在Nexus 3000中部署网段路由MPLS上的第3层 EVPN [Ospf / iBGP]

目录

简介

本文档介绍如何在Nexus 3000产品上部署/配置分段路由MPLS上的第3层EVPN。

先决条件

要求

Cisco 建议您了解以下主题：

- 边界网关协议 (BGP)
- L3VPN
- EVPN
- 分段路由

使用的组件

本文档中的信息基于以下软件和硬件版本：

- 主干硬件 — N9K-C92160YC-X，运行9.2(3)
- 枝叶硬件 — N3K-C31108PC-V，运行9.3(3)

本文档中的信息都是基于特定实验室环境中的设备编写的。本文档中使用的所有设备最初均采用原始（默认）配置。如果您使用的是真实网络，请确保您已经了解所有命令的潜在影响。

背景信息

MPLS L3VPN重述

VPN是：

- 基于IP的网络，通过公共基础设施提供专用网络服务。
- 允许通过Internet或其他公共或专用网络彼此私下通信的一组站点。

传统VPN是通过为VPN中的所有站点配置全网状隧道或永久虚电路(PVC)而创建的。这种类型的VPN不易维护或扩展，因为添加新站点需要更改VPN中的每个边缘设备。

基于MPLS的VPN在第3层创建，并基于对等体模型。对等模式使服务提供商和客户能够交换第3层路由信息。服务提供商在客户地点之间中继数据，无需客户参与。

MPLS VPN比传统VPN更易于管理和扩展。将新站点添加到MPLS VPN时，只需更新为客户站点提供服务的服务提供商的边缘路由器。

以下是MPLS VPN的组件：

- 提供商(P)路由器 — 提供商网络核心中的路由器。PE路由器运行MPLS交换，不将VPN标签附加到路由的数据包。VPN标签用于将数据包转发到正确的专用网络或客户边缘路由器。

- PE路由器 — 根据接收VPN标签的接口或子接口将VPN标签附加到传入数据包，并且还附加MPLS核心标签的路由器。PE路由器直接连接到CE路由器。

- 客户(C)路由器 — Internet服务提供商(ISP)或企业网络中的路由器。

- 客户边缘(CE)路由器 — ISP网络上连接到网络上PE路由器的边缘路由器。CE路由器必须与PE路由器进行接口。

带L3VPN的EVPN概述(MPLS SR)

数据中心(DC)部署已采用VXLAN EVPN（或）MPLS EVPN，其优势包括EVPN控制平面学习、多租户、无缝移动性、冗余和更轻松的POD添加。同样，CORE是基于标签分发协议(LDP)的MPLS L3VPN网络，或从基于传统MPLS L3VPN LDP的底层过渡到更复杂的解决方案，如分段路由(SR)。

网段路由的优点包括：

- 统一IGP和MPLS控制平面
- 更简单的流量工程方法
- 更轻松的配置
- SDN采用

EVPN(RFC 7432)是基于BGP MPLS的解决方案，已用于虚拟化数据中心网络中的下一代以太网服务。它使用多个构建块，如来自现有MPLS技术的RD、RT和VRF。

NXOS 7.0(3)I6(1)版本中引入的基于SR的L3 EVPN使用带MPLS封装的EVPN第5类路由。它为演进的数据中心服务提供多租户、可扩展性和高性能。

> 注意：在DC中，数据平面可以是VXLAN或MPLS。

传统MPLS L3 VPN	基于SR的MPLS L3 VPN
主要构建块：RD、RT和VRF	主要构建块：RD、RT和VRF
传输的底层：IGP、LDP和RSVP-TE	传输的底层：IGP/BGP-LU和SR-TE
服务的重叠层：VPNv4和VPNv6	服务的重叠层：EVPN

限制

Nexus C31108PC-V中不支持L2-EVPN,N9K云扩展适合任何SR部署，因为需要考虑扩展。

网络图
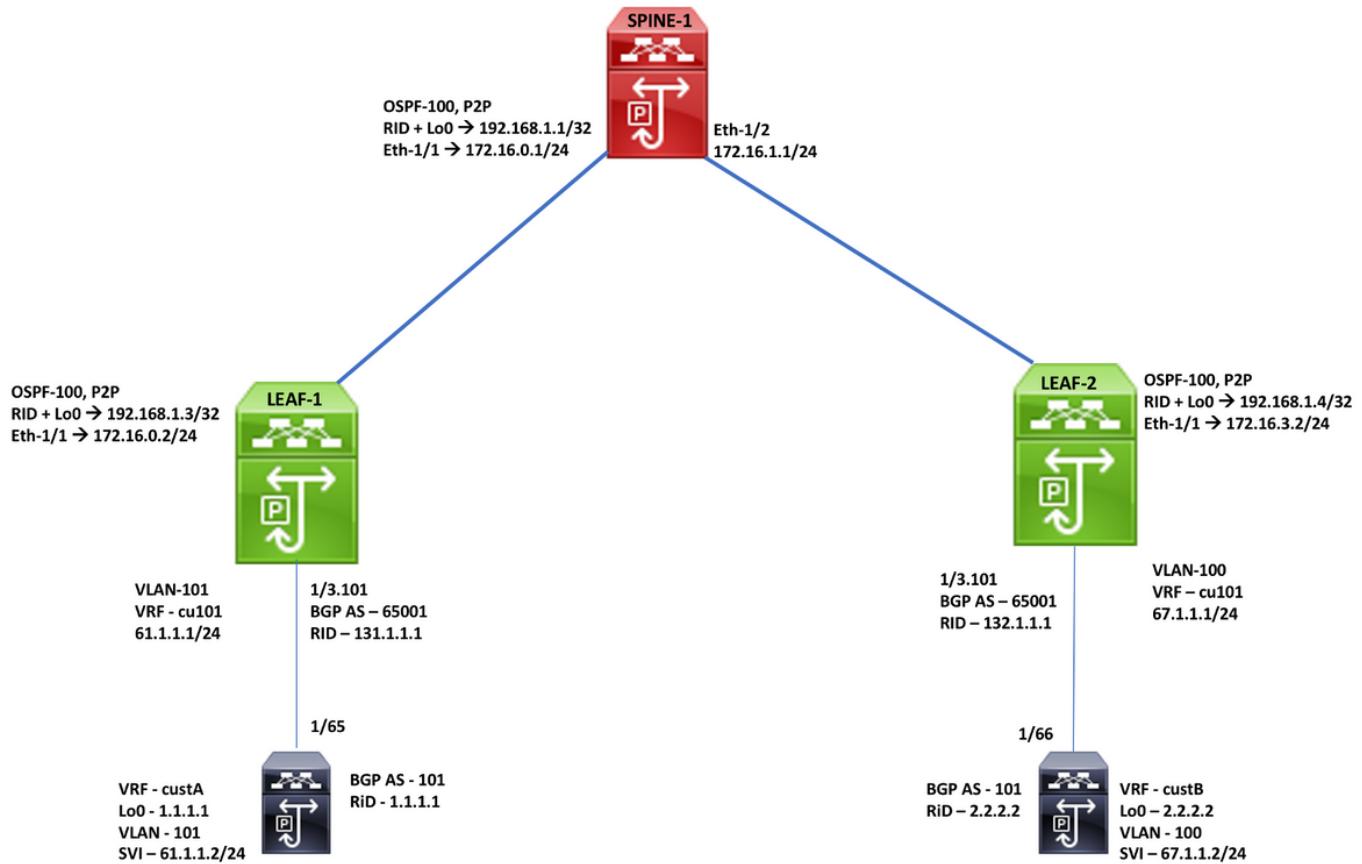
配置

高级配置

1. 安装功能
2. 配置IP地址 — 底层
3. 配置IGP -OSPF
4. 配置MP-BGP
5. 配置VLAN和EVPN重叠
6. 在主机和枝叶之间配置e-BGP

SPINE-1 Configuration

Enabling Features, Label-Range, Route-map, Label-Index	OSPF Configuration	BGP/EVPN Configuration

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
	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
		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

LEAF-1 Configuration

Enabling Features, Label-Range, Route-map, Label-Index	OSPF, VRF Configuration	BGP/EVPN Configuration

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
	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
		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

LEAF-2 Configuration

Enabling Features, Label-Range, Route-map, Label-Index	OSPF, VRF Configuration	BGP/EVPN Configuration

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
	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
		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

END-Host Configuration

Enabling Features, , Route-map, VRF-A Configuration	BGP Configuration	VRF-B Configuration

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
	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
		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

验证

```
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
*>l192.168.1.4/32   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 "cu101"(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 cu101
slot  1
======
IPv4 routes for table cu101/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 cu101
IP Route Table for VRF "cu101"
'*' 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 192.168.1.3%default, [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 192.168.1.3%default, [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#
```

相关信息

- 多协议BGP MPLS VPN
- Cisco Nexus 9500、9300、9200、3200和3100平台交换机上的分段路由白皮书

- [配置第3层EVPN和第3层VPN over Segment Routing MPLS](#)