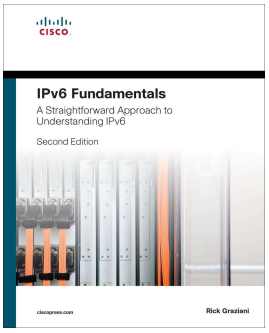


IPv6 Fundamentals, by Rick Graziani

Link Local Address

Selected by **Alvaro Barradas** for Redes II

<abarra@ualg.pt>

1

Chapter 6

Link-Local Unicast Address

2

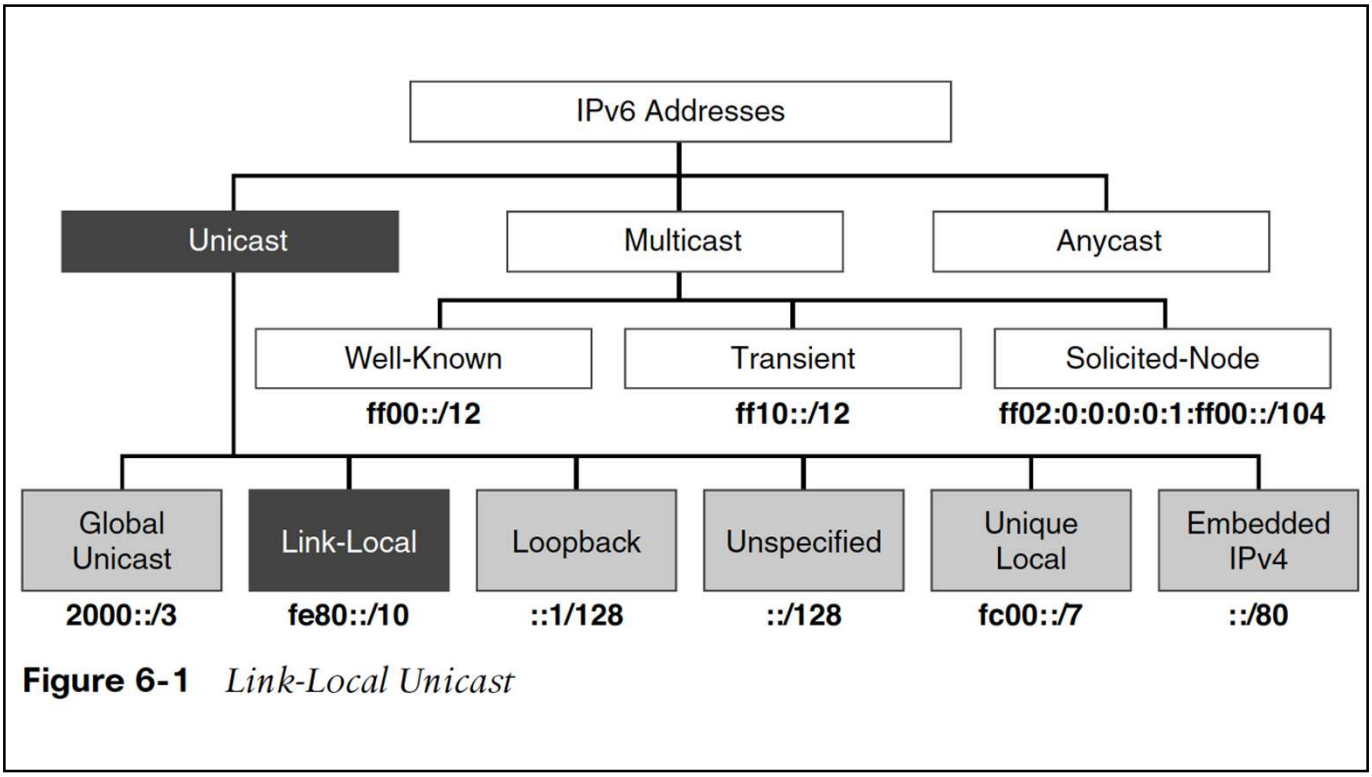


Figure 6-1 *Link-Local Unicast*

3

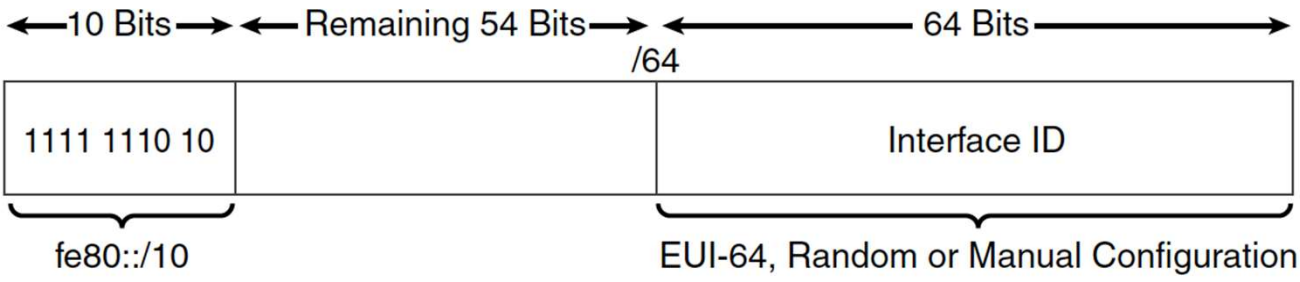


Figure 6-2 *Link-Local Unicast Address*

4

Table 6-1 *Range of Link-Local Unicast Addresses*

Link-Local Unicast Address (Hexadecimal)	Range of First Hextet	Range of First Hextet in Binary
fe80::/10	fe80	1111 1110 1000 0000
	febf	1111 1110 1011 1111

5

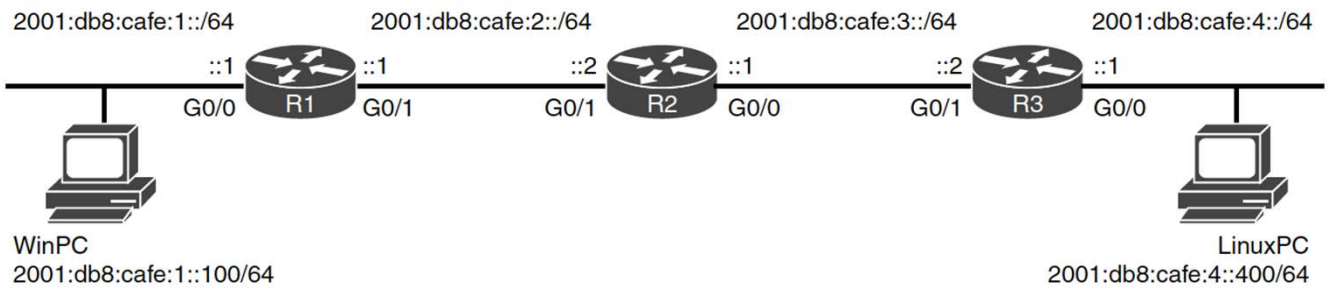


Figure 6-3 *Topology for Link-Local Addresses Example*

6

Example 6-1 *Displaying the Link-Local Address on Router R1*

```
R1# show interface gigabitethernet 0/0
GigabitEthernet0/0 is up, line protocol is up
  Hardware is CN Gigabit Ethernet, address is 58ac.7893.da00 (bia 58ac.7893.da00)
<output omitted for brevity>

R1# show ipv6 interface gigabitethernet 0/0
GigabitEthernet0/0 is up, line protocol is up
  IPv6 is enabled, link-local address is FE80::5AAC:78FF:FE93:DA00
  No Virtual link-local address(es):
  Global unicast address(es):
    2001:DB8:CAFE:1::1, subnet is 2001:DB8:CAFE:1::/64
<output omitted for brevity>

R1# show ipv6 interface brief gigabitethernet 0/0
GigabitEthernet0/0      [up/up]
    FE80::5AAC:78FF:FE93:DA00
    2001:DB8:CAFE:1::1
R1#
```

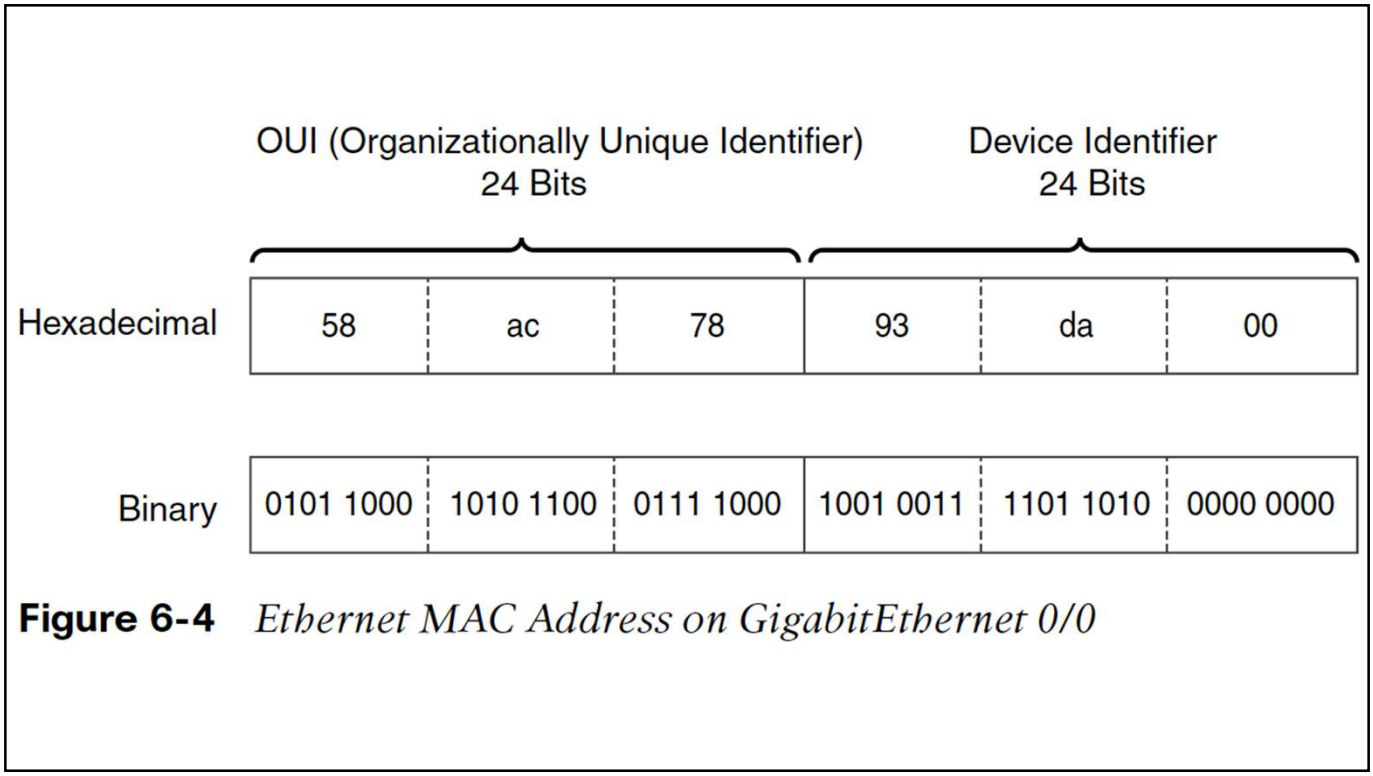



Figure 6-4 *Ethernet MAC Address on GigabitEthernet 0/0*

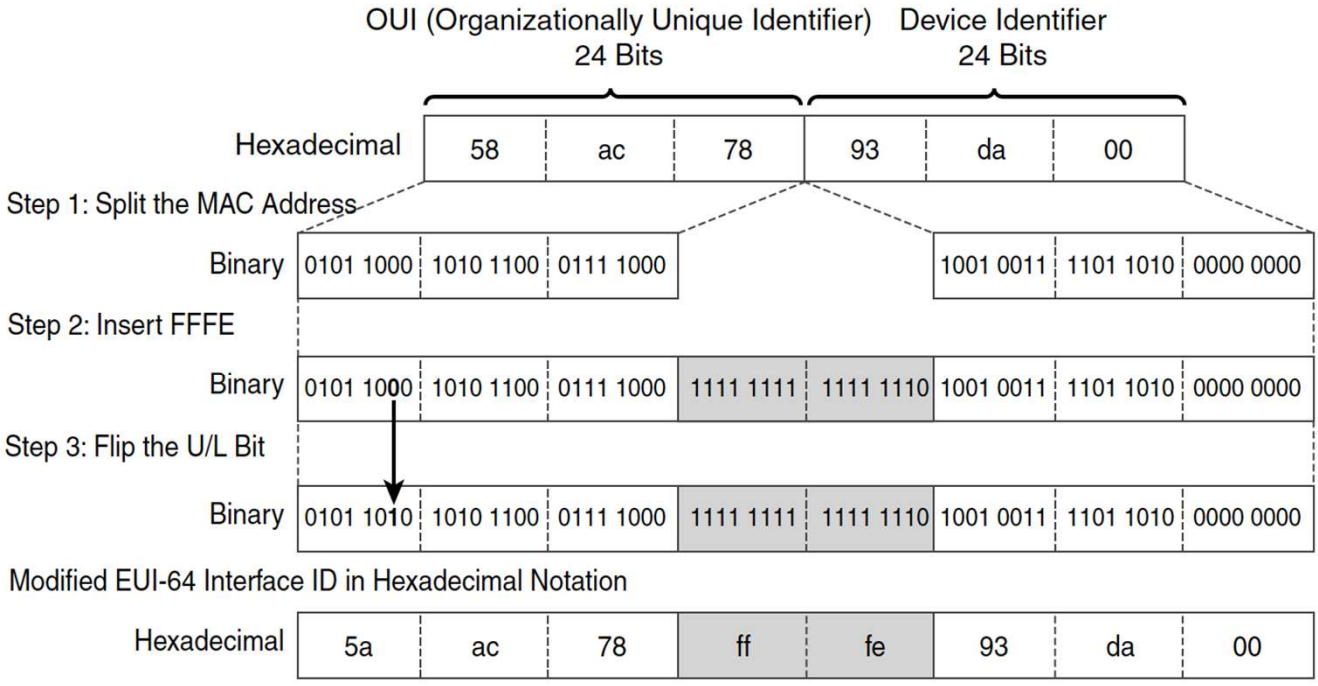


Figure 6-5 *Modified EUI-64 Format on GigabitEthernet 0/0*

9

Example 6-2 show ipv6 interface brief *Command with Serial Interface on Router R1*

```
R1# show ipv6 interface brief
GigabitEthernet0/0      [up/up]
    FE80::5AAC:78FF:FE93:DA00      ! Link-local address
    2001:DB8:CAFE:1::1             ! Global unicast address
GigabitEthernet0/1      [up/up]
    FE80::5AAC:78FF:FE93:DA01      ! Link-local address
    2001:DB8:CAFE:2::1             ! Global unicast address
Serial0/0/0             [up/up]
    FE80::5AAC:78FF:FE93:DA00      ! Link-local address
    2001:DB8:CAFE:99::1            ! Global unicast address
R1#
```

10

Example 6-3 *Viewing the Link-Local Address on the LinuxPC*

```
LinuxPC$ ifconfig
eth0      Link encap:Ethernet  HWaddr 00:50:56:af:14:1b
          inet6 addr:0.0.0.6  Bcast:255.255.255.255  Mask:0.0.0.0
          inet6 addr: 2001:db8:cafe:4::400/64 Scope:Global
          inet6 addr: fe80::250:56ff:feaf:141b/64 Scope:Link
<output omitted>
```


Linux PC 48 Bit MAC Address: 00:50:56:af:14:1b

```
              0    0    5    0   .  5    6    a    f   .  1    4    1   b
             0000 0000 0101 0000 . 0101 0110 1010 1111 . 0001 0100 0001 1011

① 0000 0000 0101 0000 . 0101 0110                      1010 1111 . 0001 0100 0001 1011
② 0000 0000 0101 0000 . 0101 0110 11111111 11111110 1010 1111 . 0001 0100 0001 1011
③ 0000 0010 0101 0000 . 0101 0110 11111111 11111110 1010 1111 . 0001 0100 0001 1011
   0    2    5    0   .  5    6    f    f    f    e    a    f   .  1    4    1    b
```

Link-local unicast address is fe80::250:56ff:feaf:141b

Interface ID
(EUI-64 Format)

Figure 6-6 *Modified EUI-64 Format on LinuxPC*

Example 6-4 *IPv6 Configuration on WinPC*

```
WinPC> ipconfig /all
Windows IP Configuration
<output omitted for brevity>

Ethernet adapter Local Area Connection:
   Connection-specific DNS Suffix  . :
   Description: Intel<R> PRO/1000 MT Network Connection
   Physical Address: 00-50-56-AF-97-68
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled:. . . . : Yes
   IPv6 Address. . . . . . . . . . . : 2001:db8:cafe:1::100
   Link-local IPv6 Address . . . . . : fe80::d0f8:9ff6:4201:7086%11
<output omitted for brevity>
```

13

Example 6-5 *Windows Host Link-Local Address and Zone ID*

```
Windows-Host> ipconfig

Windows IP Configuration

Wireless LAN adapter Wireless Network Connection:

   Connection-specific DNS Suffix  . :
   IPv6 Address. . . . . . . . . . . : 2001:db8:face:1::aaaa
   Link-local IPv6 Address . . . . . : fe80::6c51:4f86:ff70:67f5%12
   Default Gateway . . . . . . . . . : fe80::481d:70ff:fe6f:9503%12

Ethernet adapter Local Area Connection:

   Connection-specific DNS Suffix  . :
   IPv6 Address. . . . . . . . . . . : 2001:db8:face:1::bbbb
   Link-local IPv6 Address . . . . . : fe80::9d23:50de:14ce:c8ab%11
   Default Gateway . . . . . . . . . : fe80::481d:70ff:fe6f:9503%11

Windows-Host> netsh interface ipv6 show interfaces

Idx     Met         MTU          State                Name
---  ----------  ----------  ------------  ---------------------------
  1          50  4294967295  connected     Loopback Pseudo-Interface 1
 12          10        1500  connected     Wireless Network Connection
 25          50        1280  disconnected  isatap
 11          10        1500  connected     Local Area Connection
 16          50        1280  disconnected  Teredo Tunneling Pseudo-Interface
Windows-Host>
```

14

Example 6-6 *Windows Host Pinging the Default Gateway Using the Zone ID*

```
Windows-Host> ping fe80::481d:70ff:fe6f:9503%11

Pinging fe80::481d:70ff:fe6f:9503%11 with 32 bytes of data:
Reply from fe80::481d:70ff:fe6f:9503%11: time=2ms
Reply from fe80::481d:70ff:fe6f:9503%11: time=1ms
<output omitted for brevity>

Windows-Host> ping fe80::481d:70ff:fe6f:9503%12

Pinging fe80::481d:70ff:fe6f:9503%12 with 32 bytes of data:
Reply from fe80::481d:70ff:fe6f:9503%12: time=13ms
Reply from fe80::481d:70ff:fe6f:9503%12: time=4ms
<output omitted for brevity>

Windows-Host> ping fe80::481d:70ff:fe6f:9503

Pinging fe80::481d:70ff:fe6f:9503 with 32 bytes of data:
Reply from fe80::481d:70ff:fe6f:9503: time=4ms
Reply from fe80::481d:70ff:fe6f:9503: time=4ms
<output omitted for brevity>

Windows-Host> ping fe80::481d:70ff:fe6f:9503%16

Pinging fe80::481d:70ff:fe6f:9503%16 with 32 bytes of data:
Request timed out.
Request timed out.
<output omitted for brevity>
```

15

Table 6-2 *Configuring a Static Link-Local Unicast Address*

Command	Description
Router(config)# **interface** *interface-type interface-number*	Specifies the interface type and interface number.
Router(config-if)# **ipv6 address** *ipv6-address* **link-local**	Specifies the IPv6 link-local address. The **link-local** parameter is required.

16

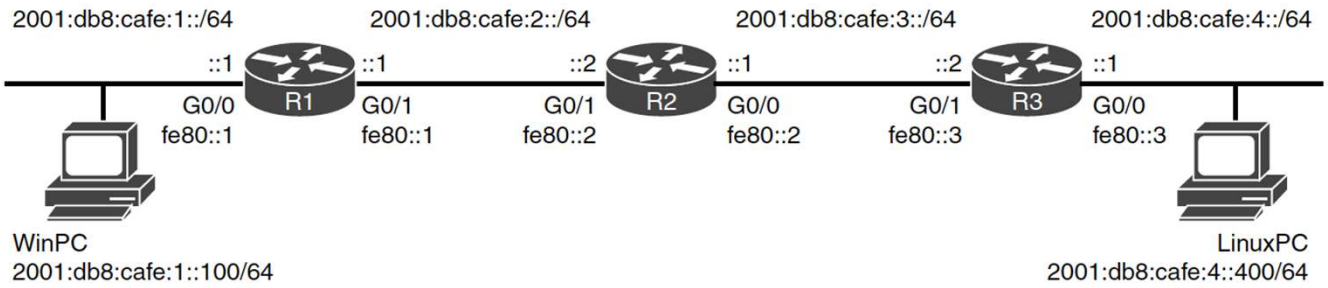


Figure 6-7 *Topology Used to Configure Static Link-Local Addresses*

17

Example 6-7 *Configuring Static Link-Local Unicast Addresses on R1, R2, and R3*

```
R1(config)# interface gigabitethernet 0/0
R1(config-if)# ipv6 address fe80::1 ?
  link-local  Use link-local address

R1(config-if)# ipv6 address fe80::1 link-local
R1(config-if)# exit
R1(config)# interface gigabitethernet 0/1
R1(config-if)# ipv6 address fe80::1 link-local
----------------------------------------
R2(config)# interface gigabitethernet 0/0
R2(config-if)# ipv6 address fe80::2 link-local
R2(config-if)# exit
R2(config)# interface gigabitethernet 0/1
R2(config-if)# ipv6 address fe80::2 link-local
----------------------------------------
R3(config)# interface gigabitethernet 0/0
R3(config-if)# ipv6 address fe80::3 link-local
R3(config-if)# exit
R3(config)# interface gigabitethernet 0/1
R3(config-if)# ipv6 address fe80::3 link-local
```

18

Example 6-8 *Verifying the Static Link-Local Unicast Addresses on R1, R2, and R3*

```
R1# show ipv6 interface brief
GigabitEthernet0/0      [up/up]
    FE80::1
    2001:DB8:CAFE:1::1
GigabitEthernet0/1      [up/up]
    FE80::1
    2001:DB8:CAFE:2::1
```

19

```
-----------------------------------------
R2# show ipv6 interface brief
GigabitEthernet0/0      [up/up]
    FE80::2
    2001:DB8:CAFE:3::1
GigabitEthernet0/1      [up/up]
    FE80::2
    2001:DB8:CAFE:2::2
R2#
-----------------------------------------
R3# show ipv6 interface brief
GigabitEthernet0/0      [up/up]
    FE80::3
    2001:DB8:CAFE:4::1
GigabitEthernet0/1      [up/up]
    FE80::3
    2001:DB8:CAFE:3::2
R3#
```

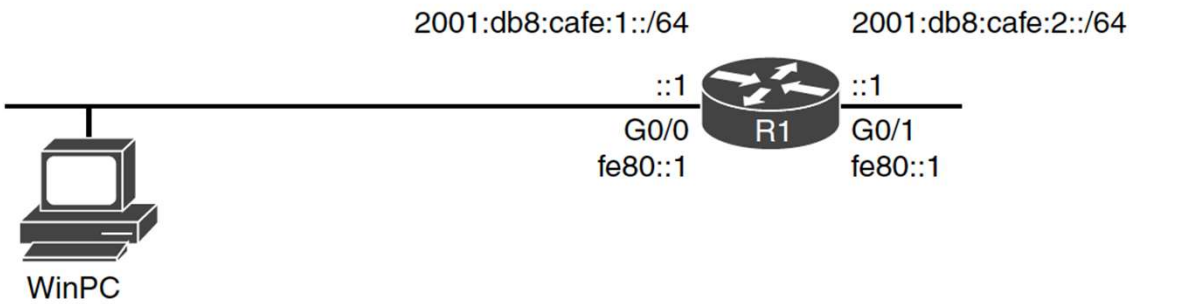
20

Example 6-9 *R1's IPv6 Routing Table*

```
R2# show ipv6 route ospf
IPv6 Routing Table - default - 7 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route
<output omitted for brevity>
       O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2

O   2001:DB8:CAFE:1::/64 [110/2]
     via FE80::1, GigabitEthernet0/1
O   2001:DB8:CAFE:4::/64 [110/2]
     via FE80::3, GigabitEthernet0/0
R2#
```

21



① Link-local address: fe80:: + locally generated Interface ID

② **NDP Neighbor Solicitation Message – DAD**
Is anyone else on this link using this link-local address?
fe80::d0f8:9ff6:4201:7086

Figure 6-8 *Link-Local Addresses and Duplicate Address Detection*

22

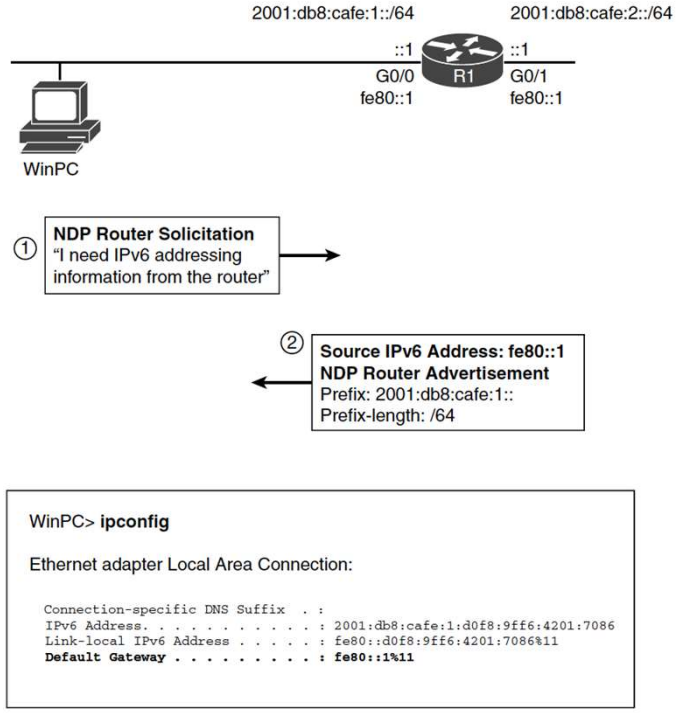


Figure 6-9 *WinPC* ipconfig *with Link-Local Address for Default Gateway*

Example 6-10 ipv6 enable *Command*

```
Router(config)# interface gigabitethernet 0/1
Router(config-if)# ipv6 enable
Router(config-if)# end
Router# show ipv6 interface brief g 0/1
GigabitEthernet0/1            [up/up]
    FE80::20C:30FF:FE10:92E1
Router#
```

Example 6-11 *Configuring an Interface with Only a Link-Local Address*

```
Router(config)# interface gigabitethernet 0/0
Router(config-if)# ipv6 address fe80::99 link-local
Router(config-if)# end
Router# show ipv6 interface brief g 0/0
GigabitEthernet0/0             [up/up]
    FE80::99
Router#
```

25

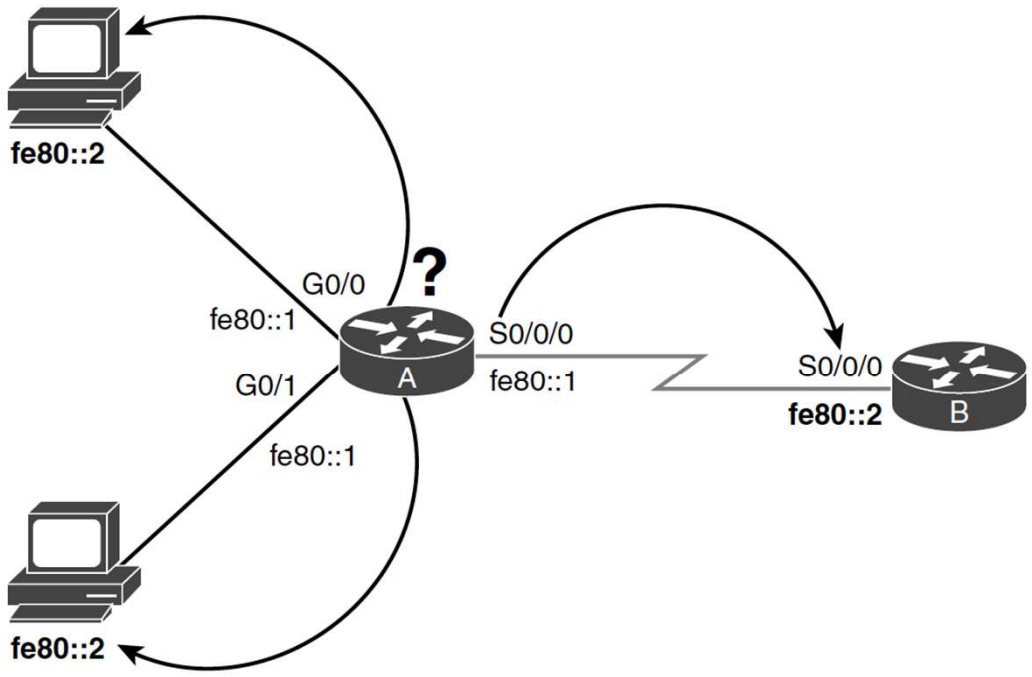


Figure 6-10 *Same Link-Local Address on Different Networks*

26

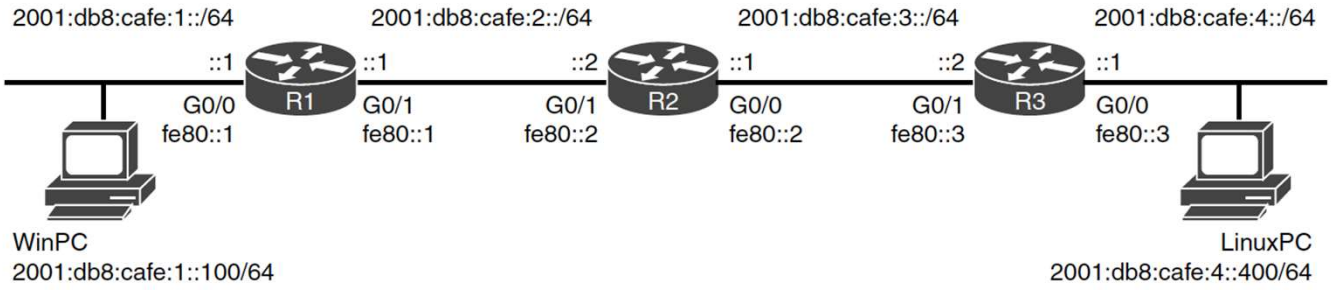


Figure 6-11 *Topology Used to Verify Link-Local Addresses*

27

Example 6-12 *Pinging a Link-Local Address Using Cisco IOS*

```
R2# ping fe80::1
Output Interface: g0/1
% Invalid interface. Use full interface name without spaces (e.g. Serial0/1)
Output Interface: gigabitethernet0/1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to FE80::1, timeout is 2 seconds:
Packet sent with a source address of FE80::2%GigabitEthernet0/1
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
R2#
```

28

Example 6-13 *Pinging a Link-Local Address from Windows OS*

```
WinPC> ping fe80::1

Pinging fe80::1 with 32 bytes of data:
Reply from fe80::1: time=2ms
Reply from fe80::1: time=1ms
<output omitted for brevity>

WinPC> netsh interface ipv6 show interfaces

Idx     Met         MTU          State                Name
---  ----------  ----------  ------------  ---------------------------
  1          50  4294967295  connected     Loopback Pseudo-Interface 1
<output omitted for brevity>
 11          10        1500  connected     Local Area Connection
 13          50        1280  disconnected  Teredo Tunneling Pseudo-Interface

WinPC> ping fe80::1%11

Pinging fe80::1%11 with 32 bytes of data:
Reply from fe80::1%11: time=1ms
Reply from fe80::1%11: time=1ms
<output omitted for brevity>
```

29

Example 6-14 *Pinging a Link-Local Address from Linux OS*

```
LinuxPC$ ping6 fe80::3
Connect: Invalid argument

LinuxPC$ ifconfig
eth0      Link encap:Ethernet  HWaddr 00:50:56:af:14:1b
          inet6 addr:0.0.0.6  Bcast:255.255.255.255  Mask:0.0.0.0
          inet6 addr: 2001:db8:cafe:4::400/64 Scope:Global
          inet6 addr: fe80::250:56ff:feaf:141b/64 Scope:Link
<output omitted>

LinuxPC$ ping6 fe80::3%eth0
PING fe80::3%eth0(fe80::3) 56 data bytes
64 bytes from fe80::3: icmp_seq=0 ttl=64 time=0.552 ms
64 bytes from fe80::3: icmp_seq=1 ttl=64 time=0.429 ms
<output omitted for brevity>

LinuxPC$ ping6 -I eth0 fe80::3
PING fe80::3%eth0(fe80::3) 56 data bytes
64 bytes from fe80::3: icmp_seq=0 ttl=64 time=0.552 ms
64 bytes from fe80::3: icmp_seq=1 ttl=64 time=0.551 ms
<output omitted for brevity>
```

30

Example 6-15 *Pinging a Link-Local Address from Mac OS*

```
MacOS$ ping6 fe80::1
ping6: sendmsg: No route to host
<output omitted for brevity>

MacOS$ ifconfig
   inet6 fe80::aa20:66ff:fe2c:9d97%en4 prefixlen 64 scopeid 0x9
    inet6 2001:db8:cafe:1::200 prefixlen 64

MacOS$ ping6 fe80::1%en4
PING6(56=40+8+8 bytes) fe80::aa20:66ff:fe2c:9d97%en4 --> fe80::1%en4
16 bytes from fe80::1%en4, icmp_seq=0 hlim=64 time=5.205 ms 16 bytes from
  fe80::1%en4, icmp_seq=1 hlim=255 time=1.676 ms
<output omitted for brevity>

MacOS$ ping6 -I en4 fe80::1
PING6(56=40+8+8 bytes) fe80::aa20:66ff:fe2c:9d97%en4 --> fe80::1%en4
16 bytes from fe80::1%en4, icmp_seq=0 hlim=64 time=1.772 ms
16 bytes from fe80::1%en4, icmp_seq=1 hlim=255 time=1.086 ms
<output omitted for brevity>
```