

Understanding IPv6 Link Local Address

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Related Information

Introduction

The purpose of this document is to provide an understanding of IPv6 Link-local address in a network. A link-local address is an IPv6 unicast address that can be automatically configured on any interface using the link-local prefix FE80::/10 (1111 1110 10) and the interface identifier in the modified EUI-64 format. Link-local addresses are not necessarily bound to the MAC address (configured in a EUI-64 format). Link-local addresses can also be manually configured in the FE80::/10 format using the **ipv6 address link-local** command.

These addresses refer only to a particular physical link and are used for addressing on a single link for purposes such as automatic address configuration and neighbor discovery protocol. Link-local addresses can be used to reach the neighboring nodes attached to the same link. The nodes do not need a globally unique address to communicate. Routers will not forward datagram using link-local addresses. IPv6 routers must not forward packets that have link-local source or destination addresses to other links. All IPv6 enabled interfaces have a link-local unicast address.

Prerequisites

Requirements

Ensure that you have knowledge of IPv6 Addressing Scheme before you attempt this configuration.

Components Used

This document is not restricted to specific software and hardware versions.

The configurations in this document are based on the Cisco 3700 series router with Cisco IOS® Software Release 12.4 (15)T1.

Conventions

Refer to Cisco Technical Tips Conventions for more information on document conventions.

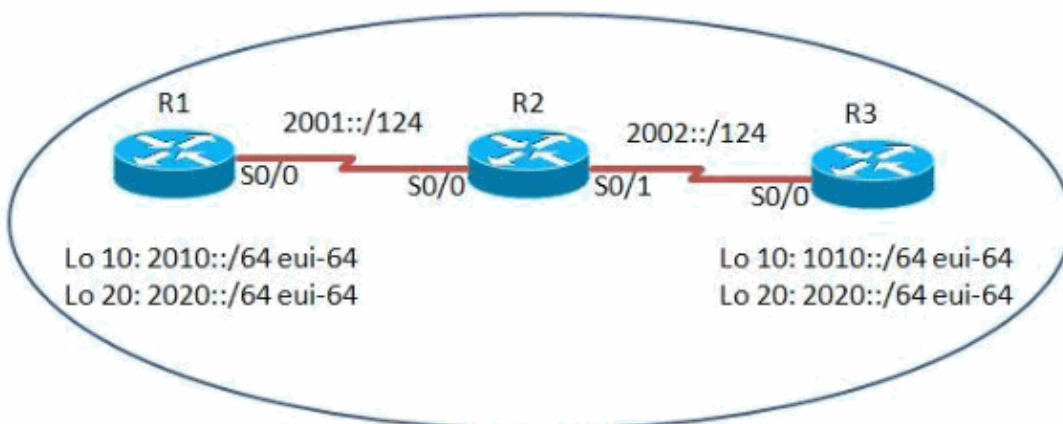
Configure

In this example, the routers R1, R2 and R3 are connected via serial interface and have the IPv6 addresses configured as mentioned in the network diagram. Loopback addresses are configured on the routers R1 and R3, and the routers use OSPFv3 to communicate with each other. This example uses the **ping** command to demonstrate the connectivity between the routers using link-local addresses. The routers R1 and R3 can ping each other with the IPv6 global unicast address, but not with their link-local address. However, router R2 being directly connected to R1 and R3 can communicate with both the routers using their link-local address, because link-local addresses are used only within that local network specific to the physical interface.

Note: Use the Command Lookup Tool to find more information on the commands used in this document.

Network Diagram

This document uses this network setup:



Configurations

This document uses these configurations:

- Router R1
- Router R2 & R3

Here is a link to a video (available on Cisco Support Community [🔗](#)) that demonstrates the key difference between the IPv6 Link-Local Address and global unicast address in Cisco IOS routers:

[Understanding IPv6 Link-Local Address 🔗](#)



Posted on Dec 13, 2011 by Sivagami Narayanan

Understanding IPv6 Link-Local Address



This video explains about IPv6 link-local address and demonstrates one of the key difference between link local address and global unicast address.

Router R1

```
!  
hostname R1  
!  
ipv6 cef  
!  
ipv6 unicast-routing  
!  
interface Loopback10  
no ip address  
  
ipv6 address 2010::/64 eui-64  
  
!--- Assigned a IPv6 unicast address in EUI-64 format.  
  
ipv6 ospf 1 area 1  
  
!--- Enables OSPFv3 on the interface and associates  
the interface loopback10 to area 1.  
  
!  
interface Loopback20  
no ip address  
  
ipv6 address 2020::/64 eui-64  
ipv6 ospf 1 area 2  
  
!--- Associates the Interface loopback20 to area 2.  
  
!  
interface Serial0/0  
no ip address  
  
ipv6 address 2001::1/124  
ipv6 ospf 1 area 0
```



```

R1#show ipv6 route ospf
IPv6 Routing Table - 10 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
       U - Per-user Static route, M - MIPv6
       I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
       O - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
       ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
       D - EIGRP, EX - EIGRP external
OI 1010::C002:1DFF:FEE0:0/128 [110/128]
   via FE80::C001:1DFF:FEE0:0, Serial0/0
O 2002::/124 [110/128]
  via FE80::C001:1DFF:FEE0:0, Serial0/0
OI 2020::C002:1DFF:FEE0:0/128 [110/128]
   via FE80::C001:1DFF:FEE0:0, Serial0/0

```

Router R3

```

R3#show ipv6 route ospf
IPv6 Routing Table - 10 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
       U - Per-user Static route, M - MIPv6
       I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
       O - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
       ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
       D - EIGRP, EX - EIGRP external
O 2001::/124 [110/128]
  via FE80::C001:1DFF:FEE0:0, Serial0/0
OI 2010::C000:1DFF:FEE0:0/128 [110/128]
   via FE80::C001:1DFF:FEE0:0, Serial0/0
OI 2020::C000:1DFF:FEE0:0/128 [110/128]
   via FE80::C001:1DFF:FEE0:0, Serial0/0

```

Verifying Link-Local Address Reachability

The routers can ping each other with the global unicast address. However, when using link-local address only the directly connected networks can communicate. For example, R1 can ping R3 using global unicast address but the two routers cannot communicate using link-local addresses. This is shown using the **ping** and **debug ipv6 icmp** commands in router R1 and R3. This section provides scenarios to develop a better understanding about link-local addresses.

Pinging Link-Local Address From Remote Network

When the router R1 tries to communicate with router R3 using the link local address, the router R1 returns with an ICMP time-out message indicating that the link-local address is locally specific and cannot communicate to link-local addresses that are outside the directly connected network.

Pinging R3's Link-Local Address from router R1

In Router R1

```

R1#ping FE80::AB8

!--- Pinging Link-Local Address of router R3.

Output Interface: serial0/0

!--- To ping LLA, output interface must be entered.

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to FE80::AB8, timeout is 2 seconds:

```

```
Packet sent with a source address of FE80::C000:1DFF:FEE0:0
```

```
.....
```

```
Success rate is 0 percent (0/5)
```

```
!--- The ping is unsuccessful and the ICMP packet cannot reach  
the destination through serial0/0. This timeout indicates that R1 has not  
received any replies from the router R3.
```

Pinging Link-Local Address From Directly Connected Network

For router R2, the routers R1 and R3 are directly connected and can ping the link-local address of both router R1 and R2 by mentioning the corresponding interface that is connected to the router. The output is shown here:

Pinging R1 Link-Local Addresses from router R2

In Router R2

```
R2#ping FE80::C000:1DFF:FEE0:0
```

```
!--- Pinging Link-Local Address of router R1.
```

```
Output Interface: serial0/0
```

```
!--- Note that, to ping LLA, output interface should be mentioned  
In our case, R2 connects to R1 via serial0/0.
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to FE80::C000:1DFF:FEE0:0, timeout is 2 seconds:
```

```
Packet sent with a source address of FE80::C001:1DFF:FEE0:0
```

```
!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/19/56 ms
```

Debug output from R1

```
R1#
```

```
*Mar 1 03:59:53.367: ICMPv6: Received echo request from FE80::C001:1DFF:FEE0:0
```

```
*Mar 1 03:59:53.371: ICMPv6: Sending echo reply to FE80::C001:1DFF:FEE0:0
```

```
*Mar 1 03:59:53.423: ICMPv6: Received echo request from FE80::C001:1DFF:FEE0:0
```

```
*Mar 1 03:59:53.427: ICMPv6: Sending echo reply to FE80::C001:1DFF:FEE0:0
```

```
*Mar 1 03:59:53.463: ICMPv6: Received echo request from FE80::C001:1DFF:FEE0:0
```

```
*Mar 1 03:59:53.463: ICMPv6: Sending echo reply to FE80::C001:1DFF:FEE0:0
```

```
*Mar 1 03:59:53.467: ICMPv6: Received echo request from FE80::C001:1DFF:FEE0:0
```

```
*Mar 1 03:59:53.467: ICMPv6: Sending echo reply to FE80::C001:1DFF:FEE0:0
```

```
R1#
```

```
*Mar 1 03:59:53.471: ICMPv6: Received echo request from FE80::C001:1DFF:FEE0:0
```

```
*Mar 1 03:59:53.471: ICMPv6: Sending echo reply to FE80::C001:1DFF:FEE0:0
```

```
!--- The debug output shows that the router R2 can  
ping router R1's link-local address.
```

Pinging R3 Link-Local Addresses from router R2

In Router R2

```
R2#pingFE80::AB8
```

```
!--- Pinging Link-Local Address of router R3.
```

Output Interface: serial0/1

*!--- Note that, to ping LLA, output interface should be mentioned.
In our case, R2 connects to R3 through serial0/1.*

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to FE80::AB8, timeout is 2 seconds:

Packet sent with a source address of FE80::C001:1DFF:FEE0:0

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 0/18/60 ms

Debug output from R3

R3#

*Mar 1 04:12:11.518: ICMPv6: Received echo request from FE80::C001:1DFF:FEE0:0

*Mar 1 04:12:11.522: ICMPv6: Sending echo reply to FE80::C001:1DFF:FEE0:0

*Mar 1 04:12:11.594: ICMPv6: Received echo request from FE80::C001:1DFF:FEE0:0

*Mar 1 04:12:11.598: ICMPv6: Sending echo reply to FE80::C001:1DFF:FEE0:0

*Mar 1 04:12:11.618: ICMPv6: Received echo request from FE80::C001:1DFF:FEE0:0

*Mar 1 04:12:11.618: ICMPv6: Sending echo reply to FE80::C001:1DFF:FEE0:0

*Mar 1 04:12:11.622: ICMPv6: Received echo request from FE80::C001:1DFF:FEE0:0

*Mar 1 04:12:11.622: ICMPv6: Sending echo reply to FE80::C001:1DFF:FEE0:0

R3#

*Mar 1 04:12:11.626: ICMPv6: Received echo request from FE80::C001:1DFF:FEE0:0

*Mar 1 04:12:11.630: ICMPv6: Sending echo reply to FE80::C001:1DFF:FEE0:0

*!--- The debug output shows that the router R2 can
ping router R3's link-local address.*

The link-local address as the name implies, is specific only to that local network. In other words, the routers can have the same link-local address and still the directly connected network can communicate with each other without any conflict. This will not be the same in case of global unicast address. The global unicast address being routable should be unique in a network. The **show ipv6 interface brief** command shows the information about link-local address on the interface.

show ipv6 interface brief

In router R1

R1#show ipv6 interface brief

Serial0/0 [up/up]

FE80::AB8

2001::1

Loopback10 [up/up]

FE80::C000:1DFF:FEE0:0

2010::C000:1DFF:FEE0:0

Loopback20 [up/up]

FE80::C000:1DFF:FEE0:0

2020::C000:1DFF:FEE0:0

In router R3

R3#show ipv6 interface brief

Serial0/0 [up/up]

FE80::AB8

2002::2

Loopback10 [up/up]

FE80::C002:1DFF:FEE0:0

1010::C002:1DFF:FEE0:0

Loopback20 [up/up]

```
FE80::C002:1DFF:FEE0:0
2020::C002:1DFF:FEE0:0
```

```
!--- Shows that R1 and R3's serial interface has same
link-local address FE80::AB8.
```

In this example, R1 and R3 are assigned with the same link-local address and R2 can still reach both the routers by specifying the corresponding output interface.

Pinging R1 and R3's Link-local address from R2

Pinging R1's link-local address from R2

```
R2#ping FE80::AB8
Output Interface: serial0/0
```

```
!--- R2 is connected to R1 through serial0/0.
```

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to FE80::AB8, timeout is 2 seconds:

Packet sent with a source address of FE80::C001:1DFF:FEE0:0

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 0/26/92 ms

Debug output from R1

```
R1#
```

```
*Mar 1 19:51:31.855: ICMPv6: Received echo request from FE80::C001:1DFF:FEE0:0
```

```
*Mar 1 19:51:31.859: ICMPv6: Sending echo reply to FE80::C001:1DFF:FEE0:0
```

```
*Mar 1 19:51:31.915: ICMPv6: Received echo request from FE80::C001:1DFF:FEE0:0
```

```
*Mar 1 19:51:31.919: ICMPv6: Sending echo reply to FE80::C001:1DFF:FEE0:0
```

```
*Mar 1 19:51:31.947: ICMPv6: Received echo request from FE80::C001:1DFF:FEE0:0
```

```
*Mar 1 19:51:31.947: ICMPv6: Sending echo reply to FE80::C001:1DFF:FEE0:0
```

```
*Mar 1 19:51:31.955: ICMPv6: Received echo request from FE80::C001:1DFF:FEE0:0
```

```
*Mar 1 19:51:31.955: ICMPv6: Sending echo reply to FE80::C001:1DFF:FEE0:0
```

```
R1#
```

```
*Mar 1 19:51:31.955: ICMPv6: Received echo request from FE80::C001:1DFF:FEE0:0
```

```
*Mar 1 19:51:31.955: ICMPv6: Sending echo reply to FE80::C001:1DFF:FEE0:0
```

Pinging R3's link-local address from R2

```
R2#ping FE80::AB8
Output Interface: serial0/1
```

```
!--- R2 is connected to R1 through serial0/1.
```

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to FE80::AB8, timeout is 2 seconds:

Packet sent with a source address of FE80::C001:1DFF:FEE0:0

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 4/28/76 ms

Debug output from R3

```
R3#
```

```
*Mar 1 19:53:38.815: ICMPv6: Received echo request from FE80::C001:1DFF:FEE0:0
```

```
*Mar 1 19:53:38.819: ICMPv6: Sending echo reply to FE80::C001:1DFF:FEE0:0
```

```
*Mar 1 19:53:38.911: ICMPv6: Received echo request from FE80::C001:1DFF:FEE0:0
```

```
*Mar 1 19:53:38.915: ICMPv6: Sending echo reply to FE80::C001:1DFF:FEE0:0
```

```
*Mar 1 19:53:38.923: ICMPv6: Received echo request from FE80::C001:1DFF:FEE0:0
```

```
*Mar 1 19:53:38.927: ICMPv6: Sending echo reply to FE80::C001:1DFF:FEE0:0
```




```
*Mar 1 19:53:38.955: ICMPv6: Received echo request from FE80::C001:1DFF:FEE0:0
*Mar 1 19:53:38.955: ICMPv6: Sending echo reply to FE80::C001:1DFF:FEE0:0
R3#
*Mar 1 19:53:38.963: ICMPv6: Received echo request from FE80::C001:1DFF:FEE0:0
*Mar 1 19:53:38.963: ICMPv6: Sending echo reply to FE80::C001:1DFF:FEE0:0
```

Note: The R2 can ping the link-local address of R1 and R3 only because they are directly connected. R2 cannot ping the link-local address of the loopback interfaces in routers R1 and R3 as they are not directly connected. Ping works on link-local addresses only in case of directly connected networks.

Note: Traceroutes do not work in case of link-local addresses and return with the *% No valid source address for destination.* error message. This is because IPv6 routers must not forward packets that have link-local source or destination addresses to other links.

Related Information

- [IP Version 6 Addressing Architecture -RFC 4291](#) 
- [IPv6 Configuration Guide, Cisco IOS Release 15.2M&T](#)
- [Implementing IPv6 Addressing and Basic Connectivity](#)
- [IPv6 Knowledge Base Portal](#)
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