Computer Networks Lab
Week 8

Vishal R

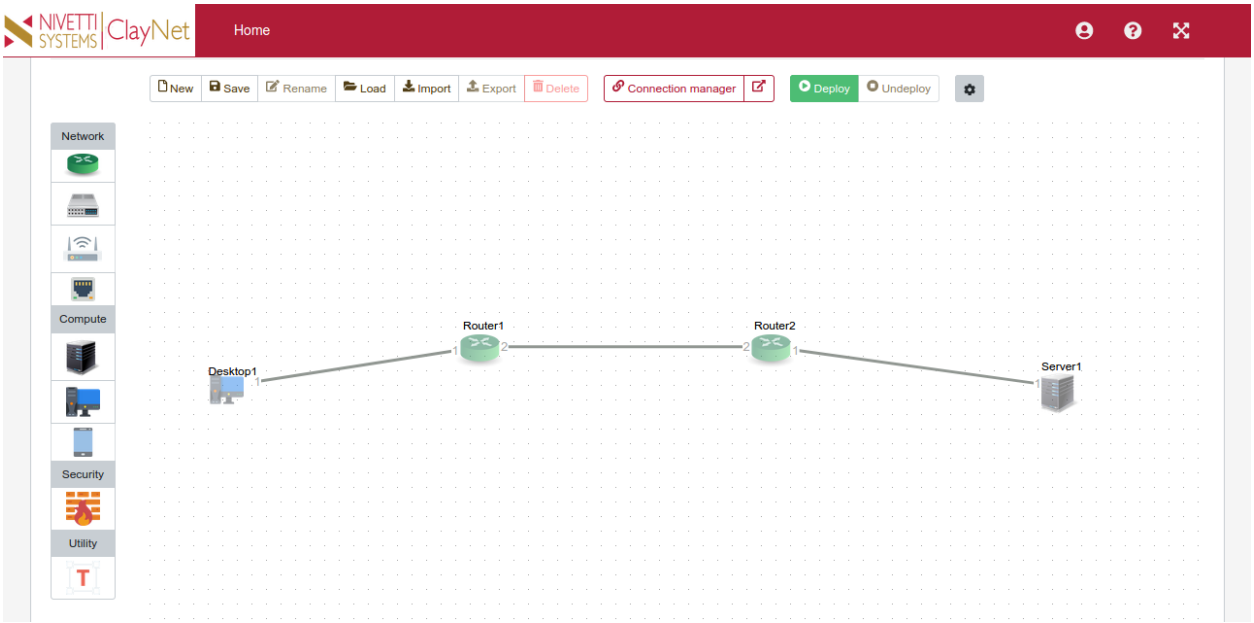
PES1UG19CS571

I Section

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

1. Creating Topology in ClayNet

The following topology was created in ClayNet



The topology consists of a client machine and server machine and two routers.

- Operating systems for both client and server machine is Ubuntu 16.04-Lite
- Both the machines were allocated 512MB size of memory respectively.
- The IP addresses and ports were setup for both the routers by selecting device configuration option.
- The intermediate connections were setup using the connection manager. Here, we have entered Source, Source Ports, Target and Target Ports in the connection manager window.

- The following configuration was setup for both the routers by going into device configurations on ClayNet.

Router	Interface Number (port)	IP Address
Router1	1	10.10.10.1/24
Router1	2	20.20.20.1/24
Router2	1	30.30.30.1/24
Router2	2	20.20.20.2/24

Finally, we will deploy the topology on the server by clicking the deploy button.

2. Setting IPv4 Addresses in Client and Server machines

- We can access the client and server machines by going to the remote desktop option.
- On both the machines, the IP address and Gateway are set as follows

End System	IP Address	Gateway
Desktop1	10.10.10.2/24	10.10.10.1
Server1	30.30.30.2/24	30.30.30.1

3. Pinging the Server from Client

- On the client machine, we will use the ping command to ping the server.
- However the command fails because the routing table entries haven't been configured yet for both Router1 and Router2.
- We obtain a `Destination Host Unreachable` status in terminal.

```
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
From 10.10.10.1 icmp_seq=5 Destination Host Unreachable
From 10.10.10.1 icmp_seq=6 Destination Host Unreachable
From 10.10.10.1 icmp_seq=7 Destination Host Unreachable
From 10.10.10.1 icmp_seq=8 Destination Host Unreachable
From 10.10.10.1 icmp_seq=9 Destination Host Unreachable
From 10.10.10.1 icmp_seq=10 Destination Host Unreachable
From 10.10.10.1 icmp_seq=11 Destination Host Unreachable
^C
--- 30.30.30.2 ping statistics ---
11 packets transmitted, 0 received, +11 errors, 100% packet loss, time 10220ms
```

4. Setting up Route Table Entries for both Router1 and Router2

- To configure the routing tables of both the routers, we need to login to both the routers first.
- We can login into the routers by clicking the `Console Access` option

```
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:
```

- To display the routing table for viewing the static routes, we need to type `show route summary -s active data` command in terminal.

```
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>
```

Route Table of Client Machine

- From the above figure, we can note that there is no route to reach the destination network `30.30.30.2/24`. To add the route into the routing table, we need to go to the configure mode and start configuring the router for all possible routes.

- A static route was added in router1 route table for destination `30.30.30.0/24` with next-hop gateway as `20.20.20.2`, which is the IP address of Router2. The following commands were executed to achieve the same.

```
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-n29" saved
configure> exit
operational>
```

Adding a static route in route table

- We will now check if the routing table has a new entry in it.

```
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       : -
```

- As you can see in the above figure, a route to the destination network has been added to the route table.
- Now, we need to repeat the same steps for router2. We will login to router2 using console access option and type `show route summary -s active data` command in terminal.

```
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
Line : 8-30, Press 'q' to quit.
```

Route table of Sever Machine

- For Router2, we need to add a static route for destination `10.10.10.0/24` with next-hop gateway as `20.20.20.1`, which is the IP address of Router1. To achieve this we will execute the following steps

```
configure> create parameter-group ip-route to-n30
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-n30" saved
configure>
```

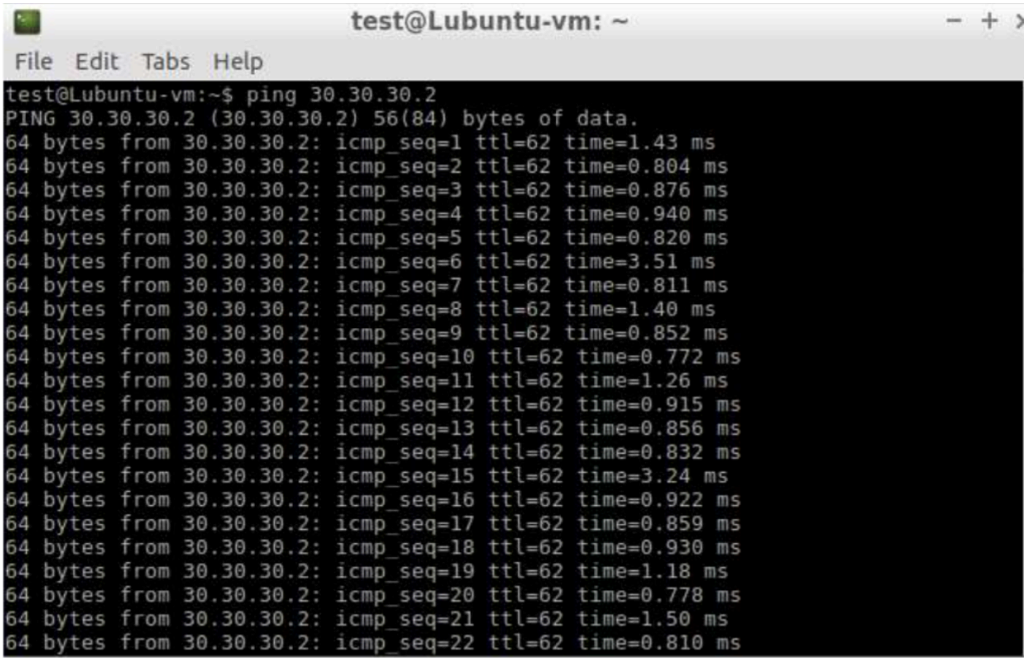
- Now, we will check if a static route has been added in the route table.

```
> 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

> 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 }
                   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
```

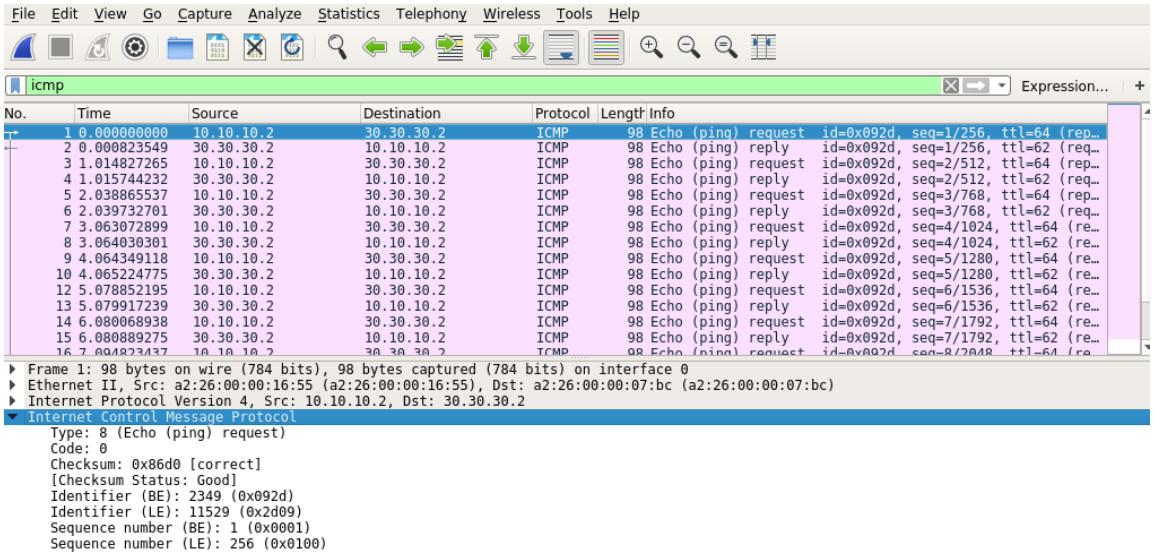
- In the above figure, we can see that a new static route has been added to route table and in theory, the server must be reachable from the client now.

5. Observations

- Since both Desktop1 and Server1 are reachable, we will verify it by pinging the server from the client. Note that this resulted in `Destination Host Unreachable` before as we had not setup the routers yet. Now we must be able to reach the server without getting errors.



- In the above figure, we can see that the ping was successful.
- Also, if we observed the TTL field, we can see that it has decreased to 62 from 64 as there are 2 hops between the systems.
- The following Wireshark Packet Capture shows the ICMP request packets being sent from Desktop1 to Server1.



- Finally, we will execute `tracepath -n 30.30.30.2` command on client and observe the output.

```
test@Lubuntu-vm:~$ tracepath -n 30.30.30.2
 1?: [LOCALHOST]                                         pmtu 1500
 1:  10.10.10.1                                            0.368ms
 1:  10.10.10.1                                            0.169ms
 2:  20.20.20.2                                            0.455ms
 3:  30.30.30.2                                            1.578ms reached
     Resume: pmtu 1500 hops 3 back 3
test@Lubuntu-vm:~$
```