

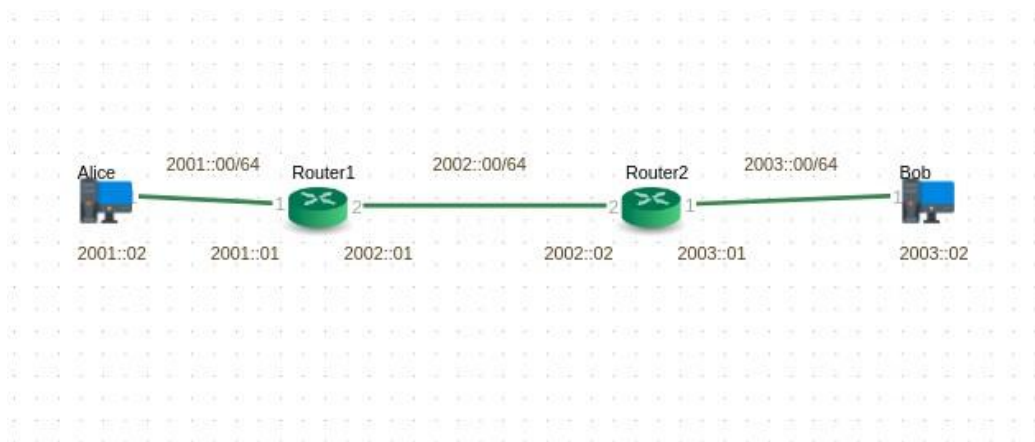
Atul Anurag
PES2UG19CS075
COMPUTER NETWORKS LAB
Week 10

IPv6 Configuration and Static Routing

Learning Objectives:

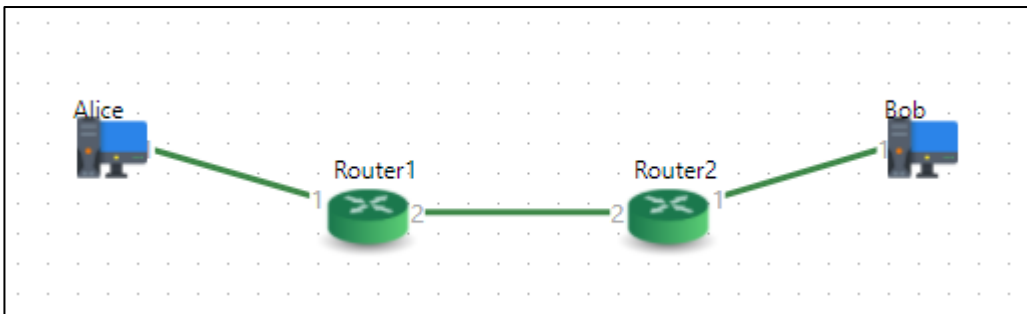
- Perform basic IPv6 configurations on a Desktop and Router.
- Distinguish between IPv4 and IPv6 addresses - Configure IPv6 static routes in Router - Observe traffic flow using IPv6 static routes.
- IPv6 neighbour cache entries
- Understanding IPv6 Link Local Address
- Working with ping6 and tracepath6

LAB Network Topology:



Steps :

1. Create and deploy the given topology.



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

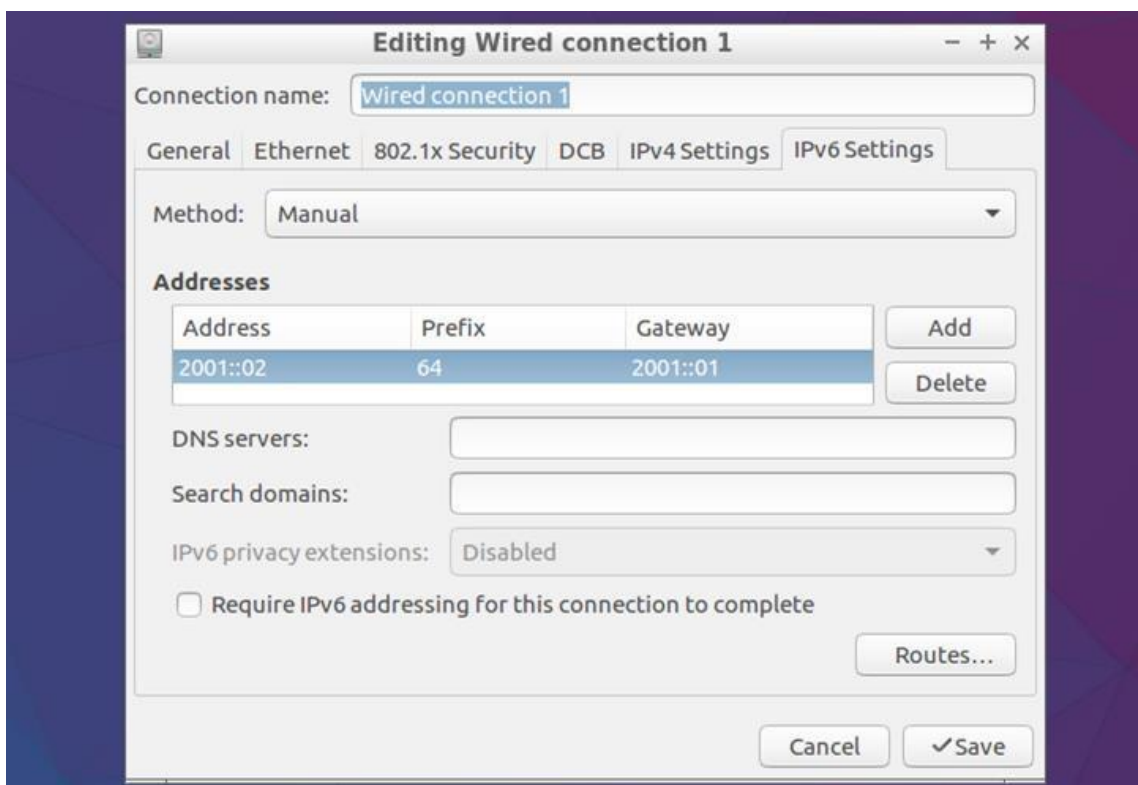
Alice

IPv6 address – 2001::02/64 , Gateway – 2001::01

Bob

IPv6 address – 2003::02/64 , Gateway – 2003::01

Example :



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>
```

```
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: No modifications to save
configure> exit
operational>
```

Check IPv6 information in router details

```
operational> show router details data
```

```
operational> show router details data

> Router : data

General information
-----
Router ID           : 1
State               : up
Interfaces          : 9
Routing gateways    : 5
Local addresses     : 6
Sockets             : 2
Flags               : -----
Last state transition : 17:13:51, Thursday, April 08, 2021 IST

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

IPv4 routes
-----
Active routes          : 2
Backup routes          : 0
Total routes           : 2

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

IPv4 listeners and connections
-----
TCP listeners            : 1
TCP connections          : 0
TCP sockets              : 1
UDP sockets              : 0

OSPFv2 information
-----
Router ID                : 1.1.1.1
Number of areas           : 0
Preference                : 50
SPF hold count            : 0
```

```

IPv6 information
-----
Default Hop Limit      : 64
Interfaces              : 3

IPv6 routes
-----
Active routes          :          6
Backup routes          :          0
Total routes           :          6

IPv6 routes by source
-----
Directly connected routes :          5
Static routes             :          1
BGP routes                :          0

IPv6 listeners and connections
-----
TCP listeners           :          1
TCP connections         :          0
TCP sockets             :          1
UDP sockets             :          0

SSH server
-----
Enabled                  : Yes
TCP keep alives          : enabled
Allowed versions         : ssh-version-2

Telnet server
-----
Enabled                   : No

SNMP
----
Enabled                   : No

XMP server
-----
Enabled                   : No

Quality of Service
-----
Default class for forwarded traffic : class-1
Default drop-profile for forwarded traffic : green
Default class for local traffic      : class-1
Default drop-profile for local traffic : green

operational> 

```

4. Configure IPv6 interfaces in Router-1

* Configure IPv6 global address 2001::01/64 to interface if-port-1

```
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>
```

```
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 yes
address 2001:0000:0000:0000:0000:0000:0000:0001
netmask ffff:ffff:ffff:ffff: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> █
```

** Configure IPv6 global address 2002::01/64 to interface if-port-2*

```
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
```

```
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> █
```

** Verify Interface configurations*

```
operational> show interface all
```

Interface name	Status	Encaps- ulation	IP address
if-port-1	up	ethernet	2001::1/64 fe80::226:f7ff:fe00:6d/64
if-port-2	up	ethernet	2002::1/64 fe80::226:f7ff:fe00:6e/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>
```

```
operational> show interface all
```

Interface name	Status	Encaps- ulation	IP address
if-port-1	up	ethernet	2001::1/64 fe80::2826:ff:fe00:3e8/64
if-port-2	up	ethernet	2002::1/64 fe80::2826:ff:fe00:3e9/64
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
```

```
operational> show interface details if-port-1 if-port-2

> Interface : if-port-1

General Information
-----
ID                  : 12
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 : 18:05:50, Thursday, April 08, 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::2826:ff:fe00:3e8
Link local Netmask   : ffff:ffff:ffff:ffff::
Scope Zone          : 33488908
Preference           : 1
Metric              : 1

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

```
> 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 : 18:07:33, Thursday, April 08, 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::2826:ff:fe00:3e9
Link local Netmask : ffff:ffff:ffff:ffff::
Scope Zone : 33488909
Preference : 1
Metric : 1
```

```
TE information
```

```
-----
```

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

```
operational> █
```


5. Configure IPv6 static routes in Router-1

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

```
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> configure>
```

```
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
Confirm: Parameter group with same index exists. Overwrite ? (y/N) y
Info: Parameter group ip-route "v6-route-2003-nw" saved
configure> █
```

6. Display IPv6 routing table in Router-1

The configured static route should appear in the IPv6 routing table

```
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  No IPv6 backup routes are
available operational>
```

```

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

No IPv6 backup routes are available

operational> █

```

7. Enable IPv6 in Router-2

```
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>
```

```
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>
```

Check IPv6 information in router details

```
operational> show router details data
```

```
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 : 18:16:32, Thursday, April 08, 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

IPv4 listeners and connections
-----
TCP listeners           :      1
TCP connections         :      0
TCP sockets             :      1
UDP sockets             :      0

OSPFv2 information
-----
Router ID           : 1.1.1.1
Number of areas     : 1
Preference          : 50
SPF hold count      : 0
```

```

IPv6 information
-----
Default Hop Limit      : 64
Interfaces             : 1

IPv6 routes
-----
Active routes          :          1
Backup routes          :          0
Total routes           :          1

IPv6 routes by source
-----
Directly connected routes :          1
Static routes             :          0
BGP routes                :          0

IPv6 listeners and connections
-----
TCP listeners           :          1
TCP connections         :          0
TCP sockets             :          1
UDP sockets             :          0

SSH server
-----
Enabled                 : Yes
TCP keep alives         : enabled
Allowed versions        : ssh-version-2

Telnet server
-----
Enabled                 : No

SNMP
----
Enabled                 : No

XMP server
-----
Enabled                 : No

Quality of Service
-----
Default class for forwarded traffic : class-1
Default drop-profile for forwarded traffic : green
Default class for local traffic     : class-1
Default drop-profile for local traffic : green

operational>

```

8. Configure IPv6 interfaces in Router-2

** Configure IPv6 global address 2003::01/64 to interface if-port-1*

```
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
```

```
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 IPv6 global address 2002::02/64 to interface if-port-2*

```
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> 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
operational> █
```

** Verify Interface configurations*

```
operational> show interface all
```

Interface name	Status	Encaps- ulation	IP address
if-port-1	up	ethernet	2003::1/64 fe80::226:f7ff:fe00:76/64
if-port-2	up	ethernet	2002::2/64 fe80::226:f7ff:fe00:77/64
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 all
```

Interface name	Status	Encaps- ulation	IP address
if-port-1	up	ethernet	2003::1/64 fe80::2826:ff:fe00:403/64
if-port-2	up	ethernet	2002::2/64 fe80::2826:ff:fe00:404/64
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
```

```
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 : 18:16:32, Thursday, April 08, 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
```

IPv4 listeners and connections

```
TCP listeners          : 1
TCP connections        : 0
TCP sockets            : 1
UDP sockets            : 0
```

OSPFv2 information

```
Router ID           : 1.1.1.1
Number of areas      : 1
Preference           : 50
SPF hold count       : 0
```



```

> Interface : if-port-2

General Information
-----
ID : 20
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 : 18:22:20, Thursday, April 08, 2021 IST
Work flags : -- -- -----

Ethernet information
-----
VLAN tagging : disabled

IP information
-----
Router : data

IPv6 information
-----
Address : 2002::2
Netmask : ffff:ffff:ffff:ffff::
Link local Address : fe80::2826:ff:fe00:404
Link local Netmask : ffff:ffff:ffff:ffff::
Scope Zone : 33488916
Preference : 1
Metric : 1

TE information
-----
Maximum Bandwidth : 10000 kbps
Maximum Reservable Bandwidth : 10000 kbps
Update threshold percentage : 10

operational>

```

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
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>

```

```

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
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> █

```

10. Display IPv6 routing table in 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  No IPv6 backup routes are
available operational>

```

```
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

No IPv6 backup routes are available

operational> █
```

11. Verify traffic flow between Alice and Bob

- * From Alice workstation ping Bob, observe the packet from and TTL in ping reply
- * From Alice workstation run tracepath to Bob's IP. Observer the intermediate hops

```
test@Lubuntu-vm: ~  
File Edit Tabs Help  
test@Lubuntu-vm:~$ ping 2003::02  
ping: unknown host 2003::02  
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=2.25 ms  
64 bytes from 2003::2: icmp_seq=2 ttl=62 time=1.40 ms  
64 bytes from 2003::2: icmp_seq=3 ttl=62 time=1.53 ms  
64 bytes from 2003::2: icmp_seq=4 ttl=62 time=1.62 ms  
64 bytes from 2003::2: icmp_seq=5 ttl=62 time=1.61 ms  
64 bytes from 2003::2: icmp_seq=6 ttl=62 time=1.60 ms  
64 bytes from 2003::2: icmp_seq=7 ttl=62 time=1.34 ms  
64 bytes from 2003::2: icmp_seq=8 ttl=62 time=1.19 ms  
64 bytes from 2003::2: icmp_seq=9 ttl=62 time=1.22 ms  
64 bytes from 2003::2: icmp_seq=10 ttl=62 time=1.20 ms  
64 bytes from 2003::2: icmp_seq=11 ttl=62 time=1.56 ms  
64 bytes from 2003::2: icmp_seq=12 ttl=62 time=1.71 ms  
64 bytes from 2003::2: icmp_seq=13 ttl=62 time=1.83 ms  
64 bytes from 2003::2: icmp_seq=14 ttl=62 time=1.81 ms  
^C  
--- 2003::02 ping statistics ---  
14 packets transmitted, 14 received, 0% packet loss, time 13022ms  
rtt min/avg/max/mdev = 1.196/1.567/2.255/0.281 ms  
test@Lubuntu-vm:~$
```

```
test@Lubuntu-vm: ~  
File Edit Tabs Help  
64 bytes from 2003::2: icmp_seq=3 ttl=62 time=1.53 ms  
64 bytes from 2003::2: icmp_seq=4 ttl=62 time=1.62 ms  
64 bytes from 2003::2: icmp_seq=5 ttl=62 time=1.61 ms  
64 bytes from 2003::2: icmp_seq=6 ttl=62 time=1.50 ms  
64 bytes from 2003::2: icmp_seq=7 ttl=62 time=1.34 ms  
64 bytes from 2003::2: icmp_seq=8 ttl=62 time=1.19 ms  
64 bytes from 2003::2: icmp_seq=9 ttl=62 time=1.22 ms  
64 bytes from 2003::2: icmp_seq=10 ttl=62 time=1.20 ms  
64 bytes from 2003::2: icmp_seq=11 ttl=62 time=1.56 ms  
64 bytes from 2003::2: icmp_seq=12 ttl=62 time=1.71 ms  
64 bytes from 2003::2: icmp_seq=13 ttl=62 time=1.83 ms  
64 bytes from 2003::2: icmp_seq=14 ttl=62 time=1.81 ms  
^C  
--- 2003::02 ping statistics ---  
14 packets transmitted, 14 received, 0% packet loss, time 13022ms  
rtt min/avg/max/mdev = 1.196/1.567/2.255/0.281 ms  
test@Lubuntu-vm:~$ tracepath6 -n 2003::02  
1?: [LOCALHOST] 0.072ms pmtu 1500  
1: 2001::1 0.516ms  
1: 2001::1 0.144ms  
2: 2002::2 0.830ms  
3: 2003::2 0.954ms reached  
Resume: pmtu 1500 hops 3 back 3  
test@Lubuntu-vm:~$
```

12. Check IPv6 NDP table on Router-1

This is similar to ARP Table in IPv4.

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

Host address	MAC address	Interface
2002::1	00:26:f7:00:00:6e	if-port-2
2003::2	00:26:f7:00:09:3c	if-port-1
fe80::226:f7ff:fe00:6e	00:26:f7:00:00:6e	if-port-2
fe80::5d97:cf2f:4a3:d8cb	00:26:f7:00:09:3c	if-port-1

Total number of NDP entries displayed : 4

```
operational>
```

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

Host address	MAC address	Interface
2001::2	2a:26:00:00:0f:08	if-port-1
2002::2	2a:26:00:00:02:03	if-port-2
fe80::2826:ff:fe00:203	2a:26:00:00:02:03	if-port-2
fe80::7e5f:89d5:abe9:65e1	2a:26:00:00:0f:08	if-port-1

Total number of NDP entries displayed : 4

```
operational>
```

13. Verify auto-configured Link Local Address on IPv6 interfaces

All IPv6 enabled interfaces will have a link-local address. IPv6 link-local address is a unicast address that is configured automatically using the prefix FE80::/10 and port MAC in the modified EUI-64 format. The linklocal address can also be manually configured.

Link-local addresses are used for a addressing on a single physical link. These addresses can be used to reach the neighboring nodes attached to the same link. Routers will not forward packets using link-local addresses.

Two routers can have same link-local address and can still communicate over directly connected network. But, the global unicast address should be unique in a network as they are routable.

Login to Router-1 and check the auto-configured link local address.

For Example :

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

```
> Interface : if-port-1
General Information
-----
ID : 21
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 : 15:19:44, Monday, March 18, 2019 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::226:f7ff:fe00:6d <===== Combination of FE08 and port MAC
Link local Netmask : ffff:ffff:ffff:ffff::
Scope Zone         : 33488917
Preference         : 1
Metric             : 1
TE information
-----
Maximum Bandwidth      : 10000 kbps
Maximum Reservable Bandwidth : 10000 kbps
Update threshold percentage : 10

```

operational>

```

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         : 00:26:f7:00:00:6d <=====
POST               : passed
Media               : copper
Loop back mode     : no-loopback
State               : up
Duplex mode         : half-duplex
Speed               : ten-mbps Work flags          : ---- ---- operational>

```

```

> Interface : if-port-1

General Information
-----
ID                  : 10
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 : 08:47:50, Saturday, April 10, 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::2826:ff:fe00:1f9
Link local Netmask : ffff:ffff:ffff:ffff::
Scope Zone         : 33488906
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:26:00:00:01:f9
POST          : passed
Media          : copper
Loop back mode : no-loopback
State          : up
Duplex mode    : half-duplex
Speed          : ten-mbps
Work flags     : -----
operational> █

```

14. Check the connectivity between Router-1 and Router-2 using Link Local Address

```

operational> show interface details if-port-2

> Interface : if-port-2

General Information
-----
ID           : 11
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 : 09:07:45, Saturday, April 10, 2021 IST
Work flags  : -----

Ethernet information
-----
VLAN tagging : disabled

IP information
-----
Router      : data

IPv6 information
-----
Address     : 2002::2
Netmask     : ffff:ffff:ffff:ffff::
Link local Address : fe80::2026:ff:fe00:203
Link local Netmask : ffff:ffff:ffff:ffff::
Scope Zone  : 33488907
Preference  : 1
Metric      : 1

TE information
-----
Maximum Bandwidth       : 10000 kbps
Maximum Reservable Bandwidth : 10000 kbps
Update threshold percentage : 10

operational> █

```



```

operational> show fast-ethernet details { shelf-1 { active-controller base-slot
} port-2 }

> Port : { shelf-1 { active-controller base-slot } port-2 }

Port details
-----
Name          :
MAC address   : 2a:26:00:00:02:03
POST          : passed
Media         : copper
Loop back mode : no-loopback
State         : up
Duplex mode   : half-duplex
Speed         : ten-mbps
Work flags    : ---- ----
operational>

```

Login to Router-2 and get the link-local address of interface connected to Router-1.

Now, Login to Router-1 and ping the link-local address on Router-2 and observe the response. When pinging link-local address, the the name if out-going interface should be specified in the command. If no interface or wrong interface name is specified, ping will result in error or unsuccessful.

```

operational> ping data:fe80::2826:ff:fe00:203%if-port-2
PING fe80:0:1ff:b:2826:ff:fe00:1fa --> fe80::2826:ff:fe00:203%33488907
16 bytes from fe80::2826:ff:fe00:203%33488907: icmp_seq=0 hoplimit=64 time=0.619
ms
16 bytes from fe80::2826:ff:fe00:203%33488907: icmp_seq=1 hoplimit=64 time=0.685
ms
16 bytes from fe80::2826:ff:fe00:203%33488907: icmp_seq=2 hoplimit=64 time=0.809
ms
16 bytes from fe80::2826:ff:fe00:203%33488907: icmp_seq=3 hoplimit=64 time=0.479
ms
16 bytes from fe80::2826:ff:fe00:203%33488907: icmp_seq=4 hoplimit=64 time=0.749 ms
16 bytes from fe80::2826:ff:fe00:203%33488907: icmp_seq=5 hoplimit=64 time=0.597 ms
16 bytes from fe80::2826:ff:fe00:203%33488907: icmp_seq=6 hoplimit=64 time=0.578 ms
16 bytes from fe80::2826:ff:fe00:203%33488907: icmp_seq=7 hoplimit=64 time=0.617 ms
16 bytes from fe80::2826:ff:fe00:203%33488907: icmp_seq=8 hoplimit=64 time=0.375 ms
8 ms
16 bytes from fe80::2826:ff:fe00:203%33488907: icmp_seq=17 hoplimit=64 time=0.54
5 ms
16 bytes from fe80::2826:ff:fe00:203%33488907: icmp_seq=18 hoplimit=64 time=0.585 ms
16 bytes from fe80::2826:ff:fe00:203%33488907: icmp_seq=19 hoplimit=64 time=0.411 ms
16 bytes from fe80::2826:ff:fe00:203%33488907: icmp_seq=20 hoplimit=64 time=0.430 ms
^C
---- PING Statistics----
21 packets transmitted, 21 packets received, 0.0% packet loss
round-trip min/avg/max/std-dev = 0.000/0.561/0.846/0.154 ms
operational>

```

```

operational> ping data:fe80::2826:ff:fe00:203%if-port-1
PING fe80:0:1ff:a:2826:ff:fe00:1f9 --> fe80::2826:ff:fe00:203%33488906
^C
---- PING Statistics----
12 packets transmitted, 0 packets received, 100.0% packet loss
operational>

```