Chapter 10: Troubleshooting OSPFv3

Instructor Materials

CCNP Enterprise: Advanced Routing

Chapter 10 Content

This chapter covers the following content:

- **Troubleshooting OSPFv3 for IPv6 -** This section examines the various commands you can use to troubleshoot OSPFv3 issues.

- **OSPFv3 Trouble Tickets -** This section presents trouble tickets that demonstrate how to use a structured troubleshooting process to solve a reported problem.

- **Troubleshooting OSPFv3 Address Families -** This section describes the commands you can use to troubleshoot issues related to OSPFv3 address family configurations.

- **OSPFv3 AF Trouble Tickets -** This section presents a trouble ticket that demonstrates how to use a structured troubleshooting process to solve a reported problem.

Troubleshooting OSPFv3 for IPv6

- Because OSPFv3 is based on OSPFv2, it presents similar issues when it comes to troubleshooting, with a few minor differences based on IPv6.
- This section describes **show** commands that you can use to troubleshoot OSPFv3 neighbor adjacency issues and route issues.

OSPFv3 Troubleshooting Commands

Use the **show ipv6 protocols** command, as shown in Example 10-1, to verify which IPv6 routing protocols are running on a device. Specifically with OSPFv3, you can verify:

- the process ID (PID)
- the router ID (RID)
- the type of router—area border router (ABR) or autonomous system boundary router (ASBR)—the number of areas the router is a member of
- whether any of the areas are stub areas or NSSAs (not-so-stubby areas)
- the interfaces participating in the routing process and the area they belong to
- whether redistribution is occurring

Example 10-1   *Identifying What Can Be Verified for OSPFv3 with show ipv6 protocols*

```
R2# show ipv6 protocols
...output omitted...
IPv6 Routing Protocol is "ospf 1"
  Router ID 2.2.2.2
  Area border and autonomous system boundary router
  Number of areas: 2 normal, 0 stub, 0 nssa
  Interfaces (Area 0):
    GigabitEthernet0/0
  Interfaces (Area 23):
    GigabitEthernet1/0
  Redistribution:
    None
```

Show IPv6 OSPF Command

Use the **show ipv6 ospf** command, as shown in Example 10-2, to display global OSPFv3 settings. You can verify:

- the OSPFv3 PID
- the RID
- the type of router—ABR or ASBR—various timers and statistics
- the number of areas on the router, and the type of area—normal, stub, or NSSA
- the reference bandwidth
- the parameters related to the different areas configured on the router (for example, whether area authentication is enabled, whether the area is a stub area, a totally stubby area, an NSSA, or a totally NSSA)

Example 10-2 *Identifying What Can Be Verified with show ipv6 ospf*

```
R1# show ipv6 ospf
Routing Process "ospfv3 1" with ID 1.1.1.1
Supports NSSA (compatible with RFC 3101)
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
Retransmission limit dc 24 non-dc 24
Number of external LSA 1. Checksum Sum 0x009871
Number of areas in this router is 2. 1 normal 1 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 2
    MD5 Authentication, SPI 257
    SPF algorithm executed 3 times
    Number of LSA 11. Checksum Sum 0x06DB20
    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
    It is a stub area, no summary LSA in this area
    Generates stub default route with cost 1
    SPF algorithm executed 4 times
    Number of LSA 7. Checksum Sum 0x03A033
    Number of DCbitless LSA 0
    Number of indication LSA 0
    Number of DoNotAge LSA 0
    Flood list length 0
```

Show IPv6 OSPF Commands (Cont.)

The command **show ipv6 ospf interface brief**, as shown in Example 10-3, enables you to verify which interfaces are participating in the OSPFv3 process.

With the **show ipv6 ospf interface** *interface_type interface_number* command, you can obtain detailed information about the interfaces participating in the OSPF process, as shown in Example 10-4.

The **show ipv6 ospf neighbor** command enables you to verify what routers successfully formed neighbor adjacencies with the local router, as shown in Example 10-5.

Example 10-3 *Identifying What Can Be Verified with show ipv6 ospf interface brief*

```
R1# show ipv6 ospf interface brief
Interface PID  Area  Intf ID  Cost  State  Nbrs F/C
Gi1/0     1    0     4        1     BDR    1/1
Gi0/0     1    0     3        1     DR     0/0
Fa3/0     1    1     6        1     BDR    1/1
```

Example 10-4 *Identifying What Can Be Verified with show ipv6 ospf interface interface_type interface_number*

```
R1# show ipv6 ospf interface fastEthernet 3/0
FastEthernet3/0 is up, line protocol is up
 Link Local Address FE80::C809:13FF:FEB8:54, Interface ID 6
 Area 1, Process ID 1, Instance ID 0, Router ID 1.1.1.1
 Network Type BROADCAST, Cost: 1
 MD5 authentication SPI 256, secure socket UP (errors: 0)
 Transmit Delay is 1 sec, State BDR, Priority 1
 Designated Router (ID) 4.4.4.4, local address FE80::C808:9FF:FE30:1C
 Backup Designated router (ID) 1.1.1.1, local address FE80::C809:13FF:FEB8:54
 Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
 Hello due in 00:00:04
 Graceful restart helper support enabled
 Index 1/1/1, flood queue length 0
 Next 0x0(0)/0x0(0)/0x0(0)
 Last flood scan length is 1, maximum is 2
 Last flood scan time is 0 msec, maximum is 0 msec
 Neighbor Count is 1, Adjacent neighbor count is 1
 Adjacent with neighbor 4.4.4.4 (Designated Router)
 Suppress hello for 0 neighbor(s)
```

Example 10-5 *Identifying What Can Be Verified with show ipv6 ospf neighbor*

```
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       1     FULL/DR   00:00:36    3              GigabitEthernet1/0
4.4.4.4       1     FULL/DR   00:00:39    4              FastEthernet3/0
```

Show IPv6 OSPF Commands (Cont.)

Example 10-6 *Displaying the OSPFv3 LSDB*

```
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      847 0x80000005       0            1        B
2.2.2.2      748 0x80000007       0            1        B E

              Net Link States (Area 0)

ADV Router   Age Seq#        Link ID     Rtr count
2.2.2.2      878 0x80000003      3            2

        Inter Area Prefix Link States (Area 0)

ADV Router   Age  Seq#         Prefix
1.1.1.1      1136 0x80000001   2001:DB8:0:14::/64
2.2.2.2      1006 0x80000002   2001:DB8:0:23::/64
2.2.2.2      1006 0x80000002   2001:DB8:0:3::/64

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

ADV Router   Age  Seq#         Link ID    Interface
1.1.1.1      847  0x80000002      4        Gi1/0
2.2.2.2      1006 0x80000002      3        Gi1/0
1.1.1.1      847  0x80000002      3        Gi0/0

        Intra Area Prefix Link States (Area 0)

ADV Router   Age  Seq#         Link ID  Ref-lstype Ref-LSID
1.1.1.1      847  0x80000006      0       0x2001      0
2.2.2.2      878  0x80000003      3072    0x2002      3

            Router Link States (Area 1)

ADV Router   Age  Seq#        Fragment ID  Link count  Bits
1.1.1.1      1151 0x80000004       0            1        B
4.4.4.4      1152 0x80000006       0            1       None
```

To verify the LSAs that were collected and placed in the LSDB, you use the **show ipv6 ospf database** command, as shown in Example 10-6. In this example, R1 has information for
Area 0 and Area 1 because it is an ABR.

```
              Net Link States (Area 1)

ADV Router   Age  Seq#         Link ID    Rtr count
4.4.4.4      1147 0x80000003      4            2

        Inter Area Prefix Link States (Area 1)

ADV Router   Age Seq#          Prefix
1.1.1.1      847 0x80000002     ::/0

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

ADV Router   Age  Seq#         Link ID    Interface
1.1.1.1      1105 0x80000002      6        Fa3/0
4.4.4.4      1158 0x80000003      4        Fa3/0

        Intra Area Prefix Link States (Area 1)

ADV Router   Age  Seq#         Link ID Ref-lstype Ref-LSID
4.4.4.4      1147 0x80000003     4096    0x2002      4

          Type-5 AS External Link States

ADV Router   Age Seq#          Prefix
2.2.2.2      748 0x80000002     ::/0
```

Show IPv6 Route OSPF Command

Notice in Example 10-6 that there are two new LSA types beyond the types listed in Table 8-4 in Chapter 8: the link (Type 8) LSA and the intra-area prefix (is also known as Type 9) LSA. Table 10-2 defines these two LSAs for OSPFv3.

To verify the OSPFv3 routes that have been installed in the routing table, use the **show ipv6 route ospf** command, as shown in Example 10-7.

In this case, R1 only knows about an external OSPFv3 route, which is the default route, and two inter-area routes (routes outside the area but still within the OSPFv3 domain).

Table 10-2   Additional OSPF LSAs for OSPFv3

LSA Type	Description
8	The link LSA provides information to neighbors about link-local addresses and the IPv6 addresses associated with the link. Therefore, it is only flooded on the local link and is not reflooded by other OSPF routers.
9	The intra-area prefix LSA provides information for two different scenarios. First, it provides information about IPv6 address prefixes associated with a transit network by referencing a network LSA. Second, it provides information about IPv6 address prefixes associated with a router by referencing a router LSA. Type 9 LSAs are flooded only within an area.

Example 10-7   *Displaying the OSPFv3 Routes in the Routing Table*

```
R1# show ipv6 route ospf
IPv6 Routing Table - default - 10 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, l - LISP
OE2 ::/0 [110/1], tag 1
     via FE80::C80A:13FF:FEB8:8, GigabitEthernet1/0
OI 2001:DB8:0:3::/64 [110/3]
     via FE80::C80A:13FF:FEB8:8, GigabitEthernet1/0
OI 2001:DB8:0:23::/64 [110/2]
     via FE80::C80A:13FF:FEB8:8, GigabitEthernet1/0
```

Show IPv6 Interface Command

Use the **show ipv6 interface** *interface_type interface_id* command, as shown in Example 10-8, when troubleshooting OSPFv3 issues to verify whether the interface is listening to the multicast group addresses FF02::5 (all OSPFv3 routers) and FF02::6 (OSPFv3 DR/BDR).

You can also verify the MTU and whether there are any IPv6 ACLs applied to the interface that might be blocking OSPFv3 packets or packets sourced from/destined to link-local addresses.

Example 10-8 *Displaying the IPv6 Interface Parameters*

```
R1# show ipv6 interface fastEthernet 3/0
FastEthernet3/0 is up, line protocol is up
 IPv6 is enabled, link-local address is FE80::C809:13FF:FEB8:54
 ...output omitted...
 Joined group address(es):
    FF02::1
    FF02::2
    FF02::5
    FF02::6
    FF02::1:FF00:1
    FF02::1:FFB8:54
 MTU is 1500 bytes
 ICMP error messages limited to one every 100 milliseconds
 ICMP redirects are enabled
 ICMP unreachables are sent
 Input features: Access List IPsec
 Output features: IPsec
 Inbound access list TSHOOT_ACL
 ND DAD is enabled, number of DAD attempts: 1
 ...output omitted...
```

OSPFv3 Trouble Ticket

- This section presents two trouble tickets related to the topics discussed so far in this chapter.
- The purpose of these trouble tickets is to show a process that you can use when troubleshooting in the real world or in an exam environment.
- Both of the trouble tickets in this section are based on the topology shown in Figure 10-1.

Trouble Ticket 10-1

Problem: The network was recently updated to reduce the number of LSAs that cross the WAN link from R1 to the Branch site. The only LSA that is supposed to be permitted is a Type 3 LSA about a default route. However, reports indicate that more Type 3 LSAs are being sent from R1 to Branch.

Your troubleshooting begins by verifying the problem with the **show ipv6 route ospf** command on Branch, as shown in Example 10-9. You confirm that there are more interarea routes than just the default interarea route.
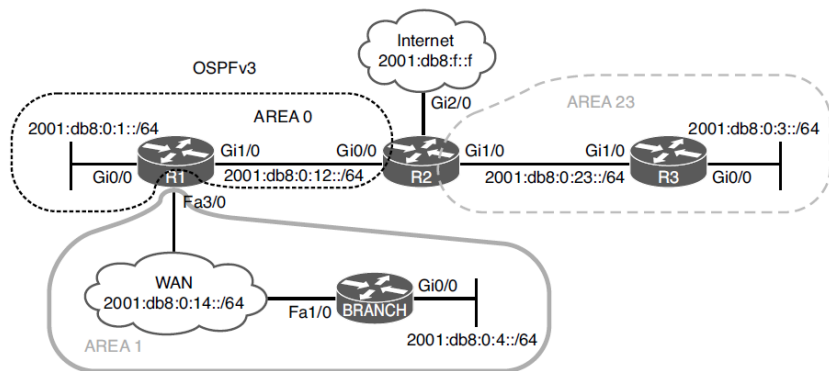

Figure 10-1 *OSPFv3 Trouble Tickets Topology*

Example 10-9 *Displaying the IPv6 Routing Table on Branch*

```
Branch# show ipv6 route ospf
IPv6 Routing Table - default - 10 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, l - LISP
OI ::/0 [110/2]
    via FE80::C801:10FF:FE20:54, FastEthernet1/0
OI 2001:DB8:0:1::/64 [110/2]
    via FE80::C801:10FF:FE20:54, FastEthernet1/0
OI 2001:DB8:0:3::/64 [110/4]
    via FE80::C801:10FF:FE20:54, FastEthernet1/0
OI 2001:DB8:0:12::/64 [110/2]
    via FE80::C801:10FF:FE20:54, FastEthernet1/0
OI 2001:DB8:0:23::/64 [110/3]
    via FE80::C801:10FF:FE20:54, FastEthernet1/0
```

Refer to your text for next steps and examples to troubleshoot and resolve this trouble ticket.

Trouble Ticket 10-2

Problem: Branch users are complaining that they are unable to access any resources outside the Branch office. You access Branch and issue the extended **ping** command, as shown in Example 10-16, to test connectivity. Connectivity fails.
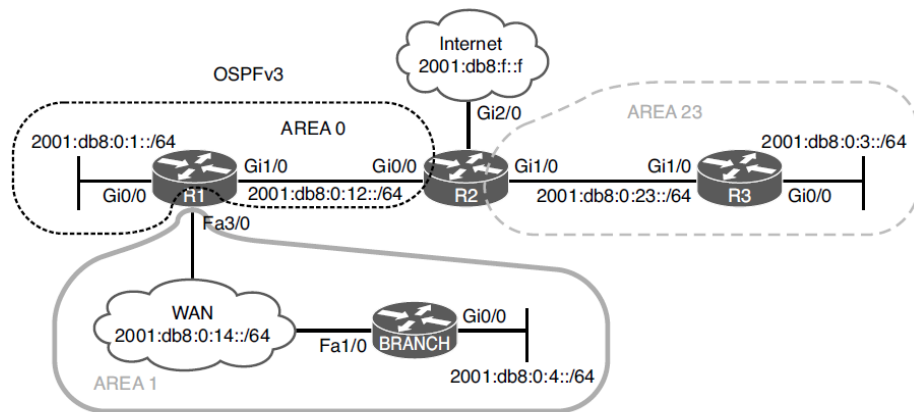

Figure 10-1 *OSPFv3 Trouble Tickets Topology*

Refer to your text for next steps and examples to troubleshoot and resolve this trouble ticket.

Example 10-16 *Testing Connectivity from Branch to a Remote Network*

```
Branch# ping
Protocol [ip]: ipv6
Target IPv6 address: 2001:db8:0:1::1
Repeat count [5]:
Datagram size [100]:
Timeout in seconds [2]:
Extended commands? [no]: yes
Source address or interface: 2001:db8:0:4::4
UDP protocol? [no]:
Verbose? [no]:
Precedence [0]:
DSCP [0]:
Include hop by hop option? [no]:
Include destination option? [no]:
Sweep range of sizes? [no]:
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2001:DB8:0:1::1, timeout is 2 seconds:
Packet sent with a source address of 2001:DB8:0:4::4
.....
Success rate is 0 percent (0/5)
```

Trouble Ticket 10-3

Problem: Users in Branch have indicated that they are not able to access any IPv6-enabled resources on the internet, but they can access IPv4-enabled resources.

An extended ping issued on Branch to the destination 2001:db8:f::f confirms the issue, as shown in Example 10-33. In addition, you ping 192.0.2.1, and it is successful in confirming connectivity to IPv4-enabled resources.
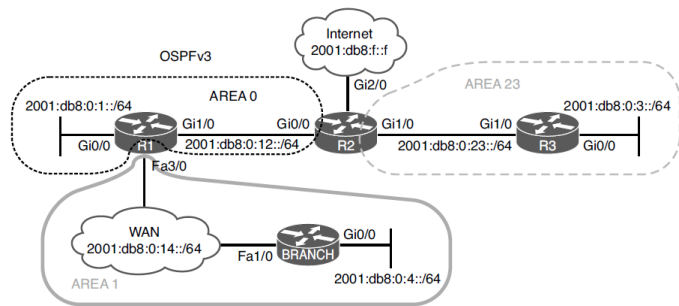
Figure 10-1 *OSPFv3 Trouble Tickets Topology*

Example 10-33 *Verifying Connectivity*

```
Branch# ping
Protocol [ip]: 1pv6
Target IPv6 address: 2001:db8:f::f
Repeat count [5]:
Datagram size [100]:
Timeout in seconds [2]:
Extended commands? [no]: yes
Source address or interface: 2001:db8:0:4::4
UDP protocol? [no]:
Verbose? [no]:
```

Refer to your text for next steps and examples to troubleshoot and resolve this trouble ticket.

Troubleshooting OSPFv3 Address Families

- OSPFv3 address families (AFs) enable you to configure a single process to support both IPv4 and IPv6. In addition, a single database is maintained for IPv4 and IPv6.
- However, adjacencies are established individually for each AF, and settings can be configured on an AF-by-AF basis.
- This section shows the commands you can use to troubleshoot an OSPFv3 implementation that uses address families.

AF Verification

Example 10-26 shows a sample OSPFv3 configuration with AFs. The OSPFv3 PID is 10 and is locally significant. Therefore, it does not have to match between neighbors.

•Any parameter configured under the main router OSPFv3 configuration mode applies to all address families.

•In this example, the **area 23 stub** command is configured under the main router OSPFv3 configuration mode; therefore, Area 23 is a stub area for both IPv4 and IPv6 address families.

•Note that if there are conflicts between configurations in router OSPFv3 configuration mode and AF configuration mode, AF configuration mode wins.

Example 10-26 *Sample OSPFv3 Configuration with Address Families*

```
R2# show run | section router ospfv3
router ospfv3 10
 area 23 stub
 !
 address-family ipv4 unicast
 passive-interface default
 no passive-interface GigabitEthernet0/0
 no passive-interface GigabitEthernet1/0
 default-information originate
 router-id 2.2.2.2
 exit-address-family
 !
 address-family ipv6 unicast
 passive-interface default
 no passive-interface GigabitEthernet0/0
 no passive-interface GigabitEthernet1/0
 default-information originate
 router-id 22.22.22.22
 exit-address-family

R2# show run int gig 1/0
interface GigabitEthernet1/0
 ip address 10.1.23.2 255.255.255.0
 ipv6 address 2001:DB8:0:23::2/64
 ospfv3 10 ipv6 area 23
 ospfv3 10 ipv4 area 23
end

R2# show run int gig 0/0
interface GigabitEthernet0/0
 ip address 10.1.12.2 255.255.255.0
 ipv6 address 2001:DB8:0:12::2/64
 ospfv3 10 hello-interval 11
 ospfv3 10 ipv6 area 0
 ospfv3 10 ipv6 hello-interval 10
 ospfv3 10 ipv4 area 0
end
```

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AF Configurations

OSPFv3 interface parameters are still configured in interface configuration mode.

- If you do not specify the AF (IPv4 or IPv6), the configured parameter applies to all address families.
- If you apply the configuration to the AF, it applies only to that AF.
- If a conflict exists, the AF configuration wins.
- In the GigabitEthernet 0/0 configuration in Example 10-26, notice that the hello interval is configured without an AF specified. Therefore, it applies to both IPv4 and IPv6. However, the hello interval is also configured for the IPv6 AF. Therefore, this configuration prevails for IPv6, and a hello interval of 10 is used; IPv4 uses the hello interval 11.

Example 10-26 *Sample OSPFv3 Configuration with Address Families*

```
R2# show run | section router ospfv3
router ospfv3 10
 area 23 stub
 !
 address-family ipv4 unicast
 passive-interface default
 no passive-interface GigabitEthernet0/0
 no passive-interface GigabitEthernet1/0
 default-information originate
 router-id 2.2.2.2
 exit-address-family
 !
 address-family ipv6 unicast
 passive-interface default
 no passive-interface GigabitEthernet0/0
 no passive-interface GigabitEthernet1/0
 default-information originate
 router-id 22.22.22.22
 exit-address-family

R2# show run int gig 1/0
interface GigabitEthernet1/0
 ip address 10.1.23.2 255.255.255.0
 ipv6 address 2001:DB8:0:23::2/64
 ospfv3 10 ipv6 area 23
 ospfv3 10 ipv4 area 23
end

R2# show run int gig 0/0
interface GigabitEthernet0/0
 ip address 10.1.12.2 255.255.255.0
 ipv6 address 2001:DB8:0:12::2/64
 ospfv3 10 hello-interval 11
 ospfv3 10 ipv6 area 0
 ospfv3 10 ipv6 hello-interval 10
 ospfv3 10 ipv4 area 0
end
```

Show IP Protocols

With OSPFv3 AFs, you can use the **show ip protocols** and **show ipv6 protocols** commands, as shown in Example 10-27.

Example 10-27 *Using show ip protocols and show ipv6 protocols*

```
R2# show ip protocols
*** IP Routing is NSF aware ***

Routing Protocol is "ospfv3 10"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 2.2.2.2
  Area border and autonomous system boundary router
  Number of areas: 1 normal, 1 stub, 0 nssa
  Interfaces (Area 0):
    GigabitEthernet0/0
  Interfaces (Area 23):
    GigabitEthernet1/0
  Maximum path: 4
  Routing Information Sources:
    Gateway Distance    Last Update
    2.2.2.2      110    00:12:39
    3.3.3.3      110    00:12:39
    10.1.14.1    110    00:00:57
  Distance: (default is 110)

R2# show ipv6 protocols
IPv6 Routing Protocol is "connected"
IPv6 Routing Protocol is "ND"
IPv6 Routing Protocol is "static"
IPv6 Routing Protocol is "ospf 10"
  Router ID 22.22.22.22
  Area border and autonomous system boundary router
  Number of areas: 1 normal, 1 stub, 0 nssa
  Interfaces (Area 0):
    GigabitEthernet0/0
  Interfaces (Area 23):
    GigabitEthernet1/0
  Redistribution:
  None
```

Show OSPFv3

The output of **show ospfv3**, as shown in Example 10-28, displays the same information you would find with the **show ip ospf** and **show ipv6 ospf** commands. Notice that the IPv4 AF is listed first, followed by the IPv6 AF.

Example 10-28 *Using show ospfv3 to Verify General OSPFv3 Parameters for AFs*

```
R2# show ospfv3
OSPFv3 10 address-family ipv4
Router ID 2.2.2.2
Supports NSSA (compatible with RFC 3101)
Event-log enabled, Maximum number of events: 1000, Mode: cyclic
It is an area border and autonomous system boundary router
Redistributing External Routes from,
Originate Default Route
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
Retransmission limit dc 24 non-dc 24
Number of external LSA 1. Checksum Sum 0x0013EB
Number of areas in this router is 2. 1 normal 1 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 13 times
        Number of LSA 11. Checksum Sum 0x05A71D
        Number of DCbitless LSA 0
        Number of indication LSA 0
        Number of DoNotAge LSA 0
        Flood list length 0
    Area 23
        Number of interfaces in this area is 1
        It is a stub area
        Generates stub default route with cost 1
        SPF algorithm executed 8 times
        Number of LSA 12. Checksum Sum 0x064322
        Number of DCbitless LSA 0
        Number of indication LSA 0
        Number of DoNotAge LSA 0
        Flood list length 0
```

```
OSPFv3 10 address-family ipv6
Router ID 22.22.22.22
Supports NSSA (compatible with RFC 3101)
Event-log enabled, Maximum number of events: 1000, Mode: cyclic
It is an area border and autonomous system boundary router
Originate Default Route
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
Retransmission limit dc 24 non-dc 24
Number of external LSA 1. Checksum Sum 0x00B8F5
Number of areas in this router is 2. 1 normal 1 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 13 times
        Number of LSA 11. Checksum Sum 0x0422C7
        Number of DCbitless LSA 0
        Number of indication LSA 0
        Number of DoNotAge LSA 0
        Flood list length 0
    Area 23
        Number of interfaces in this area is 1
        It is a stub area
        Generates stub default route with cost 1
        SPF algorithm executed 11 times
        Number of LSA 12. Checksum Sum 0x0591F5
        Number of DCbitless LSA 0
        Number of indication LSA 0
        Number of DoNotAge LSA 0
        Flood list length 0
```

Show OSPFv3 Interface

The output command **show ospfv3 interface brief** command shows the interfaces participating in the OSPFv3 process for each AF (see Example 10-29). Notice the added column that indicates which AF the interface is participating in.

The **show ospfv3 interface** command enables you to review detailed information about the interface configurations. Example 10-30 displays the IPv4 AF information at the top and the IPv6 AF information at the bottom.

Example 10-29 *Using show ospfv3 interface brief to Verify OSPFv3 Interfaces*

```
R2# show ospfv3 interface brief
Interface    PID    Area    AF      Cost    State    Nbrs F/C
Gi0/0        10     0       ipv4    1       BDR      1/1
Gi1/0        10     23      ipv4    1       BDR      1/1
Gi0/0        10     0       ipv6    1       BDR      1/1
Gi1/0        10     23      ipv6    1       BDR      1/1
```

Example 10-30 *Using show ospfv3 interface to Verify Details of OSPFv3 Interfaces*

```
R2# show ospfv3 interface gigabitEthernet 1/0
GigabitEthernet1/0 is up, line protocol is up
 Link Local Address FE80::C802:10FF:FE20:1C, Interface ID 4
 Internet Address 10.1.23.2/24
 Area 23, Process ID 10, Instance ID 64, Router ID 2.2.2.2
 Network Type BROADCAST, Cost: 1
 Transmit Delay is 1 sec, State BDR, Priority 1
 Designated Router (ID) 3.3.3.3, local address FE80::C804:10FF:FE74:1C
 Backup Designated router (ID) 2.2.2.2, local address FE80::C802:10FF:FE20:1C
 Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
   Hello due in 00:00:02
 Graceful restart helper support enabled
 Index 1/1/2, flood queue length 0
 Next 0x0(0)/0x0(0)/0x0(0)
 Last flood scan length is 4, maximum is 5
 Last flood scan time is 4 msec, maximum is 4 msec
 Neighbor Count is 1, Adjacent neighbor count is 1
   Adjacent with neighbor 3.3.3.3 (Designated Router)
 Suppress hello for 0 neighbor(s)
GigabitEthernet1/0 is up, line protocol is up
 Link Local Address FE80::C802:10FF:FE20:1C, Interface ID 4
 Area 23, Process ID 10, Instance ID 0, Router ID 22.22.22.22
 Network Type BROADCAST, Cost: 1
 Transmit Delay is 1 sec, State BDR, Priority 1
 Designated Router (ID) 33.33.33.33, local address FE80::C804:10FF:FE74:1C
 Backup Designated router (ID) 22.22.22.22, local address FE80::C802:10FF:FE20:1C
 Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
   Hello due in 00:00:03
 Graceful restart helper support enabled
 Index 1/1/2, flood queue length 0
 Next 0x0(0)/0x0(0)/0x0(0)
 Last flood scan length is 1, maximum is 4
 Last flood scan time is 0 msec, maximum is 4 msec
 Neighbor Count is 1, Adjacent neighbor count is 1
   Adjacent with neighbor 33.33.33.33 (Designated Router)
 Suppress hello for 0 neighbor(s)
```

AF Neighbors

To verify the neighbor relationships that have been formed for each AF, issue the command **show ospfv3 neighbor**, as shown in Example 10-31.

- The output is presenting the same information as discussed earlier, except this time there are different sections for each AF.
- To verify the information in the LSDB, you issue the command **show ospfv3 database**. When using AFs, the OSPFv3 database contains LSAs for both IPv4 and IPv6, as shown in Example 10-32. (The rest of the Example 10-32 is on the next slide.)

Example 10-31   *Using show ospfv3 neighbor to Verify OSPFv3 Neighbors*

```
R2# show ospfv3 neighbor

          OSPFv3 10 address-family ipv4 (router-id 2.2.2.2)

Neighbor ID    Pri    State       Dead Time    Interface ID    Interface
10.1.14.1       1     FULL/DR     00:00:34         4           GigabitEthernet0/0
3.3.3.3         1     FULL/DR     00:00:36         4           GigabitEthernet1/0

          OSPFv3 10 address-family ipv6 (router-id 22.22.22.22)

Neighbor ID    Pri    State       Dead Time    Interface ID    Interface
10.1.14.1       1     FULL/DR     00:00:31         4           GigabitEthernet0/0
33.33.33.33     1     FULL/DR     00:00:34         4           GigabitEthernet1/0
```

Example 10-32   *Verifying the LSDB with show ospfv3 database*

```
R2# show ospfv3 database

          OSPFv3 10 address-family ipv4 (router-id 2.2.2.2)

              Router Link States (Area 0)

ADV Router      Age      Seq#        Fragment ID    Link count    Bits
 2.2.2.2        1456     0x80000008  0                 1          B E
 10.1.14.1      1457     0x80000007  0                 1          B

              Net Link States (Area 0)

ADV Router      Age      Seq#        Link ID        Rtr count
 10.1.14.1      1453     0x80000003  4                 2
```

AF Neighbors (Cont.)

```
        Inter Area Prefix Link States (Area 0)

ADV Router      Age     Seq#        Prefix
2.2.2.2         1618    0x80000003  10.1.23.0/24
2.2.2.2         94      0x80000002  10.1.3.0/24
10.1.14.1       1599    0x80000002  10.1.14.0/24
10.1.14.1       1599    0x80000002  10.1.4.0/24

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

ADV Router      Age     Seq#        Link ID    Interface
2.2.2.2         1618    0x80000003  3          Gi0/0
10.1.14.1       1599    0x80000002  4          Gi0/0

        Intra Area Prefix Link States (Area 0)

ADV Router      Age     Seq#        Link ID    Ref-lstype Ref-LSID
10.1.14.1       1457    0x80000007  0          0x2001     0
10.1.14.1       1453    0x80000003  4096       0x2002     4

        Router Link States (Area 23)

ADV Router      Age     Seq#        Fragment ID  Link count   Bits
2.2.2.2         94      0x80000007  0            1            B
3.3.3.3         248     0x80000009  0            1            None

        Net Link States (Area 23)

ADV Router      Age     Seq#        Link ID    Rtr count
3.3.3.3         248     0x80000007  4          2

        Inter Area Prefix Link States (Area 23)

ADV Router      Age     Seq#        Prefix
2.2.2.2         1869    0x80000002  0.0.0.0/0
2.2.2.2         1442    0x80000001  10.1.1.0/24
2.2.2.2         1442    0x80000002  10.1.12.0/24
2.2.2.2         1442    0x80000001  10.1.4.0/24
2.2.2.2         1442    0x80000001  10.1.14.0/24

        Link (Type-8) Link States (Area 23)

ADV Router      Age     Seq#        Link       ID Interface
2.2.2.2         1618    0x80000004  4          Gi1/0
3.3.3.3         1758    0x80000004  4          Gi1/0
```

```
        Intra Area Prefix Link States (Area 23)

ADV Router      Age     Seq#        Link ID    Ref-lstype Ref-LSID
3.3.3.3         248     0x80000008  0          0x2001     0
3.3.3.3         248     0x80000007  4096       0x2002     4

        Type-5 AS External Link States

ADV Router      Age     Seq#        Prefix
2.2.2.2         1618    0x80000003  0.0.0.0/0

OSPFv3 10 address-family ipv6 (router-id 22.22.22.22)

        Router Link States (Area 0)

ADV Router      Age     Seq#        Fragment ID  Link count   Bits
10.1.14.1       330     0x80000007  0            1            B
22.22.22.22     198     0x8000000A  0            1            B E

        Net Link States (Area 0)

ADV Router      Age     Seq#        Link ID    Rtr count
10.1.14.1       330     0x80000004  4          2

        Inter Area Prefix Link States (Area 0)

ADV Router      Age     Seq#        Prefix
10.1.14.1       1598    0x80000002  2001:DB8:0:14::/64
10.1.14.1       1598    0x80000002  2001:DB8:0:4::/64
22.22.22.22     198     0x80000002  2001:DB8:0:3::/64
22.22.22.22     198     0x80000002  2001:DB8:0:23::/64

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

ADV Router      Age     Seq#        Link ID    Interface
10.1.14.1       1598    0x80000002  4          Gi0/0
22.22.22.22     1446    0x80000003  3          Gi0/0

        Intra Area Prefix Link States (Area 0)

ADV Router      Age     Seq#        Link ID    Ref-lstype Ref-LSID
10.1.14.1       330     0x80000006  0          0x2001     0
10.1.14.1       330     0x80000004  4096       0x2002     4
```

```
        Router Link States (Area 23)

ADV Router      Age     Seq#        Fragment ID  Link count Bits
22.22.22.22     198     0x8000000A  0            1          B
33.33.33.33     237     0x80000008  0            1          None

        Net Link States (Area 23)

ADV Router      Age     Seq#        Link ID    Rtr count
33.33.33.33     237     0x80000007  4          2

        Inter Area Prefix Link States (Area 23)

ADV Router      Age     Seq#        Prefix
22.22.22.22     198     0x80000005  2001:DB8:0:12::/64
22.22.22.22     1961    0x80000002  ::/0
22.22.22.22     198     0x80000002  2001:DB8:0:1::/64
22.22.22.22     198     0x80000002  2001:DB8:0:4::/64
22.22.22.22     198     0x80000002  2001:DB8:0:14::/64

        Link (Type-8) Link States (Area 23)

ADV Router      Age     Seq#        Link ID    Interface
22.22.22.22     1446    0x80000004  4          Gi1/0
33.33.33.33     1713    0x80000004  4          Gi1/0

        Intra Area Prefix Link States (Area 23)

ADV Router      Age     Seq#        Link ID    Ref-lstype Ref-LSID
33.33.33.33     237     0x8000000A  0          0x2001     0
33.33.33.33     237     0x80000007  4096       0x2002     4

        Type-5 AS External Link States

ADV Router      Age     Seq#        Prefix
22.22.22.22     1446    0x80000003  ::/0
```

OSPFv3 AF Troubleshooting Tips

When troubleshooting OSPFv3 AFs that both OSPF for IPv4 and OSPF for IPv6 use IPv6 to exchange routing information.

- Therefore, IPv6 unicast routing must be enabled on the router. Also, classic OSPFv2 and the OSPFv3 AFs are not compatible.

- Therefore, a router using OSPFv3 AFs for IPv4 does not peer with a router using the classic OSPFv2 configuration for IPv4 because they are not compatible.

- To verify the IPv4 OSPFv3 entries in the routing table, use the **show ip route ospfv3** command.

- To verify the IPv6 OSPFv3 entries in the routing table, use the **show ipv6 route ospf** command.

- If you need to perform any debugging for OSPFv3, you can issue the **debug ospfv3** command followed by what you want to debug, such as **events**, **packets**, **hellos**, or **adj**. This turns on the debugging for all AFs.

- If you want to turn it on only for a specific AF, you need to include the AF in the command. For example, in the command **debug ospfv3 ipv6 hello**, **ipv6** refers to the AF.

OSPFv3 AF Trouble Ticket

- This section presents a trouble ticket related to the topics discussed in the preceding section.
- The purpose of this trouble ticket is to show a process that you can use when troubleshooting in the real world or in an exam environment.
- This trouble ticket is based on the topology shown in Figure 10-2.

Trouble Ticket 10-3

Problem: Users in Branch have indicated that they are not able to access any IPv6-enabled resources on the Internet, but they can access IPv4-enabled resources.

An extended ping issued on Branch to the destination 2001:db8:f::f confirms the issue, as shown in Example 10-33. In addition, you ping 192.0.2.1, and it is successful in confirming connectivity to IPv4-enabled resources.
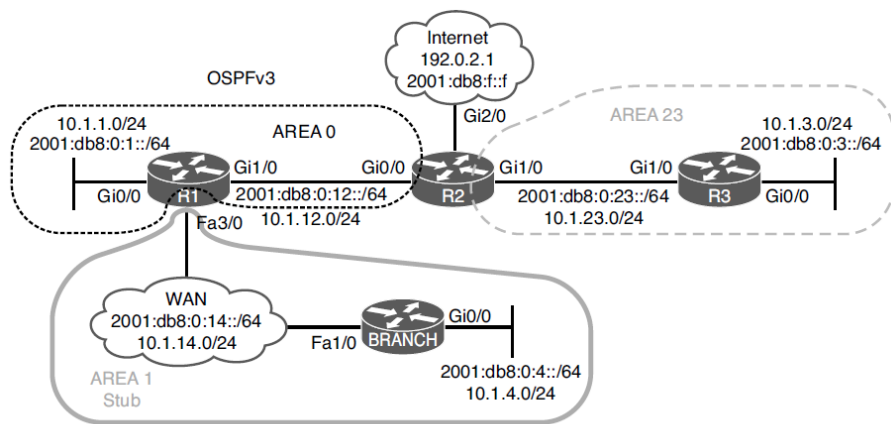

Figure 10-2   OSPFv3 AF Trouble Ticket Topology

Refer to your text for next steps and examples to troubleshoot and resolve this trouble ticket.

Example 10-33   *Verifying Connectivity*

```
Branch# ping
Protocol [ip]: ipv6
Target IPv6 address: 2001:db8:f::f
Repeat count [5]:
Datagram size [100]:
Timeout in seconds [2]:
Extended commands? [no]: yes
Source address or interface: 2001:db8:0:4::4
UDP protocol? [no]:
Verbose? [no]:

Precedence [0]:
DSCP [0]:
Include hop by hop option? [no]:
Include destination option? [no]:
Sweep range of sizes? [no]:
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2001:DB8:f::f, timeout is 2 seconds:
Packet sent with a source address of 2001:DB8:0:4::4
UUUUU
Success rate is 0 percent (0/5)

Branch# ping 192.0.2.1 source 10.1.4.4
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.0.2.1, timeout is 2 seconds:
Packet sent with a source address of 10.1.4.4
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 80/112/152 ms
```

Prepare for the Exam

Key Topics for Chapter 10

Description	Description
Identifying What Can Be Verified for OSPFv3 with **show ipv6 protocols**	Sample OSPFv3 configuration with AFs
Identifying What Can Be Verified with **show ipv6 ospf**	Using **show ospfv3** to verify general OSPFv3 parameters for AFs
Verification during the troubleshooting process with the **show ipv6 ospf interface brief** command	Using **show ospfv3 interface brief** to verify OSPFv3 interfaces
Verification during the troubleshooting process with the **show ipv6 ospf interface** command	Using **show ospfv3 interface** to verify details of OSPFv3 interfaces
Additional OSPF LSAs for OSPFv3	

Key Terms for Chapter 10

Terms		
OSPFv3 interface table	Virtual Link	Backup Designated Router
OSPFv3 neighbor table	OSPFv3 area border router (ABR)	Stub Area
OSPFv3 link-state database (LSDB)	OSPFv3 Autonomous System Boundary Router (ASBR)	Totally Stubby Area
Linkstate Advertisement (LSA)	OSPFv3	NSSA
Dijkstra's Shortest Path First (SPF) Algorithm	Address Family (AF)	Totally NSSA
OSPFv3 area	Designated Router	

Command Reference for Chapter 10

Task	Command Syntax
Display the IPv4 routing protocols enabled on the device; for OSPFv2, display whether any route filters are applied, the RID, the number of areas the router is participating in, the types of areas, the maximum paths for load balancing, the **network area** command, the interfaces explicitly participating in the routing process, passive interfaces, routing information sources, and the AD	**show ip protocols**
Display the IPv6 dynamic routing protocols enabled on the device; for OSPFv3, display the PID, the RID, the number of areas, the type of areas, the interfaces participating in the routing process, and redistribution information	**show ipv6 protocols**
Display general OSPF parameters, including the PID, the RID, the reference bandwidth, the areas configured on the router, the types of areas (stub, totally stubby, NSSA, and totally NSSA), and area authentication	**show ipv6 ospf**
Display the OSPF routes that have been installed in the IPv4 routing table	**show ipv6 ospf interface brief**
Display detailed information about the interfaces participating in the OSPF process, including the interface IPv4 address and mask, area ID, PID, RID, network type, cost, DR/BDR, priority, and timers	**show ipv6 ospf interface**

Command Reference for Chapter 10 (Cont.)

Task	Command Syntax
Display the OSPF devices that have formed a neighbor adjacency with the local router	**show ipv6 ospf neighbor**
Display the OSPF routes that have been installed in the IPv4/IPv6 routing table	**show ipv6 route**
Display general OSPFv3 parameters for IPv4 and IPv6 address families, including the PID, the RID, the reference bandwidth, the areas configured on the router, the types of areas (stub, totally stubby, NSSA, and totally NSSA), and area authentication	**show ospfv3**
Display the interfaces that are participating in the OSPFv3 process and the AF they are participating in	**show ospfv3 interface brief**
Display detailed information about the interfaces participating in the OSPFv3 address families, including interface IPv4 and IPv6 addresses, area ID, PID, RID, network type, cost, DR/BDR, priority, and timers	**show ospfv3 interface**
Display the OSPFv3 neighbor adjacencies that have been formed for each AF	**show ospfv3 neighbor**
Display the OSPF link-state database	**show ipv6 ospf database**

Command Reference for Chapter 10 (Cont.)

Task	Command Syntax
Display the OSPFv3 link-state database	**show ospfv3 database**
Display real-time information related to the exchange of OSPF hello packets; useful for identifying mismatched OSPF timers and mismatched OSPF area types	**debug {ip | ipv6} ospf hello debug ospfv3 {ip | ipv6} hello**
Display the transmission and reception of OSPF packets in real time	**debug {ip | ipv6} ospf packet debug ospfv3 {ip | ipv6} packet**
Display real-time updates about the formation of an OSPF adjacency; useful for identifying mismatched area IDs and authentication information	**debug {ip | ipv6} ospf adj debug ospfv3 {ip | ipv6} adj**
Display real-time information about OSPF events, including the transmission and reception of hello messages and LSAs; might be useful on a router that appears to be ignoring hello messages received from a neighboring router	**debug {ip | ipv6} ospf events debug ospfv3 {ip | ipv6} events**