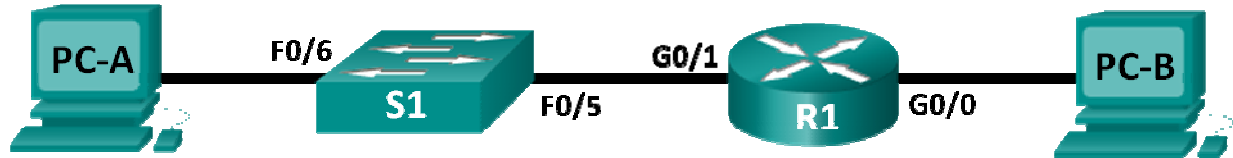# Lab - Configuring IPv6 Addresses on Network Devices

Topology

Addressing Table

Device	Interface	IPv6 Address	Prefix Length	Default Gateway
R1	G0/0	2001:DB8:ACAD:A::1	64	N/A
	G0/1	2001:DB8:ACAD:1::1	64	N/A
S1	VLAN 1	2001:DB8:ACAD:1::B	64	N/A
PC-A	NIC	2001:DB8:ACAD:1::3	64	FE80::1
PC-B	NIC	2001:DB8:ACAD:A::3	64	FE80::1

Objectives

Part 1: Set Up Topology and Configure Basic Router and Switch Settings

Part 2: Configure IPv6 Addresses Manually

Part 3: Verify End-to-End Connectivity

Background / Scenario

Knowledge of the Internet Protocol version 6 (IPv6) multicast groups can be helpful when assigning IPv6 addresses manually. Understanding how the all-router multicast group is assigned and how to control address assignments for the Solicited Nodes multicast group can prevent IPv6 routing issues and help ensure best practices are implemented.

In this lab, you will configure hosts and device interfaces with IPv6 addresses and explore how the all-router multicast group is assigned to a router. You will use **show** commands to view IPv6 unicast and multicast addresses. You will also verify end-to-end connectivity using the **ping** and **traceroute** commands.

Note: The routers used with CCNA hands-on labs are Cisco 1941 ISRs with Cisco IOS Release 15.2(4)M3 (universalk9 image). The switches used are Cisco Catalyst 2960s with Cisco IOS Release 15.0(2) (lanbasek9 image). Other routers, switches and Cisco IOS versions can be used. Depending on the model and Cisco IOS version, the commands available and output produced might vary from what is shown in the labs. Refer to the Router Interface Summary table at the end of the lab for the correct interface identifiers.

Note: Make sure that the routers and switches have been erased and have no startup configurations. If you are unsure, contact your instructor.

Required Resources

- 1 Router (Cisco 1941 with Cisco IOS software, Release 15.2(4)M3 universal image or comparable)
- 1 Switch (Cisco 2960 with Cisco IOS Release 15.0(2) lanbasek9 image or comparable)

- 2 PCs (Windows 7 with terminal emulation program, such as Tera Term)
- Console cables to configure the Cisco IOS devices via the console ports
- Ethernet cables as shown in the topology

Note: The Gigabit Ethernet interfaces on Cisco 1941 routers are autosensing and an Ethernet straight-through cable may be used between the router and PC-B. If using another model Cisco router, it may be necessary to use an Ethernet crossover cable.

Note: The IPv6 protocol is enabled in Windows 7 and Vista by default. The Windows XP operating system does not enable IPv6 by default and is not recommended for use with this lab. This lab uses Windows 7 PC hosts.

Part 1: Set Up Topology and Configure Basic Router and Switch Settings

Step 1: Cable the network as shown in the topology.

Step 2: Initialize and reload the router and switch.

Step 3: Verify that the PC interfaces are configured to use the IPv6 protocol.

Verify that the IPv6 protocol is active on both PCs by ensuring that the **Internet Protocol Version 6 (TCP/IPv6)** check box is selected in the Local Area Connection Properties window.
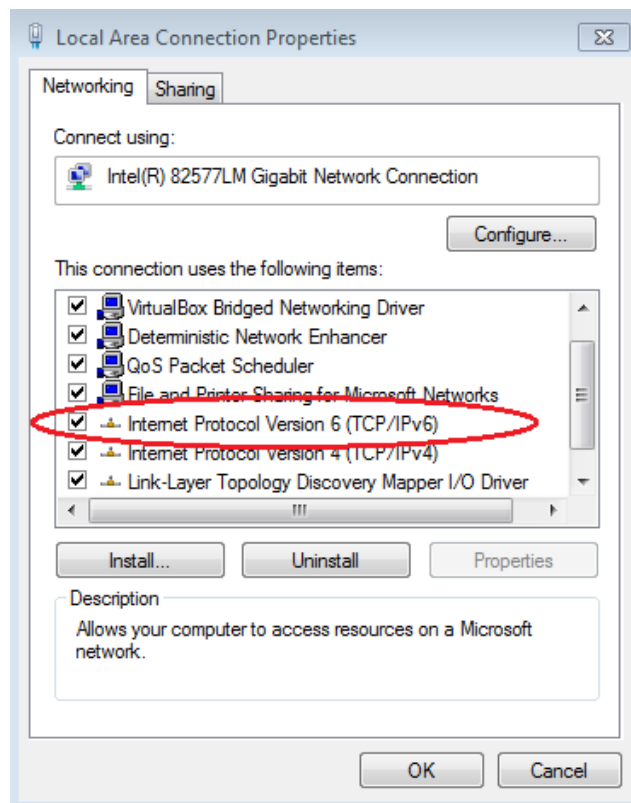
Step 4: Configure the router.

a. Console into the router and enable privileged EXEC mode.

b. Assign the device name to the router.

c.   Disable DNS lookup to prevent the router from attempting to translate incorrectly entered commands as though they were hostnames.

d.   Assign **class** as the privileged EXEC encrypted password.

e.   Assign **cisco** as the console password and enable login.

f.   Assign **cisco** as the VTY password and enable login.

g.   Encrypt the clear text passwords.

h.   Create a banner that warns anyone accessing the device that unauthorized access is prohibited.

i.   Save the running configuration to the startup configuration file.

Step 5:   Configure the switch.

a.   Console into the switch and enable privileged EXEC mode.

b.   Assign the device name to the switch.

c.   Disable DNS lookup to prevent the router from attempting to translate incorrectly entered commands as though they were hostnames.

d.   Assign **class** as the privileged EXEC encrypted password.

e.   Assign **cisco** as the console password and enable login.

f.   Assign **cisco** as the VTY password and enable login.

g.   Encrypt the clear text passwords.

h.   Create a banner that warns anyone accessing the device that unauthorized access is prohibited.

i.   Save the running configuration to the startup configuration file.

Part 2:   Configure IPv6 Addresses Manually

Step 1:   Assign the IPv6 addresses to Ethernet interfaces on R1.

a.   Assign the IPv6 global unicast addresses, listed in the Addressing Table, to both Ethernet interfaces on R1.

```
R1(config)# interface g0/0
R1(config-if)# ipv6 address 2001:db8:acad:a::1/64
R1(config-if)# no shutdown
R1(config-if)# interface g0/1
R1(config-if)# ipv6 address 2001:db8:acad:1::1/64
R1(config-if)# no shutdown
R1(config-if)# end
R1#
```

b.   Issue the **show ipv6 interface brief** command to verify that the correct IPv6 unicast address is assigned to each interface.

```
R1# show ipv6 interface brief
Em0/0                   [administratively down/down]
    unassigned
GigabitEthernet0/0      [up/up]
    FE80::D68C:B5FF:FECE:A0C0
    2001:DB8:ACAD:A::1
```

```
GigabitEthernet0/1     [up/up]
    FE80::D68C:B5FF:FECE:A0C1
    2001:DB8:ACAD:1::1
Serial0/0/0            [administratively down/down]
    unassigned
Serial0/0/1            [administratively down/down]
    unassigned
R1#
```

c. Issue the **show ipv6 interface g0/0** command. Notice that the interface is listing two Solicited Nodes multicast groups, because the IPv6 link-local (FE80) Interface ID was not manually configured to match the IPv6 unicast Interface ID.

Note: The link-local address displayed is based on EUI-64 addressing, which automatically uses the interface Media Access Control (MAC) address to create a 128-bit IPv6 link-local address.

```
R1# show ipv6 interface g0/0
GigabitEthernet0/0 is up, line protocol is up
  IPv6 is enabled, link-local address is FE80::D68C:B5FF:FECE:A0C0
  No Virtual link-local address(es):
  Global unicast address(es):
    2001:DB8:ACAD:A::1, subnet is 2001:DB8:ACAD:A::/64
  Joined group address(es):
    FF02::1
    FF02::1:FF00:1
    FF02::1:FFCE:A0C0
  MTU is 1500 bytes
  ICMP error messages limited to one every 100 milliseconds
  ICMP redirects are enabled
  ICMP unreachables are sent
  ND DAD is enabled, number of DAD attempts: 1
  ND reachable time is 30000 milliseconds (using 30000)
  ND advertised reachable time is 0 (unspecified)
  ND advertised retransmit interval is 0 (unspecified)
  ND router advertisements are sent every 200 seconds
  ND router advertisements live for 1800 seconds
  ND advertised default router preference is Medium
  Hosts use stateless autoconfig for addresses.
R1#
```

d. To get the link-local address to match the unicast address on the interface, manually enter the link-local addresses on each of the Ethernet interfaces on R1.

```
R1# config t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)# interface g0/0
R1(config-if)# ipv6 address fe80::1 link-local
R1(config-if)# interface g0/1
R1(config-if)# ipv6 address fe80::1 link-local
R1(config-if)# end
R1#
```

Note: Each router interface belongs to a separate network. Packets with a link-local address never leave the local network; therefore, you can use the same link-local address on both interfaces.

e. Re-issue the **show ipv6 interface g0/0** command. Notice that the link-local address has been changed to **FE80::1** and that there is only one Solicited Nodes multicast group listed.

```
R1# show ipv6 interface g0/0
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:ACAD:A::1, subnet is 2001:DB8:ACAD:A::/64
  Joined group address(es):
    FF02::1
    FF02::1:FF00:1
  MTU is 1500 bytes
  ICMP error messages limited to one every 100 milliseconds
  ICMP redirects are enabled
  ICMP unreachables are sent
  ND DAD is enabled, number of DAD attempts: 1
  ND reachable time is 30000 milliseconds (using 30000)
  ND advertised reachable time is 0 (unspecified)
  ND advertised retransmit interval is 0 (unspecified)
  ND router advertisements are sent every 200 seconds
  ND router advertisements live for 1800 seconds
  ND advertised default router preference is Medium
  Hosts use stateless autoconfig for addresses.
R1#
```

What multicast groups have been assigned to interface G0/0?

Step 2: Enable IPv6 routing on R1.

a. On a PC-B command prompt, enter the **ipconfig** command to examine IPv6 address information assigned to the PC interface.

Has an IPv6 unicast address been assigned to the network interface card (NIC) on PC-B?

b. Enable IPv6 routing on R1 using the **IPv6 unicast-routing** command.

```
R1 # configure terminal
R1(config)# ipv6 unicast-routing
R1(config)# exit
R1#
*Dec 17 18:29:07.415: %SYS-5-CONFIG_I: Configured from console by console
```

c. Use the **show ipv6 interface g0/0** command to see what multicast groups are assigned to interface G0/0. Notice that the all-router multicast group (FF02::2) now appears in the group list for interface G0/0.

Note: This will allow the PCs to obtain their IP address and default gateway information automatically using Stateless Address Autoconfiguration (SLAAC).

```
R1# show ipv6 interface g0/0
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:ACAD:A::1, subnet is 2001:DB8:ACAD:A::/64 [EUI]
  Joined group address(es):
    FF02::1
    FF02::2
    FF02::1:FF00:1
  MTU is 1500 bytes
  ICMP error messages limited to one every 100 milliseconds
  ICMP redirects are enabled
  ICMP unreachables are sent
  ND DAD is enabled, number of DAD attempts: 1
  ND reachable time is 30000 milliseconds (using 30000)
  ND advertised reachable time is 0 (unspecified)
  ND advertised retransmit interval is 0 (unspecified)
  ND router advertisements are sent every 200 seconds
  ND router advertisements live for 1800 seconds
  ND advertised default router preference is Medium
  Hosts use stateless autoconfig for addresses.
R1#
```

d. Now that R1 is part of the all-router multicast group, re-issue the **ipconfig** command on PC-B. Examine the IPv6 address information.

```
C:\>ipconfig

Windows IP Configuration

Ethernet adapter Local Area Connection:

   Connection-specific DNS Suffix  . :
   IPv6 Address. . . . . . . . . . . : 2001:db8:acad:a:dd0e:67fb:d14f:1288
   Temporary IPv6 Address. . . . . . : 2001:db8:acad:a:6082:dcb0:5fb2:3ece
   Link-local IPv6 Address . . . . . : fe80::dd0e:67fb:d14f:1288%11
   Autoconfiguration IPv4 Address. . : 169.254.18.136
   Subnet Mask . . . . . . . . . . . : 255.255.0.0
   Default Gateway . . . . . . . . . : fe80::1%11

Tunnel adapter isatap.{E2FC1866-B195-460A-BF40-F04F42A38FFE}:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :

Tunnel adapter Local Area Connection* 11:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :

C:\>
```

Why did PC-B receive the Global Routing Prefix and Subnet ID that you configured on R1?

Step 3: Assign IPv6 addresses to the management interface (SVI) on S1.

a. Assign the IPv6 address listed in the Addressing Table to the management interface (VLAN 1) on S1. Also assign a link-local address for this interface. IPv6 command syntax is the same as on the router.

b. Verify that the IPv6 addresses are properly assigned to the management interface using the **show ipv6 interface vlan1** command.
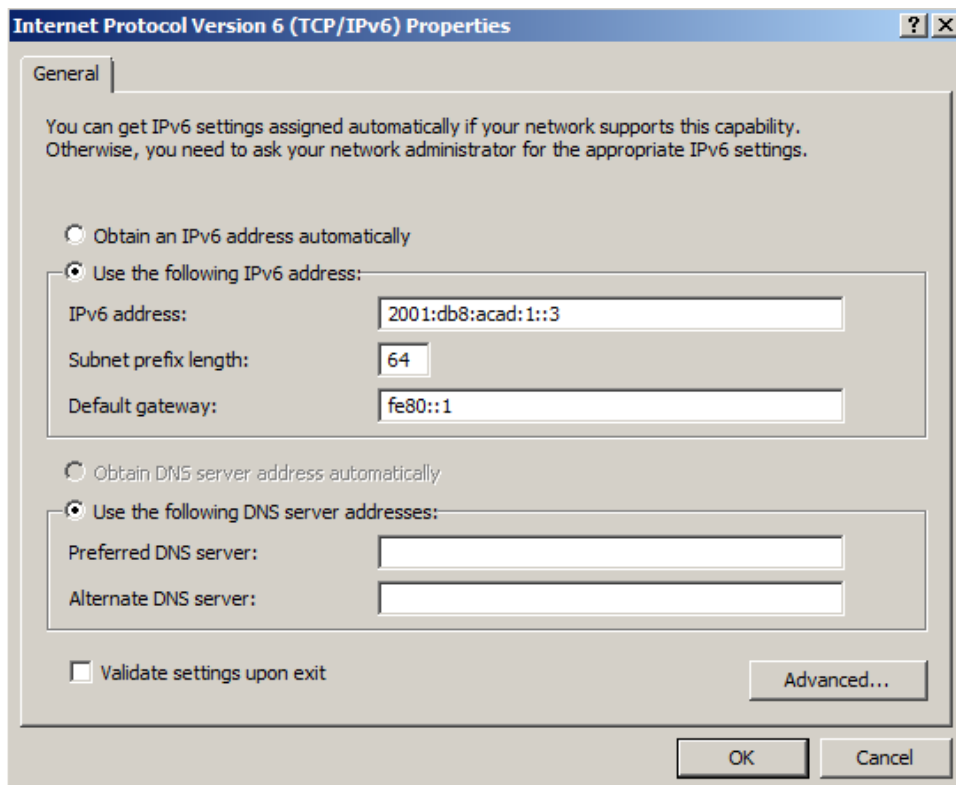
Step 4: Assign static IPv6 addresses to the PCs.

a. Open the Local Area Connection Properties window on PC-A. Select **Internet Protocol Version 6 (TCP/IPv6)** and click **Properties**.
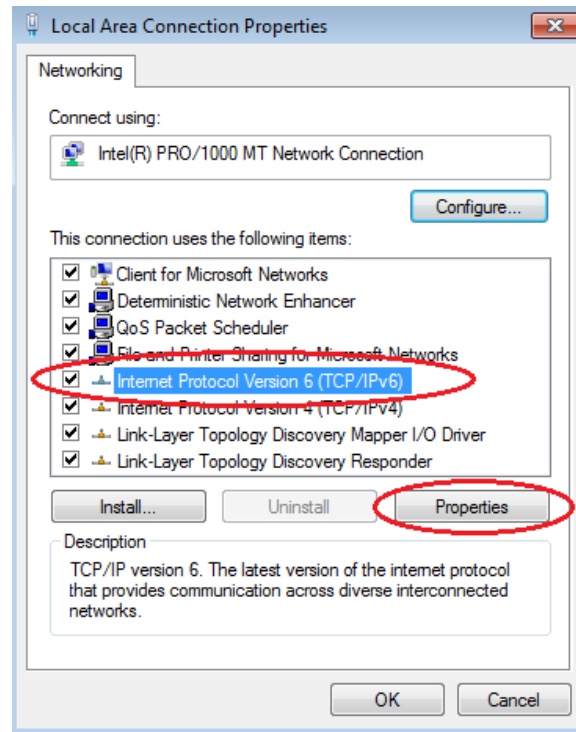
b. Click the **Use the following IPv6 address** radio button. Refer to the Addressing Table and enter the **IPv6 address**, **Subnet prefix length**, and **Default gateway** information. Click **OK**.

c. Click **Close** to close the Local Area Connection Properties window.

d. Repeat Steps 4a to c to enter the static IPv6 information on PC-B. For the correct IPv6 address information, refer to the Addressing Table.

e. Issue the **ipconfig** command from the command line on PC-B to verify the IPv6 address information.

```
C:\>ipconfig

Windows IP Configuration


Ethernet adapter Local Area Connection:

    Connection-specific DNS Suffix  . :
    IPv6 Address. . . . . . . . . . . : 2001:db8:acad:a::3
    IPv6 Address. . . . . . . . . . . : 2001:db8:acad:a:d428:7de2:997c:b05a
    Temporary IPv6 Address. . . . . . : 2001:db8:acad:a:e19e:db9f:e38e:9252
    Link-local IPv6 Address . . . . . : fe80::d428:7de2:997c:b05a%11
    Default Gateway . . . . . . . . . : fe80::1%11

Tunnel adapter isatap.{E2FC1866-B195-460A-BF40-F04F42A38FFE}:

    Media State . . . . . . . . . . . : Media disconnected
    Connection-specific DNS Suffix  . :

Tunnel adapter Local Area Connection* 11:

    Media State . . . . . . . . . . . : Media disconnected
    Connection-specific DNS Suffix  . :

C:\>
```

Part 3: Verify End-to-End Connectivity

a. From PC-A, ping **FE80::1**. This is the link-local address assigned to G0/1 on R1.

```
C:\>ping fe80::1

Pinging fe80::1 with 32 bytes of data:
Reply from fe80::1: time<1ms
Reply from fe80::1: time<1ms
Reply from fe80::1: time<1ms
Reply from fe80::1: time<1ms

Ping statistics for fe80::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>_
```

Note: You can also test connectivity by using the global unicast address, instead of the link-local address.

b. Ping the S1 management interface from PC-A.

```
C:\>ping 2001:db8:acad:1::b

Pinging 2001:db8:acad:1::b with 32 bytes of data:
Reply from 2001:db8:acad:1::b: time=14ms
Reply from 2001:db8:acad:1::b: time=2ms
Reply from 2001:db8:acad:1::b: time=2ms
Reply from 2001:db8:acad:1::b: time=3ms

Ping statistics for 2001:db8:acad:1::b:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 14ms, Average = 5ms

C:\>_
```

c. Use the **tracert** command on PC-A to verify that you have end-to-end connectivity to PC-B.

```
C:\>tracert 2001:db8:acad:a::3

Tracing route to 2001:db8:acad:a::3 over a maximum of 30 hops

  1    <1 ms    <1 ms    <1 ms  2001:db8:acad:1::1
  2     5 ms    <1 ms    <1 ms  2001:db8:acad:a::3

Trace complete.

C:\>
```

d. From PC-B, ping PC-A.

```
C:\>ping 2001:db8:acad:1::3

Pinging 2001:db8:acad:1::3 with 32 bytes of data:
Reply from 2001:db8:acad:1::3: time<1ms
Reply from 2001:db8:acad:1::3: time<1ms
Reply from 2001:db8:acad:1::3: time<1ms
Reply from 2001:db8:acad:1::3: time<1ms

Ping statistics for 2001:db8:acad:1::3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

e. From PC-B, ping the link-local address for G0/0 on R1.

```
C:\>ping fe80::1

Pinging fe80::1 with 32 bytes of data:
Reply from fe80::1: time<1ms
Reply from fe80::1: time<1ms
Reply from fe80::1: time<1ms
Reply from fe80::1: time<1ms

Ping statistics for fe80::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

Note: If end-to-end connectivity is not established, troubleshoot your IPv6 address assignments to verify that you entered the addresses correctly on all devices.

Reflection

1. Why can the same link-local address, FE80::1, be assigned to both Ethernet interfaces on R1?

2. What is the Subnet ID of the IPv6 unicast address 2001:db8:acad::aaaa:1234/64?

Router Interface Summary Table

Router Interface Summary				
Router Model	**Ethernet Interface #1**	**Ethernet Interface #2**	**Serial Interface #1**	**Serial Interface #2**
1800	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
1900	Gigabit Ethernet 0/0 (G0/0)	Gigabit Ethernet 0/1 (G0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2801	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/1/0 (S0/0/0)	Serial 0/1/1 (S0/0/1)
2811	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2900	Gigabit Ethernet 0/0 (G0/0)	Gigabit Ethernet 0/1 (G0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
Note: To find out how the router is configured, look at the interfaces to identify the type of router and how many interfaces the router has. There is no way to effectively list all the combinations of configurations for each router class. This table includes identifiers for the possible combinations of Ethernet and Serial interfaces in the device. The table does not include any other type of interface, even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in Cisco IOS commands to represent the interface.				