

# OSPF如何將外部路由傳播到多個區域

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## 簡介

本檔案將說明開放最短路徑優先(OSPF)如何將外部路由傳播到多個網路區域。

## 必要條件

### 需求

本文件沒有特定需求。

### 採用元件

本文件所述內容不限於特定軟體和硬體版本。

### 慣例

如需文件慣例的詳細資訊，請參閱[思科技術提示慣例](#)。

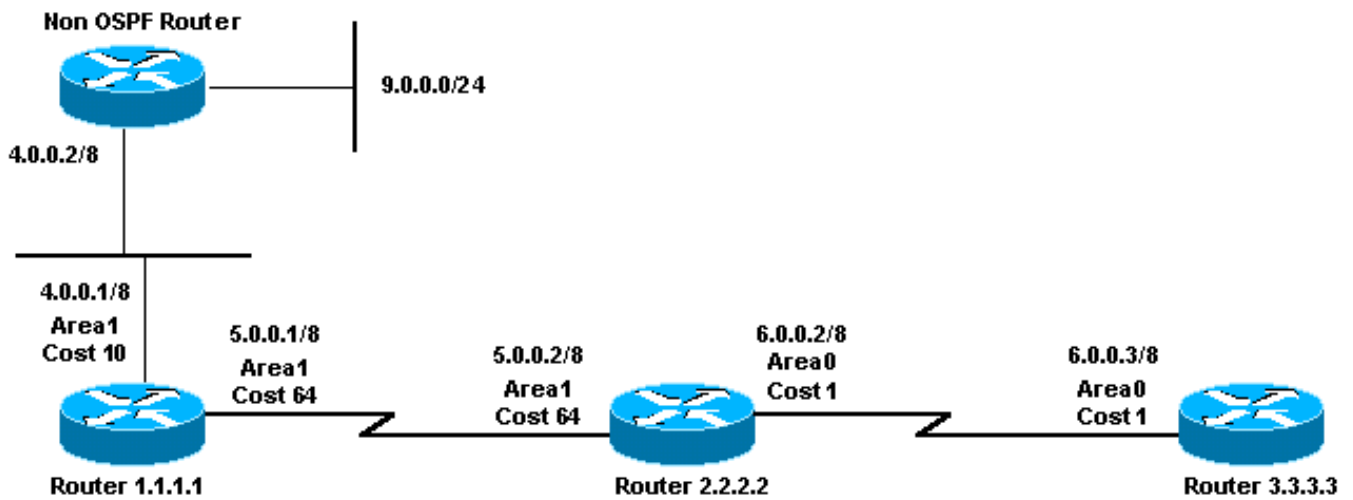
## 設定

本節提供用於設定本文件中所述功能的資訊。

**注意：**要查詢有關本文檔中使用的命令的其他資訊，請使用[命令查詢工具](#)([僅限註冊客戶](#))。

## 網路圖表

本檔案會使用下圖中所示的網路設定。



## 組態

本文檔使用此處顯示的配置。

- [路由器1.1.1.1](#)
- [路由器2.2.2.2](#)
- [路由器3.3.3.3](#)

### 路由器1.1.1.1

Current configuration:

```
hostname r1.1.1.1

interface Loopback0
 ip address 1.1.1.1 255.0.0.0

interface Serial2/1/0
 ip address 5.0.0.1 255.0.0.0

interface Ethernet2/0/0
 ip address 4.0.0.1 255.0.0.0

router ospf 4
 redistribute static metric 5 metric-type 1
 network 5.0.0.0 0.255.255.255 area 1
 network 4.0.0.0 0.255.255.255 area 1

ip route 9.0.0.0 255.0.0.0 4.0.0.2

end
```

### 路由器2.2.2.2

Current configuration:

```
hostname r2.2.2.2
```

```
interface Loopback0
 ip address 2.2.2.2 255.0.0.0

interface Serial0/1/0
 ip address 5.0.0.2 255.0.0.0

interface ATM1/0.20
 ip address 6.0.0.2 255.0.0.0

router ospf 2
 network 5.0.0.0 0.255.255.255 area 1
 network 6.0.0.0 0.255.255.255 area 0

end
```

### 路由器3.3.3.3

```
Current configuration:

hostname r3.3.3.3

interface Loopback0
 ip address 3.3.3.3 255.0.0.0

interface ATM2/0.20 point-to-point
 ip address 6.0.0.3 255.0.0.0

router ospf 2
 network 6.0.0.0 0.255.255.255 area 0

end
```

## 驗證

本節提供的資訊可用於確認您的組態是否正常運作。

[輸出直譯器工具](#)(僅供註冊客戶使用)支援某些show命令，此工具可讓您檢視show命令輸出的分析。

- [show ip ospf database](#) — 顯示鏈路狀態通告(LSA)清單並將它們鍵入到鏈路狀態資料庫中。此清單僅顯示LSA報頭中的資訊。
- [show ip ospf database \[router\] \[link-state-id\]](#) — 顯示資料庫中路由器的所有LSA的清單。LSA由每台路由器生成。這些基本LSA列出了路由器的所有鏈路或介面，以及鏈路的狀態和傳出成本。它們只被淹沒在它們的源頭地區。
- [show ip ospf database summary <link-state id>](#) — 顯示區域邊界路由器(ABR)摘要鏈路。
- [show ip ospf database external](#) — 僅顯示關於外部LSA的資訊。
- [show ip ospf database asbr-summary](#) — 僅顯示關於自治系統邊界路由器摘要LSA的資訊。

## 檢查OSPF資料庫

此輸出使用show ip ospf database命令顯示給定此網路環境的OSPF資料庫外觀。

```
r2.2.2.2#show ip ospf database
```

```
OSPF Router with ID (2.2.2.2) (Process ID 2)
```

Router Link States (Area 0)

Link ID	ADV Router	Age	Seq#	Checksum	Link count
2.2.2.2	2.2.2.2	93	0x80000020	0xCD0B	2
3.3.3.3	3.3.3.3	1225	0x8000000D	0x9057	2

Summary Net Link States (Area 0)

Link ID	ADV Router	Age	Seq#	Checksum
4.0.0.0	2.2.2.2	73	0x80000001	0xFFE6
5.0.0.0	2.2.2.2	1651	0x80000006	0x8466

Summary ASB Link States (Area 0)

Link ID	ADV Router	Age	Seq#	Checksum
1.1.1.1	2.2.2.2	74	0x80000001	0x935C

Router Link States (Area 1)

Link ID	ADV Router	Age	Seq#	Checksum	Link count
1.1.1.1	1.1.1.1	89	0x80000011	0xFF59	3
2.2.2.2	2.2.2.2	88	0x80000033	0x2130	2

Summary Net Link States (Area 1)

Link ID	ADV Router	Age	Seq#	Checksum
6.0.0.0	2.2.2.2	94	0x8000001F	0xCC43

Type-5 AS External Link States

Link ID	ADV Router	Age	Seq#	Checksum	Tag
9.0.0.0	1.1.1.1	135	0x80000001	0x3AE8	0

為了將外部路由通告到OSPF，自治系統邊界路由器(ASBR)建立 ( 型別5 ) 外部LSA。

```
r2.2.2.2#show ip ospf database external 9.0.0.0
  OSPF Router with ID (2.2.2.2) (Process ID 2)
    Type-5 AS External Link States
      Routing Bit Set on this LSA
      LS age: 286
      Options: (No TOS-capability, DC)
      LS Type: AS External Link
      Link State ID: 9.0.0.0 (External Network Number )
```

```
!--- 9.0.0.0/8 is advertised by the !--- ASBR (Router 1.1.1.1). Advertising Router: 1.1.1.1 LS
Seq Number: 80000001 Checksum: 0x3AE8 Length: 36 Network Mask: /8 Metric Type: 1 (Comparable
directly to link state metric) TOS: 0 Metric: 5 Forward Address: 0.0.0.0 !--- Forwarding address
is not specified since there !--- are no OSPF neighbors on Router 1.1.1.1's Ethernet. !--- When
the forward address is 0.0.0.0, this means that !--- the traffic for this network is to be sent
to the !--- advertising router (1.1.1.1). External Route Tag: 0
```

為了將ASBR的可達性通告到其他區域，ABR會建立 ( 型別4 ) ASBR摘要LSA。

```
r2.2.2.2#show ip ospf database asbr-summary 1.1.1.1
```

```
  OSPF Router with ID (2.2.2.2) (Process ID 2)
```

Summary ASB Link States (Area 0)

```
LS age: 266
Options: (No TOS-capability, DC)
LS Type: Summary Links(AS Boundary Router)
```

Link State ID: 1.1.1.1 (AS Boundary Router address)

*!--- ABR (Router 2.2.2.2) is advertising that it knows how !--- to reach the ASBR (Router 1.1.1.1). Advertising Router: 2.2.2.2 LS Seq Number: 8000001 Checksum: 0x935C Length: 28 Network Mask: /0 TOS: 0 Metric: 64 !--- The ABR's cost to reach the ASBR.*

ABR ( 路由器2.2.2.2 ) 安裝了從ASBR ( 路由器1.1.1.1 ) 獲知的外部路由，並從區域1將外部LSA泛洪到區域0。( 外部LSA泛洪到所有區域，未經更改。 ) 但是，ASBR不在區域0中。區域0中的路由器不知道如何到達ASBR。這就是為什麼ABR建立ASBR彙總LSA並將路由器1.1.1.1的可達性通告到區域0的原因。

**注意：**提供下一組輸出只是為了提供此示例設定中OSPF資料庫的更多詳細資訊。如果您熟悉此資訊，請跳至[計算最短路徑](#)部分。

```
r2.2.2.2#show ip ospf database router 1.1.1.1
```

```
OSPF Router with ID (2.2.2.2) (Process ID 2)
```

```
Router Link States (Area 1)
```

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

```
LS age: 109
```

```
Options: (No TOS-capability, DC)
```

```
LS Type: Router Links
```

```
Link State ID: 1.1.1.1
```

```
!--- For router links, Link State Id is always the !--- same as the Advertising Router.
```

```
Advertising Router: 1.1.1.1 !--- This is the router ID of the router that created !--- this LSA.
LS Seq Number: 80000011 Checksum: 0xFF59 Length: 60 AS Boundary Router !--- Bit E in the router
LSA indicates that this !--- router originates external LSAs. Number of Links: 3 !--- There are
three links in area 1. Link connected to: a Stub Network !--- This line represents the Ethernet
segment !--- 4.0.0.0/8. (Link ID) Network/subnet number: 4.0.0.0 (Link Data) Network Mask:
255.0.0.0 Number of TOS metrics: 0 TOS 0 Metrics: 10 !--- OSPF cost of the Ethernet segment.
Link connected to: another Router (point-to-point) !--- This line shows that Router 1.1.1.1 is a
!--- neighbor with Router 2.2.2.2. (Link ID) Neighboring Router ID: 2.2.2.2 (Link Data) Router
Interface address: 5.0.0.1 !--- The interface address that connects to !--- Router 2.2.2.2 is
5.0.0.1. Number of TOS metrics: 0 TOS 0 Metrics: 64 !--- OSPF cost of the link connecting the
two routers. Link connected to: a Stub Network !--- This line represents the serial link
5.0.0.0/8. (Link ID) Network/subnet number: 5.0.0.0 (Link Data) Network Mask: 255.0.0.0 Number
of TOS metrics: 0 TOS 0 Metrics: 64 !--- OSPF cost of the serial link. r2.2.2.2#show ip ospf
database router 2.2.2.2
```

```
OSPF Router with ID (2.2.2.2) (Process ID 2)
```

```
Router Link States (Area 0)
```

```
LS age: 135
```

```
Options: (No TOS-capability, DC)
```

```
LS Type: Router Links
```

```
Link State ID: 2.2.2.2
```

```
Advertising Router: 2.2.2.2
```

```
LS Seq Number: 80000020
```

```
Checksum: 0xCD0B
```

```
Length: 48
```

```
Area Border Router
```

```
Number of Links: 2
```

```
Link connected to: another Router (point-to-point)
(Link ID) Neighboring Router ID: 3.3.3.3
(Link Data) Router Interface address: 6.0.0.2
Number of TOS metrics: 0
TOS 0 Metrics: 1
```

Link connected to: a Stub Network  
(Link ID) Network/subnet number: 6.0.0.0  
(Link Data) Network Mask: 255.0.0.0  
Number of TOS metrics: 0  
TOS 0 Metrics: 1

Router Link States (Area 1)

LS age: 130  
Options: (No TOS-capability, DC)  
LS Type: Router Links  
Link State ID: 2.2.2.2  
Advertising Router: 2.2.2.2  
LS Seq Number: 80000033  
Checksum: 0x2130  
Length: 48  
Area Border Router  
Number of Links: 2

Link connected to: another Router (point-to-point)  
(Link ID) Neighboring Router ID: 1.1.1.1  
(Link Data) Router Interface address: 5.0.0.2  
Number of TOS metrics: 0  
TOS 0 Metrics: 64

Link connected to: a Stub Network  
(Link ID) Network/subnet number: 5.0.0.0  
(Link Data) Network Mask: 255.0.0.0  
Number of TOS metrics: 0  
TOS 0 Metrics: 64

r2.2.2.2#**show ip ospf database router 3.3.3.3**

OSPF Router with ID (2.2.2.2) (Process ID 2)

Router Link States (Area 0)

LS age: 1280  
Options: (No TOS-capability, DC)  
LS Type: Router Links  
Link State ID: 3.3.3.3  
Advertising Router: 3.3.3.3  
LS Seq Number: 8000000D  
Checksum: 0x9057  
Length: 48  
Number of Links: 2

Link connected to: another Router (point-to-point)  
(Link ID) Neighboring Router ID: 2.2.2.2  
(Link Data) Router Interface address: 6.0.0.3  
Number of TOS metrics: 0  
TOS 0 Metrics: 1

Link connected to: a Stub Network  
(Link ID) Network/subnet number: 6.0.0.0  
(Link Data) Network Mask: 255.0.0.0  
Number of TOS metrics: 0  
TOS 0 Metrics: 1

要將路由從一個區域通告到另一個區域，ABR會建立（型別3）彙總LSA。

```
r2.2.2.2#show ip ospf database summary 4.0.0.0
```

```
OSPF Router with ID (2.2.2.2) (Process ID 2)
```

```
Summary Net Link States (Area 0)
```

```
LS age: 184
```

```
Options: (No TOS-capability, DC)
```

```
LS Type: Summary Links(Network)
```

```
Link State ID: 4.0.0.0 (summary Network Number)
```

```
!--- 4.0.0.0/8 is advertised into area 0 by !--- the ABR (Router 2.2.2.2). Advertising Router:  
2.2.2.2 LS Seq Number: 80000001 Checksum: 0xFFE6 Length: 28 Network Mask: /8 TOS: 0 Metric: 74
```

```
r2.2.2.2#show ip ospf database summary 5.0.0.0
```

```
OSPF Router with ID (2.2.2.2) (Process ID 2)
```

```
Summary Net Link States (Area 0)
```

```
LS age: 1768
```

```
Options: (No TOS-capability, DC)
```

```
LS Type: Summary Links(Network)
```

```
Link State ID: 5.0.0.0 (summary Network Number)
```

```
!--- 5.0.0.0/8 is advertised into area 0 by !--- the ABR (Router 2.2.2.2). Advertising Router:  
2.2.2.2 LS Seq Number: 80000006 Checksum: 0x8466 Length: 28 Network Mask: /8 TOS: 0 Metric: 64
```

```
r2.2.2.2#show ip ospf database summary 6.0.0.0
```

```
OSPF Router with ID (2.2.2.2) (Process ID 2)
```

```
Summary Net Link States (Area 1)
```

```
LS age: 216
```

```
Options: (No TOS-capability, DC)
```

```
LS Type: Summary Links(Network)
```

```
Link State ID: 6.0.0.0
```

```
!--- 6.0.0.0/8 is advertised into area 1 by the ABR(2.2.2.2). Advertising Router: 2.2.2.2 LS  
Seq Number: 8000001F Checksum: 0xCC43 Length: 28 Network Mask: /8 TOS: 0 Metric: 1
```

## 計算最短路徑

本節從路由器3.3.3.3的角度計算最短路徑。

路由器3.3.3.3在自己的LSA中查詢，發現路由器2.2.2.2是鄰居。然後它會檢視路由器2.2.2.2的LSA，以檢驗路由器2.2.2.2是否將路由器3.3.3.3視為鄰居。如果兩台路由器都視彼此為鄰居，則認為它們是可到達的。

每台路由器還檢查其本地鄰居表(可以使用[show ip ospf neighbor](#)命令檢視)，以檢驗其介面和鄰居的介面是否位於公用IP子網中。

**注意：**未對未編號的介面執行此檢查。

如果介面位於同一個子網上，則路由器會為其鄰居的路由器LSA中列出的任何末節網路安裝路由。在本例中，60.0.0.0/8是區域0中路由器2.2.2.2的LSA中列出的唯一末節網路，路由器3.3.3.3已直接連線到該末節網路。

檢查區域0中的所有可到達路由器LSA後，路由器3.3.3.3檢查資料庫中的彙總LSA。它會找到4.0.0.0/8和5.0.0.0/8的彙總LSA。如果Router 3.3.3.3知道如何到達建立彙總LSA的通告路由器，它會將該路由安裝到其路由表中。在我們的示例中，通告路由器是Router 2.2.2.2，路由器3.3.3.3知道如何到達該路由器。它會將4.0.0.0/8和5.0.0.0/8的路由安裝到其路由表中。這些路由的度量是到達

通告路由器的度量加上彙總LSA的度量。根據到達為其生成彙總LSA的區域內或區域間路由的開銷計算彙總LSA的度量。

在計算所有內部OSPF路由（區域內和區域間）後，Router 3.3.3.3檢查外部LSA。它首先檢查由ASBR 1.1.1.1建立的外部LSA 9.0.0.0/8，然後計算如何到達ASBR。路由器3.3.3.3檢查ABR（路由器2.2.2.2）為路由器1.1.1.1建立的ASBR彙總LSA。執行此操作後，路由器3.3.3.3知道可以通過ABR到達ASBR。因此，Router 3.3.3.3在其路由表中安裝9.0.0.0/8的路由。在我們的示例中，它是E1路由，因此其度量是路由器3.3.3.3到達ABR的度量，加上到達ASBR的ABR度量，再加上外部LSA的度量。

此輸出顯示了所描述每台路由器的路由表中的OSPF路由。

```
r3.3.3.3#  
show ip route ospf  
O IA 4.0.0.0/8 [110/75] via 6.0.0.2, 00:07:59, ATM2/0.20  
O IA 5.0.0.0/8 [110/65] via 6.0.0.2, 00:07:59, ATM2/0.20  
O E1 9.0.0.0/8 [110/70] via 6.0.0.2, 00:07:59, ATM2/0.20  
  
r2.2.2.2#show ip route ospf  
O 4.0.0.0/8 [110/74] via 5.0.0.1, 00:06:55, Serial0/1/0  
O E1 9.0.0.0/8 [110/69] via 5.0.0.1, 00:06:55, Serial0/1/0  
  
r1.1.1.1#show ip route 9.0.0.0  
Routing entry for 9.0.0.0/8  
  Known via "static", distance 1, metric 0  
  Redistributing via ospf 4  
  Advertised by ospf 4 metric 5 metric-type 1  
  Routing Descriptor Blocks:  
 * 4.0.0.2  
   Route metric is 0, traffic share count is 1
```

## [疑難排解](#)

目前尚無適用於此組態的具體疑難排解資訊。

## [相關資訊](#)

- [OSPF資料庫說明指南](#)
- [OSPF支援頁](#)
- [IP 路由支援頁面](#)
- [技術支援 - Cisco Systems](#)