

使用MPLS VPN的IPv6

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簡介

IP第6版(IPv6)是IP的一個新版本，旨在取代IP第4版(IPv4)，後者目前已在全球廣泛部署和使用。IPv6的優勢主要源於其更大的定址空間，這是應對Internet擴展和支援Internet的裝置的爆炸式增長所必需的。

IPv6 VPN通過IPv6介面或子介面通過PE路由器連線到服務提供商(SP)主幹。該站點可以同時支援IPv4和IPv6。每個IPv6 VPN都有自己的地址空間，這意味著給定地址表示不同VPN中的不同系統。這是通過新的地址系列VPN-IPv6或VPNv6地址系列實現的，該系列在IP地址前面加上路由區分器(RD)。

VPNv6地址是一個24位元組的數量，從8位元組的RD開始，到16位元組的IPv6地址結束。當站點支援IPv4和IPv6時，相同的RD可用於通告IPv4和IPv6地址。

必要條件

需求

本文件沒有特定需求。

注意：對於某些平台（例如7600系列路由器）上的IPv6虛擬路由和轉發(VRF)支援，需要在全域性配置中配置[mls ipv6 vrf](#)。

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。

註：使用[Command Lookup Tool](#)(僅限註冊客戶)查詢有關本文檔中使用的命令的更多資訊。

網路圖表

本檔案會使用以下網路設定：



VRF組態

CE1路由器

```
ipv6 unicast-routing
ipv6 cef
!
interface Serial 0/0
  ipv6 address 2001:1::1/124
!
interface Loopback 0
  ipv6 address ABCD::1/128
!
```

CE2路由器

```
ipv6 unicast-routing
ipv6 cef
!
interface Serial 0/0
  ipv6 address 2001:2::1/124
!
interface Loopback 0
  ipv6 address ABCD::2/128
!
```

6VPE1路由器

```

ipv6 unicast-routing
ipv6 cef
!
mpls label protocol ldp
mpls ldp router-id Loopback 0 force
! !----- The VRF is defined with vrf definition vrf
definition CUST1
  rd 1:1
  !
  address-family ipv6
    route-target import 1:1
    route-target export 1:1
  exit-address-family
!
interface Serial 0/0
  vrf forwarding CUST1
  ipv6 address 2001:1::2/124
!
interface Loopback 0
  ip address 1.1.1.1 255.255.255.255
  ip ospf 1 area 0
!

```

6VPE2路由器

```

ipv6 unicast-routing
ipv6 cef
!
mpls label protocol ldp
mpls ldp router-id Loopback 0 force
!
vrf definition CUST1
  rd 1:1
  !
  address-family ipv6
    route-target import 1:1
    route-target export 1:1
  exit-address-family
!
interface Serial 0/0
  vrf forwarding CUST1
  ipv6 address 2001:2::2/124
!
interface Loopback 0
  ip address 3.3.3.3 255.255.255.255
  ip ospf 1 area 0
!

```

多重通訊協定BGP(MP-BGP)組態

在6VPE路由器上為iBGP連線配置了地址系列VPNv6。6VPE和CE路由器之間存在eBGP連線。

CE1路由器

```

router bgp 65101
  neighbor 2001:1::2 remote-as 100
  !
  address-family ipv6
    neighbor 2001:1::2 activate
  network ABCD::1/128

```

```
exit-address-family
```

```
!
```

6VPE1路由器

```
router bgp 100
 neighbor 3.3.3.3 remote-as 100
 neighbor 3.3.3.3 update-source Loopback 0
 !
 address-family vpnv6
 neighbor 3.3.3.3 activate
 exit-address-family
 !
 address-family ipv6 vrf CUST1
 neighbor 2001:1::1 remote-as 65101
 neighbor 2001:1::1 activate
 redistribute connected
 exit-address-family
 !
```

CE2路由器

```
router bgp 65102
 neighbor 2001:2::2 remote-as 100
 !
 address-family ipv6
 neighbor 2001:2::2 activate
 network ABCD::2/128
 exit-address-family
 !
```

6VPE2路由器

```
router bgp 100
 neighbor 1.1.1.1 remote-as 100
 neighbor 1.1.1.1 update-source Loopback 0
 !
 address-family vpnv6
 neighbor 1.1.1.1 activate
 exit-address-family
 !
 address-family ipv6 vrf CUST1
 neighbor 2001:2::1 remote-as 65102
 neighbor 2001:2::1 activate
 redistribute connected
 exit-address-family
 !
```

驗證

BGP下一躍點地址

```
6VPE2#
```

```
show bgp vpnv6 unicast vrf CUST1
```

```
BGP table version is 30, local router ID is 3.3.3.3
```

```
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,  
r RIB-failure, S Stale
```

```
Origin codes: i - IGP, e - EGP, ? - incomplete
```

Network	Next Hop	Metric	LocPrf	Weight	Path
Route Distinguisher: 1:1 (default for vrf CUST1)					
*>i2001:1::/124	::FFFF:1.1.1.1	0	100	0	?
*> 2001:2::/124	::	0		32768	?
*>iABCD::1/128	::FFFF:1.1.1.1	0	100	0	65101 i
*> ABCD::2/128	2001:2::1	0		0	65102 i

```
6VPE2# show bgp vpnv6 unicast vrf CUST1 ABCD::1/128
BGP routing table entry for [1:1]ABCD::1/128, version 30
Paths: (1 available, best #1, table CUST1)
  Advertised to update-groups:
    2
  65101
    ::FFFF:1.1.1.1 (metric 3) from 1.1.1.1 (1.1.1.1)
      Origin IGP, metric 0, localpref 100, valid, internal, best
      Extended Community: RT:1:1
      mpls labels in/out nolabel/20
```

標籤拼貼

當6VPE路由器收到來自連線的CE路由器的資料包時，它會在與該CE路由器對應的VRF表中查詢資料包IPv6目標地址。這使它能夠查詢VPNv6路由。VPNv6路由具有關聯的MPLS標籤（頂部標籤）和關聯的BGP下一跳標籤（底部標籤）。

```
6VPE2# show bgp vpnv6 unicast vrf CUST1 ABCD::1/128
BGP routing table entry for [1:1]ABCD::1/128, version 30
Paths: (1 available, best #1, table CUST1)
  Advertised to update-groups:
    2
  65101
    ::FFFF:1.1.1.1 (metric 3) from 1.1.1.1 (1.1.1.1)
      Origin IGP, metric 0, localpref 100, valid, internal, best
      Extended Community: RT:1:1
      mpls labels in/out nolabel/20
```

```
6VPE2#
show ip cef 1.1.1.1
1.1.1.1/32
  nexthop 10.2.2.1 FastEthernet2/0 label 16
```

```
6VPE2#
show ipv6 cef vrf CUST1 ABCD::1/128 detail
ABCD::1/128, epoch 0
  recursive via 1.1.1.1 label 20
  nexthop 10.2.2.1 FastEthernet2/0 label 16
```

通告給CE路由器的IPv6字首

[show ipv6 route bgp](#) 命令顯示路由器獲知的BGP路由。

```
CE1# show ipv6 route bgp
IPv6 Routing Table - 6 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
       U - Per-user Static route, M - MIPv6
       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
```

```
    D - EIGRP, EX - EIGRP external
B   2001:2::/124 [20/0]
    via FE80::C808:17FF:FE2C:0, Serial0/0
B   ABCD:2/128 [20/0]
    via FE80::C808:17FF:FE2C:0, Serial0/0
```

```
CE2# show ipv6 route bgp
```

```
IPv6 Routing Table - 6 entries
```

```
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
```

```
    U - Per-user Static route, M - MIPv6
```

```
    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
```

```
    D - EIGRP, EX - EIGRP external
```

```
B   2001:1::/124 [20/0]
    via FE80::C809:14FF:FEB4:0, Serial0/0
B   ABCD:1/128 [20/0]
    via FE80::C809:14FF:FEB4:0, Serial0/0
```

疑難排解

使用本節內容，對組態進行疑難排解。

BGP能力協商

MP-BGP用於通告MP_REACH NLRI中的IPv6 VPN路由。

註：使用的地址系列識別符號/後續地址系列識別符號(AFI/SAFI)為2/128。AFI = 2的值表示IPv6,SAFI = 128的值表示標籤為VPNv6的MPLS。

debug ip bgp

```
21:10:10.387: BGP: 3.3.3.3 went from Active to OpenSent
21:10:10.391: BGP: 3.3.3.3 sending OPEN, version 4, my as: 100, holdtime 180
seconds
21:10:10.395: BGP: 3.3.3.3 send message type 1, length (incl. header) 61
21:10:10.579: BGP: 3.3.3.3 rcv message type 1, length (excl. header) 42
21:10:10.579: BGP: 3.3.3.3 rcv OPEN, version 4, holdtime 180 seconds
21:10:10.583: BGP: 3.3.3.3 rcv OPEN w/ OPTION parameter len: 32
21:10:10.583: BGP: 3.3.3.3 rcvd OPEN w/ optional parameter type 2 (Capability)
len 6
21:10:10.583: BGP: 3.3.3.3 OPEN has CAPABILITY code: 1, length 4
21:10:10.587: BGP: 3.3.3.3 OPEN has MP_EXT CAP for afi/safi: 1/1
21:10:10.587: BGP: 3.3.3.3 rcvd OPEN w/ optional parameter type 2 (Capability)
len 6
21:10:10.587: BGP: 3.3.3.3 OPEN has CAPABILITY code: 1, length 4
21:10:10.587: BGP: 3.3.3.3 OPEN has MP_EXT CAP for afi/safi: 2/128
21:10:10.591: BGP: 3.3.3.3 rcvd OPEN w/ optional parameter type 2 (Capability)
len 2
21:10:10.591: BGP: 3.3.3.3 OPEN has CAPABILITY code: 128, length 0
21:10:10.591: BGP: 3.3.3.3 OPEN has ROUTE-REFRESH capability(old) for all
address-families
21:10:10.591: BGP: 3.3.3.3 rcvd OPEN w/ optional parameter type 2 (Capability)
len 2
21:10:10.595: BGP: 3.3.3.3 OPEN has CAPABILITY code: 2, length 0
21:10:10.595: BGP: 3.3.3.3 OPEN has ROUTE-REFRESH capability(new) for all
```

```
address-families
21:10:10.595: BGP: 3.3.3.3 rcvd OPEN w/ optional parameter type 2 (Capability)
len 6
21:10:10.595: BGP: 3.3.3.3 OPEN has CAPABILITY code: 65, length 4
21:10:10.599: BGP: 3.3.3.3 OPEN has 4-byte ASN CAP for: 100
BGP: 3.3.3.3 rcvd OPEN w/ remote AS 100, 4-byte remote AS 100
21:10:10.599: BGP: 3.3.3.3 went from OpenSent to OpenConfirm
21:10:10.603: BGP: 3.3.3.3 went from OpenConfirm to Established
21:10:10.603: %BGP-5-ADJCHANGE: neighbor 3.3.3.3 Up
21:10:11.547: %BGP-5-ADJCHANGE: neighbor 2001:1::1 vpn vrf CUST1 Up
```

```
6VPE1# show bgp vpnv6 unicast all neighbors
```

```
BGP neighbor is 3.3.3.3, remote AS 100, internal link
```

```
BGP version 4, remote router ID 3.3.3.3
```

```
BGP state = Established, up for 00:05:32
```

```
Last read 00:00:30, last write 00:00:20, hold time is 180, keepalive interval
is 60 seconds
```

```
Neighbor capabilities:
```

```
Route refresh: advertised and received(new)
```

```
New ASN Capability: advertised and received
```

```
Address family IPv4 Unicast: advertised and received
```

```
Address family VPNv6 Unicast: advertised and received
```

```
! !---output omitted ! BGP neighbor is 2001:1::1, vrf CUST1, remote AS 65101, external link
```

```
BGP version 4, remote router ID 10.210.0.1
```

```
BGP state = Established, up for 00:05:54
```

```
Last read 00:00:54, last write 00:00:43, hold time is 180, keepalive interval
is 60 seconds
```

```
Neighbor capabilities:
```

```
Route refresh: advertised and received(new)
```

```
New ASN Capability: advertised
```

```
Address family IPv6 Unicast: advertised and received
```

```
! !---output omitted !
```

[相關資訊](#)

- [IP 路由支援頁面](#)
- [技術支援與文件 - Cisco Systems](#)