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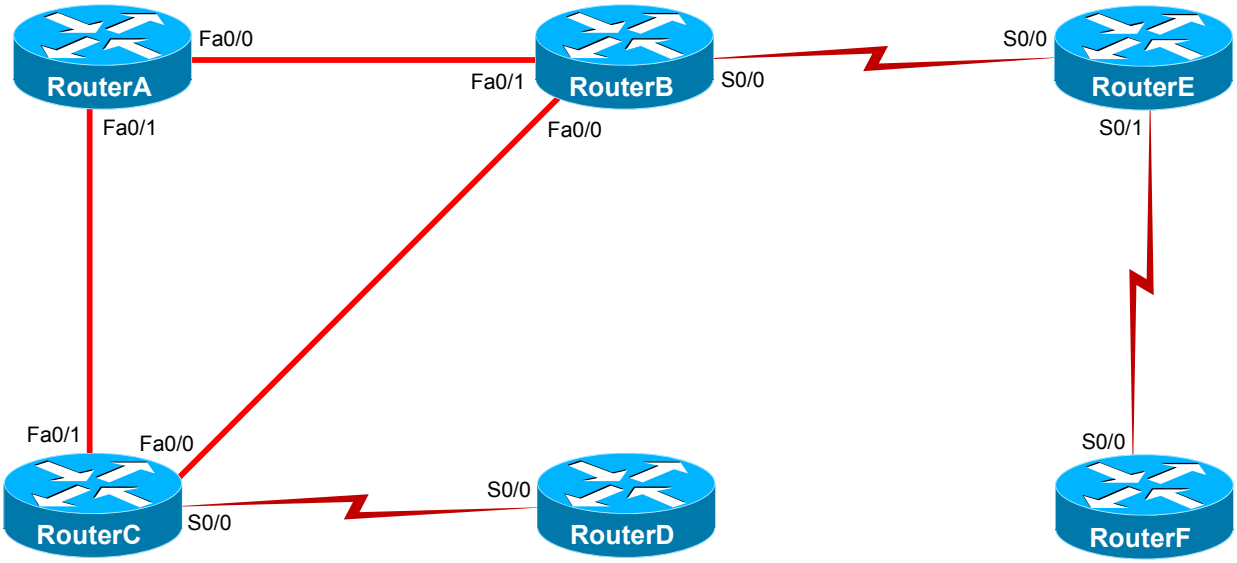
Stand-Alone Lab: Configuring Multiarea OSPFv3

Objective

In this lab, you will learn about and implement a multiarea Open Shortest Path First version 3 (OSPFv3) Internet Protocol version 6 (IPv6) network. The simulated network for this lab consists of six routers connected by point-to-point WAN links and LAN links. The routers connected by LAN links all reside at the corporate headquarters, whereas the routers connected by WAN links reside at remote branch offices.

Lab Topology

The topology diagram below represents the NetMap in the Simulator.



Command Summary

Command	Description
configure terminal	enters global configuration mode from privileged EXEC mode
enable	enters privileged EXEC mode
end	ends and exits configuration mode
exit	exits one level in the menu structure
interface *type number*	changes from global configuration mode to interface configuration mode
ipv6 ospf *process-id* **area** *area-id*	defines which interfaces operate in which OSPFv3 processes and areas
ipv6 router ospf *process-id*	enters router configuration mode for an OSPFv3 process
ipv6 unicast-routing	enables IPv6 unicast routing on a device
router-id *ip-address*	assigns a router ID to an interface; is used with OSPF

Command	Description
show ipv6 interface brief	displays a brief summary of each IPv6 interface's configuration and status
show ipv6 ospf	displays general information about OSPF routing processes
show ipv6 ospf interface	displays OSPFv3 interface information
show ipv6 ospf neighbor	displays OSPFv3 neighbor information
show ipv6 route	displays the IPv6 routing table
show running-config	displays the active configuration file

The IP addresses, subnet masks, and Router IDs used in this lab are shown in the table below:

IP Addresses

Device	Interface	IPv6 Address	Router ID
RouterA	FastEthernet 0/0	2001:db8:1:2::a/64	1.1.1.10
	FastEthernet 0/1	2001:db8:1:3::a/64	
RouterB	Serial 0/0	2001:db8:2:1::b/64	1.1.1.11
	FastEthernet 0/0	2001:db8:1:1::b/64	
	FastEthernet 0/1	2001:db8:1:2::b/64	
RouterC	Serial 0/0	2001:db8:3:1::c/64	1.1.1.12
	FastEthernet 0/0	2001:db8:1:1::c/64	
	FastEthernet 0/1	2001:db8:1:3::c/64	
RouterD	Serial 0/0	2001:db8:3:1::d/64	1.1.1.13
RouterE	Serial 0/0	2001:db8:2:1::e/64	1.1.1.14
	Serial 0/1	2001:db8:2:2::e/64	
RouterF	Serial 0/0	2001:db8:2:2::f/64	1.1.1.15

Lab Tasks

Task 1: Examine the Initial Network Configuration

1. Examine the running configuration of all six routers. The IP address assigned to each router interface should match the IP address assignments shown in the network topology diagram. Are the IP addresses correctly assigned to each device? _____

2. Based on the IP addressing scheme and the topology diagram, what can you determine regarding the logical structure of the network? _____
   _____

3. How many OSPFv3 areas should be implemented in this topology? _____

4. Which site is the best candidate for the backbone area? _____

5. Which routers should be area border routers (ABRs) in this implementation? _____

Task 2: Configure OSPFv3

A. Configure the Routing Process

1. Enable IPv6 routing on each of the routers.

2. Configure an OSPFv3 routing process with a process ID of **100** on each router.

3. Assign the appropriate Router ID to each router; refer to the IP Addresses table.

B. Configure the OSPFv3 Interfaces

1. Configure RouterA to advertise its active interfaces as part of OSPF area **0**.

2. Configure RouterB to advertise its active FastEthernet interfaces as part of OSPF area **0** and to advertise its active serial interface as part of OSPF area **1**.

3. Configure RouterC to advertise its active FastEthernet interfaces as part of OSPF area **0** and to advertise its active serial interface as part of OSPF area **2**.

4. Configure RouterD to advertise its active interfaces as part of OSPF area **2**.

5. Configure RouterE to advertise its active interfaces as part of OSPF area **1**.

6. Configure RouterF to advertise its active interfaces as part of OSPF area **1**.

Task 3: Verify OSPFv3

1. Allow time for the network to converge. On each router, display the IPv6 routing table.

2. Verify that RouterB is operating as an area border router (ABR), and verify the number of interfaces RouterB has operating in each area.

3. How many OSPFv3 neighbors does RouterB have on each interface, and what is each neighbor's Router ID? _____

4. Is RouterB functioning as a designated router (DR) or backup designated router (BDR) on any of its interfaces? _____

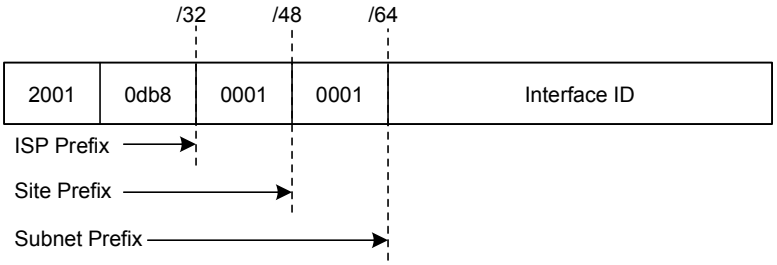
Lab Solutions

Task 1: Examine the Initial Network Configuration

1. Yes, the IP address assigned to each router interface matches the corresponding IP address shown in the IP Addresses table. You can use the show ipv6 interface brief command from privileged EXEC mode to verify the IP addressing on each router. The following is sample output from RouterA:

```
RouterA#show ipv6 interface brief
Serial0/0                  [administratively down/down]
    unassigned
Serial0/1                  [administratively down/down]
    unassigned
FastEthernet0/0            [up/up]
    FE80::20C:39FF:FE62:6232
    2001:DB8:1:2::A
FastEthernet0/1            [up/up]
    FE80::20C:59FF:FE88:4462
    2001:DB8:1:3::A
```

2. Based on the IP addressing scheme and the topology diagram, you can determine that the network is arranged in a hierarchical fashion. The Internet Assigned Numbers Authority (IANA) allocates IPv6 addresses on a 64-bit network prefix to ensure efficient address aggregation. IANA allocates large blocks of addresses to Regional Internet Registries (RIRs) which then allocate smaller blocks of addresses to Local Internet Registries (LIRs). The RIRs generally receive an allocation between /12 and /23. LIRs are typically Internet service providers (ISPs) and are responsible for allocating addresses to end users. The LIRs generally receive an allocation between /19 and /32. End users are typically allocated a /48 network prefix. This provides the user with 16 bits of network prefix, which can be used for subnetting within the organization. The network prefix is generally broken down as follows:



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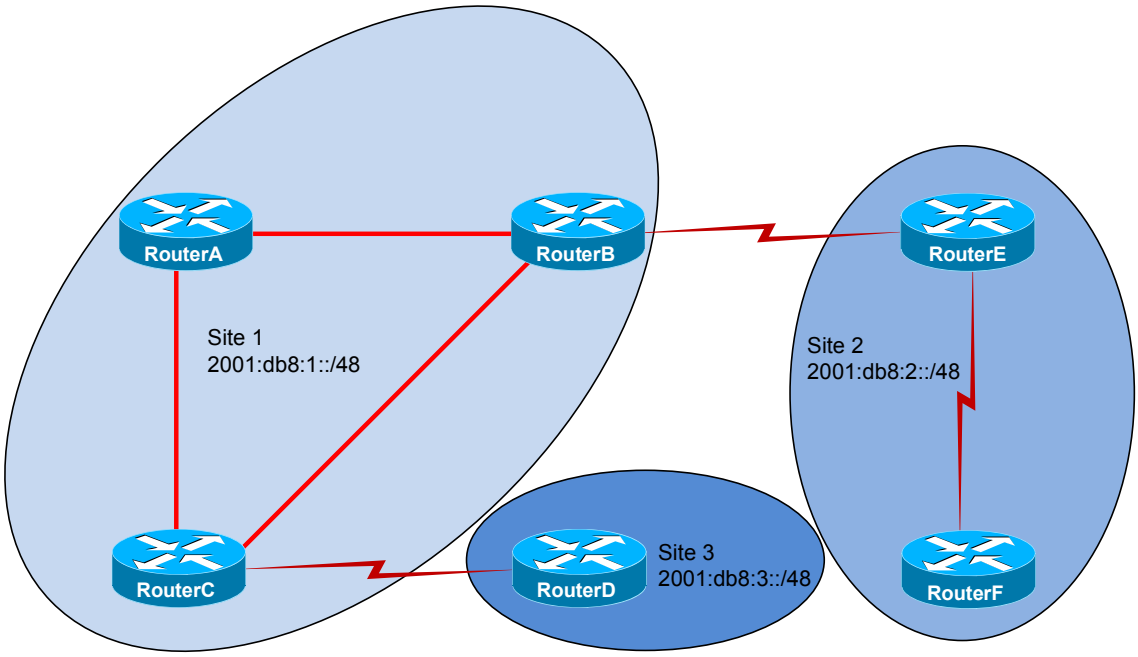
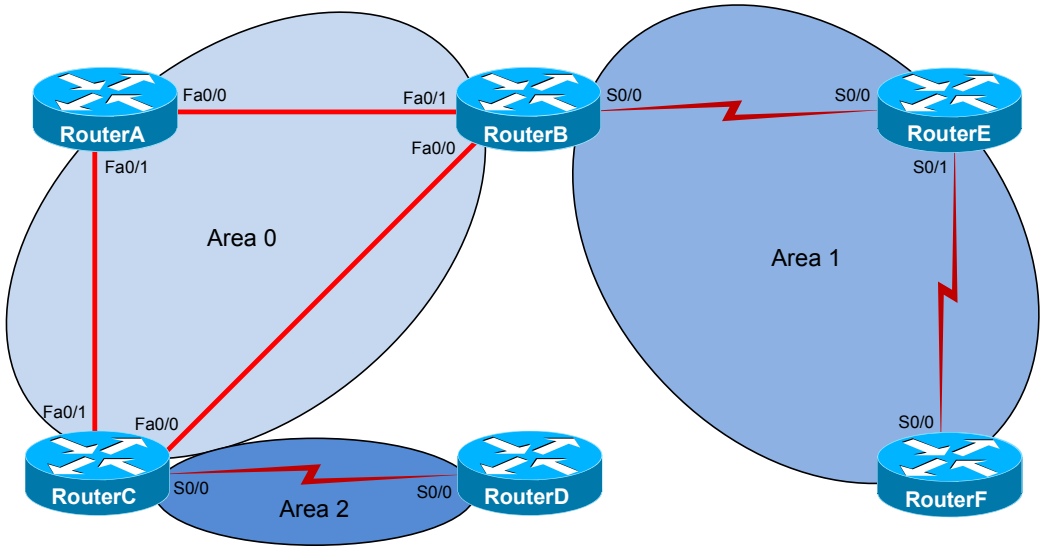
The IP addressing reveals that there are three logical sites: 2001:db8:1::/48, 2001:db8:2::/48, and 2001:db8:3::/48. The topology diagram reveals that RouterA, RouterB, and RouterC are in Site 1, RouterE and RouterF are in Site 2, and RouterD is in Site 3, as shown in the following diagram:



3. Based on the analysis above, three OSPFv3 areas should be implemented in this topology.

4. Site 1 is the best candidate for the backbone area because it connects to both Site 2 and Site 3 and because it has previously been defined as the headquarters site. All OSPF areas must connect to the backbone area. A poorly chosen backbone area can complicate the network implementation and can result in suboptimal performance.



5. RouterB and RouterC should be ABRs in this implementation. A router that connects to multiple OSPF areas within the same autonomous system (AS) is known as an ABR. An ABR can route traffic between the areas to which it is connected and maintains a separate link-state database for each of those areas. Because RouterB is a backbone router that connects directly to Site 2, it is a natural candidate for an ABR. Likewise, RouterC's connection to Site 3 makes it an ideal candidate for an ABR.

Task 2: Configure OSPFv3

A. Configure the Routing Process

1. You should issue the **ipv6 unicast-routing** command on all six routers to enable IPv6 routing, or packet forwarding:

```
RouterA(config)#ipv6 unicast-routing

RouterB(config)#ipv6 unicast-routing

RouterC(config)#ipv6 unicast-routing

RouterD(config)#ipv6 unicast-routing

RouterE(config)#ipv6 unicast-routing

RouterF(config)#ipv6 unicast-routing
```

If IPv6 routing is enabled on a router, you should see the configuration line `ipv6 unicast-routing` in the output of the **show running-config** command. However, IPv6 packet forwarding is disabled by default and most default configuration commands are not reflected in the running configuration.

2. You should issue the **ipv6 router ospf 100** command to start the OSPFv3 process on all six routers. Because the process ID is locally significant to each router, you are not required to use the same OSPFv3 process ID on adjacent routers. However, in this lab, you should use a process ID of **100** on all devices.

```
RouterA(config)#ipv6 router ospf 100

RouterB(config)#ipv6 router ospf 100

RouterC(config)#ipv6 router ospf 100

RouterD(config)#ipv6 router ospf 100

RouterE(config)#ipv6 router ospf 100

RouterF(config)#ipv6 router ospf 100
```

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OSPFv3 attempts to automatically assign the router a 32-bit dotted decimal Router ID when the OSPFv3 process is started. OSPFv3 will first attempt to use the highest IP address that is assigned to a loopback interface as the Router ID. If no loopback interfaces are configured with an IPv4 address, OSPFv3 will use the highest IP address that is assigned to a physical interface as the Router ID. If IPv4 addresses are not assigned to any interfaces on the router, a message similar to the following will appear on the router console immediately after you issue the **ipv6 router ospf 100** command:

```
*Jun 26 11:53:59.324: %OSPF-4-NORTRID: OSPF process 100 cannot pick a router-id.
  Please configure manually or bring up an interface with an ip address.
```

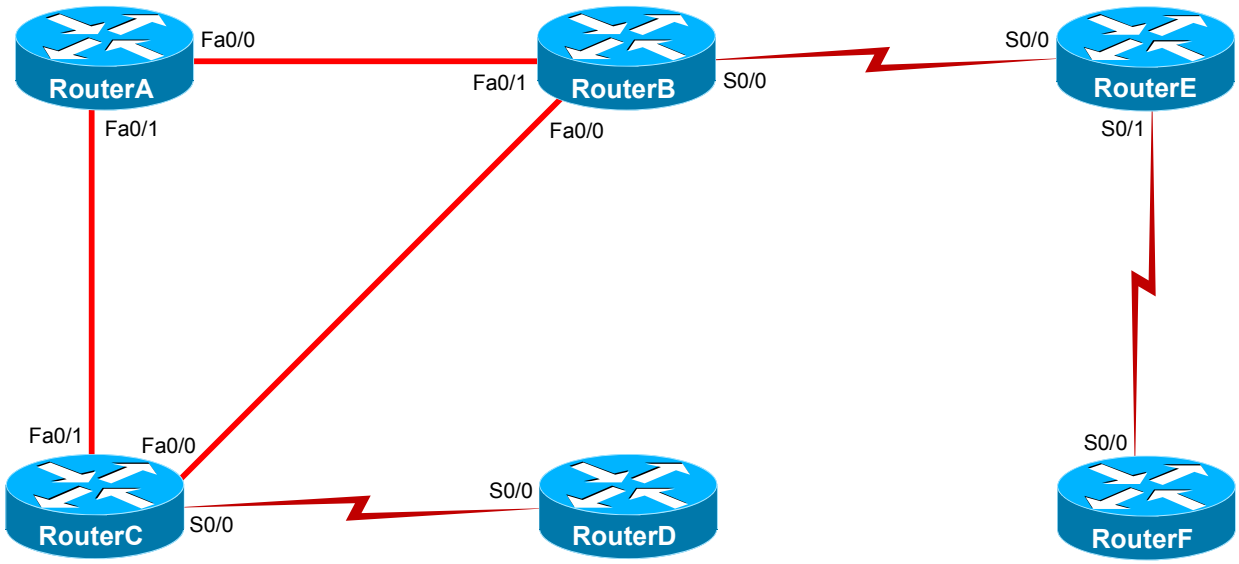
If a Router ID cannot be determined automatically and none has been assigned manually, then the OSPFv3 process will remain inactive until an IPv4 interface becomes active or a Router ID is manually configured.

3. You can manually assign a Router ID to an OSPFv3 router by issuing the **router-id** *ip-address* command in OSPFv3 router configuration mode. You should issue the following commands to configure the appropriate Router ID on each router:

```
RouterA(config-rtr)#router-id 1.1.1.10

RouterB(config-rtr)#router-id 1.1.1.11

RouterC(config-rtr)#router-id 1.1.1.12

RouterD(config-rtr)#router-id 1.1.1.13

RouterE(config-rtr)#router-id 1.1.1.14

RouterF(config-rtr)#router-id 1.1.1.15
```

B. Configure the OSPFv3 Interfaces

1. You can see from the following topology diagram that RouterA has two active IPv6 interfaces, FastEthernet 0/0 and FastEthernet 0/1:



Therefore, you should issue the following commands to configure RouterA to advertise its active interfaces as part of OSPF area 0. Unlike the OSPFv2 configuration process on a Cisco router, OSPFv3 networks cannot be configured by issuing the **network** *ip-address wildcard-mask* **area** *area-id* command in router configuration mode. OSPFv3 networks are instead configured at the interface level by issuing the **ipv6 ospf** *process-id* **area** *area-id* command.

```
RouterA(config-rtr)#interface fastethernet 0/0
RouterA(config-if)#ipv6 ospf 100 area 0
RouterA(config-if)#interface fastethernet 0/1
RouterA(config-if)#ipv6 ospf 100 area 0
```

2. You should issue the following commands to configure RouterB to advertise its active FastEthernet interfaces, which connect to RouterA and RouterC, as part of OSPF area **0** and to advertise its active serial interface, which connects to RouterE, as part of OSPF area **1**:

```
RouterB(config-rtr)#interface fastethernet 0/0
RouterB(config-if)#ipv6 ospf 100 area 0
RouterB(config-if)#interface fastethernet 0/1
RouterB(config-if)#ipv6 ospf 100 area 0
RouterB(config-if)#interface serial 0/0
RouterB(config-if)#ipv6 ospf 100 area 1
```

3. You should issue the following commands to configure RouterC to advertise its active FastEthernet interfaces, which connect to RouterA and RouterB, as part of OSPF area 0 and to advertise its active serial interface, which connects to RouterD, as part of OSPF area **2**:

```
RouterC(config-rtr)#interface fastethernet 0/0
RouterC(config-if)#ipv6 ospf 100 area 0
RouterC(config-if)#interface fastethernet 0/1
RouterC(config-if)#ipv6 ospf 100 area 0
RouterC(config-if)#interface serial 0/0
RouterC(config-if)#ipv6 ospf 100 area 2
```

4. You should issue the following commands to configure RouterD to advertise its active interface as part of OSPF area **2**:

```
RouterD(config-rtr)#interface serial 0/0
RouterD(config-if)#ipv6 ospf 100 area 2
```

5. You should issue the following commands to configure RouterE to advertise its active interfaces as part of OSPF area **1**:

```
RouterE(config-rtr)#interface serial 0/0
RouterE(config-if)#ipv6 ospf 100 area 1
RouterE(config-if)#interface serial 0/1
RouterE(config-if)#ipv6 ospf 100 area 1
```

6. You should issue the following commands to configure RouterF to advertise its active interface as part of OSPF area **1**:

```
RouterF(config-rtr)#interface serial 0/0
RouterF(config-if)#ipv6 ospf 100 area 1
```

Task 3: Verify OSPFv3

1. After the network has had time to converge, you should issue the following command on each router to display the contents of the IPv6 routing table. Below is sample output from RouterA:

```
RouterA#show ipv6 route
IPv6 Routing Table
Codes: C - Connected, L - Local, S - Static, R - RIP, B – BGP
       U - Per-user Static route
       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
C   2001:DB8:1:2::/64 [0/0]
     via FastEthernet0/0, directly connected
L   2001:DB8:1:2::A/128 [0/0]
     via FastEthernet0/0, receive
C   2001:DB8:1:3::/64 [0/0]
     via FastEthernet0/1, directly connected
L   2001:DB8:1:3::A/128 [0/0]
     via FastEthernet0/1, receive
O   2001:DB8:1:1::/64 [110/2]
     via FE80::20C:21FF:FE10:5542, FastEthernet0/0
     via FE80::20C:42FF:FE60:8261, FastEthernet0/1
OI  2001:DB8:3:1::/64 [110/129]
     via FE80::20C:42FF:FE60:8261, FastEthernet0/1
OI  2001:DB8:2:1::/64 [110/129]
     via FE80::20C:21FF:FE10:5542, FastEthernet0/0
OI  2001:DB8:2:2::/64 [110/129]
     via FE80::20C:21FF:FE10:5542, FastEthernet0/0
L   FF00::/8 [0/0]
     via Null0, receive
```

The OSPF inter-area routes highlighted in the command output above are denoted by the code OI to distinguish them from standard intra-area OSPF routes, which are denoted by the code O. Routes to a network inside the same OSPF area are called intra-area routes. Routes to a network that is located in a different OSPF area but within the same AS are called inter-area routes. An inter-area route must pass through an ABR.

2. You can use the **show ipv6 ospf** command to verify that RouterB is operating as an ABR and to verify the number of interfaces RouterB has operating in each area. You can see in the following command output that RouterB is operating as an ABR and that RouterB has two interfaces in area 0 and one interface in area 1.

```
RouterB#show ipv6 ospf
 Routing Process "ospf 100" with ID 1.1.1.11
 Supports only single TOS(TOS0) routes
 It is an area border router
 Supports opaque LSA
 Supports Link-local Signaling (LLS)
 Supports area transit capability
 Initial SPF schedule delay 5000 msecs
 Minimum hold time between two consecutive SPFs 10000 msecs
 Maximum wait time between two consecutive SPFs 10000 msecs
 Incremental-SPF disabled
 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 opaque AS LSA 0. Checksum Sum 0x000000
 Number of DCbitless external and opaque AS LSA 0
 Number of DoNotAge external and opaque AS LSA 0
 Number of areas in this router is 2. 2 normal 0 stub 0 nssa
 Number of areas transit capable is 0
 External flood list length 0
    Area BACKBONE(0)
        Number of interfaces in this area is 2
        Area has no authentication
        SPF algorithm last executed 00:00:00 ago
        SPF algorithm executed 7 times
        Area ranges are
        Number of LSA 9. Checksum Sum 0x00431F
        Number of opaque link LSA 0. Checksum Sum 0x000000
        Number of DCbitless LSA 0
        Number of indication LSA 0
        Number of DoNotAge LSA 0
        Flood list length 0
    Area 1
        Number of interfaces in this area is 1
        Area has no authentication
        SPF algorithm last executed 00:00:00 ago
        SPF algorithm executed 5 times
        Area ranges are
        Number of LSA 7. Checksum Sum 0x00336D
        Number of opaque link LSA 0. Checksum Sum 0x000000
        Number of DCbitless LSA 0
        Number of indication LSA 0
        Number of DoNotAge LSA 0
        Flood list length 0
```

3. You can issue the **show ipv6 ospf interface** command to determine the number of OSPFv3 neighbors RouterB has on each interface. Additionally, you can use the output to obtain each neighbor's Router ID; you can also determine the status of a particular IPv6 interface, the OSPFv3 area in which it is operating, the OSPFv3 process in which it is operating, and the OSPFv3 Router ID that the process is using. The following sample output indicates that RouterB has one OSPFv3 neighbor on each interface: Router ID 1.1.1.12 is a neighbor on the FastEthernet 0/0 interface, Router ID 1.1.1.10 is a neighbor on the FastEthernet 0/1 interface, and Router ID 1.1.1.14 is a neighbor on the Serial 0/0 interface. Sample output from RouterB is shown below:

```
RouterB#show ipv6 ospf interface
FastEthernet0/0 is up, line protocol is up
  Link Local Address FE80::20C:84FF:FE99:1947, Interface ID 3
  Area 0, Process 100, Instance ID 0, Router ID 1.1.1.11
  Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State BACKUP, Priority 1
  Backup Designated router (ID) 1.1.1.11, Interface address 2001:DB8:1:1::B
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:00
  Supports Link-local Signaling (LLS)
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 0, maximum is 0
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1, Adjacent neighbor count is 1
    Adjacent with neighbor 1.1.1.12
  Suppress hello for 0 neighbor(s)
FastEthernet0/1 is up, line protocol is up
  Link Local Address FE80::20C:21FF:FE10:5542, Interface ID 4
  Area 0, Process 100, Instance ID 0, Router ID 1.1.1.11
  Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 1.1.1.11, Interface address 2001:DB8:1:2::B
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:00
  Supports Link-local Signaling (LLS)
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 0, maximum is 0
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1, Adjacent neighbor count is 1
    Adjacent with neighbor 1.1.1.10
  Suppress hello for 0 neighbor(s)
```

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```
Serial0/0 is up, line protocol is up
  Link Local Address , Interface ID 1
  Area 1, Process 100, Instance ID 0, Router ID 1.1.1.11
  Network Type POINT_TO_POINT, Cost: 64
  Transmit Delay is 1 sec, State POINT_TO_POINT
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:00
  Supports Link-local Signaling (LLS)
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 0, maximum is 0
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1, Adjacent neighbor count is 1
    Adjacent with neighbor 1.1.1.14
  Suppress hello for 0 neighbor(s)
```

4. You can issue the **show ipv6 ospf interface** command to determine whether RouterB is functioning as a DR or a BDR on any of its interfaces. The `State` field in the command output indicates whether the router is functioning as a DR or a BDR. A value of `DR` indicates that the router is functioning as the DR, and a value of `BACKUP` indicates that the router is functioning as a BDR. Additionally, the command output indicates the Router ID and interface IP address that the DR or BDR is using on each interface. The following sample output indicates that RouterB is the DR for the network segment attached to the FastEthernet 0/1 interface and is the BDR for the network segment attached to the FastEthernet 0/0 interface:

```
RouterB#show ipv6 ospf interface
FastEthernet0/0 is up, line protocol is up
  Link Local Address FE80::20C:84FF:FE99:1947, Interface ID 3
  Area 0, Process 100, Instance ID 0, Router ID 1.1.1.11
  Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State BACKUP, Priority 1
  Backup Designated router (ID) 1.1.1.11, Interface address 2001:DB8:1:1::B
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:00
  Supports Link-local Signaling (LLS)
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 0, maximum is 0
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1, Adjacent neighbor count is 1
    Adjacent with neighbor 1.1.1.12
  Suppress hello for 0 neighbor(s)
```

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```
FastEthernet0/1 is up, line protocol is up
  Link Local Address FE80::20C:21FF:FE10:5542, Interface ID 4
  Area 0, Process 100, Instance ID 0, Router ID 1.1.1.11
  Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 1.1.1.11, Interface address 2001:DB8:1:2::B
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:00
  Supports Link-local Signaling (LLS)
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 0, maximum is 0
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1, Adjacent neighbor count is 1
    Adjacent with neighbor 1.1.1.10
  Suppress hello for 0 neighbor(s)
<output omitted>
```

Additionally, you can use the **show ipv6 ospf neighbor** command to determine the state of RouterB's OSPFv3 neighbors. The output from the **show ipv6 ospf neighbor** command shows specific information about OSPFv3 neighbor relationships, including the Router ID of the neighboring router, the state of the adjacency, and the interface through which the adjacency was formed. The following sample output indicates that the router with an ID of 1.1.1.12 (RouterC) is functioning as a DR on interface FastEthernet 0/1 and that the router with an ID of 1.1.1.10 (RouterA) is functioning as a BDR on interface FastEthernet 0/0:

```
RouterB#show ipv6 ospf neighbor
Neighbor ID     Pri   State           Dead Time   Interface ID    Interface
1.1.1.12          1   FULL/DR         00:00:40    3               FastEthernet0/0
1.1.1.10          1   FULL/BDR        00:00:40    3               FastEthernet0/1
1.1.1.14          0   FULL/  -        00:00:40    1               Serial0/0
```

OSPF uses the Router ID and the priority value to elect the DR and BDR for an OSPF multiaccess network segment. OSPF routers in each multiaccess network elect a DR and a BDR. The DR generates link-state advertisements (LSAs) that contain OSPF routing information, and the BDR takes over for the DR if the DR fails. Because only the DR and BDR generate LSAs, network bandwidth is conserved. The DR and BDR are elected only on multiaccess networks.

The DR is typically the router with the highest OSPF priority, and the BDR is typically the router with the second-highest OSPF priority. If priorities are equal between two or more routers, the router with the highest Router ID will be elected to become the DR. OSPF priorities can range from 0 through 255; the default OSPF priority is 1.

Sample Configuration Scripts

RouterA

```
RouterA#show running-config
Building configuration...
Current configuration : 893 bytes
!
Version 12.3
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname RouterA
!
ip subnet-zero
!
ip cef
no ip domain-lookup
!
ipv6 unicast-routing
!
interface Serial0/0
 no ip address
 no ip directed-broadcast
 shutdown
!
interface Serial0/1
 no ip address
 no ip directed-broadcast
 shutdown
!
```

RouterA (continued)

```
interface FastEthernet0/0
 no ip address
 no ip directed-broadcast
 ipv6 ospf 100 area 0
 ipv6 address 2001:DB8:1:2::A/64
!
interface FastEthernet0/1
 no ip address
 no ip directed-broadcast
 ipv6 ospf 100 area 0
 ipv6 address 2001:DB8:1:3::A/64
!
ipv6 router ospf 100
 router-id 1.1.1.10
 log-adjacency-changes
!
ip classless
no ip http server
!
line con 0
line aux 0
line vty 0 4
!
no scheduler allocate
end
```

RouterB

```
RouterB#show running-config
Building configuration...
Current configuration : 939 bytes
!
Version 12.3
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname RouterB
!
ip subnet-zero
!
ip cef
no ip domain-lookup
!
ipv6 unicast-routing
!
interface Serial0/0
 no ip address
 no ip directed-broadcast
 clock rate 1000000
 ipv6 ospf 100 area 1
 ipv6 address 2001:DB8:2:1::B/64
!
interface Serial0/1
 no ip address
 no ip directed-broadcast
 shutdown
!
```

RouterB (continued)

```
interface FastEthernet0/0
 no ip address
 no ip directed-broadcast
 ipv6 ospf 100 area 0
 ipv6 address 2001:DB8:1:1::B/64
!
interface FastEthernet0/1
 no ip address
 no ip directed-broadcast
 ipv6 ospf 100 area 0
 ipv6 address 2001:DB8:1:2::B/64
!
ipv6 router ospf 100
 router-id 1.1.1.11
 log-adjacency-changes
!
ip classless
no ip http server
!
line con 0
line aux 0
line vty 0 4
!
no scheduler allocate
end
```

RouterC

```
RouterC#show running-config
Building configuration...
Current configuration : 939 bytes
!
Version 12.3
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname RouterC
!
ip subnet-zero
!
ip cef
no ip domain-lookup
!
ipv6 unicast-routing
!
interface Serial0/0
 no ip address
 no ip directed-broadcast
 clock rate 1000000
 ipv6 ospf 100 area 2
 ipv6 address 2001:DB8:3:1::C/64
!
interface Serial0/1
 no ip address
 no ip directed-broadcast
 shutdown
!
```

RouterC (continued)

```
interface FastEthernet0/0
 no ip address
 no ip directed-broadcast
 ipv6 ospf 100 area 0
 ipv6 address 2001:DB8:1:1::C/64
!
interface FastEthernet0/1
 no ip address
 no ip directed-broadcast
 ipv6 ospf 100 area 0
 ipv6 address 2001:DB8:1:3::C/64
!
ipv6 router ospf 100
 router-id 1.1.1.12
 log-adjacency-changes
!
ip classless
no ip http server
!
line con 0
line aux 0
line vty 0 4
!
no scheduler allocation
end
```

RouterD	RouterD (continued)
RouterD#show running-config Building configuration... Current configuration : 826 bytes ! Version 12.3 service timestamps debug uptime service timestamps log uptime no service password-encryption ! hostname RouterD ! ip subnet-zero ! ip cef no ip domain-lookup ! ipv6 unicast-routing ! interface Serial0/0 no ip address no ip directed-broadcast ipv6 ospf 100 area 2 ipv6 address 2001:DB8:3:1::D/64 ! interface Serial0/1 no ip address no ip directed-broadcast shutdown !	interface FastEthernet0/0 no ip address no ip directed-broadcast shutdown ! interface FastEthernet0/1 no ip address no ip directed-broadcast shutdown ! ipv6 router ospf 100 router-id 1.1.1.13 log-adjacency-changes ! ip classless no ip http server ! line con 0 line aux 0 line vty 0 4 ! no scheduler allocation end

RouterE	RouterE (continued)
RouterE#show running-config Building configuration... Current configuration : 893 bytes ! Version 12.3 service timestamps debug uptime service timestamps log uptime no service password-encryption ! hostname RouterE ! ip subnet-zero ! ip cef no ip domain-lookup ! ipv6 unicast-routing ! interface Serial0/0 no ip address no ip directed-broadcast ipv6 ospf 100 area 1 ipv6 address 2001:DB8:2:1::E/64 ! interface Serial0/1 no ip address no ip directed-broadcast clock rate 1000000 ipv6 ospf 100 area 1 ipv6 address 2001:DB8:2:2::E/64 !	interface FastEthernet0/0 no ip address no ip directed-broadcast shutdown ! interface FastEthernet0/1 no ip address no ip directed-broadcast shutdown ! ipv6 router ospf 100 router-id 1.1.1.14 log-adjacency-changes ! ip classless no ip http server ! line con 0 line aux 0 line vty 0 4 ! no scheduler allocate end

RouterF	RouterF (continued)
RouterF#show running-config Building configuration... Current configuration : 826 bytes ! Version 12.3 service timestamps debug uptime service timestamps log uptime no service password-encryption ! hostname RouterF ! ip subnet-zero ! ip cef no ip domain-lookup ! ipv6 unicast-routing ! interface Serial0/0 no ip address no ip directed-broadcast ipv6 ospf 100 area 1 ipv6 address 2001:DB8:2:2::F/64 ! interface Serial0/1 no ip address no ip directed-broadcast shutdown !	interface FastEthernet0/0 no ip address no ip directed-broadcast shutdown ! interface FastEthernet0/1 no ip address no ip directed-broadcast shutdown ! ipv6 router ospf 100 router-id 1.1.1.15 log-adjacency-changes ! ip classless no ip http server ! line con 0 line aux 0 line vty 0 4 ! no scheduler allocate end