Week 8

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

Objectives of the Lab:

- 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.

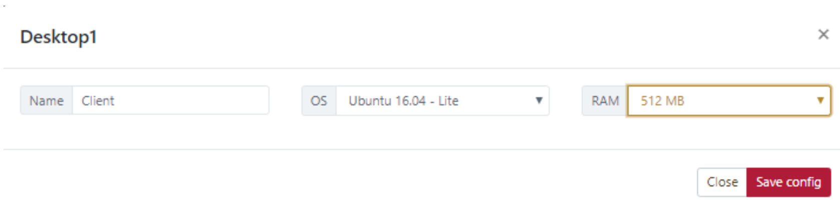
Important Instructions:

To access ClayNet, type **http://1.6.181.7:9000/** in browser**.** Login credentials will be provided by the faculty incharge.

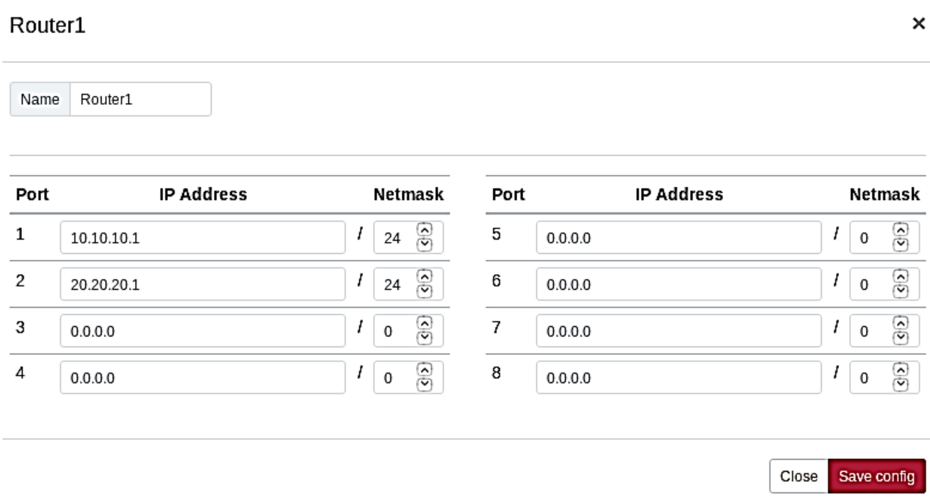
Execution Tasks:

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

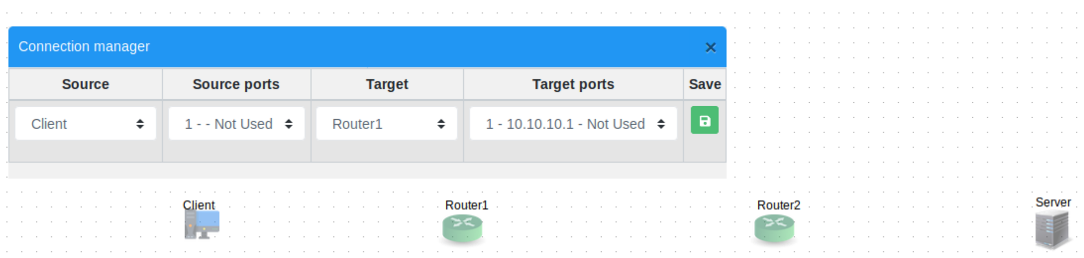
Task 2: Drag and drop the necessary components to create the given topology. Provide the names for compute, select OS (Ubuntu 16.04 – Lite or Ubuntu 16.04 – CLI) and RAM (512 MB) as shown below.



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.

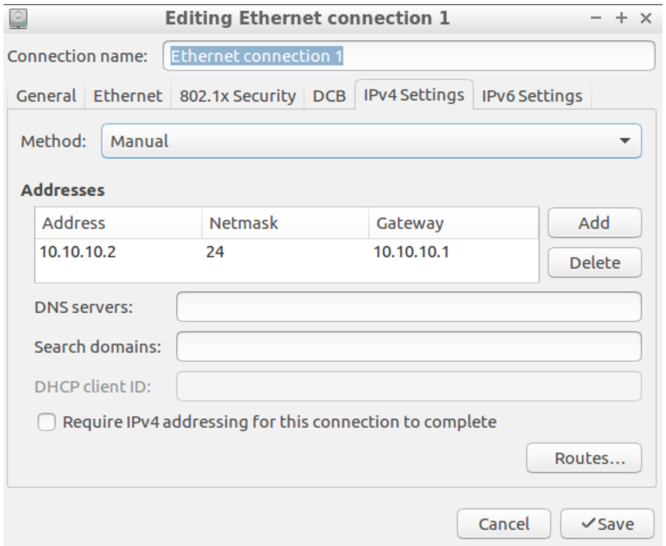


Task 5: To deploy the topology, save the topology first and deploy it by clicking 'Deploy' button available on the top. (Note: It will take few seconds or even minutes to deploy the topology for the first time).

Task 5: 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




```
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=0.862 ms
64 bytes from 10.10.10.1: icmp_seq=2 ttl=64 time=0.363 ms
^C
--- 10.10.10.1 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1001ms
rtt min/avg/max/mdev = 0.363/0.612/0.862/0.250 ms
test@Lubuntu-vm:~$ ping 10.10.10.2
PING 10.10.10.2 (10.10.10.2) 56(84) bytes of data.
64 bytes from 10.10.10.2: icmp_seq=1 ttl=64 time=0.039 ms
64 bytes from 10.10.10.2: icmp_seq=2 ttl=64 time=0.014 ms
64 bytes from 10.10.10.2: icmp_seq=3 ttl=64 time=0.011 ms
^C
--- 10.10.10.2 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2046ms
rtt min/avg/max/mdev = 0.011/0.021/0.039/0.013 ms
test@Lubuntu-vm:~$
```

Server:

IP Address ---> 30.30.30.2 Gateway ---> 30.30.30.1

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

```
test@Lubuntu-vm:~$ ping 30.30.30.2
PING 30.30.30.2 (30.30.30.2) 56(84) bytes of data.
From 10.10.10.1 icmp_seq=1 Destination Host Unreachable
From 10.10.10.1 icmp_seq=2 Destination Host Unreachable
From 10.10.10.1 icmp_seq=3 Destination Host Unreachable
^C
--- 30.30.30.2 ping statistics ---
3 packets transmitted, 0 received, +3 errors, 100% packet loss, time 2049ms

test@Lubuntu-vm:~$
```

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 - test, Password- test@12345)

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

`show route summary -s active data`

```
clayroot@ClayNet:~$ telnet 127.0.0.1  56075
Trying 127.0.0.1...
Connected to 127.0.0.1.
Escape character is '^]'.



Login: Login: test
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
                   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>
```

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.

```
operational> configure
Entering configuration mode with exclusive access.
configure> create parameter-group ip-route to-n30
Info: Parameter group instance created.
configure> set enable yes
configure> set router data
configure> set destination 30.30.30.0/24
configure> set next-hop gateway 20.20.20.2
configure> save
Info: Parameter group ip-route "to-n30" saved
configure> exit
operational>
```

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

```
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
```

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> 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>
```

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

> IPv4 active routes

>> Destination : 10.10.10.0/24
   Gateway(s)  : { if-port-2
                   20.20.20.1 }
   Source      : static
   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-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 : 5
 No IPv6 active routes are available
 No MPLS active routes are available
```

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.

```
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=62 time=0.906 ms
64 bytes from 30.30.30.2: icmp_seq=2 ttl=62 time=0.781 ms
64 bytes from 30.30.30.2: icmp_seq=3 ttl=62 time=0.865 ms
64 bytes from 30.30.30.2: icmp_seq=4 ttl=62 time=1.08 ms
^C
--- 30.30.30.2 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3069ms
rtt min/avg/max/mdev = 0.781/0.908/1.083/0.116 ms
test@Lubuntu-vm:~$
```

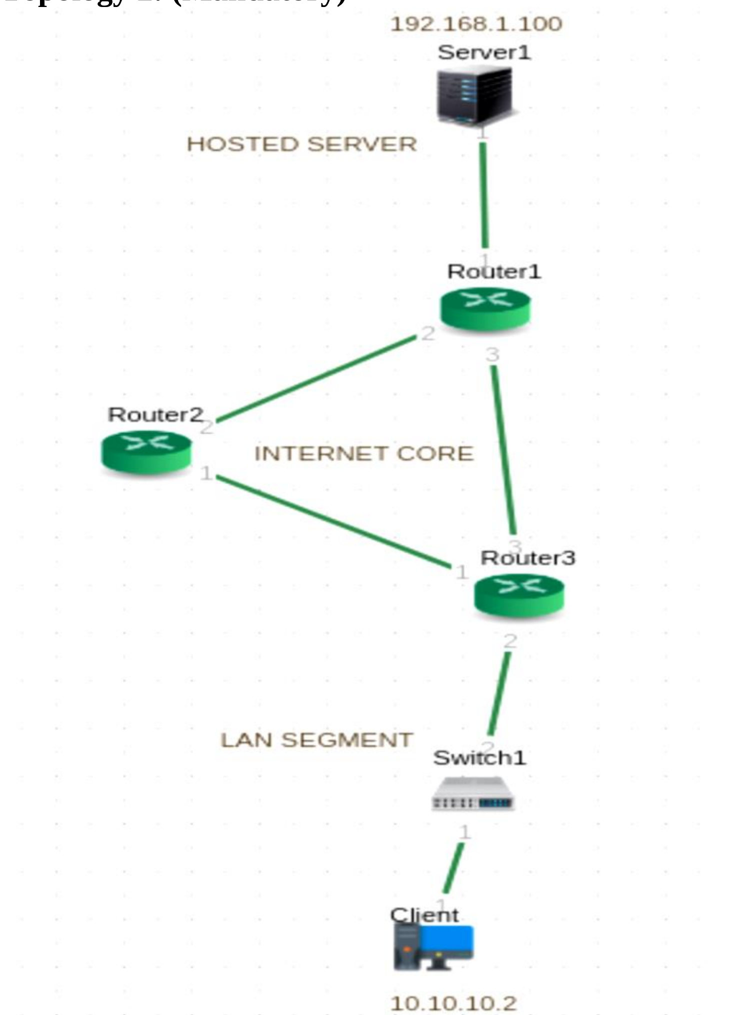
1	0.000000000	10.10.10.2	30.30.30.2	ICMP	100	Echo (ping) request	id=0x06e5, seq=1/256, ttl=6
2	0.000951130	30.30.30.2	10.10.10.2	ICMP	100	Echo (ping) reply	id=0x06e5, seq=1/256, ttl=6
3	1.001056986	10.10.10.2	30.30.30.2	ICMP	100	Echo (ping) request	id=0x06e5, seq=2/512, ttl=6
4	1.001749765	30.30.30.2	10.10.10.2	ICMP	100	Echo (ping) reply	id=0x06e5, seq=2/512, ttl=6
5	2.015331316	10.10.10.2	30.30.30.2	ICMP	100	Echo (ping) request	id=0x06e5, seq=3/768, ttl=6
6	2.016067278	30.30.30.2	10.10.10.2	ICMP	100	Echo (ping) reply	id=0x06e5, seq=3/768, ttl=6
7	3.039417776	10.10.10.2	30.30.30.2	ICMP	100	Echo (ping) request	id=0x06e5, seq=4/1024, ttl=
8	3.040217193	30.30.30.2	10.10.10.2	ICMP	100	Echo (ping) reply	id=0x06e5, seq=4/1024, ttl=
9	4.063367384	10.10.10.2	30.30.30.2	ICMP	100	Echo (ping) request	id=0x06e5, seq=5/1280, ttl=
10	4.064747719	30.30.30.2	10.10.10.2	ICMP	100	Echo (ping) reply	id=0x06e5, seq=5/1280, ttl=
11	5.064965592	10.10.10.2	30.30.30.2	ICMP	100	Echo (ping) request	id=0x06e5, seq=6/1536, ttl=
12	5.065842624	30.30.30.2	10.10.10.2	ICMP	100	Echo (ping) reply	id=0x06e5, seq=6/1536, ttl=
13	6.080629150	10.10.10.2	30.30.30.2	ICMP	100	Echo (ping) request	id=0x06e5, seq=7/1792, ttl=
14	6.081360600	30.30.30.2	10.10.10.2	ICMP	100	Echo (ping) reply	id=0x06e5, seq=7/1792, ttl=
15	7.103340029	10.10.10.2	30.30.30.2	ICMP	100	Echo (ping) request	id=0x06e5, seq=8/2048, ttl=
16	7.104075101	30.30.30.2	10.10.10.2	ICMP	100	Echo (ping) reply	id=0x06e5, seq=8/2048, ttl=
17	8.127362145	10.10.10.2	30.30.30.2	ICMP	100	Echo (ping) request	id=0x06e5, seq=9/2304, ttl=
18	8.128168354	30.30.30.2	10.10.10.2	ICMP	100	Echo (ping) reply	id=0x06e5, seq=9/2304, ttl=

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

Record these observations in your notebook. Upload the following screenshots in Edmodo.

1) Pinging
2) Wireshark capture

Topology 2: (Mandatory)



- Create and deploy the topology as show above.
- Appropriately configure static routing entries in all three routers, so that server is reachable from client desktop.

Observations Required:

- How many hops will client take to reach the server?
- Observe the RTT and justify your observation.
- While pinging, cut the link between Router1 and Router3. What will happen now?

Record these observations in your notebook. Upload the following screenshots in Edmodo.

1) Pinging
2) Wireshark capture