Implante o EVPN da camada 3 sobre o SR MPLS [Ospf / iBGP] [PE-CE é OSPF] no Nexus 9300

Contents

Introduction

Este documento descreve como implantar/configurar o Layer3 EVPN sobre Segment Routing (SR) Multiprotocol Label Switching (MPLS) em produtos Nexus 9300 com protocolo PE-CE como Open Shortest Path First (OSPF).

Prerequisites

Requirements

A Cisco recomenda que você tenha conhecimento destes tópicos:

- BGP (Border Gateway Protocol)
- Abra o protocolo OSPF
- L3VPN
- EVPN
- Roteamento de segmento (SR)

Componentes Utilizados

As informações neste documento são baseadas nestas versões de software e hardware:

- Hardware SPINE - 93360YC-FX2 em execução com a versão 9.3.3(3)
- Hardware LEAF - 93240YC-FX2 em execução com a versão 9.3.(3)
- CLIENTE - 93216TC-FX2 (Host-1), Catalyst-3750 (Host-2)

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, make sure that you understand the potential impact of any command.

Informações de Apoio

Recapitulação L3VPN MPLS

Uma VPN é:

- Uma rede baseada em IP que fornece serviços de rede privada em uma infraestrutura pública.
- Um conjunto de sites que podem se comunicar privadamente pela Internet ou por outras redes públicas ou privadas.

As VPNs convencionais são criadas pela configuração de uma malha completa de túneis ou PVCs (Permanent Virtual Circuits, circuitos virtuais permanentes) para todos os locais em uma VPN. Esse tipo de VPN não é fácil de manter ou expandir, pois a adição de um novo local exige a alteração de cada dispositivo de borda na VPN.

As VPNs baseadas em MPLS são criadas na Camada 3 e são baseadas no modelo de peer. O modelo de peer permite que o provedor de serviços e o cliente troquem informações de roteamento da Camada 3. O provedor de serviços retransmite os dados entre os locais do cliente sem o envolvimento do cliente.

As VPNs MPLS são mais fáceis de gerenciar e expandir do que as VPNs convencionais. Quando um novo local é adicionado a uma VPN MPLS, somente o roteador de borda do provedor de serviços que fornece serviços para o local do cliente precisa ser atualizado.

Estes são os componentes da VPN MPLS:

- Roteador do provedor (P) - Roteador no núcleo da rede do provedor. Os roteadores PE executam a comutação MPLS e não conectam rótulos de VPN aos pacotes roteados. Os rótulos de VPN são usados para direcionar pacotes de dados para a rede privada ou roteador de borda do cliente corretos.

- Roteador PE - Roteador que conecta o rótulo VPN aos pacotes de entrada com base na interface ou subinterface na qual eles são recebidos e também conecta os rótulos do núcleo MPLS. Um roteador PE se conecta diretamente a um roteador CE.

- Cliente (C) Roteador - Roteador no provedor de serviços de Internet (ISP) ou na rede corporativa.

- Roteador de borda do cliente (CE) na rede do ISP que se conecta ao roteador PE na rede. Um roteador CE deve fazer interface com um roteador PE.

Visão geral do EVPN com L3VPN (MPLS SR)

As implantações de data center (DC) adotaram o VXLAN EVPN (ou) MPLS EVPN para seus

benefícios, como aprendizagem do plano de controle EVPN, multilocação, mobilidade contínua, redundância e acréscimos de POD mais fáceis. Da mesma forma, o CORE é uma rede MPLS L3VPN baseada em Protocolo de Distribuição de Rótulo (LDP - Label Distribution Protocol) ou está fazendo a transição da base tradicional baseada em LDP de L3VPN MPLS para uma solução mais sofisticada, como o Roteamento de Segmento (SR - Segment Routing).

O roteamento de segmento é adotado para seus benefícios, como:

- Planos de controle de IGP e MPLS unificados
- Métodos de engenharia de tráfego mais simples
- Configuração mais fácil
- adoção de SDN
- O EVPN (RFC 7432) é uma solução baseada em BGP MPLS que foi usada para serviços Ethernet de próxima geração em uma rede de data center virtualizado.
- O EVPN usa vários blocos componentes como RD, RT e VRF das tecnologias MPLS existentes.
- O EVPN L3 sobre SR que foi introduzido na versão NXOS 7.0(3)I6(1) usa a rota EVPN Tipo 5 com encapsulamento MPLS.
- O L3 EVPN sobre SR oferece multilocação, escalabilidade e alto desempenho para serviços de data center evoluídos.

Note: No DC, o plano de dados pode ser VXLAN ou MPLS.

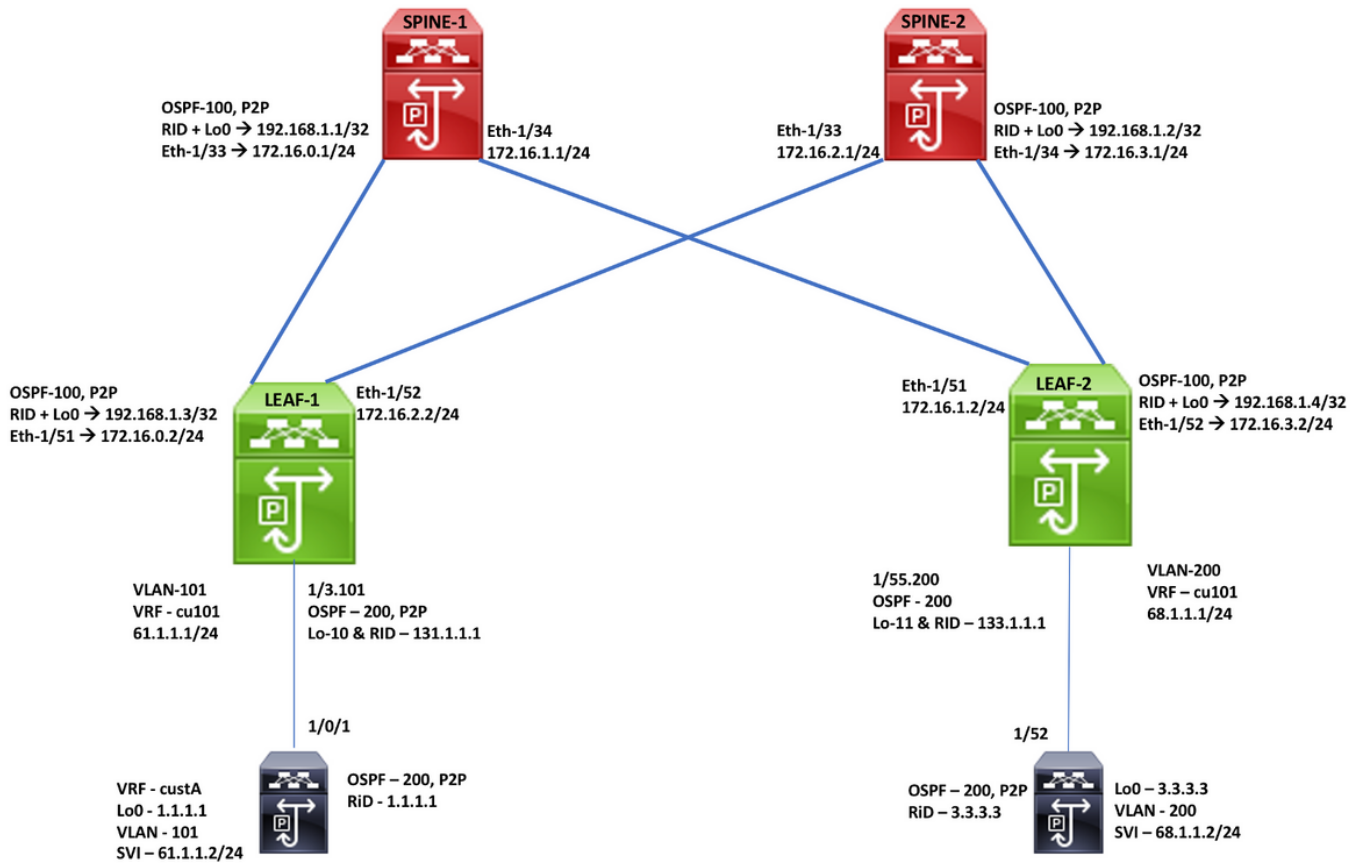| VPN L3 MPLS tradicional	VPN L3 MPLS sobre SR
Principais blocos de construção: RD, RT e VRF	Principais blocos de construção: RD, RT e VRF
Camada de sobreposição para transporte: IGP, LDP e RSVP-TE	Camada de sobreposição para transporte: IGP/BGP-LU e SR-TE
Camada de sobreposição para serviço: VPNv4 e VPNv6	Camada de sobreposição para serviço: EVPN

Diagrama de Rede

SPINE-1

SPINE-2

OSPF-100, P2P
RID + Lo0 → 192.168.1.1/32
Eth-1/33 → 172.16.0.1/24

Eth-1/34
172.16.1.1/24

Eth-1/33
172.16.2.1/24

OSPF-100, P2P
RID + Lo0 → 192.168.1.2/32
Eth-1/34 → 172.16.3.1/24

LEAF-1

LEAF-2

OSPF-100, P2P
RID + Lo0 → 192.168.1.3/32
Eth-1/51 → 172.16.0.2/24

Eth-1/52
172.16.2.2/24

Eth-1/51
172.16.1.2/24

OSPF-100, P2P
RID + Lo0 → 192.168.1.4/32
Eth-1/52 → 172.16.3.2/24

VLAN-101
VRF - cu101
61.1.1.1/24

1/3.101
OSPF – 200, P2P
Lo-10 & RID – 131.1.1.1

1/55.200
OSPF - 200
Lo-11 & RID – 133.1.1.1

VLAN-200
VRF – cu101
68.1.1.1/24

1/0/1

1/52

VRF - custA
Lo0 - 1.1.1.1
VLAN - 101
SVI – 61.1.1.2/24

OSPF – 200, P2P
RiD - 1.1.1.1

OSPF – 200, P2P
RiD - 3.3.3.3

Lo0 – 3.3.3.3
VLAN - 200
SVI – 68.1.1.2/24

Configuração

SPINE-1 Configuration		
Enabling Features, Label-Range, Route-map, Label-Index	**OSPF Configuration**	**BGP/EVPN Configuration**
feature-set mpls	interface Ethernet1/33	router bgp 65001
feature ospf	ip address 172.16.0.1/24	router-id 192.168.1.1
feature bgp	ip ospf network point-to-point	address-family ipv4 unicast
feature mpls segment-routing	ip router ospf 100 area 0.0.0.0	network 192.168.1.1/32 route-map label-index-spine1
feature mpls evpn	mpls ip forwarding	allocate-label all
feature interface-vlan	no shutdown	address-family ipv4 labeled-unicast
feature mpls oam		address-family l2vpn evpn
	interface Ethernet1/34	template peer EVPN
	ip address 172.16.1.1/24	remote-as 65001
	ip ospf network point-to-point	update-source loopback0
mpls label range 5000 450000	ip router ospf 100 area 0.0.0.0	address-family l2vpn evpn
segment-routing	mpls ip forwarding	send-community extended
mpls	no shutdown	route-reflector-client
global-block 16000 25000		encapsulation mpls
connected-prefix-sid-map		template peer Labeled-unicast
address-family ipv4		remote-as 65001
192.168.1.1/32 index 211	interface loopback0	address-family ipv4 labeled-unicast
	ip address 192.168.1.1/32	send-community extended
	ip router ospf 100 area 0.0.0.0	route-reflector-client
		next-hop-self
route-map label-index-spine1 permit 10		soft-reconfiguration inbound always
set label-index 211	router ospf 100	neighbor 172.16.0.2
	segment-routing mpls	inherit peer Labeled-unicast
	router-id 192.168.1.1	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

SPINE-2 Configuration

Enabling Features, Label-Range, Route-map, Label-Index	OSPF Configuration	BGP/EVPN Configuration
feature-set mpls	interface Ethernet1/33	router bgp 65001
feature ospf	ip address 172.16.2.1/24	router-id 192.168.1.2
feature bgp	ip ospf network point-to-point	address-family ipv4 unicast
feature mpls segment-routing	ip router ospf 100 area 0.0.0.0	network 192.168.1.2/32 route-map label-index-spine2
feature mpls evpn	mpls ip forwarding	allocate-label all
feature interface-vlan	no shutdown	address-family ipv4 labeled-unicast
feature mpls oam		address-family l2vpn evpn
		template peer EVPN
mpls label range 5000 450000	interface Ethernet1/34	remote-as 65001
	ip address 172.16.3.1/24	update-source loopback0
segment-routing	ip ospf network point-to-point	address-family l2vpn evpn
mpls	ip router ospf 100 area 0.0.0.0	send-community extended
global-block 16000 25000	mpls ip forwarding	route-reflector-client
connected-prefix-sid-map	no shutdown	encapsulation mpls
address-family ipv4		template peer Labeled-unicast
192.168.1.2/32 index 221		remote-as 65001
	interface loopback0	address-family ipv4 labeled-unicast
	ip address 192.168.1.2/32	send-community extended
route-map label-index-spine2 permit 10	ip router ospf 100 area 0.0.0.0	route-reflector-client
set label-index 221		next-hop-self
		soft-reconfiguration inbound always
		neighbor 172.16.2.2
	router ospf 100	inherit peer Labeled-unicast
	segment-routing mpls	neighbor 172.16.3.2
	router-id 192.168.1.2	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 Configuration	BGP/EVPN Configuration
install feature-set mpls	interface Ethernet1/51	router bgp 65001
feature-set mpls	ip address 172.16.0.2/24	router-id 192.168.1.3
nv overlay evpn	ip ospf network point-to-point	address-family ipv4 unicast
feature ospf	ip router ospf 100 area 0.0.0.0	network 192.168.1.3/32 route-map label-index-leaf-1
feature bgp	mpls ip forwarding	allocate-label all
feature mpls segment-routing	no shutdown	address-family ipv4 labeled-unicast
feature mpls evpn		address-family l2vpn evpn
feature interface-vlan	interface Ethernet1/52	
feature mpls oam	ip address 172.16.2.2/24	template peer EVPN
feature nv overlay	ip ospf network point-to-point	remote-as 65001
	ip router ospf 100 area 0.0.0.0	update-source loopback0
mpls label range 5000 450000	mpls ip forwarding	address-family l2vpn evpn
segment-routing	no shutdown	send-community extended
mpls		encapsulation mpls
global-block 16000 25000	interface loopback0	
connected-prefix-sid-map	ip address 192.168.1.3/32	template peer Labeled-unicast
address-family ipv4	ip router ospf 100 area 0.0.0.0	remote-as 65001
192.168.1.3/32 index 311		address-family ipv4 labeled-unicast
	router ospf 100	send-community extended
ip prefix-list test1 seq 5 permit 61.1.1.0/24	segment-routing mpls	soft-reconfiguration inbound always
ip prefix-list test1 seq 10 permit 131.1.1.1/32	router-id 192.168.1.3	
		neighbor 172.16.0.1
ip prefix-list test3 seq 5 permit 1.1.1.1/32	**PE-CE**	inherit peer Labeled-unicast
	vrf cu101	neighbor 172.16.2.1
	address-family ipv4 unicast	inherit peer Labeled-unicast
route-map bgp65001 permit 10		neighbor 192.168.1.1
match route-type internal	interface Ethernet1/3	inherit peer EVPN
route-map direct1 permit 10	no shutdown	neighbor 192.168.1.2
match ip address prefix-list test1	interface Ethernet1/3.101	inherit peer EVPN
set community 65001:10	encapsulation dot1q 101	
route-map label-index-leaf-1 permit 10	vrf member cu101	
set label-index 311	ip address 61.1.1.1/24	
route-map ospf200 permit 10	ip ospf network point-to-point	vrf cu101
match ip address prefix-list test3	ip router ospf 200 area 0.0.0.0	router-id 131.1.1.1
	no shutdown	address-family ipv4 unicast
vrf context cu101		advertise l2vpn evpn
rd auto	interface loopback10	redistribute direct route-map direct1
address-family ipv4 unicast	vrf member cu101	redistribute ospf 200 route-map ospf200
route-target import 1:101	ip address 131.1.1.1/32	
route-target import 1:101 evpn	ip router ospf 200 area 0.0.0.0	
route-target export 1:101		
route-target export 1:101 evpn	router ospf 200	
	vrf cu101	
	router-id 131.1.1.1	
	redistribute bgp 65001 route-map bgp65001	

LEAF-2 Configuration

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

```
install feature-set mpls                          interface Ethernet1/51
feature-set mpls                                    ip address 172.16.1.2/24           router bgp 65001
nv overlay evpn                                      ip ospf network point-to-point      router-id 192.168.1.4
feature ospf                                         ip router ospf 100 area 0.0.0.0     address-family ipv4 unicast
feature bgp                                          mpls ip forwarding                    network 192.168.1.4/32 route-map label-index-Leaf2
feature mpls segment-routing                         no shutdown                           allocate-label all
feature mpls evpn                                                                        address-family ipv4 labeled-unicast
feature interface-vlan                            interface Ethernet1/52               address-family l2vpn evpn
feature mpls oam                                     ip address 172.16.3.2/24
feature nv overlay                                   ip ospf network point-to-point      template peer EVPN
                                                     ip router ospf 100 area 0.0.0.0      remote-as 65001
mpls label range 5000 450000                         mpls ip forwarding                   update-source loopback0
segment-routing                                      no shutdown                          address-family l2vpn evpn
  mpls                                                                                      send-community extended
    global-block 16000 25000                      interface loopback0                      encapsulation mpls
    connected-prefix-sid-map                         ip address 192.168.1.4/32
      address-family ipv4                            ip router ospf 100 area 0.0.0.0    template peer Labeled-unicast
        192.168.1.4/32 index 321                                                          remote-as 65001
                                                  router ospf 100                          address-family ipv4 labeled-unicast
ip prefix-list new seq 5 permit 68.1.1.0/24         segment-routing mpls                     send-community extended
ip prefix-list new seq 10 permit 133.1.1.1/32       router-id 192.168.1.4                    soft-reconfiguration inbound always

ip prefix-list new1 seq 5 permit 3.3.3.3/32       PE-CE                                  neighbor 172.16.1.1
                                                    vrf cu101                              inherit peer Labeled-unicast
ip prefix-list redtoospf seq 5 permit 61.1.1.0/24     address-family ipv4 unicast        neighbor 172.16.3.1
ip prefix-list redtoospf seq 10 permit 1.1.1.1/32   interface Ethernet1/55                 inherit peer Labeled-unicast
                                                      no shutdown                        neighbor 192.168.1.1
route-map bgp65001 permit 10                        interface Ethernet1/55.200             inherit peer EVPN
  match route-type internal                          encapsulation dot1q 200            neighbor 192.168.1.2
route-map direct1 permit 10                          vrf member cu101                      inherit peer EVPN
  match ip address prefix-list new                   ip address 68.1.1.1/24
route-map label-index-Leaf2 permit 10               ip ospf network point-to-point
  set label-index 321                                ip router ospf 200 area 0.0.0.0    vrf cu101
route-map ospf200 permit 10                          no shutdown                          router-id 133.1.1.1
  match ip address prefix-list new1                                                       address-family ipv4 unicast
                                                  interface loopback11                      advertise l2vpn evpn
vrf context cu101                                    vrf member cu101                       redistribute direct route-map direct1
  rd auto                                            ip address 133.1.1.1/32               redistribute ospf 200 route-map ospf200
  address-family ipv4 unicast                       ip router ospf 200 area 0.0.0.0
    route-target import 1:101
    route-target import 1:101 evpn               router ospf 200
    route-target export 1:101                       vrf cu101
    route-target export 1:101 evpn                  router-id 133.1.1.1
                                                    redistribute bgp 65001 route-map bgp65001
```

End-Host Configuration

Host-1 / Cat-3750

```
vrf definition custA
 rd 101:1
 !
 address-family ipv4
 exit-address-family
 !


interface Loopback0
 vrf forwarding custA
 ip address 1.1.1.1 255.255.255.255


interface GigabitEthernet1/0/1
 switchport trunk allowed vlan 101
 switchport trunk encapsulation dot1q
 switchport mode trunk
 !


interface Vlan101
 vrf forwarding custA
 ip address 61.1.1.2 255.255.255.0
 ip ospf network point-to-point
 ip ospf 200 area 0.0.0.0


router ospf 200 vrf custA
 router-id 1.1.1.1
 network 1.1.1.1 0.0.0.0 area 0.0.0.0
 network 61.1.1.0 0.0.0.255 area 0.0.0.0
```

Host-2 / N9K

```
feature ospf
feature interface-vlan


interface Ethernet1/52
 switchport
 switchport mode trunk
 switchport trunk allowed vlan 200
 no shutdown


interface Vlan200
 no shutdown
 ip address 68.1.1.2/24
 ip ospf network point-to-point
 ip router ospf 200 area 0.0.0.0


interface loopback0
 ip address 3.3.3.3/32
 ip router ospf 200 area 0.0.0.0


router ospf 200
 router-id 3.3.3.3
```

Verificar

```
Host2# show ip int brief
IP Interface Status for VRF "default"(1)
Interface       IP Address      Interface Status
Vlan200         68.1.1.2        protocol-up/link-up/admin-up
Vlan1001        100.0.0.100     protocol-down/link-down/admin-up
Lo0             3.3.3.3         protocol-up/link-up/admin-up

Host2# show ip route
IP Route Table for VRF "default"
'*' 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 68.1.1.1, Vlan200, [110/1], 00:29:24, ospf-200, type-2, tag 65001
3.3.3.3/32, ubest/mbest: 2/0, attached
    *via 3.3.3.3, Lo0, [0/0], 20:16:34, local
    *via 3.3.3.3, Lo0, [0/0], 20:16:34, direct
61.1.1.0/24, ubest/mbest: 1/0
    *via 68.1.1.1, Vlan200, [110/1], 00:29:24, ospf-200, type-2, tag 65001
68.1.1.0/24, ubest/mbest: 1/0, attached
    *via 68.1.1.2, Vlan200, [0/0], 20:20:55, direct
68.1.1.2/32, ubest/mbest: 1/0, attached
    *via 68.1.1.2, Vlan200, [0/0], 20:20:55, local
131.1.1.1/32, ubest/mbest: 1/0
    *via 68.1.1.1, Vlan200, [110/1], 00:29:24, ospf-200, type-2, tag 65001
133.1.1.1/32, ubest/mbest: 1/0
    *via 68.1.1.1, Vlan200, [110/41], 20:15:32, ospf-200, intra
```

```
Host2# traceroute 1.1.1.1
traceroute to 1.1.1.1 (1.1.1.1), 30 hops max, 40 byte packets
 1  68.1.1.1 (68.1.1.1)  0.989 ms  0.585 ms  0.407 ms
 2  172.16.3.1 (172.16.3.1)  0.886 ms 172.16.1.1 (172.16.1.1)  0.765 ms  0.731 ms
    [Label=16311 E=0 TTL=1 S=0, Label=492289 E=0 TTL=1 S=1]
    [Label=16311 E=0 TTL=1 S=0, Label=492289 E=0 TTL=1 S=1]
    [Label=16311 E=0 TTL=1 S=0, Label=492289 E=0 TTL=1 S=1]
 3  172.16.0.2 (172.16.0.2)  0.717 ms 172.16.2.2 (172.16.2.2)  0.509 ms 172.16.0.2 (172.16.0.2)  0.678 ms
    [Label=492289 E=0 TTL=1 S=1]
    [Label=492289 E=0 TTL=1 S=1]
    [Label=492289 E=0 TTL=1 S=1]
 4  61.1.1.2 (61.1.1.2)  2.061 ms *  1.315 ms

Host2# ping 1.1.1.1 source 3.3.3.3
PING 1.1.1.1 (1.1.1.1) from 3.3.3.3: 56 data bytes
64 bytes from 1.1.1.1: icmp_seq=0 ttl=251 time=5.538 ms
64 bytes from 1.1.1.1: icmp_seq=1 ttl=251 time=1.338 ms
64 bytes from 1.1.1.1: icmp_seq=2 ttl=251 time=2.201 ms
64 bytes from 1.1.1.1: icmp_seq=3 ttl=251 time=2.217 ms
64 bytes from 1.1.1.1: icmp_seq=4 ttl=251 time=4.021 ms

--- 1.1.1.1 ping statistics ---
5 packets transmitted, 5 packets received, 0.00% packet loss
round-trip min/avg/max = 1.338/3.063/5.538 ms
```

```
Leaf1# show ip route 3.3.3.3/32 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>

3.3.3.3/32, ubest/mbest: 1/0
    *via 192.168.1.4%default, [200/2], 00:44:27, bgp-65001, internal, tag 65001 (mpls-vpn)
```

```
Leaf1# show forwarding mpls 192.168.1.4/32
slot  1
=======

--------+-----------+--------------------+----------------+-------------+-------
Local   |Prefix     |FEC                 |Next-Hop        |Interface    |Out
Label   |Table Id   |(Prefix/Tunnel id)  |                |             |Label
--------+-----------+--------------------+----------------+-------------+-------
16321   |0x1        |192.168.1.4/32      |172.16.0.1      |Eth1/51      |16321   SWAP
    "   |0x1        |192.168.1.4/32      |172.16.2.1      |Eth1/52      |16321   SWAP
```

```
Leaf1# show forwarding 3.3.3.3/32 vrf cu101
slot  1
=======

IPv4 routes for table cu101/base

-------------------+------------------------+-----------------+------------------+-------------------
Prefix             | Next-hop               | Interface       | Labels           | Partial Install
-------------------+------------------------+-----------------+------------------+-------------------
*3.3.3.3/32         172.16.0.1               Ethernet1/51      PUSH 16321 492288
                    172.16.2.1               Ethernet1/52      PUSH 16321 492288
```

Informações Relacionadas

- [VPN MPLS de BGP multiprotocolo](#)
- [Segmento de roteamento nos switches de plataforma Cisco Nexus 9500, 9300, 9200, 3200 e 3100 White paper](#)
- [Configurando o EVPN de Camada 3 e VPN de Camada 3 sobre MPLS de Roteamento de Segmento](#)