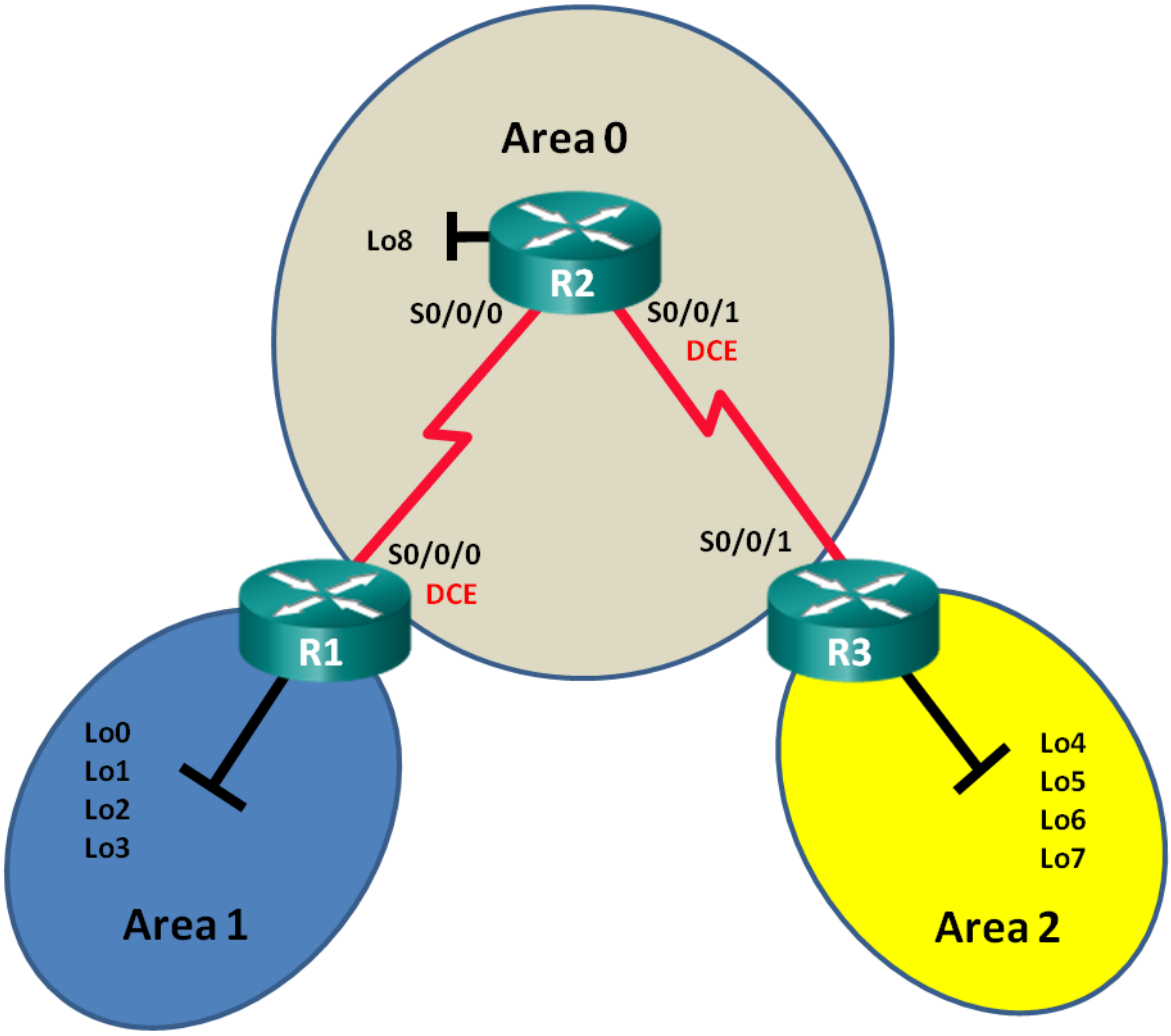
Lab - Configuring Multiarea OSPFv3 (Instructor Version)

Instructor Note: Red font color or Gray highlights indicate text that appears in the instructor copy only.

Topology



Addressing Table

Device	Interface	IPv6 Address	Default Gateway
R1	S0/0/0 (DCE)	2001:DB8:ACAD:12::1/64 FE80::1 link-local	N/A
	Lo0	2001:DB8:ACAD::1/64	N/A
	Lo1	2001:DB8:ACAD:1::1/64	N/A
	Lo2	2001:DB8:ACAD:2::1/64	N/A
	Lo3	2001:DB8:ACAD:3::1/64	N/A
R2	S0/0/0	2001:DB8:ACAD:12::2/64 FE80::2 link-local	N/A
	S0/0/1 (DCE)	2001:DB8:ACAD:23::2/64 FE80::2 link-local	N/A
	Lo8	2001:DB8:ACAD:8::1/64	N/A
R3	S0/0/1	2001:DB8:ACAD:23::3/64 FE80::3 link-local	N/A
	Lo4	2001:DB8:ACAD:4::1/64	N/A
	Lo5	2001:DB8:ACAD:5::1/64	N/A
	Lo6	2001:DB8:ACAD:6::1/64	N/A
	Lo7	2001:DB8:ACAD:7::1/64	N/A

Objectives

Part 1: Build the Network and Configure Basic Device Settings

Part 2: Configure Multiarea OSPFv3 Routing

Part 3: Configure Interarea Route Summarization

Background / Scenario

Using multiarea OSPFv3 in large IPv6 network deployments can reduce router processing by creating smaller routing tables and requiring less memory overhead. In multiarea OSPFv3, all areas are connected to the backbone area (area 0) through area border routers (ABRs).

In this lab, you will implement OSPFv3 routing for multiple areas and configure interarea route summarizations on the Area Border Routers (ABRs). You will also use a number of **show** commands to display and verify OSPFv3 routing information. This lab uses loopback addresses to simulate networks in multiple OSPFv3 areas.

Note: The routers used with CCNA hands-on labs are Cisco 1941 Integrated Services Routers (ISRs) with Cisco IOS Release 15.2(4)M3 (universalk9 image). Other routers 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 this end of this lab for the correct interface identifiers.

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

Instructor Note: Refer to the Instructor Lab Manual for the procedures to initialize and reload devices.

Required Resources

- 3 Routers (Cisco 1941 with Cisco IOS Release 15.2(4)M3 universal image or comparable)
- 3 PCs (Windows 7, Vista, or XP with terminal emulation program, such as Tera Term)
- Console cables to configure the Cisco IOS devices via the console ports
- Serial cables as shown in the topology

Part 1: Build the Network and Configure Basic Device Settings

In Part 1, you will set up the network topology and configure basic settings on the routers.

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

Step 2: Initialize and reload the routers as necessary.

Step 3: Configure basic settings for each router.

a. Disable DNS lookup.

b. Configure device name as shown in the topology.

c. Assign **class** as the privileged EXEC password.

d. Assign **cisco** as the vty password.

e. Configure a MOTD banner to warn users that unauthorized access is prohibited.

f. Configure **logging synchronous** for the console line.

g. Encrypt plain text passwords.

h. Configure the IPv6 unicast and link-local addresses listed in the Addressing Table for all interfaces.

i. Enable IPv6 unicast routing on each router.

j. Copy the running configuration to the startup configuration.

Step 4: Test connectivity.

The routers should be able to ping one another. The routers are unable to ping distant loopbacks until OSPFv3 routing is configured. Verify and troubleshoot if necessary.

Part 2: Configure Multiarea OSPFv3 Routing

In Part 2, you will configure OSPFv3 routing on all routers to separate the network domain into three distinct areas, and then verify that routing tables are updated correctly.

Step 1: Assign router IDs.

a. On R1, issue the **ipv6 router ospf** command to start an OSPFv3 process on the router.

```
R1(config)# ipv6 router ospf 1
```

Note: The OSPF process ID is kept locally and has no meaning to other routers on the network.

b. Assign the OSPFv3 router ID **1.1.1.1** to R1.

```
R1(config-rtr)# router-id 1.1.1.1
```

c. Assign a router ID of **2.2.2.2** to R2 and a router ID of **3.3.3.3** to R3.

d. Issue the **show ipv6 ospf** command to verify the router IDs on all routers.

```
R2# show ipv6 ospf
 Routing Process "ospfv3 1" with ID 2.2.2.2
 Event-log enabled, Maximum number of events: 1000, Mode: cyclic
 Router is not originating router-LSAs with maximum metric
 <output omitted>
```

Step 2: Configure multiarea OSPFv3.

a. Issue the **ipv6 ospf 1 area** *area-id* command for each interface on R1 that is to participate in OSPFv3 routing. The loopback interfaces are assigned to area 1 and the serial interface is assigned to area 0. You will change the network type on the loopback interfaces to ensure that the correct subnet is advertised.

```
R1(config)# interface lo0
R1(config-if)# ipv6 ospf 1 area 1
R1(config-if)# ipv6 ospf network point-to-point
R1(config-if)# interface lo1
R1(config-if)# ipv6 ospf 1 area 1
R1(config-if)# ipv6 ospf network point-to-point
R1(config-if)# interface lo2
R1(config-if)# ipv6 ospf 1 area 1
R1(config-if)# ipv6 ospf network point-to-point
R1(config-if)# interface lo3
R1(config-if)# ipv6 ospf 1 area 1
R1(config-if)# ipv6 ospf network point-to-point
R1(config-if)# interface s0/0/0
R1(config-if)# ipv6 ospf 1 area 0
```

b. Use the **show ipv6 protocols** command to verify multiarea OSPFv3 status.

```
R1# show ipv6 protocols
IPv6 Routing Protocol is "connected"
IPv6 Routing Protocol is "ND"
IPv6 Routing Protocol is "ospf 1"
  Router ID 1.1.1.1
  Area border router
  Number of areas: 2 normal, 0 stub, 0 nssa
  Interfaces (Area 0):
    Serial0/0/0
  Interfaces (Area 1):
    Loopback0
    Loopback1
    Loopback2
    Loopback3
  Redistribution:
    None
```

c. Assign all interfaces on R2 to participate in OSPFv3 area 0. For the loopback interface, change the network type to point-to point. Write the commands used in the space below.

```
R2(config)# interface lo8
R2(config-if)# ipv6 ospf 1 area 0
R2(config-if)# ipv6 ospf network point-to-point
R2(config-if)# interface s0/0/0
R2(config-if)# ipv6 ospf 1 area 0
R2(config-if)# interface s0/0/1
R2(config-if)# ipv6 ospf 1 area 0
```

d. Use the **show ipv6 ospf interface brief** command to view OSPFv3 enabled interfaces.

```
R2# show ipv6 ospf interface brief
Interface    PID   Area            Intf ID    Cost  State Nbrs F/C
Lo8          1     0               13         1     P2P   0/0
Se0/0/1      1     0               7          64    P2P   1/1
Se0/0/0      1     0               6          64    P2P   1/1
```

e. Assign the loopback interfaces on R3 to participate in OSPFv3 area 2 and change the network type to point-to-point. Assign the serial interface to participate in OSPFv3 area 0. Write the commands used in the space below.

```
R3(config)# interface lo4
R3(config-if)# ipv6 ospf 1 area 2
R3(config-if)# ipv6 ospf network point-to-point
R3(config-if)# interface lo5
R3(config-if)# ipv6 ospf 1 area 2
R3(config-if)# ipv6 ospf network point-to-point
R3(config-if)# interface lo6
R3(config-if)# ipv6 ospf 1 area 2
R3(config-if)# ipv6 ospf network point-to-point
R3(config-if)# interface lo7
R3(config-if)# ipv6 ospf 1 area 2
```

```
R3(config-if)# ipv6 ospf network point-to-point
R3(config-if)# interface s0/0/1
R3(config-if)# ipv6 ospf 1 area 0
```

f. Use the **show ipv6 ospf** command to verify configurations.

```
R3# show ipv6 ospf
 Routing Process "ospfv3 1" with ID 3.3.3.3
 Event-log enabled, Maximum number of events: 1000, Mode: cyclic
 It is an area border router
 Router is not originating router-LSAs with maximum metric
 Initial SPF schedule delay 5000 msecs
 Minimum hold time between two consecutive SPFs 10000 msecs
 Maximum wait time between two consecutive SPFs 10000 msecs
 Minimum LSA interval 5 secs
 Minimum LSA arrival 1000 msecs
 LSA group pacing timer 240 secs
 Interface flood pacing timer 33 msecs
 Retransmission pacing timer 66 msecs
 Number of external LSA 0. Checksum Sum 0x000000
 Number of areas in this router is 2. 2 normal 0 stub 0 nssa
 Graceful restart helper support enabled
 Reference bandwidth unit is 100 mbps
 RFC1583 compatibility enabled
    Area BACKBONE(0)
        Number of interfaces in this area is 1
        SPF algorithm executed 2 times
        Number of LSA 16. Checksum Sum 0x0929F8
        Number of DCbitless LSA 0
        Number of indication LSA 0
        Number of DoNotAge LSA 0
        Flood list length 0
    Area 2
        Number of interfaces in this area is 4
        SPF algorithm executed 2 times
        Number of LSA 13. Checksum Sum 0x048E3C
        Number of DCbitless LSA 0
        Number of indication LSA 0
        Number of DoNotAge LSA 0
        Flood list length 0
```

Step 3: Verify OSPFv3 neighbors and routing information.

a. Issue the **show ipv6 ospf neighbor** command on all routers to verify that each router is listing the correct routers as neighbors.

```
R1# show ipv6 ospf neighbor

            OSPFv3 Router with ID (1.1.1.1) (Process ID 1)

Neighbor ID     Pri   State           Dead Time   Interface ID    Interface
```

```
2.2.2.2           0   FULL/  -        00:00:39    6               Serial0/0/0
```

b. Issue the **show ipv6 route ospf** command on all routers to verify that each router has learned routes to all networks in the Addressing Table.

```
R1# show ipv6 route ospf
IPv6 Routing Table - default - 16 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route
       B - BGP, R - RIP, H - NHRP, I1 - ISIS L1
       I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary, D - EIGRP
       EX - EIGRP external, ND - ND Default, NDp - ND Prefix, DCE - Destination
       NDr - Redirect, O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1
       OE2 - OSPF ext 2, ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
OI  2001:DB8:ACAD:4::/64 [110/129]
     via FE80::2, Serial0/0/0
OI  2001:DB8:ACAD:5::/64 [110/129]
     via FE80::2, Serial0/0/0
OI  2001:DB8:ACAD:6::/64 [110/129]
     via FE80::2, Serial0/0/0
OI  2001:DB8:ACAD:7::/64 [110/129]
     via FE80::2, Serial0/0/0
O   2001:DB8:ACAD:8::/64 [110/65]
     via FE80::2, Serial0/0/0
O   2001:DB8:ACAD:23::/64 [110/128]
     via FE80::2, Serial0/0/0
```

What is the significance of an OI route?

_____

An OI route is an OSPF interarea route, which was learned from an OSPF neighbor participating in another area.

c. Issue the **show ipv6 ospf database** command on all routers.

```
R1# show ipv6 ospf database

            OSPFv3 Router with ID (1.1.1.1) (Process ID 1)

                Router Link States (Area 0)

ADV Router       Age         Seq#        Fragment ID  Link count  Bits
 1.1.1.1         908         0x80000001  0            1           B
 2.2.2.2         898         0x80000003  0            2           None
 3.3.3.3         899         0x80000001  0            1           B

               Inter Area Prefix Link States (Area 0)

ADV Router       Age         Seq#        Prefix
 1.1.1.1         907         0x80000001  2001:DB8:ACAD::/62
 3.3.3.3         898         0x80000001  2001:DB8:ACAD:4::/62

               Link (Type-8) Link States (Area 0)
```

```
ADV Router       Age         Seq#        Link ID    Interface
 1.1.1.1         908         0x80000001  6          Se0/0/0
 2.2.2.2         909         0x80000002  6          Se0/0/0

               Intra Area Prefix Link States (Area 0)

ADV Router       Age         Seq#        Link ID    Ref-lstype  Ref-LSID
 1.1.1.1         908         0x80000001  0          0x2001      0
 2.2.2.2         898         0x80000003  0          0x2001      0
 3.3.3.3         899         0x80000001  0          0x2001      0

               Router Link States (Area 1)

ADV Router       Age         Seq#        Fragment ID  Link count  Bits
 1.1.1.1         908         0x80000001  0            0           B

               Inter Area Prefix Link States (Area 1)

ADV Router       Age         Seq#        Prefix
 1.1.1.1         907         0x80000001  2001:DB8:ACAD:12::/64
 1.1.1.1         907         0x80000001  2001:DB8:ACAD:8::/64
 1.1.1.1         888         0x80000001  2001:DB8:ACAD:23::/64
 1.1.1.1         888         0x80000001  2001:DB8:ACAD:4::/62

               Link (Type-8) Link States (Area 1)

ADV Router       Age         Seq#        Link ID    Interface
 1.1.1.1         908         0x80000001  13         Lo0
 1.1.1.1         908         0x80000001  14         Lo1
 1.1.1.1         908         0x80000001  15         Lo2
 1.1.1.1         908         0x80000001  16         Lo3

               Intra Area Prefix Link States (Area 1)

ADV Router       Age         Seq#        Link ID    Ref-lstype  Ref-LSID
 1.1.1.1         908         0x80000001  0          0x2001      0
```

How many link state databases are found on R1? _____ 2

How many link state databases are found on R2? _____ 1

How many link state databases are found on R3? _____ 2

Part 3: Configure Interarea Route Summarization

In Part 3, you will manually configure interarea route summarization on the ABRs.

Step 1: Summarize networks on R1.

a. List the network addresses for the loopback interfaces and identify the hextet section where the addresses differ.

2001:DB8:ACAD:0000::1/64

2001:DB8:ACAD:0001::1/64

2001:DB8:ACAD:0002::1/64

2001:DB8:ACAD:0003::1/64

b. Convert the differing section from hex to binary.

2001:DB8:ACAD: 0000 0000 0000 0000::1/64

2001:DB8:ACAD: 0000 0000 0000 0001::1/64

2001:DB8:ACAD: 0000 0000 0000 0010::1/64

2001:DB8:ACAD: 0000 0000 0000 0011::1/64

c. Count the number of leftmost matching bits to determine the prefix for the summary route.

2001:DB8:ACAD: 0000 0000 0000 0000::1/64

2001:DB8:ACAD: 0000 0000 0000 0001::1/64

2001:DB8:ACAD: 0000 0000 0000 0010::1/64

2001:DB8:ACAD: 0000 0000 0000 0011::1/64

How many bits match? _____ /62

d. Copy the matching bits and then add zero bits to determine the summarized network address.

2001:DB8:ACAD: 0000 0000 0000 0000::0

e. Convert the binary section back to hex.

2001:DB8:ACAD::

f. Append the prefix of the summary route (result of Step 1c).

2001:DB8:ACAD::/62

Step 2: Configure interarea route summarization on R1.

a. To manually configure interarea route summarization on R1, use the **area** *area-id* **range** *address mask* command.

```
R1(config)# ipv6 router ospf 1
R1(config-rtr)# area 1 range 2001:DB8:ACAD::/62
```

b. View the OSPFv3 routes on R3.

```
R3# show ipv6 route ospf
IPv6 Routing Table - default - 14 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route
       B - BGP, R - RIP, H - NHRP, I1 - ISIS L1
       I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary, D - EIGRP
       EX - EIGRP external, ND - ND Default, NDp - ND Prefix, DCE - Destination
       NDr - Redirect, O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1
       OE2 - OSPF ext 2, ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
OI  2001:DB8:ACAD::/62 [110/129]
     via FE80::2, Serial0/0/1
O   2001:DB8:ACAD:8::/64 [110/65]
     via FE80::2, Serial0/0/1
O   2001:DB8:ACAD:12::/64 [110/128]
```

```
     via FE80::2, Serial0/0/1
```

Compare this output to the output from Part 2, Step 3b. How are the networks in area 1 now expressed in the routing table on R3?

The networks are summarized as a single OSPF interarea route.

c. View the OSPFv3 routes on R1.

```
R1# show ipv6 route ospf
IPv6 Routing Table - default - 18 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route
       B - BGP, R - RIP, H - NHRP, I1 - ISIS L1
       I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary, D - EIGRP
       EX - EIGRP external, ND - ND Default, NDp - ND Prefix, DCE - Destination
       NDr - Redirect, O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1
       OE2 - OSPF ext 2, ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
O   2001:DB8:ACAD::/62 [110/1]
     via Null0, directly connected
OI  2001:DB8:ACAD:4::/64 [110/129]
     via FE80::2, Serial0/0/0
OI  2001:DB8:ACAD:5::/64 [110/129]
     via FE80::2, Serial0/0/0
OI  2001:DB8:ACAD:6::/64 [110/129]
     via FE80::2, Serial0/0/0
OI  2001:DB8:ACAD:7::/64 [110/129]
     via FE80::2, Serial0/0/0
O   2001:DB8:ACAD:8::/64 [110/65]
     via FE80::2, Serial0/0/0
O   2001:DB8:ACAD:23::/64 [110/128]
     via FE80::2, Serial0/0/0
```

Compare this output to the output from Part 2, Step 3b. How are the summarized networks expressed in the routing table on R1?

The summarized networks appear as an OSPF intra-area (O) entry with a Null0 exit interface. This is a bogus entry created by the router to prevent routing loops.

Step 3: Summarize networks and configure interarea route summarization on R3.

a. Summarize the loopback interfaces on R3.

1) List the network addresses and identify the hextet section where the addresses differ.
2) Convert the differing section from hex to binary.
3) Count the number of left-most matching bits to determine the prefix for the summary route.
4) Copy the matching bits and then add zero bits to determine the summarized network address.
5) Convert the binary section back to hex.
6) Append the prefix of the summary route.

Write the summary address in the space provided.

2001:db8:acad:4::/62

b. Manually configure interarea route summarization on R3. Write the commands in the space provided.

_____

```
R3(config)# ipv6 router ospf 1
R3(config-rtr)# area 2 range 2001:db8:acad:4::/62
```

c. Verify that area 2 routes are summarized on R1. What command was used?

_____

show ipv6 route or **show ipv6 route ospf**

d. Record the routing table entry on R1 for the summarized route advertised from R3.

_____

```
OI  2001:DB8:ACAD:4::/62 [110/129]
     via FE80::2, Serial0/0/0
```

Reflection

1. Why would multiarea OSPFv3 be used?

_____

_____

Answers will vary. Multiarea OSPFv3 can be used in large network domains to improve the efficiency of the routing process, decrease the size of routing tables, and decrease router CPU/memory processing requirements.

2. What is the benefit of configuring interarea route summarization?

_____

_____

Configuring interarea route summarization decreases the size of routing tables throughout the network domain and decreases the number of type 3 link state advertisements (LSAs) sent from area border routers to the backbone area. If one of the summarized networks is down, it does not necessarily cause the routers in other areas to rerun their SPF algorithm.

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 (S0/1/0)	Serial 0/1/1 (S0/1/1)
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.

Device Configs - Final

Router R1

```
R1#show run
Building configuration...

Current configuration : 2078 bytes
!
version 15.2
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R1
!
boot-start-marker
boot-end-marker
!
!
!
no aaa new-model
!
!
no ip domain lookup
ip cef
```

```
ipv6 unicast-routing
ipv6 cef
!
multilink bundle-name authenticated
!
redundancy
!
interface Loopback0
 no ip address
 ipv6 address 2001:DB8:ACAD::1/64
 ipv6 ospf 1 area 1
 ipv6 ospf network point-to-point
!
interface Loopback1
 no ip address
 ipv6 address 2001:DB8:ACAD:1::1/64
 ipv6 ospf 1 area 1
 ipv6 ospf network point-to-point
!
interface Loopback2
 no ip address
 ipv6 address 2001:DB8:ACAD:2::1/64
 ipv6 ospf 1 area 1
 ipv6 ospf network point-to-point
!
interface Loopback3
 no ip address
 ipv6 address 2001:DB8:ACAD:3::1/64
 ipv6 ospf 1 area 1
 ipv6 ospf network point-to-point
!
interface Embedded-Service-Engine0/0
 no ip address
 shutdown
!
interface GigabitEthernet0/0
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface GigabitEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface Serial0/0/0
no ip address
```

```
 ipv6 address FE80::1 link-local
 ipv6 address 2001:DB8:ACAD:12::1/64
 ipv6 ospf 1 area 0
 clock rate 2000000
!
interface Serial0/0/1
 no ip address
 shutdown
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
!
ipv6 router ospf 1
 router-id 1.1.1.1
 area 1 range 2001:DB8:ACAD::/62
!
!
!
!
control-plane
!
!
banner motd ^CUnauthorized access is strictly prohibited.^C
!
line con 0
 password 7 045802150C2E
 logging synchronous
 login
line aux 0
line 2
 no activation-character
 no exec
 transport preferred none
 transport input all
 transport output pad telnet rlogin lapb-ta mop udptn v120 ssh
 stopbits 1
line vty 0 4
 password 7 060506324F41
 login
 transport input all
!
scheduler allocate 20000 1000
!
end
```

Router R2

```
R2#show run
Building configuration...

Current configuration : 1809 bytes
!
version 15.2
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R2
!
boot-start-marker
boot-end-marker
!
no aaa new-model
!
no ip domain lookup
ip cef
ipv6 unicast-routing
ipv6 cef
!
multilink bundle-name authenticated
!
redundancy
!
interface Loopback8
 no ip address
 ipv6 address 2001:DB8:ACAD:8::1/64
 ipv6 ospf 1 area 0
 ipv6 ospf network point-to-point
!
interface Embedded-Service-Engine0/0
 no ip address
 shutdown
!
interface GigabitEthernet0/0
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface GigabitEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
```

```
interface Serial0/0/0
no ip address
 ipv6 address FE80::2 link-local
 ipv6 address 2001:DB8:ACAD:12::2/64
 ipv6 ospf 1 area 0
!
interface Serial0/0/1
no ip address
 ipv6 address FE80::2 link-local
 ipv6 address 2001:DB8:ACAD:23::2/64
 ipv6 ospf 1 area 0
 clock rate 2000000
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
!
ipv6 router ospf 1
 router-id 2.2.2.2
!
!
!
control-plane
!
!
banner motd ^CUnauthorized access is strictly prohibited.^C
!
line con 0
 password 7 0822455D0A16
 logging synchronous
 login
line aux 0
line 2
 no activation-character
 no exec
 transport preferred none
 transport input all
 transport output pad telnet rlogin lapb-ta mop udptn v120 ssh
 stopbits 1
line vty 0 4
 password 7 110A1016141D
 login
 transport input all
!
scheduler allocate 20000 1000
!
end
```

Router R3

```
R3#show run
Building configuration...

Current configuration : 2142 bytes
!
version 15.2
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R3
!
boot-start-marker
boot-end-marker
!
no aaa new-model
memory-size iomem 15
!
no ip domain lookup
ip cef
ipv6 unicast-routing
ipv6 cef
!
multilink bundle-name authenticated!
!
redundancy
!
interface Loopback4
 no ip address
 ipv6 address 2001:DB8:ACAD:4::1/64
 ipv6 ospf 1 area 2
 ipv6 ospf network point-to-point
!
interface Loopback5
 no ip address
 ipv6 address 2001:DB8:ACAD:5::1/64
 ipv6 ospf 1 area 2
 ipv6 ospf network point-to-point
!
interface Loopback6
 no ip address
 ipv6 address 2001:DB8:ACAD:6::1/64
 ipv6 ospf 1 area 2
 ipv6 ospf network point-to-point
!
interface Loopback7
 no ip address
 ipv6 address 2001:DB8:ACAD:7::1/64
```

```
 ipv6 ospf 1 area 2
 ipv6 ospf network point-to-point
!
interface Embedded-Service-Engine0/0
 no ip address
 shutdown
!
interface GigabitEthernet0/0
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface GigabitEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface Serial0/0/0
 no ip address
 shutdown
 clock rate 2000000
!
interface Serial0/0/1
 no ip address
 ipv6 address FE80::3 link-local
 ipv6 address 2001:DB8:ACAD:23::3/64
 ipv6 ospf 1 area 0
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
ipv6 router ospf 1
 router-id 3.3.3.3
 area 2 range 2001:DB8:ACAD:4::/62
!
control-plane
!
banner motd ^CUnauthorized access is strictly prohibited.^C
!
line con 0
 password 7 02050D480809
 logging synchronous
 login
line aux 0
line 2
```

```
 no activation-character
 no exec
 transport preferred none
 transport input all
 transport output pad telnet rlogin lapb-ta mop udptn v120 ssh
 stopbits 1
line vty 0 4
 password 7 14141B180F0B
 login
 transport input all
!
scheduler allocate 20000 1000
!
end
```