Lab7

1 Lab7 Creating an IPv6 Network

1.1 About This Lab

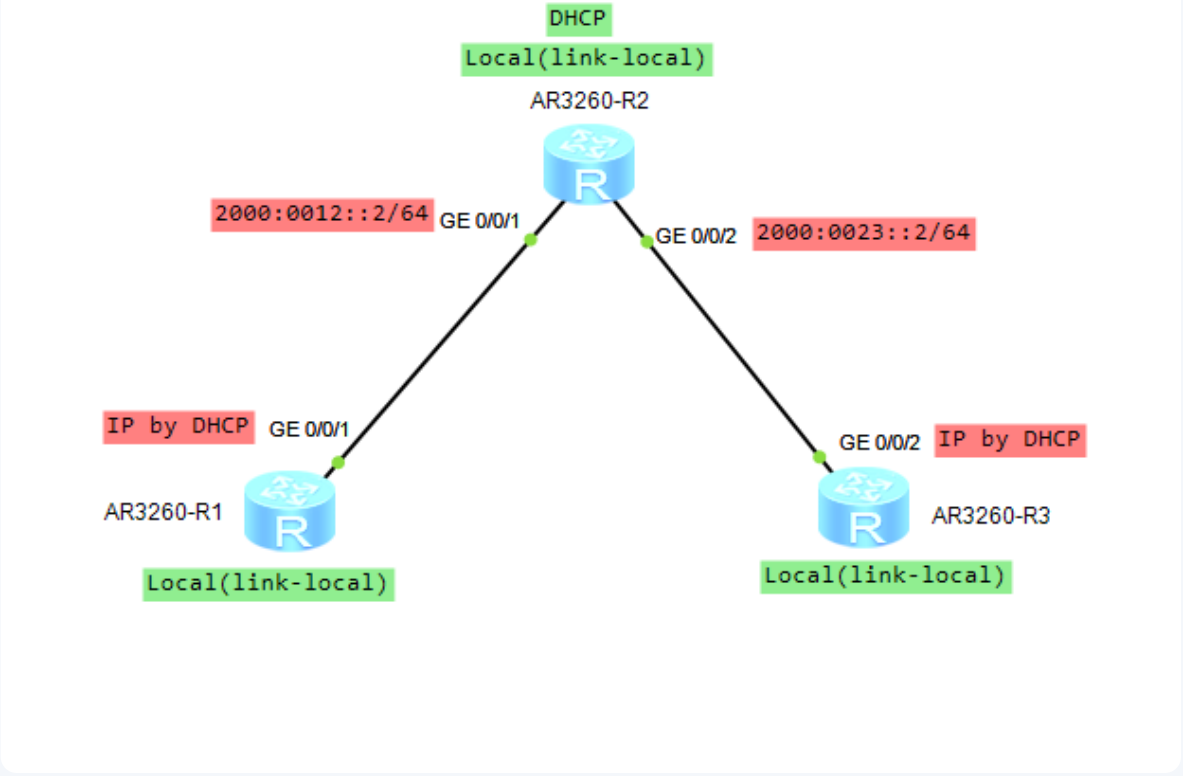
Understanding the configuration of IPv6 addresses, DHCPv6 server setup, stateless address configuration, static routes, and viewing IPv6 information in a lab environment.

1.2 Objectives

- Configure static IPv6 addresses and DHCPv6 server
- learn stateless address configuration
- set up static routes
- view IPv6 info upon task completion.

1.3 Networking Topology

Deploying IPv6 in an enterprise network requires configuring static addresses for R2 interfaces and stateless autoconfiguration for R1's GigabitEthernet0/0/1; use DHCPv6 for R3’s GigabitEthernet0/0/2.



1.4 Basic IPv6 Interface Configuration

R1:

```
[R2-GigabitEthernet0/0/1]ipv6
[R2-GigabitEthernet0/0/1]interface GigabitEthern0/0/1
[R2-GigabitEthernet0/0/1]ipv6 enable
[R2-GigabitEthernet0/0/1]ipv6 address auto link-local
```

> Activates IPv6 on a specified interface.

> Generates a unique link-local address.

> Link-local addresses are used for communication within the same network

> segment or broadcast domain.

R2:

```Markdown
[R2]ipv6
[R2]interface GigabitEthern0/0/1
[R2-GigabitEthernet0/0/1]ipv6 enable
[R2-GigabitEthernet0/0/1]ipv6 address auto link-local
[R2-GigabitEthernet0/0/1]interface GigabitEthern0/0/2
[R2-GigabitEthernet0/0/2]ipv6 enable
[R2-GigabitEthernet0/0/2]ipv6 address auto link-local
[R2-GigabitEthernet0/0/2]interface GigabitEthern0/0/1
[R2-GigabitEthernet0/0/1]ipv6 address 2000:0012::2 64
[R2-GigabitEthernet0/0/1]interface GigabitEthern0/0/2
[R2-GigabitEthernet0/0/2]ipv6 address 2000:0023::2 64
```

> Activates IPv6 on a specified interface.

> Generates a unique link-local address.

> Link-local addresses are used for communication within the same network segment or broadcast domain.

> Assign global ip as gateway to used as dhcp for our scenario

> In ipv6 each interface can have more than one type ip like `global` , `unicast`

R3:

```Markdown
[R3]ipv6
```

```
[R3]interface GigabitEthern0/0/2
[R3-GigabitEthernet0/0/1]ipv6 enable
[R3-GigabitEthernet0/0/1]ipv6 address auto link-local
```

Activates IPv6 on a specified interface.

Generates a unique link-local address.

Link-local addresses are used for communication within the same network segment or broadcast domain.

1.5 Testing Connectivity with IPv6

Markdown

```
[R1]display ipv6 interface gig0/0/1
```

```
GigabitEthernet0/0/1 current state : UP
IPv6 protocol current state : UP
IPv6 is enabled, link-local address is FE80::2E0:FCFF:FE29:7399
  Global unicast address(es):
    2000:12::2E0:FCFF:FE29:7399,
    subnet is 2000:12::/64 [SLAAC 1970-01-01 02:51:56 2592000S]
  Joined group address(es):
    FF02::1:FF29:7399
    FF02::2
    FF02::1
  MTU is 1500 bytes
  ND DAD is enabled, number of DAD attempts: 1
  ND reachable time is 30000 milliseconds
  ND retransmit interval is 1000 milliseconds
  Hosts use stateless autoconfig for addresses
```

Check IPv6 status and link-local address.

> Ping using link-local addresses requires specifying the source interface with `-i` .

```
<R1>ping ipv6 FE80::2E0:FCFF:FE12:6486 -i GigabitEthernet 0/0/3
  PING FE80::2E0:FCFF:FE12:6486 : 56  data bytes, press CTRL_C to break
    Reply from FE80::2E0:FCFF:FE12:6486
    bytes=56 Sequence=1 hop limit=64  time = 90 ms
    Reply from FE80::2E0:FCFF:FE12:6486
    bytes=56 Sequence=2 hop limit=64  time = 10 ms
    Reply from FE80::2E0:FCFF:FE12:6486
    bytes=56 Sequence=3 hop limit=64  time = 20 ms
    Reply from FE80::2E0:FCFF:FE12:6486
    bytes=56 Sequence=4 hop limit=64  time = 10 ms
    Reply from FE80::2E0:FCFF:FE12:6486
    bytes=56 Sequence=5 hop limit=64  time = 30 ms

  --- FE80::2E0:FCFF:FE12:6486 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
round-trip min/avg/max = 10/32/90 ms
```

1.6 DHCPv6 Server and Client Configuration

1.6.1 Server Setup

`dhcpv6 server <pool_name>`

Markdown

```
[R2]dhcp enable
[R2]dhcpv6 pool poolv6
[R2-dhcpv6-pool-poolv6]address prefix 2000:0023::/64
[R2-dhcpv6-pool-poolv6]dns-server 2000:0023::2
```

```
[R2-dhcpv6-pool-poolv6]q
[R2]interface GigabitEthernet0/0/2
[R2-GigabitEthernet0/0/2]dhcpv6 server poolv6
```

Enable DHCP service

Create an address pool

Define address prefix

Set DNS server within pool

Associate pool with an interface for also gateway

1.6.2 Client Setup

```Markdown
[R3]dhcp enable
[R3]interface GigabitEthern0/0/2
[R3-GigabitEthernet0/0/2]ipv6 address auto dhcp
```

Enable DHCP client function

The DHCPv6 server does not allocate gateway information; clients learn default routes through RA messages or stateful configuration.

Display the client address:

```
*down: administratively down
(l): loopback
(s): spoofing
Interface                         Physical
GigabitEthernet0/0/2              up
[IPv6 Address] 2000:23::1
```

1.7 Router Advertisement (RA) Flags Configuration

Markdown

```
[R2]interface GigabitEthern0/0/2
[R2-GigabitEthernet0/0/2]ipv6 nd autoconfig managed-address-flag
[R2-GigabitEthernet0/0/2]ipv6 nd autoconfig other-flag
```

- Managed Address Flag (M flag): Informs whether hosts should use stateful configuration for IP addresses.
- Other Configuration Flag (O flag): Indicates if other configurations should be obtained through stateful configuration.

1.8 Stateless Address Autoconfiguration on R1

Markdown

```
1. : `undo ipv6 nd ra halt`
2. : `ipv6 address auto global`
```

R2:

Markdown

```
[R2]interface GigabitEthern0/0/2
```

```
[R2-GigabitEthernet0/0/2]undo ipv6 nd ra halt
[R2-GigabitEthernet0/0/2]interface GigabitEthern0/0/1
[R2-GigabitEthernet0/0/1]undo ipv6 nd ra halt
```

> Enable RA reception

R1:

```Markdown
[R1]interface GigabitEthern0/0/1
[R1-GigabitEthernet0/0/1]ipv6 address auto global
```

> Activate stateless autoconfiguration

R3:

```Markdown
[R3]interface GigabitEthern0/0/2
[R3-GigabitEthernet0/0/2]ipv6 address auto global
```

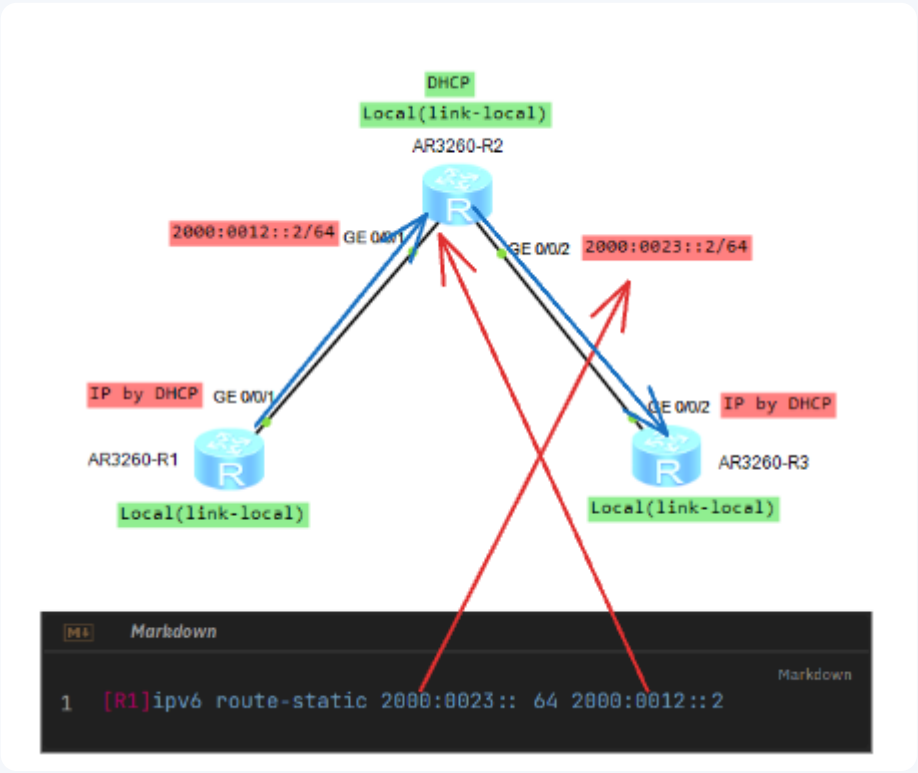
> Activate stateless autoconfiguration

> Stateless mode allows devices to automatically generate their own IP addresses based on received prefixes.

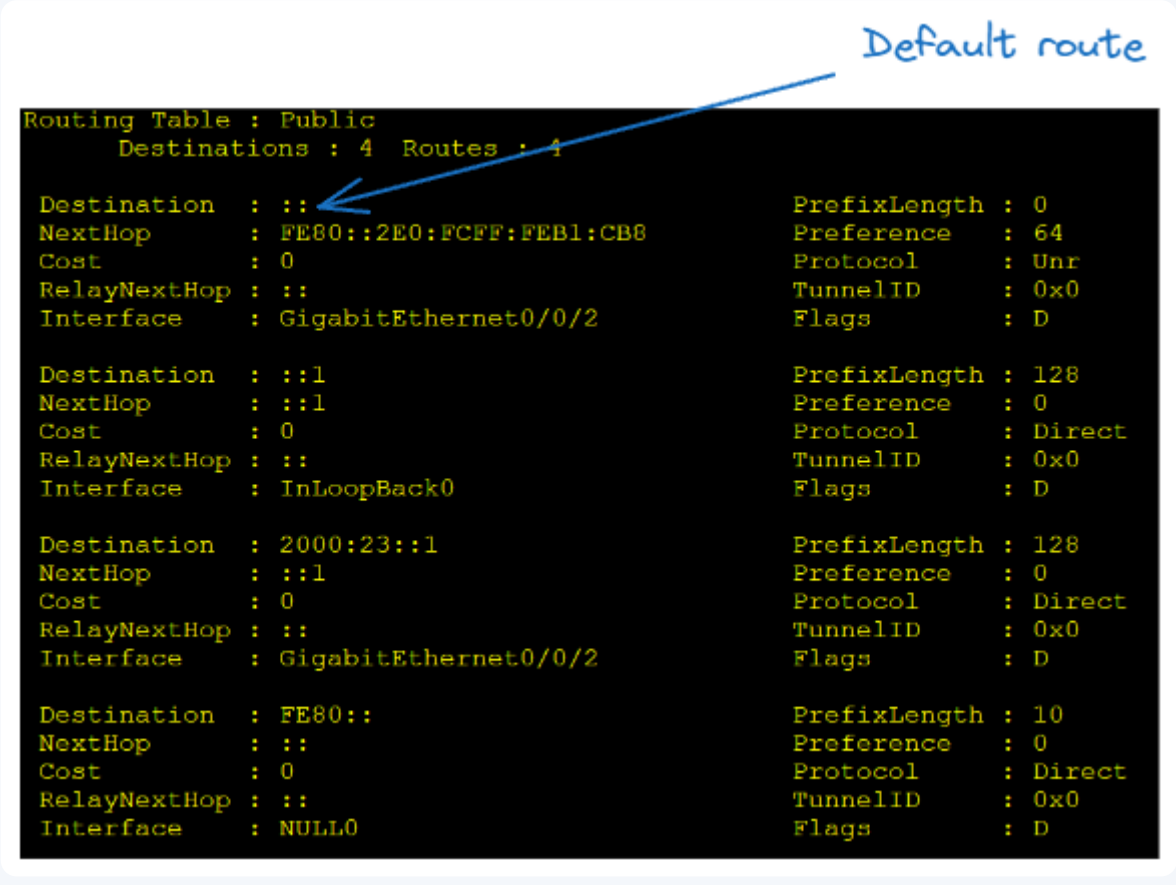
1.9 Static Route Configuration for Connectivity Between R1 and R3

```Markdown
[R1]ipv6 route-static 2000:0023:: 64 2000:0012::2
```

> Add static route on R1 towards network of R3



R3:



> **Note**
>
> R1 has a static route to the network 2000:23::/64. R3 obtains the default route through DHCPv6. Therefore, GigabitEthernet0/0/3 on R1 and GigabitEthernet0/0/3 on R3 can communicate with each other

Test connectivity:

```
[R1]ping ipv6 2000:23::1
  PING 2000:23::1 : 56  data bytes, press CTRL_C to break
    Reply from 2000:23::1
    bytes=56 Sequence=1 hop limit=63   time = 20 ms
    Reply from 2000:23::1
    bytes=56 Sequence=2 hop limit=63   time = 20 ms
    Reply from 2000:23::1
    bytes=56 Sequence=3 hop limit=63   time = 30 ms
    Reply from 2000:23::1
    bytes=56 Sequence=4 hop limit=63   time = 20 ms
    Reply from 2000:23::1
    bytes=56 Sequence=5 hop limit=63   time = 30 ms

  --- 2000:23::1 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
round-trip min/avg/max = 20/24/30 ms
```

1.10 Verification Commands

Display current IP configuration:

R2:

```
*down: administratively down
(l): loopback
(s): spoofing
Interface                         Physical
GigabitEthernet0/0/1              up
[IPv6 Address] 2000:12::2
GigabitEthernet0/0/2              up
[IPv6 Address] 2000:23::2
```

Check routing table entries:

R2:

```
Routing Table : Public
      Destinations : 6  Routes : 6

 Destination  : ::1                              PrefixLength : 128
 NextHop      : ::1                              Preference   : 0
 Cost         : 0                                Protocol     : Direct
 RelayNextHop : ::                               TunnelID     : 0x0
 Interface    : InLoopBack0                      Flags        : D

 Destination  : 2000:12::                        PrefixLength : 64
 NextHop      : 2000:12::2                       Preference   : 0
 Cost         : 0                                Protocol     : Direct
 RelayNextHop : ::                               TunnelID     : 0x0
 Interface    : GigabitEthernet0/0/1             Flags        : D

 Destination  : 2000:12::2                       PrefixLength : 128
 NextHop      : ::1                              Preference   : 0
 Cost         : 0                                Protocol     : Direct
 RelayNextHop : ::                               TunnelID     : 0x0
 Interface    : GigabitEthernet0/0/1             Flags        : D

 Destination  : 2000:23::                        PrefixLength : 64
 NextHop      : 2000:23::2                       Preference   : 0
 Cost         : 0                                Protocol     : Direct
 RelayNextHop : ::                               TunnelID     : 0x0
 Interface    : GigabitEthernet0/0/2             Flags        : D

 Destination  : 2000:23::2                       PrefixLength : 128
 NextHop      : ::1                              Preference   : 0
 Cost         : 0                                Protocol     : Direct
 RelayNextHop : ::                               TunnelID     : 0x0
 Interface    : GigabitEthernet0/0/2             Flags        : D

 Destination  : FE80::                           PrefixLength : 10
 NextHop      : ::                               Preference   : 0
 Cost         : 0                                Protocol     : Direct
 RelayNextHop : ::                               TunnelID     : 0x0
 Interface    : NULL0                            Flags        : D
```

Validate neighbor discovery cache entries:

R2:

```
--------------------------------------------------------------------------------
IPv6 Address : 2000:12::2E0:FCFF:FE29:7399
Link-layer   : 00e0-fc29-7399                    State : STALE
Interface    : GE0/0/1                           Age   : 21
VLAN         : -                                 CEVLAN: -
VPN name     :                                   Is Router: TRUE
Secure FLAG  : UN-SECURE

IPv6 Address : FE80::2E0:FCFF:FE29:7399
Link-layer   : 00e0-fc29-7399                    State : STALE
Interface    : GE0/0/1                           Age   : 21
VLAN         : -                                 CEVLAN: -
VPN name     :                                   Is Router: TRUE
Secure FLAG  : UN-SECURE

IPv6 Address : 2000:23::1
Link-layer   : 00e0-fccf-7091                    State : DELAY
Interface    : GE0/0/2                           Age   : 53
VLAN         : -                                 CEVLAN: -
VPN name     :                                   Is Router: TRUE
Secure FLAG  : UN-SECURE

IPv6 Address : FE80::2E0:FCFF:FECF:7091
Link-layer   : 00e0-fccf-7091                    State : STALE
Interface    : GE0/0/2                           Age   : 21
VLAN         : -                                 CEVLAN: -
VPN name     :                                   Is Router: TRUE
Secure FLAG  : UN-SECURE

--------------------------------------------------------------------------------
Total: 4        Dynamic: 4        Static: 0
```

1.11 Quiz

Question1

Why the source interface must be specified in Step 3 (testing the connectivity between link-local addresses) but not in Step 7 (testing the connectivity between GUA addresses)?

Answer1

- The source interface must be specified when testing link-local addresses because these addresses are only valid on their specific interface and are not routable, so the system needs to know which interface to use. For Global Unicast Addresses (GUAs), the system can determine the

appropriate source address/interface based on routing tables, hence it's not necessary to specify.

- The router has multiple interfaces on the FE80::/10 network. When the destination IPv6 address is a link-local address, the outgoing interface cannot be determined by querying the routing table. Therefore, the source interface must be specified

Question2

Describe the difference between stateful address configuration and stateless address configuration and explain why.

Answer2

- Stateful configuration involves a server (like DHCP) assigning IP addresses and other network settings to clients, while stateless configuration (SLAAC) allows devices to self-configure their own IP addresses without a centralized server.
- In stateful mode, all the 128 bits in an IPv6 interface address are specified by the DHCPv6 server. In stateless mode, a 64-bit interface ID is generated based on the EUI-64 specification