

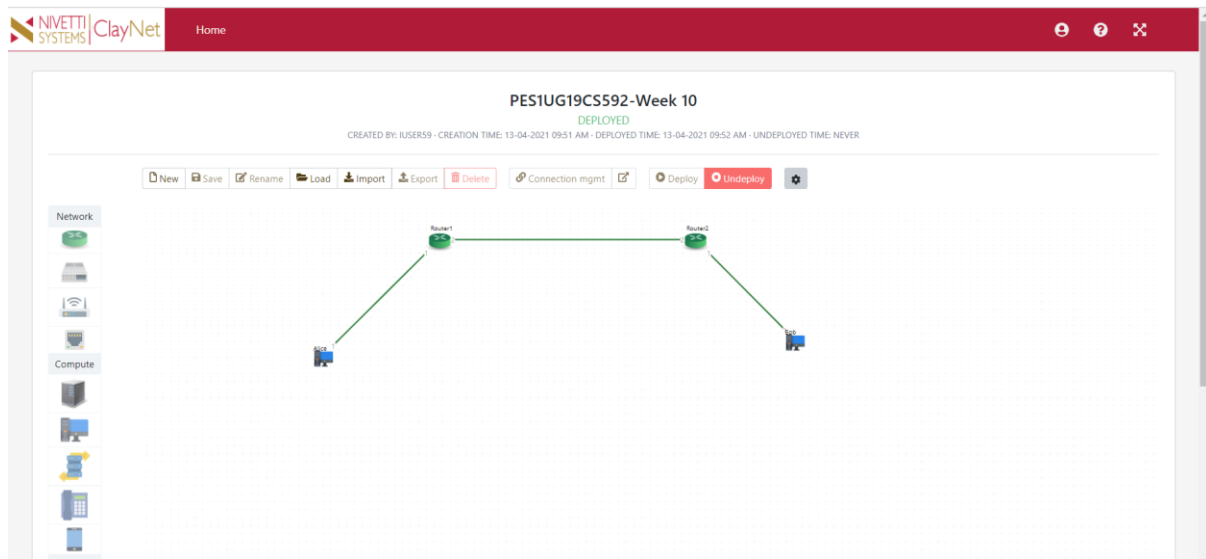
Computer Networks Lab – Week 10

PES1UG19CS592

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1. IPv6 Address and Topology Creation

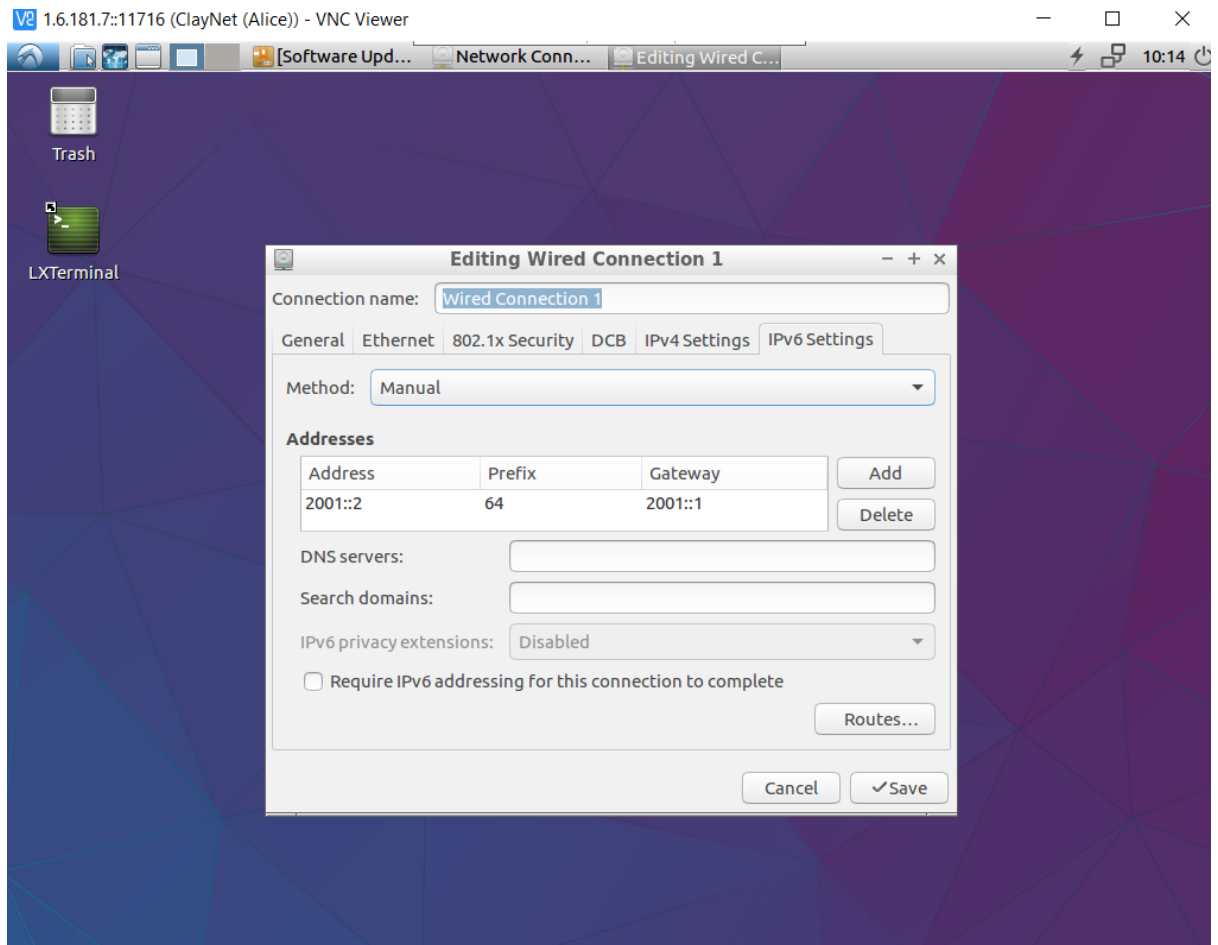
The following topology was created and deployed on Claynet
Alice and Bob are the two workstations for this experiment.



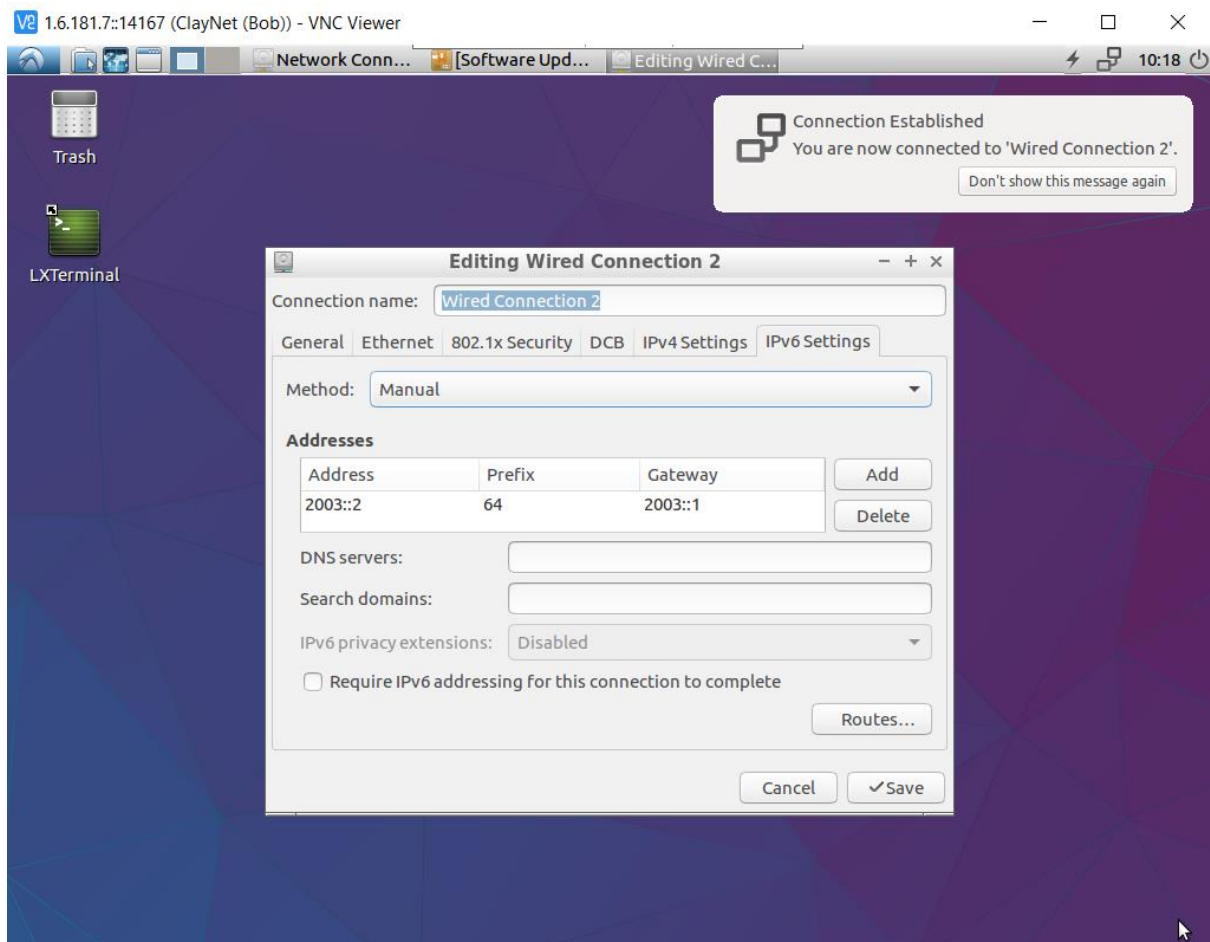
2. Configuring IP address for end systems

The end systems are configured as

End system name	IP address	Gateway
Alice	2001::02/64	2001::01
Bob	2003::02/64	2003::01



Alice



Bob

3. Router 1 Configuration

```

Inbox (3,2) x | 2020-2021 x | ClayNet™ x | clayroot@ x | Watch 'Cl... x | +
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Apps Courses CLG Daily

clayroot@ClayNet:~$ telnet 127.0.0.1 51333
Trying 127.0.0.1...
Connected to 127.0.0.1.
Escape character is '^]'.

Login: test
Password:
Login incorrect
Login: test
Password:

operational> configure
Entering configuration mode with exclusive access.
configure> modify parameter-group router data
Info: Parameter group instance loaded for modification.
configure> set ipv6 enable yes
configure> save
Info: Parameter group router "data" saved

```

Enabling IPv6 mode

```

operational> show router details data

> Router : data

General information
-----
Router ID           : 16387
State               : up
Interfaces          : 9
Routing gateways    : 4
Local addresses     : 2
Sockets             : 2
Flags               : -----
Last state transition : 10:21:23, Tuesday, April 13, 2021 IST

IPv4 information
-----
Default source address : 0.0.0.0
Default TTL            : 64
Interfaces             : 9

IPv4 routes
-----
Active routes          : 3
Line : 1-23, Press 'q' to quit.

```

```

operational> configure
Entering configuration mode with exclusive access.
configure> modify parameter-group interface if-port-1

Error: Unknown argument(s) specified

Usage: modify <sub-commands>

List of sub-commands available are:

parameter-group          Load an existing parameter group instance for
                           modification

configure> modify parameter-group interface if-port-1
Info: Parameter group instance loaded for modification.
configure> default ip ipv4
configure> enter ip ipv6
[ interface:"if-port-1" > ip > ipv6 ]
configure> show draft -e
[ interface:"if-port-1" > ip > ipv6 ]
enable no
address 0000:0000:0000:0000:0000:0000:0000:0000
netmask 0000:0000:0000:0000:0000:0000:0000:0000
peer-address 0000:0000:0000:0000:0000:0000:0000:0000
peer-netmask 0000:0000:0000:0000:0000:0000:0000:0000
link-local-address 0000:0000:0000:0000:0000:0000:0000:0000
link-local-netmask 0000:0000:0000:0000:0000:0000:0000:0000
preference 1
metric 1
ndp {
    cache-timeout 1200
    unsolicited-learning enable
}
vrrp {
    enable no
    virtual-router [+] {
    }
}
}

configure> set enable yes

```

Assigning IPv6 Address 2001::01/64 to the if-port-1 interface

```

configure> set enable yes
configure> set address 2001::01/64
configure> save
Info: Parameter group interface "if-port-1" saved
configure>

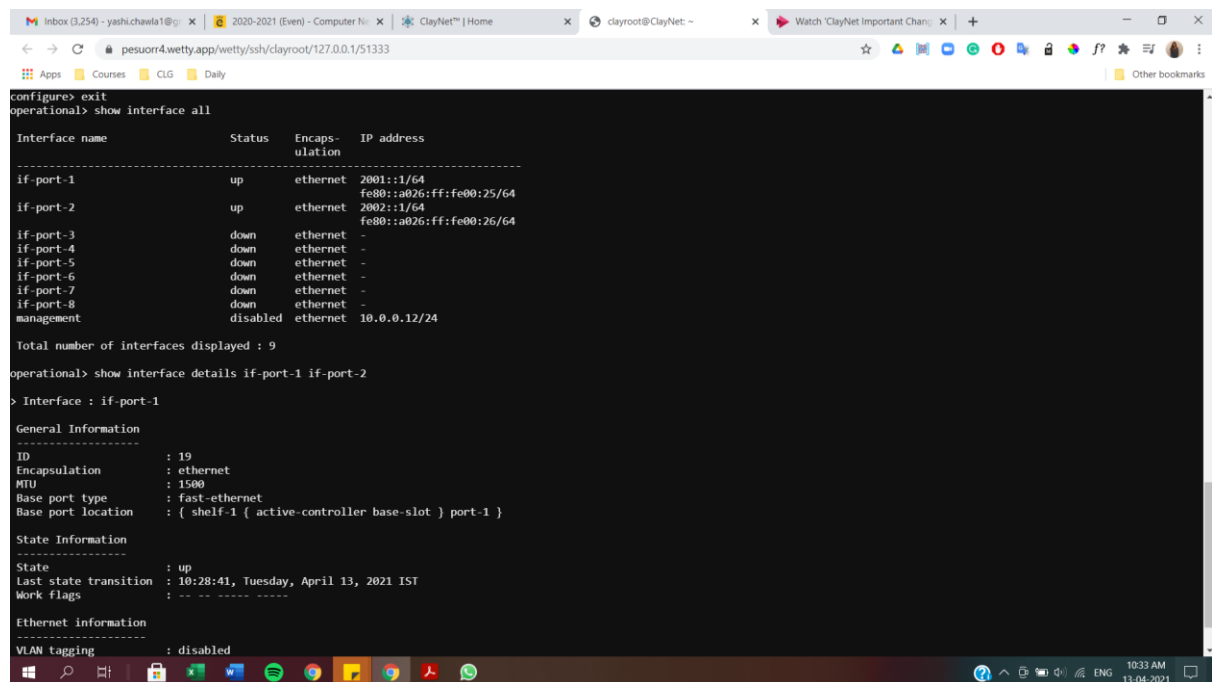
```

```

configure> modify parameter-group interface if-port-2
Info: Parameter group instance loaded for modification.
configure> default ip ipv4
configure> set ip ipv6 enable yes
configure> set ip ipv6 address 2002::01/64
configure> save
Info: Parameter group interface "if-port-2" saved

```

Assigning IPv6 address of 2002::01/64 for the if-port-2 interface



The screenshot shows a web browser window with multiple tabs. The active tab is titled 'pesuor4.wetty.app/wetty/ssh/clayroot/127.0.0.1/51333'. The terminal window displays the following output:

```

configure> exit
operational> show interface all

```

Interface name	Status	Encapsulation	IP address
if-port-1	up	ethernet	2001::1/64 fe80::a026:ff:fe00:25/64
if-port-2	up	ethernet	2002::1/64 fe80::a026:ff:fe00:26/64
if-port-3	down	ethernet	-
if-port-4	down	ethernet	-
if-port-5	down	ethernet	-
if-port-6	down	ethernet	-
if-port-7	down	ethernet	-
if-port-8	down	ethernet	-
management	disabled	ethernet	10.0.0.12/24

```

Total number of interfaces displayed : 9
operational> show interface details if-port-1 if-port-2
> Interface : if-port-1
General Information
-----
ID : 19
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 : 10:28:41, Tuesday, April 13, 2021 IST
Work flags : - - - - -
Ethernet information
-----
VLAN tagging : disabled

```

Full interface configuration

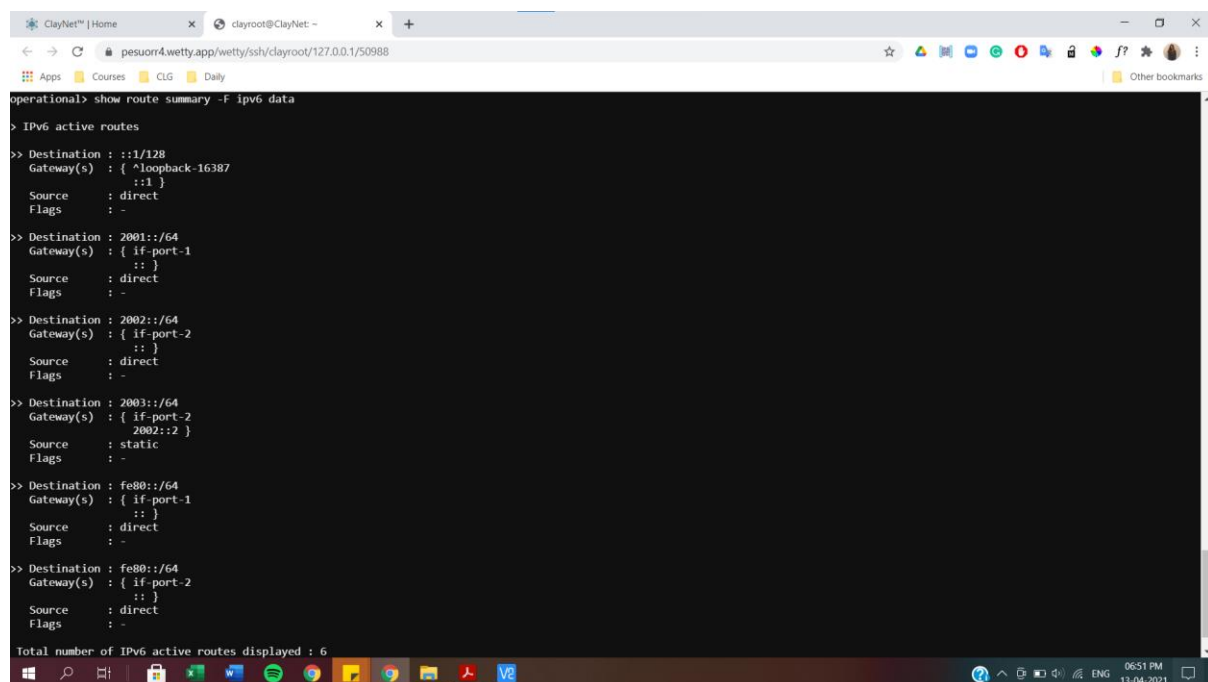
```

operational>
operational> configure
Entering configuration mode with exclusive access.
configure> create parameter-group ip-route v6-route-2003-nw
Info: Parameter group instance created.
configure> show draft -e
[ ip-route:"v6-route-2003-nw" ]
*name "v6-route-2003-nw"
  enable no
  router ""
  destination 0.0.0.0
  netmask 0.0.0.0
  next-hop {
    router ""
    gateway 0.0.0.0
    label-switched-path ""
  }
  preference 30
  metric 2

configure> set enable yes
configure> set router data
configure> set destination 2003::/64
configure> set next-hop gateway 2002::02
configure> save
Info: Parameter group ip-route "v6-route-2003-nw" saved
configure>

```

Configuring a static route to reach 2003::00/64 network(Bob) with gateway as 2002::02(Router 2)



The screenshot shows a web browser window with a terminal session. The terminal displays the command 'operational> show route summary -F ipv6 data' and its output, which lists IPv6 active routes. The routes include destinations like ::1/128, 2001::/64, 2002::/64, 2003::/64, and fe80::/64, along with their respective gateways and sources. The route for 2003::/64 is highlighted, showing a static configuration with gateway 2002::2. The total number of IPv6 active routes displayed is 6.

```

operational> show route summary -F ipv6 data
> IPv6 active routes
>> Destination : ::1/128
  Gateway(s) : { ^loopback-16387
    : ::1 }
  Source : direct
  Flags : -
>> Destination : 2001::/64
  Gateway(s) : { if-port-1
    : :: }
  Source : direct
  Flags : -
>> Destination : 2002::/64
  Gateway(s) : { if-port-2
    : :: }
  Source : direct
  Flags : -
>> Destination : 2003::/64
  Gateway(s) : { if-port-2
    : 2002::2 }
  Source : static
  Flags : -
>> Destination : fe80::/64
  Gateway(s) : { if-port-1
    : :: }
  Source : direct
  Flags : -
>> Destination : fe80::/64
  Gateway(s) : { if-port-2
    : :: }
  Source : direct
  Flags : -
Total number of IPv6 active routes displayed : 6

```

Routing table entries as seen above

4. Router 2 configuration

```
clayroot@ClayNet:~$ telnet 127.0.0.1 53794
Trying 127.0.0.1...
Connected to 127.0.0.1.
Escape character is '^['.

login: test
Password:

operational> configure
Entering configuration mode with exclusive access.
configure> modify parameter-group router
Error: Parameter group instance index not specified
configure> modify parameter-group router data
Info: Parameter group instance loaded for modification.
configure> set ipv6 enable yes
configure> save
Info: Parameter group router "data" saved
configure> modify parameter-group interface if-port-1
Info: Parameter group instance loaded for modification.
configure> default ip ipv4
configure> set ip ipv6 enable yes
configure> set ip ipv6 address 2003::01/64
configure> save
Info: Parameter group interface "if-port-1" saved
configure> exit
operational> configure
Entering configuration mode with exclusive access.
configure> modify parameter-group interface if-port-2
Info: Parameter group instance loaded for modification.
configure> default ip ipv4
configure> set ip ipv6 enable yes
configure> set ip ipv6 address 2002::02/64
configure> save
Info: Parameter group interface "if-port-2" saved
configure> exit
```

Assigning IPv6 address 2003::01/64 to interface if-port-1 and 2002::02/64 to interface if-port-2

```
Info: Parameter group interface "if-port-2" saved
configure> exit
operational> show interface all

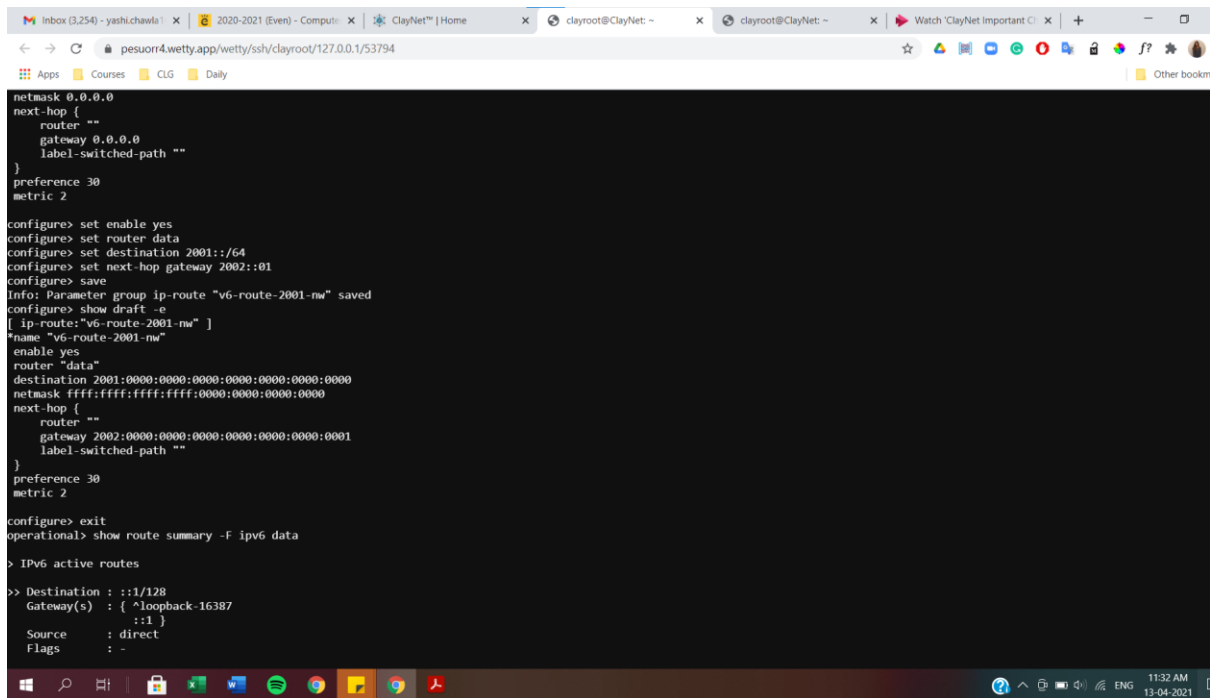
Interface name      Status      Encaps-  IP address
                   ulation
-----
if-port-1           up          ethernet 2003::1/64
                   fe80:a036:ff:fe00:2e/64
if-port-2           up          ethernet 2002::2/64
                   fe80:a026:ff:fe00:2f/64
if-port-3           down        ethernet -
if-port-4           down        ethernet -
if-port-5           down        ethernet -
if-port-6           down        ethernet -
if-port-7           down        ethernet -
if-port-8           down        ethernet -
management          disabled    ethernet 10.0.0.12/24

Total number of interfaces displayed : 9

operational> configure
Entering configuration mode with exclusive access.
configure> create parameter-group ip-route v6-route-2001-nw
Info: Parameter group instance created.
configure> show draft -e
[ ip-route:"v6-route-2001-nw" ]
*name "v6-route-2001-nw"
enable no
router ""
destination 0.0.0.0
netmask 0.0.0.0
next-hop {
  router ""
  gateway 0.0.0.0
  label-switched-path ""
}
preference 30
metric 2

configure> set enable yes
```

Static route to reach 2001::00/64 network(Alice) with gateway as 2002::01(Router-1)



```
netmask 0.0.0.0
next-hop {
  router ""
  gateway 0.0.0.0
  label-switched-path ""
}
preference 30
metric 2

configure> set enable yes
configure> set router data
configure> set destination 2001::/64
configure> set next-hop gateway 2002::01
configure> save
Info: Parameter group ip-route "v6-route-2001-nw" saved
configure> show draft -e
[ ip-route:"v6-route-2001-nw" ]
"name "v6-route-2001-nw"
enable yes
router "data"
destination 2001:0000:0000:0000:0000:0000:0000:0000
netmask ffff:ffff:ffff:ffff:0000:0000:0000:0000
next-hop {
  router ""
  gateway 2002:0000:0000:0000:0000:0000:0000:0001
  label-switched-path ""
}
preference 30
metric 2

configure> exit
operational> show route summary -F ipv6 data

> IPv6 active routes

>> Destination : ::1/128
Gateway(s) : { ^loopback-16387
Source      : ::1
Flags      : -

>> Destination : 2001::/64
Gateway(s) : { if-port-2
Source      : 2002::1
Flags      : -

>> Destination : 2002::/64
Gateway(s) : { if-port-2
Source      : ::
Flags      : -

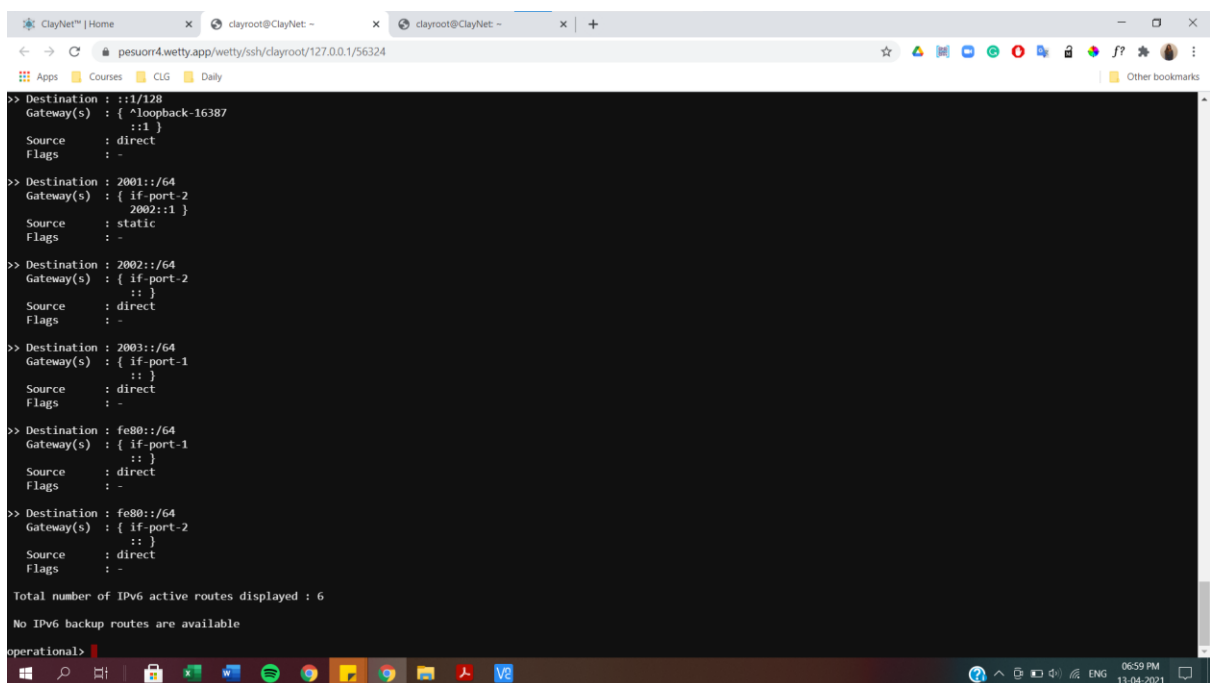
>> Destination : 2003::/64
Gateway(s) : { if-port-1
Source      : ::
Flags      : -

>> Destination : fe80::/64
Gateway(s) : { if-port-1
Source      : ::
Flags      : -

>> Destination : fe80::/64
Gateway(s) : { if-port-2
Source      : ::
Flags      : -

Total number of IPv6 active routes displayed : 6
No IPv6 backup routes are available

operational>
```



```
>> Destination : ::1/128
Gateway(s) : { ^loopback-16387
Source      : ::1
Flags      : -

>> Destination : 2001::/64
Gateway(s) : { if-port-2
Source      : 2002::1
Flags      : -

>> Destination : 2002::/64
Gateway(s) : { if-port-2
Source      : ::
Flags      : -

>> Destination : 2003::/64
Gateway(s) : { if-port-1
Source      : ::
Flags      : -

>> Destination : fe80::/64
Gateway(s) : { if-port-1
Source      : ::
Flags      : -

>> Destination : fe80::/64
Gateway(s) : { if-port-2
Source      : ::
Flags      : -

Total number of IPv6 active routes displayed : 6
No IPv6 backup routes are available

operational>
```

Final routing table

5. Ping Command and Tracpath

Successful ping requests can be sent from Alice to Bob workstations as shown below.


```
test@Lubuntu-vm: ~  
File Edit Tabs Help  
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=1.77 ms  
64 bytes from 2003::2: icmp_seq=2 ttl=62 time=1.06 ms  
64 bytes from 2003::2: icmp_seq=3 ttl=62 time=1.01 ms  
64 bytes from 2003::2: icmp_seq=4 ttl=62 time=1.15 ms  
64 bytes from 2003::2: icmp_seq=5 ttl=62 time=0.884 ms  
64 bytes from 2003::2: icmp_seq=6 ttl=62 time=0.880 ms  
64 bytes from 2003::2: icmp_seq=7 ttl=62 time=0.789 ms  
64 bytes from 2003::2: icmp_seq=8 ttl=62 time=1.05 ms  
64 bytes from 2003::2: icmp_seq=9 ttl=62 time=1.00 ms  
64 bytes from 2003::2: icmp_seq=10 ttl=62 time=0.817 ms  
64 bytes from 2003::2: icmp_seq=11 ttl=62 time=1.02 ms  
^C  
--- 2003::02 ping statistics ---  
11 packets transmitted, 11 received, 0% packet loss, time 10063ms  
rtt min/avg/max/mdev = 0.789/1.042/1.772/0.254 ms  
test@Lubuntu-vm:~$
```

Similarly for tracepath

```
test@Lubuntu-vm: ~  
File Edit Tabs Help  
test@Lubuntu-vm:~$ tracepath6 -n 2003::02  
17: [LOCALHOST] 0.051ms pmtu 1500  
1: 2001::1 0.382ms  
1: 2001::1 0.202ms  
2: 2002::2 0.581ms  
3: 2003::2 0.699ms reached  
Resume: pmtu 1500 hops 3 back 3  
test@Lubuntu-vm:~$
```

6. NDP table on Router -1

```
operational> show ipv6 neighbour summary data
```

Host address	MAC address	Interface
2001::2	a2:26:00:00:15:bb	if-port-1
2002::2	a2:26:00:00:01:f7	if-port-2
fe80::1139:1385:3acc:cb2a	a2:26:00:00:15:bb	if-port-1
fe80::a026:ff:fe00:1f7	a2:26:00:00:01:f7	if-port-2

Total number of NDP entries displayed : 4

7. Verifying auto configured link local address on IPv6 interfaces

The screenshot shows a web browser window with three tabs. The active tab is titled 'pesuor4.wetty.app/wetty/ssh/clayroot/127.0.0.1/50988'. The browser's address bar and tabs are visible at the top. The main content area displays a terminal window with a dark background and white text. The terminal shows the output of the command 'show fast-ethernet details { shelf-1 { active-controller base-slot } port-1 }'. The output is organized into sections: Ethernet information, IP information, IPv6 information, TE information, and Port details. The Port details section shows the MAC address as 'a2:26:00:00:01:ed'. Below this, the terminal shows the command 'show interface details if-port-1'. The output for this command is also organized into sections: General Information, State Information, Ethernet information, IP information, IPv6 information, and TE information. The General Information section shows the interface ID as '19' and the base port location as '{ shelf-1 { active-controller base-slot } port-1 }'. The State Information section shows the state as 'up' and the last state transition as '18:37:48, Tuesday, April 13, 2021 IST'. The Ethernet information section shows VLAN tagging as 'disabled'. The IP information section shows the router as 'data'. The IPv6 information section shows the address as '2001::1' and the netmask as 'ffff:ffff:ffff:ffff::'. The TE information section shows the maximum bandwidth as '10000 kbps' and the maximum reservable bandwidth as '10000 kbps'. The terminal window is overlaid on a Windows desktop environment, with the taskbar and system tray visible at the bottom.

```
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   : a2:26:00:00:01:ed
POST          : passed
Media         : copper
Loop back mode : no-loopback
State         : up
Duplex mode    : half-duplex
Speed         : ten-mbps
Work flags    : ----

operational> show interface details if-port-1
> Interface : if-port-1

General Information
-----
ID              : 19
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 : 18:37:48, Tuesday, April 13, 2021 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::a026:ff:fe00:1ed
Link local Netmask : ffff:ffff:ffff:ffff::
Scope Zone     : 33488915
Preference     : 1
Metric         : 1

TE information
-----
Maximum Bandwidth      : 10000 kbps
Maximum Reservable Bandwidth : 10000 kbps
```

8. Checking connectivity between Router-1 and Router-2 using link local address

```
operational> ping data:fe80::a026:ff:fe00:1f7%if-port-2
PING fe80:0:1ff:15:a026:ff:fe00:1ee --> fe80::a026:ff:fe00:1f7%33488917
16 bytes from fe80::a026:ff:fe00:1f7%33488917: icmp_seq=0 hoplimit=64 time=0.531 ms
16 bytes from fe80::a026:ff:fe00:1f7%33488917: icmp_seq=1 hoplimit=64 time=0.330 ms
16 bytes from fe80::a026:ff:fe00:1f7%33488917: icmp_seq=2 hoplimit=64 time=0.353 ms
16 bytes from fe80::a026:ff:fe00:1f7%33488917: icmp_seq=3 hoplimit=64 time=0.330 ms
16 bytes from fe80::a026:ff:fe00:1f7%33488917: icmp_seq=4 hoplimit=64 time=0.456 ms
^C
---- PING Statistics----
5 packets transmitted, 5 packets received, 0.0% packet loss
round-trip min/avg/max/std-dev = 0.000/0.400/0.531/0.080 ms
operational> ping -c 5 data:fe80::a026:ff:fe00:1f7
```

Error: No source address found for this destination

```
operational> ping data:fe80::a026:ff:fe00:1f7%if-port-1
PING fe80:0:1ff:13:a026:ff:fe00:1ed --> fe80::a026:ff:fe00:1f7%33488915
^C
---- PING Statistics----
6 packets transmitted, 0 packets received, 100.0% packet loss
operational> ■
```