

# COMPUTER NETWORKS LAB

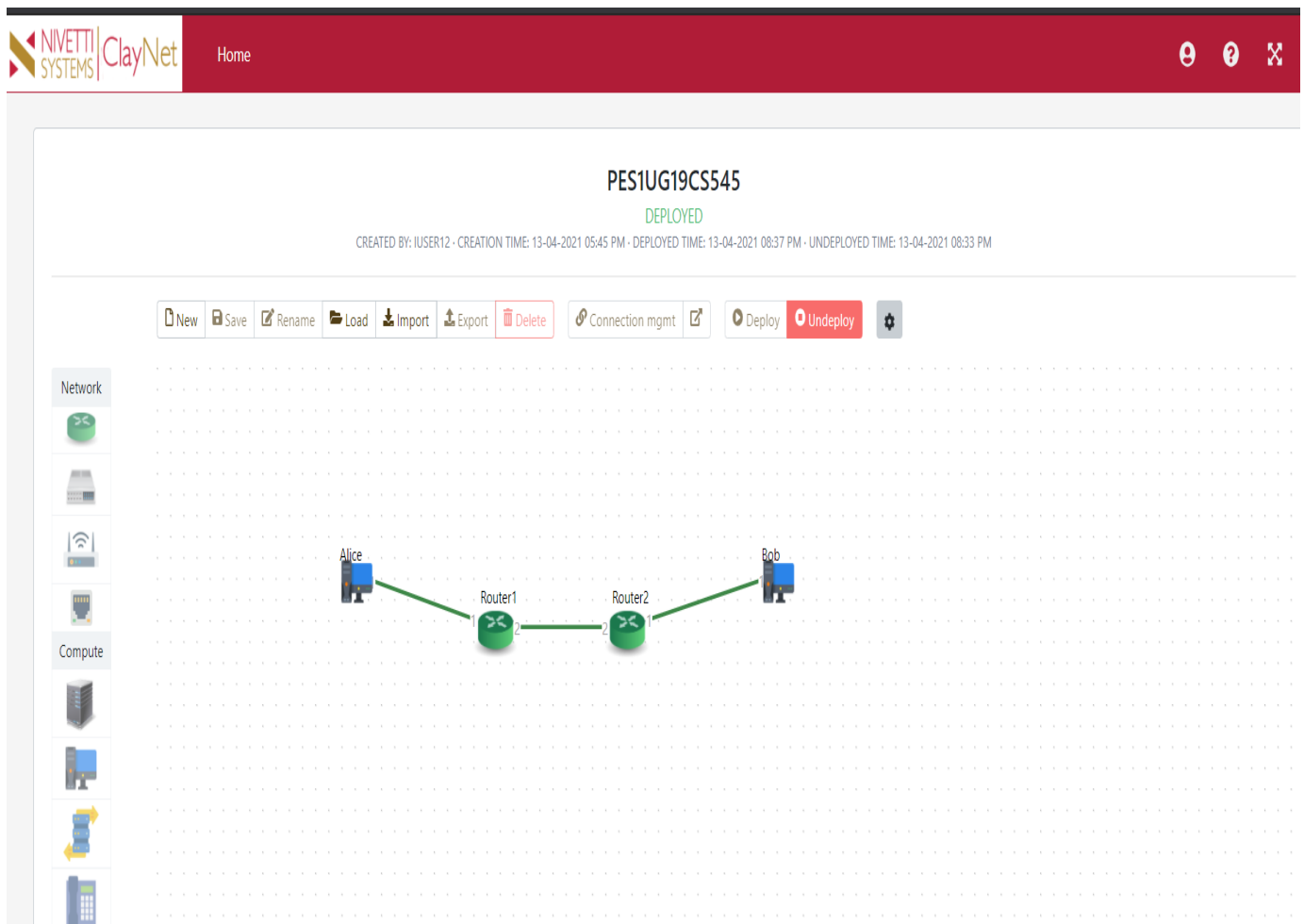
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## IPv6 Configuration and static routing

1) Topology creation and IPv4 addressing:

- The topology which was created and deployed on claynet is shown below:



- As can be seen in the topology, there are 2 end systems and 2 routers.

- The end systems are configured as given below:

End system	IP Address	Gateway
Alice	2001::02/24	2001::02
Bob	2003::02/24	2003::01

## 2) Router configuration:

- IPv6 addresses must be set for both the routers.
- Firstly, we need to enable IPv6 mode in both the routers.

```
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> █
```

### 2.1. Router 1:

- if-port-1 interface of Router 1 is assigned with an IPv6 address 2001::01/64.

```

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

```

- Similarly, if-port-2 interface of Router 2 is assigned with an IPv6 address 2002::01/64.

```

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>

```

## - Full interface configuration of Router 1:

```
operational> show interface all
```

Interface name	Status	Encapsulation	IP address
if-port-1	up	ethernet	2001::1/64 fe80::a026:ff:fe00:10f/64
if-port-2	up	ethernet	2002::1/64 fe80::a026:ff:fe00:110/64
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>
```

## - Routing table for Router 1:

```
operational> show route summary -F ipv6 data
```

```
> IPv6 active routes
```

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

## 2.2. Router 2:

- if-port-1 interface of Router 1 is assigned with an IPv6 address 2003::01/64.
- if-port-2 interface of Router 2 is assigned with an IPv6 address 2002::02/64.

```
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> 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> █
```

## - Interfaces:

```
operational> show interface all
```

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

## - Routing table entries for Router 2:

```
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        : -

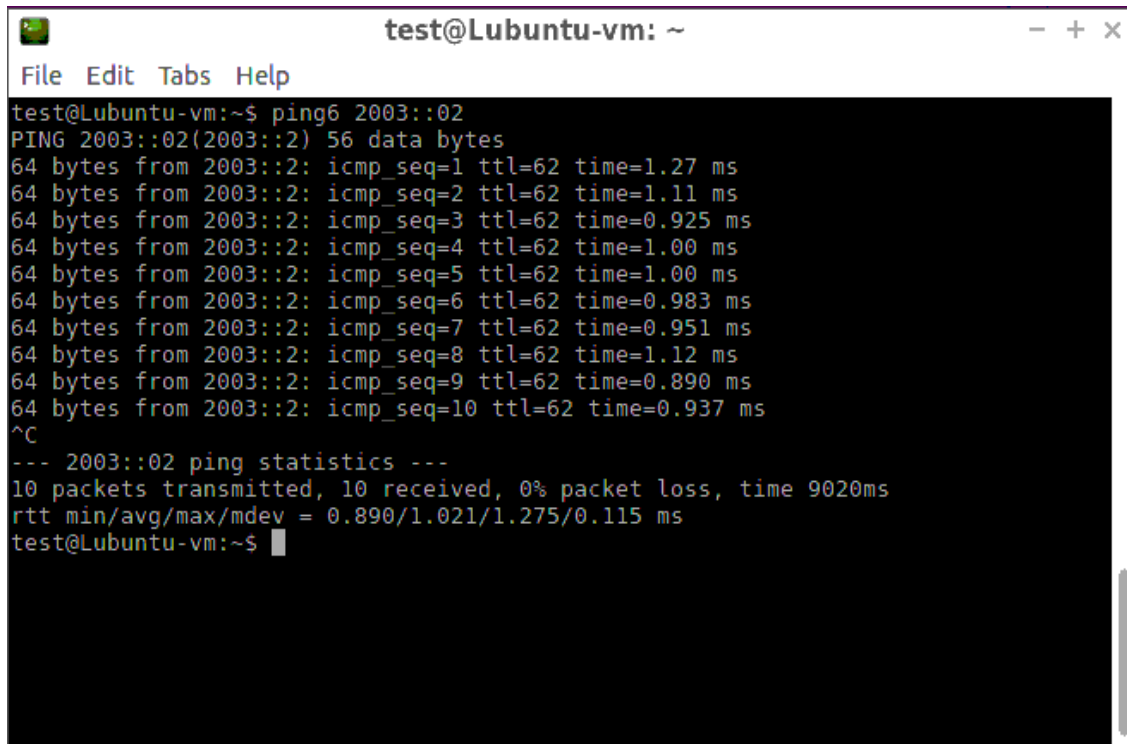
>> Destination : fe80::/64
  Gateway(s)   : { if-port-2
                  :: }
  Source       : direct
  Flags        : -

Total number of IPv6 active routes displayed : 6
```

### 3) Observations:

#### 3.1. Pinging

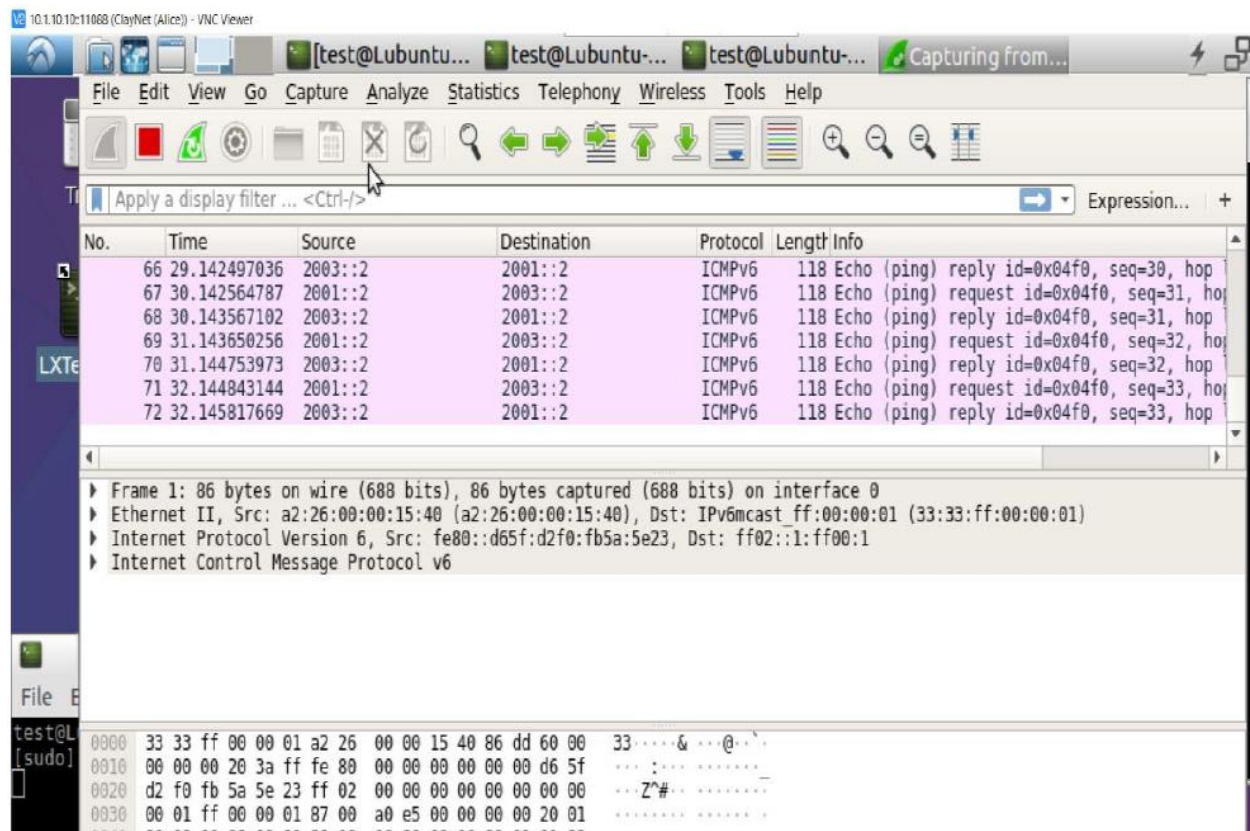
- Alice can ping Bob successfully. Screenshot of the same is shown below:

A screenshot of a terminal window titled 'test@Lubuntu-vm: ~'. The terminal shows the execution of the 'ping6 2003::02' command. The output displays 10 successful ping responses, each showing 64 bytes from 2003::2 with a TTL of 62 and various response times. After the ping command, the user presses '^C' to interrupt, followed by the display of ping statistics: 10 packets transmitted, 10 received, 0% packet loss, and a total time of 9020ms. The round-trip time (rtt) statistics are also shown: min/avg/max/mdev = 0.890/1.021/1.275/0.115 ms. The prompt 'test@Lubuntu-vm:~\$' is visible at the bottom.

```
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=1.27 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=0.925 ms
64 bytes from 2003::2: icmp_seq=4 ttl=62 time=1.00 ms
64 bytes from 2003::2: icmp_seq=5 ttl=62 time=1.00 ms
64 bytes from 2003::2: icmp_seq=6 ttl=62 time=0.983 ms
64 bytes from 2003::2: icmp_seq=7 ttl=62 time=0.951 ms
64 bytes from 2003::2: icmp_seq=8 ttl=62 time=1.12 ms
64 bytes from 2003::2: icmp_seq=9 ttl=62 time=0.890 ms
64 bytes from 2003::2: icmp_seq=10 ttl=62 time=0.937 ms
^C
--- 2003::02 ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 9020ms
rtt min/avg/max/mdev = 0.890/1.021/1.275/0.115 ms
test@Lubuntu-vm:~$
```

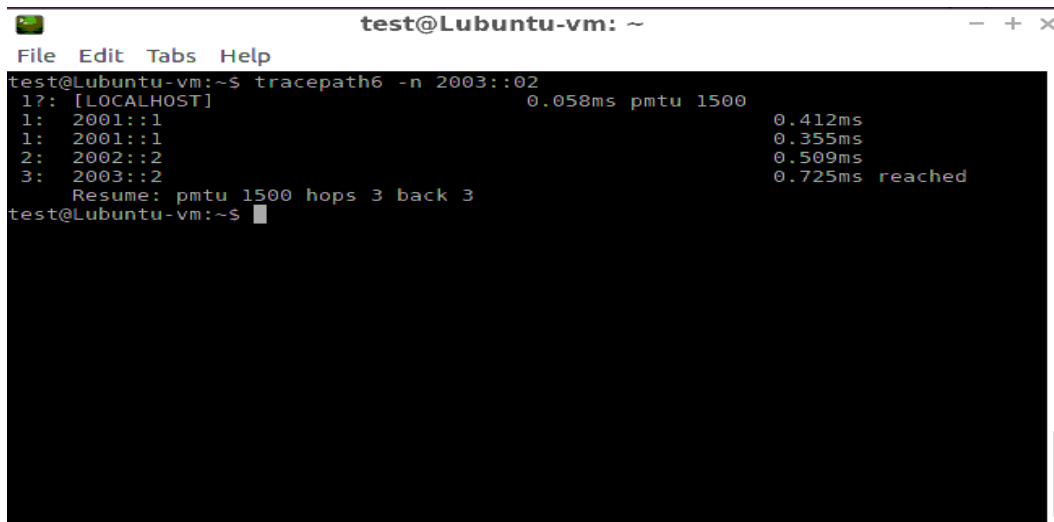
- As can be observed above , the TTL is reduced to 62 from 64 (as there are 2 hops between the workstations).

### 3.2. Wireshark Packet Capture:



### 3.3. Tracpath

- Tracpath command from Alice to Bob.





### 3.4. Neighbour table

#### - Neighbour table for Router 1:

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

Host address	MAC address	Interface
2001::2	a2:26:00:00:15:73	if-port-1
2002::2	a2:26:00:00:01:ee	if-port-2
fe80::8dec:4421:fb44:684a	a2:26:00:00:15:73	if-port-1
fe80::a026:ff:fe00:1ee	a2:26:00:00:01:ee	if-port-2

Total number of NDP entries displayed : 4

```
operational> █
```

#### - Link local address from Router 2:

```
> Interface : if-port-2
```

##### General Information

```
-----
ID : 13
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 : 15:35:58, Sunday, April 11, 2021 IST
Work flags : -- -- -----
```

##### Ethernet information

```
-----
VLAN tagging : disabled
```

##### IP information

```
-----
Router : data
```

##### IPv6 information

```
-----
Address : 2002::1
Netmask : ffff:ffff:ffff:ffff::
Link local Address : fe80::a026:ff:fe00:80
Link local Netmask : ffff:ffff:ffff:ffff::
Scope Zone : 33400909
Preference : 1
Metric : 1
```

##### TE information

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

- Fastethernet interface:

```
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   : a2:26:00:00:01:0f
POST          : passed
Media         : copper
Loop back mode : no-loopback
State         : up
Duplex mode   : half-duplex
Speed        : ten-mbps
Work flags    : ----
```

- The link local address that was retrieved from Router 2 is used to ping from Router 1.

```
operational> ping data:fe80::a026:ff:fe00:89%if-port-2
PING fe80:0:1ff:d:a026:ff:fe00:80 --> fe80::a026:ff:fe00:89%33488909
16 bytes from fe80::a026:ff:fe00:89%33488909: icmp_seq=0 hoplimit=64 time=0.389 ms
16 bytes from fe80::a026:ff:fe00:89%33488909: icmp_seq=1 hoplimit=64 time=0.365 ms
16 bytes from fe80::a026:ff:fe00:89%33488909: icmp_seq=2 hoplimit=64 time=0.375 ms
16 bytes from fe80::a026:ff:fe00:89%33488909: icmp_seq=3 hoplimit=64 time=0.379 ms
16 bytes from fe80::a026:ff:fe00:89%33488909: icmp_seq=4 hoplimit=64 time=0.389 ms
16 bytes from fe80::a026:ff:fe00:89%33488909: icmp_seq=5 hoplimit=64 time=0.378 ms
16 bytes from fe80::a026:ff:fe00:89%33488909: icmp_seq=6 hoplimit=64 time=0.379 ms
16 bytes from fe80::a026:ff:fe00:89%33488909: icmp_seq=7 hoplimit=64 time=0.404 ms
16 bytes from fe80::a026:ff:fe00:89%33488909: icmp_seq=8 hoplimit=64 time=0.420 ms
16 bytes from fe80::a026:ff:fe00:89%33488909: icmp_seq=9 hoplimit=64 time=0.362 ms
16 bytes from fe80::a026:ff:fe00:89%33488909: icmp_seq=10 hoplimit=64 time=0.384 ms
16 bytes from fe80::a026:ff:fe00:89%33488909: icmp_seq=11 hoplimit=64 time=0.372 ms
16 bytes from fe80::a026:ff:fe00:89%33488909: icmp_seq=12 hoplimit=64 time=0.398 ms
16 bytes from fe80::a026:ff:fe00:89%33488909: icmp_seq=13 hoplimit=64 time=0.359 ms
16 bytes from fe80::a026:ff:fe00:89%33488909: icmp_seq=14 hoplimit=64 time=0.379 ms
16 bytes from fe80::a026:ff:fe00:89%33488909: icmp_seq=15 hoplimit=64 time=0.372 ms
16 bytes from fe80::a026:ff:fe00:89%33488909: icmp_seq=16 hoplimit=64 time=0.383 ms
16 bytes from fe80::a026:ff:fe00:89%33488909: icmp_seq=17 hoplimit=64 time=0.387 ms
16 bytes from fe80::a026:ff:fe00:89%33488909: icmp_seq=18 hoplimit=64 time=0.406 ms
16 bytes from fe80::a026:ff:fe00:89%33488909: icmp_seq=19 hoplimit=64 time=0.435 ms
16 bytes from fe80::a026:ff:fe00:89%33488909: icmp_seq=20 hoplimit=64 time=0.418 ms
^C
---- PING Statistics----
21 packets transmitted, 21 packets received, 0.0% packet loss
round-trip min/avg/max/std-dev = 0.000/0.387/0.435/0.019 ms
operational>
```

As can be seen above, the ping request is successful.