig eth1 10.0.0.5/30 up
ifconfig eth2 10.0.0.1/30 up
/etc/init.d/quagga start
thienng@thienng-VirtualBox:~/LAB4/EX19$ cat riosp.startup
ifconfig eth0 11.1.0.1/30 up
ifconfig eth1 10.1.0.2/30 up
/etc/init.d/quagga start
thienng@thienng-VirtualBox:~/LAB4/EX19$
```



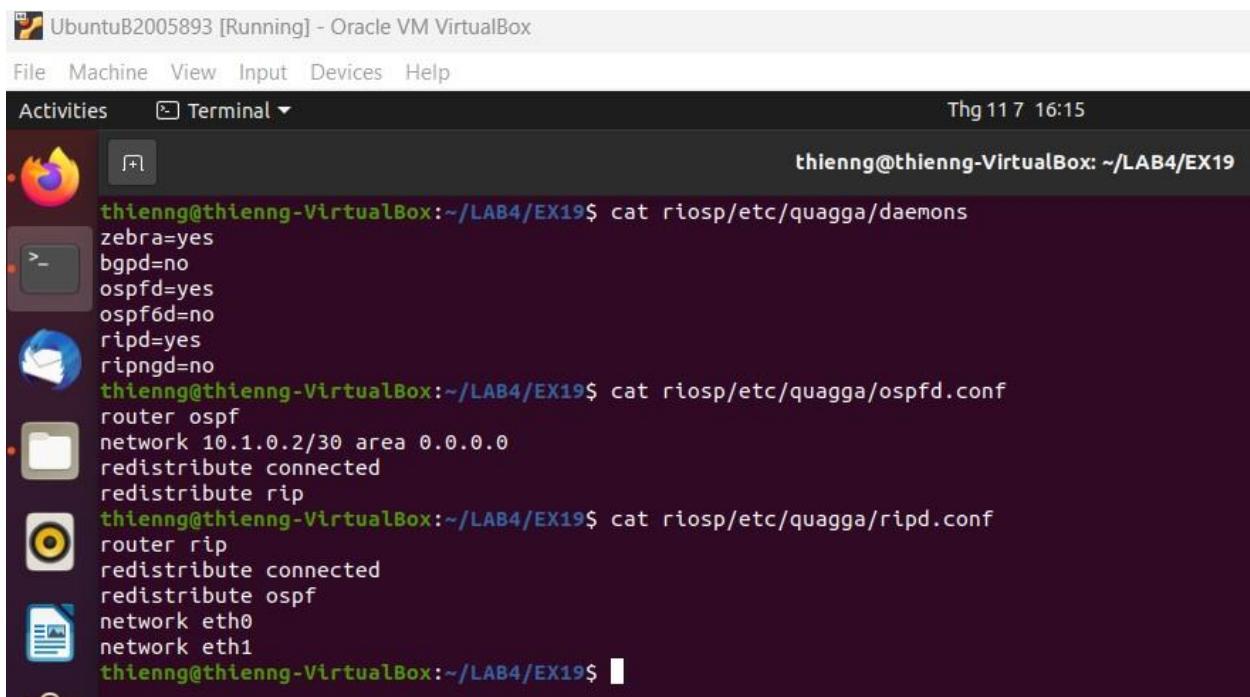
```
UbuntuB2005893 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Thg 11 7 16:10
thienng@thienng-VirtualBox: ~/LAB4/EX19
thienng@thienng-VirtualBox:~/LAB4/EX19$ cat rip1.startup
ifconfig eth0 11.0.0.1/30 up
ifconfig eth1 11.1.0.2/30 up
/etc/init.d/quagga start
thienng@thienng-VirtualBox:~/LAB4/EX19$ cat rip2.startup
ifconfig eth0 2.0.0.1/24 up
ifconfig eth1 11.0.0.2/30 up
/etc/init.d/quagga start
thienng@thienng-VirtualBox:~/LAB4/EX19$ cat server.startup
ifconfig eth0 2.0.0.2/24 up
route add default gw 2.0.0.1
/etc/init.d/apache2 start
thienng@thienng-VirtualBox:~/LAB4/EX19$
```



```
UbuntuB2005893 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Thg 11 7 16:13
thienng@thienng-VirtualBox: ~/LAB4/EX19
thienng@thienng-VirtualBox:~/LAB4/EX19$ cat ospf1/etc/quagga/daemons
zebra=yes
bgpd=no
ospfd=yes
ospf6d=no
ripd=no
ripngd=no
thienng@thienng-VirtualBox:~/LAB4/EX19$ cat ospf1/etc/quagga/ospfd.conf
interface eth0
ospf cost 90

router ospf
network 10.0.0.0/24 area 0.0.0.0
network 10.1.0.0/24 area 0.0.0.0
network 1.0.0.0/24 area 0.0.0.0
redistribute connected
thienng@thienng-VirtualBox:~/LAB4/EX19$ cat ospf2/etc/quagga/ospfd.conf
router ospf
network 10.0.0.0/24 area 0.0.0.0
network 10.1.0.0/24 area 0.0.0.0
network 1.0.0.0/24 area 0.0.0.0
redistribute connected
thienng@thienng-VirtualBox:~/LAB4/EX19$ cat ospf3/etc/quagga/ospfd.conf
interface eth2
ospf cost 90

router ospf
network 10.0.0.0/24 area 0.0.0.0
network 10.1.0.0/24 area 0.0.0.0
network 1.0.0.0/24 area 0.0.0.0
redistribute connected
thienng@thienng-VirtualBox:~/LAB4/EX19$
```

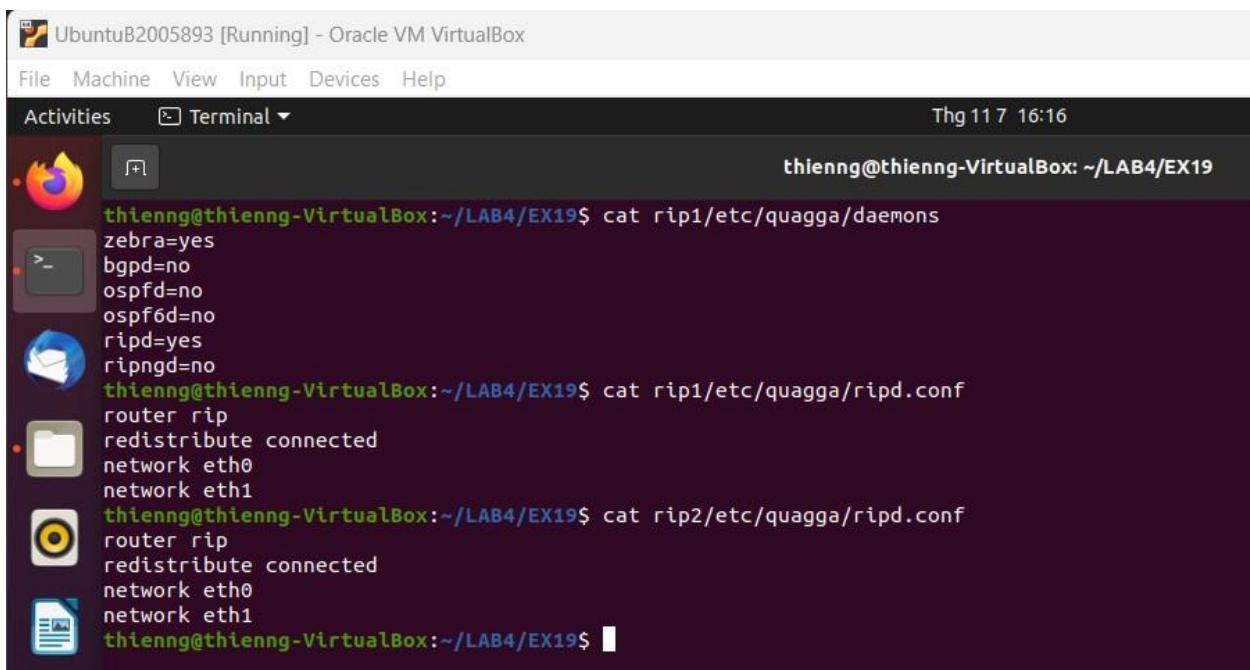


UbuntuB2005893 [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities Terminal Thg 11 7 16:15

```
thienng@thienng-VirtualBox:~/LAB4/EX19$ cat riosp/etc/quagga/daemons
zebra=yes
bgpd=no
ospfd=yes
ospf6d=no
ripd=yes
ripngd=no
thienng@thienng-VirtualBox:~/LAB4/EX19$ cat riosp/etc/quagga/ospfd.conf
router ospf
network 10.1.0.2/30 area 0.0.0.0
redistribute connected
redistribute rip
thienng@thienng-VirtualBox:~/LAB4/EX19$ cat riosp/etc/quagga/ripd.conf
router rip
redistribute connected
redistribute ospf
network eth0
network eth1
thienng@thienng-VirtualBox:~/LAB4/EX19$
```

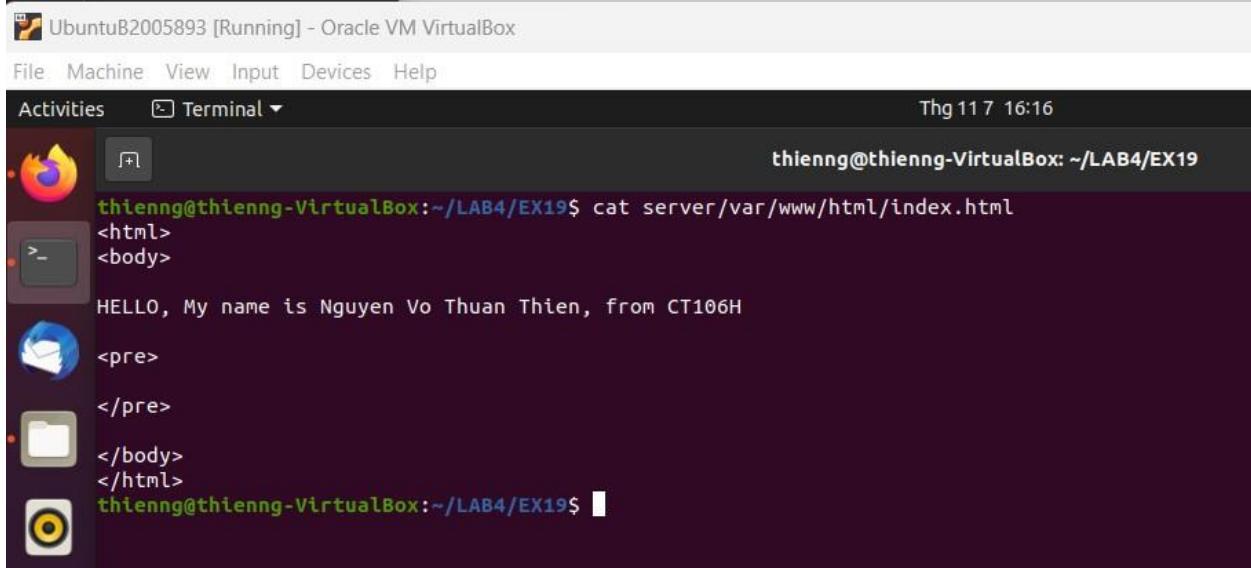


UbuntuB2005893 [Running] - Oracle VM VirtualBox

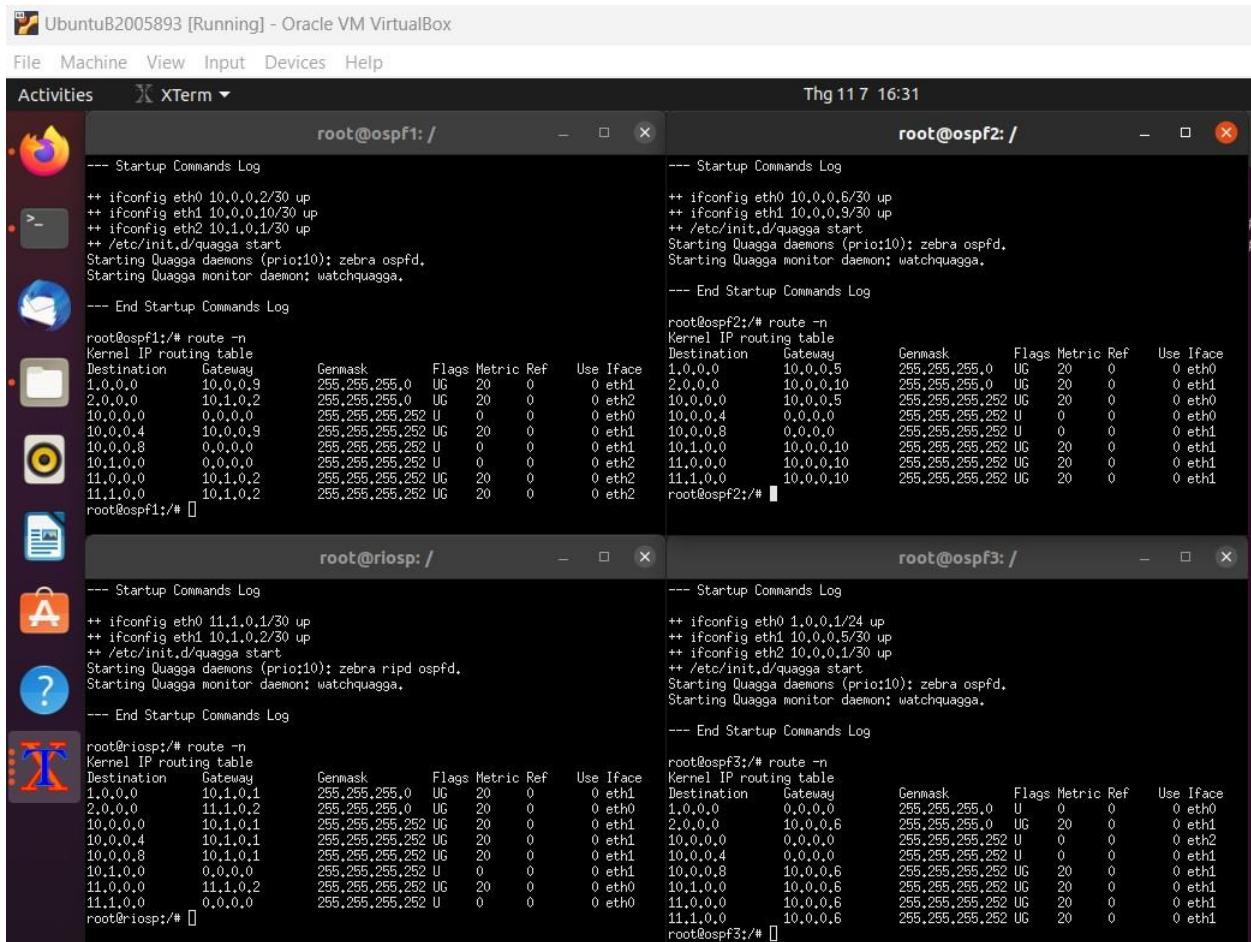
File Machine View Input Devices Help

Activities Terminal Thg 11 7 16:16

```
thienng@thienng-VirtualBox:~/LAB4/EX19$ cat rip1/etc/quagga/daemons
zebra=yes
bgpd=no
ospfd=no
ospf6d=no
ripd=yes
ripngd=no
thienng@thienng-VirtualBox:~/LAB4/EX19$ cat rip1/etc/quagga/ripd.conf
router rip
redistribute connected
network eth0
network eth1
thienng@thienng-VirtualBox:~/LAB4/EX19$ cat rip2/etc/quagga/ripd.conf
router rip
redistribute connected
network eth0
network eth1
thienng@thienng-VirtualBox:~/LAB4/EX19$
```



3. Routing table of ospf



4. Routing table of RIP, host and server

The screenshot shows four terminal windows in a Linux desktop environment (Ubuntu 20.04 LTS) running in Oracle VM VirtualBox. The desktop interface includes a dock with icons for a browser, file manager, terminal, and system settings.

- Host Terminal:** Shows the command `route -n` output. It has one entry for the default gateway (1.0.0.1) via interface eth0.
- Server Terminal:** Shows the command `route -n` output. It has two entries: one for the default gateway (2.0.0.1) via interface eth0, and another for the local network (2.0.0.0) via interface eth0.
- RIP1 Terminal:** Shows the command `route -n` output. It lists several routes for the 11.0.0.0/24 subnet, including routes to 11.0.0.1 via eth1 and 11.0.0.2 via eth0, and a default route via eth1.
- RIP2 Terminal:** Shows the command `route -n` output. It lists several routes for the 11.0.0.0/24 subnet, including routes to 11.0.0.1 via eth1 and 11.0.0.2 via eth0, and a default route via eth1.

```

root@host: ~
--- Startup Commands Log
++ ifconfig eth0 1.0.0.2/24 up
++ route add default gw 1.0.0.1
--- End Startup Commands Log
root@host:/# route -n
Kernel IP routing table
Destination     Gateway      Genmask      Flags Metric Ref  Use Iface
0.0.0.0         1.0.0.1      0.0.0.0      UG        0   0       0 eth0
1.0.0.0         0.0.0.0      255.255.255.0 U          0   0       0 eth0
root@host:/# []

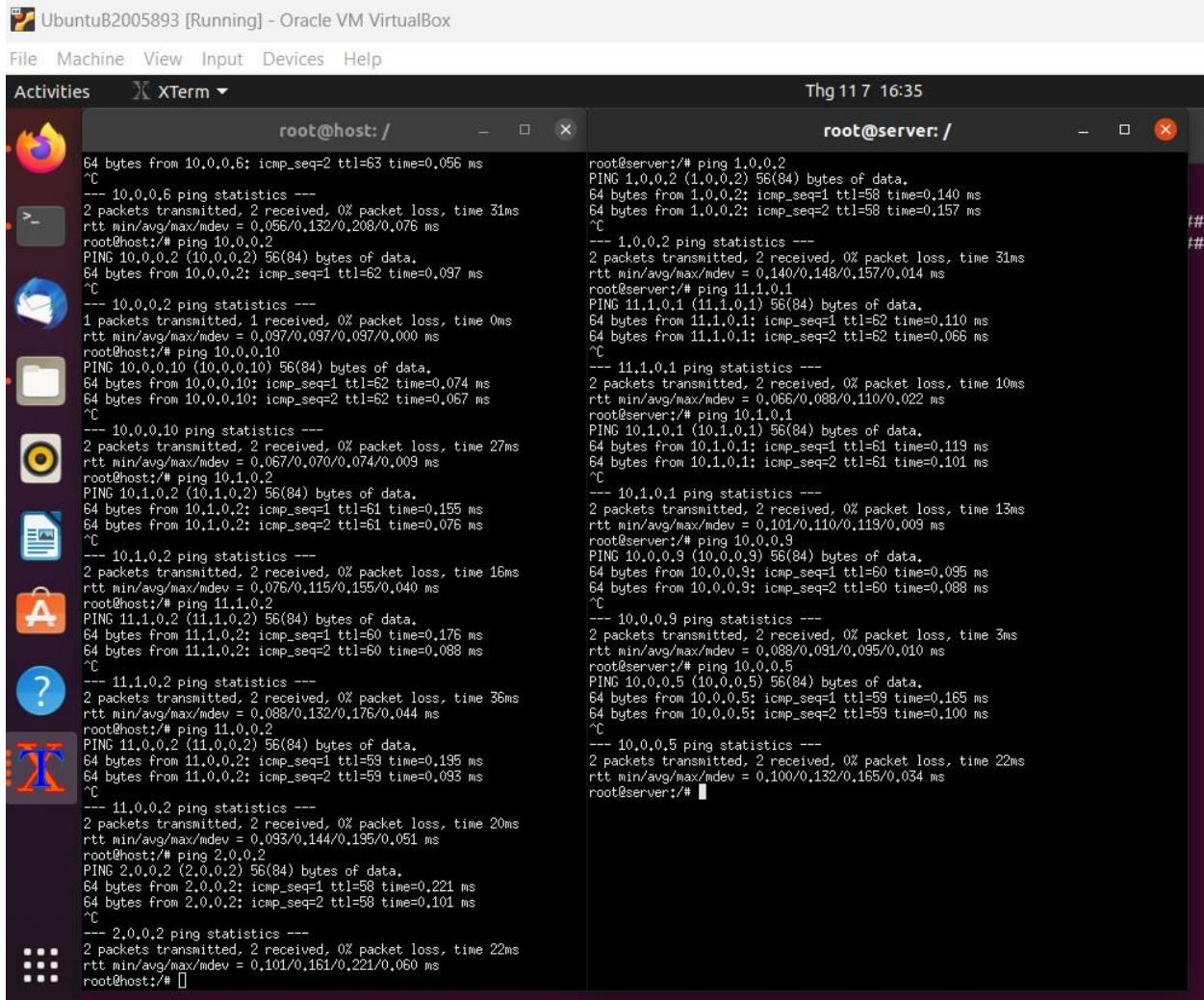
root@server: ~
--- Startup Commands Log
++ ifconfig eth0 2.0.0.2/24 up
++ route add default gw 2.0.0.1
++ /etc/init.d/apache2 start
Starting Apache httpd web server: apache2@AH00557: apache2: apr_sockaddr_info_get() failed for server
AH00558: apache2: Could not reliably determine the server's fully qualified domain name, using 127.0.0.1. Set the 'ServerName' directive globally to suppress this message
--- End Startup Commands Log
root@server:/# route -n
Kernel IP routing table
Destination     Gateway      Genmask      Flags Metric Ref  Use Iface
0.0.0.0         2.0.0.1      0.0.0.0      UG        0   0       0 eth0
2.0.0.0         0.0.0.0      255.255.255.0 U          0   0       0 eth0
root@server:/# []

root@rip1: ~
--- Startup Commands Log
++ ifconfig eth0 11.0.0.1/30 up
++ ifconfig eth1 11.1.0.2/30 up
++ /etc/init.d/quagga start
Starting Quagga daemons (priorities): zebra ripd.
Starting Quagga monitor daemon: watchquagga.
--- End Startup Commands Log
root@rip1:/# route -n
Kernel IP routing table
Destination     Gateway      Genmask      Flags Metric Ref  Use Iface
1.0.0.0         11.1.0.1    255.255.255.0 UG        20  0       0 eth1
2.0.0.0         11.1.0.2    255.255.255.0 UG        20  0       0 eth0
10.0.0.0        11.1.0.1    255.255.255.252 UG       20  0       0 eth1
10.0.0.4        11.1.0.1    255.255.255.252 UG       20  0       0 eth1
10.0.0.8        11.1.0.1    255.255.255.252 UG       20  0       0 eth1
10.1.0.0        11.1.0.1    255.255.255.252 UG       20  0       0 eth1
11.0.0.0        0.0.0.0      255.255.255.252 UG       0   0       0 eth0
11.1.0.0        0.0.0.0      255.255.255.252 UG       0   0       0 eth1
root@rip1:/# []

root@rip2: ~
--- Startup Commands Log
++ ifconfig eth0 2.0.0.1/24 up
++ ifconfig eth1 11.0.0.2/30 up
++ /etc/init.d/quagga start
Starting Quagga daemons (priorities): zebra ripd.
Starting Quagga monitor daemon: watchquagga.
--- End Startup Commands Log
root@rip2:/# route -n
Kernel IP routing table
Destination     Gateway      Genmask      Flags Metric Ref  Use Iface
1.0.0.0         11.0.0.1    255.255.255.0 UG        20  0       0 eth1
2.0.0.0         0.0.0.0      255.255.255.0 UG        0   0       0 eth0
10.0.0.0        11.0.0.1    255.255.255.252 UG       20  0       0 eth1
10.0.0.4        11.0.0.1    255.255.255.252 UG       20  0       0 eth1
10.0.0.8        11.0.0.1    255.255.255.252 UG       20  0       0 eth1
10.1.0.0        11.0.0.1    255.255.255.252 UG       20  0       0 eth1
11.0.0.0        0.0.0.0      255.255.255.252 UG       0   0       0 eth1
11.1.0.0        11.0.0.1    255.255.255.252 UG       20  0       0 eth1
root@rip2:/# ]

```

5. Test connectivity. Ping from host to server and server to host



The screenshot shows two terminal windows side-by-side. The left window is titled 'root@host: /' and the right window is titled 'root@server: /'. Both windows are running on an Ubuntu system, indicated by the desktop icons in the background.

root@host: /

```

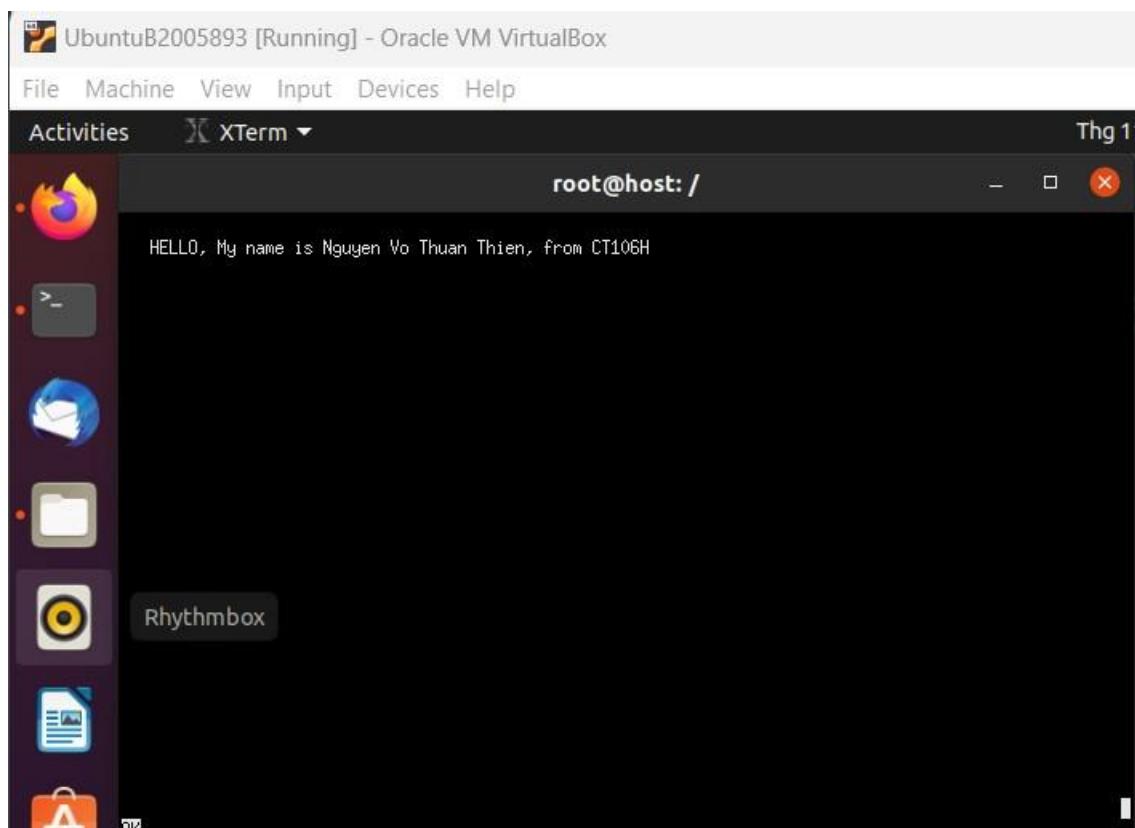
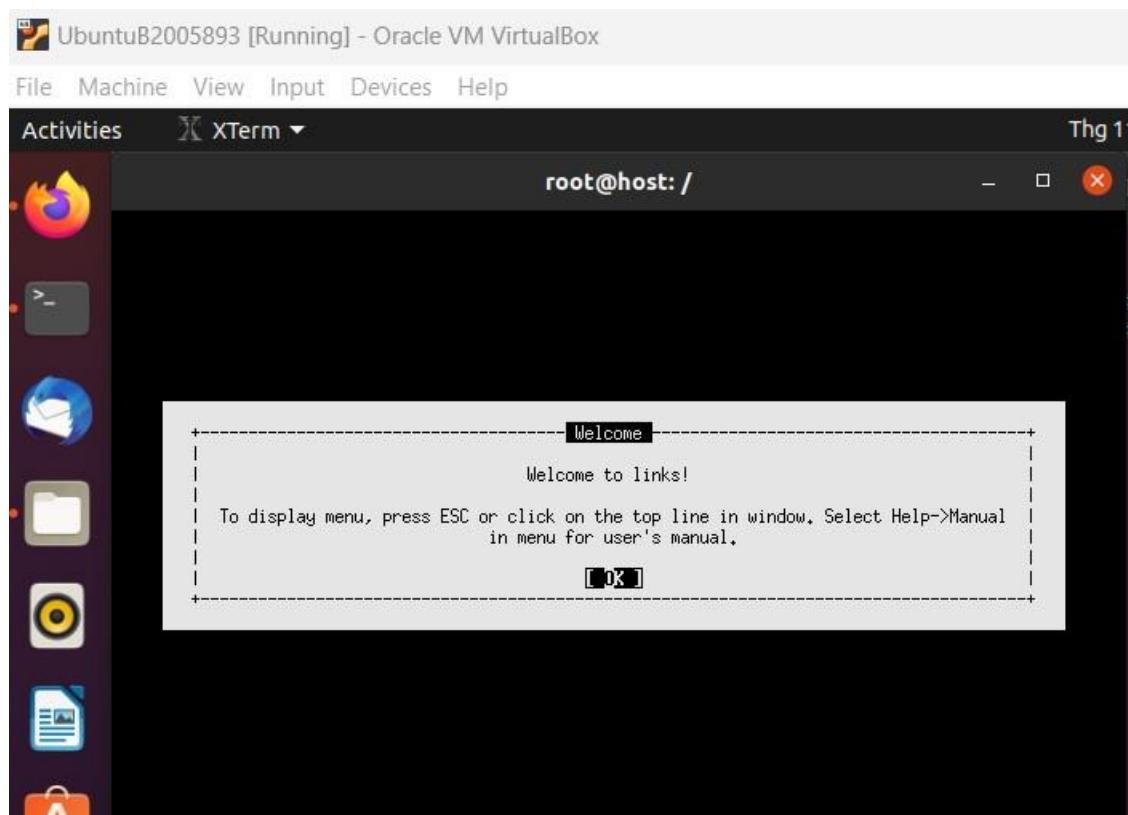
64 bytes from 10.0.0.6: icmp_seq=2 ttl=63 time=0.056 ms
^C
--- 10.0.0.6 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 31ms
rtt min/avg/max/mdev = 0.056/0.132/0.208/0.076 ms
root@host:# ping 10.0.0.2
PING 10.0.0.2 (10.0.0.2) 56(84) bytes of data.
64 bytes from 10.0.0.2: icmp_seq=1 ttl=62 time=0.097 ms
^C
--- 10.0.0.2 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.097/0.097/0.097/0.000 ms
root@host:# ping 10.0.0.10
PING 10.0.0.10 (10.0.0.10) 56(84) bytes of data.
64 bytes from 10.0.0.10: icmp_seq=1 ttl=62 time=0.074 ms
64 bytes from 10.0.0.10: icmp_seq=2 ttl=62 time=0.067 ms
^C
--- 10.0.0.10 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 27ms
rtt min/avg/max/mdev = 0.067/0.070/0.074/0.009 ms
root@host:# ping 10.1.0.2
PING 10.1.0.2 (10.1.0.2) 56(84) bytes of data.
64 bytes from 10.1.0.2: icmp_seq=1 ttl=61 time=0.155 ms
64 bytes from 10.1.0.2: icmp_seq=2 ttl=61 time=0.076 ms
^C
--- 10.1.0.2 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 16ms
rtt min/avg/max/mdev = 0.076/0.115/0.155/0.040 ms
root@host:# ping 11.0.0.2
PING 11.0.0.2 (11.0.0.2) 56(84) bytes of data.
64 bytes from 11.0.0.2: icmp_seq=1 ttl=60 time=0.176 ms
64 bytes from 11.0.0.2: icmp_seq=2 ttl=60 time=0.088 ms
^C
--- 11.0.0.2 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 36ms
rtt min/avg/max/mdev = 0.088/0.132/0.176/0.044 ms
root@host:# ping 11.0.0.2
PING 11.0.0.2 (11.0.0.2) 56(84) bytes of data.
64 bytes from 11.0.0.2: icmp_seq=1 ttl=59 time=0.195 ms
64 bytes from 11.0.0.2: icmp_seq=2 ttl=59 time=0.093 ms
^C
--- 11.0.0.2 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 20ms
rtt min/avg/max/mdev = 0.093/0.144/0.195/0.051 ms
root@host:# ping 2.0.0.2
PING 2.0.0.2 (2.0.0.2) 56(84) bytes of data.
64 bytes from 2.0.0.2: icmp_seq=1 ttl=58 time=0.221 ms
64 bytes from 2.0.0.2: icmp_seq=2 ttl=58 time=0.101 ms
^C
--- 2.0.0.2 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 22ms
rtt min/avg/max/mdev = 0.101/0.161/0.221/0.060 ms
root@host:# 
```

root@server: /

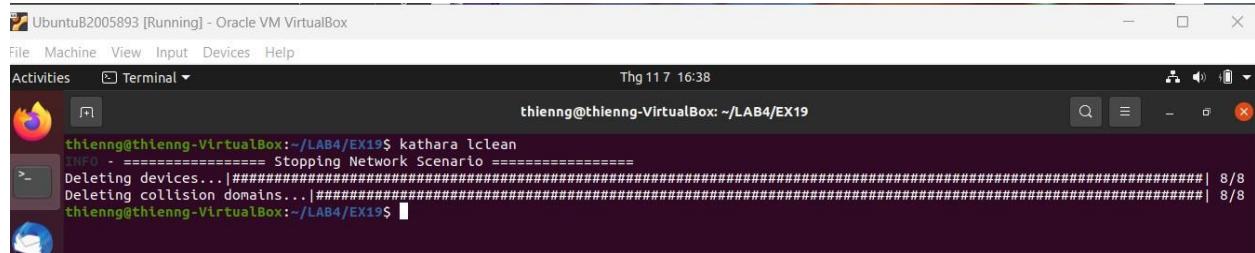
```

Thg 11 7 16:35
root@server:/# ping 1.0.0.2 (1.0.0.2) 56(84) bytes of data.
64 bytes from 1.0.0.2: icmp_seq=1 ttl=58 time=0.140 ms
64 bytes from 1.0.0.2: icmp_seq=2 ttl=58 time=0.157 ms
^C
--- 1.0.0.2 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 31ms
rtt min/avg/max/mdev = 0.140/0.148/0.157/0.014 ms
root@server:# ping 11.1.0.1
PING 11.1.0.1 (11.1.0.1) 56(84) bytes of data.
64 bytes from 11.1.0.1: icmp_seq=1 ttl=62 time=0.110 ms
64 bytes from 11.1.0.1: icmp_seq=2 ttl=62 time=0.066 ms
^C
--- 11.1.0.1 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 10ms
rtt min/avg/max/mdev = 0.066/0.088/0.110/0.022 ms
root@server:# ping 10.1.0.1
PING 10.1.0.1 (10.1.0.1) 56(84) bytes of data.
64 bytes from 10.1.0.1: icmp_seq=1 ttl=61 time=0.119 ms
64 bytes from 10.1.0.1: icmp_seq=2 ttl=61 time=0.101 ms
^C
--- 10.1.0.1 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 13ms
rtt min/avg/max/mdev = 0.101/0.110/0.119/0.009 ms
root@server:# ping 10.0.0.9
PING 10.0.0.9 (10.0.0.9) 56(84) bytes of data.
64 bytes from 10.0.0.9: icmp_seq=1 ttl=60 time=0.095 ms
64 bytes from 10.0.0.9: icmp_seq=2 ttl=60 time=0.088 ms
^C
--- 10.0.0.9 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 3ms
rtt min/avg/max/mdev = 0.088/0.091/0.095/0.010 ms
root@server:# ping 10.0.0.5
PING 10.0.0.5 (10.0.0.5) 56(84) bytes of data.
64 bytes from 10.0.0.5: icmp_seq=1 ttl=59 time=0.165 ms
64 bytes from 10.0.0.5: icmp_seq=2 ttl=59 time=0.100 ms
^C
--- 10.0.0.5 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 22ms
rtt min/avg/max/mdev = 0.100/0.132/0.165/0.034 ms
root@server:# 
```

6. Links on host and connect it to the server



7. Delete VMs

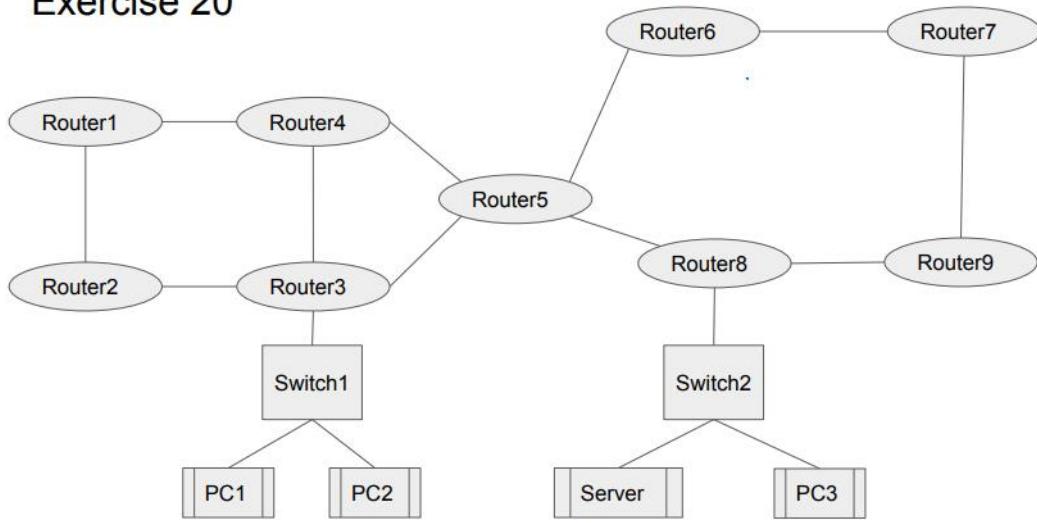


The screenshot shows a terminal window titled "UbuntuB2005893 [Running] - Oracle VM VirtualBox". The window has a dark theme. At the top, there's a menu bar with "File", "Machine", "View", "Input", "Devices", and "Help". Below the menu is a toolbar with "Activities" and "Terminal". The terminal itself has a header "thienng@thienng-VirtualBox: ~/LAB4/EX19" and a timestamp "Thg 11 7 16:38". The main content of the terminal is a command-line session:

```
thienng@thienng-VirtualBox:~/LAB4/EX19$ kathara lclean
INFO - ===== Stopping Network Scenario =====
Deleting devices...|#####| 8/8
Deleting collision domains...|#####| 8/8
thienng@thienng-VirtualBox:~/LAB4/EX19$
```

Exercise 20: Construct the following network.

Exercise 20



Original network 182.182.182.128/26

→ Netmask: 255.255.255.192

→ Broadcast: 182.182.182.191

- ➔ The network has 7 LAN, in order to store it we need to use 3 bits for subnetting and 3 bits for representing hosts

# LAN	Subnet	Netmask	Broadcast	IP Range
1	182.182.182.128/29	255.255.255.248	182.182.182.135	182.182.182.129 - 182.182.182.134
2	182.182.182.136/29	255.255.255.248	182.182.182.143	182.182.182.137 - 182.182.182.142
3	182.182.182.144/29	255.255.255.248	182.182.182.151	182.182.182.145 - 182.182.182.150
4	182.182.182.152/29	255.255.255.248	182.182.182.159	182.182.182.153 - 182.182.182.158
5	182.182.182.160/29	255.255.255.248	182.182.182.167	182.182.182.161 - 182.182.182.166
6	182.182.182.168/29	255.255.255.248	182.182.182.175	182.182.182.169 - 182.182.182.174
7	182.182.182.176/29	255.255.255.248	182.182.182.183	182.182.182.177 - 182.182.182.182

Original network 190.190.190.0/25

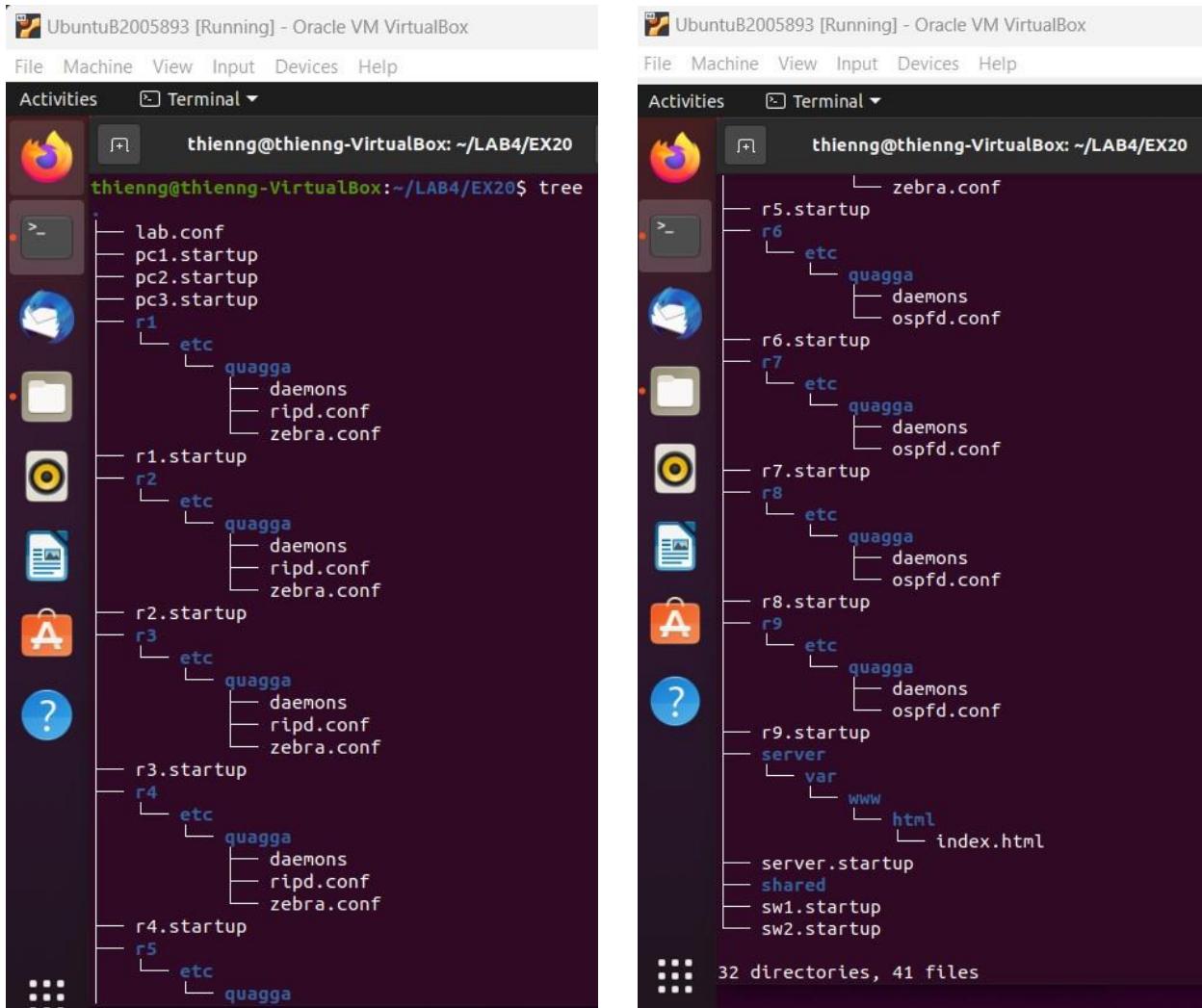
→ Netmask: 255.255.255.128

→ Broadcast: 190.190.190.127

- ➔ The network has 6 Lan, in order to store it we need to use 3 bits for subnetting and 4 bits for representing hosts

# LAN	Subnet	Netmask	Broadcast	IP Range
1	190.190.190.0/28	255.255.255.240	190.190.190.15	190.190.190.1 - 190.190.190.14
2	190.190.190.16/28	255.255.255.240	190.190.190.31	190.190.190.17 - 190.190.190.30
3	190.190.190.32/28	255.255.255.240	190.190.190.47	190.190.190.33 - 190.190.190.46
4	190.190.190.48/28	255.255.255.240	190.190.190.63	190.190.190.49 - 190.190.190.62
5	190.190.190.64/28	255.255.255.240	190.190.190.79	190.190.190.65 - 190.190.190.78
6	190.190.190.80/28	255.255.255.240	190.190.190.95	190.190.190.81 - 190.190.190.94

1. Files and Folders



The image shows two side-by-side terminal windows from an Ubuntu environment. Both terminals are running under the user 'thienng' and are located in the directory '/LAB4/EX20'. The left terminal displays a tree structure for a network configuration, while the right terminal shows a more complex directory structure.

Left Terminal Output:

```
thienng@thienng-VirtualBox:~/LAB4/EX20$ tree
.
├── lab.conf
├── pc1.startup
├── pc2.startup
├── pc3.startup
└── r1
    ├── etc
    │   └── quagga
    │       ├── daemons
    │       ├── ripd.conf
    │       └── zebra.conf
    └── r1.startup
```

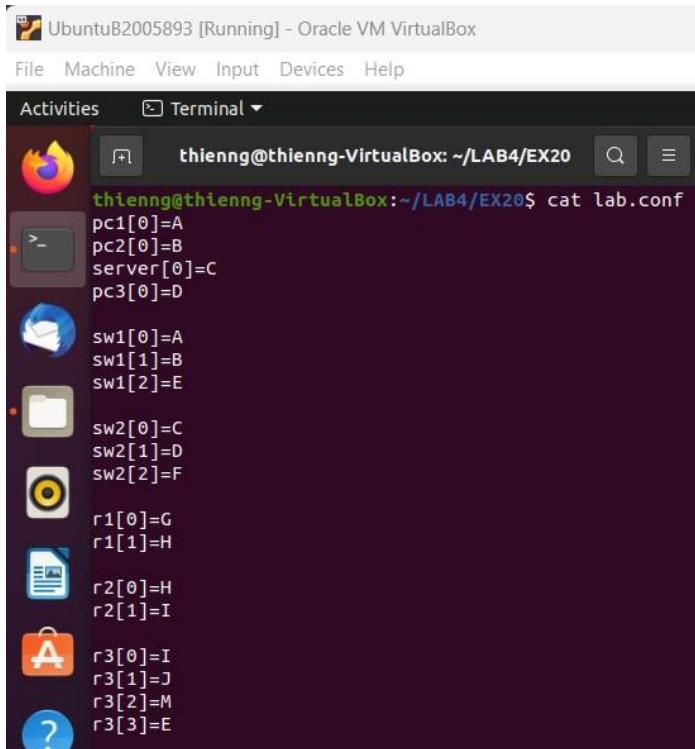
Right Terminal Output:

```
thienng@thienng-VirtualBox:~/LAB4/EX20$ tree
.
├── r5.startup
├── r6
│   ├── etc
│   │   └── quagga
│   │       ├── daemons
│   │       └── ospfd.conf
│   └── r6.startup
├── r7
│   ├── etc
│   │   └── quagga
│   │       ├── daemons
│   │       └── ospfd.conf
│   └── r7.startup
├── r8
│   ├── etc
│   │   └── quagga
│   │       ├── daemons
│   │       └── ospfd.conf
│   └── r8.startup
└── r9
    ├── etc
    │   └── quagga
    │       ├── daemons
    │       └── ospfd.conf
    └── r9.startup
```

Summary:

```
32 directories, 41 files
```

2. Files configurations



A screenshot of a Linux desktop environment, specifically Oracle VM VirtualBox. The terminal window shows the command `cat lab.conf` being run, displaying configuration data for network components. The data includes:

```
thienng@thienng-VirtualBox:~/LAB4/EX20$ cat lab.conf
pc1[0]=A
pc2[0]=B
server[0]=C
pc3[0]=D

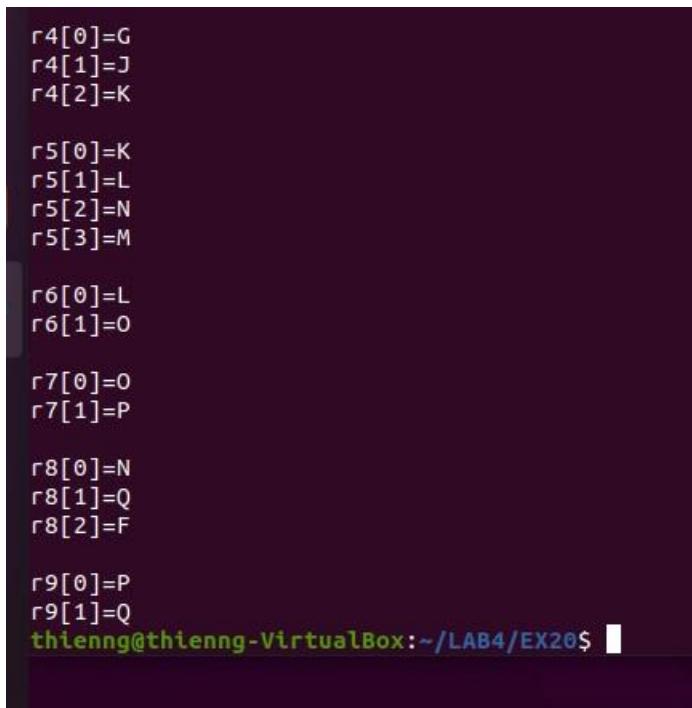
sw1[0]=A
sw1[1]=B
sw1[2]=E

sw2[0]=C
sw2[1]=D
sw2[2]=F

r1[0]=G
r1[1]=H

r2[0]=H
r2[1]=I

r3[0]=I
r3[1]=J
r3[2]=M
r3[3]=E
```



A screenshot of a Linux terminal window showing configuration data for switches and routers. The data includes:

```
r4[0]=G
r4[1]=J
r4[2]=K

r5[0]=K
r5[1]=L
r5[2]=N
r5[3]=M

r6[0]=L
r6[1]=O

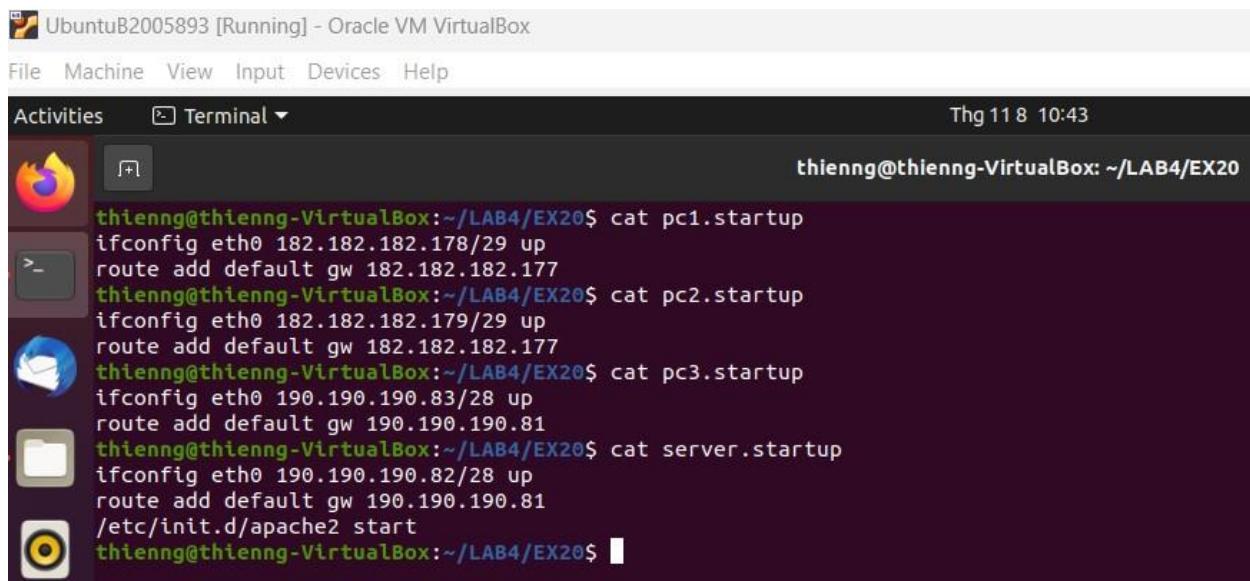
r7[0]=O
r7[1]=P

r8[0]=N
r8[1]=Q
r8[2]=F

r9[0]=P
r9[1]=Q
```

The terminal prompt shows the user is still at the command line.

```
thienng@thienng-VirtualBox:~/LAB4/EX20$
```

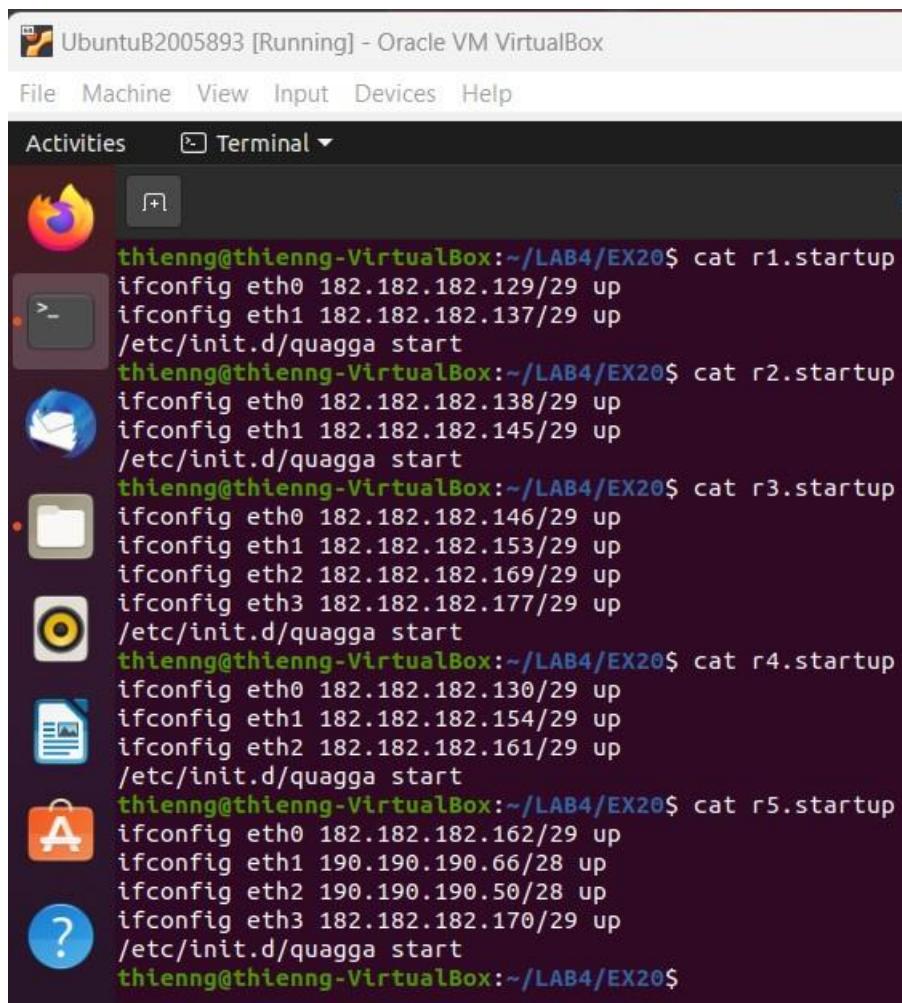


UbuntuB2005893 [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities Terminal Thg 11 8 10:43

```
thienng@thienng-VirtualBox:~/LAB4/EX20$ cat pc1.startup
ifconfig eth0 182.182.182.178/29 up
route add default gw 182.182.182.177
thienng@thienng-VirtualBox:~/LAB4/EX20$ cat pc2.startup
ifconfig eth0 182.182.182.179/29 up
route add default gw 182.182.182.177
thienng@thienng-VirtualBox:~/LAB4/EX20$ cat pc3.startup
ifconfig eth0 190.190.190.83/28 up
route add default gw 190.190.190.81
thienng@thienng-VirtualBox:~/LAB4/EX20$ cat server.startup
ifconfig eth0 190.190.190.82/28 up
route add default gw 190.190.190.81
/etc/init.d/apache2 start
thienng@thienng-VirtualBox:~/LAB4/EX20$
```

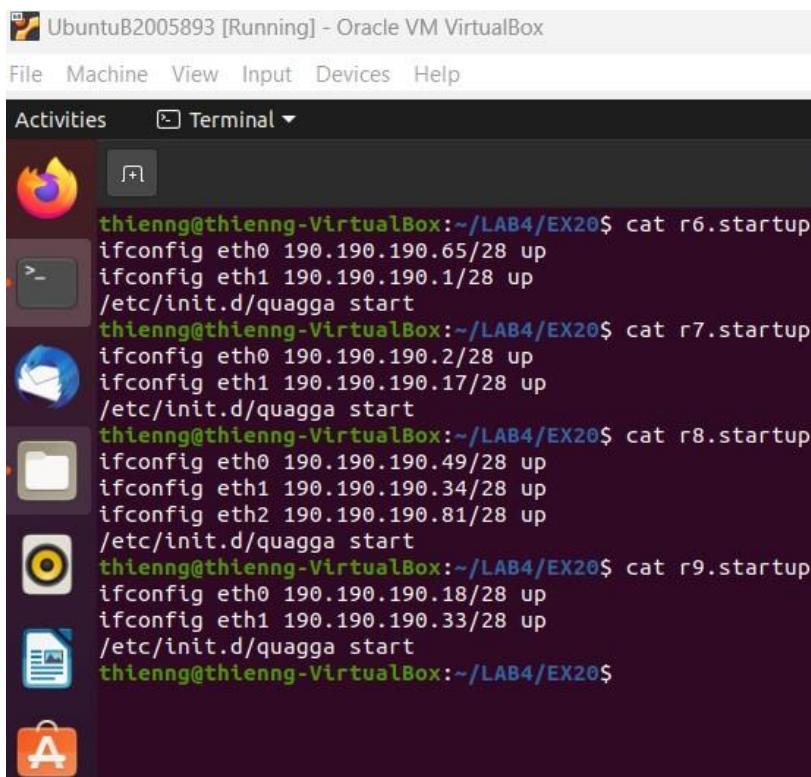


UbuntuB2005893 [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities Terminal

```
thienng@thienng-VirtualBox:~/LAB4/EX20$ cat r1.startup
ifconfig eth0 182.182.182.129/29 up
ifconfig eth1 182.182.182.137/29 up
/etc/init.d/quagga start
thienng@thienng-VirtualBox:~/LAB4/EX20$ cat r2.startup
ifconfig eth0 182.182.182.138/29 up
ifconfig eth1 182.182.182.145/29 up
/etc/init.d/quagga start
thienng@thienng-VirtualBox:~/LAB4/EX20$ cat r3.startup
ifconfig eth0 182.182.182.146/29 up
ifconfig eth1 182.182.182.153/29 up
ifconfig eth2 182.182.182.169/29 up
ifconfig eth3 182.182.182.177/29 up
/etc/init.d/quagga start
thienng@thienng-VirtualBox:~/LAB4/EX20$ cat r4.startup
ifconfig eth0 182.182.182.130/29 up
ifconfig eth1 182.182.182.154/29 up
ifconfig eth2 182.182.182.161/29 up
/etc/init.d/quagga start
thienng@thienng-VirtualBox:~/LAB4/EX20$ cat r5.startup
ifconfig eth0 182.182.182.162/29 up
ifconfig eth1 190.190.190.66/28 up
ifconfig eth2 190.190.190.50/28 up
ifconfig eth3 182.182.182.170/29 up
/etc/init.d/quagga start
thienng@thienng-VirtualBox:~/LAB4/EX20$
```

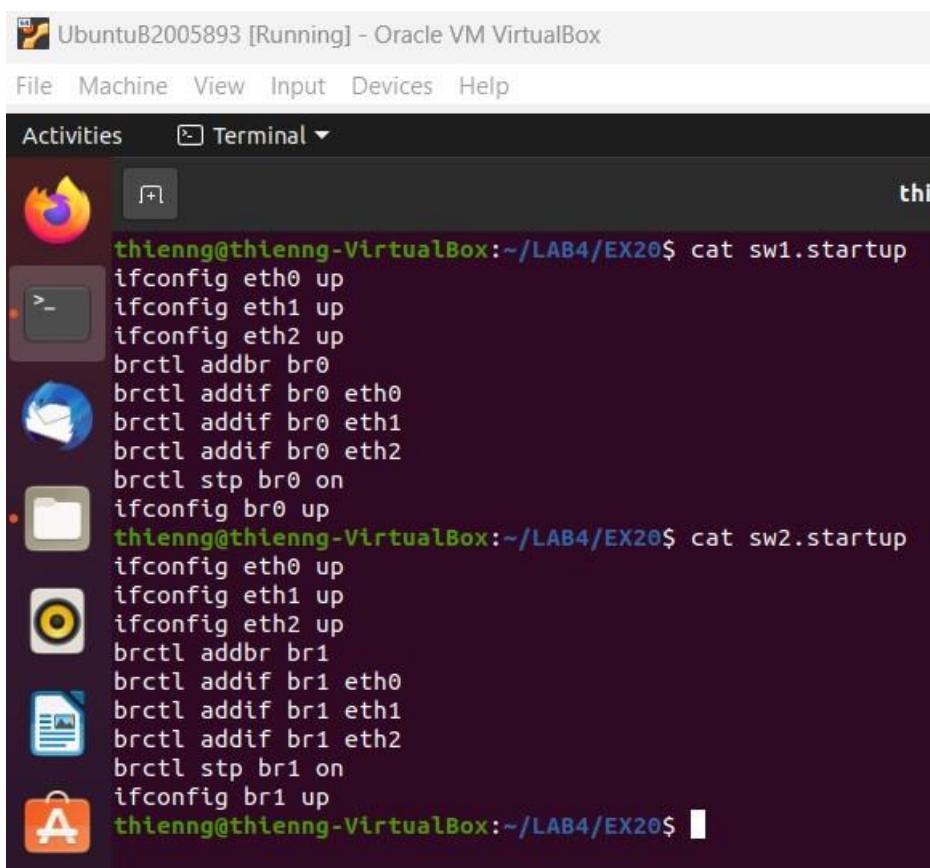


UbuntuB2005893 [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities Terminal

```
thienng@thienng-VirtualBox:~/LAB4/EX20$ cat r6.startup
ifconfig eth0 190.190.190.65/28 up
ifconfig eth1 190.190.190.1/28 up
/etc/init.d/quagga start
thienng@thienng-VirtualBox:~/LAB4/EX20$ cat r7.startup
ifconfig eth0 190.190.190.2/28 up
ifconfig eth1 190.190.190.17/28 up
/etc/init.d/quagga start
thienng@thienng-VirtualBox:~/LAB4/EX20$ cat r8.startup
ifconfig eth0 190.190.190.49/28 up
ifconfig eth1 190.190.190.34/28 up
ifconfig eth2 190.190.190.81/28 up
/etc/init.d/quagga start
thienng@thienng-VirtualBox:~/LAB4/EX20$ cat r9.startup
ifconfig eth0 190.190.190.18/28 up
ifconfig eth1 190.190.190.33/28 up
/etc/init.d/quagga start
thienng@thienng-VirtualBox:~/LAB4/EX20$
```



UbuntuB2005893 [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities Terminal

```
thienng@thienng-VirtualBox:~/LAB4/EX20$ cat sw1.startup
ifconfig eth0 up
ifconfig eth1 up
ifconfig eth2 up
brctl addbr br0
brctl addif br0 eth0
brctl addif br0 eth1
brctl addif br0 eth2
brctl stp br0 on
ifconfig br0 up
thienng@thienng-VirtualBox:~/LAB4/EX20$ cat sw2.startup
ifconfig eth0 up
ifconfig eth1 up
ifconfig eth2 up
brctl addbr br1
brctl addif br1 eth0
brctl addif br1 eth1
brctl addif br1 eth2
brctl stp br1 on
ifconfig br1 up
thienng@thienng-VirtualBox:~/LAB4/EX20$
```

UbuntuB2005893 [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities Terminal ▾ Thg 11

```
thienng@thienng-VirtualBox:~/LAB4/EX20$ cat r1/etc/quagga/daemons
zebra=yes
bgpd=no
ospfd=no
ospf6d=no
ripd=yes
ripngd=no
thienng@thienng-VirtualBox:~/LAB4/EX20$ cat r1/etc/quagga/ripd.conf
hostname ripd
password zebra
enable password zebra

router rip
redistribute connected
network 182.182.182.128/26

log file /var/log/quagga/ripd.log
thienng@thienng-VirtualBox:~/LAB4/EX20$ cat r1/etc/quagga/zebra.conf
hostname r1
password zebra
enable password zebra
log file /var/log/quagga/zebra.log
thienng@thienng-VirtualBox:~/LAB4/EX20$
```

UbuntuB2005893 [Running] - Oracle VM VirtualBox

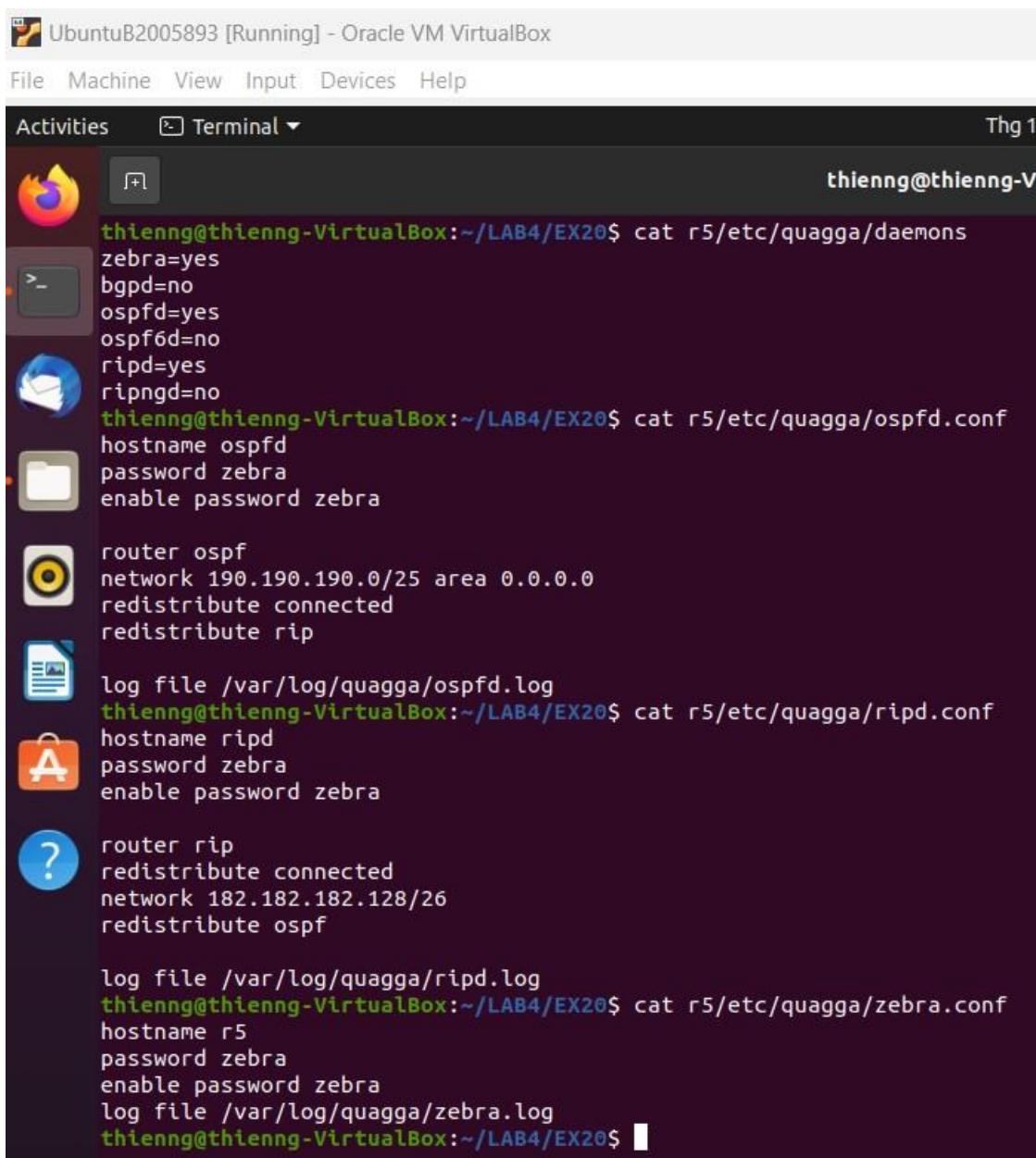
File Machine View Input Devices Help

Activities Terminal ▾ Thg 1

```
thienng@thienng-VirtualBox:~/LAB4/EX20$ cat r6/etc/quagga/daemons
zebra=yes
bgpd=no
ospfd=yes
ospf6d=no
ripd=no
ripngd=no
thienng@thienng-VirtualBox:~/LAB4/EX20$ cat r6/etc/quagga/ospfd.conf
hostname ospfd
password zebra
enable password zebra

router ospf
network 190.190.190.0/25 area 0.0.0.0
redistribute connected

log file /var/log/quagga/ospfd.log
thienng@thienng-VirtualBox:~/LAB4/EX20$
```



The screenshot shows a Linux desktop environment with a terminal window open. The terminal window title is "UbuntuB2005893 [Running] - Oracle VM VirtualBox". The terminal window contains the following command-line session:

```
thienng@thienng-VirtualBox:~/LAB4/EX20$ cat r5/etc/quagga/daemons
zebra=yes
bgpd=no
ospfd=yes
ospf6d=no
ripd=yes
ripngd=no
thienng@thienng-VirtualBox:~/LAB4/EX20$ cat r5/etc/quagga/ospfd.conf
hostname ospfd
password zebra
enable password zebra

router ospf
network 190.190.190.0/25 area 0.0.0.0
redistribute connected
redistribute rip

log file /var/log/quagga/ospfd.log
thienng@thienng-VirtualBox:~/LAB4/EX20$ cat r5/etc/quagga/ripd.conf
hostname ripd
password zebra
enable password zebra

router rip
redistribute connected
network 182.182.182.128/26
redistribute ospf

log file /var/log/quagga/ripd.log
thienng@thienng-VirtualBox:~/LAB4/EX20$ cat r5/etc/quagga/zebra.conf
hostname r5
password zebra
enable password zebra
log file /var/log/quagga/zebra.log
thienng@thienng-VirtualBox:~/LAB4/EX20$
```

3. Routing table of router

```

root@r1:/# ifconfig eth1 182.182.182.137/29 up
++ /etc/init.d/quagga start
Starting Quagga daemons (priorities: zebra ripd,
Starting Quagga monitor daemon: watchquagga.

--- End Startup Commands Log

root@r1:/# route -n
Kernel IP routing table
Destination     Gateway      Genmask      Flags Metric Ref  Use Iface
182.182.182.128 0.0.0.0    255.255.255.248 U        0      0    0 eth0
182.182.182.136 0.0.0.0    255.255.255.248 U        0      0    0 eth1
182.182.182.144 182.182.138 255.255.255.248 UG     20     0    0 eth1
182.182.182.152 182.182.182.130 255.255.255.248 UG     20     0    0 eth0
182.182.182.160 182.182.182.130 255.255.255.248 UG     20     0    0 eth0
182.182.182.168 182.182.182.130 255.255.255.248 UG     20     0    0 eth0
182.182.182.176 182.182.182.130 255.255.255.248 UG     20     0    0 eth0
190.190.190.0   182.182.182.130 255.255.255.240 UG     20     0    0 eth0
190.190.190.16  182.182.182.130 255.255.255.240 UG     20     0    0 eth0
190.190.190.32  182.182.182.130 255.255.255.240 UG     20     0    0 eth0
190.190.190.48  182.182.182.130 255.255.255.240 UG     20     0    0 eth0
190.190.190.64  182.182.182.130 255.255.255.240 UG     20     0    0 eth0
190.190.190.80  182.182.182.130 255.255.255.240 UG     20     0    0 eth0
root@r1:/# 

root@r2:/# ifconfig eth1 182.182.182.145/29 up
++ /etc/init.d/quagga start
Starting Quagga daemons (priorities: zebra ripd,
Starting Quagga monitor daemon: watchquagga.

--- End Startup Commands Log

root@r2:/# route -n
Kernel IP routing table
Destination     Gateway      Genmask      Flags Metric Ref  Use Iface
182.182.182.128 182.182.182.138 255.255.255.248 UG     20     0    0 eth0
182.182.182.136 0.0.0.0    255.255.255.248 U        0      0    0 eth0
182.182.182.144 0.0.0.0    255.255.255.248 U        0      0    0 eth1
182.182.182.152 182.182.182.146 255.255.255.248 UG     20     0    0 eth1
182.182.182.160 182.182.182.146 255.255.255.248 UG     20     0    0 eth0
182.182.182.168 182.182.182.146 255.255.255.248 UG     20     0    0 eth0
182.182.182.176 182.182.182.146 255.255.255.248 UG     20     0    0 eth1
190.190.190.0   182.182.182.146 255.255.255.240 UG     20     0    0 eth0
190.190.190.16  182.182.182.146 255.255.255.240 UG     20     0    0 eth1
190.190.190.32  182.182.182.146 255.255.255.240 UG     20     0    0 eth1
190.190.190.48  182.182.182.146 255.255.255.240 UG     20     0    0 eth1
190.190.190.64  182.182.182.146 255.255.255.240 UG     20     0    0 eth1
190.190.190.80  182.182.182.146 255.255.255.240 UG     20     0    0 eth1
root@r2:/# 

root@r3:/# ifconfig eth3 182.182.182.177/29 up
++ /etc/init.d/quagga start
Starting Quagga daemons (priorities: zebra ripd,
Starting Quagga monitor daemon: watchquagga.

--- End Startup Commands Log

root@r3:/# route -n
Kernel IP routing table
Destination     Gateway      Genmask      Flags Metric Ref  Use Iface
182.182.182.128 182.182.182.154 255.255.255.248 UG     20     0    0 eth1
182.182.182.136 182.182.182.145 255.255.255.248 UG     20     0    0 eth0
182.182.182.144 0.0.0.0    255.255.255.248 U        0      0    0 eth0
182.182.182.152 0.0.0.0    255.255.255.248 U        0      0    0 eth1
182.182.182.160 182.182.182.154 255.255.255.248 UG     20     0    0 eth1
182.182.182.168 0.0.0.0    255.255.255.248 U        0      0    0 eth2
182.182.182.176 0.0.0.0    255.255.255.248 U        0      0    0 eth3
190.190.190.0   182.182.182.170 255.255.255.240 UG     20     0    0 eth2
190.190.190.16  182.182.182.170 255.255.255.240 UG     20     0    0 eth2
190.190.190.32  182.182.182.170 255.255.255.240 UG     20     0    0 eth2
190.190.190.48  182.182.182.170 255.255.255.240 UG     20     0    0 eth2
190.190.190.64  182.182.182.170 255.255.255.240 UG     20     0    0 eth2
190.190.190.80  182.182.182.170 255.255.255.240 UG     20     0    0 eth2
root@r3:/# 

root@r4:/# ifconfig eth2 182.182.182.161/29 up
++ /etc/init.d/quagga start
Starting Quagga daemons (priorities: zebra ripd,
Starting Quagga monitor daemon: watchquagga.

--- End Startup Commands Log

root@r4:/# route -n
Kernel IP routing table
Destination     Gateway      Genmask      Flags Metric Ref  Use Iface
182.182.182.128 182.182.182.129 255.255.255.248 UG     0      0    0 eth0
182.182.182.136 182.182.182.129 255.255.255.248 UG     20     0    0 eth0
182.182.182.144 182.182.182.153 255.255.255.248 UG     20     0    0 eth1
182.182.182.152 0.0.0.0    255.255.255.248 U        0      0    0 eth1
182.182.182.160 0.0.0.0    255.255.255.248 U        0      0    0 eth2
182.182.182.168 182.182.182.153 255.255.255.248 UG     20     0    0 eth1
182.182.182.176 182.182.182.153 255.255.255.248 UG     20     0    0 eth1
190.190.190.0   182.182.182.162 255.255.255.240 UG     20     0    0 eth2
190.190.190.16  182.182.182.162 255.255.255.240 UG     20     0    0 eth2
190.190.190.32  182.182.182.162 255.255.255.240 UG     20     0    0 eth2
190.190.190.48  182.182.182.162 255.255.255.240 UG     20     0    0 eth2
190.190.190.64  182.182.182.162 255.255.255.240 UG     20     0    0 eth2
190.190.190.80  182.182.182.162 255.255.255.240 UG     20     0    0 eth2
root@r4:/#

```

CT106H – Computer Network

The screenshot shows four terminal windows in a Linux environment, likely Ubuntu, running on hosts r6, r7, r8, and r9. Each host has its own terminal window with a title bar indicating the host name and time (e.g., "Thg 11 8 11:07"). The terminals are arranged in a 2x2 grid.

Host r6: Shows the output of the command `route -n`. It lists several network routes, mostly via interface `eth0`, with destination ranges like 182.182.182.0/24 and 190.190.190.0/24. It also shows the startup log for Quagga daemons.

```
++ ifconfig eth1 190.190.190.1/28 up
++ /etc/init.d/quagga start
Starting Quagga daemons (priorities: zebra ospfd).
Starting Quagga monitor daemon: watchquagga.

--- End Startup Commands Log

root@r6:/# route -n
Kernel IP routing table
Destination     Gateway         Genmask        Flags Metric Ref  Use Iface
182.182.182.0   0.0.0.0       255.255.255.0 UG    0      0    0 eth0
182.182.182.128 190.190.190.64 255.255.255.248 UG    20     0    0 eth0
182.182.182.136 190.190.190.64 255.255.255.248 UG    20     0    0 eth0
182.182.182.144 190.190.190.64 255.255.255.248 UG    20     0    0 eth0
182.182.182.152 190.190.190.64 255.255.255.248 UG    20     0    0 eth0
182.182.182.160 190.190.190.64 255.255.255.248 UG    20     0    0 eth0
182.182.182.168 190.190.190.64 255.255.255.248 UG    20     0    0 eth0
182.182.182.176 190.190.190.64 255.255.255.248 UG    20     0    0 eth0
190.190.190.0    0.0.0.0       255.255.255.252 UG    0      0    0 eth1
190.190.190.16   190.190.190.2  255.255.255.240 UG    20     0    0 eth1
190.190.190.32   190.190.190.64 255.255.255.240 UG    20     0    0 eth1
190.190.190.48   190.190.190.64 255.255.255.240 UG    20     0    0 eth1
190.190.190.64   0.0.0.0       255.255.255.240 UG    0      0    0 eth0
190.190.190.80   190.190.190.64 255.255.255.240 UG    20     0    0 eth0
root@r6:/#
```

Host r7: Shows the output of the command `route -n`. It lists several network routes, mostly via interface `eth0`, with destination ranges like 182.182.182.0/24 and 190.190.190.0/24. It also shows the startup log for Quagga daemons.

```
++ ifconfig eth1 190.190.190.17/28 up
++ /etc/init.d/quagga start
Starting Quagga daemons (priorities: zebra ospfd).
Starting Quagga monitor daemon: watchquagga.

--- End Startup Commands Log

root@r7:/# route -n
Kernel IP routing table
Destination     Gateway         Genmask        Flags Metric Ref  Use Iface
182.182.182.128 190.190.190.1 255.255.255.248 UG    20     0    0 eth0
182.182.182.136 190.190.190.1 255.255.255.248 UG    20     0    0 eth0
182.182.182.144 190.190.190.1 255.255.255.248 UG    20     0    0 eth0
182.182.182.152 190.190.190.1 255.255.255.248 UG    20     0    0 eth0
182.182.182.160 190.190.190.1 255.255.255.248 UG    20     0    0 eth0
182.182.182.168 190.190.190.1 255.255.255.248 UG    20     0    0 eth0
182.182.182.176 190.190.190.1 255.255.255.248 UG    20     0    0 eth0
190.190.190.0    0.0.0.0       255.255.255.252 UG    0      0    0 eth1
190.190.190.16   190.190.190.2  255.255.255.240 UG    20     0    0 eth1
190.190.190.32   190.190.190.18 255.255.255.240 UG    20     0    0 eth1
190.190.190.48   190.190.190.18 255.255.255.240 UG    20     0    0 eth1
190.190.190.64   190.190.190.18 255.255.255.240 UG    20     0    0 eth0
190.190.190.80   190.190.190.18 255.255.255.240 UG    20     0    0 eth1
root@r7:/#
```

Host r8: Shows the output of the command `route -n`. It lists several network routes, mostly via interface `eth0`, with destination ranges like 182.182.182.0/24 and 190.190.190.0/24. It also shows the startup log for Quagga daemons.

```
Starting Quagga daemons (priorities: zebra ospfd).
Starting Quagga monitor daemon: watchquagga.

--- End Startup Commands Log

root@r8:/# route -n
Kernel IP routing table
Destination     Gateway         Genmask        Flags Metric Ref  Use Iface
182.182.182.128 190.190.190.50 255.255.255.248 UG    20     0    0 eth0
182.182.182.136 190.190.190.50 255.255.255.248 UG    20     0    0 eth0
182.182.182.144 190.190.190.50 255.255.255.248 UG    20     0    0 eth0
182.182.182.152 190.190.190.50 255.255.255.248 UG    20     0    0 eth0
182.182.182.160 190.190.190.50 255.255.255.248 UG    20     0    0 eth0
182.182.182.168 190.190.190.50 255.255.255.248 UG    20     0    0 eth0
182.182.182.176 190.190.190.50 255.255.255.248 UG    20     0    0 eth0
190.190.190.0    0.0.0.0       255.255.255.252 UG    0      0    0 eth1
190.190.190.16   190.190.190.33 255.255.255.240 UG    20     0    0 eth1
190.190.190.32   0.0.0.0       255.255.255.240 UG    0      0    0 eth0
190.190.190.48   0.0.0.0       255.255.255.240 UG    0      0    0 eth0
190.190.190.64   190.190.190.50 255.255.255.240 UG    20     0    0 eth0
190.190.190.80   0.0.0.0       255.255.255.240 UG    0      0    0 eth2
root@r8:/#
```

Host r9: Shows the output of the command `route -n`. It lists several network routes, mostly via interface `eth0`, with destination ranges like 182.182.182.0/24 and 190.190.190.0/24. It also shows the startup log for Quagga daemons.

```
++ ifconfig eth1 190.190.190.33/28 up
++ /etc/init.d/quagga start
Starting Quagga daemons (priorities: zebra ospfd).
Starting Quagga monitor daemon: watchquagga.

--- End Startup Commands Log

root@r9:/# route -n
Kernel IP routing table
Destination     Gateway         Genmask        Flags Metric Ref  Use Iface
182.182.182.128 190.190.190.34 255.255.255.248 UG    20     0    0 eth1
182.182.182.136 190.190.190.34 255.255.255.248 UG    20     0    0 eth1
182.182.182.144 190.190.190.34 255.255.255.248 UG    20     0    0 eth1
182.182.182.152 190.190.190.34 255.255.255.248 UG    20     0    0 eth1
182.182.182.160 190.190.190.34 255.255.255.248 UG    20     0    0 eth1
182.182.182.168 190.190.190.34 255.255.255.248 UG    20     0    0 eth1
182.182.182.176 190.190.190.34 255.255.255.248 UG    20     0    0 eth1
190.190.190.0    0.0.0.0       255.255.255.252 UG    0      0    0 eth0
190.190.190.16   190.190.190.17 255.255.255.240 UG    20     0    0 eth0
190.190.190.32   0.0.0.0       255.255.255.240 UG    0      0    0 eth0
190.190.190.48   190.190.190.34 255.255.255.240 UG    20     0    0 eth1
190.190.190.64   190.190.190.17 255.255.255.240 UG    20     0    0 eth0
190.190.190.80   190.190.190.34 255.255.255.240 UG    20     0    0 eth1
root@r9:/#
```

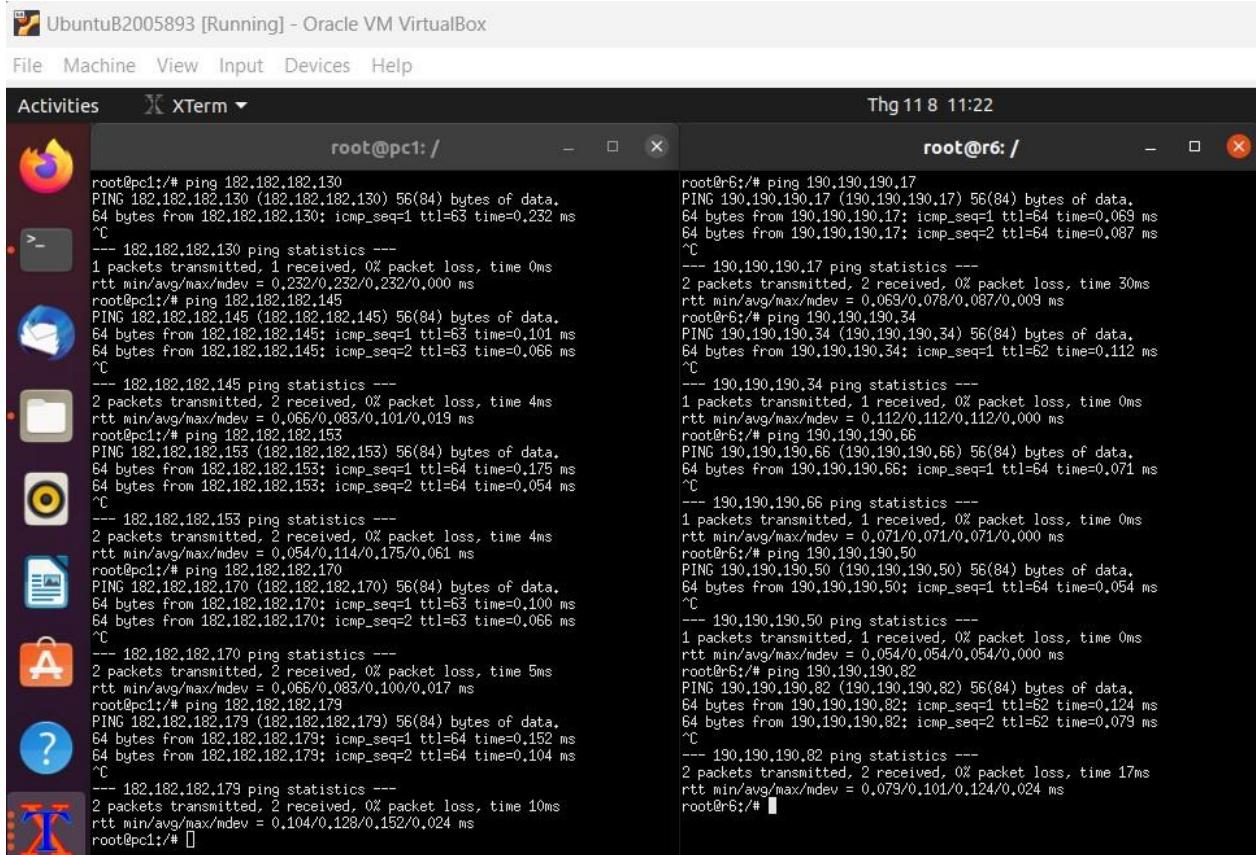
4. Routing table of r5 , pc , server

```

UbuntuB2005893 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities XTerm ▾
root@pc1: / --- Startup Commands Log
++ ifconfig eth0 182.182.182.179/29 up
++ route add default gw 182.182.182.177
--- End Startup Commands Log
root@pc1:/# route -n
Kernel IP routing table
Destination Gateway Genmask Flags Metric Ref Use Iface
0.0.0.0 182.182.182.177 0.0.0.0 UG 0 0 0 eth0
182.182.182.178 0.0.0.0 255.255.255.248 U 0 0 0 eth0
root@pc1:/# []
root@pc2: / --- Startup Commands Log
++ ifconfig eth0 182.182.182.179/29 up
++ route add default gw 182.182.182.177
--- End Startup Commands Log
root@pc2:/# route -n
Kernel IP routing table
Destination Gateway Genmask Flags Metric Ref Use Iface
0.0.0.0 182.182.182.177 0.0.0.0 UG 0 0 0 eth0
182.182.182.176 0.0.0.0 255.255.255.248 U 0 0 0 eth0
root@pc2:/# []
root@pc3: / --- Startup Commands Log
++ ifconfig eth0 190.190.190.81/28 up
++ route add default gw 190.190.190.81
--- End Startup Commands Log
root@pc3:/# route -n
Kernel IP routing table
Destination Gateway Genmask Flags Metric Ref Use Iface
0.0.0.0 190.190.190.81 0.0.0.0 UG 0 0 0 eth0
190.190.190.80 0.0.0.0 255.255.255.240 U 0 0 0 eth0
root@pc3:/# []
root@r5: / --- Startup Commands Log
++ ifconfig eth3 182.182.182.179/29 up
++ /etc/init.d/quagga start
Starting Quagga daemons (priorities): zebra ripd ospfd.
Starting Quagga monitor daemon: watchquagga.
--- End Startup Commands Log
root@r5:/# route -n
Kernel IP routing table
Destination Gateway Genmask Flags Metric Ref Use Iface
182.182.182.180 182.182.182.161 255.255.255.248 UG 20 0 0 eth0
182.182.182.138 182.182.182.159 255.255.255.248 UG 20 0 0 eth3
182.182.182.145 182.182.182.159 255.255.255.248 UG 20 0 0 eth3
182.182.182.145 182.182.182.169 255.255.255.248 UG 20 0 0 eth3
182.182.182.160 0.0.0.0 255.255.255.248 U 0 0 0 eth0
182.182.182.168 0.0.0.0 255.255.255.248 U 0 0 0 eth3
182.182.182.178 182.182.182.163 255.255.255.248 UG 20 0 0 eth3
190.190.190.0 190.190.190.69 255.255.255.240 UG 20 0 0 eth1
190.190.190.16 190.190.190.69 255.255.255.240 UG 20 0 0 eth1
190.190.190.49 190.190.190.49 255.255.255.240 UG 20 0 0 eth2
190.190.190.48 0.0.0.0 255.255.255.240 U 0 0 0 eth2
190.190.190.64 0.0.0.0 255.255.255.240 U 0 0 0 eth1
190.190.190.80 190.190.190.49 255.255.255.240 UG 20 0 0 eth1
root@r5:/# []
root@server: / --- Startup Commands Log
++ ifconfig eth0 190.190.190.82/28 up
++ route add default gw 190.190.190.81
++ /etc/init.d/apache2 start
Starting apache httpd web server: apache2[49]: apr_sockaddr_info_get()
Failed for server
AH00558: apache2: Could not reliably determine the server's fully qualified domain name, using 127.0.0.1. Set the 'ServerName' directive globally to suppress this message
.
--- End Startup Commands Log
root@server:/# route -n
Kernel IP routing table
Destination Gateway Genmask Flags Metric Ref Use Iface
0.0.0.0 190.190.190.81 0.0.0.0 UG 0 0 0 eth0
190.190.190.80 0.0.0.0 255.255.255.240 U 0 0 0 eth0
root@server:/# []

```

5. Test connectivity: Ping pc1 to its own area and r6 to its own area



```

UbuntuB2005893 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities XTerm ▾
root@pc1:/# ping 182.182.182.130
PING 182.182.182.130 (182.182.182.130) 56(84) bytes of data.
64 bytes from 182.182.182.130: icmp_seq=1 ttl=63 time=0.232 ms
^C
--- 182.182.182.130 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.232/0.232/0.232/0.000 ms
root@pc1:/# ping 182.182.182.145
PING 182.182.182.145 (182.182.182.145) 56(84) bytes of data.
64 bytes from 182.182.182.145: icmp_seq=1 ttl=63 time=0.101 ms
64 bytes from 182.182.182.145: icmp_seq=2 ttl=63 time=0.066 ms
^C
--- 182.182.182.145 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 4ms
rtt min/avg/max/mdev = 0.066/0.083/0.101/0.019 ms
root@pc1:/# ping 182.182.182.153
PING 182.182.182.153 (182.182.182.153) 56(84) bytes of data.
64 bytes from 182.182.182.153: icmp_seq=1 ttl=64 time=0.175 ms
64 bytes from 182.182.182.153: icmp_seq=2 ttl=64 time=0.054 ms
^C
--- 182.182.182.153 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 4ms
rtt min/avg/max/mdev = 0.054/0.114/0.175/0.061 ms
root@pc1:/# ping 182.182.182.170
PING 182.182.182.170 (182.182.182.170) 56(84) bytes of data.
64 bytes from 182.182.182.170: icmp_seq=1 ttl=63 time=0.100 ms
64 bytes from 182.182.182.170: icmp_seq=2 ttl=63 time=0.066 ms
^C
--- 182.182.182.170 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 5ms
rtt min/avg/max/mdev = 0.066/0.083/0.100/0.017 ms
root@pc1:/# ping 182.182.182.179
PING 182.182.182.179 (182.182.182.179) 56(84) bytes of data.
64 bytes from 182.182.182.179: icmp_seq=1 ttl=64 time=0.152 ms
64 bytes from 182.182.182.179: icmp_seq=2 ttl=64 time=0.104 ms
^C
--- 182.182.182.179 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 10ms
rtt min/avg/max/mdev = 0.104/0.128/0.152/0.024 ms
root@pc1:/#

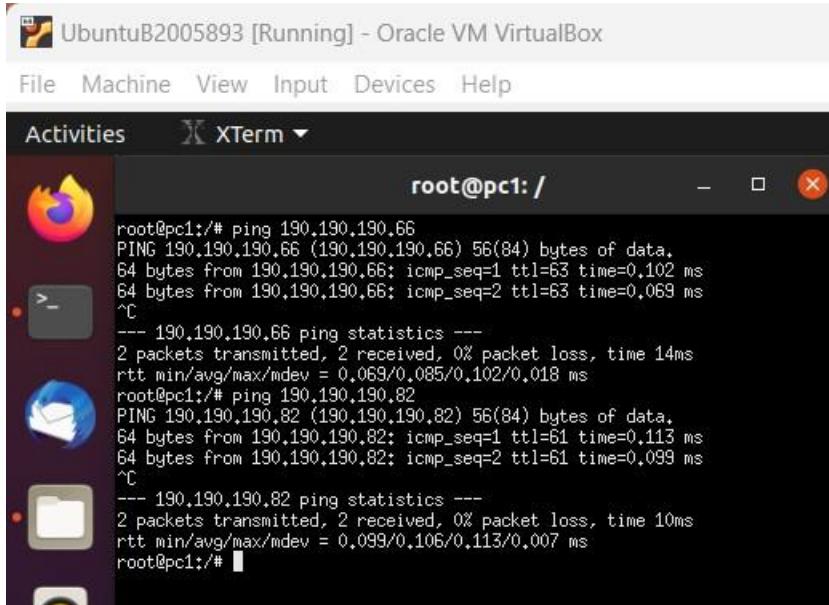
```

```

Thg 11 8 11:22
root@r6:/#
root@r6:/# ping 190.190.190.17
PING 190.190.190.17 (190.190.190.17) 56(84) bytes of data.
64 bytes from 190.190.190.17: icmp_seq=1 ttl=64 time=0.069 ms
64 bytes from 190.190.190.17: icmp_seq=2 ttl=64 time=0.087 ms
^C
--- 190.190.190.17 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 30ms
rtt min/avg/max/mdev = 0.063/0.078/0.087/0.009 ms
root@r6:/# ping 190.190.190.34
PING 190.190.190.34 (190.190.190.34) 56(84) bytes of data.
64 bytes from 190.190.190.34: icmp_seq=1 ttl=62 time=0.112 ms
^C
--- 190.190.190.34 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.112/0.112/0.000 ms
root@r6:/# ping 190.190.190.66
PING 190.190.190.66 (190.190.190.66) 56(84) bytes of data.
64 bytes from 190.190.190.66: icmp_seq=1 ttl=64 time=0.071 ms
^C
--- 190.190.190.66 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.071/0.071/0.000 ms
root@r6:/# ping 190.190.190.50
PING 190.190.190.50 (190.190.190.50) 56(84) bytes of data.
64 bytes from 190.190.190.50: icmp_seq=1 ttl=64 time=0.054 ms
^C
--- 190.190.190.50 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.054/0.054/0.000 ms
root@r6:/# ping 190.190.190.82
PING 190.190.190.82 (190.190.190.82) 56(84) bytes of data.
64 bytes from 190.190.190.82: icmp_seq=1 ttl=62 time=0.124 ms
64 bytes from 190.190.190.82: icmp_seq=2 ttl=62 time=0.079 ms
^C
--- 190.190.190.82 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 17ms
rtt min/avg/max/mdev = 0.079/0.101/0.124/0.024 ms
root@r6:/#

```

6. Test connectivity: From pc1 ping to r5 and to the server

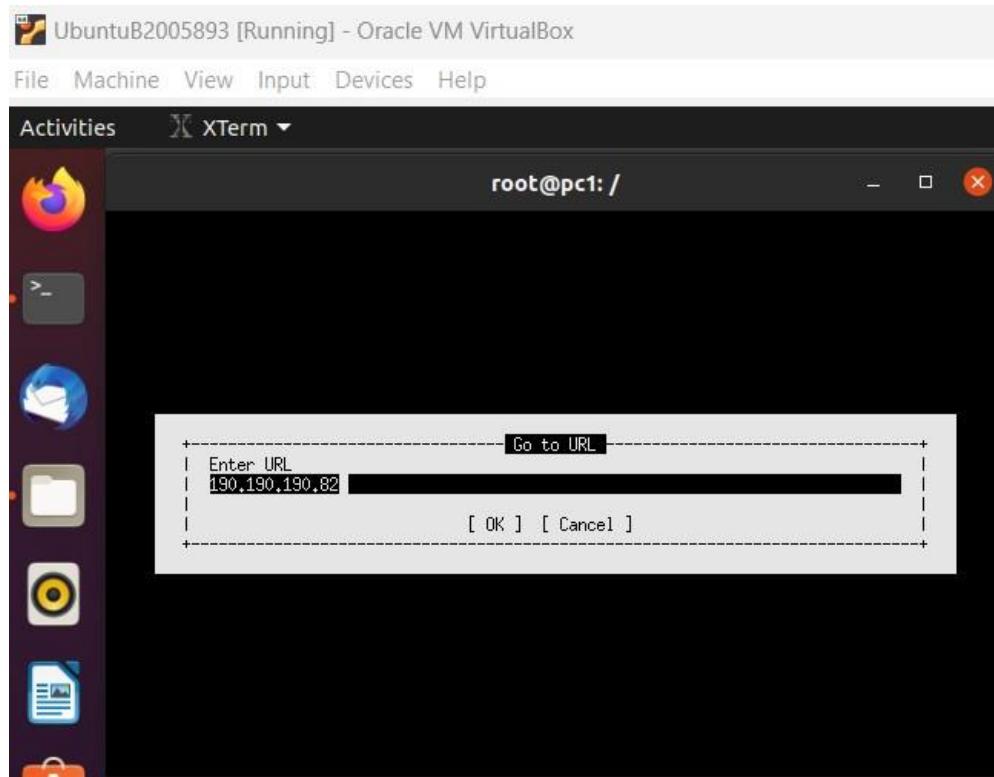


```

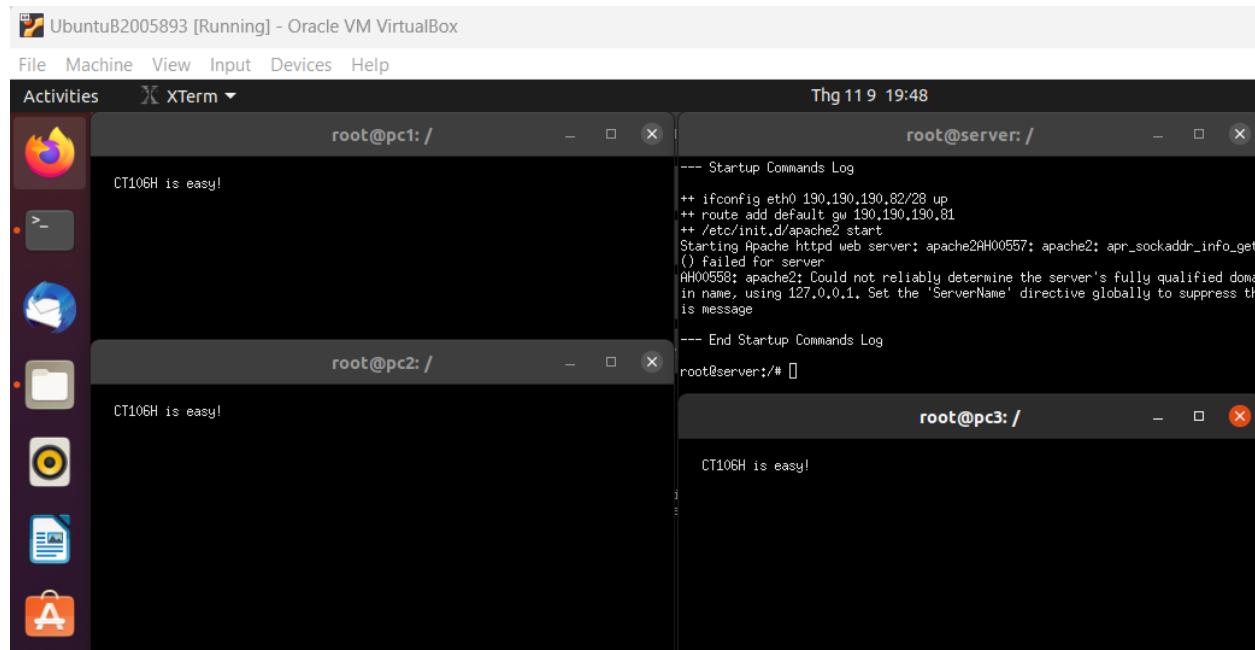
UbuntuB2005893 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities XTerm ▾
root@pc1:/# ping 190.190.190.66
PING 190.190.190.66 (190.190.190.66) 56(84) bytes of data.
64 bytes from 190.190.190.66: icmp_seq=1 ttl=63 time=0.102 ms
64 bytes from 190.190.190.66: icmp_seq=2 ttl=63 time=0.068 ms
^C
--- 190.190.190.66 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 14ms
rtt min/avg/max/mdev = 0.068/0.085/0.102/0.018 ms
root@pc1:/# ping 190.190.190.82
PING 190.190.190.82 (190.190.190.82) 56(84) bytes of data.
64 bytes from 190.190.190.82: icmp_seq=1 ttl=61 time=0.113 ms
64 bytes from 190.190.190.82: icmp_seq=2 ttl=61 time=0.099 ms
^C
--- 190.190.190.82 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 10ms
rtt min/avg/max/mdev = 0.099/0.106/0.113/0.007 ms
root@pc1:/#

```

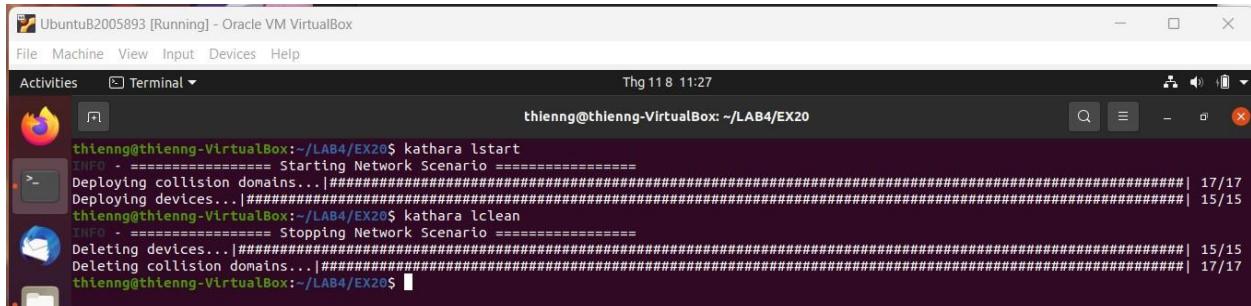
7. Link on pc1 and connect it to the server



→ The Server provides a web service which shows “CT106H is easy!”



8. Delete VMs



The screenshot shows a terminal window titled "UbuntuB2005893 [Running] - Oracle VM VirtualBox". The window contains the following command-line session:

```
thienng@thienng-VirtualBox:~/LAB4/EX20$ kathara lstart
INFO - ===== Starting Network Scenario =====
Deploying collision domains...|#####| 17/17
Deploying devices...|#####| 15/15
thienng@thienng-VirtualBox:~/LAB4/EX20$ kathara lclean
INFO - ===== Stopping Network Scenario =====
Deleting devices...|#####| 15/15
Deleting collision domains...|#####| 17/17
thienng@thienng-VirtualBox:~/LAB4/EX20$
```