

IPv6 Fundamentals, Second Edition by Rick Graziani

- Slides for Chapter 7 Multicast Addresses
- <http://www.ciscopress.com/store/ipv6-fundamentals-a-straightforward-approach-to-understanding-9781587144776>

1

Chapter 7

Multicast Addresses

2

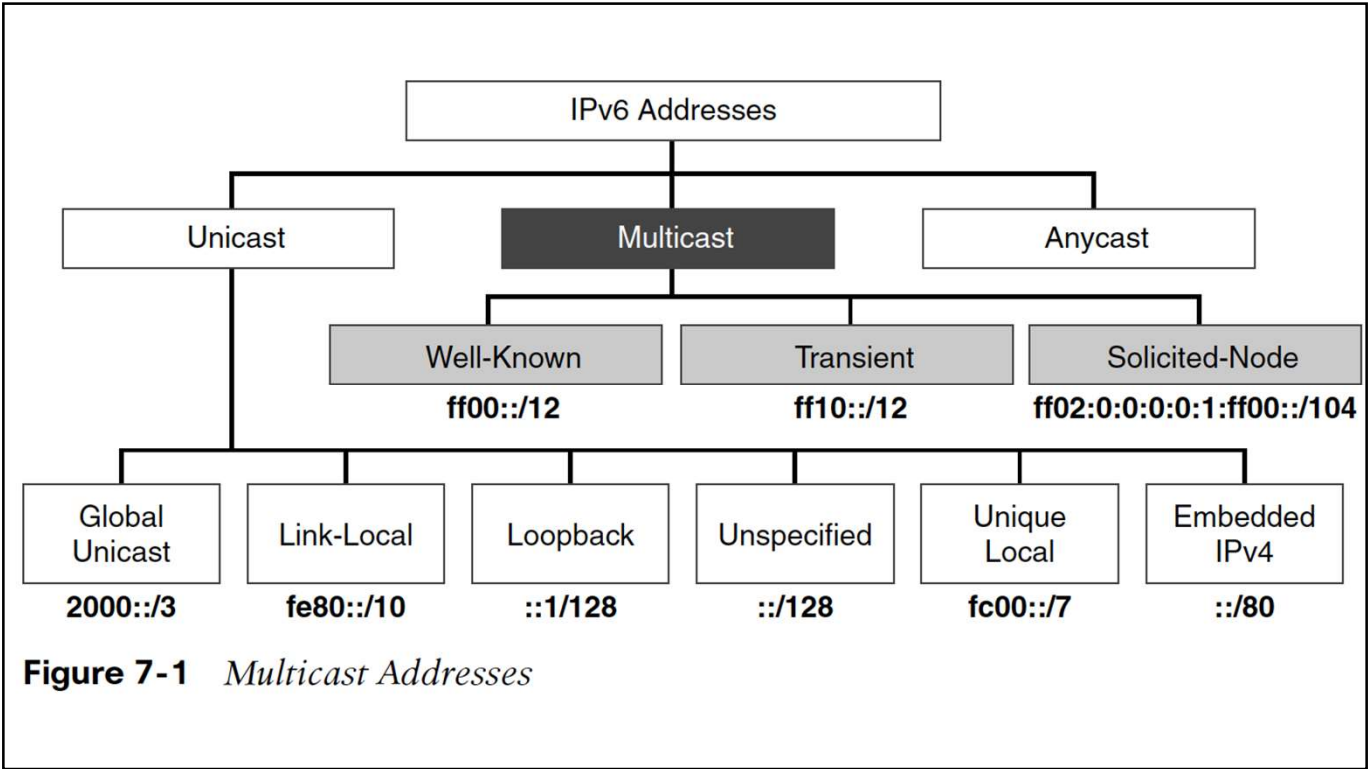


Figure 7-1 *Multicast Addresses*

3

Table 7-1 IPv6 Multicast Address Representations	
Representation	IPv6 Multicast Address
Preferred	ff00:0000:0000:0000:0000:0000:0000:0000/8
No leading 0s	ff00:0:0:0:0:0:0:0/8
Compressed	ff00::/8

4

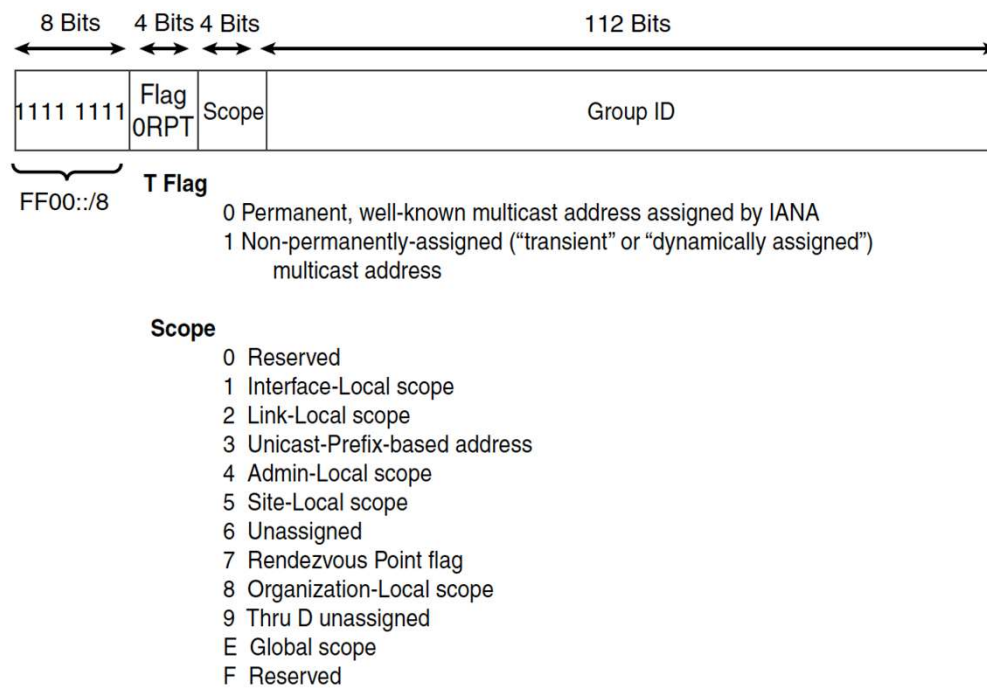


Figure 7-2 *IPv6 Multicast Address*

5

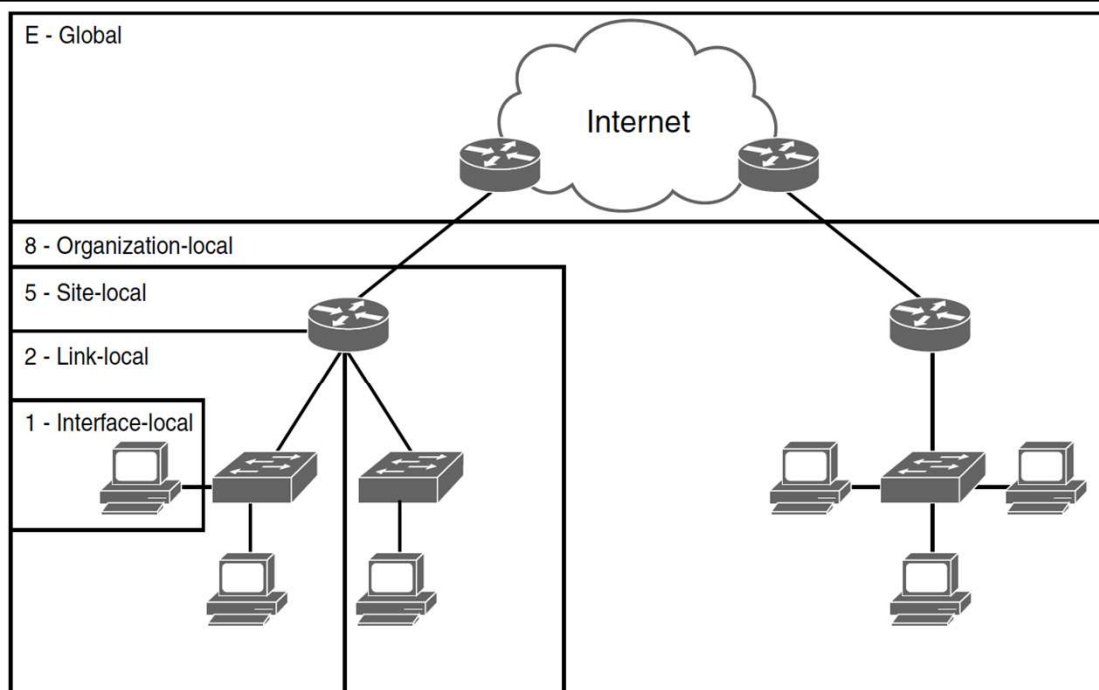
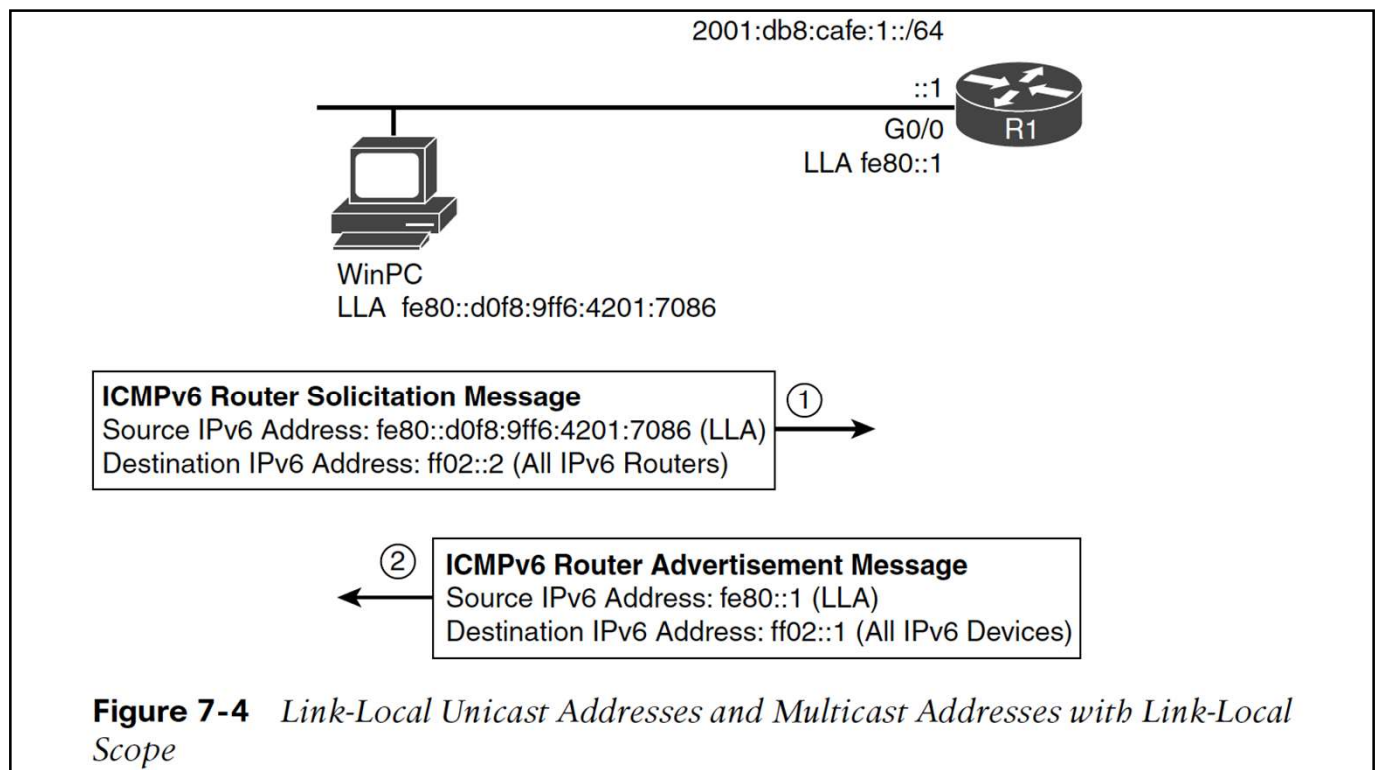


Figure 7-3 *Multicast Scope*

6



7

Table 7-2 *Well-Known Multicast Addresses*

/8 Prefix	Flag	Scope	Predefined Group ID	Compressed Format	Description
<i>Interface-Local Scope</i>					
ff	0	1	0:0:0:0:0:0:1	ff01::1	All-nodes
ff	0	1	0:0:0:0:0:0:2	ff01::2	All-routers
<i>Link-Local Scope</i>					
ff	0	2	0:0:0:0:0:0:1	ff02::1	All-nodes
ff	0	2	0:0:0:0:0:0:2	ff02::2	All-routers
ff	0	2	0:0:0:0:0:0:5	ff02::5	OSPF routers
ff	0	2	0:0:0:0:0:0:6	ff02::6	OSPF designated routers
ff	0	2	0:0:0:0:0:0:9	ff02::9	RIP routers
ff	0	2	0:0:0:0:0:0:a	ff02::a	EIGRP routers
ff	0	2	0:0:0:0:0:1:2	ff02::1:2	All-DHCP agents
<i>Site-Local Scope</i>					
ff	0	5	0:0:0:0:0:0:2	ff05::2	All-routers
ff	0	5	0:0:0:0:0:1:3	ff05::1:3	All-DHCP servers

8

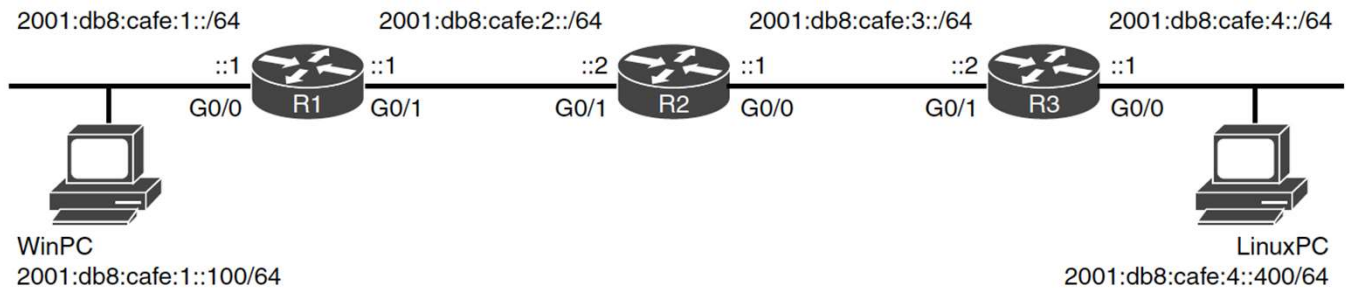


Figure 7-5 *Topology for Multicast Addresses Example*

9

Example 7-1 *Displaying Multicast Groups on Router R1's G0/0 Interface*

```
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
Joined group address(es):
  FF02::1          ! All-IPv6 devices
  FF02::2          ! All-IPv6 routers
  FF02::FB         ! Multicast DNS
  FF02::1:FF00:1   ! Solicited-node multicast for GUA
  FF02::1:FF93:DA00 ! Solicited-node multicast for LLA
<output omitted for brevity>

R1# show running-config
<partial output>
ipv6 unicast-routing
ipv6 route ::/0 2001:DB8:CAFE:2::2
```

10

Example 7-2 *Displaying Multicast Groups on WinPC and LinuxPC*

Windows PC

```
WinPC> netsh interface ipv6 show joins
```

Interface 11: Local Area Connection

Scope	References	Last	Address

! All-IPv6 devices, local scope			
0	0	Yes	ff01::1
! All-IPv6 devices, link-local scope			
0	0	Yes	ff02::1
! Multicast Name Resolution			
0	1	Yes	ff02::1:3

11

```
! Solicited-node GUA
0          1  Yes  ff02::1:ff00:100
! Solicited-node LLA
0          2  Yes  ff02::1:ff01:7086
```

<output omitted for brevity>

Ubuntu Linux PC

```
LinuxPC$ netstat -g
```

IPv6/IPv4 Group Memberships

Interface	RefCnt	Group

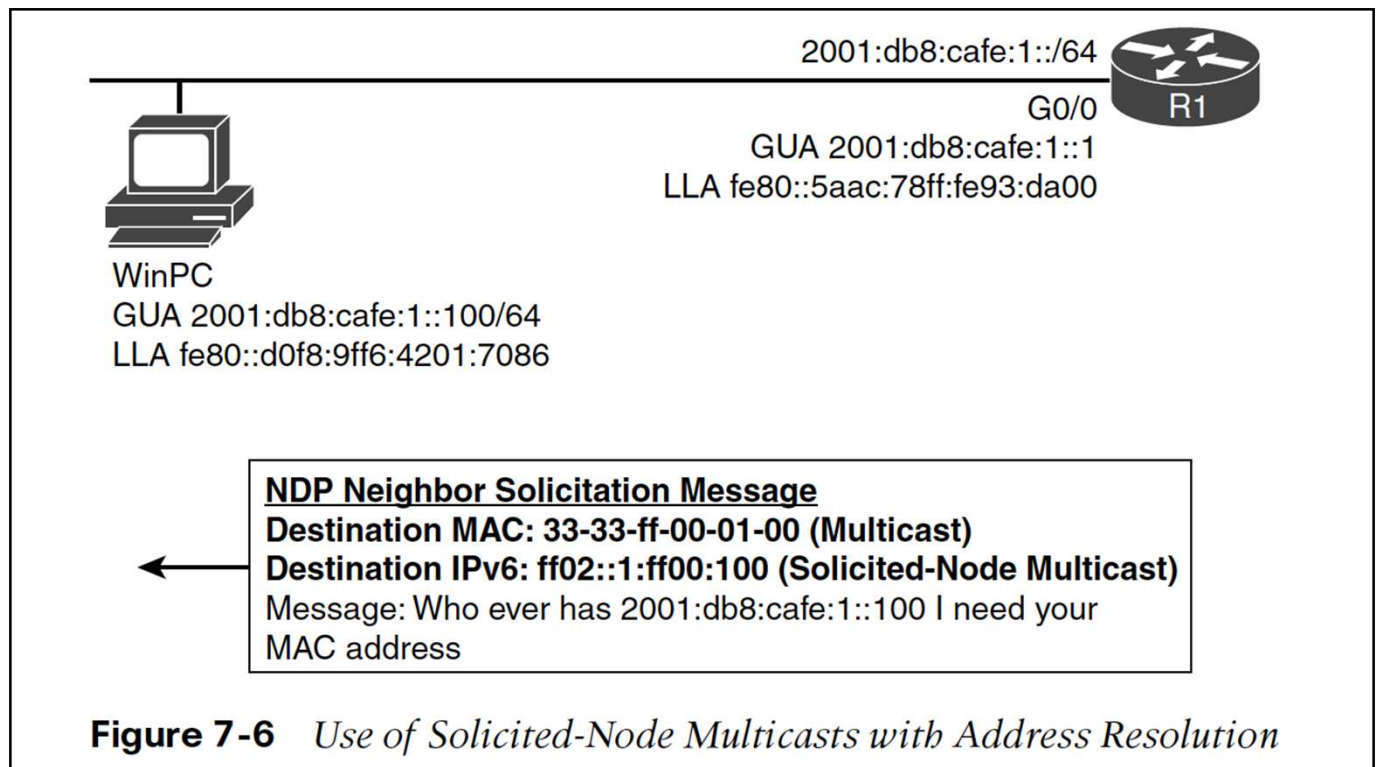
! Solicited-node multicast GUA		
eth0	1	ff02::1:ff00:400
! Solicited-node multicast LLA		
eth0	1	ff02::1:ffaf:141b
! Multicast Name Resolution		
eth0	1	ff02::fb
! All-IPv6 devices, link-local scope		
eth0	1	ip6-allnodes
! All-IPv6 devices, local scope		
eth0	1	ff01::1
<some output omitted for brevity>		

12

Table 7-3 *IPv6 Solicited-Node Multicast Address Representations*

Representation	IPv6 Loopback Address
Preferred	ff02:0000:0000:0000:0001:ff00::/104
Compressed	ff02:0:0:0:0:1:ff00::/104

13



14

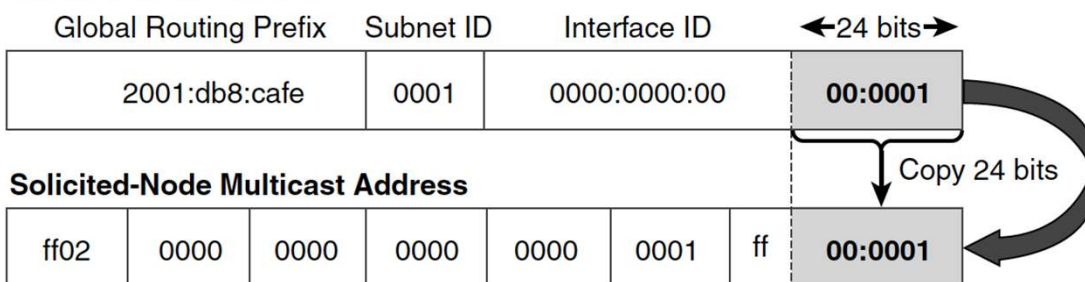
Example 7-3 *Displaying Solicited-Node Multicasts on Router R1's G0/0 Interface*

```

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
  Joined group address(es):
    FF02::1          ! All-IPv6 devices
    FF02::2          ! All-IPv6 routers
    FF02::FB         ! Multicast DNS
    FF02::1:FF00:1   ! Solicited-node multicast for GUA
    FF02::1:FF93:DA00 ! Solicited-node multicast for LLA
<output omitted for brevity>

```

15

Global Unicast Address**Figure 7-7** *Mapping R1's Global Unicast Address to a Solicited-Node Multicast Address*

16

Link-Local Unicast Address

Link-Local Prefix

Link-Local Prefix				Interface ID	←24 bits→
fe80	0000	0000	0000	5aac:78ff:fe	93:da00

Solicited-Node Multicast Address

Solicited-Node Multicast Address							
ff02	0000	0000	0000	0000	0001	ff	93:da00

Copy 24 bits

Figure 7-8 Mapping R1's Link-Local Unicast Address to a Solicited-Node Multicast Address

17

Global Unicast Address

Global Routing Prefix

Subnet ID

Interface ID

Global Routing Prefix	Subnet ID	Interface ID	←24 bits→
2001:db8:cafe	0001	0000:0000:00	00:0001

Solicited-Node Multicast Address

Solicited-Node Multicast Address							
ff02	0000	0000	0000	0000	0001	ff	00:0001

Copy 24 bits

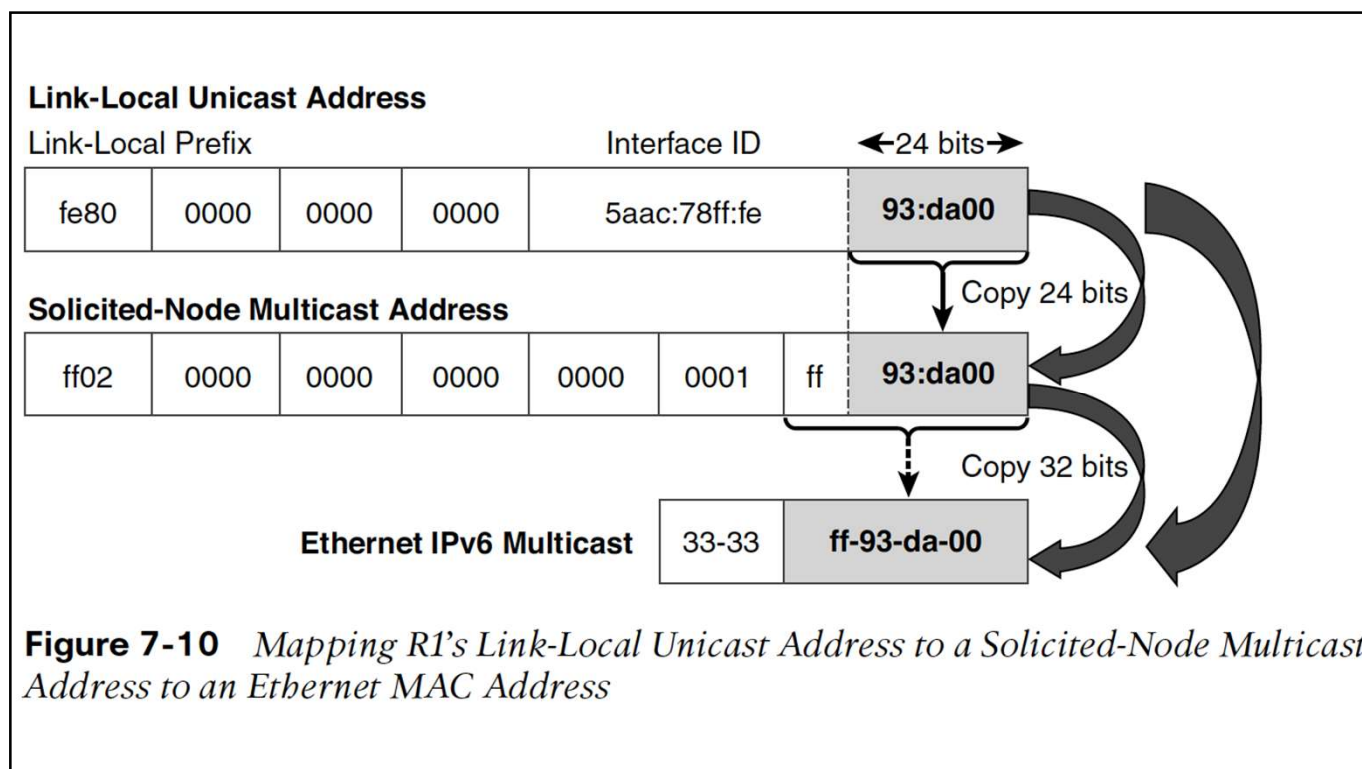
Copy 32 bits

Ethernet IPv6 Multicast

33-33	ff-00-00-01
-------	-------------

Figure 7-9 Mapping R1's Global Unicast Address to a Solicited-Node Multicast Address to an Ethernet MAC Address

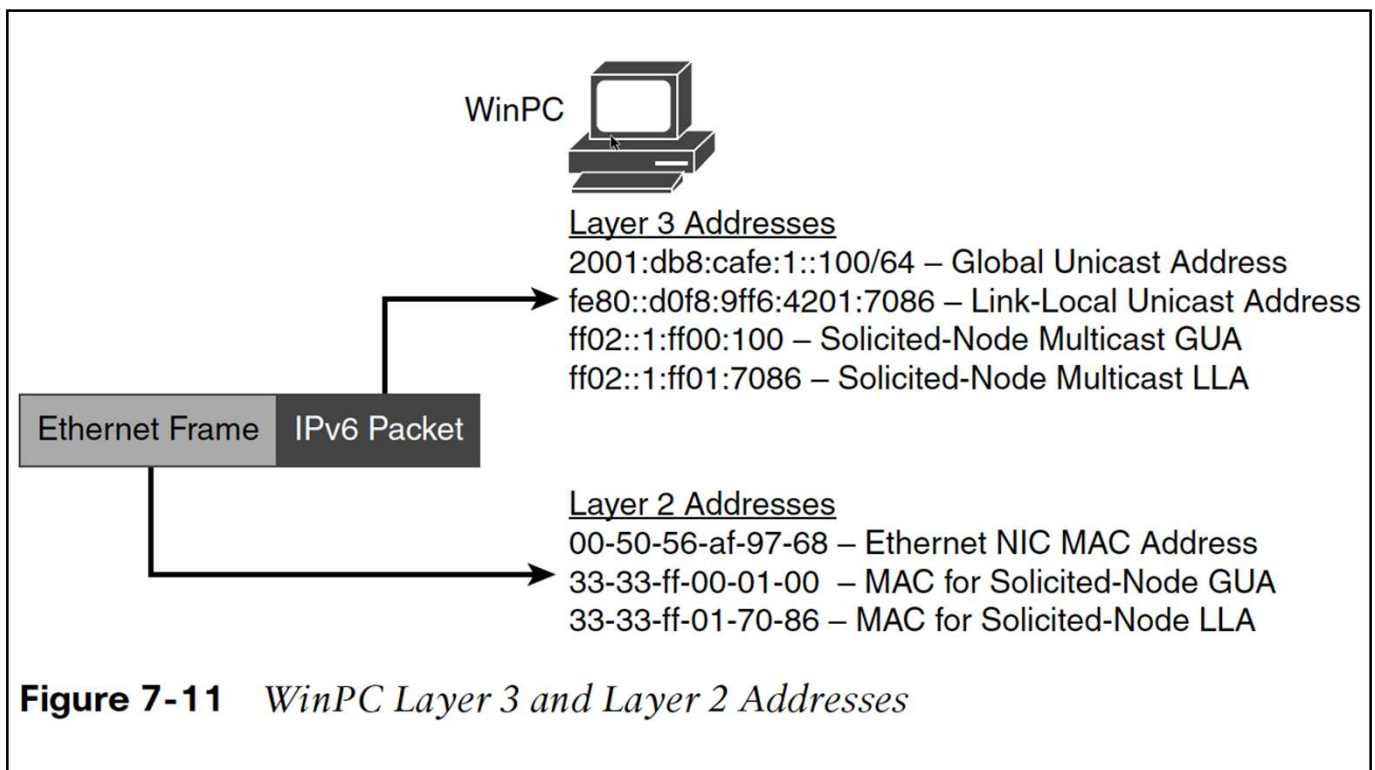
18



19

Table 7-4 Unicast to Solicited-Node Multicast to Ethernet MAC Address Mappings			
Unicast Address		Solicited-Node Multicast Address	Ethernet Multicast MAC Address
<i>Router R1</i>			
Global	2001:db8:cafe:1::1	ff02::1:ff00:1	33-33-ff-00-01-00
Link-local	fe80::5aac:78ff:fe93:da00	ff02::1:ff93:da00	33-33-ff-93-da-00
<i>WinPC</i>			
Global	2001:db8:cafe:1::100	ff02::1:ff00:100	33-33-ff-00-01-00
Link-local	fe80::d0f8:9ff6:4201:7086	ff02::1:ff01:7086	33-33-ff-01-70-86
<i>LinuxPC</i>			
Global	2001:db8:cafe:4::400	ff02::1:ff00:400	33-33-ff-00-04-00
Link-local	fe80::250:56ff:feaf:141b	ff02::1:ffaf:141b	33-33-ff-af-14-1b

20



21

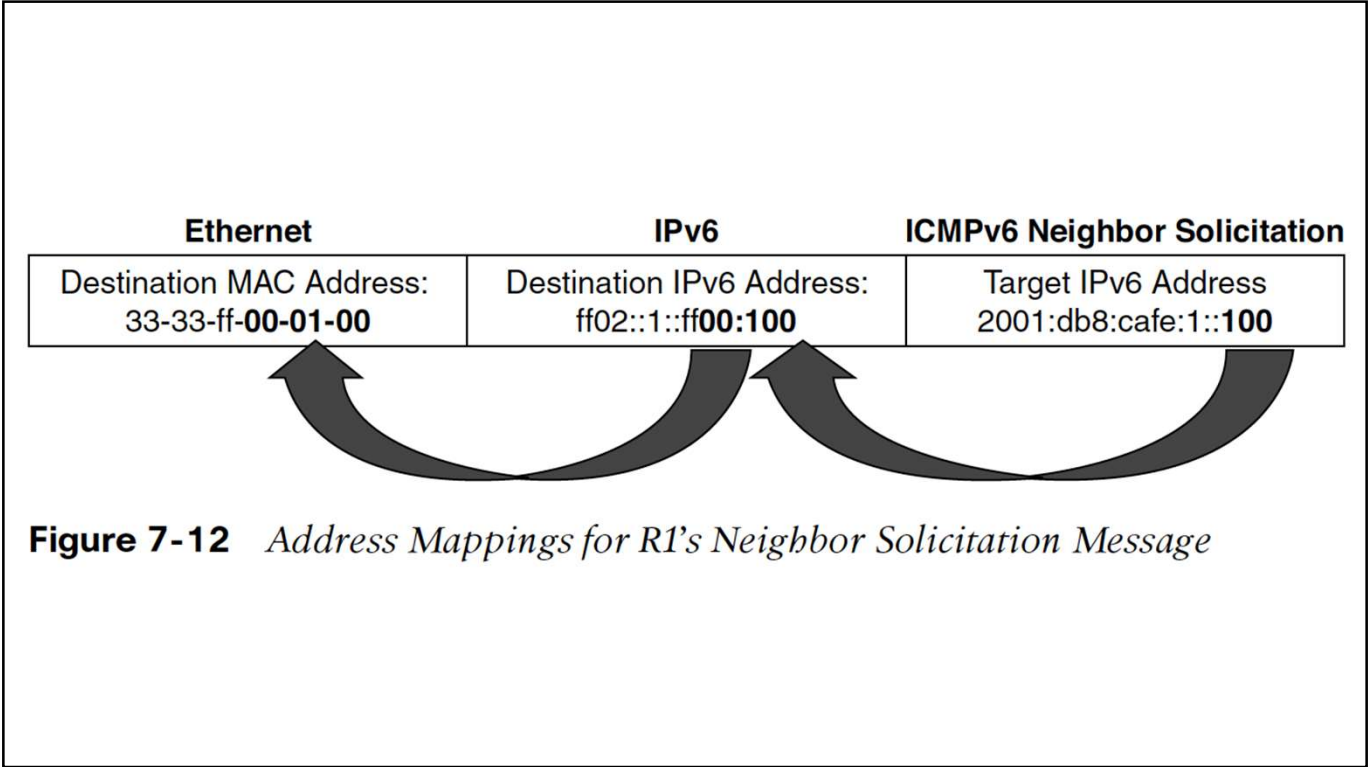
Example 7-4 Wireshark Capture of ICMPv6 Neighbor Solicitation Message from R1

```

Ethernet II, Src: 58:ac:78:93:da:00, Dst: 33:33:ff:00:01:00
Internet Protocol Version 6
  0110 .... = Version: 6
  .... 0000 0000 .... = Traffic class: 0x00000000
  .... 0000 0000 0000 0000 0000 = Flowlabel: 0x00000000
Payload length: 32
Next header: ICMPv6 (0x3a)
Hop limit: 255
Source: 2001:db8:cafe:1::1
Destination: ff02::1:ff00:100
Internet Control Message Protocol v6
  Type: 135 (Neighbor solicitation)
  Code: 0
  Target: 2001:db8:cafe:1::100
  ICMPv6 Option (Source link-layer address)
    Type: Source link-layer address (1)
    Length: 8
    Link-layer address: 58:ac:78:93:da:00

```

22



23

Table 7-5 Well-Known Multicast to Ethernet MAC Address Mappings		
Description	Well-Known Multicast	Mapped Ethernet MAC Address
All-Devices	ff02::1	33-33-ff-00-00-01
All-Routers	ff02::2	33-33-ff-00-00-02
All-OSPF Routers	ff02::5	33-33-ff-00-00-05
All-EIGRP Routers	ff02::a	33-33-ff-00-00-0a

24

Example 7-5 *Verifying the Solicited-Node Multicasts on Router R1's G0/0 Interface*

```

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
  Joined group address(es):
    FF02::1
    FF02::2
    FF02::FB
  FF02::1:FF00:1      ! Solicited-node multicast for GUA
  FF02::1:FF93:DA00  ! Solicited-node multicast for LLA
<output omitted for brevity>

```

25

Example 7-6 *Verifying the Solicited-Node Multicasts on WinPC*

```

WinPC> ipconfig

Ethernet adapter Local Area Connection:

    Connection-specific DNS Suffix  . : 
    IPv6 Address. . . . . : 2001:db8:cafe:1::100
    Link-local IPv6 Address . . . . . : fe80::d0f8:9ff6:4201:7086%11
    Default Gateway . . . . . : 2001:db8:cafe:1::1
<output omitted for brevity>

WinPC> netsh interface ipv6 show joins

Interface 11: Local Area Connection

Scope  References  Last  Address
-----
0      0      Yes  ff01::1
0      0      Yes  ff02::1
0      1      Yes  ff02::1:3
! Solicited-node GUA
0      1      Yes  ff02::1:ff00:100
! Solicited-node LLA
0      2      Yes  ff02::1:ff01:7086
<output omitted for brevity>

```

26

Example 7-7 *Verifying the Solicited-Node Multicasts on 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>

LinuxPC$ netstat -g
IPv6/IPv4 Group Memberships
Interface  RefCnt Group
-----
! Solicited-node multicast GUA
eth0       1      ff02::1:ff00:400
! Solicited-node multicast LLA
eth0       1      ff02::1:ffaf:141b
! Multicast Name Resolution
eth0       1      ff02::fb
! All-IPv6 devices, link-local scope
eth0       1      ip6-allnodes
! All-IPv6 devices, local scope
eth0       1      ff01::1
<some output omitted for brevity>
```

27

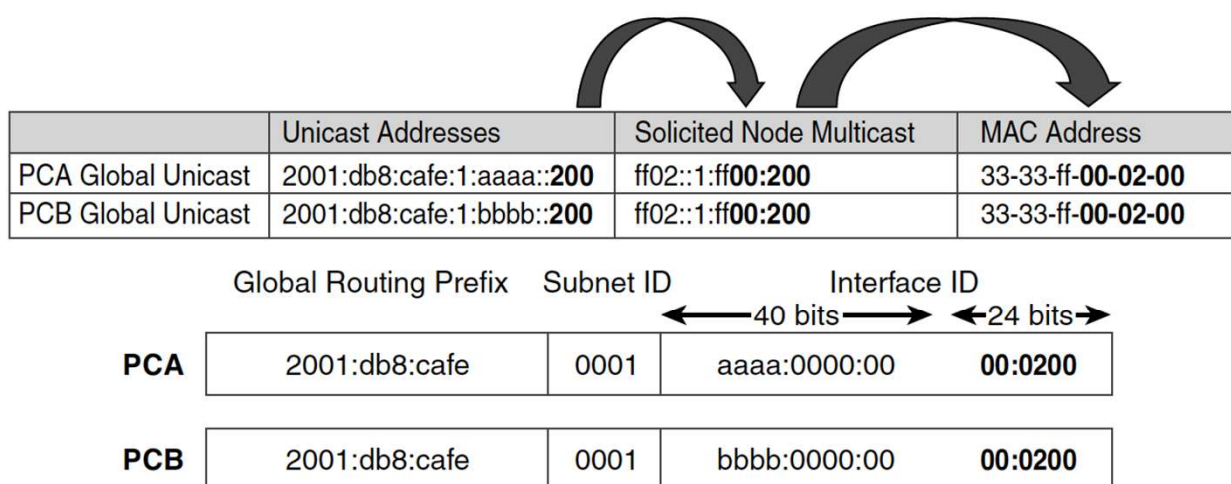
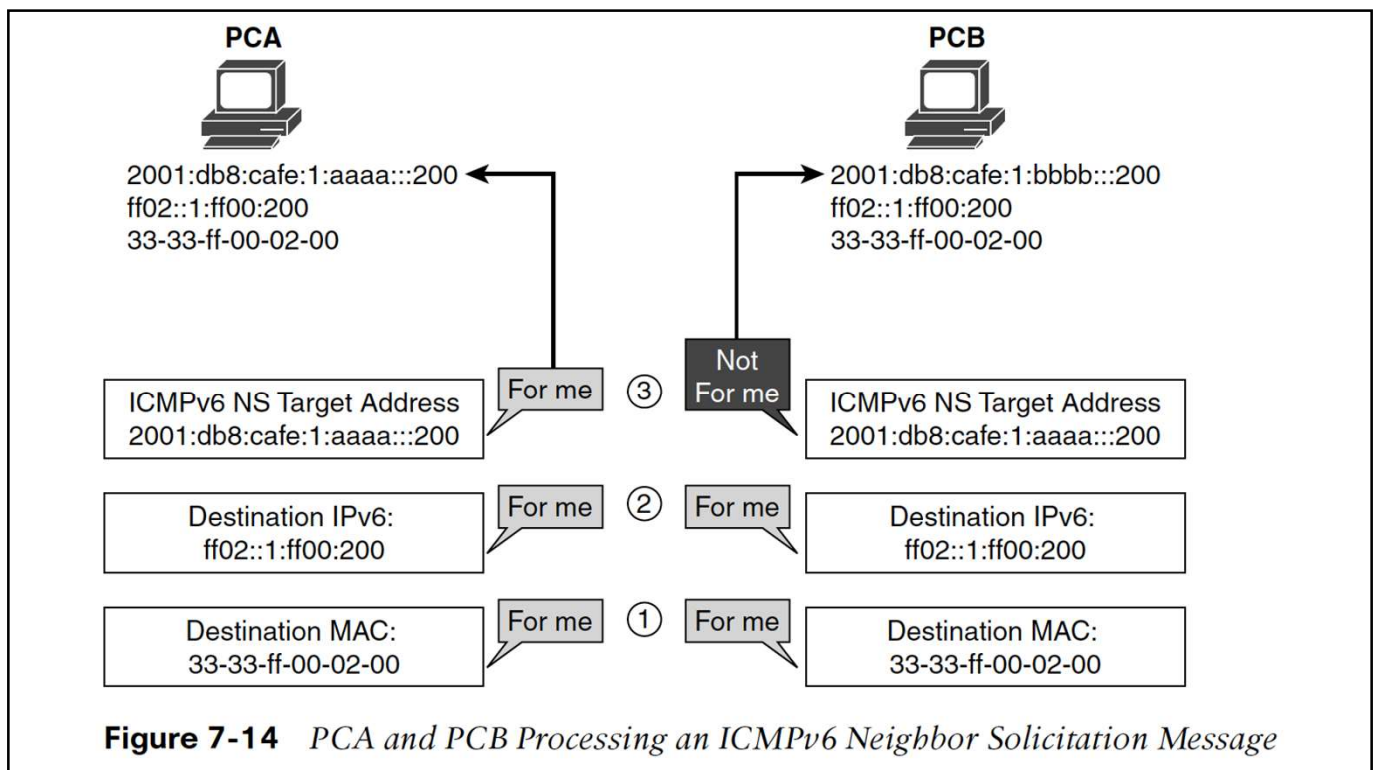


Figure 7-13 *PCA and PCB with Different GUA Addresses but the Same Solicited-Node Multicast Address*

28



29

Example 7-8 R1 Multicast Groups

```
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
  Joined group address(es):
    FF02::1          ! All-IPv6 devices
    FF02::2          ! All-IPv6 routers
    FF02::FB         ! Multicast DNS
  ! Solicited-node multicast for GUA
    FF02::1:FF00:1
  ! Solicited-node multicast for LLA
    FF02::1:FF93:DA00
<output omitted for brevity>
```

30

```

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

R1# show ipv6 interface gigabitethernet 0/0
GigabitEthernet0/0 is up, line protocol is up
  IPv6 is enabled, link-local address is FE80::1
  No Virtual link-local address(es):
  Global unicast address(es):
    2001:DB8:CAFE:1::1, subnet is 2001:DB8:CAFE:1::/64
  Joined group address(es):
! All-IPv6 devices
  FF02::1
! All-IPv6 routers
  FF02::2
! Multicast DNS
  FF02::FB
! Solicited-node multicast for GUA and LLA
  FF02::1:FF00:1

```

31

Multicast Listener Discovery (MLD) – RFC 2710

Protocol used to discover multicast clients (listeners) on a particular subnet.

IPv6 uses MLDv2 – RFC 3810 – for this purpose

IPv4 uses Internet Group Management Protocol (IGMP)

MLDv2 uses ICMPv6 to transport MLD messages

There are 3 types of MLD messages:

- Multicast Listener Queries (Type = 130)
- Multicast Listener Report (Type = 131)
- Multicast Listener Done (Type 132)

AB

32

MLD messages:

- **Multicast Listener Queries (Type = 130)**

To determine which multicast groups still have members on the router's attached networks.

- **General query**

Used to learn which multicast addresses have listeners on an attached link.

- **Multicast-address-specific query**

Used to learn whether a particular multicast address (group) has any listeners on an attached link.

- **Multicast Listener Report (Type = 131)**

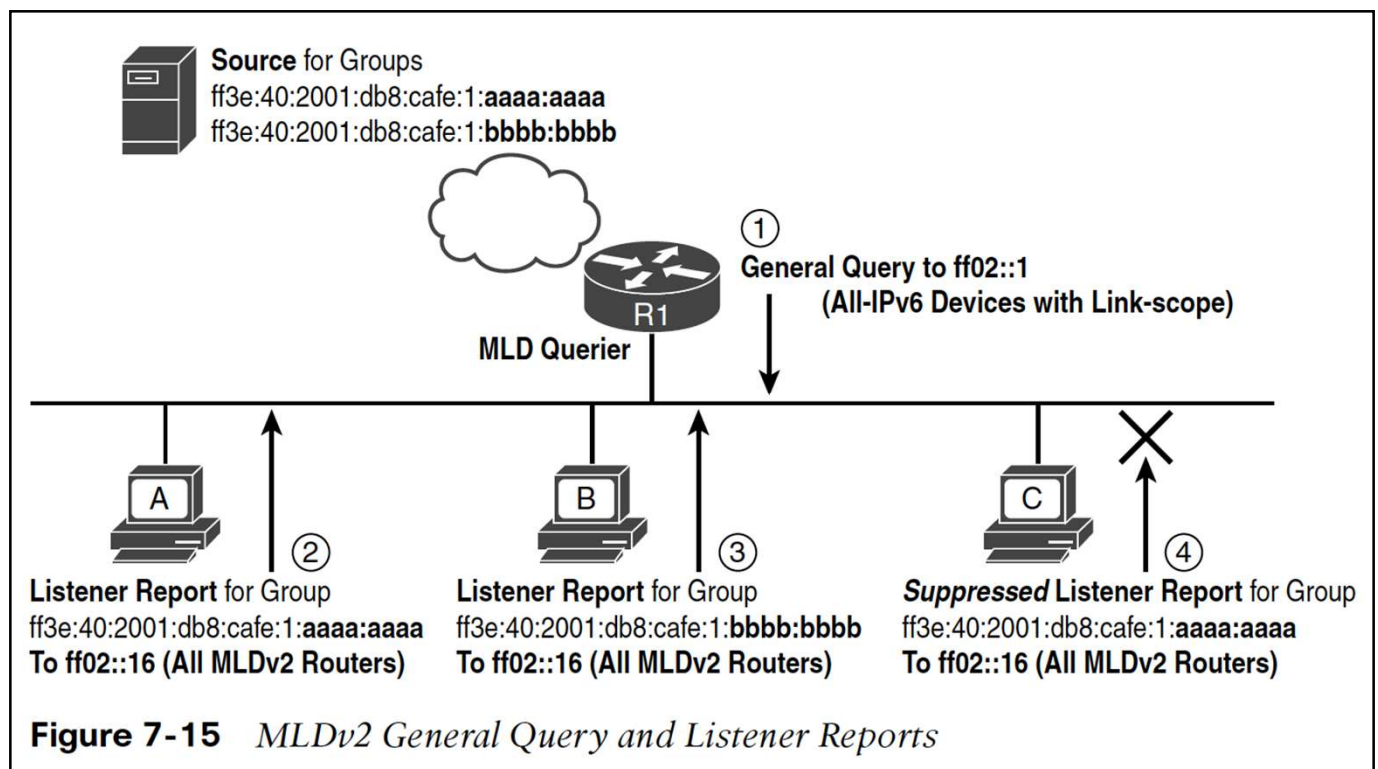
Sent by the listener to register for a multicast group. Can be sent in response to a query or sent unsolicited. If in response, only one member of the multicast group needs to send this message.

- **Multicast Listener Done (Type 132)**

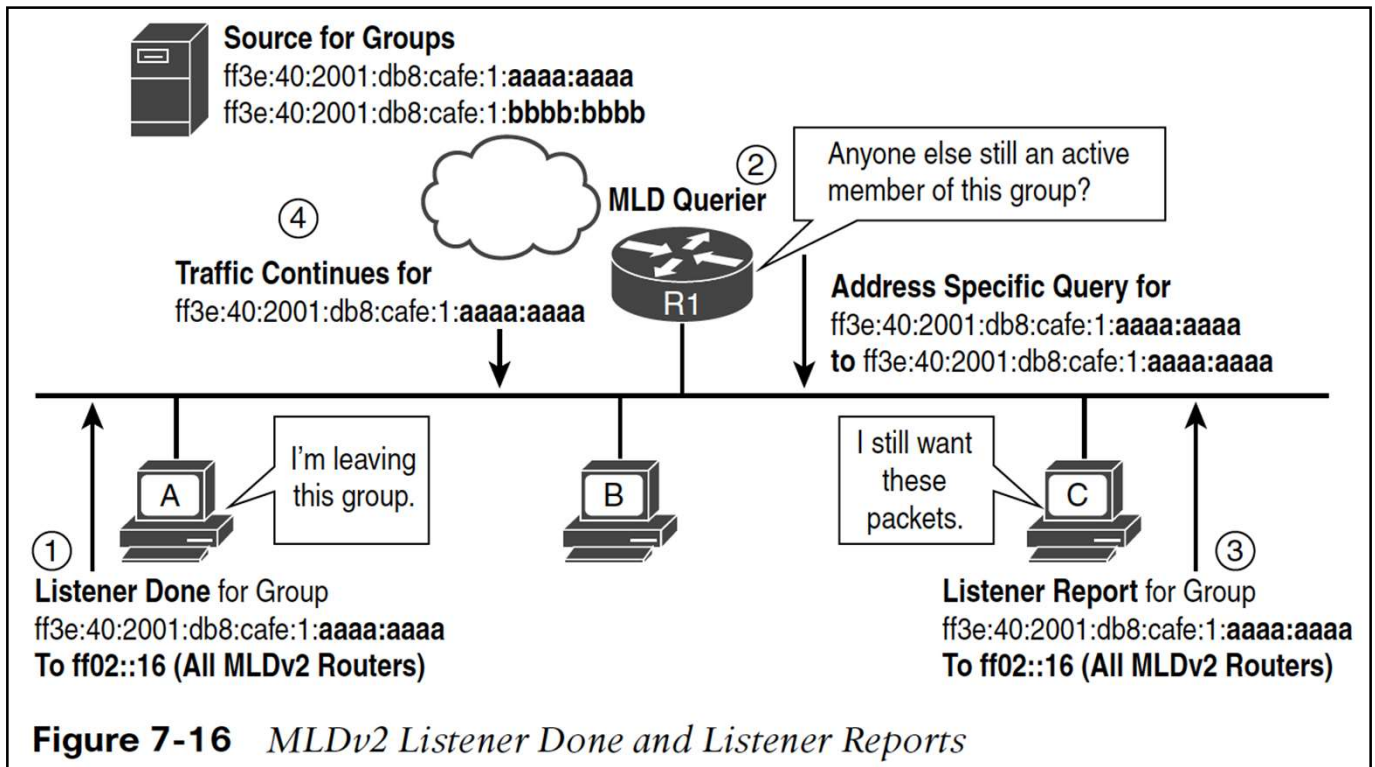
Sent when a listener no longer wants to receive traffic for a particular multicast group.

AB

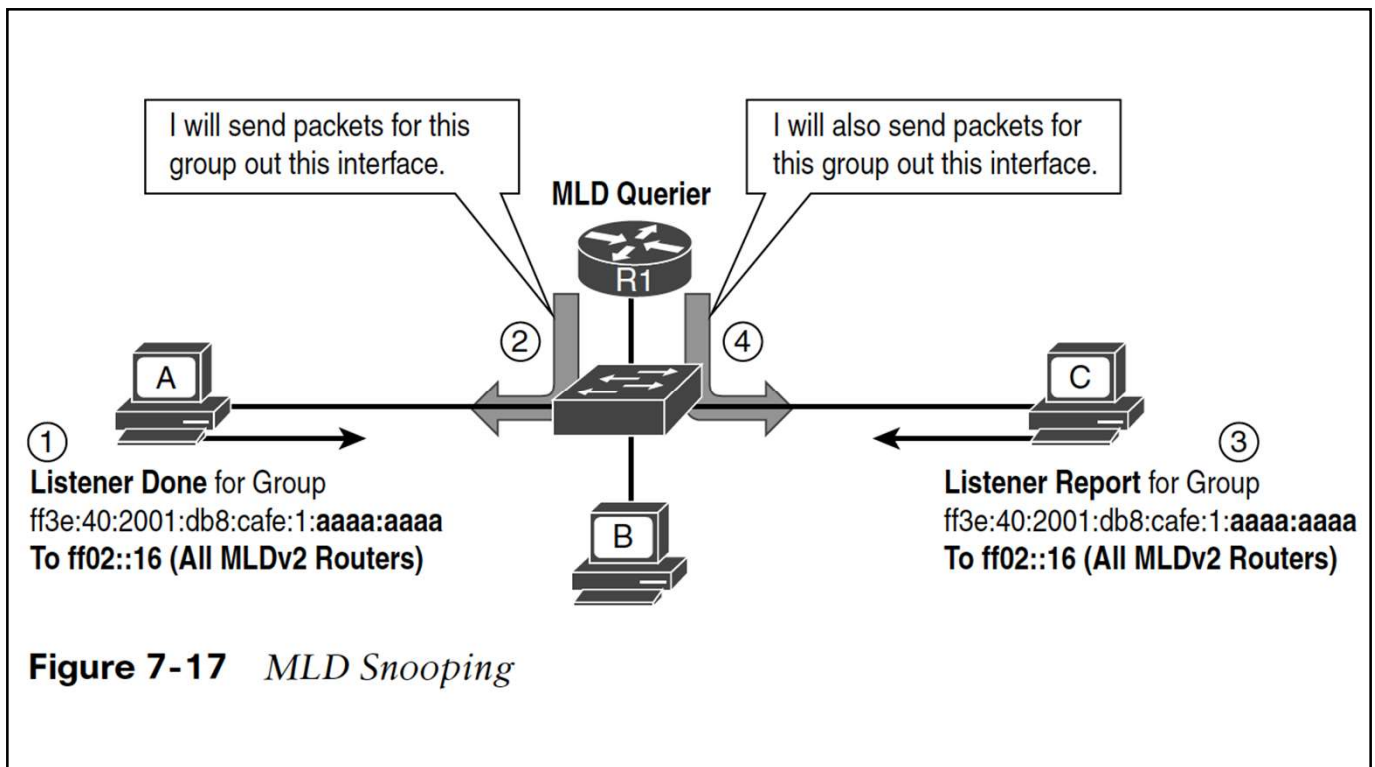
33



34



35



36