**PES1UG20CS821**

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WEEK 10: IPv6 Configuration and Static Routing.

<u>Objectives:</u>

- Perform basic IPv6 configurations on a Desktop and Router.
- Distinguish between IPv4 and IPv6 addresses
- Configure IPv6 static routes in Router
- Observe traffic flow using IPv6 static routes.
- IPv6 neighbor cache entries
- Understanding IPv6 Link Local Address
- Working with ping6 and tracepath

<u>LAB Network Topology:</u>
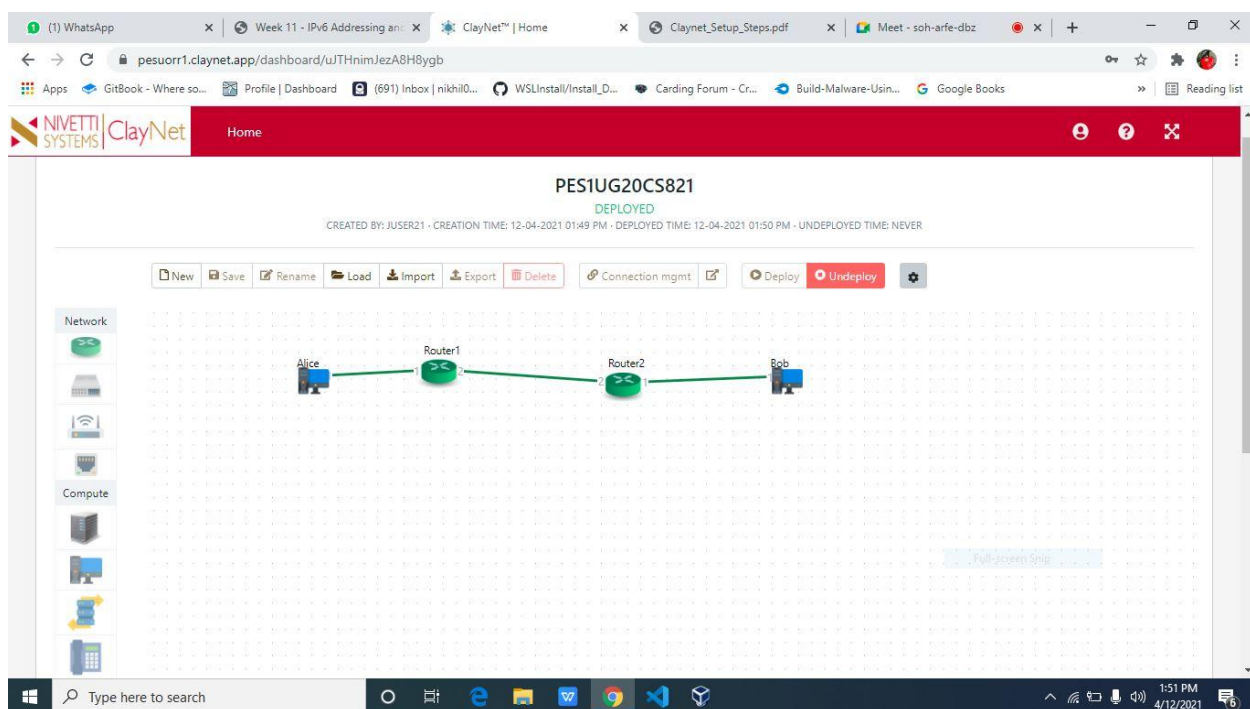
<u>Steps :</u>

1. Create and deploy the given topology.

2. Configure the PC/Workstation IP address as mentioned in topology.

- **Alice**
  IPv6 address – 2001::02/64
  Gateway – 2001::01

- **Bob**
  IPv6 address – 2003::02/64
  Gateway – 2003::01

3.Enable ipv6 in router 1

```
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
configure> exit
```

- Show router details

```
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  : 14:03:44, Monday, April 12, 2021 IST

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

IPv4 routes
-----------
Active routes          :            3
operational>
```

4. Configure IPV6 interfaces in router1

- Configuring IPv6 address 2001::01/64 as if-port-1 and 2002::01/64 as if-port-2

```
configure> set enable yes
configure> set address 2001::01/64
configure> save
Info: Parameter group interface "if-port-1" saved
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 enable yes
configure> set ip ipv6 address 2002::01/64
configure> save
Info: Parameter group interface "if-port-2" saved
configure> exit
```

- Verify interface configurations

```
operational> show interface all

Interface name                Status     Encaps-    IP address
                                         ulation
-------------------------------------------------------------------------
if-port-1                     up         ethernet   2001::1/64
                                                    fe80::a026:ff:fe00:37/64
if-port-2                     up         ethernet   2002::1/64
                                                    fe80::a026:ff:fe00:38/64
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>
```

- Check IPv6 information in "show interface details" command output

```
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 : 14:12:17, Monday, April 12, 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:fe00:37
Link local Netmask    : ffff:ffff:ffff:ffff::
Scope Zone            : 33488915
```

5.Configure IPV6 static routers in router1
- Configure static route to reach 2003::0/64 with gateway as 2002::02

```
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 address 2001::01/64
configure> save
Info: Parameter group interface "if-port-1" saved
configure> modify parameter-group interface if-port-2
Info: Parameter group instance loaded for modification.
configure> default ip ipv4
configure> set ipv6 enable yes
Error: 'ipv6' is not a valid parameter name
configure> set ip ipv6 enable yes
configure> set ip ipv6 address 2002::01/64
configure> save
Info: Parameter group interface "if-port-2" saved
configure> exit
```

```
operational> modify parameter-group interface if-port-2
Error: Command not available
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::01/64
configure> save
Info: Parameter group interface "if-port-2" saved
configure> exit
operational>
```

6. Display IPv6 routing table in router1

```
   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

 No IPv6 backup routes are available

operational>
```

7.Enable IPv6 in router2

```
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  : 14:29:00, Monday, April 12, 2021 IST

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

IPv4 routes
-----------
Active routes          :              3
Backup routes          :              0
Total routes           :              3

IPv4 routes by source
---------------------
Directly connected routes :           2
Static routes          :              0
RIP routes             :              0
OSPFv2 routes          :              1
BGP routes             :              0
```

8.Configure IPv6 interfaces in router 2
• Configuring IPv6 address 2003::01/64 as if-port-1 and 2002::02/64 as if-port-2

```
operational> configure
Entering configuration mode with exclusive access.
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>
configure>  set ip ipv6 address 2002::02/64
configure> save
Info: Parameter group interface "if-port-2" saved
configure>
```

- Verifying interface configurations

```
operational> show interface all

Interface name                 Status    Encaps-   IP address
                                         ulation
--------------------------------------------------------------------------------
if-port-1                      up        ethernet  2003::1/64
                                                   fe80::a026:ff:fe00:40/64
if-port-2                      up        ethernet  2002::2/64
                                                   fe80::a026:ff:fe00:41/64
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>
```

- Check IPv6 using "show interface details" command output

```
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  : 14:36:34, Monday, April 12, 2021 IST
Work flags             : -- -- ----- -----

Ethernet information
--------------------
VLAN tagging           : disabled

IP information
--------------
Router                 : data

IPv6 information
----------------
Address                : 2003::1
Netmask                : ffff:ffff:ffff:ffff::
Link local Address     : fe80::a026:ff:fe00:40
Link local Netmask     : ffff:ffff:ffff:ffff::
Scope Zone             : 33488915
Preference             : 1
```

9. Configure IPv6 static route in router 2
   - Configure a static route to reach 2001:00/64 network (Alice) with gateway as 2002::01(Router-1)

```
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
```

10. Display IPv6 routing table in router 2

```
configure> exit
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-2
                     2002::1 }
   Source      : static
   Flags       : -

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

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

>> Destination : fe80::/64
   Gateway(s)  : { if-port-1
                     :: }
   Source      : direct
   Flags       : -
```
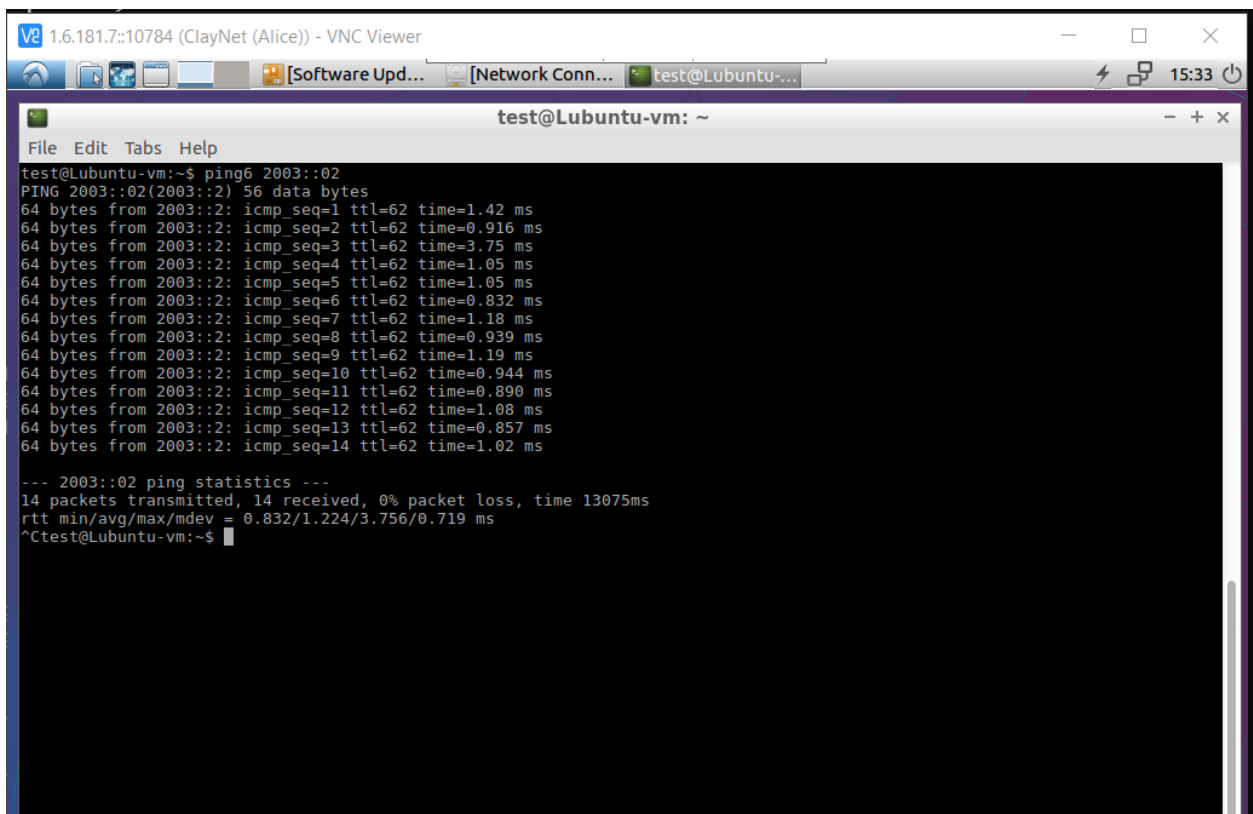
11. Verify traffic flow between Alice and Bob

- From Alice workstation ping to Bob
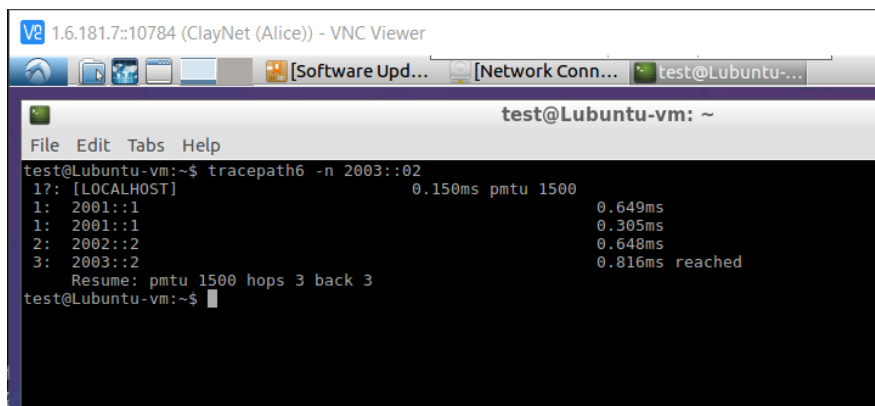
V2 1.6.181.7::10784 (ClayNet (Alice)) - VNC Viewer

[Software Upd...   [Network Conn...   test@Lubuntu-...   15:33

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=1.42 ms
64 bytes from 2003::2: icmp_seq=2 ttl=62 time=0.916 ms
64 bytes from 2003::2: icmp_seq=3 ttl=62 time=3.75 ms
64 bytes from 2003::2: icmp_seq=4 ttl=62 time=1.05 ms
64 bytes from 2003::2: icmp_seq=5 ttl=62 time=1.05 ms
64 bytes from 2003::2: icmp_seq=6 ttl=62 time=0.832 ms
64 bytes from 2003::2: icmp_seq=7 ttl=62 time=1.18 ms
64 bytes from 2003::2: icmp_seq=8 ttl=62 time=0.939 ms
64 bytes from 2003::2: icmp_seq=9 ttl=62 time=1.19 ms
64 bytes from 2003::2: icmp_seq=10 ttl=62 time=0.944 ms
64 bytes from 2003::2: icmp_seq=11 ttl=62 time=0.890 ms
64 bytes from 2003::2: icmp_seq=12 ttl=62 time=1.08 ms
64 bytes from 2003::2: icmp_seq=13 ttl=62 time=0.857 ms
64 bytes from 2003::2: icmp_seq=14 ttl=62 time=1.02 ms

--- 2003::02 ping statistics ---
14 packets transmitted, 14 received, 0% packet loss, time 13075ms
rtt min/avg/max/mdev = 0.832/1.224/3.756/0.719 ms
^Ctest@Lubuntu-vm:~$
```

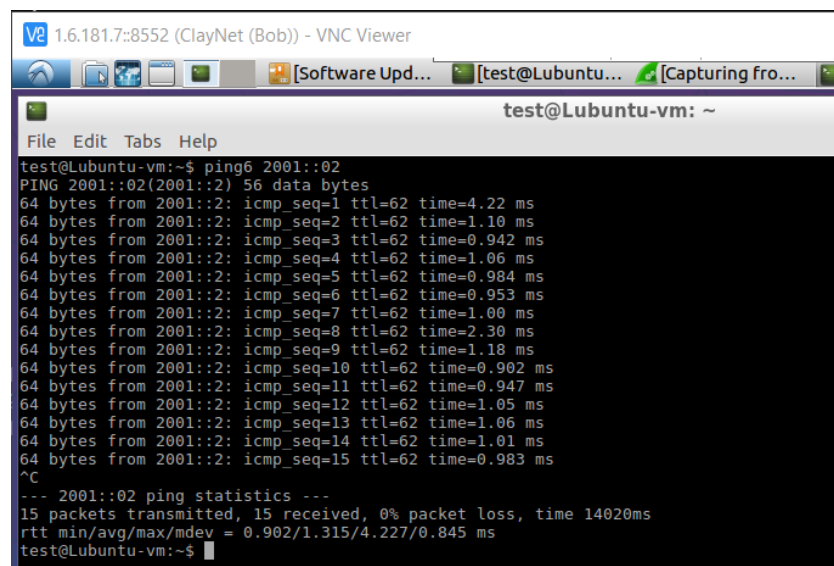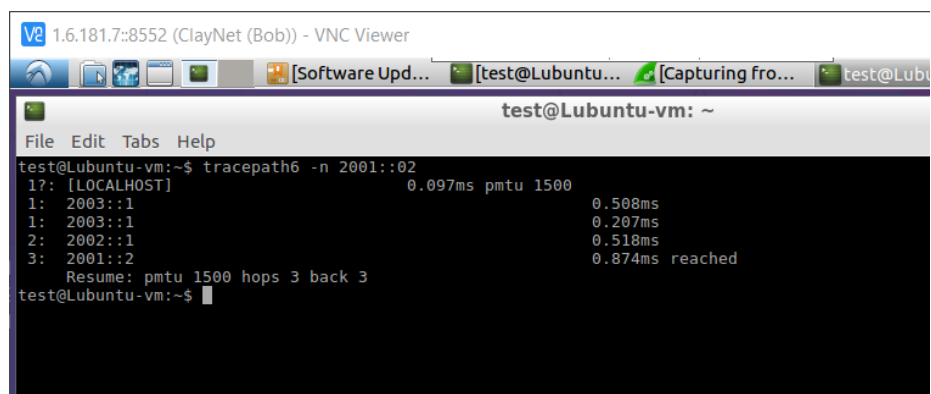- From Alice workstation run tracepath to Bob's IP.

- From Bob workstation ping to Alice

- From Bob workstation run tracepath to Alice's IP.

12. Check IPv6 NDP table on router 1

```
operational> show ipv6 neighbour summary data

Host address                         MAC address        Interface
--------------------------------------------------------------------------
2001::2                              2a:26:00:00:0f:53  if-port-1
2002::2                              2a:26:00:00:03:fb  if-port-2
fe80::2826:ff:fe00:3fb               2a:26:00:00:03:fb  if-port-2
fe80::b685:5eb2:42d5:224             2a:26:00:00:0f:53  if-port-1

Total number of NDP entries displayed : 4

operational>
```

13. Verify auto configured link local address on IPv6 interfaces

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

> Interface : if-port-1

General Information
-------------------
ID                   : 3
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 : 07:39:49, Friday, April 09, 2021 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              : 2001::1
Netmask              : ffff:ffff:ffff:ffff::
Link local Address   : fe80::2826:ff:fe00:3f1
Link local Netmask   : ffff:ffff:ffff:ffff::
Scope Zone           : 33488899
Preference           : 1
Metric               : 1

TE information
--------------
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:26:00:00:03:f1
 POST                  : passed
 Media                 : copper
 Loop back mode        : no-loopback
 State                 : up
 Duplex mode           : half-duplex
 Speed                 : ten-mbps
 Work flags            : ---- ----

operational>
```

14.Check connectivity between router1 and router2 using link local address

- Successful ping to if-port-1

```
operational> ping data:fe80::2826:ff:fe00:3fa%if-port-1
PING fe80:0:1ff:3:2826:ff:fe00:3f1 --> fe80::2826:ff:fe00:3fa%33488899
^C
---- PING Statistics----
3 packets transmitted, 0 packets received, 100.0% packet loss
operational>
```

- Successful ping to if-port-2

```
operational> ping data:fe80::2826:ff:fe00:3fb%if-port-2
PING fe80:0:1ff:4:2826:ff:fe00:3f2 --> fe80::2826:ff:fe00:3fb%33488900
16 bytes from fe80::2826:ff:fe00:3fb%33488900: icmp_seq=0 hoplimit=64 time=0.474 ms
16 bytes from fe80::2826:ff:fe00:3fb%33488900: icmp_seq=1 hoplimit=64 time=0.406 ms
16 bytes from fe80::2826:ff:fe00:3fb%33488900: icmp_seq=2 hoplimit=64 time=0.466 ms
16 bytes from fe80::2826:ff:fe00:3fb%33488900: icmp_seq=3 hoplimit=64 time=0.575 ms
16 bytes from fe80::2826:ff:fe00:3fb%33488900: icmp_seq=4 hoplimit=64 time=0.592 ms
16 bytes from fe80::2826:ff:fe00:3fb%33488900: icmp_seq=5 hoplimit=64 time=0.483 ms
16 bytes from fe80::2826:ff:fe00:3fb%33488900: icmp_seq=6 hoplimit=64 time=0.556 ms
16 bytes from fe80::2826:ff:fe00:3fb%33488900: icmp_seq=7 hoplimit=64 time=0.536 ms
^C
---- PING Statistics----
8 packets transmitted, 8 packets received, 0.0% packet loss
round-trip min/avg/max/std-dev = 0.000/0.511/0.592/0.060 ms
operational>
```