

# Implementación del routing de tránsito de ACI (multipod)

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## Introducción

Este documento describe cómo configurar el ruteo de tránsito en un entorno multipod de Infraestructura centrada en aplicaciones (ACI).

## Prerequisites

### Requirements

Cisco recomienda que tenga conocimiento sobre estos temas:

1. multipod ACI
2. L3Out
3. Contratos
4. Protocolos de ruteo

### Componentes Utilizados

La información que contiene este documento se basa en las siguientes versiones de software y hardware.

1. 2 switches N5K-C5548UP, ambos en NXOS versión 7.3(8) (se utilizan como routers externos)
2. 1 switch de hoja N9K-C9332PQ y 1 switch de hoja N9K-C93108TC-EX, ambos en ACI versión 14.2(7f)
3. 2 switches de columna N9K-C9336PQ, ambos en ACI versión 14.2(7f)
4. 1 switch N9K-C9232C (utilizado como dispositivo IPN) en NXOS versión 10.3(3)

La información de este documento se creó utilizando los dispositivos anteriores en un entorno de laboratorio específico. Todos los dispositivos que se utilizan en este documento se pusieron en funcionamiento con una configuración verificada (predeterminada). Si tiene una red en vivo, asegúrese de entender el posible impacto de cualquier comando.

## Antecedentes

En el routing de tránsito, el fabric de Cisco ACI anuncia las rutas que se aprenden de una conexión de salida de capa 3 (L3Out) a otra conexión L3Out. Los dominios de capa 3 externos se emparejan con el fabric en los switches de hoja de borde. El fabric es un dominio de protocolo de gateway fronterizo multiprotocolo (MP-BGP) de tránsito entre los pares.

## Configurar

### Diagrama de la red

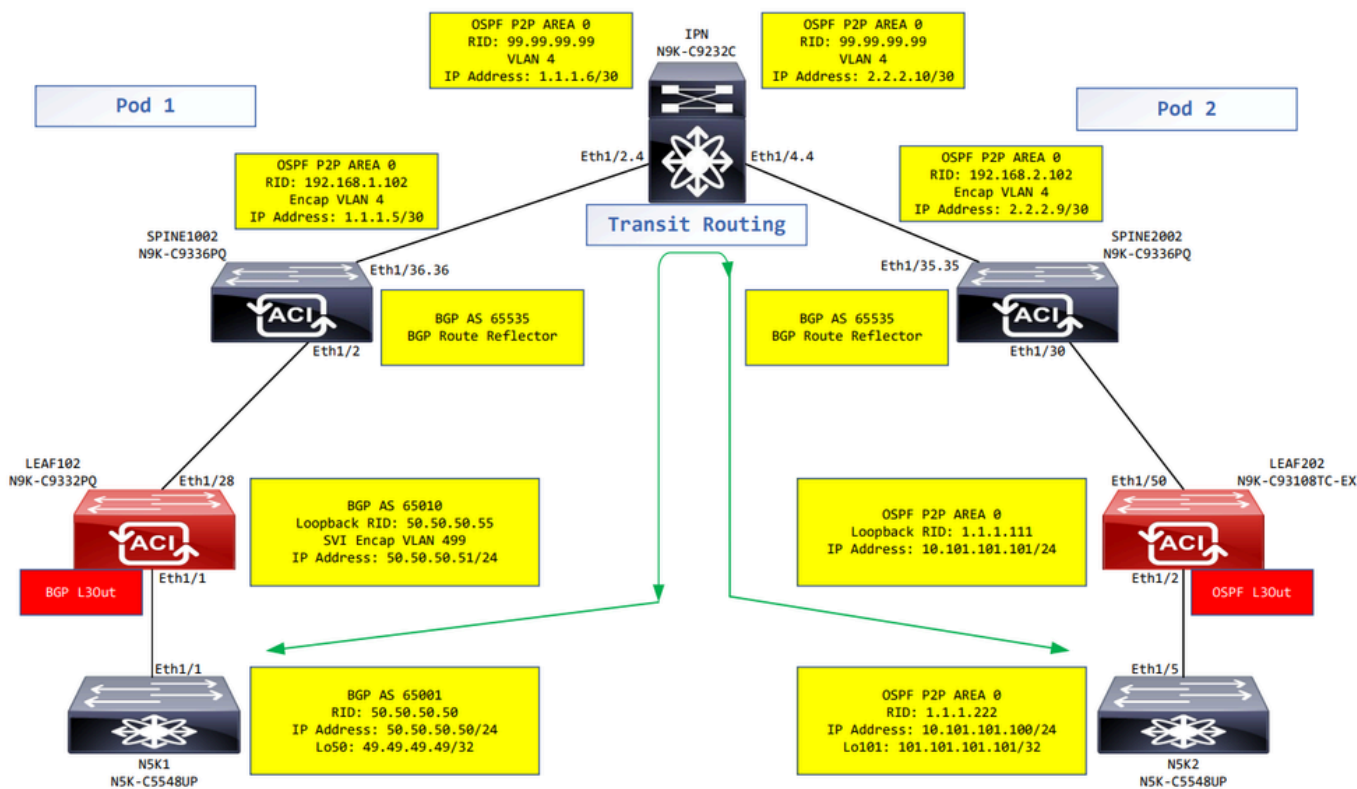


Diagrama de la red

## Configuraciones

Un perfil de nodo lógico se utiliza para identificar el switch de hoja que está conectado a redes externas y que puede implementar el protocolo de ruteo o rutas estáticas hacia él. Para ver el perfil de nodo lógico en el L3Out, desplácese hasta el Tenant > Networking > L3Outs > L3Out > Logical Node Profiles > Logical Node Profile como se muestra en la imagen.

Logical Node Profile - MR-BGP\_nodeProfile

Policy Faults History

Properties

Name: MR-BGP\_nodeProfile  
 Description: optional  
 Alias:  
 Target DSCP: Unspecified

Nodes:

Node ID	Router ID	Loopback Address
topology/pod-1/node-102	50.50.50.55	50.50.50.55

BGP Peer Connectivity:

Peer IP Address	Peer Controls	Interface
50.50.50.24		Pod-1/Node-102/eth1/1

Perfil de nodo lógico para LEAF102

Logical Node Profile - MR-OSPF\_nodeProfile

Policy Faults History

Properties

Name: MR-OSPF\_nodeProfile  
 Description: optional  
 Alias:  
 Target DSCP: Unspecified

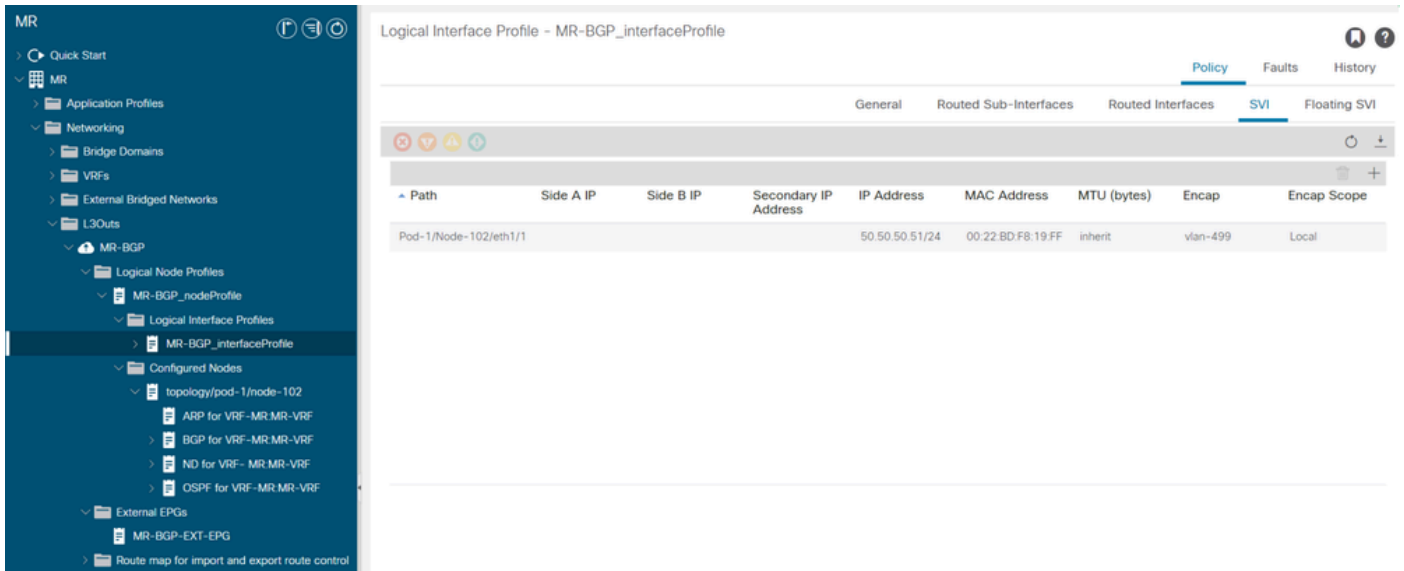
Nodes:

Node ID	Router ID	Loopback Address
topology/pod-2/node-202	1.1.1.111	1.1.1.111

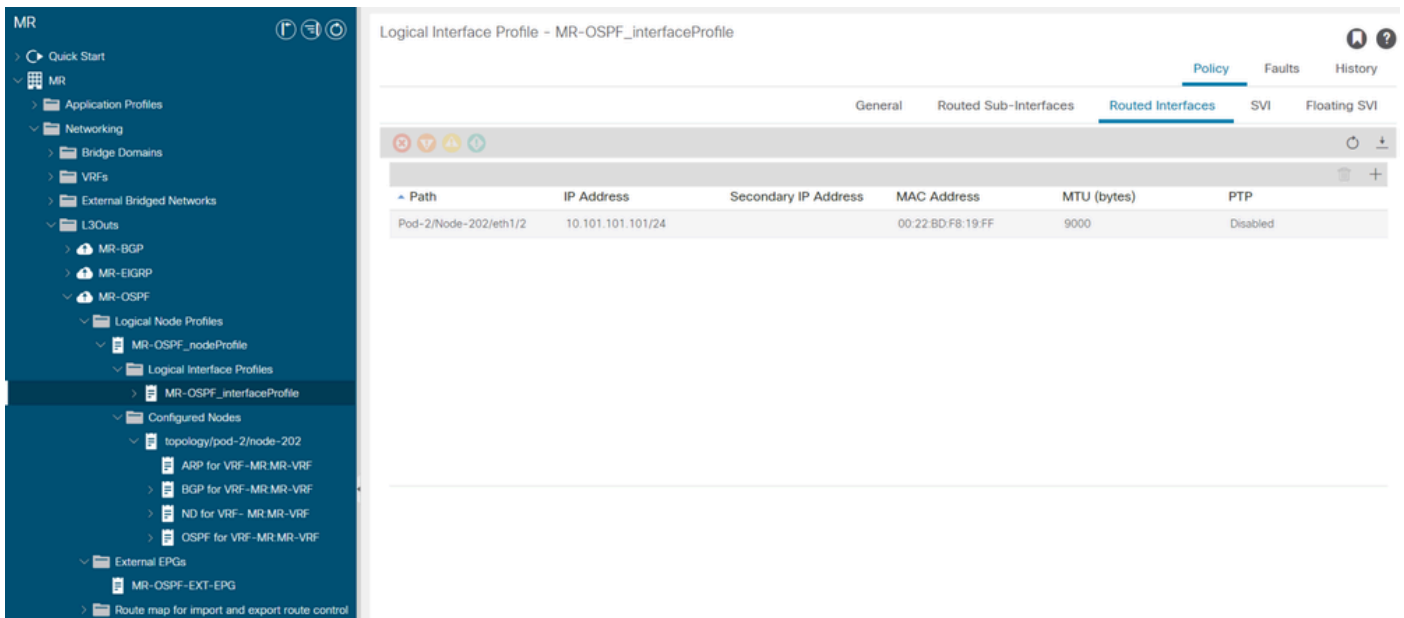
Create BGP Protocol Profile:

Perfil de nodo lógico para LEAF202

Se utiliza un perfil de interfaz lógica para identificar la interfaz L3Out que se conecta al dispositivo externo. Puede ver varios elementos de función definidos para el routing y el reenvío virtuales (VRF): protocolo de resolución de direcciones (ARP), protocolo de gateway fronterizo (BGP), detección de vecinos y ruta de acceso más corta primero (OSPF) como consecuencia de ambos perfiles. Para ver el perfil de interfaz lógica en el L3Out, desplácese hasta el Tenant > Networking > L3Outs > L3Out > Logical Node Profiles > Logical Node Profile > Logical Interface Profiles > Logical Interface Profile. En estos ejemplos, se configura una SVI en el perfil de interfaz lógica.



Perfil de interfaz lógico para LEAF102, eth1/1



Perfil de interfaz lógico para LEAF202, eth1/2

Un perfil de instancia de EPG externo (EPG externo, EPG L3Out) representa un grupo de subredes externas que tienen el mismo comportamiento de seguridad. Otras subredes también se pueden asociar a otros ámbitos, que definen el comportamiento de enrutamiento de esa subred. Para ver el EPG externo en el L3Out, desplácese hasta el Tenant > Networking > L3Outs > L3Out > External EPGs > External EPG como se muestra en la imagen.

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

Policy Operational Stats Health Faults History

General Contracts Inherited Contracts

Properties

Name: MR-BGP-EXT-EPG

Alias:

Tags:

Global Alias:

Description: optional

pcTag: 49159

Contract Exception Tag:

Configured VRF Name: MR-VRF

Resolved VRF: uni/tn-MR/ctx-MR-VRF

QoS Class: Unspecified

Target DSCP: Unspecified

Configuration Status: applied

Configuration Issues:

Preferred Group Member:  Exclude  Include

Subnets:

IP Address	Scope	Name	Aggregate	Route Control Profile	Route Summarization Policy
49.49.49.32					External Subnets for th...

Perfil de instancia EPG externo para MR-BGP L3Out

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

Policy Operational Stats Health Faults History

General Contracts Inherited Contracts

Properties

Name: MR-OSPF-EXT-EPG

Alias:

Tags:

Global Alias:

Description: optional

pcTag: 49156

Contract Exception Tag:

Configured VRF Name: MR-VRF

Resolved VRF: uni/tn-MR/ctx-MR-VRF

QoS Class: Unspecified

Target DSCP: Unspecified

Configuration Status: applied

Configuration Issues:

Preferred Group Member:  Exclude  Include

Subnets:

IP Address	Scope	Name	Aggregate	Route Control Profile	Route Summarization Policy
101.101.101.32					External Subnets for th...

Perfil de instancia EPG externo para MR-OSPF L3Out

En estos ejemplos, el MR-PERMIT-ICMPse aplica como contrato suministrado y consumido en ambos EPG 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
<b>Contract Type: Contract</b>								
MR-PERMIT-ICMP	MR		Contract	Provided	Unspecified	formed		
MR-PERMIT-ICMP	MR		Contract	Consumed	Unspecified	formed		

Contrato MR-PERMIT-ICMP aplicado a 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
<b>Contract Type: Contract</b>								
MR-PERMIT-ICMP	MR		Contract	Provided	Unspecified	formed		
MR-PERMIT-ICMP	MR		Contract	Consumed	Unspecified	formed		

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

Encendido LEAF102, BGP se establece con el vecino 50.50.50.50 y está recibiendo la red 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 peer BGP en 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
```

Resumen de BGP para VRF MR:MR-VRF en 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
```

Ruta BGP para VRF MR:MR-VRF en LEAF102

Encendido LEAF202, OSPF se establece con el vecino 1.1.1.222 y está recibiendo la red 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 vecino OSPF en 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
```

vecino OSPF para VRF MR:MR-VRF en 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
```

Ruta OSPF para VRF MR:MR-VRF en LEAF202

En ambos LEAF102 y LEAF202, la tabla MP-BGP para el VRF muestra la red BGP externa, 49.49.49.49/32, pero aparece como externo en LEAF102 y interna en LEAF202. La red externa OSPF, 101.101.101.101/32, también aparece en las tablas de BGP en ambos switches hoja; en LEAF202 se muestra como redistribuido desde OSPF y encendido LEAF102 se muestra 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 ?
```



Tabla MP-BGP para VRF MR:MR-VRF en 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 ?
```

Tabla MP-BGP para VRF MR:MR-VRF en LEAF202

La tabla BGP IPv4 contiene información equivalente.

```
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      41          100         0 65010 65001 i
*>i101.101.101.101/32 20.0.248.0       41          100         0 ?
```

Tabla BGP IPv4 para VRF MR:MR-VRF en 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 ?
```

Tabla BGP IPv4 para VRF MR:MR-VRF en LEAF202

Sin embargo, la red externa OSPF, 101.101.101.101/32, no se encuentra en la tabla de enrutamiento 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 en N5K1

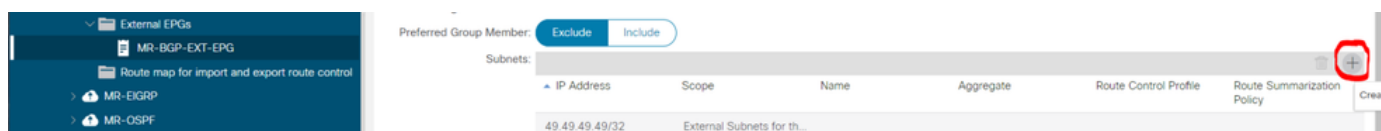
Del mismo modo, la red externa BGP, 49.49.49.49/32, no está en N5K2 Es RIB.

```
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 en N5K2

En BGP L3Out, navegue hasta External EPGs > External EPG > Subnets y seleccione la + situado en la esquina superior derecha de la tabla. Introduzca la dirección IP de la subred externa recibida desde OSPF L3Out, 101.101.101.101/32. Elegir Export Route Control Subnet en el Route Control y borre la External Subnets for the External EPG clasificación. Haga clic en Submit. Export Route Control Subnet permite exportar (anunciar) una red al par externo.



Crear nueva subred

Create Subnet form with fields for IP Address (101.101.101.101/32), Name, Route Control (Export Route Control Subnet checked), Aggregate, Route Summarization Policy, Route Control Profile, and External EPG classification. A red circle highlights the Submit button at the bottom right.

Configure las opciones correctas para la nueva subred

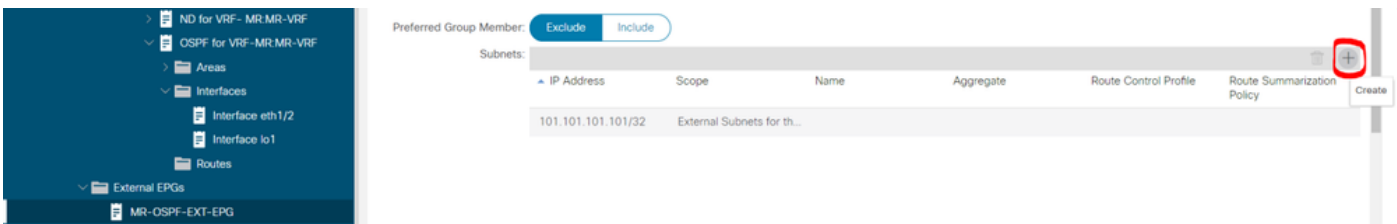
Encendido N5K1, la red externa OSPF, 101.101.101.101/32, ahora se recibe sobre BGP.

```
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 en N5K1

En OSPF L3Out, navegue hasta External EPGs > External EPG > Subnets y seleccione la + situado en la esquina superior derecha de la tabla. Ingrese la dirección IP de la subred externa recibida desde el BGP L3Out, 49.49.49.49/32. Elegir Export Route Control Subnet en el Route Control sección y borrar External Subnets for the External EPG clasificación. Haga clic en Submit.



The screenshot shows a configuration page for 'MR-OSPF-EXT-EPG'. On the left is a navigation tree with 'External EPGs' selected. The main area shows a 'Subnets' table with columns: IP Address, Scope, Name, Aggregate, Route Control Profile, and Route Summarization Policy. A red circle highlights a '+' icon in the top right corner of the table. Below the table is a 'Create' button.

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

Crear nueva subred

## 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

Configure las opciones correctas para la nueva subred

Ahora en N5K2, la red externa BGP, 49.49.49.49/32, se recibe a través de 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 en N5K2

Ping funciona entre las dos redes debido a la MR-PERMIT-ICMP que se aplicó anteriormente a ambos EPG externos.

```
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
```

Verificación de la comunicación en 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
```

Verificación de la comunicación en N5K2

## Información Relacionada

- [Guía de configuración de redes de capa 3 de Cisco APIC, versión 6.0\(x\)](#)
- [Fundamentos de Cisco Application Centric Infrastructure, versión 4.2\(x\)](#)
- [Guía de configuración de redes de capa 3 de Cisco APIC, versión 3.x y anteriores](#)
- [Soporte técnico y descargas de Cisco](#)

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