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PES2UG19CS075
COMPUTER NETWORKS LAB
Week 9

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 behaviour such as default and static routes and routing tables.
- Use common network utilities to verify LAN operation and analyse 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.

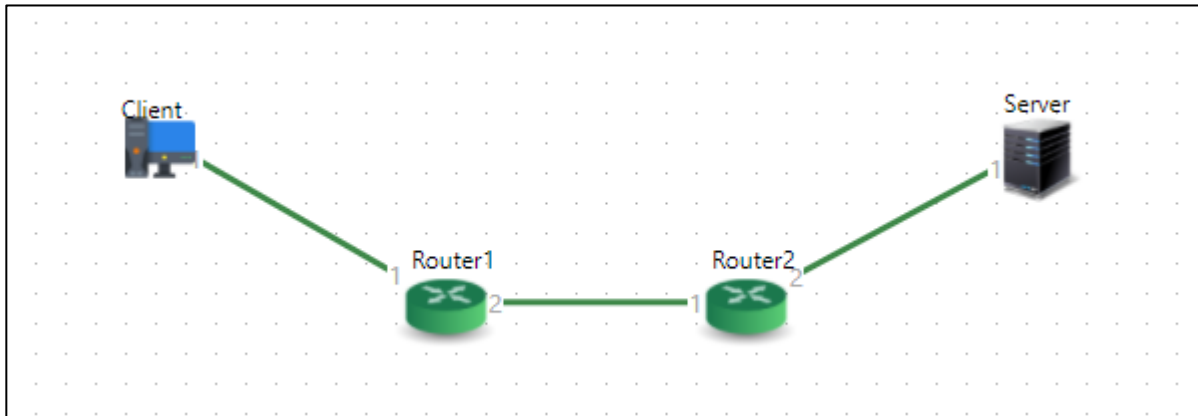


Important Instructions:

To access ClayNet, type **<http://1.6.180.226:9000/>** in browser. Login credentials will be provided by the faculty in charge.

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'.)

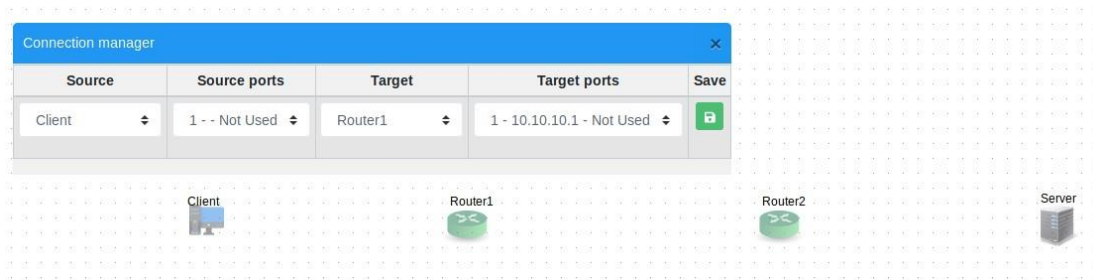
Router1

Name: Router1

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

Close Save config

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 6: 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: ~  
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=0.583 ms  
64 bytes from 10.10.10.1: icmp_seq=2 ttl=64 time=0.705 ms  
64 bytes from 10.10.10.1: icmp_seq=3 ttl=64 time=0.467 ms  
^C  
--- 10.10.10.1 ping statistics ---  
3 packets transmitted, 3 received, 0% packet loss, time 2054ms  
rtt min/avg/max/mdev = 0.467/0.585/0.705/0.097 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=0.032 ms  
64 bytes from 10.10.10.2: icmp_seq=2 ttl=64 time=0.025 ms  
64 bytes from 10.10.10.2: icmp_seq=3 ttl=64 time=0.025 ms  
64 bytes from 10.10.10.2: icmp_seq=4 ttl=64 time=0.040 ms  
^C  
--- 10.10.10.2 ping statistics ---  
4 packets transmitted, 4 received, 0% packet loss, time 3065ms  
rtt min/avg/max/mdev = 0.025/0.030/0.040/0.008 ms  
test@Lubuntu-vm:~$
```

Server:

IP Address ---> 30.30.30.2

Gateway ---> 30.30.30.1

```
test@Lubuntu-vm: ~  
File Edit Tabs Help  
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=0.099 ms  
64 bytes from 30.30.30.2: icmp_seq=2 ttl=64 time=0.032 ms  
64 bytes from 30.30.30.2: icmp_seq=3 ttl=64 time=0.035 ms  
^C  
--- 30.30.30.2 ping statistics ---  
3 packets transmitted, 3 received, 0% packet loss, time 2052ms  
rtt min/avg/max/mdev = 0.032/0.055/0.099/0.031 ms  
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=0.879 ms  
64 bytes from 30.30.30.1: icmp_seq=2 ttl=64 time=0.446 ms  
64 bytes from 30.30.30.1: icmp_seq=3 ttl=64 time=0.645 ms  
64 bytes from 30.30.30.1: icmp_seq=4 ttl=64 time=0.461 ms  
^C  
--- 30.30.30.1 ping statistics ---  
4 packets transmitted, 4 received, 0% packet loss, time 3061ms  
rtt min/avg/max/mdev = 0.446/0.607/0.879/0.177 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'.

```
test@Lubuntu-vm: ~  
File Edit Tabs Help  
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  
From 10.10.10.1 icmp_seq=4 Destination Host Unreachable  
^C  
--- 30.30.30.2 ping statistics ---  
4 packets transmitted, 0 received, +4 errors, 100% packet loss, time 3078ms  
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

```
nivappadmin@ClayNet:~$ telnet 127.0.0.1 54977
Trying 127.0.0.1...
Connected to 127.0.0.1.
Escape character is '^]'.
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
                   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> 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

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.

```
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

> 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         : -

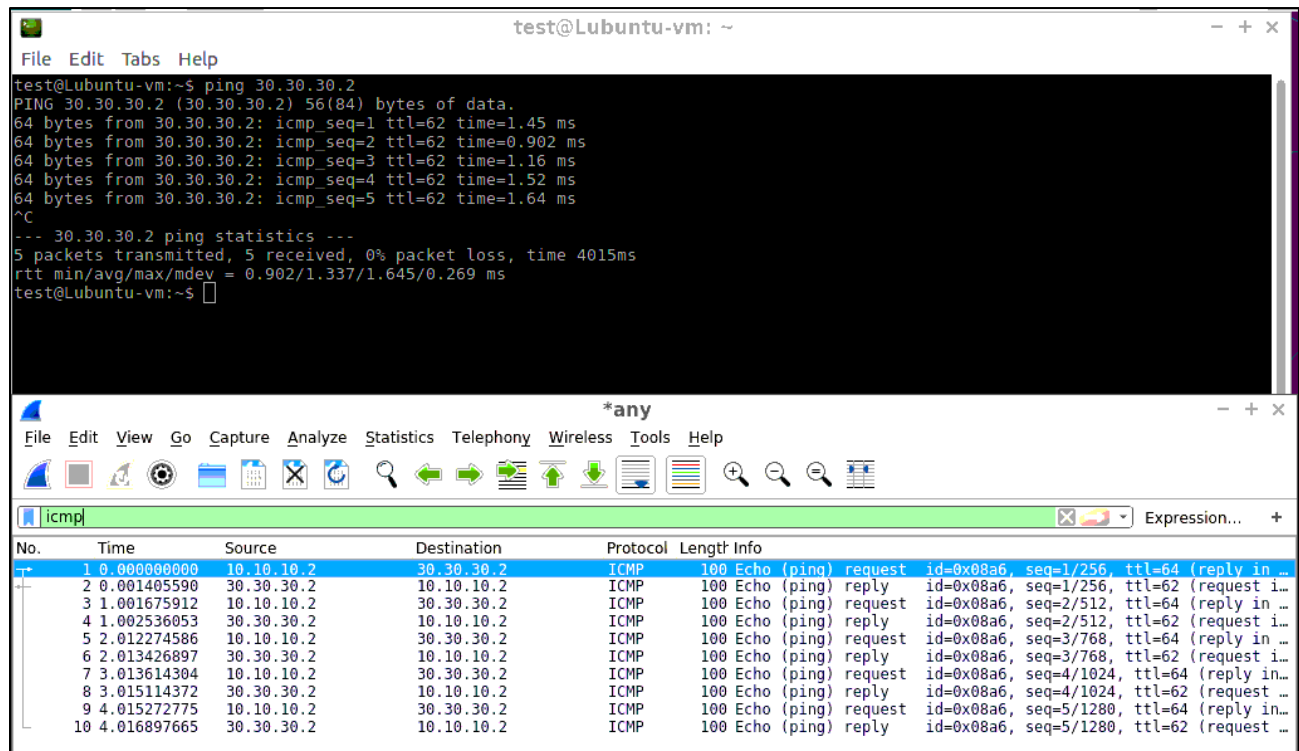
>> Destination : 127.0.0.0/8
   Gateway(s)   : { ^loopback-1
                    127.0.0.1 }
   Source        : direct
   Flags         : R

>> 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

operational> █
```


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.

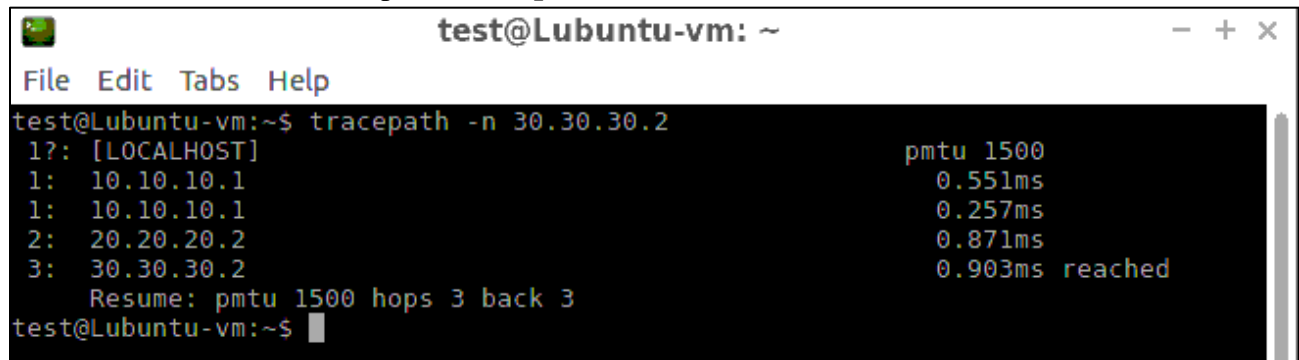


```
test@Lubuntu-vm: ~  
File Edit Tabs Help  
test@Lubuntu-vm:~$ ping 30.30.30.2  
PING 30.30.30.2 (30.30.30.2) 56(84) bytes of data:  
64 bytes from 30.30.30.2: icmp_seq=1 ttl=62 time=1.45 ms  
64 bytes from 30.30.30.2: icmp_seq=2 ttl=62 time=0.902 ms  
64 bytes from 30.30.30.2: icmp_seq=3 ttl=62 time=1.16 ms  
64 bytes from 30.30.30.2: icmp_seq=4 ttl=62 time=1.52 ms  
64 bytes from 30.30.30.2: icmp_seq=5 ttl=62 time=1.64 ms  
^C  
--- 30.30.30.2 ping statistics ---  
5 packets transmitted, 5 received, 0% packet loss, time 4015ms  
rtt min/avg/max/mdev = 0.902/1.337/1.645/0.269 ms  
test@Lubuntu-vm:~$
```

Wireshark interface showing captured ICMP packets:

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	10.10.10.2	30.30.30.2	ICMP	100	Echo (ping) request id=0x08a6, seq=1/256, ttl=64 (reply in ...)
2	0.001405590	30.30.30.2	10.10.10.2	ICMP	100	Echo (ping) reply id=0x08a6, seq=1/256, ttl=62 (request i...
3	1.001675912	10.10.10.2	30.30.30.2	ICMP	100	Echo (ping) request id=0x08a6, seq=2/512, ttl=64 (reply in ...)
4	1.002536053	30.30.30.2	10.10.10.2	ICMP	100	Echo (ping) reply id=0x08a6, seq=2/512, ttl=62 (request i...
5	2.012274586	10.10.10.2	30.30.30.2	ICMP	100	Echo (ping) request id=0x08a6, seq=3/768, ttl=64 (reply in ...)
6	2.013426897	30.30.30.2	10.10.10.2	ICMP	100	Echo (ping) reply id=0x08a6, seq=3/768, ttl=62 (request i...
7	3.013614304	10.10.10.2	30.30.30.2	ICMP	100	Echo (ping) request id=0x08a6, seq=4/1024, ttl=64 (reply in ...)
8	3.015114372	30.30.30.2	10.10.10.2	ICMP	100	Echo (ping) reply id=0x08a6, seq=4/1024, ttl=62 (request ...)
9	4.015272775	10.10.10.2	30.30.30.2	ICMP	100	Echo (ping) request id=0x08a6, seq=5/1280, ttl=64 (reply in ...)
10	4.016897665	30.30.30.2	10.10.10.2	ICMP	100	Echo (ping) reply id=0x08a6, seq=5/1280, ttl=62 (request ...)

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



```
test@Lubuntu-vm: ~  
File Edit Tabs Help  
test@Lubuntu-vm:~$ tracpath -n 30.30.30.2  
1?: [LOCALHOST] pmtu 1500  
1: 10.10.10.1 0.551ms  
1: 10.10.10.1 0.257ms  
2: 20.20.20.2 0.871ms  
3: 30.30.30.2 0.903ms reached  
Resume: pmtu 1500 hops 3 back 3  
test@Lubuntu-vm:~$
```

Observations:

How many hops will client take to reach the serve? - 3 hops

Observe the RTT - The RTT is 2.582 ms