

OSPFv3的配置示例

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简介

开放最短路径优先 (OSPF) 是一种 IP 路由协议。它是一种链路状态协议，与距离矢量协议相对。链路状态协议根据连接源计算机和目标计算机的链路状态做出路由决策。链路状态描述接口以及接口与相邻网络设备的关系。接口信息包括接口的 IPv6 前缀、网络掩码、连接网络类型、该网络所连接的路由器等。此信息在多种类型的链路状态通告 (LSA) 中传播。

RFC 2740 中描述的 OSPF 版本 3 支持 IPv6。

先决条件

要求

在接口上为 IPv6 启用 OSPF 之前，您必须执行以下操作：

- 完成 OSPF 网络策略和 IPv6 网络计划。例如，您必须确定是否需要多个区域。
- 启用 IPv6 单播路由。
- 在接口上启用 IPv6。
- 在 OSPF 上为 IPv6 配置 IP 安全 (IPSec) 安全套接应用程序编程接口 (API)，以启用验证和加密。

使用的组件

本文档不限于特定的软件和硬件版本。

本文档中的信息都是基于特定实验室环境中的设备编写的。本文档中使用的所有设备最初均采用原始（默认）配置。如果您使用的是真实网络，请确保您已经了解所有命令的潜在影响。

规则

有关文档规则的详细信息，请参阅 [Cisco 技术提示规则](#)。

配置

本部分提供有关如何配置本文档所述功能的信息。

注意： 有关本文档所用命令的详细信息，请使用 [命令查找工具](#) ([仅限注册用户](#))。

网络图

本文档使用以下网络设置：

配置

图中所示的是路由器的 OSPFv3 配置：

末节路由器
<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 路由器
<pre>ipv6 unicast-routing ipv6 cef ! 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 !</pre>
ASBR 路由器
<pre>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 !</pre>

外部路由器

```
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
```

验证

使用本部分可确认配置能否正常运行。

[命令输出解释程序 \(仅限注册用户 \)](#) (OIT) 支持某些 **show** 命令。使用 OIT 可查看对 **show** 命令输出的分析。

[show ipv6 ospf database 命令显示路由器的链路状态数据库 \(LSDB\)。](#)

```
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 B 3.3.3.3 919 0x80000008 0 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-lstype Ref-LSID 1.1.1.1 964 0x80000005 0 0x2001 0 3.3.3.3 1172 0x80000005 0 0x2001 0
```

[显示IPv6 OSPF数据库路由器自生成](#)命令显示路由器LSA路由器产生和接收的地方。路由器 LSA 不传输地址或前缀信息。

```
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
```

LSA 传输的 Options 字段包含以下位：

- **V6 位** - 指示路由器/链路是否应该用于路由计算。
- **R 位** - 这是“路由器位”。它指示发送方是否为活动路由器。
- **DC 位** - 指示路由器对需求电路的处理。

[显示IPv6 OSPF数据库链路自生成](#)命令显示林克LSA运载林克特定地址。

```
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
```

由于末节路由器属于完全残域，因此，ABR1 路由器仅将默认路由发送到末节路由器。

```
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
```

ABR1 路由器是区域边界路由器。

```
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 msecs Retransmission pacing timer 66 msecs 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
```

ABR1 路由器从 ASBR 路由器接收外部路由 (RIP 路由)。

```
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
```

ASBR 路由器是网络的自治系统边界路由器。它通过 Serial 0/0 接口连接到 RIP 网络。

```
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
```

故障排除

使用本部分可排除配置故障。

注意：使用 debug 命令之前，请参阅[有关 Debug 命令的重要信息](#)。

debug ipv6

在末节路由器上启用 OSPFv3 之后，即发送 OSPFv3 类型 1 Hello 消息到 FF02::5 多播地址。收到来自 ABR1 路由器的 Hello 数据包之后，即协商主/从关系，然后开始发送 DBD 数据包。

```
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
```

DBD 数据包交换之后，路由器即发送链路状态请求 (LS REQ) 和链路状态更新 (LS UPD) 消息，以建立其 LSDB。在连续的 LS REQ 和 LS UPD 消息之后且状态达到 FULL 时，路由器继续交换 Hello 数据包。

```
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 52 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 60 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
```

[相关信息](#)

- [IP 版本 6 \(IPv6\) 技术支持](#)
- [开放最短路径优先 \(OSPF\) 技术支持](#)
- [实现IPv6的OSPF](#)
- [技术支持和文档 - Cisco Systems](#)