

在MPLS VPN的IPv6

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简介

IP 版本 6 (IPv6) 是设计用于替换 IP 版本 4 (IPv4) 的新 IP 版本，目前在全世界得到了广泛的部署和应用。IPv6 的优点主要在于具有大得多的地址空间，能满足 Internet 扩张和 Internet 设备急剧增加之后的需求。

IPv6 VPN 在 IPv6 接口或子接口上通过 PE 路由器连接到服务提供商 (SP) 骨干网。该站点可支持 IPv4 和 IPv6。每个 IPv6 VPN 都有自己的地址空间，这意味着在不同的 VPN 中由指定地址表示不同的系统。这通过可在 IP 地址开头添加路由区分符的全新 address-family (**VPN-IPv6** 或 **VPNv6 address-family**) 实现。

一个 VPNv6 地址为 24 字节，以 8 字节的 RD 开始，以 16 字节的 IPv6 地址结束。如果站点支持 IPv4 和 IPv6，则同一 RD 可用于对 IPv4 和 IPv6 地址进行通告。

先决条件

要求

本文档没有任何特定的要求。

注意：对于IPv6在一些平台的虚拟路由和转发(VRF)支持(例如，7600系列路由器)，您在全局配置方面将需要配置[MLS IPv6 VRF](#)。

使用的组件

本文档不限于特定的软件和硬件版本。

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：

VRF 配置

CE1 路由器
<pre>ipv6 unicast-routing ipv6 cef ! interface Serial 0/0 ipv6 address 2001:1::1/124 ! interface Loopback 0 ipv6 address ABCD::1/128 !</pre>
CE2 路由器
<pre>ipv6 unicast-routing ipv6 cef ! interface Serial 0/0 ipv6 address 2001:2::1/124 ! interface Loopback 0 ipv6 address ABCD::2/128 !</pre>
6VPE1 路由器
<pre>ipv6 unicast-routing ipv6 cef ! mpls label protocol ldp mpls ldp router-id Loopback 0 force ! !----- The VRF is defined with vrf definition <vrf- name> and is made IPv6 aware ! 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 !</pre>

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 !
```

多协议 BGP (MP-BGP) 配置

在 6VPE 路由器上为 iBGP 连接配置了 Address-family VPNv6。在 6VPE 和 CE 路由器之间具有 eBGP 连接。

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 !
```

验证

[BGP 下一跳地址](#)

```
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
```

[附加标签](#)

当 6VPE 路由器收到来自所连 CE 路由器的数据包时，它会在与该 CE 路由器对应的 VRF 表中查找数据包 IPv6 目标地址。从而找到 VPNv6 路由。VPNv6 路由具有相关的 MPLS 标签（顶部标签）和相关的 BGP 下一跳标签（底部标签）。

```
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
```

[向 CE 路由器发出通告的 IPv6 前缀](#)

[show ipv6 route bgp 命令显示路由器获取的 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
```

[故障排除](#)

使用本部分可排除配置故障。

[BGP 功能协商](#)

MP-BGP 用于在 MP_REACH NLRI 中通告 IPv6 VPN 路由。

注意：使用的地址族标识符/后续地址族标识符 (AFI/SAFI) 为 2/128。AFI 的值为 2，代表 IPv6；SAFI 的值为 128，代表标记为 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 !
```

相关信息

- [IP 路由支持页](#)
- [技术支持和文档 - Cisco Systems](#)