CCNA 200-301, Volume I

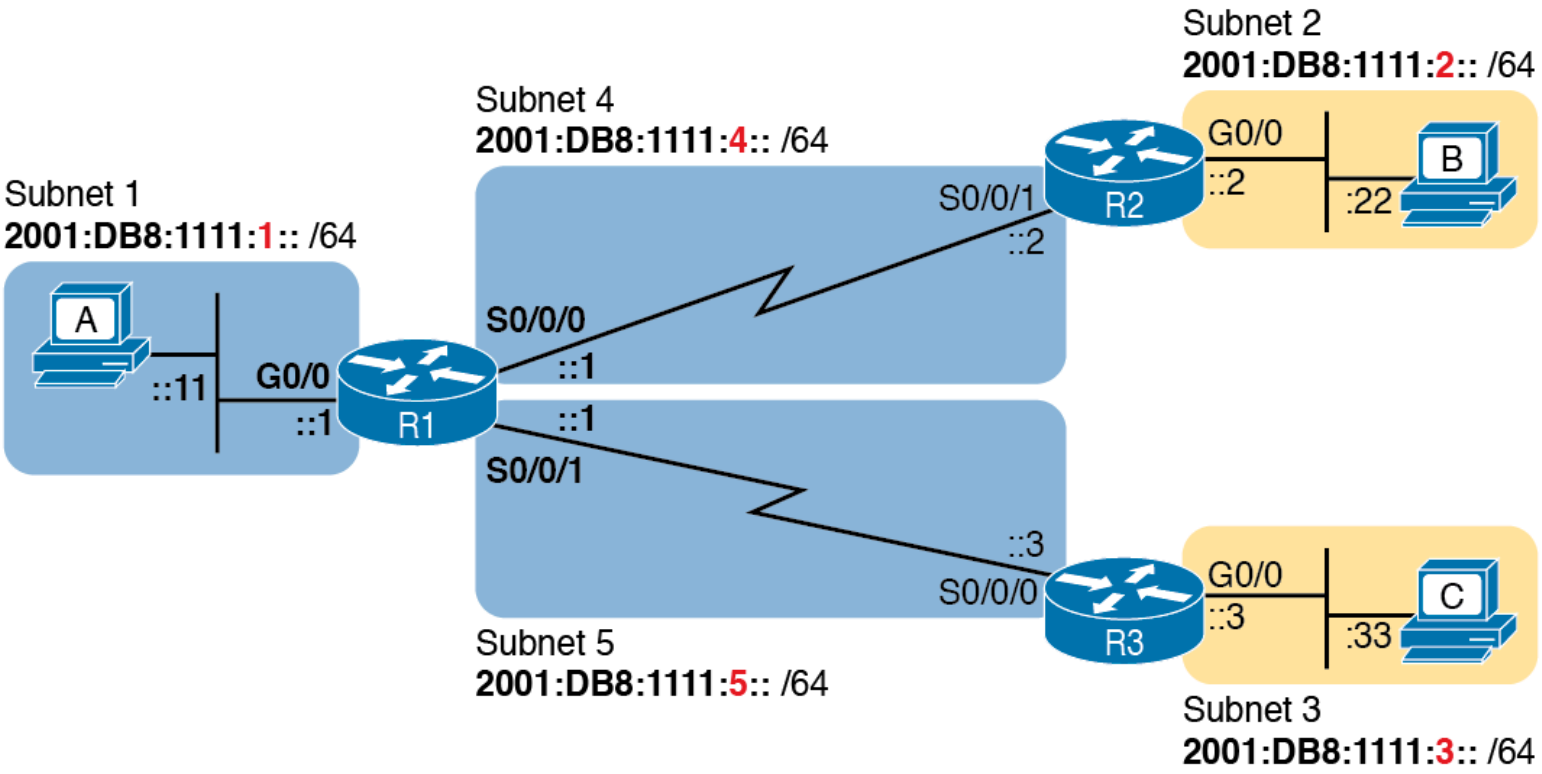
Chapter 35

Implementing IPv6 Routing

Objectives

- Connected and Local IPv6 Routes
- Static IPv6 Routes
- The Neighbor Discovery Protocol

Sample Network Used to Show Connected and Local Routes



IPv6 Addressing Configuration on Router R1

```
ipv6 unicast-routing
!
interface GigabitEthernet0/0
 ipv6 address 2001:DB8:1111:1::1/64
!
interface Serial0/0/0
 ipv6 address 2001:db8:1111:4::1/64
!
interface GigabitEthernet0/1/0
 ipv6 address 2001:db8:1111:5::1/64
```

Routes on Router R1 before Adding Static or Routing Protocols

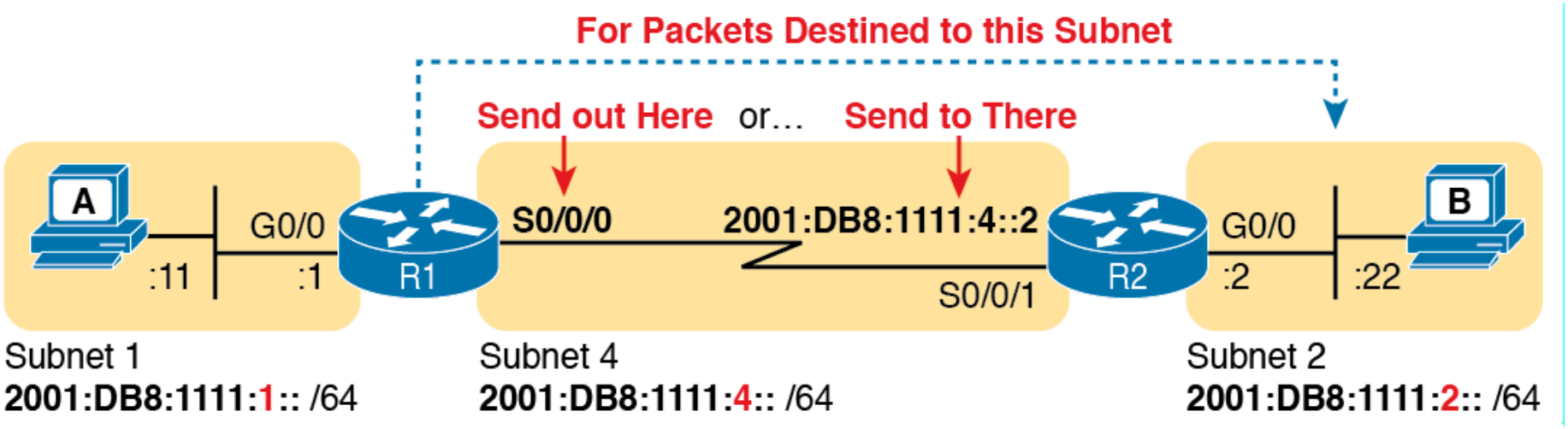
```
R1# show ipv6 route
IPv6 Routing Table - default - 7 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route
       B - BGP, HA - Home Agent, MR - Mobile Router, R - RIP
       H - NHRP, I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea
       IS - ISIS summary, D - EIGRP, EX - EIGRP external, NM - NEMO
       ND - ND Default, NDp - ND Prefix, DCE - Destination, NDr - Redirect
       RL - RPL, O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1
       OE2 - OSPF ext 2, ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
       la - LISP alt, lr - LISP site-registrations, ld - LISP dyn-eid
       lA - LISP away, a - Application
C   2001:DB8:1111:1::/64 [0/0]
     via GigabitEthernet0/0, directly connected
L   2001:DB8:1111:1::1/128 [0/0]
     via GigabitEthernet0/0, receive
C   2001:DB8:1111:4::/64 [0/0]
     via Serial0/0/0, directly connected
L   2001:DB8:1111:4::1/128 [0/0]
     via GigabitEthernet0/0/0, receive
C   2001:DB8:1111:5::/64 [0/0]
     via GigabitEthernet0/1/0, directly connected
L   2001:DB8:1111:5::1/128 [0/0]
     via GigabitEthernet0/1/0, receive
L   FF00::/8 [0/0]
     via Null0, receive
```

Local IPv6 Routes on Router R1

```
R1# show ipv6 route local
! Legend omitted for brevity

L   2001:DB8:1111:1::1/128 [0/0]
     via GigabitEthernet0/0, receive
L   2001:DB8:1111:4::1/128 [0/0]
     via Serial0/0/0, receive
L   2001:DB8:1111:5::1/128 [0/0]
     via GigabitEthernet0/1/0, receive
L   FF00::/8 [0/0]
     via Null0, receive
```

Logic Behind IPv6 Static Route Commands (IPv6 Route)



Static IPv6 Routes on Router R1

```
! Static route on router R1
R1(config)# ipv6 route 2001:db8:1111:2::/64 S0/0/0
```

Static IPv6 Routes on Router R2

```
! Static route on router R2
R2(config)# ipv6 route 2001:db8:1111:1::/64 s0/0/1
```

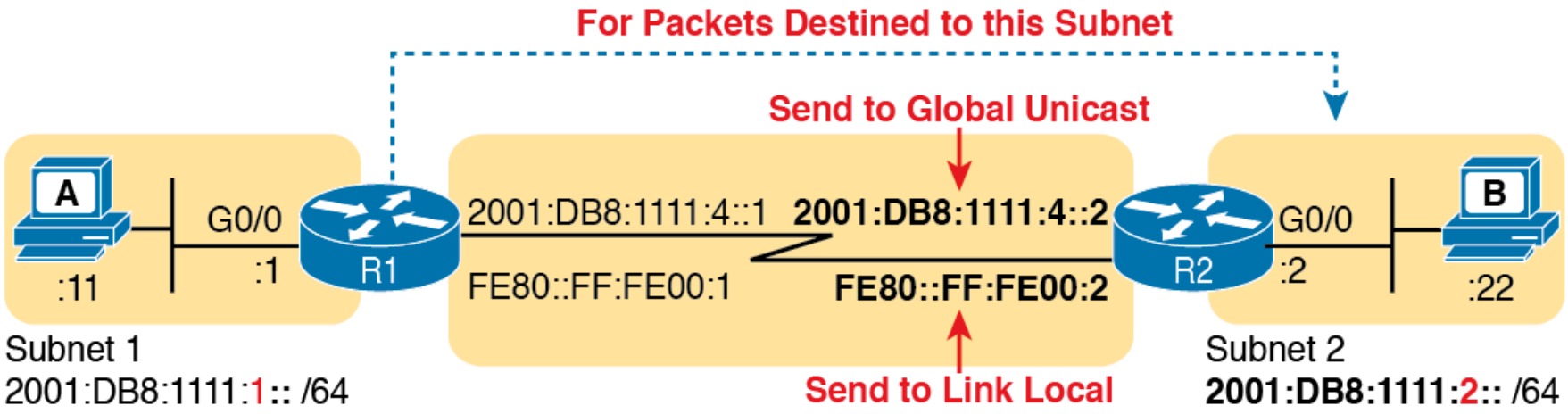
Verification of Static Routes Only on R1

```
R1# show ipv6 route static
! Legend omitted for brevity
S   2001:DB8:1111:2::/64 [1/0]
     via Serial0/0/0, directly connected
```

Displaying the Router R1 Uses to Forward to Host B

```
R1# show ipv6 route 2001:db8:1111:2::22
Routing entry for 2001:DB8:1111:2::/64
  Known via "static", distance 1, metric 0
  Route count is 1/1, share count 0
  Routing paths:
    directly connected via Serial0/0/0
      Last updated 00:01:29 ago
```

Using Unicast or Link-Local as Next-Hop Address for Static Routes



Static IPv6 Routes Using Global Unicast Addresses

```
! The first command is on router R1, listing R2's global unicast address
R1(config)# ipv6 route 2001:db8:1111:2::/64 2001:DB8:1111:4::2
```

```
! The next command is on router R2, listing R1's global unicast address
R2(config)# ipv6 route 2001:db8:1111:1::/64 2001:db8:1111:4::1
```

Verification of Static Routes to a Next-hop Global Unicast Address

```
R1# show ipv6 route static
! Legend omitted for brevity
S   2001:DB8:1111:2::/64 [1/0]
     via 2001:DB8:1111:4::2

R1# show ipv6 route 2001:db8:1111:2::22/64
Routing entry for 2001:DB8:1111:2::/64
  Known via "static", distance 1, metric 0
  Backup from "ospf 1 [110]"
  Route count is 1/1, share count 0
  Routing paths:
    2001:DB8:1111:4::2
      Last updated 00:07:43 ago
```

Static IPv6 Routes Using Link-Local Neighbor Addresses

```
! The first command is on router R1, listing R2's link-local address
R1(config)# ipv6 route 2001:db8:1111:2::/64 S0/0/0 FE80::FF:FE00:2
```

```
! The next command is on router R2, listing R1's link-local address
R2(config)# ipv6 route 2001:db8:1111:1::/64 S0/0/1 FE80::FF:FE00:1
```

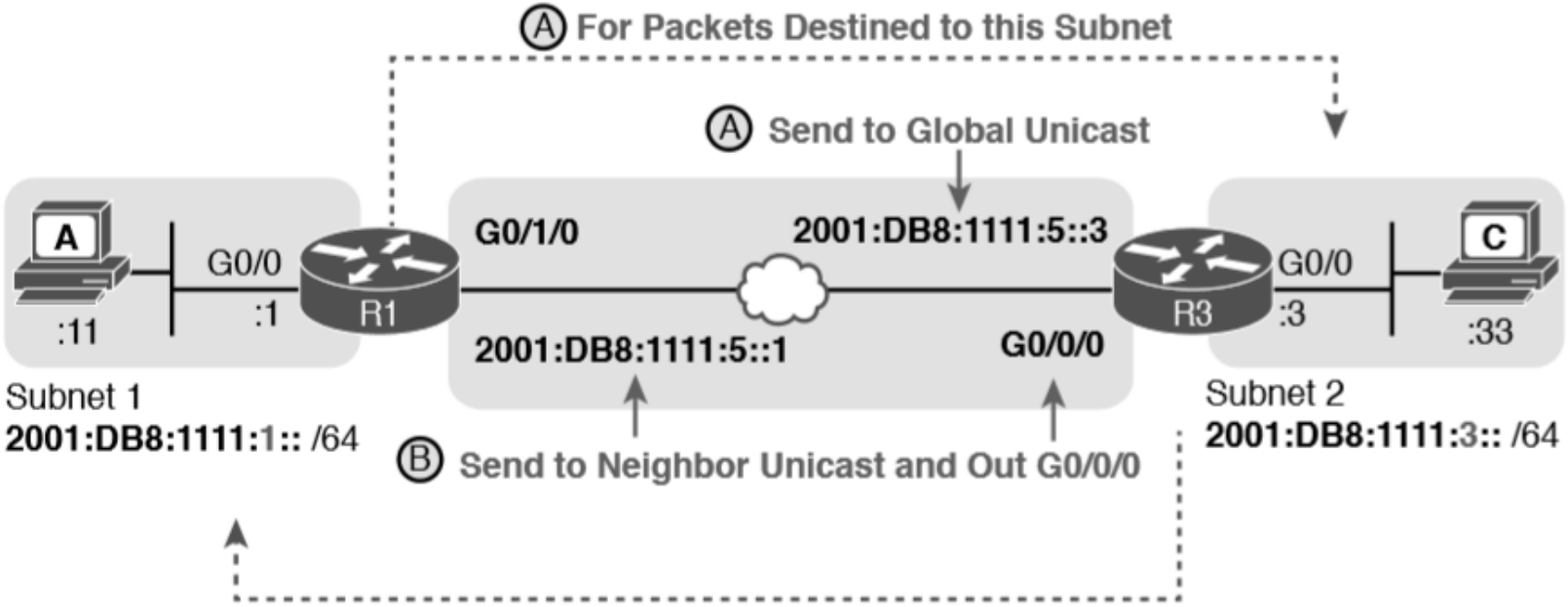
Verification of Static Routes to a Next-Hop Link-local Address

```
R1# show ipv6 route static
! Legend omitted for brevity

S   2001:DB8:1111:2::/64 [1/0]
      via FE80::FF:FE00:2, Serial0/0/0

R1# show ipv6 route 2001:db8:1111:2::22
Routing entry for 2001:DB8:1111:2::/64
  Known via "static", distance 1, metric 0
  Backup from "ospf 1 [110]"
  Route count is 1/1, share count 0
  Routing paths:
    FE80::FF:FE00:2, Serial0/0/0
      Last updated 00:08:10 ago
```

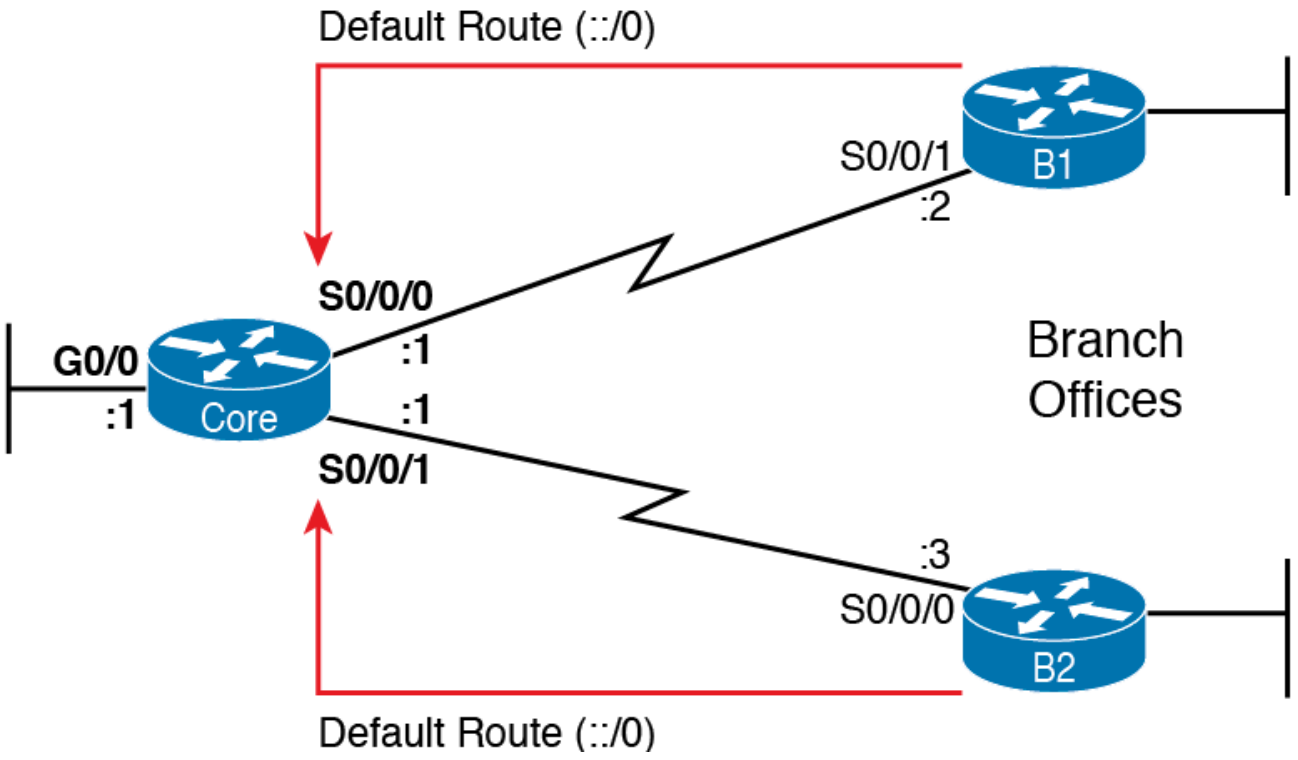
Network Details for IPv6 Static Routes on an Ethernet Interface




```
! The first command is on router R1, listing R3's global unicast address
R1(config)# ipv6 route 2001:db8:1111:3::/64 2001:db8:1111:5::3
```

```
! The next command is on router R2, listing R1's link-local address
R2(config)# ipv6 route 2001:db8:1111:1::/64 G0/0/0 2001:db8:1111:5::1
```

Using Static Default Routes at Branches to Forward Back to the Core



Static Default Route for Branch Router B1

```
!Forward out B1's S0/0/1 local interface...
B1(config)# ipv6 route ::/0 S0/0/1
```

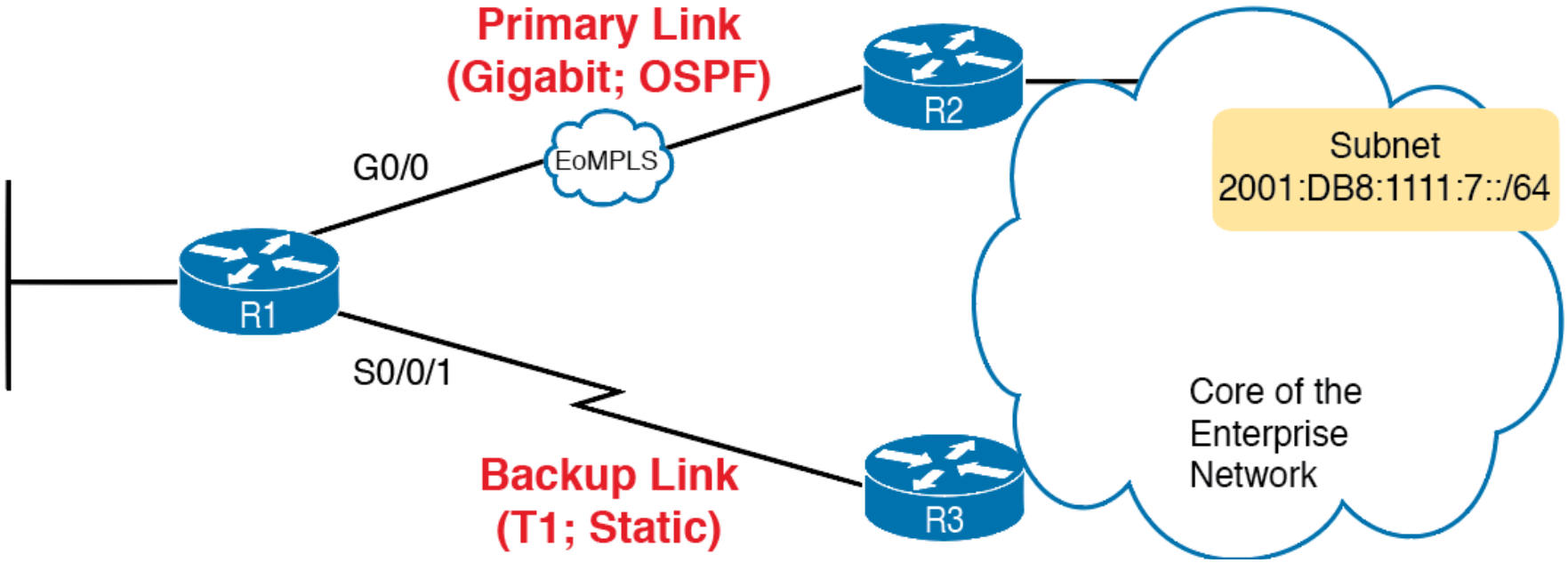
Router B1's Static Default Route (Using Outgoing Interface)

```
B1# show ipv6 route static
IPv6 Routing Table - default - 10 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route
       B - BGP, R - RIP, I1 - ISIS L1, I2 - ISIS L2
       IA - ISIS interarea, IS - ISIS summary, D - EIGRP, EX - EIGRP external
       ND - ND Default, NDp - ND Prefix, DCE - Destination, NDr - Redirect
       O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
       ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
S   ::/0 [1/0]
     via Serial0/0/1, directly connected
```

Static Host IPv6 Routes on R1, for Host B

```
! The first command lists host B's address, prefix length /128,
! with R2's link-local address as next-hop, with an outgoing interface.
R1(config)# ipv6 route 2001:db8:1111:2::22/128 S0/0/0 FE80::FF:FE00:2
R1(config)#
! The next command also lists host B's address, prefix length /128,
! but with R2's global unicast address as next-hop, and no outgoing interface.
R1(config)# ipv6 route 2001:db8:1111:2::22/128 2001:DB8:1111:4::2
```

Using a Floating Static Route to Key Subnet 172.16.2.0/24



Displaying the Administrative Distance of the Static Route

```
R1# show ipv6 route static
! Legend omitted for brevity
S   2001:db8:1111:7::/64 [130/0]
      via 2001:db8:1111:9::3

R1# show ipv6 route 2001:db8:1111:7::/64
Routing entry for 2001:db8:1111:7::/64
  Known via "static", distance 130, metric 0
  Route count is 1/1, share count 0
  Routing paths:
    2001:db8:1111:9::3
      Last updated 00:00:58 ago
```

IOS Defaults for Administrative Distance

Route Source	Administrative Distance
Connected routes	0
Static routes	1
NDP	2
EIGRP	90
OSPF	110
RIP	120
Unknown or unbelievable	255

Sample Topology for Incorrect IPv6 Route Examples

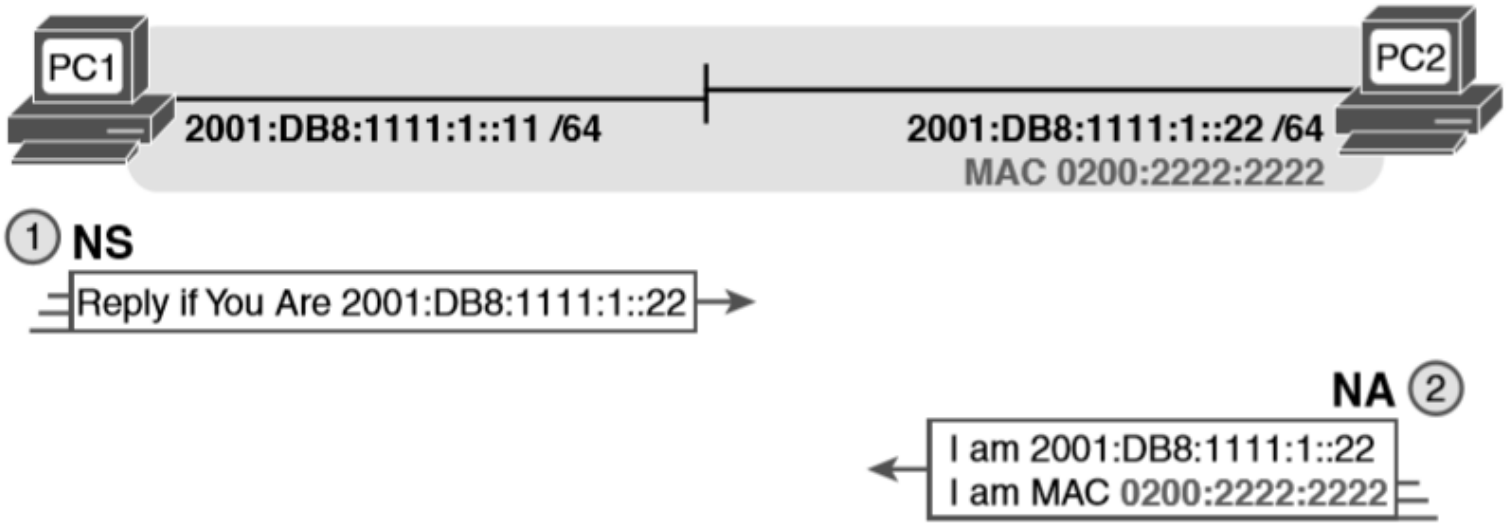
ipv6 route Commands with Correct Syntax but Incorrect Ideas

```
ipv6 route 2001:DB8:9:33::/64 2001:DB8:9:2::2    ! Step 1: Wrong prefix
ipv6 route 2001:DB8:9:3::/64 G0/2 FE80::AAA9     ! Step 2A: Wrong neighbor link local
ipv6 route 2001:DB8:9:3::/64 FE80::2             ! Step 2B: Missing outgoing interface
ipv6 route 2001:DB8:9:3::/64 2001:DB8:9:2::1     ! Step 3: Wrong neighbor address
ipv6 route 2001:DB8:9:3::/64 G0/1 FE80::2        ! Step 4: Wrong interface on R1
```

IOS Rejects the ipv6 route Command with Link-Local and No Outgoing Interface

```
R1# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)# ipv6 route 2001:DB8:9:3::/64 FE80::2
% Interface has to be specified for a link-local nexthop
R1(config)# ^Z
R1#
R1# show running-config | include ipv6 route
R1#
```

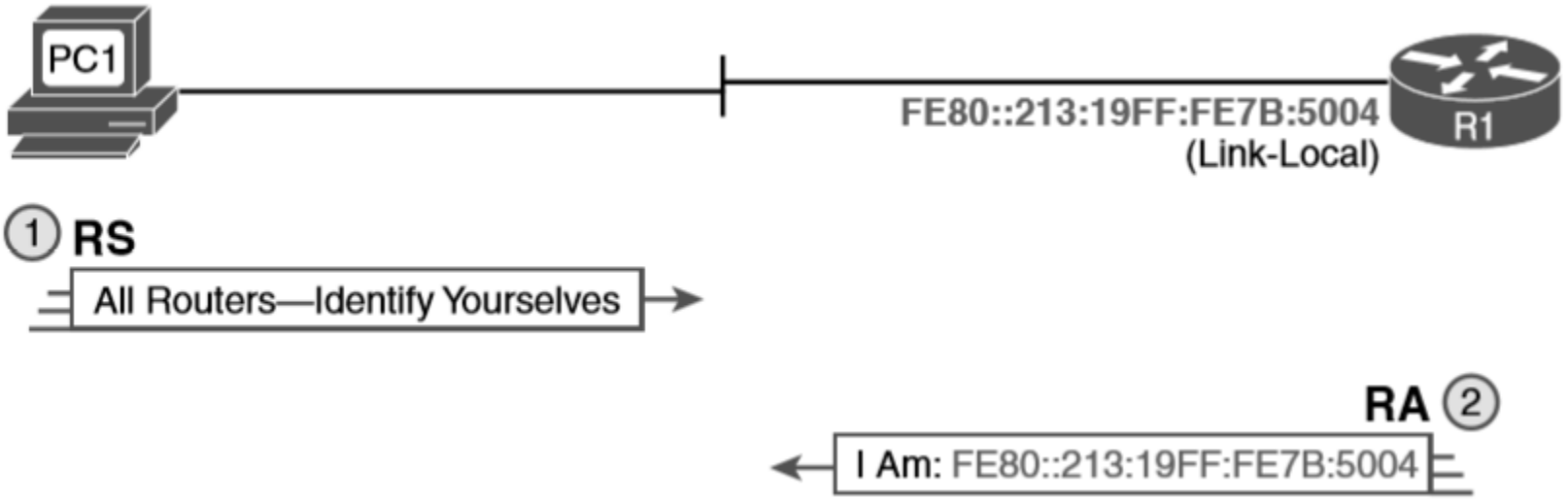
Example NDP NS/NA Process to Find the Neighbor's Link Addresses



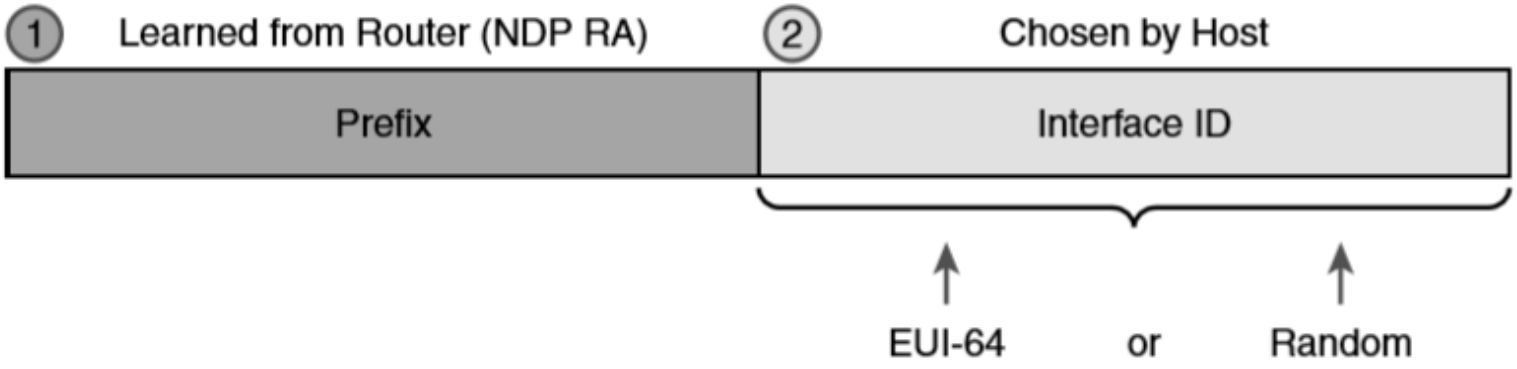
IPv6 Neighbor Table on Router R3

```
R3# show ipv6 neighbors
IPv6 Address                              Age Link-layer Addr State Interface
2001:DB8:1111:5::1                          0 0201.a010.0001  REACH Gi0/0/0
FE80::1:A0FF:FE10:1                         0 0201.a010.0001  REACH Gi0/0/0
```

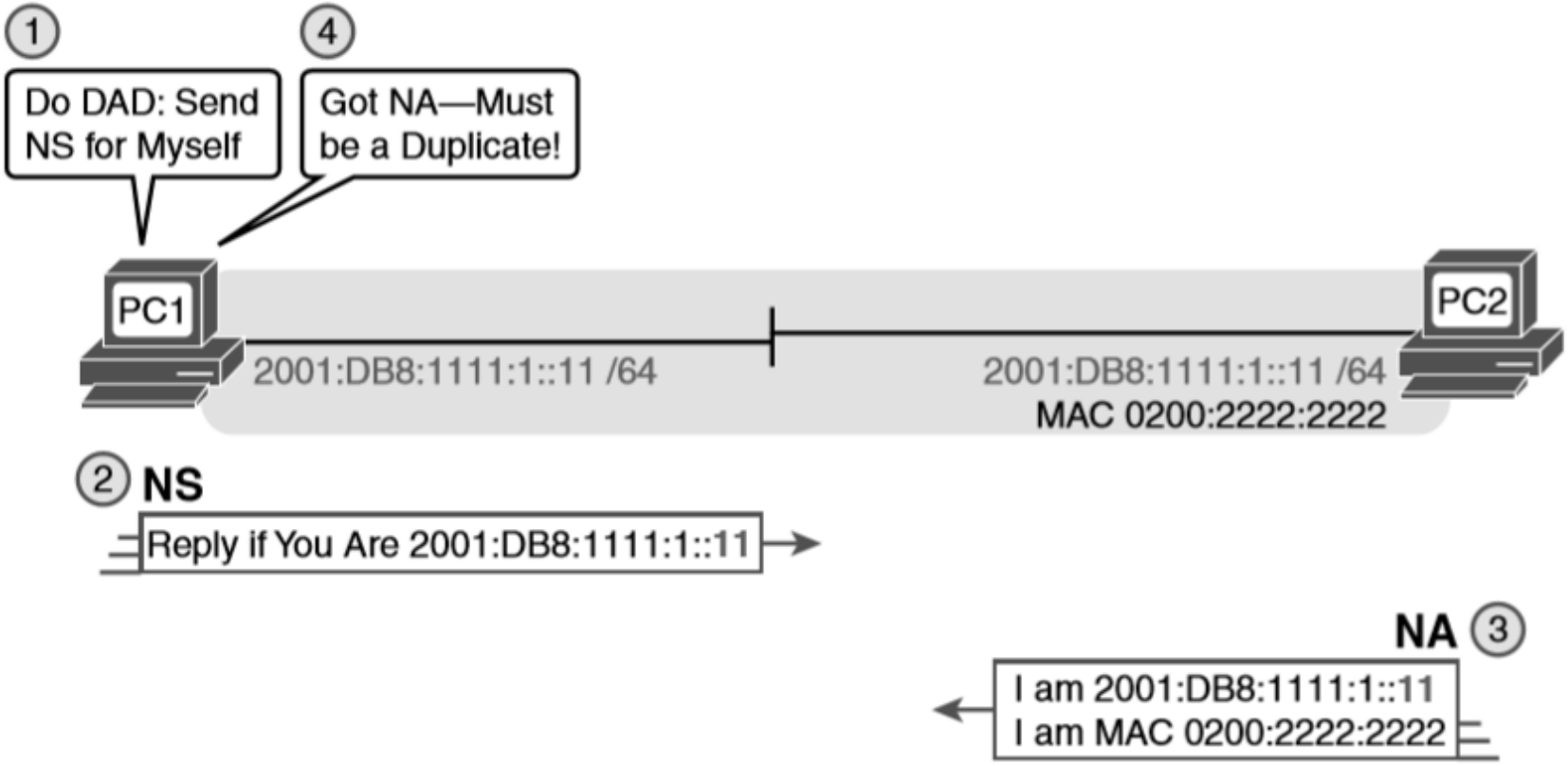
Example NDP RS/RA Process to Find the Default Routers



Host IPv6 Address Formation Using SLAAC



Example Duplicate Address Detection (DAD) with NDP NS/NA



NDP Function Summary

Function	Protocol Messages	Who Discovers Info	Who Supplies Info	Info Supplied
Router discovery	RS and RA	Any IPv6 host	Any IPv6 router	Link-local IPv6 address of router
Prefix/length discovery	RS and RA	Any IPv6 host	Any IPv6 router	Prefix(es) and associated prefix lengths used on local link
Neighbor discovery	NS and NA	Any IPv6 host	Any IPv6 host	Link-layer address (for example, MAC address) used by a neighbor
Duplicate Address Detection	NS and NA	Any IPv6 host	Any IPv6 host	Simple confirmation whether a unicast address is already in use