

Week 9 and 10

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Understand the building blocks and usage of ClayNet Network

Virtualization platform with reference to OSI Layer.

Objectives of the Lab:

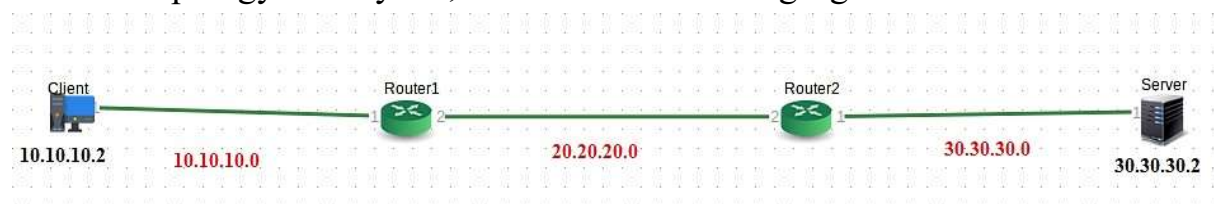
- Understand the building blocks of ClayNet.
- Build a simple client-server network using routers, switches, and network hosts.
- To learn the static IP routing behavior such as default and static routes and routing tables.
- Use common network utilities to verify LAN operation and analyze data traffic.

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://1.6.180.226:9000/>** 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.

Desktop1

Name

Client

OS

Ubuntu 16.04 - Lite

RAM

512 MB

Close

Save config

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’.)

Router1

Name

Router1

Port	IP Address	Netmask
1	10.10.10.1	/ 24
2	20.20.20.1	/ 24
3	0.0.0.0	/ 0
4	0.0.0.0	/ 0
5	0.0.0.0	/ 0
6	0.0.0.0	/ 0
7	0.0.0.0	/ 0
8	0.0.0.0	/ 0

Close

Save config

Router 2-:

Router2

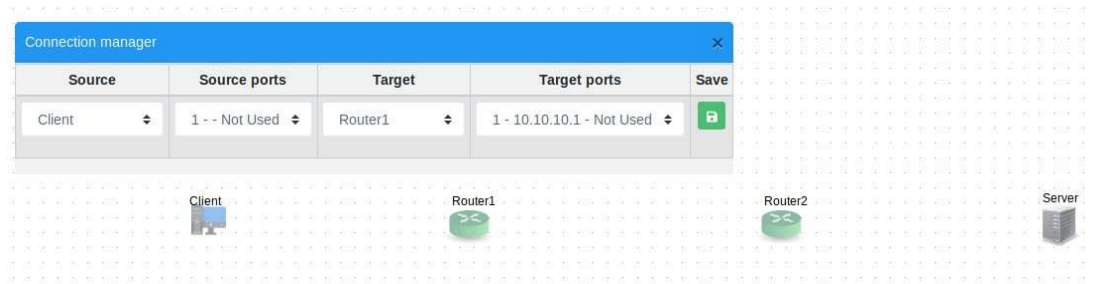
Name

Router2

Port	IP Address	Netmask
1	30.30.30.1	/ 24
2	20.20.20.2	/ 24
3	0.0.0.0	/ 0
4	0.0.0.0	/ 0
5	0.0.0.0	/ 0
6	0.0.0.0	/ 0
7	0.0.0.0	/ 0
8	0.0.0.0	/ 0

Close

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



Existing connections				
Source	Source ports	Target	Target ports	Delete
Client1	1	Router1	1	
Router1	2	Router2	2	
Router2	1	Server1	1	

Task 5: To deploy the topology, save the topology first and deploy it by clicking ‘Deploy’ button available on the top.

Task 5: Go to ‘Remote Desktop’ by right clicking on client and server icons and set the IP addresses accordingly. (Login: user - test, password - test)

Client: IP Address ---> 10.10.10.2 Gateway ---> 10.10.10.1

```
test@Lubuntu-vm:~$ ifconfig
eth0      Link encap:Ethernet  HWaddr a2:26:00:00:17:26
          inet addr:10.10.10.2  Bcast:10.10.10.255  Mask:255.255.255.0
          inet6 addr: fe80::2b35:d83a:891b:9279/64  Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:496 errors:8 dropped:0 overruns:0 frame:8
          TX packets:776 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:61741 (61.7 KB)  TX bytes:82833 (82.8 KB)

eth1      Link encap:Ethernet  HWaddr a2:26:00:00:17:27
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:45 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:9214 (9.2 KB)

eth2      Link encap:Ethernet  HWaddr a2:26:00:00:17:28
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:48 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:10240 (10.2 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:160 errors:0 dropped:0 overruns:0 frame:0
          TX packets:160 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:11208 (11.2 KB)  TX bytes:11208 (11.2 KB)
```

When it pings itself -:

```
test@Lubuntu-vm
File Edit Tabs Help
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=0.847 ms
64 bytes from 10.10.10.1: icmp_seq=2 ttl=64 time=0.305 ms
64 bytes from 10.10.10.1: icmp_seq=3 ttl=64 time=0.288 ms
^C
--- 10.10.10.1 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2043ms
rtt min/avg/max/mdev = 0.288/0.480/0.847/0.259 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=0.037 ms
64 bytes from 10.10.10.2: icmp_seq=2 ttl=64 time=0.032 ms
^C
--- 10.10.10.2 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1000ms
rtt min/avg/max/mdev = 0.032/0.034/0.037/0.006 ms
```

Server: IP Address ---> 30.30.30.2

Gateway--> 30.30.30.1

```
test@Lubuntu-vm:~$ ifconfig
eth0      Link encap:Ethernet  HWaddr a2:26:00:00:15:e3
          inet addr:30.30.30.2  Bcast:30.30.30.255  Mask:255.255.255.0
          inet6 addr: fe80::b933:e043:cb0e:eb41/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:520 errors:16 dropped:0 overruns:0 frame:16
          TX packets:808 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:65494 (65.4 KB)  TX bytes:86822 (86.8 KB)

eth1      Link encap:Ethernet  HWaddr a2:26:00:00:15:e4
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:47 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:9898 (9.8 KB)

eth2      Link encap:Ethernet  HWaddr a2:26:00:00:15:e5
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:46 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:9556 (9.5 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:180 errors:0 dropped:0 overruns:0 frame:0
          TX packets:180 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:12208 (12.2 KB)  TX bytes:12208 (12.2 KB)
```

When it pings itself -:

```
test@Lubuntu-vm:~$ ping 30.30.30.1
PING 30.30.30.1 (30.30.30.1) 56(84) bytes of data.
64 bytes from 30.30.30.1: icmp_seq=1 ttl=64 time=0.588 ms
64 bytes from 30.30.30.1: icmp_seq=2 ttl=64 time=0.279 ms
^C
--- 30.30.30.1 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1013ms
rtt min/avg/max/mdev = 0.279/0.433/0.588/0.155 ms
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=0.058 ms
64 bytes from 30.30.30.2: icmp_seq=2 ttl=64 time=0.041 ms
^C
--- 30.30.30.2 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1005ms
rtt min/avg/max/mdev = 0.041/0.049/0.058/0.011 ms
test@Lubuntu-vm:~$ ssh 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

```
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
```

There is no route to reach 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.

```
operational> configure
Entering configuration mode with exclusive access.
configure> create parameter-group ip-routeconfigure> create parameter-group ip-route
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 "n30" saved
configure> exit
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       : -
```


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 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 "n10" saved
configure> exit
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
```

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=1.18 ms
64 bytes from 30.30.30.2: icmp_seq=2 ttl=62 time=0.815 ms
64 bytes from 30.30.30.2: icmp_seq=3 ttl=62 time=0.914 ms
64 bytes from 30.30.30.2: icmp_seq=4 ttl=62 time=19.0 ms
64 bytes from 30.30.30.2: icmp_seq=5 ttl=62 time=1.06 ms
64 bytes from 30.30.30.2: icmp_seq=6 ttl=62 time=1.01 ms
64 bytes from 30.30.30.2: icmp_seq=7 ttl=62 time=0.807 ms
64 bytes from 30.30.30.2: icmp_seq=8 ttl=62 time=0.942 ms
64 bytes from 30.30.30.2: icmp_seq=9 ttl=62 time=0.946 ms
64 bytes from 30.30.30.2: icmp_seq=10 ttl=62 time=0.853 ms
64 bytes from 30.30.30.2: icmp_seq=11 ttl=62 time=0.863 ms
64 bytes from 30.30.30.2: icmp_seq=12 ttl=62 time=0.810 ms
64 bytes from 30.30.30.2: icmp_seq=13 ttl=62 time=0.788 ms
64 bytes from 30.30.30.2: icmp_seq=14 ttl=62 time=15.0 ms
64 bytes from 30.30.30.2: icmp_seq=15 ttl=62 time=0.845 ms
64 bytes from 30.30.30.2: icmp_seq=16 ttl=62 time=0.828 ms
64 bytes from 30.30.30.2: icmp_seq=17 ttl=62 time=0.995 ms
64 bytes from 30.30.30.2: icmp_seq=18 ttl=62 time=34.3 ms
64 bytes from 30.30.30.2: icmp_seq=19 ttl=62 time=1.00 ms
64 bytes from 30.30.30.2: icmp_seq=20 ttl=62 time=0.967 ms
64 bytes from 30.30.30.2: icmp_seq=21 ttl=62 time=0.855 ms
```

Wireshark capture -:

The image shows a Wireshark capture of network traffic. The top pane displays a list of 22 packets, all of which are ICMP Echo (ping) requests and replies between the source IP 10.10.10.2 and the destination IP 30.30.30.2. The middle pane shows the details of the selected packet (Frame 1), indicating it is an Internet Control Message Protocol (ICMP) Echo (ping) request. The bottom pane shows the raw packet data in hexadecimal and ASCII format.

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	10.10.10.2	30.30.30.2	ICMP	100	Echo (ping) request id=0x0697, seq=1/256, ttl=64 (reply in 2)
2	0.001151393	30.30.30.2	10.10.10.2	ICMP	100	Echo (ping) reply id=0x0697, seq=1/256, ttl=62 (request in 1)
3	1.001268464	10.10.10.2	30.30.30.2	ICMP	100	Echo (ping) request id=0x0697, seq=2/512, ttl=64 (reply in 4)
4	1.002064603	30.30.30.2	10.10.10.2	ICMP	100	Echo (ping) reply id=0x0697, seq=2/512, ttl=62 (request in 3)
5	2.011045004	10.10.10.2	30.30.30.2	ICMP	100	Echo (ping) request id=0x0697, seq=3/768, ttl=64 (reply in 6)
6	2.011942151	30.30.30.2	10.10.10.2	ICMP	100	Echo (ping) reply id=0x0697, seq=3/768, ttl=62 (request in 5)
7	3.035049460	10.10.10.2	30.30.30.2	ICMP	100	Echo (ping) request id=0x0697, seq=4/1024, ttl=64 (reply in 8)
8	3.054056179	30.30.30.2	10.10.10.2	ICMP	100	Echo (ping) reply id=0x0697, seq=4/1024, ttl=62 (request in 7)
9	4.036157518	10.10.10.2	30.30.30.2	ICMP	100	Echo (ping) request id=0x0697, seq=5/1280, ttl=64 (reply in 10)
10	4.037202274	30.30.30.2	10.10.10.2	ICMP	100	Echo (ping) reply id=0x0697, seq=5/1280, ttl=62 (request in 9)
11	5.037368974	10.10.10.2	30.30.30.2	ICMP	100	Echo (ping) request id=0x0697, seq=6/1536, ttl=64 (reply in 12)
12	5.038365103	30.30.30.2	10.10.10.2	ICMP	100	Echo (ping) reply id=0x0697, seq=6/1536, ttl=62 (request in 11)
13	6.038502501	10.10.10.2	30.30.30.2	ICMP	100	Echo (ping) request id=0x0697, seq=7/1792, ttl=64 (reply in 14)
14	6.039293363	30.30.30.2	10.10.10.2	ICMP	100	Echo (ping) reply id=0x0697, seq=7/1792, ttl=62 (request in 13)
15	7.067047721	10.10.10.2	30.30.30.2	ICMP	100	Echo (ping) request id=0x0697, seq=8/2048, ttl=64 (reply in 16)
16	7.067970756	30.30.30.2	10.10.10.2	ICMP	100	Echo (ping) reply id=0x0697, seq=8/2048, ttl=62 (request in 15)
17	8.091047150	10.10.10.2	30.30.30.2	ICMP	100	Echo (ping) request id=0x0697, seq=9/2304, ttl=64 (reply in 18)
18	8.091974239	30.30.30.2	10.10.10.2	ICMP	100	Echo (ping) reply id=0x0697, seq=9/2304, ttl=62 (request in 17)
19	9.092081077	10.10.10.2	30.30.30.2	ICMP	100	Echo (ping) request id=0x0697, seq=10/2560, ttl=64 (reply in 20)
20	9.092914747	30.30.30.2	10.10.10.2	ICMP	100	Echo (ping) reply id=0x0697, seq=10/2560, ttl=62 (request in 19)
21	10.107133858	10.10.10.2	30.30.30.2	ICMP	100	Echo (ping) request id=0x0697, seq=11/2816, ttl=64 (reply in 22)
22	10.107925764	30.30.30.2	10.10.10.2	ICMP	100	Echo (ping) reply id=0x0697, seq=11/2816, ttl=62 (request in 21)

Frame 1: 100 bytes on wire (800 bits), 100 bytes captured (800 bits) on interface 0
 Linux cooked capture
 Internet Protocol Version 4, Src: 10.10.10.2, Dst: 30.30.30.2
 Internet Control Message Protocol

0000 00 04 00 01 00 06 a2 26 00 00 17 26 00 00 08 00&...&...
 0010 45 00 00 54 2c 3c 40 00 40 01 be 41 0a 0a 0a 02 E..T,<@. @..A...
 0020 1e 1e 1e 02 08 00 5c 1d 06 97 00 01 93 84 60 60\\.....
 0030 00 00 00 00 d8 92 0a 00 00 00 00 00 10 11 12 13
 0040 14 15 16 17 18 19 1a 1b 1c 1d 1e 1f 20 21 22 23!*"#
 0050 24 25 26 27 28 29 2a 2b 2c 2d 2e 2f 30 31 32 33 \$%&'()*+,-./0123
 0060 34 35 36 37 4567

wireshark_any_20210328185834_lrVklB.pcapng Packets: 22 · Displayed: 22 (100.0%) · Dropped: 0 (0.0%) Profile: Default

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

```
test@Lubuntu-vm:~$ tracert -n 30.30.30.2
 1?: [LOCALHOST] pmtu 1500
 1: 10.10.10.1 0.383ms
 1: 10.10.10.1 0.180ms
 2: 20.20.20.2 0.440ms
 3: 30.30.30.2 0.766ms reached
    Resume: pmtu 1500 hops 3 back 3
test@Lubuntu-vm:~$
```


WEEK 10

Topology -:



Router 1 if port 1 -:

```
operational> show interface details if-port-1

> Interface : if-port-1

General Information
-----
ID                : 10
Encapsulation     : ethernet
MTU               : 1500
Base port type    : fast-ethernet
Base port location : { shelf-1 { active-controller base-slot } port-1 }

State Information
-----
State             : up
Last state transition : 09:13:26, Thursday, November 05, 2020 IST
Work flags        : - - - - -

Ethernet information
-----
VLAN tagging      : disabled

IP information
-----
Router           : data

IPv6 information
-----
Address          : 2001::1
Netmask          : ffff:ffff:ffff:ffff::
Link local Address : fe80::2826:ff:fe00:1c8
Link local Netmask : ffff:ffff:ffff:ffff::
Scope Zone       : 33488906
Preference       : 1
Metric           : 1

-----
Maximum Bandwidth      : 10000 kbps
Maximum Reservable Bandwidth : 10000 kbps
Update threshold percentage : 10

operational> show fast-ethernet details { shelf-1 { active-controller base-slot } port-1 }

> Port : { shelf-1 { active-controller base-slot } port-1 }

Port details
-----
Name                :
MAC address         : 2a:26:00:00:01:c8
POST               : passed
Media              : copper
Loop back mode     : no-loopback
State              : up
Duplex mode        : half-duplex
Speed              : ten-mbps
Work flags         : - - - - -

operational>
```

Router 2 if port 2 -:

```
operational> show interface details if-port-2

> Interface : if-port-2

General Information
-----
ID                : 11
Encapsulation     : ethernet
MTU               : 1500
Base port type    : fast-ethernet
Base port location : { shelf-1 { active-controller base-slot } port-2 }

State Information
-----
State              : up
Last state transition : 10:48:23, Thursday, November 05, 2020 IST
Work flags         : -- -- -- -- --

Ethernet information
-----
VLAN tagging       : disabled

IP information
-----
Router             : data

IPv4 information
-----
Address            : 0.0.0.0
Netmask            : 0.0.0.0
Preference         : 1
Metric             : 1

IPv6 information
-----
Address            : 2002::2
Netmask            : ffff:ffff:ffff:ffff::
Link local Address : fe80::2826:ff:fe00:1d2
Link local Netmask : ffff:ffff:ffff:ffff::
Scope Zone         : 33488907
Preference         : 1
Metric             : 1

TE information
-----
Maximum Bandwidth      : 10000 kbps
Maximum Reservable Bandwidth : 10000 kbps
Update threshold percentage : 10

operational>
```

Check for connectivity between router 1 and router 2 -:

```
operational> ping data:fe80::2826:ff:fe00:1d2%if-port-2
PING fe80:0:1ff:b:2826:ff:fe00:1c9 -> fe80::2826:ff:fe00:1d2%33488907
16 bytes from fe80::2826:ff:fe00:1d2%33488907: icmp_seq=0 hoplimit=64 time=0.400 ms
16 bytes from fe80::2826:ff:fe00:1d2%33488907: icmp_seq=1 hoplimit=64 time=0.361 ms
16 bytes from fe80::2826:ff:fe00:1d2%33488907: icmp_seq=2 hoplimit=64 time=0.466 ms
16 bytes from fe80::2826:ff:fe00:1d2%33488907: icmp_seq=3 hoplimit=64 time=0.518 ms
16 bytes from fe80::2826:ff:fe00:1d2%33488907: icmp_seq=4 hoplimit=64 time=0.394 ms
16 bytes from fe80::2826:ff:fe00:1d2%33488907: icmp_seq=5 hoplimit=64 time=0.547 ms
^C
---- PING Statistics----
6 packets transmitted, 6 packets received, 0.0% packet loss
round-trip min/avg/max/std-dev = 0.000/0.448/0.547/0.068 ms
operational>
```

```
operational>
operational> ping data:fe80::2826:ff:fe00:1d1%if-port-2
PING fe80:0:1ff:b:2826:ff:fe00:1c9 -> fe80::2826:ff:fe00:1d1%33488907
^C
---- PING Statistics----
1 packets transmitted, 0 packets received, 100.0% packet loss
operational>
operational> ping data:fe80::2826:ff:fe00:1d1%if-port-1
PING fe80:0:1ff:a:2826:ff:fe00:1c8 -> fe80::2826:ff:fe00:1d1%33488906
^C
---- PING Statistics----
2 packets transmitted, 0 packets received, 100.0% packet loss
operational>
```

Verifying traffic flow between Alice and Bob -:

```
test@Lubuntu-vm: ~  
File Edit Tabs Help  
test@Lubuntu-vm:~$ clear  
test@Lubuntu-vm:~$ ping6 2003::02  
PING 2003::02(2003::2) 56 data bytes  
64 bytes from 2003::2: icmp_seq=1 ttl=62 time=2.60 ms  
64 bytes from 2003::2: icmp_seq=2 ttl=62 time=1.11 ms  
64 bytes from 2003::2: icmp_seq=3 ttl=62 time=0.766 ms  
64 bytes from 2003::2: icmp_seq=4 ttl=62 time=1.06 ms  
64 bytes from 2003::2: icmp_seq=5 ttl=62 time=0.954 ms  
64 bytes from 2003::2: icmp_seq=6 ttl=62 time=1.20 ms  
^C  
--- 2003::02 ping statistics ---  
6 packets transmitted, 6 received, 0% packet loss, time 5006ms  
rtt min/avg/max/mdev = 0.766/1.284/2.605/0.606 ms  
test@Lubuntu-vm:~$  
test@Lubuntu-vm:~$ tracepath -n 2003::02  
gethostbyname2: Unknown host  
test@Lubuntu-vm:~$ tracepath6 -n 2003::02  
1?: [LOCALHOST] 0.058ms pmtu 1500  
1: 2001::1 0.458ms  
1: 2001::1 0.137ms  
2: 2002::2 0.638ms  
3: 2003::2 0.801ms reached  
Resume: pmtu 1500 hops 3 back 3  
test@Lubuntu-vm:~$
```

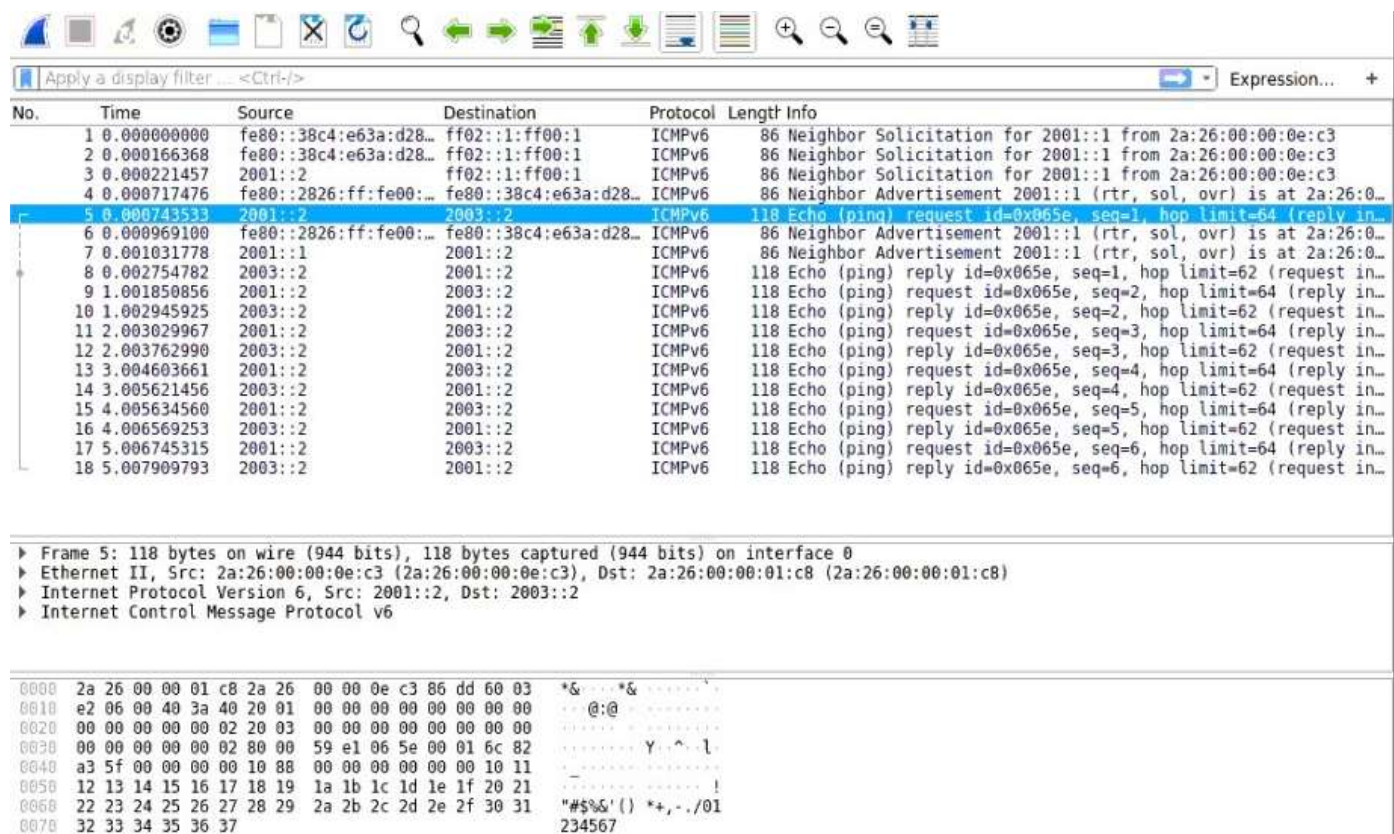
NDP table of Router 1-:

```
operational> show ipv6 neighbour summary data  
  
Host address          MAC address           Interface  
-----  
2001::2               2a:26:00:00:0e:c3    if-port-1  
2002::2               2a:26:00:00:01:d2    if-port-2  
fe80::2826:ff:fe00:1d2 2a:26:00:00:01:d2    if-port-2  
fe80::38c4:e63a:d28c:f465 2a:26:00:00:0e:c3    if-port-1  
  
Total number of NDP entries displayed : 4
```

NDP table of Router 2 -:

```
operational> show ipv6 neighbour summary data  
  
Host address          MAC address           Interface  
-----  
2002::1               2a:26:00:00:01:c9    if-port-2  
2003::2               2a:26:00:00:0e:c6    if-port-1  
fe80::2826:ff:fe00:1c9 2a:26:00:00:01:c9    if-port-2  
fe80::7567:e6fa:fdc0:b9a8 2a:26:00:00:0e:c6    if-port-1  
  
Total number of NDP entries displayed : 4  
operational>
```

Wireshark Capture -:



The image displays a Wireshark network traffic capture. The top toolbar shows various icons for file operations, packet list, packet details, packet bytes, and zooming. Below the toolbar is a filter bar with the text "Apply a display filter ... <Ctrl-/>". The main pane is divided into three sections: Packet List, Packet Details, and Packet Bytes.

Packet List: This section shows a list of captured packets. The selected packet is packet 5, which is an ICMPv6 Echo (ping) request. The columns are No., Time, Source, Destination, Protocol, Length, and Info.

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	fe80::38c4:e63a:d28...	ff02::1:ff00:1	ICMPv6	86	Neighbor Solicitation for 2001::1 from 2a:26:00:00:0e:c3
2	0.000166368	fe80::38c4:e63a:d28...	ff02::1:ff00:1	ICMPv6	86	Neighbor Solicitation for 2001::1 from 2a:26:00:00:0e:c3
3	0.000221457	2001::2	ff02::1:ff00:1	ICMPv6	86	Neighbor Solicitation for 2001::1 from 2a:26:00:00:0e:c3
4	0.000717476	fe80::2826:ff:fe00:...	fe80::38c4:e63a:d28...	ICMPv6	86	Neighbor Advertisement 2001::1 (rtr, sol, ovr) is at 2a:26:0...
5	0.000743533	2001::2	2003::2	ICMPv6	118	Echo (ping) request id=0x065e, seq=1, hop limit=64 (reply in...
6	0.000969100	fe80::2826:ff:fe00:...	fe80::38c4:e63a:d28...	ICMPv6	86	Neighbor Advertisement 2001::1 (rtr, sol, ovr) is at 2a:26:0...
7	0.001031778	2001::1	2001::2	ICMPv6	86	Neighbor Advertisement 2001::1 (rtr, sol, ovr) is at 2a:26:0...
8	0.002754782	2003::2	2001::2	ICMPv6	118	Echo (ping) reply id=0x065e, seq=1, hop limit=62 (request in...
9	1.001850856	2001::2	2003::2	ICMPv6	118	Echo (ping) request id=0x065e, seq=2, hop limit=64 (reply in...
10	1.002945925	2003::2	2001::2	ICMPv6	118	Echo (ping) reply id=0x065e, seq=2, hop limit=62 (request in...
11	2.003029967	2001::2	2003::2	ICMPv6	118	Echo (ping) request id=0x065e, seq=3, hop limit=64 (reply in...
12	2.003762990	2003::2	2001::2	ICMPv6	118	Echo (ping) reply id=0x065e, seq=3, hop limit=62 (request in...
13	3.004603661	2001::2	2003::2	ICMPv6	118	Echo (ping) request id=0x065e, seq=4, hop limit=64 (reply in...
14	3.005621456	2003::2	2001::2	ICMPv6	118	Echo (ping) reply id=0x065e, seq=4, hop limit=62 (request in...
15	4.005634560	2001::2	2003::2	ICMPv6	118	Echo (ping) request id=0x065e, seq=5, hop limit=64 (reply in...
16	4.006569253	2003::2	2001::2	ICMPv6	118	Echo (ping) reply id=0x065e, seq=5, hop limit=62 (request in...
17	5.006745315	2001::2	2003::2	ICMPv6	118	Echo (ping) request id=0x065e, seq=6, hop limit=64 (reply in...
18	5.007909793	2003::2	2001::2	ICMPv6	118	Echo (ping) reply id=0x065e, seq=6, hop limit=62 (request in...

Packet Details: This section shows the details of the selected packet (Frame 5). It indicates that the frame is 118 bytes on wire (944 bits), 118 bytes captured (944 bits) on interface 0. The details are as follows:

- Ethernet II, Src: 2a:26:00:00:0e:c3 (2a:26:00:00:0e:c3), Dst: 2a:26:00:00:01:c8 (2a:26:00:00:01:c8)
- Internet Protocol Version 6, Src: 2001::2, Dst: 2003::2
- Internet Control Message Protocol v6

Packet Bytes: This section shows the raw bytes of the packet in hexadecimal and ASCII. The first 118 bytes are shown, corresponding to the ICMPv6 Echo request.

```

0000  2a 26 00 00 01 c8 2a 26 00 00 0e c3 86 dd 60 03  *&...*& .....
0010  e2 06 00 40 3a 40 20 01 00 00 00 00 00 00 00  @: @ .....
0020  00 00 00 00 00 02 20 03 00 00 00 00 00 00 00  .....
0030  00 00 00 00 00 02 80 00 59 e1 06 5e 00 01 6c 82  .....Y...{
0040  a3 5f 00 00 00 00 10 88 00 00 00 00 00 00 10 11  .....
0050  12 13 14 15 16 17 18 19 1a 1b 1c 1d 1e 1f 20 21  .....!
0060  22 23 24 25 26 27 28 29 2a 2b 2c 2d 2e 2f 30 31  "##$%&'()*+,-./01
0070  32 33 34 35 36 37 234567
  
```