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FACULTY OF OCEAN ENGINEERING TECHNOLOGY & INFORMATICS

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NETWORKING

CSF 3223

LAB 8 REPORT

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## Show showLab - 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 or 8 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.

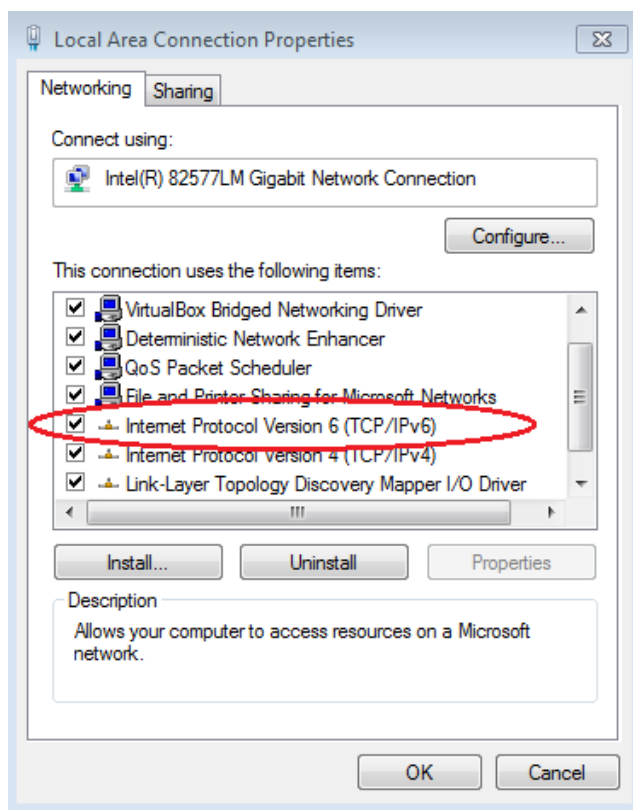
### Part 1: Set Up Topology and Configure Basic Router and Switch Settings

**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. 0 15Disable DNS lookup to prevent the router from attempting to translate incorrectly entered commands as though they were hostnames.

```
S1#no ip commands ?
% Unrecognized command
S1#config t
Enter configuration commands, one per line. End with CNTL/Z.
S1(config)#no ip d?
default-gateway  device  dhcp          dhcp-client
dhcp-server      domain  domain-list  domain-lookup
domain-name

S1(config)#no ip domain-lookup
S1(config)#
```

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

```
s1(config)#hostname S1
S1(config)#enable secret class
S1(config)#login
```

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

```
S1(config)#line console 0
S1(config-line)#password cisco
S1(config-line)#login
S1(config-line)#exit
S1(config)#
```

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

```
S1(config)#line vty 0 15
S1(config-line)#cisco
^
% Invalid input detected at '^' marker.

S1(config-line)#password cisco
S1(config-line)#login
S1(config-line)#exit
S1(config)#
```

- g. Encrypt the clear text passwords.

```
S1(config)#service password-encryption
S1(config)#
```

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

```
S1(config)#banner motd "don't you ever think of entering here"
```

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

```
S1#copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
0 bytes copied in 0.914 secs (0 bytes/sec)
S1#
```

## 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.
- copy
- 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
<output omitted>
```

- 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
```

<output omitted>

- 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
    FE80::1:FF00:1
  MTU is 1500 bytes
<output omitted>
```

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

The all-nodes multicast group (FF02::1) and the Solicited Nodes multicast group (ff02::1:ff00:1)

---

### 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? No

- 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
<output omitted>
```

- 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.

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

On R1 all IPv6 interfaces are now part of the All-router multicast group, FF02::2. This allows it to send Router Advertisement (RA) messages with the Global Network Address and Subnet ID information to all nodes on the LAN. Notice that R1 also sent the link-local address, fe80::1, as the Default Gateway. The PCs will receive their IPv6 addresses and default gateway via SLAAC as long as the advertised prefix length is 64 bits.

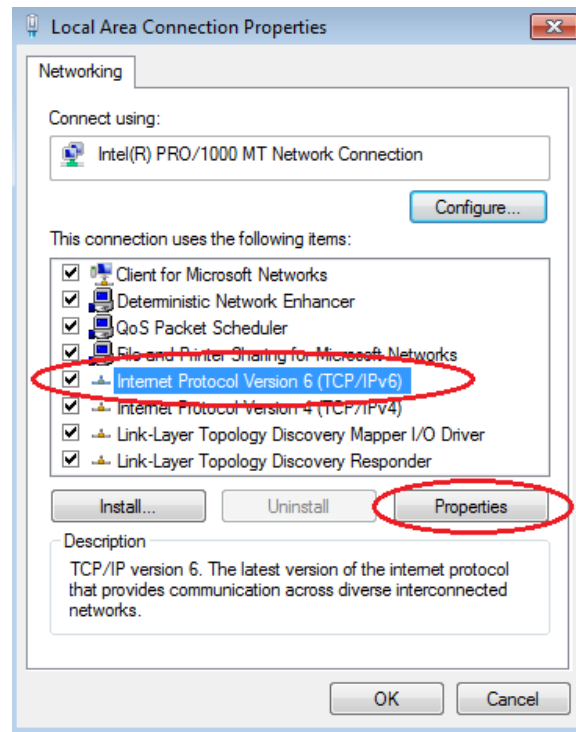
### Step 3: Assign IPv6 addresses to the management interface (SVI) on S1.

- 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.
- Verify that the IPv6 addresses are properly assigned to the management interface using the **show ipv6 interface vlan1** command.

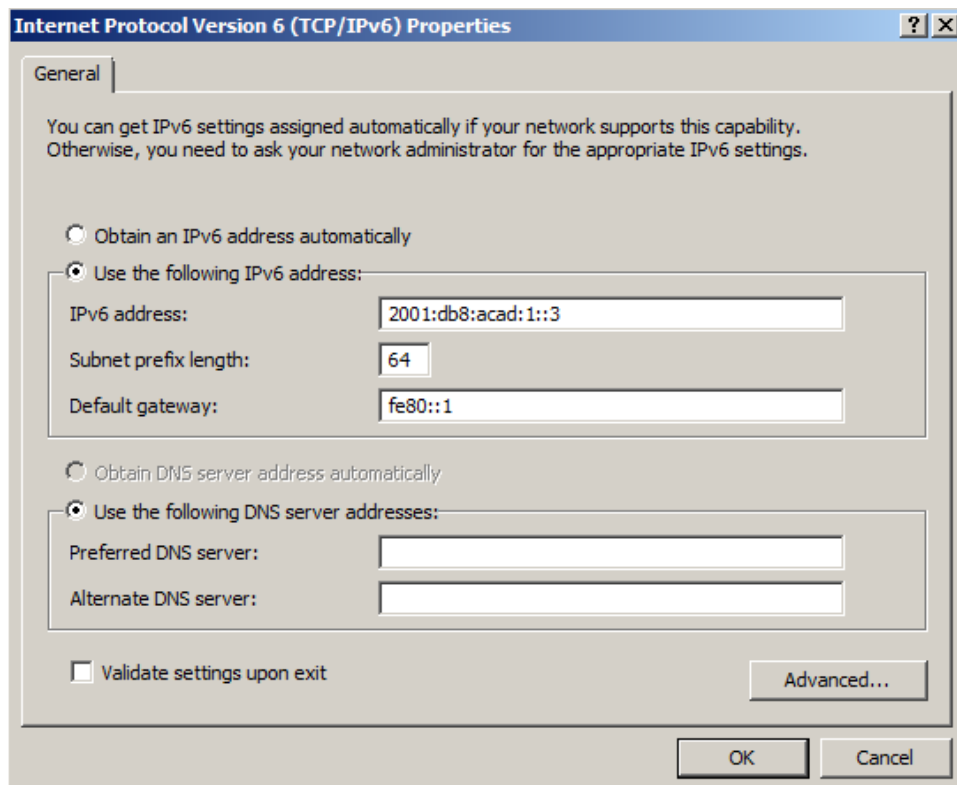
**Note:** The default 2960 Switch Database Manager (SDM) template does not support IPv6. It may be necessary to issue the command **sdm prefer dual-ipv4-and-ipv6 default** to enable IPv6 addressing before applying an IPv6 address to the VLAN 1 SVI.

### Step 4: Assign static IPv6 addresses to the PCs.

- 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.

### 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?

Link-local packets never leave the local network, so the same link-local address can be used on an interface associated to a different local network.

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

0 (zero) or 0000 (zeros). The fourth hextet is the Subnet ID of an IPv6 address with a prefix of /64. In the example, the fourth hextet contains all zeros and the IPv6 Omitting All 0 Segment rule is using the double colon to depict the Subnet ID and the first two hextets of the Interface ID. This is why the subnet of the Global unicast address of 2001:acad::aaaa:1234/64 is 2001:db8:acad::/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)
<b>Note:</b> 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.				

## Lab - Configuring IPv6 Addresses on Network Devices

```
COM6 - PuTTY
!
hostname s1
!
boot-start-marker
boot-end-marker
!
enable secret 5 $l$WxYF$bCkW9vwNup3kK3St8ZUv9/
!
!
!
no aaa new-model
system mtu routing 1500
!
!
no ip domain-lookup
!
!
crypto pki trustpoint TP-self-signed-443499776
  enrollment selfsigned
  subject-name cn=IOS-Self-Signed-Certificate-443499776
  revocation-check none
  rsakeypair TP-self-signed-443499776
!
!
crypto pki certificate chain TP-self-signed-443499776
  certificate self-signed 01
    30820239 308201A2 A0030201 02020101 300D0609 2A864886 F70D0101 04050030
    30312E30 2C060355 04031325 494F532D 53656C66 2D536967 6E65642D 43657274
    69666963 6174652D 34343334 39393737 36301E17 0D393330 33303130 30303135
    385A170D 32303031 30313030 30303030 5A303031 2E302C06 03550403 1325494F
    532D5365 6C662D53 69676E65 642D4365 72746966 69636174 652D3434 33343939
    37373630 819F300D 06092A86 4886F70D 01010105 0003818D 00308189 02818100
    CDA94A9A A5DA5CFD AD513A51 D0BE0BCC A15F7E61 F1A0E4B3 414113F6 69CCE99A
    DF62AF50 5762C98C FBA5A567 6DCC65F6 203C2F3F D86CA1E0 4F4D22A4 3ED808BE
    CA189FC1 E9583931 F5739F44 D8DA0C61 4A402D45 468950F6 9397E3D8 10473328
    92C71EC4 22E170C4 5E1115C8 77BB96BC 05AF132F 21EA7A6E 4919850F D350B4F3
    02030100 01A36330 61300F06 03551D13 0101FF04 05300301 01FF300E 0603551D
    11040730 05820373 312E301F 0603551D 23041830 1680142F BC09C9B1 0DDBFA3E
    275C976E 8B640F95 80702E30 1D060355 1D0E0416 04142FBC 09C9B10D DBFA3E27
    5C976E8B 640F9580 702E300D 06092A86 4886F70D 01010405 00038181 00AA7393
    9422A08E 90C7345A 2D9C7C9D 8A9FE3CF 55E2C900 3B92B5A0 7A785918 80890F83
    15D6016F 4FC98A62 A9BEA11C 7B90DF33 B83241ED 5BF2A0CC 007103F6 AC518AC2
    CDE7DEB6 F06ED901 658A2830 9E1A8CB8 CF8C5A96 AC4F6A2F 85B2463D 53BF9211
    9D9A2BB5 E5A66890 A9FA3243 D8ABC2B4 9FDD4384 246CBAAD 2E057837 92
  quit
!
!
!
spanning-tree mode pvst
spanning-tree extend system-id
!
!
vlan internal allocation policy ascending
!
!
!
interface FastEthernet0/1
!
interface FastEthernet0/2
!
interface FastEthernet0/3
!
--More--
```

```
COM6 - PuTTY
!
interface FastEthernet0/7
!
interface FastEthernet0/8
!
interface FastEthernet0/9
!
interface FastEthernet0/10
!
interface FastEthernet0/11
!
interface FastEthernet0/12
!
interface FastEthernet0/13
!
interface FastEthernet0/14
!
interface FastEthernet0/15
!
interface FastEthernet0/16
!
interface FastEthernet0/17
!
interface FastEthernet0/18
!
interface FastEthernet0/19
!
interface FastEthernet0/20
!
interface FastEthernet0/21
!
interface FastEthernet0/22
!
interface FastEthernet0/23
!
interface FastEthernet0/24
!
interface GigabitEthernet0/1
!
interface GigabitEthernet0/2
!
interface Vlan1
  no ip address
  ipv6 address FE80::1 link-local
  ipv6 address 2001:DB8:ACAD:1::B/64
!
ip http server
ip http secure-server
banner motd ^CUnauthorized access is prohibited^C
!
line con 0
  password 7 14141B180F0B
  login
line vty 0 4
  password 7 14141B180F0B
  login
line vty 5 15
  login
!
end

sl#
```

## Lab - Configuring IPv6 Addresses on Network Devices

### PC-A

Internet Protocol Version 6 (TCP/IPv6) Properties

General

You can get IPv6 settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IPv6 settings.

☐ Obtain an IPv6 address automatically

☒ Use the following IPv6 address:

IPv6 address: 2001:DB8:ACAD:1::3

Subnet prefix length: 64

Default gateway: FE80::1

☐ Obtain DNS server address automatically

☒ Use the following DNS server addresses:

Preferred DNS server:

Alternate DNS server:

☐ Validate settings upon exit

Advanced...

OK Cancel

### PC-B

Internet Protocol Version 6 (TCP/IPv6) Properties

General

You can get IPv6 settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IPv6 settings.

☐ Obtain an IPv6 address automatically

☒ Use the following IPv6 address:

IPv6 address: 2001:DB8:ACAD:A::3

Subnet prefix length: 64

Default gateway: FE80::1

☐ Obtain DNS server address automatically

☒ Use the following DNS server addresses:

Preferred DNS server:

Alternate DNS server:

☐ Validate settings upon exit

Advanced...

OK Cancel

```
C:\Users\PC 48>ping 2001:DB8:ACAD:A::3

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

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

