

Sample Configuration for OSPFv3

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Introduction

Open Shortest Path First (OSPF) is a routing protocol for IP. It is a link–state protocol, as opposed to a distance–vector protocol. A link–state protocol makes routing decisions based on the states of the links that connect source and destination machines. The state of a link is a description of that interface and the relationship to its neighboring networking devices. The interface information includes the IPv6 prefix of the interface, the network mask, the type of network it is connected to, the routers connected to that network, and so forth. This information is propagated in various type of link–state advertisements (LSAs).

OSPF version 3, which is described in RFC 2740, supports IPv6.

Prerequisites

Requirements

Before you enable OSPF for IPv6 on an interface, you must perform the following:

- Complete the OSPF network strategy and planning for your IPv6 network. For example, you must decide whether multiple areas are required.
- Enable IPv6 unicast routing.
- Enable IPv6 on the interface.
- Configure the IP Security (IPsec) secure socket application program interface (API) on OSPF for IPv6 in order to enable authentication and encryption.

Components Used

This document is not restricted to specific software and hardware versions.

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, make sure that you understand the potential impact of any command.

Conventions

Refer to Cisco Technical Tips Conventions for more information on document conventions.

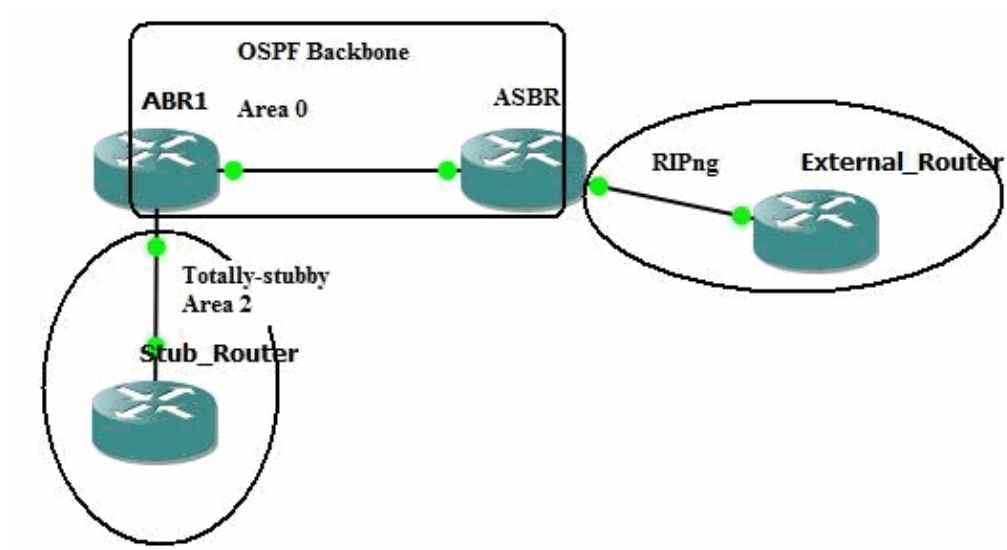
Configure

In this section, you are presented with the information to configure the features described in this document.

Note: Use the Command Lookup Tool (registered customers only) to find more information on the commands used in this document.

Network Diagram

This document uses this network setup:



Configuration

This is the configuration of OSPFv3 for the routers shown in the diagram:

Stub Router
<pre>ipv6 unicast-routing ipv6 cef ! interface serial 0/0 no ip address ipv6 enable ipv6 address 2001:ABAB::/64 eui-64 ipv6 ospf 1 area 2 ! ipv6 router ospf 1 router-id 3.3.3.3 area 2 stub !</pre>

ABR1 Router
<pre>ipv6 unicast-routing ipv6 cef</pre>

```

!
interface FastEthernet0/0
  no ip address
  speed auto
  ipv6 address 2003::1/124
  ipv6 enable
  ipv6 ospf 1 area 0
!
interface Serial0/0
  no ip address
  ipv6 address 2002:ABAB::/64 eui-64
  ipv6 enable
  ipv6 ospf 1 area 2
!
ipv6 router ospf 1
  router-id 1.1.1.1
  area 2 stub no-summary
!

```

ASBR Router

```

ipv6 unicast-routing
ipv6 cef
!
interface FastEthernet0/0
  no ip address
  ipv6 address 2003::2/124
  ipv6 enable
  ipv6 ospf 1 area 0
!
interface Serial0/0
  no ip address
  ipv6 address 2003::1:1/124
  ipv6 enable
  ipv6 rip EXT enable
!
ipv6 router ospf 1
  router-id 2.2.2.2
  default-metric 25
  redistribute rip EXT metric-type 1 include-connected
!
ipv6 router rip EXT
  redistribute ospf 1 match internal external 1 external 2 include-connected
!

```

External Router

```

ipv6 unicast-routing
ipv6 cef
!
interface Loopback0
  no ip address
  ipv6 address 2004:ABAB::/64 eui-64
  ipv6 enable
  ipv6 rip EXT enable
!
interface Serial0/0
  no ip address
  ipv6 address 2003::1:2/124
  ipv6 enable
  ipv6 rip EXT enable
!
ipv6 router rip EXT

```

Verify

Use this section to confirm that your configuration works properly.

The Output Interpreter Tool (registered customers only) (OIT) supports certain **show** commands. Use the OIT to view an analysis of **show** command output.

The **show ipv6 ospf database** command shows the Link State Database (LSDB) of the router.

```
Stub_Router#show ipv6 ospf database

      OSPFv3 Router with ID (3.3.3.3) (Process ID 1)

      Router Link States (Area 2)

ADV Router      Age          Seq#          Fragment ID   Link count    Bits
1.1.1.1         885          0x80000007   0              1              1      B
3.3.3.3         919          0x80000008   0              1              1      None

      Inter Area Prefix Link States (Area 2)

ADV Router      Age          Seq#          Prefix
1.1.1.1         373          0x80000002   ::/0

      Link (Type-8) Link States (Area 2)

ADV Router      Age          Seq#          Link ID       Interface
1.1.1.1         964          0x80000006   5             Se0/0
3.3.3.3         1165         0x80000006   5             Se0/0

      Intra Area Prefix Link States (Area 2)

ADV Router      Age          Seq#          Link ID       Ref-lstyp     Ref-LSID
1.1.1.1         964          0x80000005   0             0x2001        0
3.3.3.3         1172         0x80000005   0             0x2001        0
```

The **show ipv6 ospf database router self-originate** command shows the Router LSAs where the router originates and receives. The Router LSAs carry no address or prefix information.

```
Stub_Router#

      OSPFv3 Router with ID (3.3.3.3) (Process ID 1)

      Router Link States (Area 2)

      Routing Bit Set on this LSA
      LS age: 753
      Options: (V6-Bit R-bit DC-Bit)
      LS Type: Router Links
      Link State ID: 0
      Advertising Router: 1.1.1.1
      LS Seq Number: 80000007
      Checksum: 0xFCA4
      Length: 40
      Area Border Router
      Number of Links: 1

      Link connected to: another Router (point-to-point)
      Link Metric: 64
      Local Interface ID: 5
      Neighbor Interface ID: 5
      Neighbor Router ID: 3.3.3.3
```

```

LS age: 791
Options: (V6-Bit R-bit DC-Bit)
LS Type: Router Links
Link State ID: 0
Advertising Router: 3.3.3.3
LS Seq Number: 80000008
Checksum: 0x178A
Length: 40
Number of Links: 1

    Link connected to: another Router (point-to-point)
        Link Metric: 64
        Local Interface ID: 5
        Neighbor Interface ID: 5
        Neighbor Router ID: 1.1.1.1

```

The LSAs carry an Options field which has these bits:

- **V6 bit** Indicates whether the router/link should be used in routing calculation.
- **R bit** This is the "Router bit". It indicates if the originator is an active router.
- **DC bit** Indicates the router's handling of Demand Circuit.

The **show ipv6 ospf database link self-originate** command shows that Link LSAs carry link-specific addresses.

```

Stub_Router#show ipv6 ospf database link self-originate

      OSPFv3 Router with ID (3.3.3.3) (Process ID 1)

          Link (Type-8) Link States (Area 2)

LS age: 627
Options: (V6-Bit R-bit DC-Bit)
LS Type: Link-LSA (Interface: Serial0/0)
Link State ID: 5 (Interface ID)
Advertising Router: 1.1.1.1
LS Seq Number: 80000006
Checksum: 0x215C
Length: 56
Router Priority: 1
Link Local Address: FE80::D20E:16FF:FE50:0
Number of Prefixes: 1
Prefix Address: 2002:ABAB::
Prefix Length: 64, Options: None

LS age: 828
Options: (V6-Bit R-bit DC-Bit)
LS Type: Link-LSA (Interface: Serial0/0)
Link State ID: 5 (Interface ID)
Advertising Router: 3.3.3.3
LS Seq Number: 80000006
Checksum: 0xB4C2
Length: 56
Router Priority: 1
Link Local Address: FE80::D20D:16FF:FE50:0
Number of Prefixes: 1
Prefix Address: 2001:ABAB::
Prefix Length: 64, Options: None

```

Because the Stub Router belongs to a Totally-Stub Area, the ABR1 Router sends only the default route to the Stub Router.

```

Stub_Router#
show ipv6 route

IPv6 Routing Table - 6 entries
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
OI  ::/0 [110/65]
    via FE80::D20E:16FF:FE50:0, Serial0/0
C   2001:ABAB::/64 [0/0]
    via ::, Serial0/0
L   2001:ABAB::D20D:16FF:FE50:0/128 [0/0]
    via ::, Serial0/0
O   2002:ABAB::/64 [110/128]
    via FE80::D20E:16FF:FE50:0, Serial0/0
L   FE80::/10 [0/0]
    via ::, Null0
L   FF00::/8 [0/0]
    via ::, Null0

```

The ABR1 Router is the Area Border Router.

```

ABR1#
show ipv6 ospf

Routing Process "ospfv3 1" with ID 1.1.1.1
It is an area border router
SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
LSA group pacing timer 240 secs
Interface flood pacing timer 33 msec
Retransmission pacing timer 66 msec
Number of external LSA 2. Checksum Sum 0x00A1E0
Number of areas in this router is 2. 1 normal 1 stub 0 nssa
Reference bandwidth unit is 100 mbps
  Area BACKBONE(0)
    Number of interfaces in this area is 1
    SPF algorithm executed 5 times
    Number of LSA 8. Checksum Sum 0x052E71
    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 1
    It is a stub area, no summary LSA in this area
    generates stub default route with cost 1
    SPF algorithm executed 6 times
    Number of LSA 7. Checksum Sum 0x042237
    Number of DCbitless LSA 0
    Number of indication LSA 0
    Number of DoNotAge LSA 0
    Flood list length 0

```

The ABR1 Router receives external routes (RIP routes) from the ASBR Router.

```

ABR1#
show ipv6 route

IPv6 Routing Table - 9 entries
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
O 2001:ABAB::/64 [110/128]
  via FE80::D20D:16FF:FE50:0, Serial0/0
C 2002:ABAB::/64 [0/0]
  via ::, Serial0/0
L 2002:ABAB::D20E:16FF:FE50:0/128 [0/0]
  via ::, Serial0/0
C 2003::/124 [0/0]
  via ::, FastEthernet0/0
L 2003::1/128 [0/0]
  via ::, FastEthernet0/0
OE1 2003::1:0/124 [110/26]
  via FE80::D20F:BFF:FE24:0, FastEthernet0/0
OE1 2004:ABAB::/64 [110/26]
  via FE80::D20F:BFF:FE24:0, FastEthernet0/0
L FE80::/10 [0/0]
  via ::, Null0
L FF00::/8 [0/0]
  via ::, Null0

```

The ASBR Router is the Autonomous System Boundary Router for the network. It is connected to the RIP network through Serial 0/0 interface.

ASBR#

show ipv6 ospf

```

Routing Process "ospfv3 1" with ID 2.2.2.2
It is an autonomous system boundary router
Redistributing External Routes (with default metric 25) from,
  rip with metric-type 1 include-connected
SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
LSA group pacing timer 240 secs
Interface flood pacing timer 33 msecs
Retransmission pacing timer 66 msecs
Number of external LSA 2. Checksum Sum 0x00A1E0
Number of areas in this router is 1. 1 normal 0 stub 0 nssa
Reference bandwidth unit is 100 mbps
  Area BACKBONE(0)
    Number of interfaces in this area is 1
    SPF algorithm executed 2 times
    Number of LSA 8. Checksum Sum 0x052E71
    Number of DCbitless LSA 0
    Number of indication LSA 0
    Number of DoNotAge LSA 0
    Flood list length 0

```

ASBR#

show ipv6 rip

```

RIP process "EXT", port 521, multicast-group FF02::9, pid 156
  Administrative distance is 120. Maximum paths is 16
  Updates every 30 seconds, expire after 180
  Holddown lasts 0 seconds, garbage collect after 120
  Split horizon is on; poison reverse is off
  Default routes are not generated
  Periodic updates 69, trigger updates 6
Interfaces:
  Serial0/0
Redistribution:
  Redistributing protocol ospf 1 include-connected

```

Troubleshoot

Use this section to troubleshoot your configuration.

Note: Refer to Important Information on Debug Commands before you use **debug** commands.

debug ipv6

As soon as OSPFv3 is enabled on the Stub Router, it sends out OSPFv3 Type 1 Hello messages to the FF02::5 multicast address. Once it receives Hello packets from the ABR1 Router, they negotiate the Master/Slave relationship and then start to send DBD packets.

```
Stub_Router#debug ipv6 ospf events
```

```
Stub_Router# debug ipv6 ospf packet
```

```
*Mar 1 00:14:20.999: OSPFv3: rcv. v:3 t:1 l:36 rid:1.1.1.1
aid:0.0.0.2 chk:142A inst:0 from Serial0/0
*Mar 1 00:14:21.023: OSPFv3: rcv. v:3 t:2 l:28 rid:1.1.1.1
aid:0.0.0.2 chk:EB8A inst:0 from Serial0/0
*Mar 1 00:14:21.027: OSPFv3: rcv. v:3 t:1 l:40 rid:1.1.1.1
aid:0.0.0.2 chk:E1C inst:0 from Serial0/0
*Mar 1 00:14:21.027: OSPFv3: 2 Way Communication to 1.1.1.1 on Serial0/0, state 2WAY
*Mar 1 00:14:21.027: OSPFv3: Send DBD to 1.1.1.1 on Serial0/0 seq 0x1737 opt 0x0011
flag 0x7 len 28
*Mar 1 00:14:21.031: OSPFv3: Rcv DBD from 1.1.1.1 on Serial0/0 seq 0x2402 opt 0x0011
flag 0x7 len 28 mtu 1500 state EXSTART
*Mar 1 00:14:21.031: OSPFv3: First DBD and we are not SLAVE
*Mar 1 00:14:21.035: OSPFv3: rcv. v:3 t:2 l:88 rid:1.1.1.1
aid:0.0.0.2 chk:5CF3 inst:0 from Serial0/0
*Mar 1 00:14:21.039: OSPFv3: Rcv DBD from 1.1.1.1 on Serial0/0 seq 0x1737 opt 0x0011 flag
0x2 len 88 mtu 1500 state EXSTART
*Mar 1 00:14:21.039: OSPFv3: NBR Negotiation Done. We are the MASTER
*Mar 1 00:14:21.039: OSPFv3: Send DBD to 1.1.1.1 on Serial0/0 seq 0x1738 opt 0x0011 flag
0x3 len 88
*Mar 1 00:14:21.043: OSPFv3: rcv. v:3 t:2 l:28 rid:1.1.1.1
aid:0.0.0.2 chk:F85B inst:0 from Serial0/0
*Mar 1 00:14:21.047: OSPFv3: Rcv DBD from 1.1.1.1 on Serial0/0 seq 0x1738 opt 0x0011 flag
0x0 len 28 mtu 1500 state EXCHANGE
*Mar 1 00:14:21.047: OSPFv3: Send DBD to 1.1.1.1 on Serial0/0 seq 0x1739 opt 0x0011 flag
0x1 len 28Send LS REQ to 1.1.1.1 length 36 LSA count 3
*Mar 1 00:14:21.051: OSPFv3: rcv. v:3 t:3 l:52 rid:1.1.1.1
aid:0.0.0.2 chk:C326 inst:0 from Serial0/0
*Mar 1 00:14:21.055: OSPFv3: rcv. v:3 t:2 l:28 rid:1.1.1.1
aid:0.0.0.2 chk:F85A inst:0 from Serial0/0
```

Once the DBD packets are exchanged, the routers send Link-State Request (LS REQ) and Link-State Update (LS UPD) messages to build their LSDB. After successive LS REQ and LS UPD messages, and when the state reaches FULL, the routers continue to exchange Hello packets.

```
Stub_Router#
```

```
*Mar 1 00:14:21.055: OSPFv3: rcv. v:3 t:4 l:144 rid:1.1.1.1
aid:0.0.0.2 chk:58BC inst:0 from Serial0/0Rcv LS REQ from 1.1.1.1 on Serial0/0 length
LSA count 3Send UPD to 131.88.101.156 on Serial0/0 length 128 LSA count 3
*Mar 1 00:14:21.059: OSPFv3: Rcv DBD from 1.1.1.1 on Serial0/0 seq 0x1739 opt 0x0011 flag
0x0 len 28 mtu 1500 state EXCHANGE
*Mar 1 00:14:21.063: OSPFv3: Exchange Done with 1.1.1.1 on Serial0/0Rcv LS UPD from
1.1.1.1 on Serial0/0 length 144 LSA count 3
*Mar 1 00:14:21.067: OSPFv3: Synchronized with 1.1.1.1 on Serial0/0, state FULL
*Mar 1 00:14:21.067: %OSPFv3-5-ADJCHG: Process 1, Nbr 1.1.1.1 on Serial0/0 from
LOADING to FULL, Loading Done
*Mar 1 00:14:21.687: OSPFv3: rcv. v:3 t:4 l:60 rid:1.1.1.1
aid:0.0.0.2 chk:66EB inst:0 from Serial0/0Rcv LS UPD from 1.1.1.1 on Serial0/0 length
```


LSA count 1

*Mar 1 00:14:23.683: OSPFv3: rcv. v:3 t:5 l:96 rid:1.1.1.1
aid:0.0.0.2 chk:4BB5 inst:0 from Serial0/0

Related Information

- **IP Version 6 (IPv6) Technology Support**
 - **Open Shortest Path First (OSPF) Technology Support**
 - **Implementing OSPF for IPv6**
 - **Technical Support & Documentation – Cisco Systems**
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