COMPUTER NETWORKS LABORATORY WEEK 8

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Week number: 8

Date: 5/4/2021

Name of the experiment: Understand the building blocks and usage of ClayNet Network Virtualization platform with reference to OSI Layer.

Objectives:

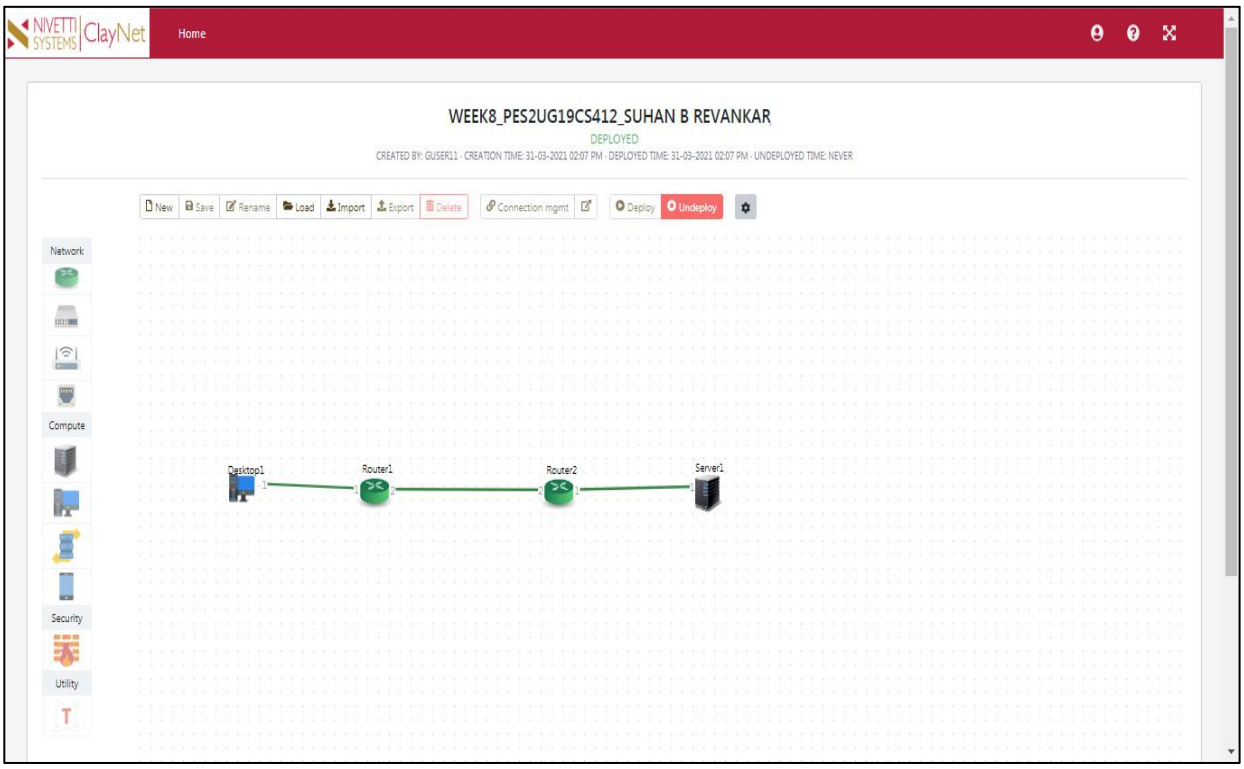
- Understand the building blocks of ClayNet.
- Build a simple client-server network using routers, switches, and network hosts.
- To learn the static IP routing behavior such as default and static routes and routing tables.
- Use common network utilities to verify LAN operation and analyze data traffic.

Prerequisites:

This lab assumes some understanding of the building blocks of communication networks and basic client-server architecture.

Topology 1:

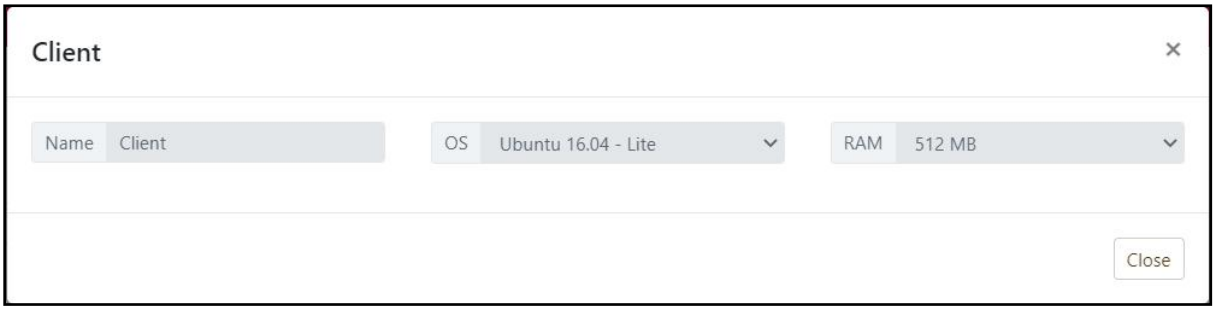
Create a topology in ClayNet, as shown in following figure



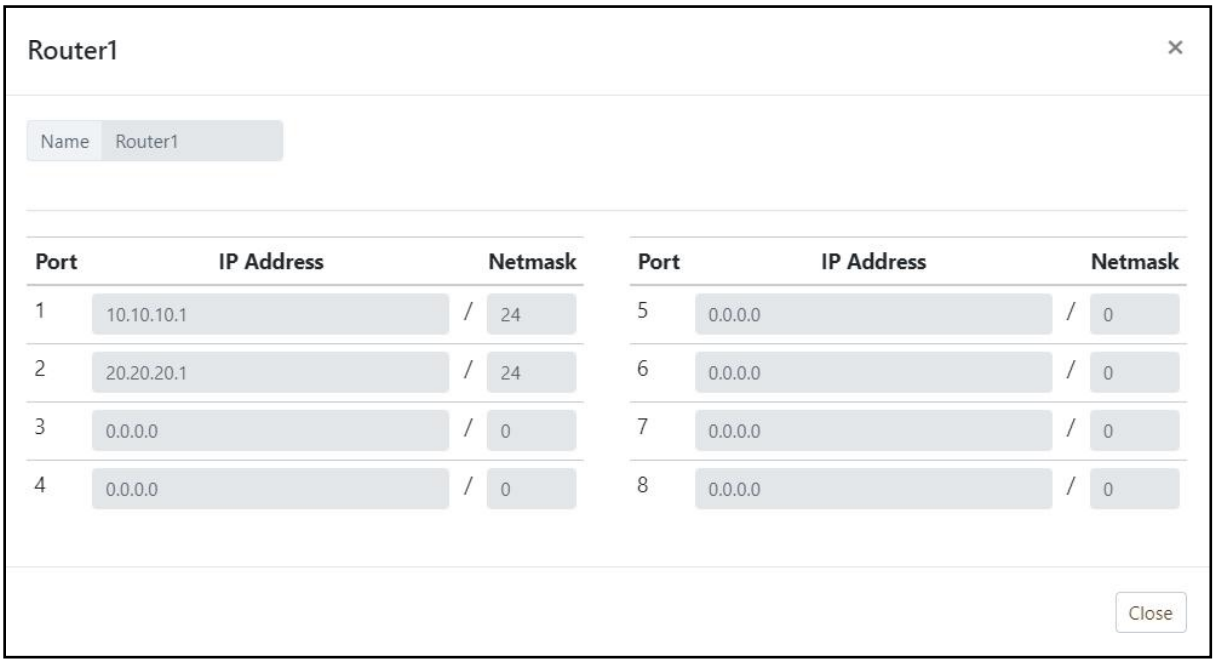
Execution Tasks:

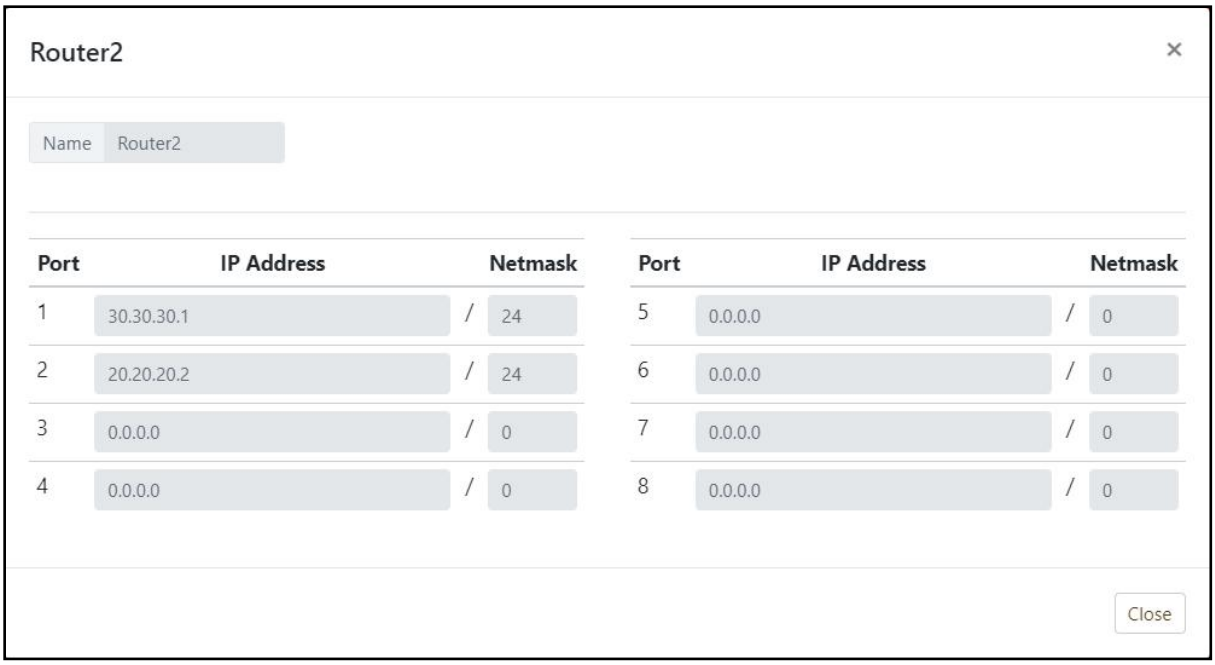
Task 1: Understand the network and compute components available in ClayNet.

Task 2: Drag and drop the necessary components to create the given topology. Provide the names for compute, select OS (Ubuntu 16.04 – Lite or Ubuntu
16.04 – CLI) and RAM (512 MB) as shown below.



Task 3: Drag and drop the Routers and set the IP addresses for all the necessary router ports. (You can also set them later by right clicking on the router icon and selecting 'Device Configuration'.)





Task 4: Go to connection manager and select appropriate Source, Source ports, Target and Target ports and save the connection.

Task 5: To deploy the topology, save the topology first and deploy it by clicking 'Deploy' button available on the top. (Note: It will take few seconds or even minutes to deploy the topology for the first time).

<u>Task 6</u>: Go to 'Remote Desktop' by right clicking on client and server icons and set the IP addresses accordingly. Also add the gateway address. (Login: user - test, password - test)

Client:

IP Address →

10.10.10.2 Gateway

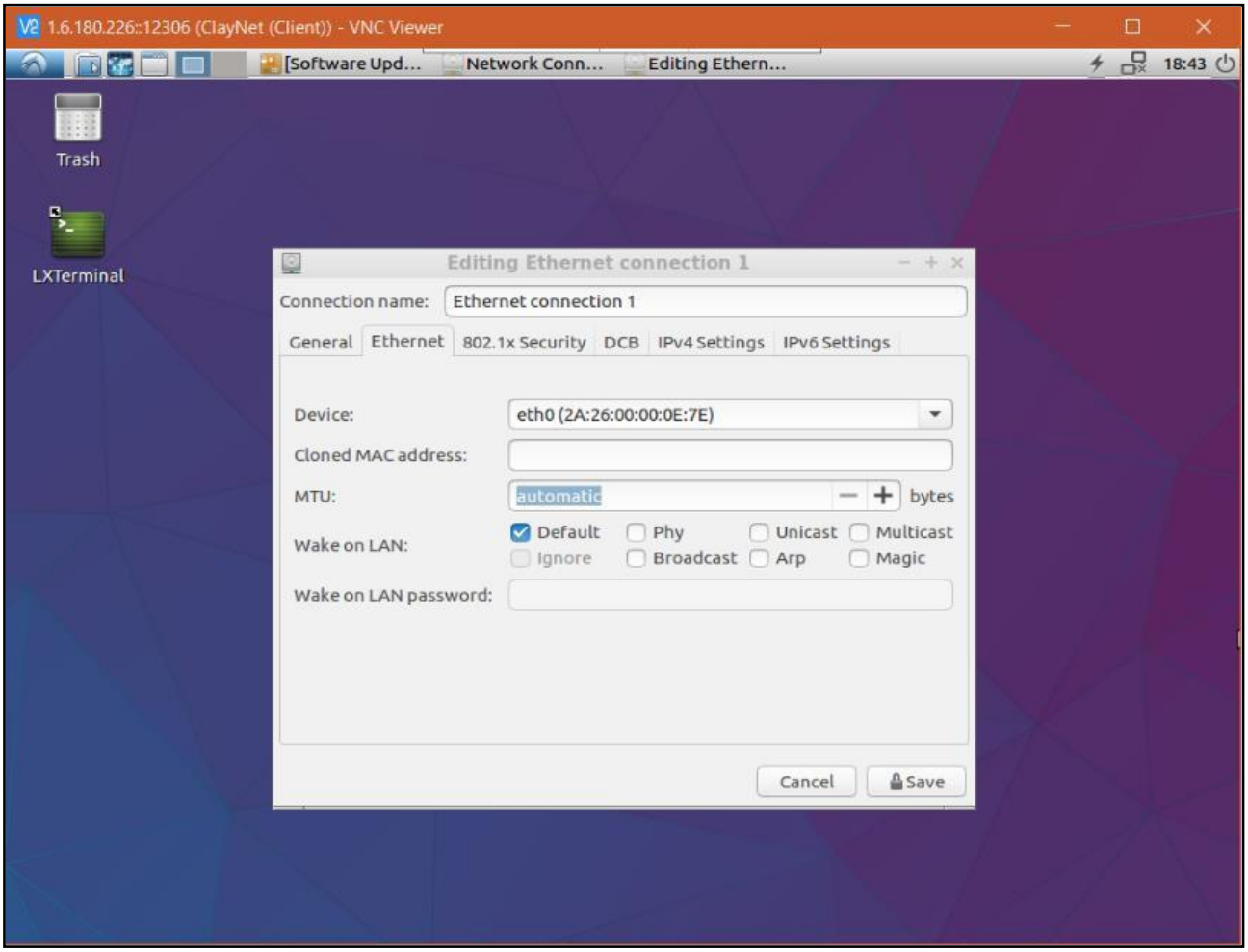
→ 10.10.10.1

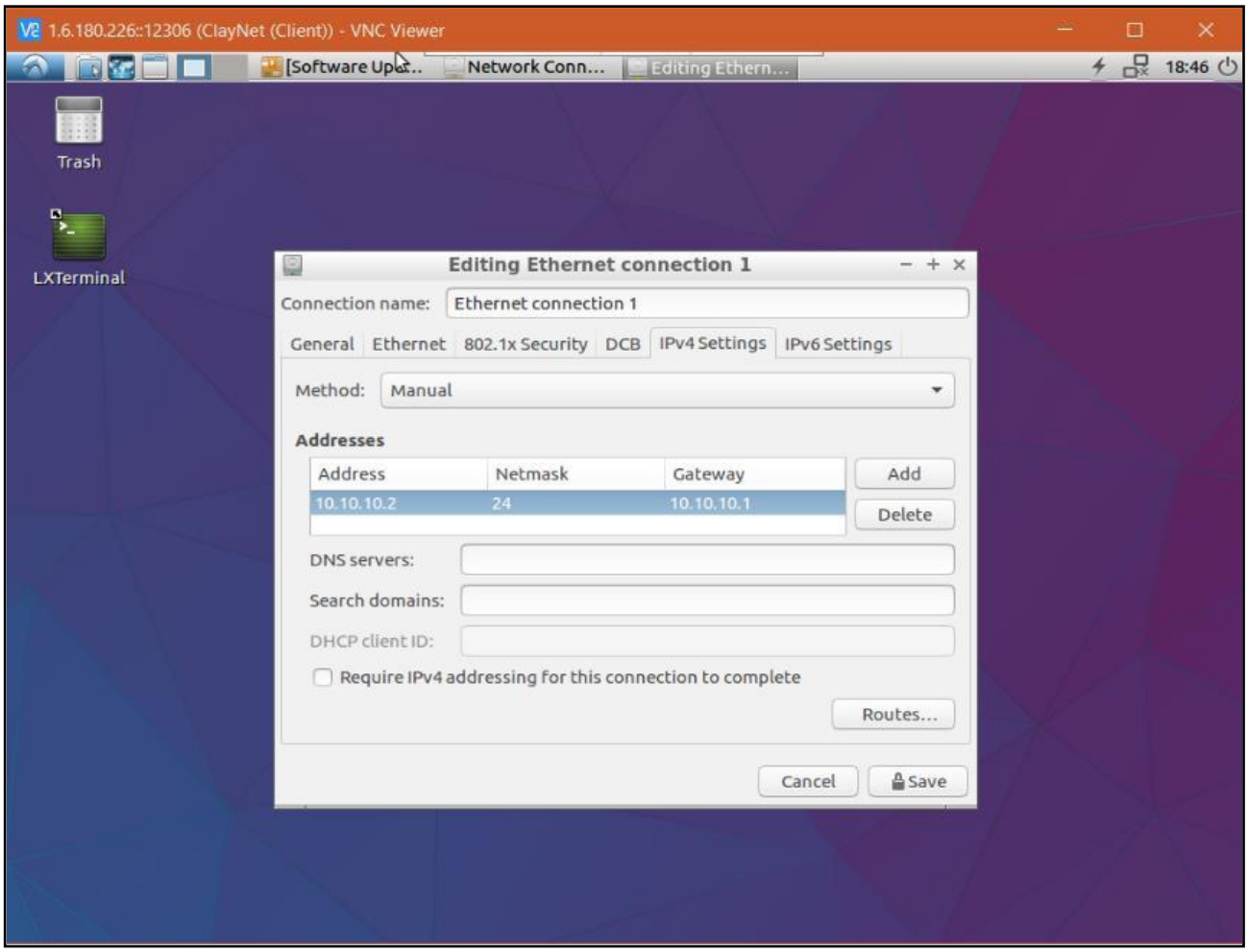
Server:

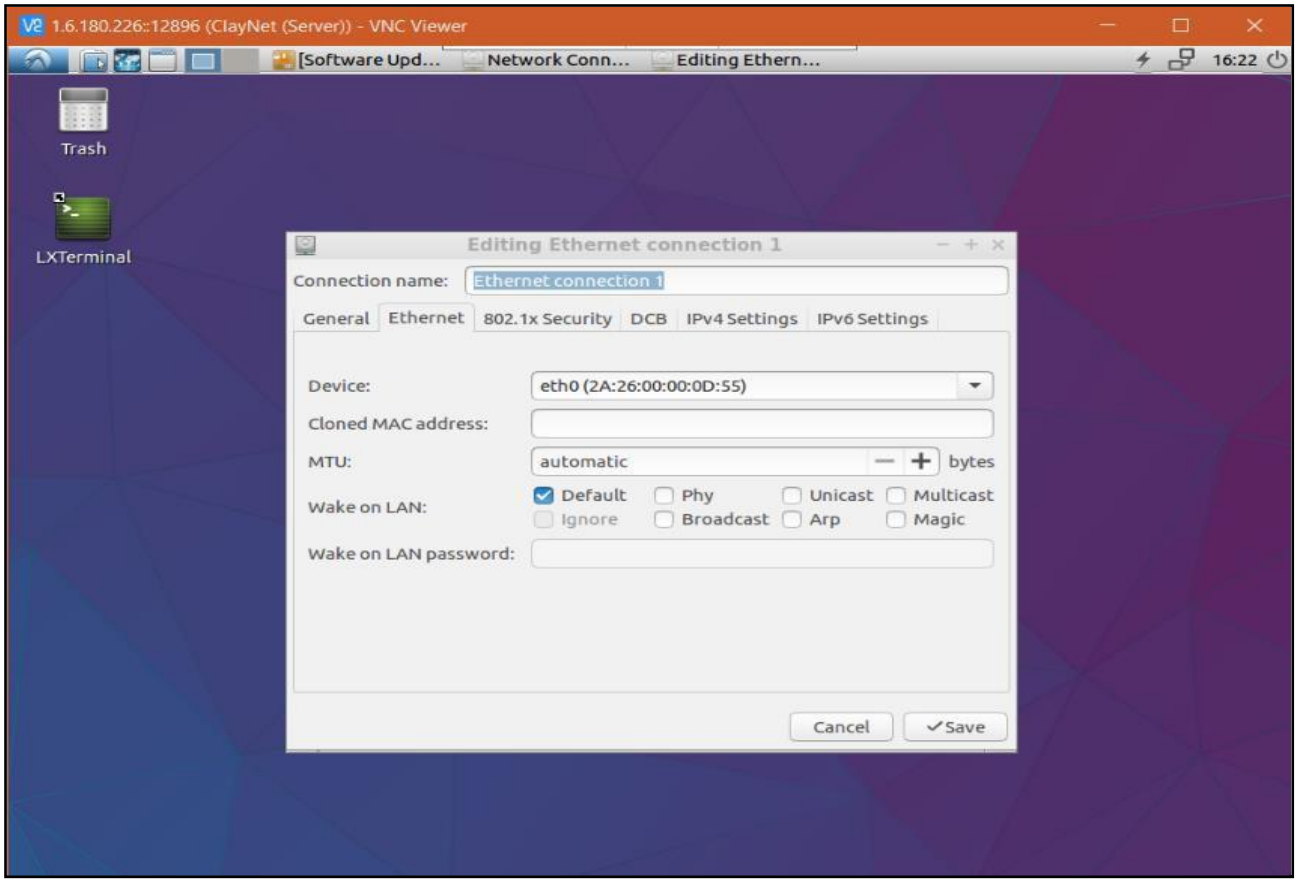
IP Address →

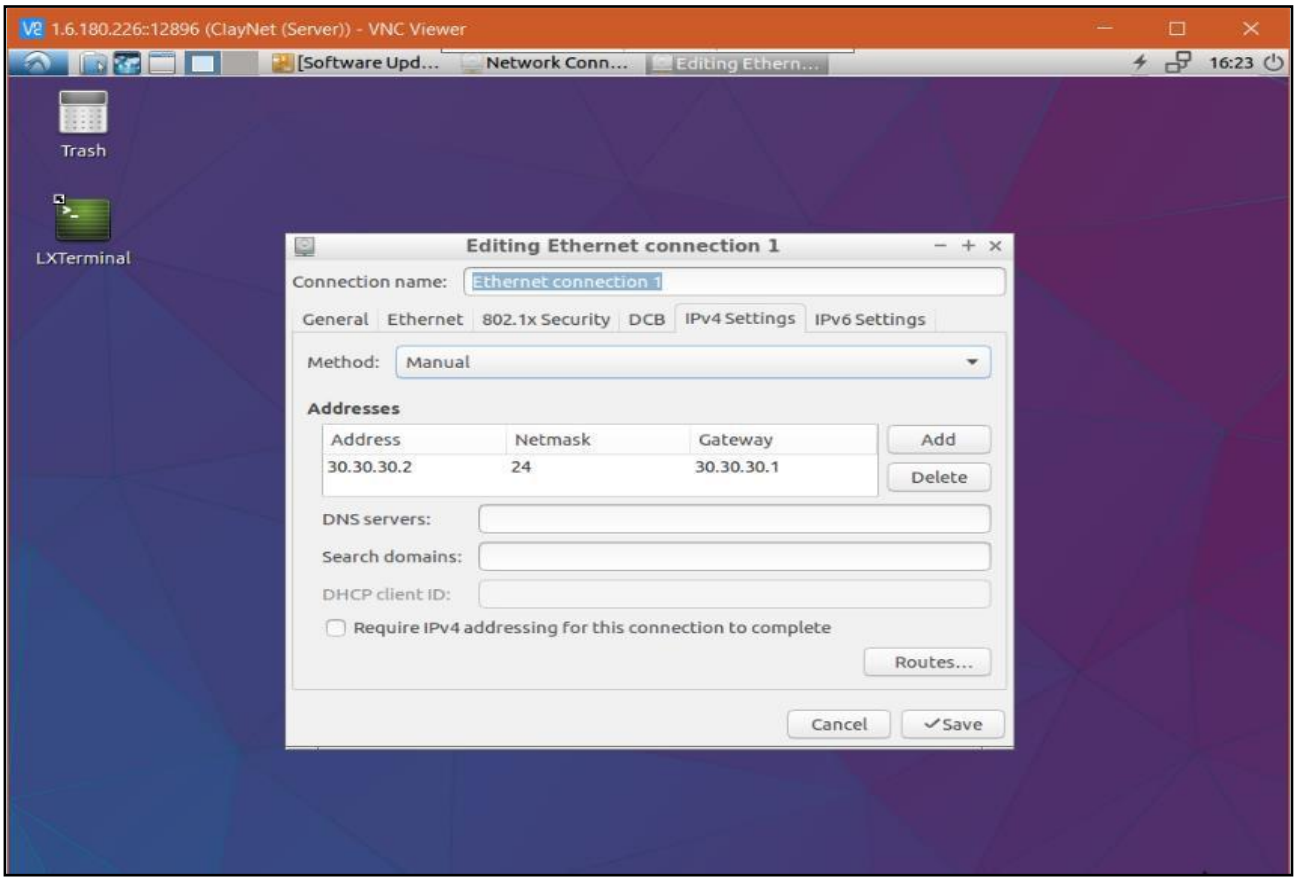
30.30.30.2 Gateway

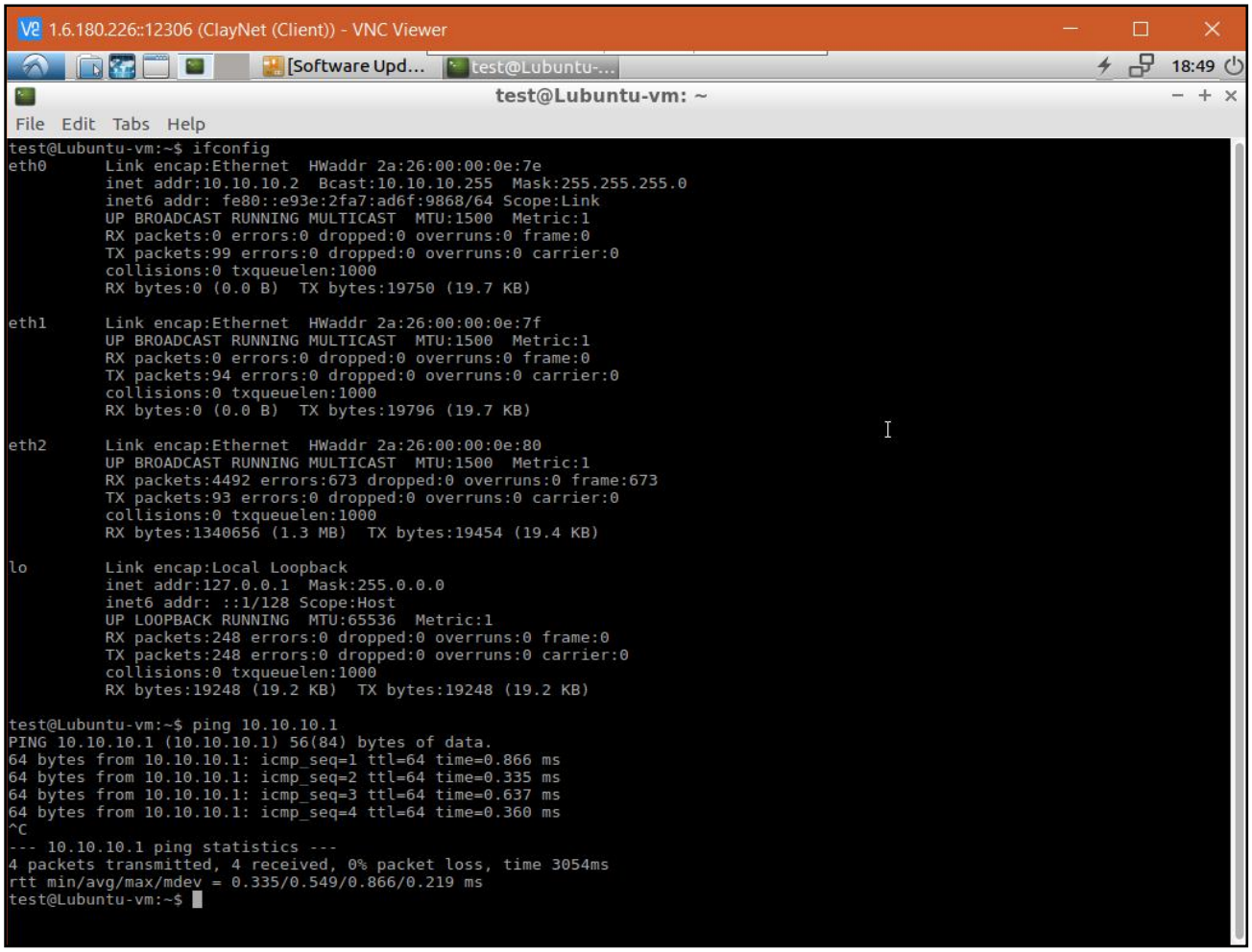
→ 30.30.30.1

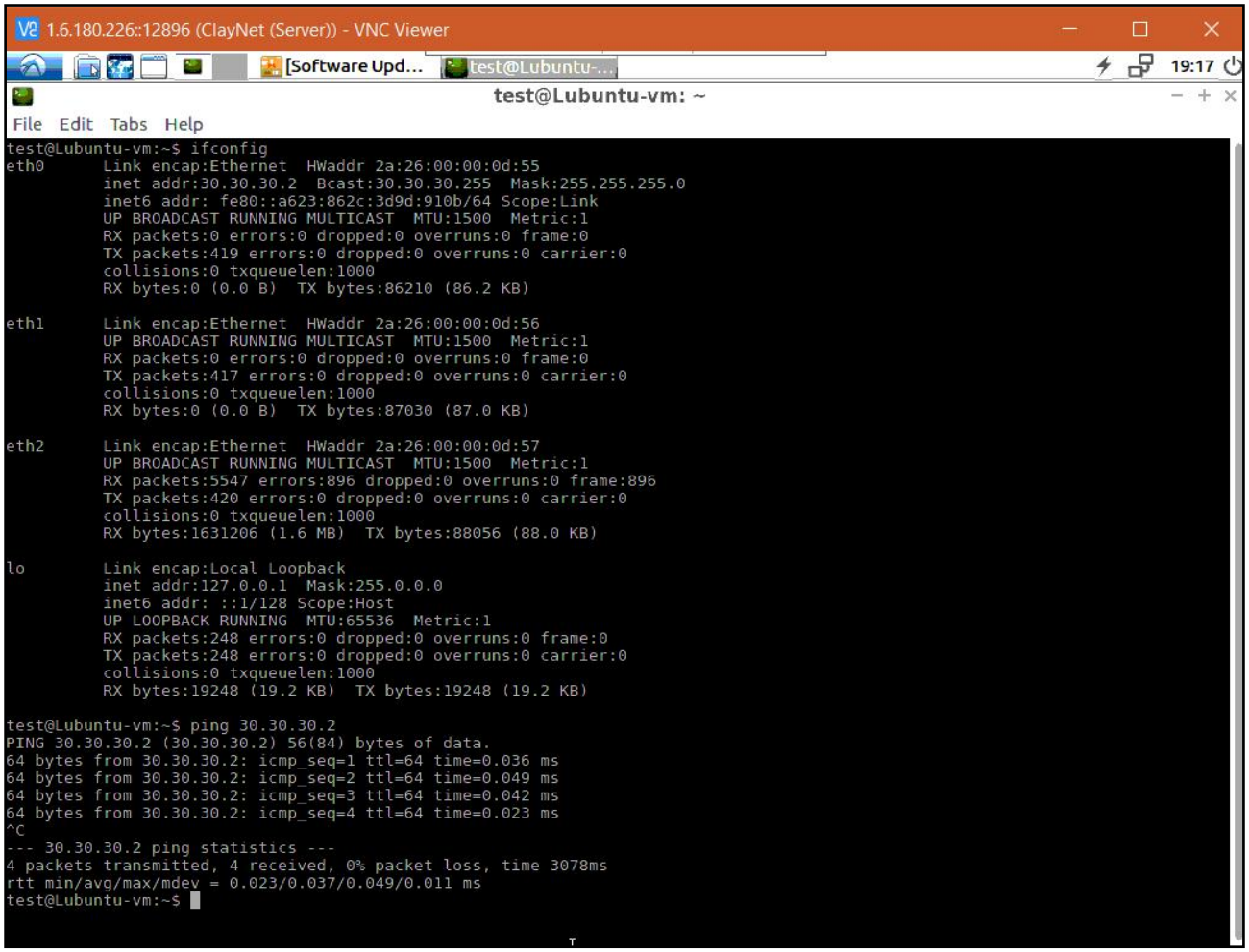



1.6.180.226::12306 (ClayNet (Client)) - VNC Viewer
[Software Upd...
Network Conn...
Editing Ethern...
18:46
Trash
LXTerminal
Editing Ethernet connection 1
Connection name:
Ethernet connection 1
General
Ethernet
802.1x Security
DCB
IPv4 Settings
IPv6 Settings
Method:
Manual
Addresses
Address
Netmask
Gateway
Add
10.10.10.2
24
10.10.10.1
Delete
DNS servers:
Search domains:
DHCP client ID:
Require IPv4 addressing for this connection to complete
Routes...
Cancel
Save

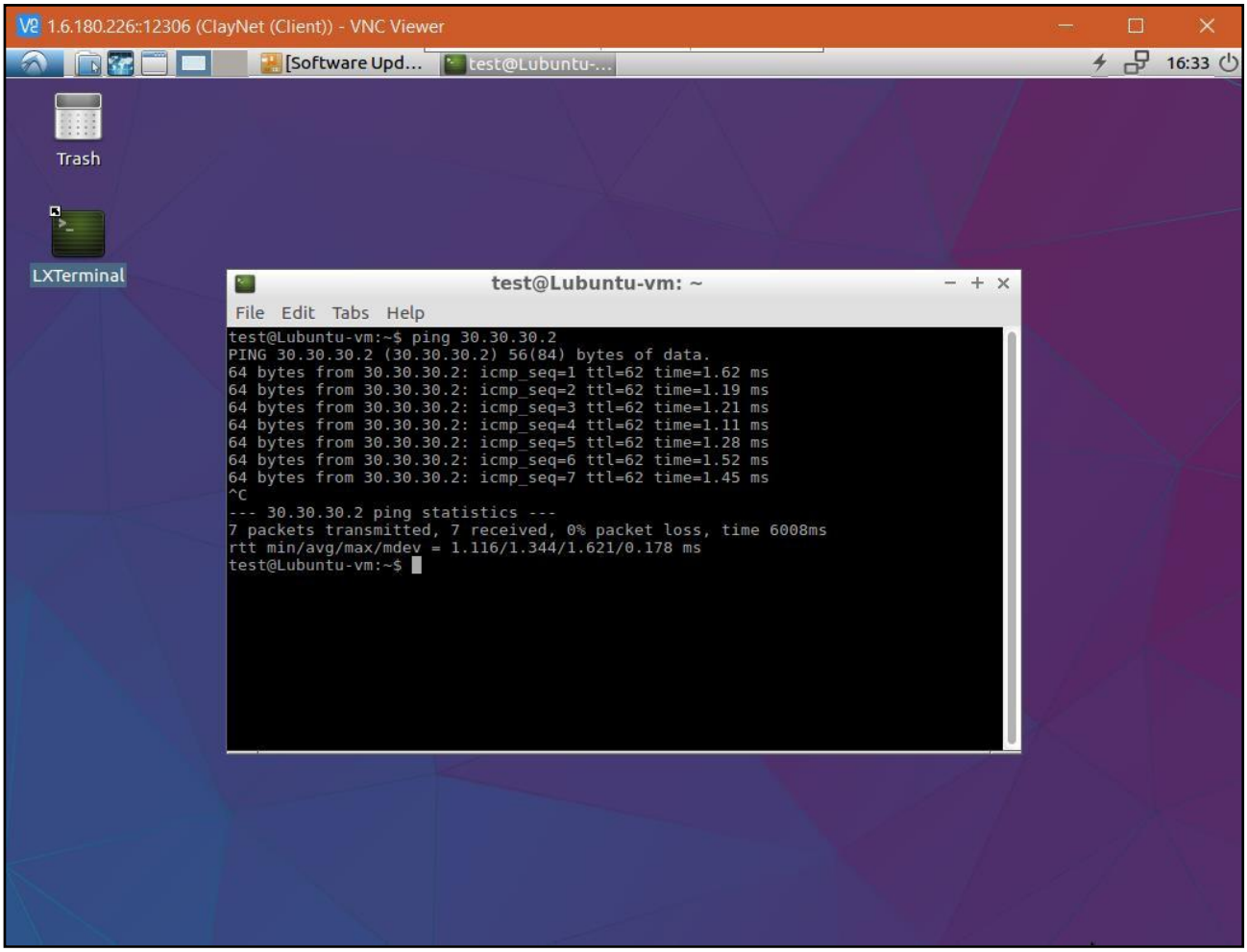

1.6.180.226::12896 (ClayNet (Server)) - VNC Viewer
[Software Upd...
Network Conn...
Editing Ethern...
16:22
Trash
LXTerminal
Editing Ethernet connection 1
Connection name:
Ethernet connection 1
General
Ethernet
802.1x Security
DCB
IPv4 Settings
IPv6 Settings
Device:
eth0 (2A:26:00:00:0D:55)
Cloned MAC address:
MTU:
automatic
bytes
Wake on LAN:
Default
Phy
Unicast
Multicast
Ignore
Broadcast
Arp
Magic
Wake on LAN password:
Cancel
Save


1.6.180.226::12896 (ClayNet (Server)) - VNC Viewer
[Software Upd...
Network Conn...
Editing Ethern...
16:23
Trash
LXTerminal
Editing Ethernet connection 1
Connection name:
Ethernet connection 1
General
Ethernet
802.1x Security
DCB
IPv4 Settings
IPv6 Settings
Method:
Manual
Addresses
Address
Netmask
Gateway
Add
30.30.30.2
24
30.30.30.1
Delete
DNS servers:
Search domains:
DHCP client ID:
Require IPv4 addressing for this connection to complete
Routes...
Cancel
Save


1.6.180.226::12306 (ClayNet (Client)) - VNC Viewer
[Software Upd...
test@Lubuntu-...
18:49
test@Lubuntu-vm: ~
File Edit Tabs Help
test@Lubuntu-vm:~$ ifconfig
eth0 Link encap:Ethernet HWaddr 2a:26:00:00:0e:7e
inet addr:10.10.10.2 Bcast:10.10.10.255 Mask:255.255.255.0
inet6 addr: fe80::e93e:2fa7:ad6f:9868/64 Scope:Link
UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
RX packets:0 errors:0 dropped:0 overruns:0 frame:0
TX packets:99 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
RX bytes:0 (0.0 B) TX bytes:19750 (19.7 KB)
eth1 Link encap:Ethernet HWaddr 2a:26:00:00:0e:7f
UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
RX packets:0 errors:0 dropped:0 overruns:0 frame:0
TX packets:94 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
RX bytes:0 (0.0 B) TX bytes:19796 (19.7 KB)
eth2 Link encap:Ethernet HWaddr 2a:26:00:00:0e:80
UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
RX packets:4492 errors:673 dropped:0 overruns:0 frame:673
TX packets:93 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
RX bytes:1340656 (1.3 MB) TX bytes:19454 (19.4 KB)
lo Link encap:Local Loopback
inet addr:127.0.0.1 Mask:255.0.0.0
inet6 addr: ::1/128 Scope:Host
UP LOOPBACK RUNNING MTU:65536 Metric:1
RX packets:248 errors:0 dropped:0 overruns:0 frame:0
TX packets:248 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
RX bytes:19248 (19.2 KB) TX bytes:19248 (19.2 KB)
test@Lubuntu-vm:~$ ping 10.10.10.1
PING 10.10.10.1 (10.10.10.1) 56(84) bytes of data.
64 bytes from 10.10.10.1: icmp_seq=1 ttl=64 time=0.866 ms
64 bytes from 10.10.10.1: icmp_seq=2 ttl=64 time=0.335 ms
64 bytes from 10.10.10.1: icmp_seq=3 ttl=64 time=0.637 ms
64 bytes from 10.10.10.1: icmp_seq=4 ttl=64 time=0.360 ms
^C
--- 10.10.10.1 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3054ms
rtt min/avg/max/mdev = 0.335/0.549/0.866/0.219 ms
test@Lubuntu-vm:~$


1.6.180.226::12896 (ClayNet (Server)) - VNC Viewer
[Software Upd...
test@Lubuntu-...
19:17
test@Lubuntu-vm: ~
File Edit Tabs Help
test@Lubuntu-vm:~$ ifconfig
eth0 Link encap:Ethernet HWaddr 2a:26:00:00:0d:55
inet addr:30.30.30.2 Bcast:30.30.30.255 Mask:255.255.255.0
inet6 addr: fe80::a623:862c:3d9d:910b/64 Scope:Link
UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
RX packets:0 errors:0 dropped:0 overruns:0 frame:0
TX packets:419 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
RX bytes:0 (0.0 B) TX bytes:86210 (86.2 KB)
eth1 Link encap:Ethernet HWaddr 2a:26:00:00:0d:56
UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
RX packets:0 errors:0 dropped:0 overruns:0 frame:0
TX packets:417 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
RX bytes:0 (0.0 B) TX bytes:87030 (87.0 KB)
eth2 Link encap:Ethernet HWaddr 2a:26:00:00:0d:57
UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
RX packets:5547 errors:896 dropped:0 overruns:0 frame:896
TX packets:420 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
RX bytes:1631206 (1.6 MB) TX bytes:88056 (88.0 KB)
lo Link encap:Local Loopback
inet addr:127.0.0.1 Mask:255.0.0.0
inet6 addr: ::1/128 Scope:Host
UP LOOPBACK RUNNING MTU:65536 Metric:1
RX packets:248 errors:0 dropped:0 overruns:0 frame:0
TX packets:248 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
RX bytes:19248 (19.2 KB) TX bytes:19248 (19.2 KB)
test@Lubuntu-vm:~$ ping 30.30.30.2
PING 30.30.30.2 (30.30.30.2) 56(84) bytes of data.
64 bytes from 30.30.30.2: icmp_seq=1 ttl=64 time=0.036 ms
64 bytes from 30.30.30.2: icmp_seq=2 ttl=64 time=0.049 ms
64 bytes from 30.30.30.2: icmp_seq=3 ttl=64 time=0.042 ms
64 bytes from 30.30.30.2: icmp_seq=4 ttl=64 time=0.023 ms
^C
--- 30.30.30.2 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3078ms
rtt min/avg/max/mdev = 0.023/0.037/0.049/0.011 ms
test@Lubuntu-vm:~$

Task 6: From client, ping to server 30.30.30.2. Ping will not be successful and Router1 will reply with 'Destination host unreachable'.



Task 7: Set up the following routing table entries for Routers 1 & 2.

Routers	Destination	Next hop gateway	Via
Router 1	30.30.30.0	20.20.20.2	Direct
Router 2	10.10.10.0	20.20.20.1	Direct

Steps to add the routing table entries:

Step 1: Login to Router1 by right clicking on Router icon and selecting ‘Console Access’. (Type ‘Enter’ key once to get into Login screen. Username – admin , Password- admin@12345)

Step 2: Display the routing table to view all static routes using the command.

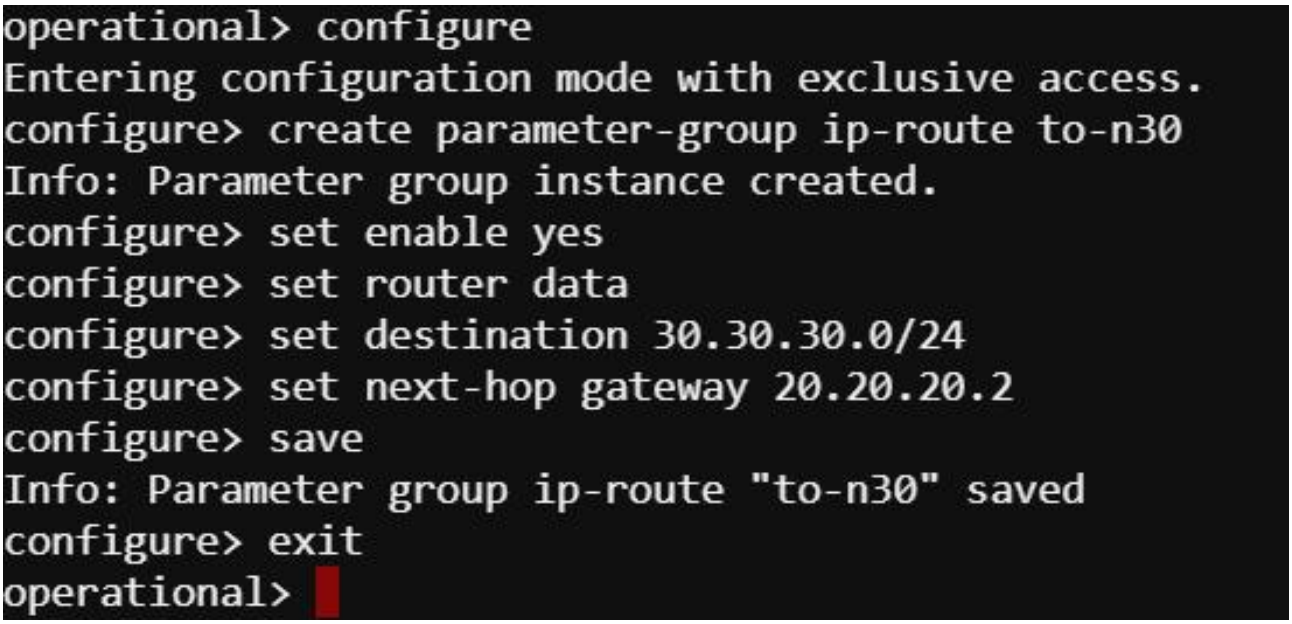
```
show route summary -s active
                    data
```

```
nivappadmin@ClayNet:~$ telnet 127.0.0.1  58111
Trying 127.0.0.1...
Connected to 127.0.0.1.
Escape character is '^]'.

Login: admin
Password:

operational> show route summary -s active data

> IPv4 active routes

>> Destination : 10.10.10.0/24
   Gateway(s)  : { if-port-1
                   0.0.0.0 }
   Source      : direct
   Flags       : -

>> Destination : 20.20.20.0/24
   Gateway(s)  : { if-port-2
                   0.0.0.0 }
   Source      : direct
   Flags       : -

>> Destination : 127.0.0.0/8
   Gateway(s)  : { ^loopback-1
                   127.0.0.1 }
   Source      : direct
   Flags       : R

>> Destination : 127.0.0.1/32
   Gateway(s)  : { ^loopback-1
 Line : 1-23, Press 'q' to quit.
```

Note in routing table of Router1 that there is no route to reach the destination network 30.30.30.0/24. Go to configure mode and start configuring the router for all the possible routes.

Step 3: Configure a static route in Router1 for destination 30.30.30.0/24 with next-hop gateway as 20.20.20.2, which is the IP address of Router2

.



Step 4: Check routing table again and verify that the route is added.

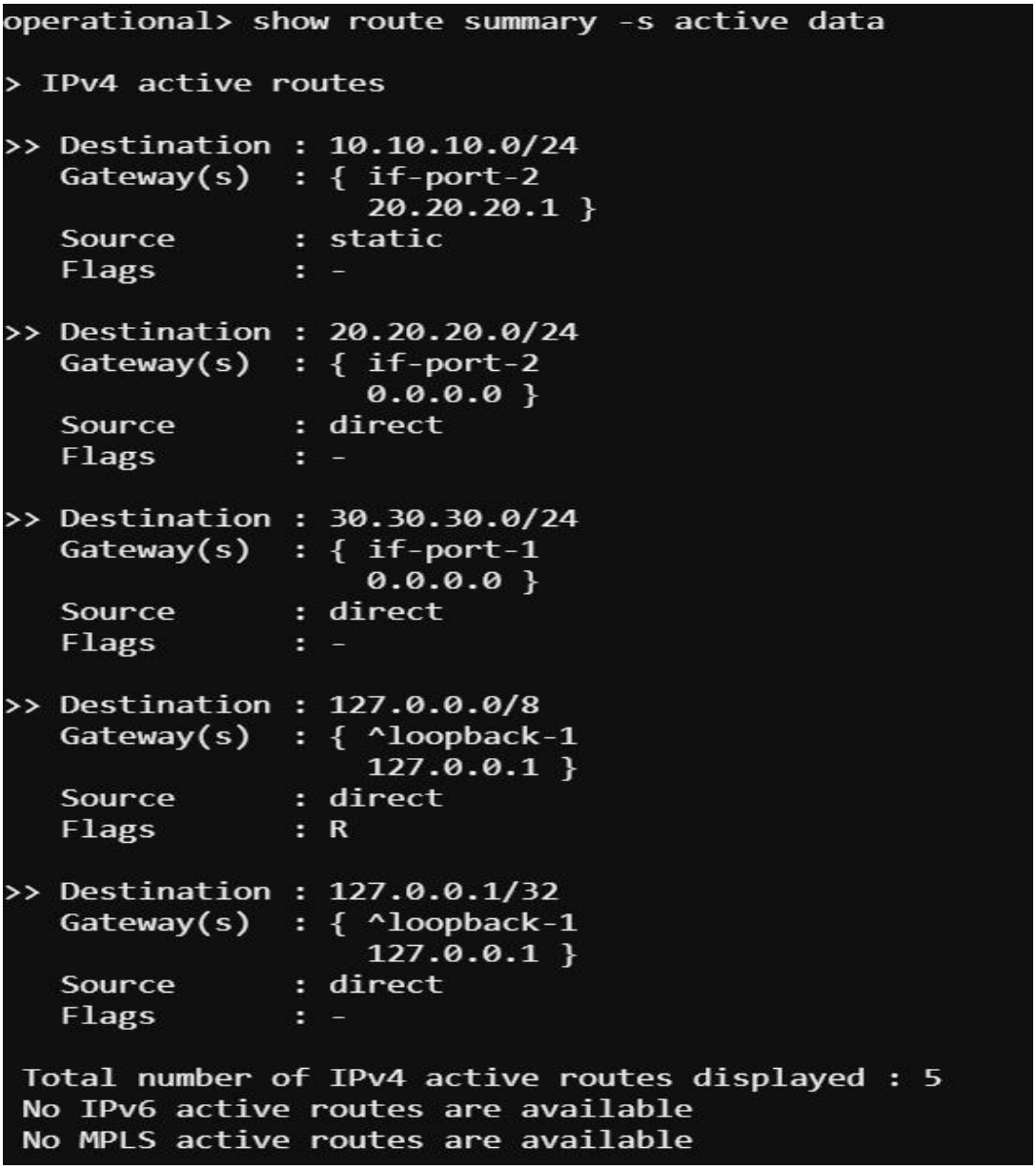
The routing table is successfully completed.

Step 5: Repeat the steps 3 & 4 to configure a static route in Router2 for destination 10.10.10.0/24 with next-hop gateway as 20.20.20.1, which is the IP address of Router1.

```
operational> show route summary -s active data

> IPv4 active routes

>> Destination : 10.10.10.0/24
   Gateway(s)  : { if-port-1
                   0.0.0.0 }
   Source      : direct
   Flags       : -

>> Destination : 20.20.20.0/24
   Gateway(s)  : { if-port-2
                   0.0.0.0 }
   Source      : direct
   Flags       : -

>> Destination : 30.30.30.0/24
   Gateway(s)  : { if-port-2
                   20.20.20.2 }
   Source      : static
   Flags       : -

>> Destination : 127.0.0.0/8
   Gateway(s)  : { ^loopback-1
                   127.0.0.1 }
   Source      : direct
   Flags       : R

>> Destination : 127.0.0.1/32
   Gateway(s)  : { ^loopback-1
                   127.0.0.1 }
   Source      : direct
   Flags       : -

 Total number of IPv4 active routes displayed : 5
 No IPv6 active routes are available
 No MPLS active routes are available
```

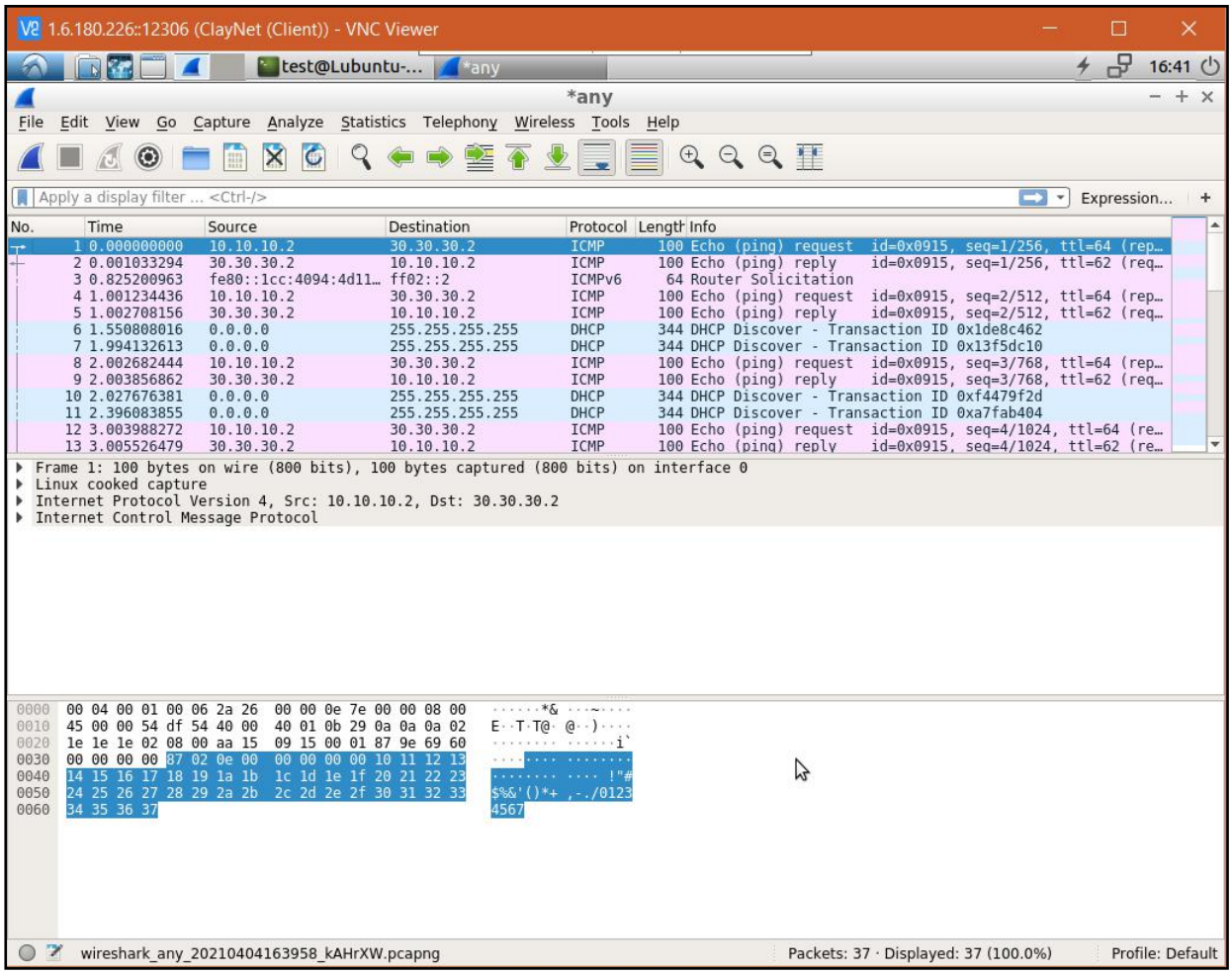
```
nivappadmin@ClayNet:~$ telnet 127.0.0.1  51616
Trying 127.0.0.1...
Connected to 127.0.0.1.
Escape character is '^]'.

Login: admin
Password:

operational> show route summary -s active data

> IPv4 active routes

>> Destination : 20.20.20.0/24
   Gateway(s)  : { if-port-2
                   0.0.0.0 }
   Source      : direct
   Flags       : -

>> Destination : 30.30.30.0/24
   Gateway(s)  : { if-port-1
                   0.0.0.0 }
   Source      : direct
   Flags       : -

>> Destination : 127.0.0.0/8
   Gateway(s)  : { ^loopback-1
                   127.0.0.1 }
   Source      : direct
   Flags       : R

>> Destination : 127.0.0.1/32
   Gateway(s)  : { ^loopback-1
                   127.0.0.1 }
   Source      : direct
   Flags       : -

 Total number of IPv4 active routes displayed : 4
 No IPv6 active routes are available
 No MPLS active routes are available
```

```
operational> configure
Entering configuration mode with exclusive access.
configure> create parameter-group ip-route to-n10
Info: Parameter group instance created.
configure> set enable yes
configure> set router data
configure> set destination 10.10.10.0/24
configure> set next-hop gateway 20.20.20.1
configure> save
Info: Parameter group ip-route "to-n10" saved
configure> exit
operational> show route summary -s active data
```

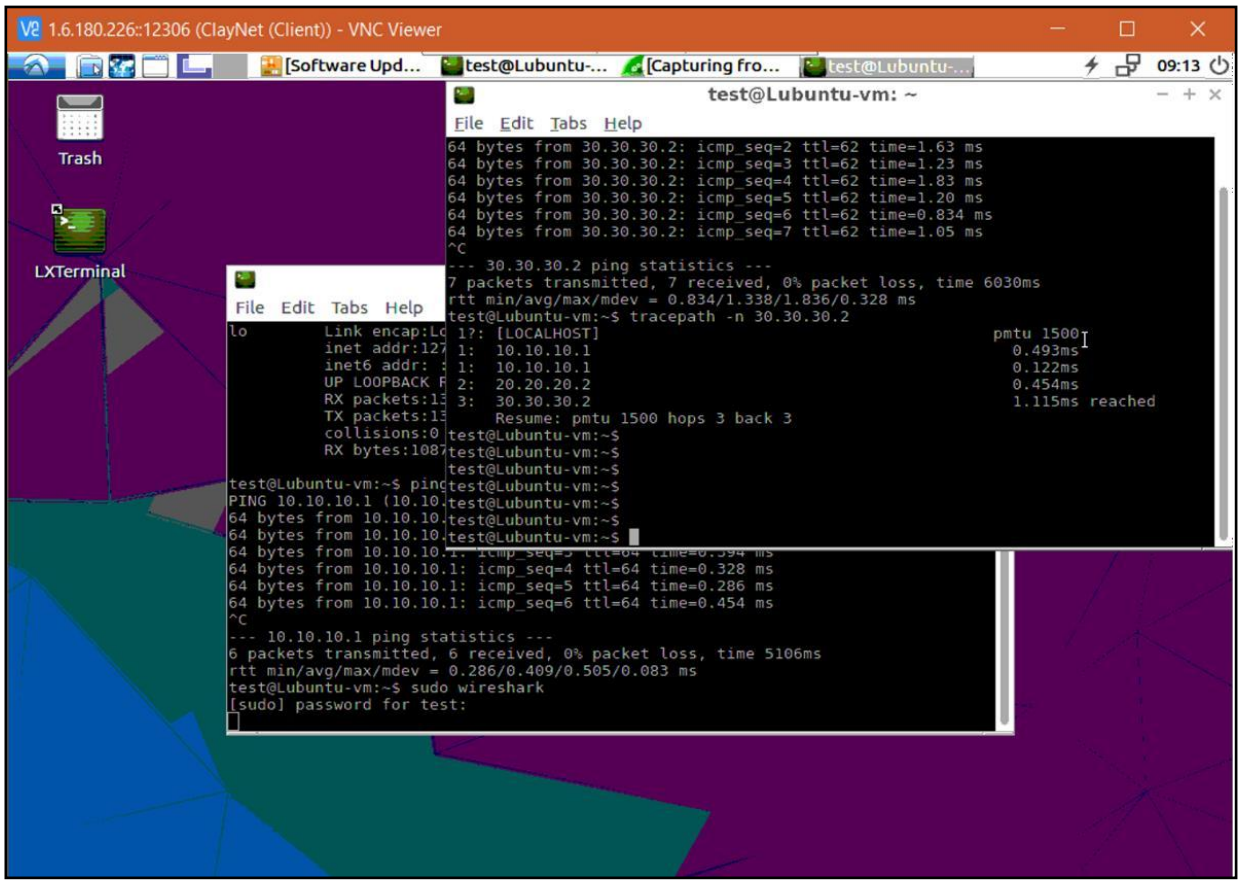


The routing is successfully completed

Task 8: Now Ping will be successful as all the required routers are now configured. Observe the TTL getting decremented by 2 because two hops/routers are in between. Also keep the Wireshark ready for observation.



Task 9: Also observe the output of tracepath -n 30.30.30.2 command on Client.



The server is henceforth reachable

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