

# 使用OSPFv3配置示例

## 目錄

[簡介](#)

[必要條件](#)

[需求](#)

[採用元件](#)

[慣例](#)

[背景資訊](#)

[設定](#)

[網路圖表](#)

[組態](#)

[驗證](#)

[疑難排解](#)

[相關資訊](#)

## 簡介

本文說明如何為介面上的IPv6啟用開放最短路徑優先(OSPF)第3版。

## 必要條件

### 需求

在介面上為IPv6啟用OSPF之前，必須：

- 完成OSPF網路策略並規劃IPv6網路。例如，必須確定是否需要多個區域。
- 啟用IPv6單播路由。
- 在介面上啟用IPv6。
- 在OSPF for IPv6上配置IP安全(IPsec)安全套接字應用程式介面(API)，以啟用身份驗證和加密。

### 採用元件

本文件所述內容不限於特定軟體和硬體版本。

本文中的資訊是根據特定實驗室環境內的裝置所建立。文中使用到的所有裝置皆從已清除（預設）的組態來啟動。如果您的網路運作中，請確保您瞭解任何指令可能造成的影響。

### 慣例

如需文件慣例的詳細資訊，請參閱[思科技術提示慣例](#)。

## 背景資訊

開放最短路徑優先 (OSPF) 是一種 IP 路由通訊協定。它是鏈路狀態協定，與距離向量協定相反。鏈路狀態協定根據連線源電腦和目的電腦的鏈路狀態做出路由決策。鏈路的狀態描述該介面及其與其相鄰網路裝置的關係。介面資訊包括介面的IPv6字首、網路掩碼、所連線的網路型別、所連線的路由器等。此資訊在各種型別的鏈路狀態通告(LSA)中傳播。RFC 2740中所述的OSPF第3版支援IPv6。

## 設定

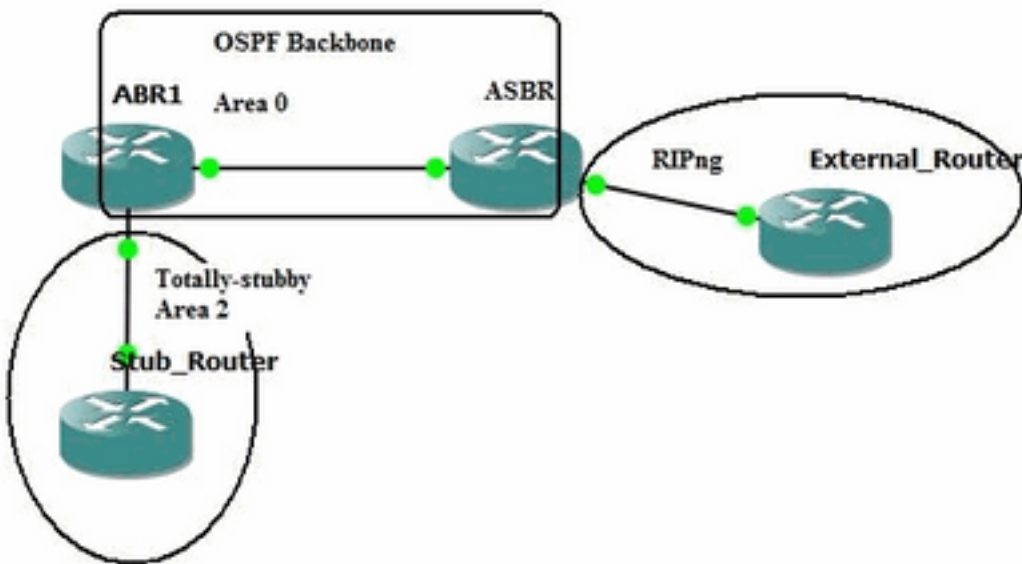
本節提供用於設定本文件中所述功能的資訊。

**注意：** 使用命令查詢工具/a>查詢有關本文檔中使用的命令的詳細資訊。

**注意：** 只有註冊思科使用者才能訪問內部思科工具和資訊。

## 網路圖表

本檔案會使用以下網路設定：



網路圖表

## 組態

這是圖中所示路由器的OSPFv3配置：

### 末節路由器

```
ipv6 unicast-routing
ipv6 cef
!
interface GigabitEthernet0/0
no ip address
ipv6 address FD01:ABAB::/64 eui-64
ipv6 enable ipv6 ospf 1 area 2
ipv6 ospf network point-to-point ! ipv6 router ospf 1 router-id 10.3.3.3 area 2 stub !
```

### ABR1路由器

```
ipv6 unicast-routing
```

```

ipv6 cef
!
interface GigabitEthernet1
  no ip address
  speed auto
  ipv6 address FD03::1/124
  ipv6 enable
  ipv6 ospf 1 area 0
!
interface GigabitEthernet2
  no ip address
  ipv6 address FD02:ABAB::/64 eui-64
  ipv6 enable
  ipv6 ospf 1 area 2
ipv6 ospf network point-to-point ! ipv6 router ospf 1 router-id 10.1.1.1 area 2 stub no-summary !

```

### ASBR路由器

```

ipv6 unicast-routing
ipv6 cef
!
interface GigabitEthernet1
  no ip address
  ipv6 address FD03::2/124
  ipv6 enable
  ipv6 ospf 1 area 0
!
interface GigabitEthernet2
  no ip address
  ipv6 address FD03::1:1/124
  ipv6 enable
  ipv6 rip EXT enable
!
ipv6 router ospf 1
  router-id 10.2.2.2
  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
!

```

### 外部路由器

```

ipv6 unicast-routing
ipv6 cef ! interface Loopback0 no ip address ipv6 address FD04:ABAB::/64 eui-64 ipv6 enable ipv6 rip EXT
enable
!
interface GigabitEthernet0/0
  no ip address
  ipv6 address FD03::1:2/124
  ipv6 enable
  ipv6 rip EXT enable
!
ipv6 router rip EXT

```

## 驗證

使用本節內容，確認您的組態是否正常運作。

Output Interpreter工具支援某些**show**命令。使用OIT檢視show命令輸出的分析。

[show ipv6 ospf database](#) 命令顯示路由器的鏈路狀態資料庫(LSDB)。

**注意：**只有註冊的思科使用者才能訪問內部思科工具和資訊。

```
Stub_Router#show ipv6 ospf database
```

```
OSPFv3 Router with ID (10.3.3.3) (Process ID 1)
```

**Router Link States (Area 2)**

ADV Router	Age	Seq#	Fragment ID	Link count	Bits
10.1.1.1	5	0x8000000F	0	1	B
10.3.3.3	38	0x8000000E	0	1	None

**Inter Area Prefix Link States (Area 2)**

ADV Router	Age	Seq#	Prefix
10.1.1.1	5	0x80000002	::/0

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

ADV Router	Age	Seq#	Link ID	Interface
10.1.1.1	5	0x8000000A	8	Gi0/0
10.3.3.3	292	0x80000005	2	Gi0/0

**Intra Area Prefix Link States (Area 2)**

ADV Router	Age	Seq#	Link ID	Ref-lstype	Ref-LSID
10.1.1.1	5	0x8000000B	0	0x2001	0
10.3.3.3	548	0x80000002	0	0x2001	0

**show ipv6 ospf database router** 命令會顯示路由器發出和接收的Router LSA。路由器LSA沒有地址或字首資訊。

```
Stub_Router#show ipv6 ospf database router
```

```
OSPFv3 Router with ID (10.3.3.3) (Process ID 1)
```

**Router Link States (Area 2)**

```
Routing Bit Set on this LSA
```

```
LS age: 141
```

```
Options: (V6-Bit, R-Bit, DC-Bit)
```

```
LS Type: Router Links
```

```
Link State ID: 0
```

```
Advertising Router: 10.1.1.1
```

```
LS Seq Number: 8000000F
```

```
Checksum: 0x9C2C
```

```
Length: 40
```

```
Area Border Router
```

```
Number of Links: 1
```

```
Link connected to: another Router (point-to-point)
```

```
Link Metric: 1
```

```
Local Interface ID: 8
```

```
Neighbor Interface ID: 2
```

```
Neighbor Router ID: 10.3.3.3
```

```
LS age: 174
Options: (V6-Bit, R-Bit, DC-Bit)
LS Type: Router Links
Link State ID: 0
Advertising Router: 10.3.3.3
LS Seq Number: 8000000E
Checksum: 0xBBF
Length: 40
Number of Links: 1
```

```
Link connected to: another Router (point-to-point)
Link Metric: 1
Local Interface ID: 2
Neighbor Interface ID: 8
Neighbor Router ID: 10.1.1.1
```

LSA帶有具有以下位的Options欄位：

- **V6位** — 指示是否必須在路由計算中使用路由器/鏈路。
- **R位** — 這是「路由器位」。指示發起方是否為活動路由器。
- **DC位** — 指示請求電路的路由器處理。

[show ipv6 ospf database link self-originate](#) 命令顯示鏈路LSA帶有鏈路特定地址。

```
Stub_Router#show ipv6 ospf database link self-originate
```

```
OSPFv3 Router with ID (10.3.3.3) (Process ID 1)
```

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

```
LS age: 650
Options: (V6-Bit, R-Bit, DC-Bit)
LS Type: Link-LSA (Interface: GigabitEthernet0/0)
Link State ID: 2 (Interface ID)
Advertising Router: 10.3.3.3
LS Seq Number: 80000005
Checksum: 0x8578
Length: 56
Router Priority: 1
Link Local Address: FE80::5054:FF:FE00:3A
Number of Prefixes: 1
Prefix Address: FD01:ABAB::
Prefix Length: 64, Options: None
```

由於末節路由器屬於完全末節區域，因此ABR1路由器只向末節路由器傳送預設路由。

```
Stub_Router#show ipv6 route
```

```
IPv6 Routing Table - default - 5 entries
```

```
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route
B - BGP, HA - Home Agent, MR - Mobile Router, R - RIP
H - NHRP, I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea
IS - ISIS summary, D - EIGRP, EX - EIGRP external, NM - NEMO
ND - ND Default, NDp - ND Prefix, DCE - Destination, NDr - Redirect
RL - RPL, O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1
OE2 - OSPF ext 2, ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
la - LISP alt, lr - LISP site-registrations, ld - LISP dyn-eid
lA - LISP away, a - Application
```

```
OI ::/0 [110/2] via FE80::5054:FF:FE00:15, GigabitEthernet0/0
```

```
C FD01:ABAB::/64 [0/0]
```

```
    via GigabitEthernet0/0, directly connected
L   FD01:ABAB::5054:FF:FE00:3A/128 [0/0]
    via GigabitEthernet0/0, receive
O   FD02:ABAB::/64 [110/2]
    via FE80::5054:FF:FE00:15, GigabitEthernet0/0
L   FF00::/8 [0/0]
    via Null0, receive
```

ABR1路由器是區域邊界路由器。

#### ABR1#show ipv6 ospf

```
Routing Process "ospfv3 1" with ID 10.1.1.1
Supports NSSA (compatible with RFC 3101)
Supports Database Exchange Summary List Optimization (RFC 5243)
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 50 msec
Minimum hold time between two consecutive SPF's 200 msec
Maximum wait time between two consecutive SPF's 5000 msec
Initial LSA throttle delay 50 msec
Minimum hold time for LSA throttle 200 msec
Maximum wait time for LSA throttle 5000 msec
Minimum LSA arrival 100 msec
LSA group pacing timer 240 secs
Interface flood pacing timer 33 msec
Retransmission pacing timer 66 msec
Retransmission limit dc 24 non-dc 24
EXCHANGE/LOADING adjacency limit: initial 300, process maximum 300
Number of external LSA 2. Checksum Sum 0x011699
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 17 times
Number of LSA 8. Checksum Sum 0x05579B
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 20 times
Number of LSA 7. Checksum Sum 0x0380EA
Number of DCbitless LSA 0
Number of indication LSA 0
Number of DoNotAge LSA 0
Flood list length 0
```

ABR1路由器從ASBR路由器接收外部路由 ( RIP路由 )。

#### ABR1#show ipv6 route

```
IPv6 Routing Table - default - 8 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, RL - RPL, O - OSPF Intra, OI - OSPF Inter
```

```

    OE1 - OSPF ext 1, OE2 - OSPF ext 2, ON1 - OSPF NSSA ext 1
    ON2 - OSPF NSSA ext 2, la - LISP alt, lr - LISP site-registrations
    ld - LISP dyn-eid, lA - LISP away, le - LISP extranet-policy
    lp - LISP publications, a - Application, m - OMP
O   FD01:ABAB::/64 [110/2]
    via FE80::5054:FF:FE00:3A, GigabitEthernet2
C   FD02:ABAB::/64 [0/0]
    via GigabitEthernet2, directly connected
L   FD02:ABAB::5054:FF:FE00:15/128 [0/0]
    via GigabitEthernet2, receive
C   FD03::/124 [0/0]
    via GigabitEthernet1, directly connected
L   FD03::1/128 [0/0]
    via GigabitEthernet1, receive
OE1 FD03::1:0/124 [110/26] via FE80::5054:FF:FE00:3E, GigabitEthernet1 OE1 FD04:ABAB::/64
[110/26] via FE80::5054:FF:FE00:3E, GigabitEthernet1
L   FF00::/8 [0/0]
    via Null0, receive

```

ASBR路由器是網路的自治系統邊界路由器。它通過Serial 0/0介面連線到RIP網路。

#### ASBR#show ipv6 ospf

```

Routing Process "ospfv3 1" with ID 10.2.2.2
Supports NSSA (compatible with RFC 3101)
Supports Database Exchange Summary List Optimization (RFC 5243)
Event-log enabled, Maximum number of events: 1000, Mode: cyclic
It is an autonomous system boundary router
Redistributing External Routes (with default metric 25) from,
    rip EXT with metric-type 1 include-connected
Router is not originating router-LSAs with maximum metric
Initial SPF schedule delay 50 msec
Minimum hold time between two consecutive SPFs 200 msec
Maximum wait time between two consecutive SPFs 5000 msec
Initial LSA throttle delay 50 msec
Minimum hold time for LSA throttle 200 msec
Maximum wait time for LSA throttle 5000 msec
Minimum LSA arrival 100 msec
LSA group pacing timer 240 secs
Interface flood pacing timer 33 msec
Retransmission pacing timer 66 msec
Retransmission limit dc 24 non-dc 24
EXCHANGE/LOADING adjacency limit: initial 300, process maximum 300
Number of external LSA 2. Checksum Sum 0x011699
Number of areas in this router is 1. 1 normal 0 stub 0 nssa
Graceful restart helper support enabled
Reference bandwidth unit is 100 mbps
RFC1583 compatibility enabled
Area BACKBONE(0)
    Number of interfaces in this area is 1
    SPF algorithm executed 10 times
    Number of LSA 8. Checksum Sum 0x05579B
    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 678
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 267, trigger updates 11
Full Advertisement 1, Delayed Events 0
Interfaces:
  GigabitEthernet2
Redistribution:
  Redistributing protocol ospf 1 with transparent metric (internal, external 1 & 2, ) include-
connected
```

## 疑難排解

使用本節內容，對組態進行疑難排解。

**附註：**使用 debug 指令之前，請先參閱有關 Debug 指令的重要資訊。

### debug ipv6

一旦在末節路由器上啟用了 OSPFv3，它就會向 FF02::5 組播地址傳送 OSPFv3 第 1 類 Hello 消息。收到來自 ABR1 路由器的 Hello 資料包後，它們會協商主/次關係，然後開始傳送 DBD 資料包。

```
Stub_Router#debug ipv6 ospf events
Stub_Router#debug ipv6 ospf packet
Stub_Router#debug ipv6 ospf adj
*Mar 8 17:47:01.324: OSPFv3-1-IPv6 PAK : Gi0/0: OUT: FE80::5054:FF:FE00:3A->FF02::5: ver:3 type:1 len:36 rid:10.3.3.3
area:0.0.0.2 chksum:A0F9 inst:0 *Mar 8 17:47:03.307: OSPFv3-1-IPv6 PAK : Gi0/0: IN: FE80::5054:FF:FE00:15->FF02::5: ver:3
type:1 len:36 rid:10.1.1.1 area:0.0.0.2 chksum:A31C inst:0 *Mar 8 17:47:03.308: OSPFv3-1-IPv6 ADJ Gi0/0: Added 10.1.1.1 to nbr
list *Mar 8 17:47:03.308: OSPFv3-1-IPv6 PAK : Gi0/0: OUT: FE80::5054:FF:FE00:3A->FE80::5054:FF:FE00:15: ver:3 type:1
len:40 rid:10.3.3.3 area:0.0.0.2 chksum:470D inst:0 *Mar 8 17:47:03.320: OSPFv3-1-IPv6 PAK : Gi0/0: IN:
FE80::5054:FF:FE00:15->FE80::5054:FF:FE00:3A: ver:3 type:1 len:40 rid:10.1.1.1 area:0.0.0.2 chksum:4707 inst:0 *Mar 8
17:47:03.321: OSPFv3-1-IPv6 ADJ Gi0/0: 2 Way Communication to 10.1.1.1, state 2WAY *Mar 8 17:47:03.321: OSPFv3-1-IPv6
ADJ Gi0/0: Nbr 10.1.1.1: Prepare dbase exchange *Mar 8 17:47:03.322: OSPFv3-1-IPv6 ADJ Gi0/0: Send DBD to 10.1.1.1
seq 0x983C9C0 opt 0x11 flag 0x7 len 28
*Mar 8 17:47:03.322: OSPFv3-1-IPv6 PAK : Gi0/0: OUT: FE80::5054:FF:FE00:3A-
>FE80::5054:FF:FE00:15: ver:3 type:2 len:28 rid:10.3.3.3 area:0.0.0.2 chksum:7A33 inst:0
*Mar 8 17:47:03.328: OSPFv3-1-IPv6 PAK : Gi0/0: IN: FE80::5054:FF:FE00:15-
>FE80::5054:FF:FE00:3A: ver:3 type:2 len:148 rid:10.1.1.1 area:0.0.0.2 chksum:141A inst:0
*Mar 8 17:47:03.329: OSPFv3-1-IPv6 ADJ Gi0/0: Rcv DBD from 10.1.1.1 seq 0x983C9C0 opt 0x11
flag 0x2 len 148 mtu 1500 state EXSTART
*Mar 8 17:47:03.330: OSPFv3-1-IPv6 ADJ Gi0/0: NBR Negotiation Done. We are the MASTER
*Mar 8 17:47:03.330: OSPFv3-1-IPv6 ADJ Gi0/0: Nbr 10.1.1.1: Summary list built, size 7
*Mar 8 17:47:03.331: OSPFv3-1-IPv6 ADJ Gi0/0: Send DBD to 10.1.1.1 seq 0x983C9C1 opt 0x11
flag 0x1 len 128
*Mar 8 17:47:03.331: OSPFv3-1-IPv6 PAK : Gi0/0: OUT: FE80::5054:FF:FE00:3A-
>FE80::5054:FF:FE00:15: ver:3 type:2 len:128 rid:10.3.3.3 area:0.0.0.2 chksum:F771 inst:0
*Mar 8 17:47:03.334: OSPFv3-1-IPv6 PAK : Gi0/0: IN: FE80::5054:FF:FE00:15-
>FE80::5054:FF:FE00:3A: ver:3 type:3 len:64 rid:10.1.1.1 area:0.0.0.2 chksum:C6FA inst:0
*Mar 8 17:47:03.335: OSPFv3-1-IPv6 PAK : Gi0/0: IN: FE80::5054:FF:FE00:15-
>FE80::5054:FF:FE00:3A: ver:3 type:2 len:28 rid:10.1.1.1 area:0.0.0.2 chksum:7C3D inst:0
交換DBD資料包後，路由器會傳送鏈路狀態請求(LS REQ)和鏈路狀態更新(LS UPD)消息以構建其
LSDB。在連續的LS REQ和LS UPD消息之後，當狀態達到FULL時，路由器繼續交換Hello資料包
。
```

```
Stub_Router#
*Mar 8 17:47:03.337: OSPFv3-1-IPv6 ADJ Gi0/0: Rcv LS REQ from 10.1.1.1 length 64 LSA count 4
*Mar 8 17:47:03.337: OSPFv3-1-IPv6 ADJ Gi0/0: Send LS UPD to FE80::5054:FF:FE00:15 length 172
LSA count 4
*Mar 8 17:47:03.338: OSPFv3-1-IPv6 PAK : Gi0/0: OUT: FE80::5054:FF:FE00:3A-
>FE80::5054:FF:FE00:15: ver:3 type:4 len:172 rid:10.3.3.3 area:0.0.0.2 chksum:D2CE inst:0
```



```
*Mar 8 17:47:03.339: OSPFv3-1-IPv6 ADJ Gi0/0: Rcv DBD from 10.1.1.1 seq 0x983C9C1 opt 0x11
flag 0x0 len 28 mtu 1500 state EXCHANGE
*Mar 8 17:47:03.339: OSPFv3-1-IPv6 ADJ Gi0/0: Exchange Done with 10.1.1.1 *Mar 8 17:47:03.340:
OSPFv3-1-IPv6 ADJ Gi0/0: Send LS REQ to 10.1.1.1 length 40
*Mar 8 17:47:03.340: OSPFv3-1-IPv6 PAK : Gi0/0: OUT: FE80::5054:FF:FE00:3A-
>FE80::5054:FF:FE00:15: ver:3 type:3 len:40 rid:10.3.3.3 area:0.0.0.2 chksum:FD46 inst:0
*Mar 8 17:47:03.343: OSPFv3-1-IPv6 PAK : Gi0/0: IN: FE80::5054:FF:FE00:15-
>FE80::5054:FF:FE00:3A: ver:3 type:4 len:72 rid:10.1.1.1 area:0.0.0.2 chksum:825E inst:0
*Mar 8 17:47:03.345: OSPFv3-1-IPv6 ADJ Gi0/0: Rcv LS UPD from Nbr ID 10.1.1.1 length 72 LSA
count 2
*Mar 8 17:47:03.345: OSPFv3-1-IPv6 ADJ Gi0/0: Synchronized with 10.1.1.1, state FULL
*Mar 8 17:47:03.346: %OSPFv3-5-ADJCHG: Process 1, Nbr 10.1.1.1 on GigabitEthernet0/0 from
LOADING to FULL, Loading Done
```

## 相關資訊

- [IP第6版\(IPv6\)技術支援](#)
- [開放最短路徑優先\(OSPF\)技術支援](#)
- [思科技術支援與下載](#)

## 關於此翻譯

思科已使用電腦和人工技術翻譯本文件，讓全世界的使用者能夠以自己的語言理解支援內容。請注意，即使是最佳機器翻譯，也不如專業譯者翻譯的內容準確。Cisco Systems, Inc. 對這些翻譯的準確度概不負責，並建議一律查看原始英文文件（提供連結）。