

在Nexus 3000中通過分段路由MPLS [Ospf/iBGP]部署第3層EVPN

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簡介

本文說明如何在Nexus 3000產品上透過區段路由MPLS部署/設定第3層EVPN。

必要條件

需求

思科建議您瞭解以下主題：

- 邊界閘道通訊協定(BGP)
- L3VPN
- EVPN
- 分段路由

採用元件

本文中的資訊係根據以下軟體和硬體版本：

- 主乾硬體 — N9K-C92160YC-X，運行9.2(3)
- 枝葉硬體 — N3K-C31108PC-V，運行9.3(3)

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。如果您的網路正在作用，請確保您已瞭解任何指令可能造成的影響。

背景資訊

MPLS L3VPN重述

VPN是：

- 基於IP的網路，通過公共基礎設施提供專用網路服務。
- 允許通過Internet或其它公共或專用網路相互私下通訊的一組站點。

傳統VPN是通過配置到VPN中所有站點的全網狀隧道或永久虛擬電路(PVC)建立的。這種型別的VPN不易維護或擴展，因為新增新站點需要更改VPN中的每個邊緣裝置。

基於MPLS的VPN在第3層建立，並基於對等體模型。對等體模型使服務提供商和客戶能夠交換第3層路由資訊。服務提供商在客戶站點之間轉發資料，而無需客戶參與。

MPLS VPN比傳統VPN更易於管理和擴展。向MPLS VPN新增新站點時，僅需要更新向客戶站點提供服務的服務提供商的邊緣路由器。

以下是MPLS VPN的元件：

- 提供商(P)路由器 — 提供商網路核心的路由器。PE路由器運行MPLS交換，並且不會將VPN標籤附加到路由資料包。VPN標籤用於將資料包定向到正確的專用網路或客戶邊緣路由器。
- PE路由器 — 根據接收傳入資料包的介面或子介面將VPN標籤附加到這些資料包的路由器，同時附加MPLS核心標籤。PE路由器直接連線到CE路由器。
- 客戶(C)路由器 — 網際網路服務提供商(ISP)或企業網路中的路由器。
- 客戶邊緣(CE)路由器 — ISP網路上的邊緣路由器，連線到網路上的PE路由器。CE路由器必須與PE路由器介面。

含L3VPN(MPLS SR)的EVPN概觀

資料中心(DC)部署已採用VXLAN EVPN (或) MPLS EVPN，其優勢包括EVPN控制平面學習、多租戶、無縫移動性、冗餘和更輕鬆的POD新增。同樣，CORE是基於標籤分發協定(LDP)的MPLS L3VPN網路，或從傳統的基於MPLS L3VPN LDP的底層過渡到更複雜的解決方案，如分段路由(SR)。

分部路由以其優勢獲採納，例如：

- 整合IGP和MPLS控制平面
- 更簡單的流量工程方法
- 更輕鬆的配置
- SDN採用

EVPN(RFC 7432)是基於BGP MPLS的解決方案，已用於虛擬化資料中心網路中的下一代乙太網服務。它使用來自現有MPLS技術的多個構建塊，例如RD、RT和VRF。

NXOS 7.0(3)I6(1)版本中引入的L3 EVPN over SR使用帶MPLS封裝的EVPN第5類路由。它為演化的資料中心服務提供多租戶、可擴充性和高效能。

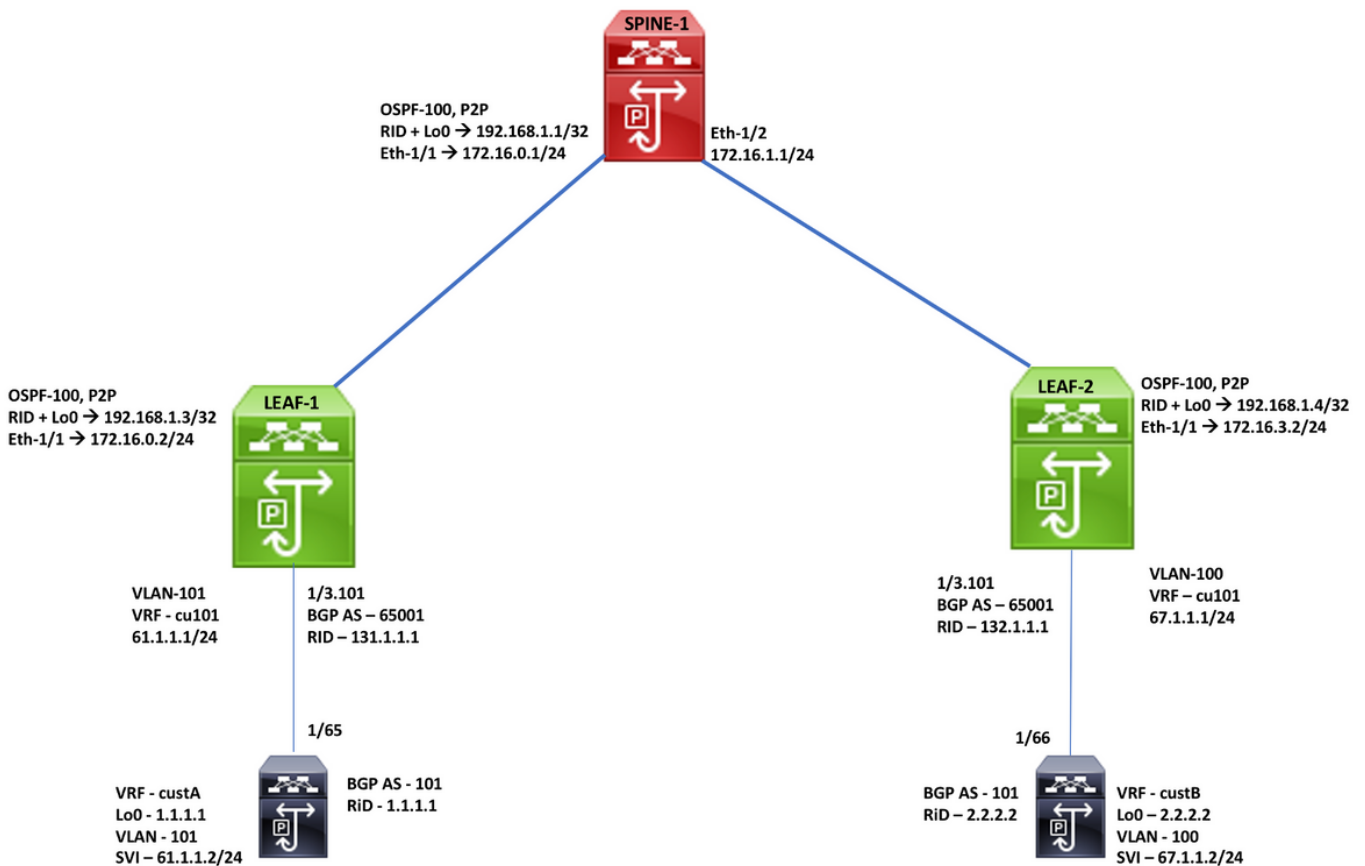
附註：在DC中，資料平面可以是VXLAN或MPLS。

傳統MPLS第3層VPN	使用SR的MPLS第3層VPN
主構建塊：RD、RT和VRF	主構建塊：RD、RT和VRF
用於傳輸的底層層：IGP、LDP和RSVP-TE	用於傳輸的底層層：IGP/BGP-LU和SR-TE
服務的覆蓋層：VPNv4和VPNv6	服務的覆蓋層：EVPN

限制

Nexus C31108PC-V不支援L2-EVPN，N9K Cloud-Scale由於規模方面的考慮而適用於任何SR部署。

網路圖表



組態

高級配置

1. 安裝功能
2. 配置IP地址 — Underlay
3. 配置IGP -OSPF
4. 設定MP-BGP
5. 配置VLAN和EVPN重疊
6. 在主機和枝葉之間配置e-BGP

SPINE-1 Configuration

Enabling Features, Label-Range, Route-map, Label-Index	OSPF Configuration	BGP/EVPN Configuration
<pre>feature-set mpls feature ospf feature bgp feature mpls segment-routing feature mpls evpn feature interface-vlan feature mpls oam mpls label range 5000 45000 segment-routing mpls global-block 16000 25000 connected-prefix-sid-map address-family ipv4 192.168.1.1/32 index 211 route-map label-index-spine1 permit 10 set label-index 211</pre>	<pre>interface Ethernet1/1 ip address 172.16.0.1/24 ip ospf network point-to-point ip router ospf 100 area 0.0.0.0 mpls ip forwarding no shutdown interface Ethernet1/2 ip address 172.16.1.1/24 ip ospf network point-to-point ip router ospf 100 area 0.0.0.0 mpls ip forwarding no shutdown interface loopback0 ip address 192.168.1.1/32 ip router ospf 100 area 0.0.0.0 router ospf 100 segment-routing mpls router-id 192.168.1.1</pre>	<pre>router bgp 65001 router-id 192.168.1.1 address-family ipv4 unicast network 192.168.1.1/32 route-map label-index-spine1 allocate-label all address-family ipv4 labeled-unicast address-family l2vpn evpn template peer EVPN remote-as 65001 update-source loopback0 address-family l2vpn evpn send-community extended route-reflector-client encapsulation mpls template peer Labeled-unicast remote-as 65001 address-family ipv4 labeled-unicast send-community extended route-reflector-client next-hop-self soft-reconfiguration inbound always neighbor 172.16.0.2 inherit peer Labeled-unicast neighbor 172.16.1.2 inherit peer Labeled-unicast neighbor 192.168.1.3 inherit peer EVPN neighbor 192.168.1.4 inherit peer EVPN</pre>

LEAF-1 Configuration

Enabling Features, Label-Range, Route-map, Label-Index	OSPF, VRF Configuration	BGP/EVPN Configuration
<pre>feature-set mpls feature ospf feature bgp feature mpls segment-routing feature mpls evpn feature interface-vlan feature lacp feature mpls oam mpls label range 5000 450000 segment-routing mpls global-block 16000 25000 connected-prefix-sid-map address-family ipv4 192.168.1.3/32 index 311 route-map label-index-leaf-1 permit 10 set label-index 311</pre>	<pre>interface Ethernet1/1 no switchport ip address 172.16.0.2/24 ip ospf network point-to-point ip router ospf 100 area 0.0.0.0 mpls ip forwarding no shutdown interface loopback0 ip address 192.168.1.3/32 ip router ospf 100 area 0.0.0.0 router ospf 100 segment-routing mpls router-id 192.168.1.3 interface Ethernet1/3 no switchport no shutdown interface Ethernet1/3.101 encapsulation dot1q 101 vrf member cu101 ip address 61.1.1.1/24 ip ospf network point-to-point ip router ospf 200 area 0.0.0.0 no shutdown vrf context cu101 rd auto address-family ipv4 unicast route-target import 1:101 route-target import 1:101 evpn</pre>	<pre>router bgp 65001 router-id 192.168.1.3 address-family ipv4 unicast network 192.168.1.3/32 route-map label-index-leaf-1 allocate-label all address-family ipv4 labeled-unicast address-family l2vpn evpn template peer EVPN remote-as 65001 update-source loopback0 address-family l2vpn evpn send-community extended encapsulation mpls template peer Labeled-unicast remote-as 65001 address-family ipv4 labeled-unicast send-community extended soft-reconfiguration inbound always template peer cu1 address-family ipv4 unicast as-override send-community soft-reconfiguration inbound always neighbor 172.16.0.1 inherit peer Labeled-unicast neighbor 192.168.1.1 inherit peer EVPN vrf cu101 router-id 131.1.1.1 address-family ipv4 unicast advertise l2vpn evpn neighbor 61.1.1.2 inherit peer cu1 remote-as 101</pre>

LEAF-2 Configuration		
Enabling Features, Label-Range, Route-map, Label-Index	OSPF, VRF Configuration	BGP/EVPN Configuration
<pre>feature-set mpls feature ospf feature bgp feature mpls segment-routing feature mpls evpn feature interface-vlan feature mpls oam mpls label range 5000 450000 segment-routing mpls global-block 16000 25000 connected-prefix-sid-map address-family ipv4 192.168.1.4/32 index 321 route-map label-index-Leaf2 permit 10 set label-index 321</pre>	<pre>interface Ethernet1/1 no switchport ip address 172.16.1.2/24 ip ospf network point-to-point ip router ospf 100 area 0.0.0.0 mpls ip forwarding no shutdown interface loopback0 ip address 192.168.1.4/32 ip router ospf 100 area 0.0.0.0 router ospf 100 segment-routing mpls router-id 192.168.1.4 interface Ethernet1/3 no switchport no shutdown interface Ethernet1/3.101 encapsulation dot1q 100 vrf member cu101 ip address 67.1.1.1/24 no shutdown vrf context cu101 rd auto address-family ipv4 unicast route-target import 1:101 route-target import 1:101 evpn</pre>	<pre>router bgp 65001 router-id 192.168.1.4 address-family ipv4 unicast network 192.168.1.4/32 route-map label-index-Leaf2 allocate-label all address-family ipv4 labeled-unicast address-family l2vpn evpn template peer EVPN remote-as 65001 update-source loopback0 address-family l2vpn evpn send-community extended encapsulation mpls template peer Labeled-unicast remote-as 65001 address-family ipv4 labeled-unicast send-community extended soft-reconfiguration inbound always template peer cu1 address-family ipv4 unicast as-override send-community soft-reconfiguration inbound always neighbor 172.16.1.1 inherit peer Labeled-unicast neighbor 192.168.1.1 inherit peer EVPN vrf cu101 router-id 132.1.1.1 address-family ipv4 unicast advertise l2vpn evpn neighbor 67.1.1.2 inherit peer cu1 remote-as 101</pre>

END-Host Configuration		
Enabling Features, , Route-map, VRF-A Configuration	BGP Configuration	VRF-B Configuration
<pre>feature bgp feature interface-vlan vlan 1,100-101 route-map twist permit 10 set metric 10 vrf context custA rd 101:1 address-family ipv4 unicast interface loopback0 vrf member custA ip address 1.1.1.1/32 interface Vlan101 no shutdown vrf member custA ip address 61.1.1.2/24 interface Ethernet1/65 switchport switchport mode trunk switchport trunk allowed vlan 101 no shutdown</pre>	<pre>router bgp 101 vrf custA router-id 1.1.1.1 address-family ipv4 unicast network 1.1.1.1/32 redistribute direct route-map twist neighbor 61.1.1.1 remote-as 65001 address-family ipv4 unicast send-community send-community extended vrf custB router-id 2.2.2.2 address-family ipv4 unicast network 2.2.2.2/32 redistribute direct route-map twist neighbor 67.1.1.1 remote-as 65001 address-family ipv4 unicast send-community send-community extended soft-reconfiguration inbound</pre>	<pre>vrf context custB rd 101:2 address-family ipv4 unicast interface loopback1 vrf member custB ip address 2.2.2.2/32 interface Vlan100 no shutdown vrf member custB ip address 67.1.1.2/24 interface Ethernet1/66 switchport switchport mode trunk switchport trunk allowed vlan 100 no shutdown</pre>

驗證

Leaf2(config)# show bgp l2vpn evpn

BGP routing table information for VRF default, address family L2VPN EVPN
BGP table version is 14, Local Router ID is 192.168.1.4
Status: s-suppressed, x-deleted, S-stale, d-dampened, h-history, *-valid, >-best
Path type: i-internal, e-external, c-confed, l-local, a-aggregate, r-redist, I-injected
Origin codes: i - IGP, e - EGP, ? - incomplete, | - multipath, & - backup, 2 - best2

Network	Next Hop	Metric	LocPrf	Weight	Path
Route Distinguisher: 192.168.1.3:4					
*>i[5]:[0]:[0]:[24]:[61.1.1.0]/224	192.168.1.3	10	100	0	101 ?
*>i[5]:[0]:[0]:[32]:[1.1.1.1]/224	192.168.1.3		100		0 101 i
Route Distinguisher: 192.168.1.4:3					
*>i[5]:[0]:[0]:[24]:[61.1.1.0]/224	192.168.1.3	10	100	0	101 ?
*>l[5]:[0]:[0]:[24]:[67.1.1.0]/224	0.0.0.0	10		0	101 ?
*>i[5]:[0]:[0]:[32]:[1.1.1.1]/224	192.168.1.3		100		0 101 i
*>l[5]:[0]:[0]:[32]:[2.2.2.2]/224	0.0.0.0			0	101 i

Leaf2(config)# show bgp ipv4 labeled-unicast

BGP routing table information for VRF default, address family IPv4 Label Unicast
BGP table version is 8, Local Router ID is 192.168.1.4
Status: s-suppressed, x-deleted, S-stale, d-dampened, h-history, *-valid, >-best
Path type: i-internal, e-external, c-confed, l-local, a-aggregate, r-redist, I-injected
Origin codes: i - IGP, e - EGP, ? - incomplete, | - multipath, & - backup, 2 - best2

Network	Next Hop	Metric	LocPrf	Weight	Path
*>i192.168.1.1/32	172.16.1.1		100		0 i
*>i192.168.1.3/32	172.16.0.2		100		0 i
*>i192.168.1.4/32	0.0.0.0		100		32768 i

Leaf2(config)# show ip int brief vrf all

IP Interface Status for VRF "default"(1)

Interface	IP Address	Interface Status
Lo0	192.168.1.4	protocol-up/link-up/admin-up
Eth1/1	172.16.1.2	protocol-up/link-up/admin-up
Eth1/2	172.16.5.2	protocol-up/link-up/admin-up

IP Interface Status for VRF "management"(2)

Interface	IP Address	Interface Status
mgmt0	10.82.139.100	protocol-up/link-up/admin-up

IP Interface Status for VRF "cul01"(3)

Interface	IP Address	Interface Status
Eth1/3.101	67.1.1.1	protocol-up/link-up/admin-up

Leaf2(config)# show forwarding 1.1.1.1/32 vrf cul01

slot 1
=====
IPv4 routes for table cul01/base

Prefix	Next-hop	Interface	Labels	Partial Install
*1.1.1.1/32	172.16.1.1	Ethernet1/1	PUSH 16311 492288	

Leaf2(config)# show forwarding 192.168.1.3/32

slot 1
=====
IPv4 routes for table default/base

Prefix	Next-hop	Interface	Labels	Partial Install
192.168.1.3/32	172.16.1.1	Ethernet1/1	PUSH 16311	

Leaf2(config)# show ip route vrf 101

No IP Route Table for VRF "101"
Leaf2(config)# show ip route vrf cul01
IP Route Table for VRF "cul01"
*** denotes best ucast next-hop
*** denotes best mcast next-hop
'[x/y]' denotes [preference/metric]
'%<string>' in via output denotes VRF <string>

1.1.1.1/32, ubest/mbest: 1/0
*via 192.168.1.34default, [200/0], 00:15:39, bgp-65001, internal, tag 101 (mpls-vpn)
2.2.2.2/32, ubest/mbest: 1/0
*via 67.1.1.2, [20/0], 00:36:44, bgp-65001, external, tag 101
61.1.1.0/24, ubest/mbest: 1/0
*via 192.168.1.34default, [200/10], 00:15:39, bgp-65001, internal, tag 101 (mpls-vpn)
67.1.1.0/24, ubest/mbest: 1/0, attached
*via 67.1.1.1, Eth1/3.101, [0/0], 00:39:32, direct
67.1.1.1/32, ubest/mbest: 1/0, attached
*via 67.1.1.1, Eth1/3.101, [0/0], 00:39:32, local

host1# show ip route vrf custA

IP Route Table for VRF "custA"
*** denotes best ucast next-hop
*** denotes best mcast next-hop
'[x/y]' denotes [preference/metric]
'%<string>' in via output denotes VRF <string>

1.1.1.1/32, ubest/mbest: 2/0, attached
*via 1.1.1.1, Lo0, [0/0], 00:40:10, local
*via 1.1.1.1, Lo0, [0/0], 00:40:10, direct
2.2.2.2/32, ubest/mbest: 1/0
*via 61.1.1.1, [20/0], 00:37:21, bgp-101, external, tag 65001
61.1.1.0/24, ubest/mbest: 1/0, attached
*via 61.1.1.2, Vlan101, [0/0], 00:37:38, direct
61.1.1.2/32, ubest/mbest: 1/0, attached
*via 61.1.1.2, Vlan101, [0/0], 00:37:38, local
67.1.1.0/24, ubest/mbest: 1/0
*via 61.1.1.1, [20/0], 00:37:21, bgp-101, external, tag 65001
RTP_host1#

host1# ping 2.2.2.2 vrf custA

PING 2.2.2.2 (2.2.2.2): 56 data bytes
64 bytes from 2.2.2.2: icmp_seq=0 ttl=251 time=0.737 ms
64 bytes from 2.2.2.2: icmp_seq=1 ttl=251 time=0.579 ms
64 bytes from 2.2.2.2: icmp_seq=2 ttl=251 time=0.513 ms
64 bytes from 2.2.2.2: icmp_seq=3 ttl=251 time=0.472 ms
64 bytes from 2.2.2.2: icmp_seq=4 ttl=251 time=0.466 ms

--- 2.2.2.2 ping statistics ---
5 packets transmitted, 5 packets received, 0.00% packet loss
round-trip min/avg/max = 0.466/0.553/0.737 ms
RTP_host1#

host2# show ip route vrf custB

IP Route Table for VRF "custB"
*** denotes best ucast next-hop
*** denotes best mcast next-hop
'[x/y]' denotes [preference/metric]
'%<string>' in via output denotes VRF <string>

1.1.1.1/32, ubest/mbest: 1/0
*via 67.1.1.1, [20/0], 00:37:25, bgp-101, external, tag 65001
2.2.2.2/32, ubest/mbest: 2/0, attached
*via 2.2.2.2, Lo1, [0/0], 00:40:14, local
*via 2.2.2.2, Lo1, [0/0], 00:40:14, direct
61.1.1.0/24, ubest/mbest: 1/0
*via 67.1.1.1, [20/0], 00:37:25, bgp-101, external, tag 65001
67.1.1.0/24, ubest/mbest: 1/0, attached
*via 67.1.1.2, Vlan100, [0/0], 00:38:08, direct
67.1.1.2/32, ubest/mbest: 1/0, attached
*via 67.1.1.2, Vlan100, [0/0], 00:38:08, local
host2#

host2# ping 1.1.1.1 vrf custB

PING 1.1.1.1 (1.1.1.1): 56 data bytes
64 bytes from 1.1.1.1: icmp_seq=0 ttl=251 time=0.786 ms
64 bytes from 1.1.1.1: icmp_seq=1 ttl=251 time=0.526 ms
64 bytes from 1.1.1.1: icmp_seq=2 ttl=251 time=0.604 ms
64 bytes from 1.1.1.1: icmp_seq=3 ttl=251 time=0.568 ms
64 bytes from 1.1.1.1: icmp_seq=4 ttl=251 time=0.522 ms

--- 1.1.1.1 ping statistics ---
5 packets transmitted, 5 packets received, 0.00% packet loss
round-trip min/avg/max = 0.522/0.601/0.786 ms
RTP_host1#

相關資訊

- [多重通訊協定BGP MPLS VPN](#)
- [Cisco Nexus 9500、9300、9200、3200和3100平台交換機上的分段路由白皮書](#)

- 在分段路由MPLS上配置第3層EVPN和第3層VPN