

Implemente o roteamento de trânsito da ACI (multipod)

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Introdução

Este documento descreve como configurar o roteamento de trânsito em um ambiente multipod da Application Centric Infrastructure (ACI).

Pré-requisitos

Requisitos

A Cisco recomenda que você tenha conhecimento destes tópicos:

1. ACI multipod
2. L3Saída
3. Contratos
4. Protocolos de Roteamento

Componentes Utilizados

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

1. 2 switches N5K-C5548UP, ambos no NXOS versão 7.3(8) (usados como roteadores externos)
2. 1 switch leaf N9K-C9332PQ e 1 switch leaf N9K-C93108TC-EX, ambos na versão 14.2(7f) do ACI
3. 2 switches spine N9K-C9336PQ, ambos na versão 14.2(7f) da ACI
4. 1 switch N9K-C9232C (usado como dispositivo IPN) no NXOS versão 10.3(3)

As informações neste documento foram criadas usando os dispositivos acima em um ambiente de

laboratório específico. Todos os dispositivos utilizados neste documento foram iniciados com uma configuração (padrão) inicial. Se a rede estiver ativa, certifique-se de que você entenda o impacto potencial de qualquer comando.

Informações de Apoio

No roteamento em trânsito, a estrutura da Cisco ACI anuncia as rotas aprendidas de uma conexão L3Out (L3Out) de Camada 3 para outra conexão L3Out. Os domínios externos de Camada 3 correspondem à estrutura nos switches leaf de borda. A estrutura é um domínio de protocolo de gateway de borda multiprotocolo (MP-BGP) de trânsito entre os correspondentes.

Configurar

Diagrama de Rede

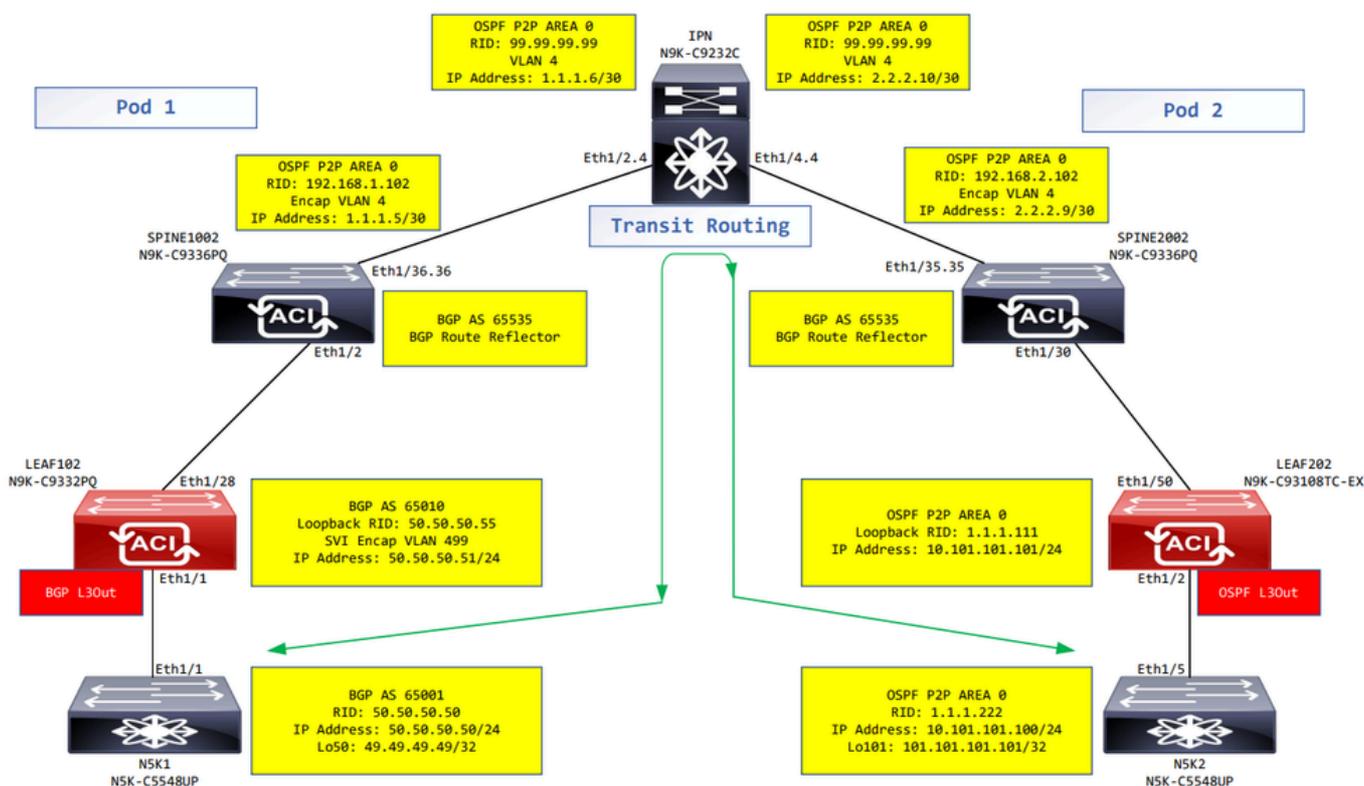
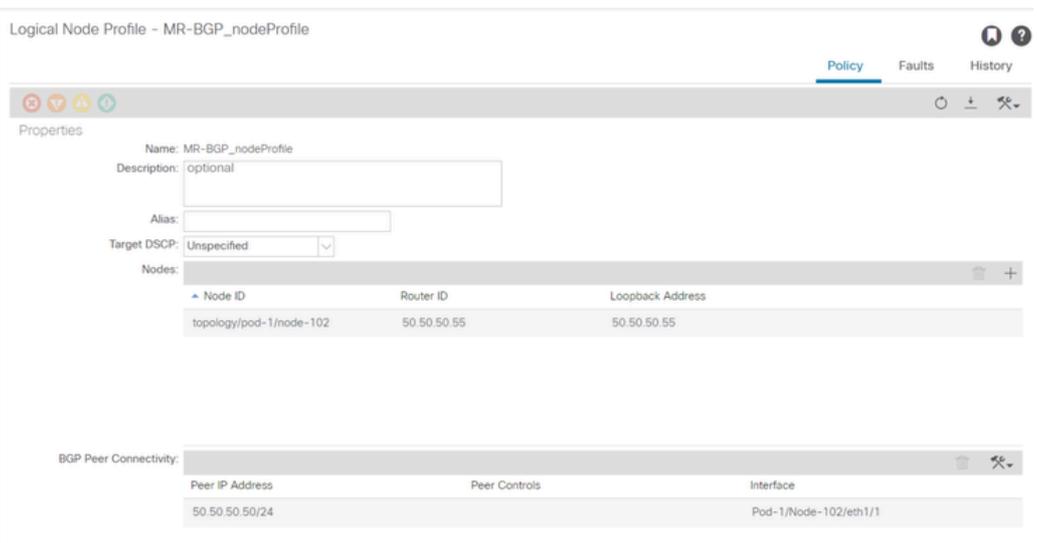
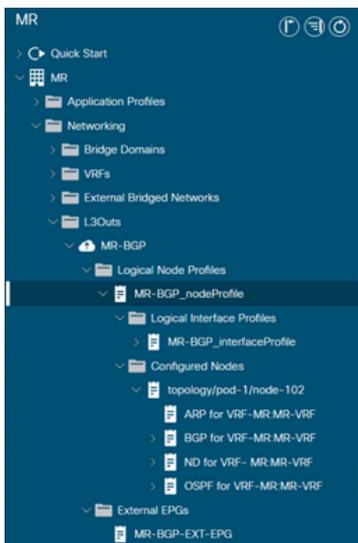


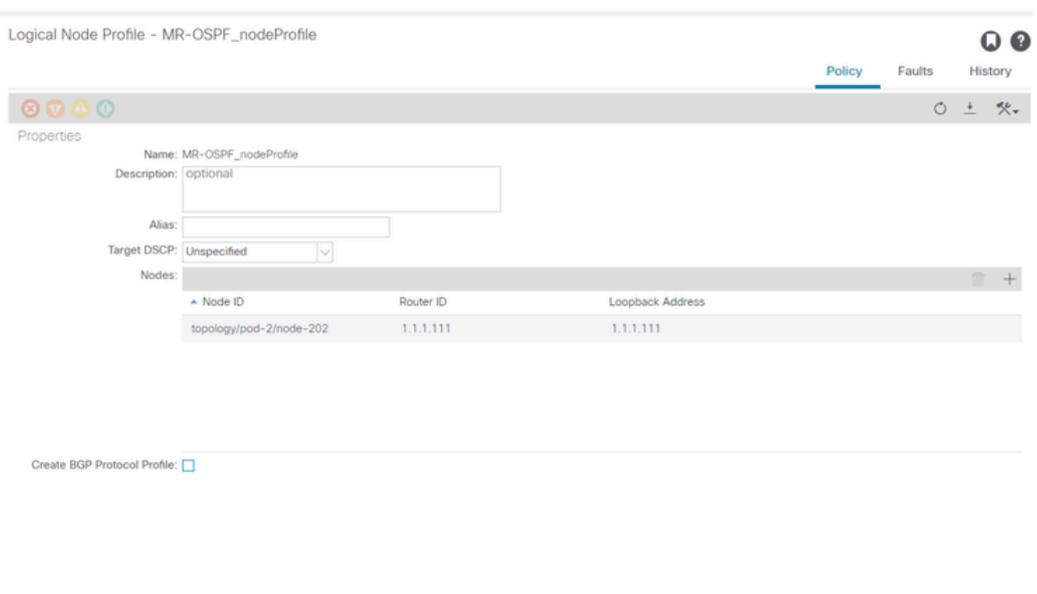
Diagrama de Rede

Configurações

Um perfil de nó lógico é usado para identificar o switch leaf que está conectado a redes externas e que pode implantar o protocolo de roteamento ou rotas estáticas para ele. Para exibir o perfil do nó lógico na L3Out, navegue até o Tenant > Networking > L3Outs > L3Out > Logical Node Profiles > Logical Node Profile conforme mostrado na imagem.

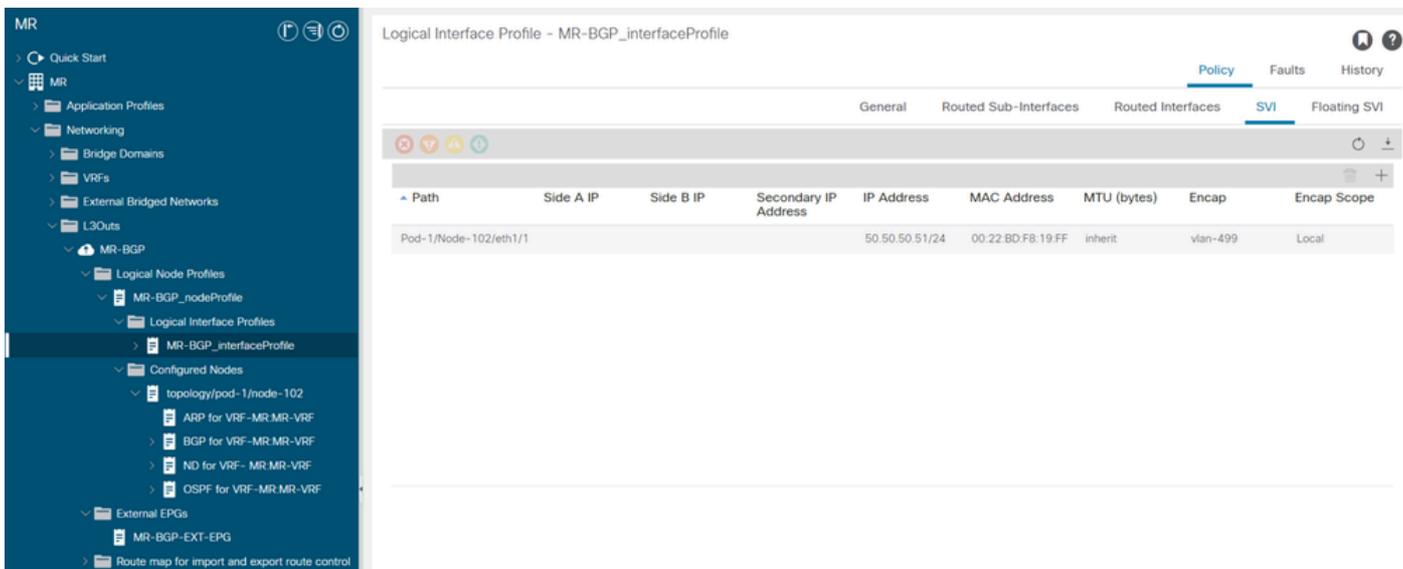


Perfil de nó lógico para LEAF102

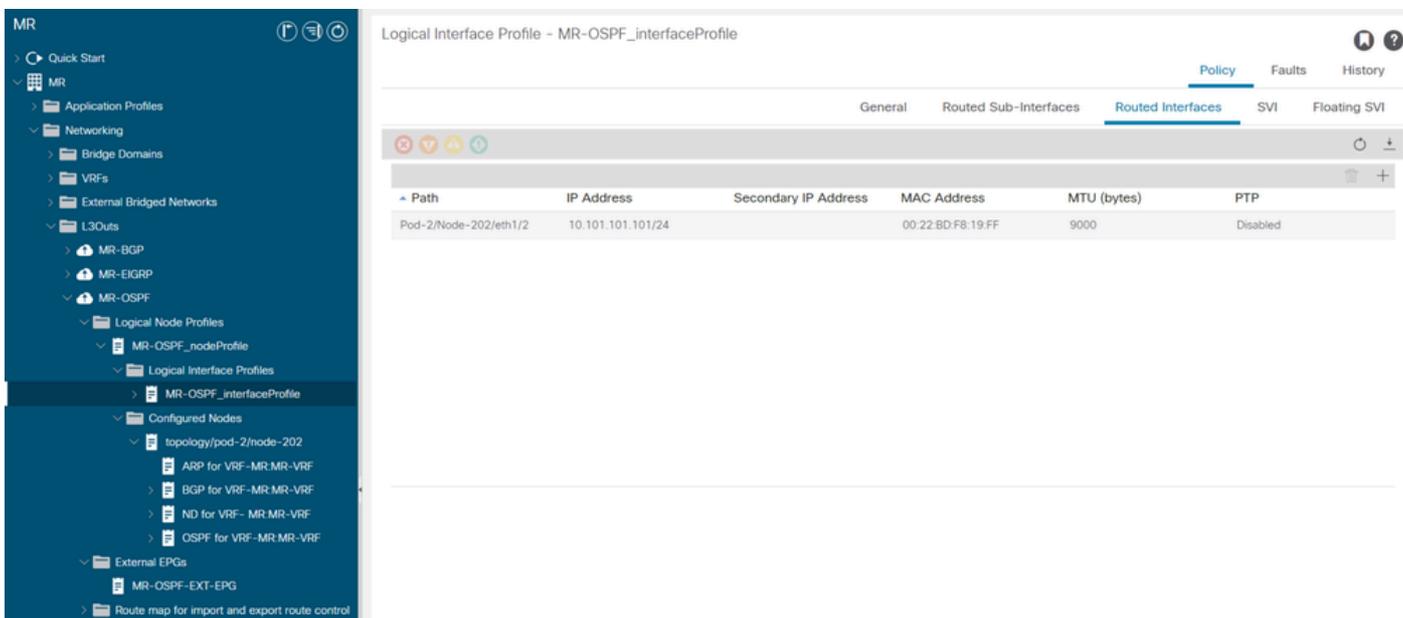


Perfil de nó lógico para LEAF202

Um perfil de interface lógica é usado para identificar a interface L3Out que se conecta ao dispositivo externo. Você vê vários elementos de função que são definidos para roteamento e encaminhamento virtual (VRF): Address Resolution Protocol (ARP), Border Gateway Protocol (BGP), Neighbor Discovery e Open Shortest Path First (OSPF) como consequência de ambos os perfis. Para exibir o perfil da interface lógica na L3Out, navegue até o Tenant > Networking > L3Outs > L3Out > Logical Node Profiles > Logical Node Profile > Logical Interface Profiles > Logical Interface Profile. **Nesses exemplos, um SVI é configurado no perfil de interface lógica.**



Perfil de interface lógica para LEAF102, eth1/1



Perfil de interface lógica para LEAF202, eth1/2

Um perfil de instância de EPG externo (EPG externo, EPG L3Out) representa um grupo de sub-redes externas que têm o mesmo comportamento de segurança. Outras sub-redes também podem se associar a outros escopos, que definem o comportamento de roteamento para essa sub-rede. Para exibir o EPG externo na L3Out, navegue até o Tenant > Networking > L3Outs > L3Out > External EPGs > External EPG conforme mostrado na imagem.

The screenshot displays the configuration page for 'External EPG Instance Profile - MR-BGP-EXT-EPG'. The left sidebar shows a navigation tree with 'MR-BGP-EXT-EPG' selected under 'External EPGs'. The main panel has tabs for 'Policy', 'Operational', 'Stats', 'Health', 'Faults', and 'History', with 'General' selected. The 'Properties' section includes:

- Name: MR-BGP-EXT-EPG
- Alias: (empty field)
- Tags: (dropdown menu)
- Global Alias: (empty field)
- Description: optional
- pcTag: 49159
- Contract Exception Tag: (empty field)
- Configured VRF Name: MR-VRF
- Resolved VRF: uni/tn-MR/ctx-MR-VRF
- QoS Class: Unspecified
- Target DSCP: Unspecified
- Configuration Status: applied
- Configuration Issues: (empty)
- Preferred Group Member: Exclude (selected) / Include

The 'Subnets' table is as follows:

IP Address	Scope	Name	Aggregate	Route Control Profile	Route Summarization Policy
49.49.49.49/32					External Subnets for th...

Perfil de instância de EPG externo para MR-BGP L3Out

The screenshot displays the configuration page for 'External EPG Instance Profile - MR-OSPF-EXT-EPG'. The left sidebar shows a navigation tree with 'MR-OSPF-EXT-EPG' selected under 'External EPGs'. The main panel has tabs for 'Policy', 'Operational', 'Stats', 'Health', 'Faults', and 'History', with 'General' selected. The 'Properties' section includes:

- Name: MR-OSPF-EXT-EPG
- Alias: (empty field)
- Tags: (dropdown menu)
- Global Alias: (empty field)
- Description: optional
- pcTag: 49156
- Contract Exception Tag: (empty field)
- Configured VRF Name: MR-VRF
- Resolved VRF: uni/tn-MR/ctx-MR-VRF
- QoS Class: Unspecified
- Target DSCP: Unspecified
- Configuration Status: applied
- Configuration Issues: (empty)
- Preferred Group Member: Exclude / Include

The 'Subnets' table is as follows:

IP Address	Scope	Name	Aggregate	Route Control Profile	Route Summarization Policy
101.101.101.101/32					External Subnets for th...

Perfil de instância de EPG externo para MR-OSPF L3Out

Nesses exemplos, o MR-PERMIT-ICMP contrato é aplicado como um contrato fornecido e consumido em ambos os EPGs externos.

External EPG Instance Profile - MR-BGP-EXT-EPG

Policy Operational Stats Health Faults History

General Contracts Inherited Contracts

Healthy

Name	Tenant	Tenant Alias	Contract Type	Provided / Consumed	QoS Class	State	Label	Subject Label
Contract Type: Contract								
MR-PERMIT-ICMP	MR		Contract	Provided	Unspecified	formed		
MR-PERMIT-ICMP	MR		Contract	Consumed	Unspecified	formed		

Contrato MR-PERMIT-ICMP aplicado ao MR-BGP-EXT-EPG

External EPG Instance Profile - MR-OSPF-EXT-EPG

Policy Operational Stats Health Faults History

General Contracts Inherited Contracts

Healthy

Name	Tenant	Tenant Alias	Contract Type	Provided / Consumed	QoS Class	State	Label	Subject Label
Contract Type: Contract								
MR-PERMIT-ICMP	MR		Contract	Provided	Unspecified	formed		
MR-PERMIT-ICMP	MR		Contract	Consumed	Unspecified	formed		

Contrato MR-PERMIT-ICMP aplicado ao MR-OSPF-EXT-EPG

Ligado LEAF102, o BGP é estabelecido com o vizinho 50.50.50.50 e está recebendo a rede externa 49.49.49.32.

BGP Peer Entry - 50.50.50.50

General Address Health Faults History

Properties

- Vrf Name: MR-MR-VRF
- BGP Version: BGP Version 4
- Remote Router Id: 50.50.50.50
- BGP State: Established
- Up For: 2022-07-27T17:17:22.493+00:00
- Remote As: 65001
- Update Source: vlan14
- Restart Time Advertised By Peer: Default
- Hold Time: 180
- Keepalive Interval: 60
- Neighbor: 50.50.50.50
- Link: eBGP
- Peer Index: 1
- Shutdown Reason: Unspecified
- State Reason: none
- Directly Attached Interface: vlan14
- Tcp Md5 Authentication: disabled
- Connection Established: 1
- Connection Dropped: 0
- Connection Attempts: na

Message Statistics

	Sent	Rcvd
Opens	1	1
Notifications	0	0
Updates	8	2
Keepalives	1692	1689
Route Refresh	0	0
Capability	1	1
Total	1702	1693
Total bytes	32485	32186
Bytes in queue	0	0

Next Hop

Address:	Resolved Using:
Refcount	

Entrada de par BGP em LEAF102

```
LEAF102# show ip bgp summary vrf MR:MR-VRF
BGP summary information for VRF MR:MR-VRF, address family IPv4 Unicast
BGP router identifier 50.50.50.55, local AS number 65535
BGP table version is 37, IPv4 Unicast config peers 4, capable peers 2
14 network entries and 16 paths using 1952 bytes of memory
BGP attribute entries [12/1776], BGP AS path entries [0/0]
BGP community entries [0/0], BGP clusterlist entries [5/28]

Neighbor      V   AS MsgRcvd MsgSent  TblVer  InQ  OutQ  Up/Down  State/PfxRcd
50.50.50.50   4 65001  1691    1700    37    0    0    1d04h 1
```

Resumo do BGP para VRF MR:MR-VRF no LEAF102

```
LEAF102# show ip route bgp vrf MR:MR-VRF
IP Route Table for VRF "MR:MR-VRF"
'*' denotes best ucast next-hop
***' denotes best mcast next-hop
'[x/y]' denotes [preference/metric]
'%<string>' in via output denotes VRF <string>

49.49.49.49/32, ubest/mbest: 1/0
*via 50.50.50.50%MR:MR-VRF, [20/0], 1d04h, bgp-65535, external, tag 65010
```

Rota BGP para VRF MR:MR-VRF em LEAF102

Ligado LEAF202, o OSPF é estabelecido com o vizinho 1.1.1.222 e está recebendo a rede externa 101.101.101.101/32.

OSPF - MR:MR-VRF

General Health Faults History

PROPERTIES

Name: MR:MR-VRF
Route ID: 1.1.1.111
Distance: 110
Max ECMP: 8
Bandwidth Reference (Mbps): 40000
Operational State: Up

STATS

Interface Count: 2
Activeareact: 1
Active Nssa Areaact: 0
Active Stub Areaact: 0
Active Ext Areaact: 1
Extareaact: 1
Nssa Areaact: 0
Stubareaact: 0
Areaact: 1
Ext Lsact: 1
Opaqas Lsact: 0

Neighbors

Neighbor Id	State	Peer Ip	Interface
1.1.1.222	Full	10.101.101.100	eth1/2

Page 1 of 1
Objects Per Page: 15
Displaying Objects 1 - 1 Of 1

Inter Protocol Route Leak Into OSPF

Name	Redistribution Protocol	Route Map	Scope	Asn
MR:MR-VRF	BGP	exp-ctx-PROTO-2555906	Inter protocol leak	65535
MR:MR-VRF	COOP	exp-ctx-st-2555906	Inter protocol leak	1
MR:MR-VRF	Direct	exp-ctx-st-2555906	Inter protocol leak	1
MR:MR-VRF	EIGRP	exp-ctx-PROTO-2555906	Inter protocol leak	1
MR:MR-VRF	Static	exp-ctx-st-2555906	Inter protocol leak	1

Entrada de vizinho OSPF em LEAF202

```
LEAF202# show ip ospf neighbors vrf MR:MR-VRF
OSPF Process ID default VRF MR:MR-VRF
Total number of neighbors: 1
Neighbor ID      Pri State           Up Time    Address          Interface
1.1.1.222        1 FULL/ -          2d04h     10.101.101.100  Eth1/2
```

Vizinho OSPF para VRF MR:MR-VRF no LEAF202

```
LEAF202# show ip route ospf vrf MR:MR-VRF
IP Route Table for VRF "MR:MR-VRF"
'*' denotes best ucast next-hop
'**' denotes best mcast next-hop
'[x/y]' denotes [preference/metric]
'%<string>' in via output denotes VRF <string>

101.101.101.101/32, ubest/mbest: 1/0
 *via 10.101.101.100, eth1/2, [110/41], 1d00h, ospf-default, intra
```

Rota OSPF para VRF MR:MR-VRF em LEAF202

Em ambos LEAF102 e LEAF202, a tabela MP-BGP para o VRF mostra a rede BGP externa, 49.49.49.49/32, mas aparece como externo em LEAF102 e interno em LEAF202. A rede externa OSPF, 101.101.101.101/32, também aparece nas tabelas BGP em ambos os switches leaf; em LEAF202 ele aparece como redistribuído do OSPF e em LEAF102 é mostrado como interno.

```
LEAF102# show bgp vpnv4 unicast vrf MR:MR-VRF
BGP routing table information for VRF overlay-1, address family VPNv4 Unicast
BGP table version is 119, local router ID is 10.0.232.68
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

Network          Next Hop          Metric      LocPrf      Weight Path
Route Distinguisher: 102:2555906 (VRF MR:MR-VRF)
*>e49.49.49.49/32  50.50.50.50      0           100         0 65010 65001 i
*>i101.101.101.101/32 20.0.248.0      41          100         0 ?
```

Tabela MP-BGP para VRF MR:MR-VRF no LEAF102

```
LEAF202# show bgp vpnv4 unicast vrf MR:MR-VRF
BGP routing table information for VRF overlay-1, address family VPNv4 Unicast
BGP table version is 95, local router ID is 20.0.248.0
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

  Network          Next Hop          Metric      LocPrf      Weight Path
Route Distinguisher: 202:2555906 (VRF MR:MR-VRF)
*>i49.49.49.49/32  10.0.232.68      100         100         0 65010 65001 i
*>r101.101.101.101/32 0.0.0.0          41          100         32768 ?
```

Tabela MP-BGP para VRF MR:MR-VRF no LEAF202

A tabela BGP IPv4 contém informações equivalentes.

```
LEAF102# show bgp ipv4 unicast vrf MR:MR-VRF
BGP routing table information for VRF MR:MR-VRF, address family IPv4 Unicast
BGP table version is 37, local router ID is 50.50.50.55
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

  Network          Next Hop          Metric      LocPrf      Weight Path
*>e49.49.49.49/32  50.50.50.50      100         100         0 65010 65001 i
*>i101.101.101.101/32 20.0.248.0       41          100         0 ?
```

Tabela BGP IPv4 para VRF MR:MR-VRF no LEAF102

```
LEAF202# show bgp ipv4 unicast vrf MR:MR-VRF
BGP routing table information for VRF MR:MR-VRF, address family IPv4 Unicast
BGP table version is 31, local router ID is 1.1.1.111
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

  Network          Next Hop          Metric      LocPrf      Weight Path
*>i49.49.49.49/32  10.0.232.68      100         100         0 65010 65001 i
*>r101.101.101.101/32 0.0.0.0          41          100         32768 ?
```

Tabela BGP IPv4 para VRF MR:MR-VRF no LEAF202

No entanto, a rede externa OSPF, 101.101.101.101/32, não está na tabela de roteamento de N5K1.

```
N5K1# show ip route vrf MR-BGP
IP Route Table for VRF "MR-BGP"
'*' denotes best ucast next-hop
'**' denotes best mcast next-hop
'[x/y]' denotes [preference/metric]
'%<string>' in via output denotes VRF <string>

49.49.49.49/32, ubest/mbest: 2/0, attached
  *via 49.49.49.49, Lo50, [0/0], 1d07h, local
  *via 49.49.49.49, Lo50, [0/0], 1d07h, direct
50.50.50.0/24, ubest/mbest: 1/0, attached
  *via 50.50.50.50, Vlan499, [0/0], 1d07h, direct
50.50.50.50/32, ubest/mbest: 1/0, attached
  *via 50.50.50.50, Vlan499, [0/0], 1d07h, local
```

RIB para VRF MR-BGP em N5K1

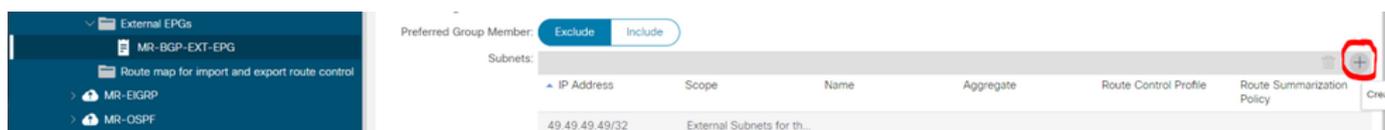
Da mesma forma, a rede externa de BGP, 49.49.49.49/32, não está em N5K2 É o RIB.

```
N5K2# show ip route vrf MR-OSPF
IP Route Table for VRF "MR-OSPF"
'*' denotes best ucast next-hop
 '**' denotes best mcast next-hop
 '[x/y]' denotes [preference/metric]
 '%<string>' in via output denotes VRF <string>

1.1.1.111/32, ubest/mbest: 1/0
  *via 10.101.101.101, Eth1/5, [110/41], 2d05h, ospf-1, intra
10.101.101.0/24, ubest/mbest: 1/0, attached
  *via 10.101.101.100, Eth1/5, [0/0], 6d22h, direct
10.101.101.100/32, ubest/mbest: 1/0, attached
  *via 10.101.101.100, Eth1/5, [0/0], 6d22h, local
101.101.101.101/32, ubest/mbest: 2/0, attached
  *via 101.101.101.101, Lo101, [0/0], 2d04h, local
  *via 101.101.101.101, Lo101, [0/0], 2d04h, direct
```

RIB para VRF MR-OSPF no N5K2

No BGP L3Out, navegue até External EPGs > External EPG > Subnets e selecione a opção + no canto superior direito da tabela. Insira o endereço IP da sub-rede externa recebida da L3Out do OSPF, 101.101.101.101/32. Escolher Export Route Control Subnet no Route Control e desmarque a caixa de seleção External Subnets for the External EPG classificação. Clique em Submit. O Export Route Control Subnet permite que uma rede seja exportada (anunciada) para o peer externo.



Criar nova sub-rede

Create Subnet dialog box. Fields include IP Address (101.101.101.101/32), Name, Route Control (Export Route Control Subnet checked), Aggregate (Aggregate Export, Import, Shared Routes unchecked), Route Summarization Policy (BGP Route Summarization Policy), Route Control Profile table, and External EPG classification (External Subnets for External EPG checked). Buttons for Cancel and Submit are at the bottom right, with Submit circled in red.

Configurar as opções corretas para a nova sub-rede

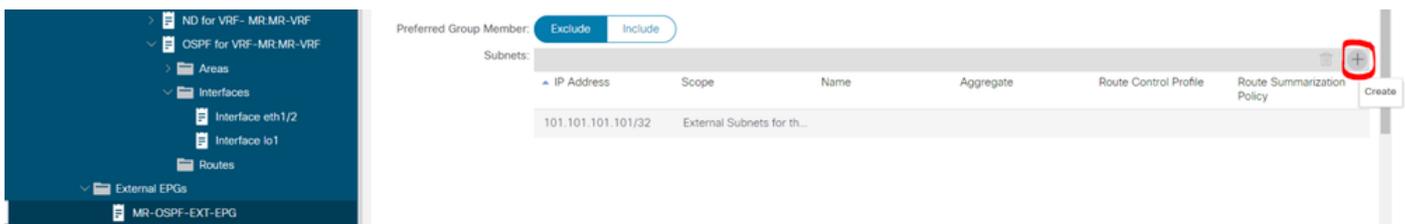
Ligado N5K1, a rede externa OSPF, 101.101.101.101/32, agora é recebido pelo BGP.

```
N5K1# show ip route vrf MR-BGP
IP Route Table for VRF "MR-BGP"
*' denotes best ucast next-hop
**' denotes best mcast next-hop
'[x/y]' denotes [preference/metric]
'%<string>' in via output denotes VRF <string>

49.49.49.49/32, ubest/mbest: 2/0, attached
  *via 49.49.49.49, Lo50, [0/0], 1d08h, local
  *via 49.49.49.49, Lo50, [0/0], 1d08h, direct
50.50.50.0/24, ubest/mbest: 1/0, attached
  *via 50.50.50.50, Vlan499, [0/0], 1d08h, direct
50.50.50.50/32, ubest/mbest: 1/0, attached
  *via 50.50.50.50, Vlan499, [0/0], 1d08h, local
101.101.101.101/32, ubest/mbest: 1/0
  *via 50.50.50.51, [20/0], 00:00:03, bgp-65001, external, tag 65010,
```

RIB para VRF MR-BGP em N5K1

Na L3Out do OSPF, navegue até External EPGs > External EPG > Subnets e selecione a opção + no canto superior direito da tabela. Insira o endereço IP da sub-rede externa recebida do BGP L3Out, 49.49.49.49/32. Escolher Export Route Control Subnet no Route Control section and clear External Subnets for the External EPG classificação. Clique em Submit.



Criar nova sub-rede

Create Subnet



IP Address:
address/mask

Name:

Route Control:

- Export Route Control Subnet
- Import Route Control Subnet
- Shared Route Control Subnet

- ### Aggregate
- Aggregate Export
 - Aggregate Import
 - Aggregate Shared Routes

Route Summarization Policy

Route Control Profile:

Name	Direction
------	-----------

Route control is used for filtering external routes advertised out of the fabric, allowed into the fabric, or leaked to other VRFs within the fabric.

External EPG classification:

- External Subnets for External EPG
- Shared Security Import Subnet

External EPG classification is used to identify the external networks associated with this external EPG for policy enforcement (Contracts).

Cancel

Submit

Configurar as opções corretas para a nova sub-rede

Agora em N5K2, a rede externa BGP, 49.49.49.49/32, é recebido através do OSPF.

```
N5K2# show ip route vrf MR-OSPF
IP Route Table for VRF "MR-OSPF"
'*' denotes best ucast next-hop
 '**' denotes best mcast next-hop
 '[x/y]' denotes [preference/metric]
 '%<string>' in via output denotes VRF <string>

1.1.1.111/32, ubest/mbest: 1/0
  *via 10.101.101.101, Eth1/5, [110/41], 2d05h, ospf-1, intra
10.101.101.0/24, ubest/mbest: 1/0, attached
  *via 10.101.101.100, Eth1/5, [0/0], 6d22h, direct
10.101.101.100/32, ubest/mbest: 1/0, attached
  *via 10.101.101.100, Eth1/5, [0/0], 6d22h, local
49.49.49.49/32, ubest/mbest: 1/0
  *via 10.101.101.101, Eth1/5, [110/1], 00:01:59, ospf-1, type-2, tag 4294967295,
101.101.101.101/32, ubest/mbest: 2/0, attached
  *via 101.101.101.101, Lo101, [0/0], 2d05h, local
  *via 101.101.101.101, Lo101, [0/0], 2d05h, direct
```

RIB para VRF MR-OSPF no N5K2

O ping funciona entre as duas redes devido à MR-PERMIT-ICMP que foi aplicado a ambos os EPGs externos anteriormente.

```
N5K1# ping 101.101.101.101 vrf MR-BGP source 49.49.49.49
PING 101.101.101.101 (101.101.101.101) from 49.49.49.49: 56 data bytes
64 bytes from 101.101.101.101: icmp_seq=0 ttl=252 time=3.059 ms
64 bytes from 101.101.101.101: icmp_seq=1 ttl=252 time=2.963 ms
64 bytes from 101.101.101.101: icmp_seq=2 ttl=252 time=7.928 ms
64 bytes from 101.101.101.101: icmp_seq=3 ttl=252 time=2.954 ms
64 bytes from 101.101.101.101: icmp_seq=4 ttl=252 time=2.982 ms

--- 101.101.101.101 ping statistics ---
5 packets transmitted, 5 packets received, 0.00% packet loss
round-trip min/avg/max = 2.954/3.977/7.928 ms
```

Verificação de comunicação no N5K1

```
N5K2# ping 49.49.49.49 vrf MR-OSPF source 101.101.101.101
PING 49.49.49.49 (49.49.49.49) from 101.101.101.101: 56 data bytes
64 bytes from 49.49.49.49: icmp_seq=0 ttl=252 time=3.107 ms
64 bytes from 49.49.49.49: icmp_seq=1 ttl=252 time=2.99 ms
64 bytes from 49.49.49.49: icmp_seq=2 ttl=252 time=2.98 ms
64 bytes from 49.49.49.49: icmp_seq=3 ttl=252 time=2.986 ms
64 bytes from 49.49.49.49: icmp_seq=4 ttl=252 time=2.99 ms

--- 49.49.49.49 ping statistics ---
5 packets transmitted, 5 packets received, 0.00% packet loss
round-trip min/avg/max = 2.98/3.01/3.107 ms
```

Verificação de comunicação no N5K2

Informações Relacionadas

- [Guia de configuração de rede da camada 3 do Cisco APIC, versão 6.0\(x\)](#)
- [Fundamentos da Cisco Application Centric Infrastructure, versão 4.2\(x\)](#)
- [Guia de configuração de rede da camada 3 do Cisco APIC, versão 3.x e anterior](#)
- [Suporte técnico e downloads da Cisco](#)

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