

Configure EVPN Service over SRTE

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Introduction

This document describes how to configure Ethernet Virtual Private Network (EVPN) services over Segment Routing Traffic Engineering (SRTE).

Prerequisites

Requirements

Cisco recommends that you have basic knowledge of:

- Intermediate System-to-Intermediate System (ISIS)
- SRTE
- EVPN

Components Used

The information in this document is based on Device: Aggregation Services Router 9000 (ASR9K).

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, ensure that you understand the potential impact of any command.

Network Topology

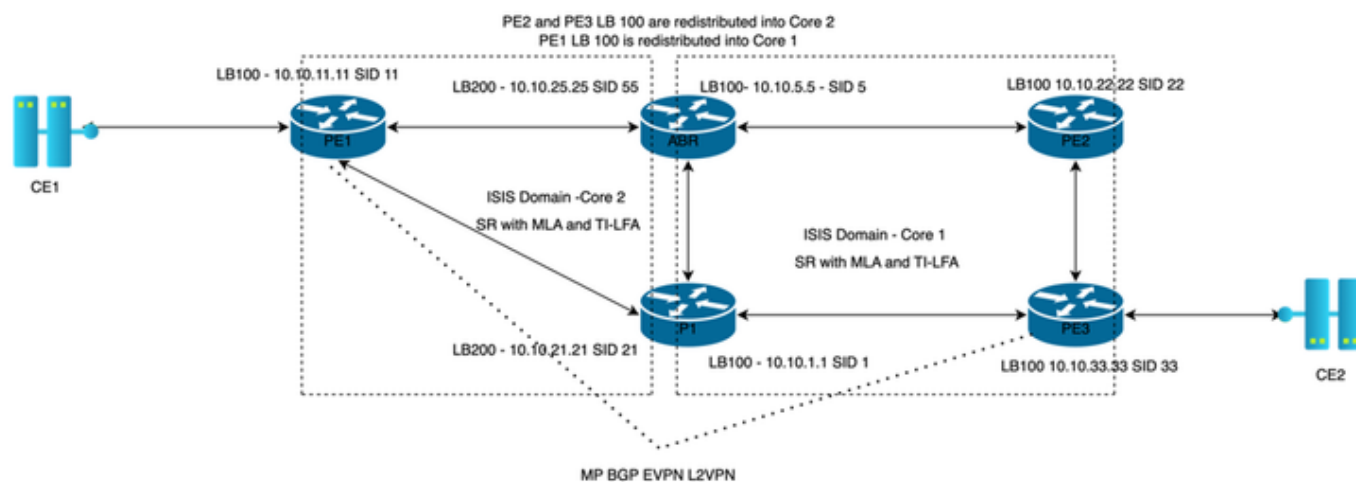
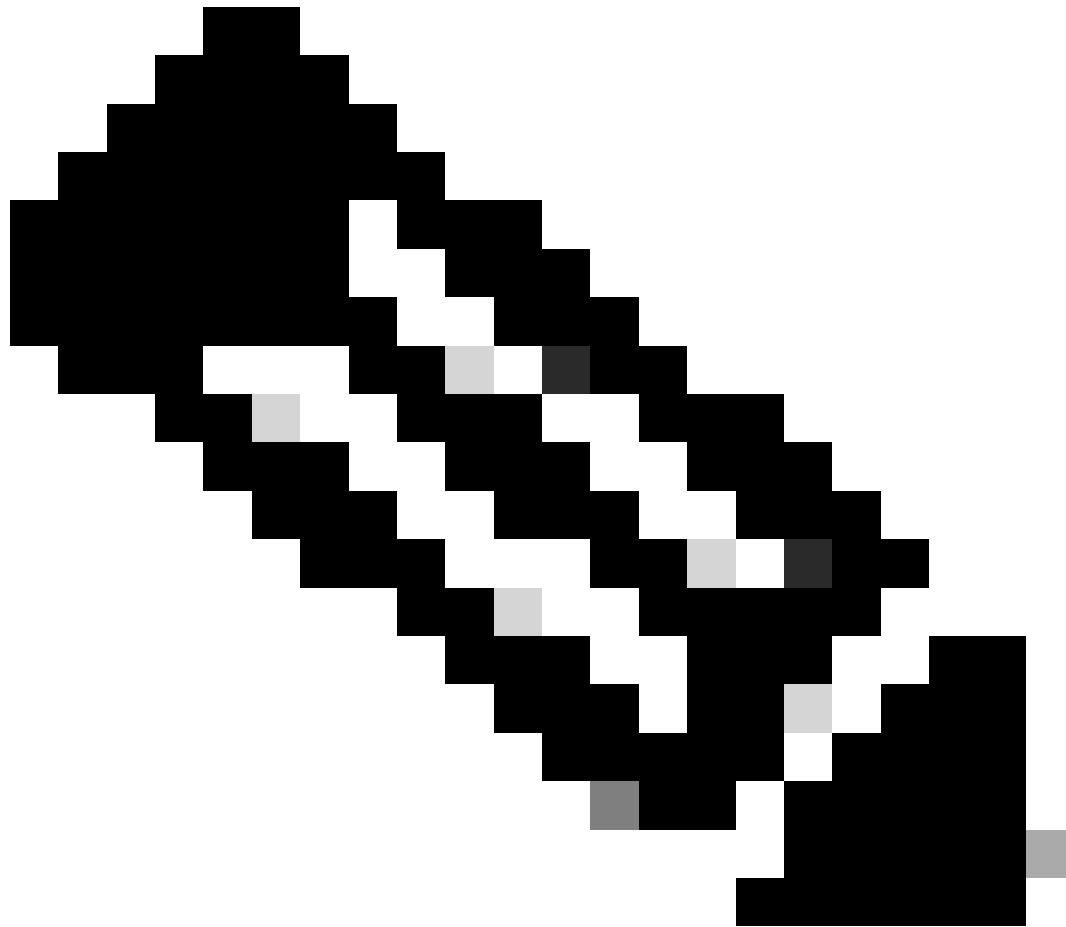


Figure 1. Network Topology Diagram



Note: To establish inter-domain SRTE policy, you need to use PCE to have visibility of all the nodes in multiple domains.

Segment-Routing Traffic Engineering Overview

SRTE Policy

An SR Policy is identified through the parameters:

- The head end where the policy is instantiated/implemented
- The endpoint (that is the destination of the policy)
- The color (an arbitrary numerical value)

SR-TE Database

SRTE Database is a key component in the Segment Routing (SR) architecture, it is used to store:

- The SID values of the node and network segments.
- Details about the network topology, including available links, metrics, and constraints like bandwidth

- It is used by routers to determine the best paths for forwarding packets based on predefined constraints or optimization goals specified in the SR policy.

```
RP0/RSP1/CPU0:ASR9906-1-PE1#traceroute mpls ipv4 10.10.33.33/32 source 10.10.11.11
Type escape sequence to abort.
 0 10.10.111.11 MRU 1500 [Labels: 16033 Exp: 0]
L 1 10.10.111.1 MRU 1500 [Labels: explicit-null Exp: 0] 7 ms >>> P1
! 2 10.10.133.33 4 ms>>> PE3
```



<#root>

distribute link-state

```
address-family ipv4 unicast
```



Note:

- Distribute link-state is required for populating the SRTE database.
- when this command is not configured the SRTE database would be empty .

Verification

<#root>

```
RP/0/RSP0/CPU0:ASR9906-2-ABR #show segment-routing traffic-eng ipv4 topology  
SR-TE topology database
```

```
-----
```

Node 2

TE router ID: 10.10.1.1

Host name: ASR9910-4-P1

ISIS system ID: 0000.1010.0101 level-2

Prefix SID:

Prefix 10.10.1.1, label 16001

(regular), flags: X:0, R:0, N:1, P:1, E:1, V:0, L:0, M:0 >>>>> node details
Link[0]:

local address 10.10.15.1, remote address 10.10.15.5

Local node:

ISIS system ID: 0000.1010.0101 level-2

Remote node:

TE router ID: 10.10.5.5

Host name: ASR9906-2-ABR

ISIS system ID: 0000.1010.0505 level-2

Metric: IGP 10, TE 10, Latency 10 microseconds >>>>>>> metric and latency of this link between P1 and

Bandwidth: Total link 12499999744, Reservable 0 >>>>>>> BW of this link

Admin-groups: 0x00000000

Admin-groups-detail:

Adj SID: 24005 (protected) 24006 (unprotected) >>>>>>> adj sid of link on P1

Static SRTE Policy

Configuration

Configure the SRTE Static policy on the Head end router PE1:

```
segment-routing
traffic-eng
segment-list STATIC-SID-LIST
index 1 mpls label 16055 >>>>>>> node SID of ABR
index 2 mpls label 16022 >>>>>>> node SID of PE2
index 3 mpls label 16033 >>>>>>> node SID of PE3
!
policy Static-policy-evpnvpws
binding-sid mpls 3000
color 10 end-point ipv4 10.10.33.33
candidate-paths
preference 5
explicit segment-list STATIC-SID-LIST
```



Note:

- Manually configured Binding SID 3000
- Color is 10 and the end point PE3
- This SR TE policy is using the explicit SID list to steer the traffic in a predefined path

<#root>

RP/0/RSP1/CPU0:ASR9906-1-PE1#traceroute sr-mpls policy binding-sid 3000 lsp-end-point 10.10.33.33 source

Type escape sequence to abort.

0 10.10.115.11 10.10.115.5 MRU 1500 [Labels:

16022/16033

Exp: 0/0]

L 1 10.10.115.5 10.10.225.22 MRU 1500 [Labels:

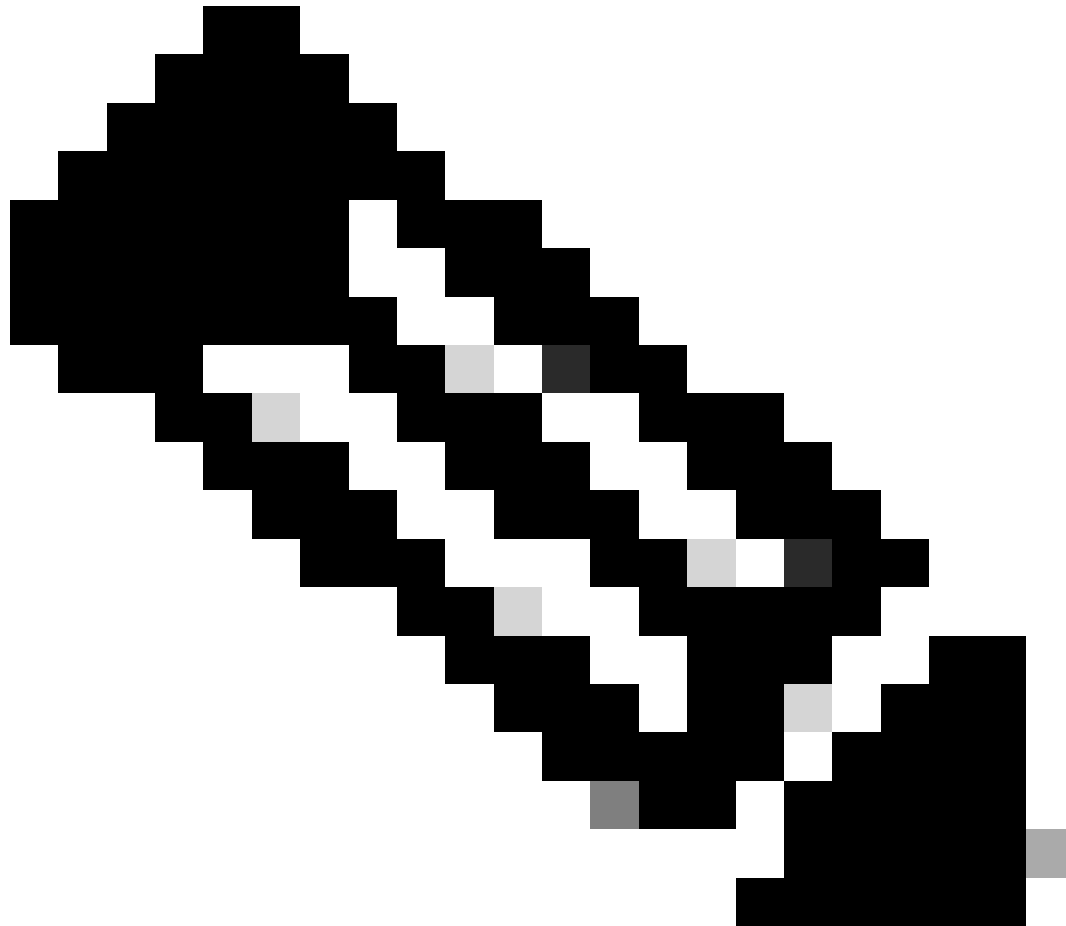
explicit-null/16033

Exp: 0/0] 6 ms, ret code 8

L 2 10.10.225.22 10.10.123.33 MRU 1500 [Labels:

explicit-null

Exp: 0] 5 ms, ret code 8
! 3 10.10.123.33 5 ms, ret code 3



Note: The first hop is ABR, which has the node SID 16055; hence it is not appended when the packet is sent out.

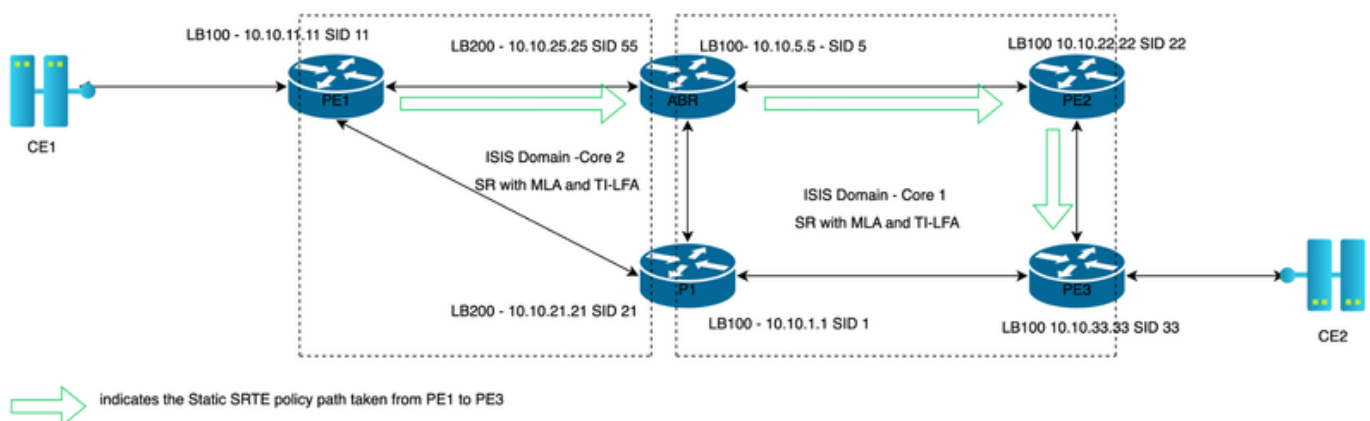


Figure 3 Static SRTE policy path taken from PE1 to PE3

Verification

<#root>

RP/0/RSP1/CPU0:ASR9906-1-PE1#show segment-routing traffic-eng policy color 10
SR-TE policy database

Color: 10, End-point: 10.10.33.33
Name: srte_c_10_ep_10.10.33.33
Status:

Admin: up Operational: up for 3d02h (since Jan 14 08:39:30.042)

Candidate-paths:

Preference: 5 (configuration) (active)
Name: Static-policy-evpnvps

Requested BSID: 3000

Protection Type: protected-preferred
Maximum SID Depth: 10

Explicit: segment-list STATIC-SID-LIST (valid)

Weight: 1, Metric Type: TE

16055 [Prefix-SID, 10.10.25.25]

16022

16033

Attributes:

Binding SID: 3000
Forward Class: Not Configured
Steering labeled-services disabled: no
Steering BGP disabled: no
IPv6 caps enable: yes
Invalidation drop enabled: no

<#root>

RP/0/RSP1/CPU0:ASR9906-1-PE1#show segment-routing traffic-eng forwarding policy color 10
SR-TE Policy Forwarding database

Color: 10, End-point: 10.10.33.33

Name: srte_c_10_ep_10.10.33.33

Binding SID: 3000

Active LSP:

Candidate path:

Preference: 5 (configuration)

Name: Static-policy-evpnvpws

Local label: 24012

Segment lists:

SL[0]:

Name: STATIC-SID-LIST

Switched Packets/Bytes: 30/2740

[MPLS -> MPLS]: 30/2740

Paths:

Path[0]:

Outgoing Label: 16022

Outgoing Interfaces: HundredGigE0/1/0/0

Next Hop: 10.10.115.5

Switched Packets/Bytes: 30/2740>>>>>>>>> this is the number packet steered using this path

[MPLS -> MPLS]: 30/2740

FRR Pure Backup: No

ECMP/LFA Backup: No

Internal Recursive Label: Unlabelled (recursive)

Label Stack (Top -> Bottom): { 16022, 16033 }

Policy Packets/Bytes Switched: 30/2620>>>>>>>>> this counter shows the packets were transmitted using

<#root>

RP/0/RSP1/CPU0:ASR9906-1-PE1#show mpls forwarding labels 3000 detail

Local Label	Outgoing Label	Prefix or ID	Outgoing Interface	Next Hop	Bytes Switched
3000	Pop	No ID	srte_c_10_ep	point2point	2620

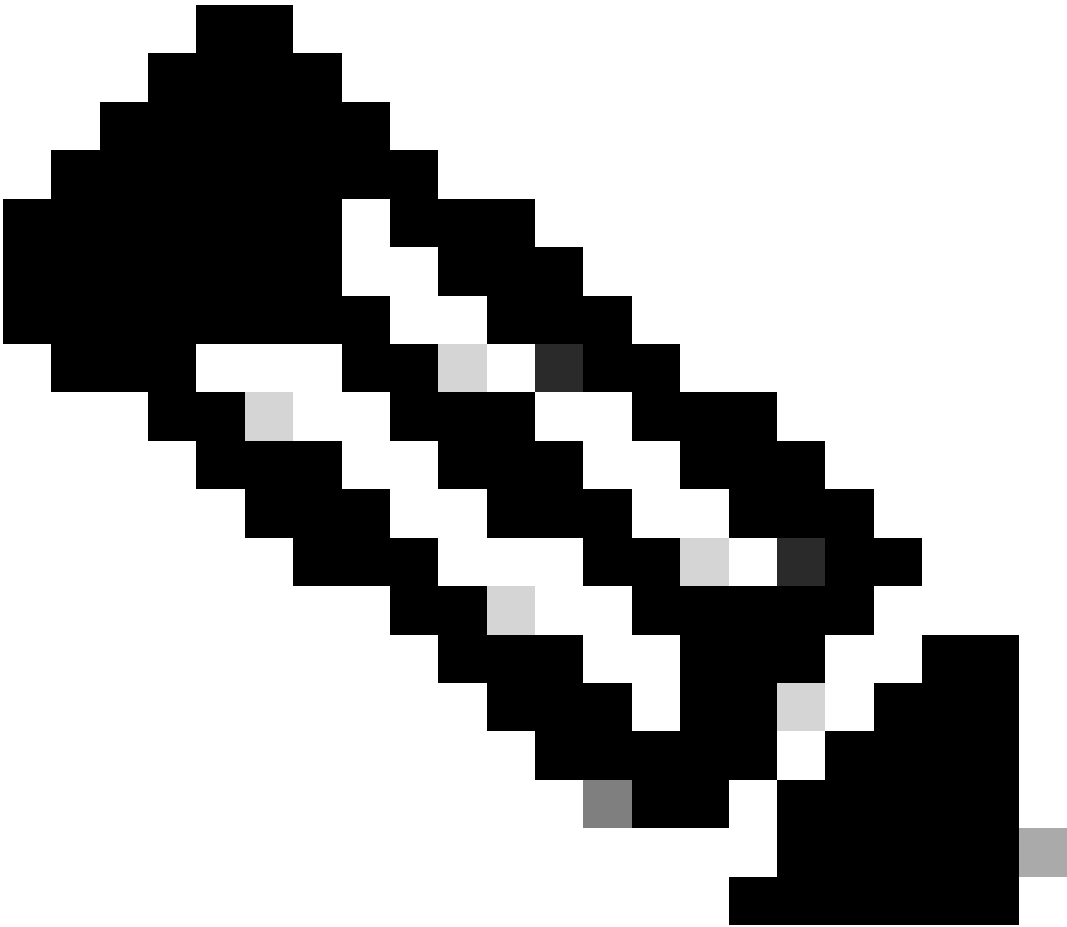
Version: 69, Priority: 2

Label Stack (Top -> Bottom): { Unlabelled Imp-Null }

NHID: 0x0, Encap-ID: N/A, Path idx: 0, Backup path idx: 0, Weight: 0
MAC/Encaps: 0/0, MTU: 0

Outgoing Interface: srte_c_10_ep_10.10.33.33 (ifhandle 0x020001e0)

Packets Switched: 30



Note: 3000 -Binding sid is used to steer the packets into the SRTE.

<#root>

RP/0/RSP1/CPU0:ASR9906-1-PE1#show mpls forwarding labels 24012 detail					
Local	Outgoing	Prefix	Outgoing	Next Hop	Bytes
Label	Label	or ID	Interface		Switched

24012	16022	SR TE: 1 [TE-INT]	Hu0/1/0/0	10.10.115.5	2740

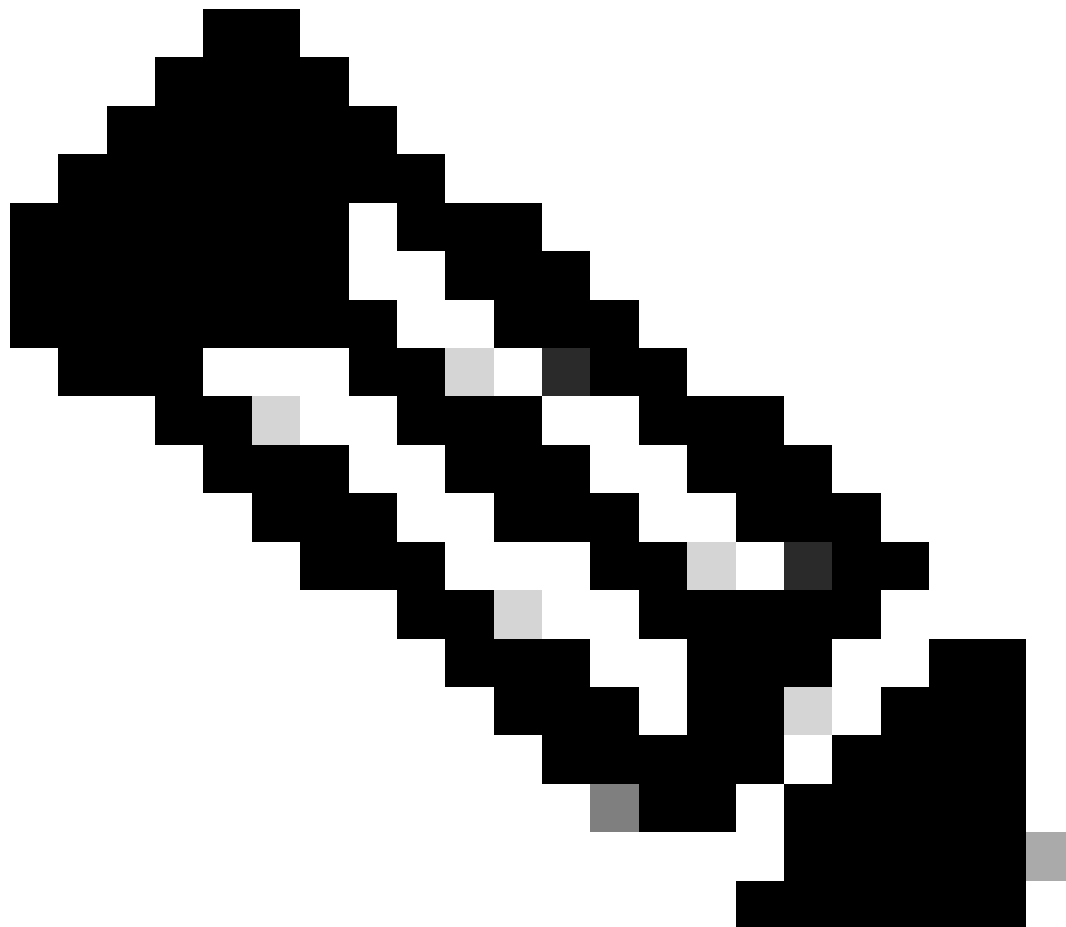
Version: 68, Priority: 2

Label Stack (Top -> Bottom): { 16022 16033 }

NHID: 0x0, Encap-ID: N/A, Path idx: 0, Backup path idx: 0, Weight: 0
MAC/Encaps: 4/12, MTU: 1500

Outgoing Interface: HundredGigE0/1/0/0 (ifhandle 0x06000480)

Packets Switched: 30



Note: 24012 this is the local label assigned to this policy which is swapped with the outgoing label of the policy.

Associating Static SRTE Policy static-policy-evpnvpws with EVPN VPWS

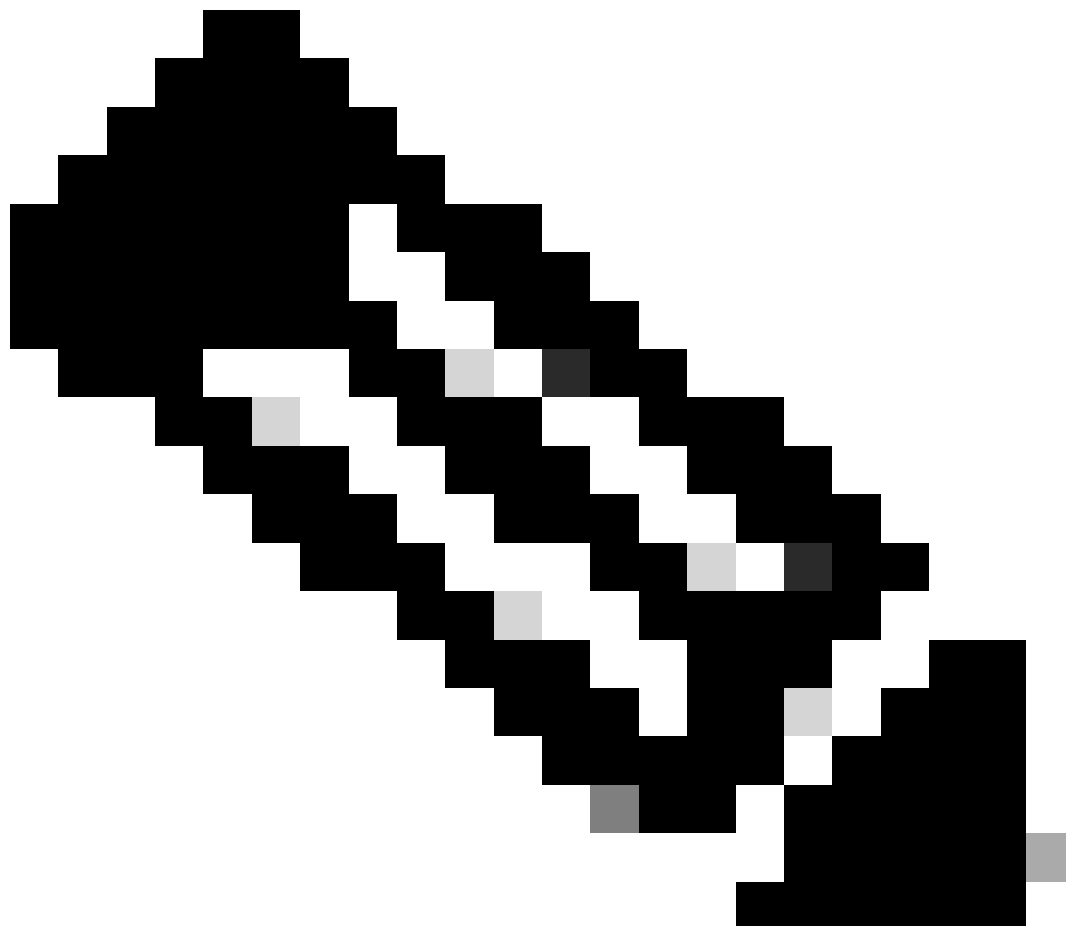
Configuration

```
l2vpn
  pw-class evpn-srte
    encapsulation mpls
    preferred-path sr-te policy srte_c_10_ep_10.10.33.33
```

<#root>

```
xconnect group EVPN-vpws
  p2p EVPN-vpws-400
    interface HundredGigE0/1/0/2.400
    neighbor evpn evi 400 target 333 source 111

  pw-class evpn-srte
```



Note: The EVPN routes are not colored, as the SRTE policy is manually associated with the l2vpn and all the traffic via this xconnect takes the SRTE policy path.

Verification

```
RP/0/RSP1/CPU0:ASR9906-1-PE1#show bgp l2vpn evpn
Route Distinguisher: 10.10.11.11:400 (default for vrf VPWS:400)
*> [1][0000.0000.0000.0000.0000][111]/120
                                0.0.0.0                                0 i
*>i [1][0000.0000.0000.0000.0000][333]/120
                                10.10.33.33                            100      0 i
```

```
RP/0/RSP1/CPU0:ASR9906-1-PE1#show l2vpn xconnect
XConnect
Group      Name      ST      Segment 1
-----
EVPN-vpws  EVPN-vpws-400
                                UP      Hu0/1/0/2.400
                                UP      EVPN 400,333,10.10.33.33
                                UP
```

<#root>

```
RP/0/RSP1/CPU0:ASR9906-1-PE1#show l2vpn xconnect group EVPN-vpws xc-name EVPN-vpws-400 detail
Group EVPN-vpws, XC EVPN-vpws-400,
```

state is up

```
; Interworking none
AC: HundredGigE0/1/0/2.400, state is up
Type VLAN; Num Ranges: 1
Rewrite Tags: []
VLAN ranges: [400, 400]
MTU 1500; XC ID 0x1800008; interworking none
Statistics:
  packets: received 90, sent 89
  bytes: received 7140, sent 7296
  drops: illegal VLAN 0, illegal length 0
```

EVPN: neighbor 10.10.33.33, PW ID: evi 400, ac-id 333, state is up (established

```
)
XC ID 0xa000000b
Encapsulation MPLS
Encap type Ethernet, control word enabled
Sequencing not set
```

Preferred path Active : SR TE srte_c_10_ep_10.10.33.33 (BSID:3000, IFH:0x20001e0), Statically configured

```
Ignore MTU mismatch: Enabled
Transmit MTU zero: Enabled
Tunnel : Up
```

EVPN	Local	Remote
Label	24014	24016
MTU	1514	unknown
Control word enabled		enabled

AC ID	111	333
EVPN type	Ethernet	Ethernet

Create time: 14/01/2025 08:49:57 (1w1d ago)
Last time status changed: 14/01/2025 11:14:31 (1w0d ago)
Statistics:
 packets: received 89, sent 90
 bytes: received 7296, sent 7140

<#root>

RP/0/RSP1/CPU0:ASR9906-1-PE1#show im database ifhandle 0x20001e0
Node 0/RSP1/CPU0 (0x120)

Interface srte_c_10_ep_10.10.33.33,

ifh 0x020001e0 (up, 1500)
Interface flags: 0x000000000042c457 (PHYS_ON_RP|REPLICATED
 |DYN_REP|TUNNEL|IFINDEX|VIRTUAL|CONFIG|VIS|DATA
 |CONTROL)
Encapsulation: mpls_te
Interface type: IFT_TUNNEL_TE
Control parent: None
Data parent: None
Views: UL|GDP|LDP|G3P|L3P|OWN
Protocol Caps (state, mtu)

None mpls_te (up, 1500)
ipv4 ipv4 (up, 1500)
mpls mpls (up, 1500)
ipv6 ipv6_preswitch (up, 1500)
ipv6 ipv6 (up, 1500)

On-Demand Nexthop (ODN) SRTE

ODN SRTE policy automates the creation of segment routing traffic engineering paths based on real-time network demand and specified constraints, ensuring dynamic and efficient traffic steering.

These policies are triggered by received routes that share the same color as the ODN policy. The LSP (Label Switched Path) endpoint dynamically associates with the protocol next-hop of these routes.

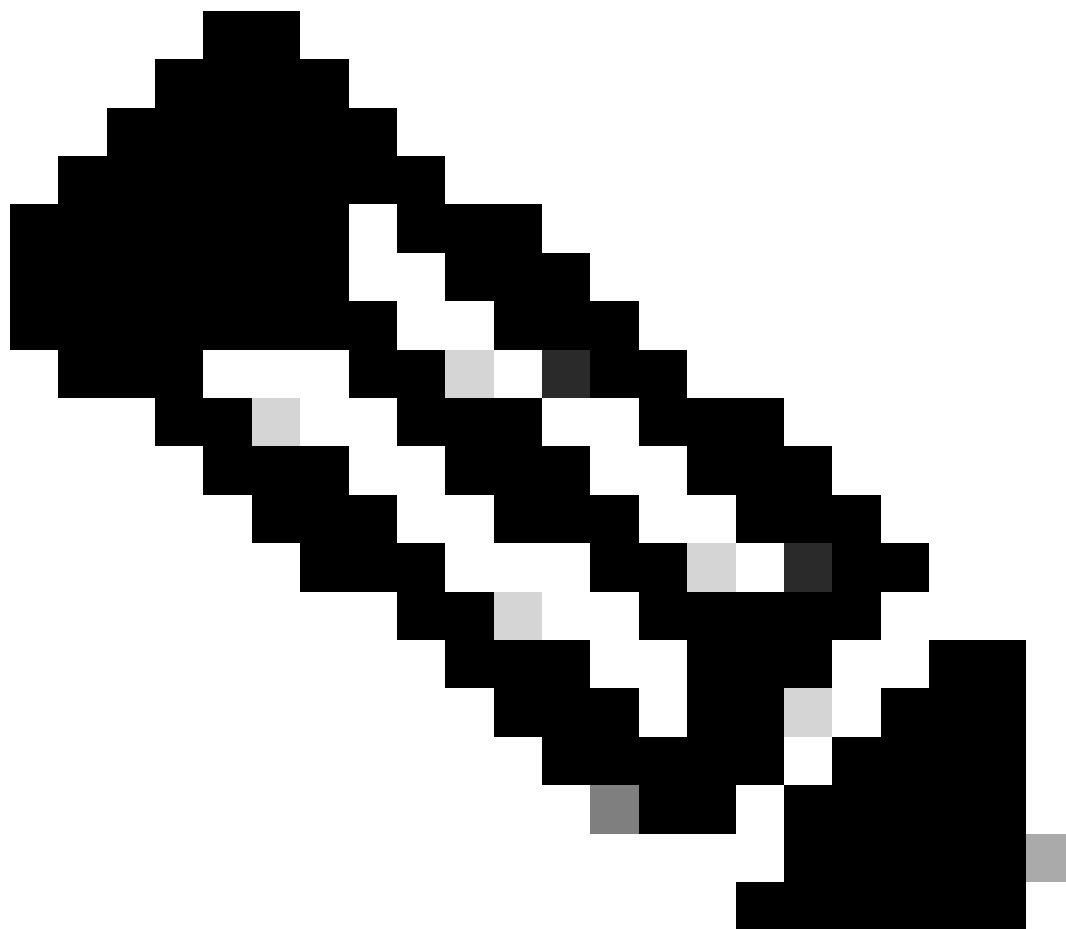
Configuration

<#root>

segment-routing
 traffic-eng
 on-demand

color 500

 dynamic
 metric
 type te



Note: this policy comes up only with a valid LSP end point which is Next-Hop of the received routes with the matching color extended community.

Use ODN SRTE Policy for EVPN ELAN Service

As ODN SRTE is a dynamic policy the routes received need to be colored 500. Because of this coloring, the traffic destined to that route's Next-Hop takes the ODN SRTE policy path. If the route is not colored, it takes the IGP path.

Configuration

```
<#root>
```

```
  extcommunity-set opaque
```

```
    color_500
```

```
      500
    end-set
```

The color is defined in the extended community:

```
<#root>
```

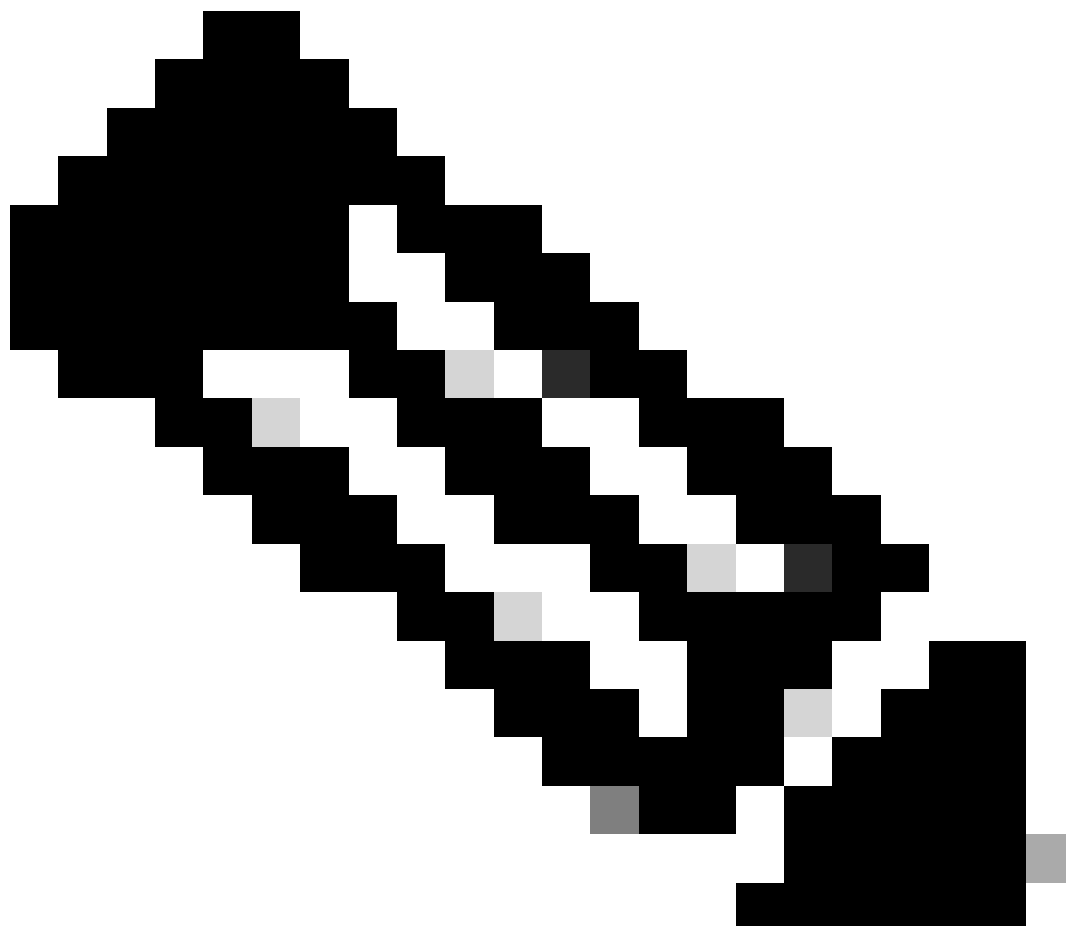
```
route-policy
```

```
RPL_color_500
```

```
  if evpn-route-type is 1 or evpn-route-type is 3 then  
    set extcommunity color
```

```
color_500
```

```
  endif  
end-policy
```



Note:

- **evpn-route-type 3** needs to be colored, as it provides the label to carry the BUM traffic, when BUM traffic must be sent to a remote PE3 from PE1 to be sent via SRTE policy color 500.
- For unicast traffic, the unicast label for a MAC is advertised by RT-2, but when RT-2 is colored using RPL, an error message is observed:

RP/0/RP0/CPU0:PE2#RP/0/RP0/CPU0: UTC: l2vpn_mgr[1291]: %L2-EVPN-4-ODN_ON_UNSUPPORTED_ROUTE : EVPN

- Associating the access interface (even for SH) with an ESI and coloring per EAD/EVI route to steer the traffic via the SRTE policy:

<#root>

```

evl 500
  bgp
    route-policy export

```

RPL_color_500

```

!
advertise-mac

```

```

l2vpn
bridge group EVPN-ELAN-500
  bridge-domain EVPN-ELAN-500
  interface HundredGigE0/1/0/2.500
  !
  evl 500

```

Verification

<#root>

```

RP/0/RSP0/CPU0:ASR9910-3-PE3#show bgp l2vpn evpn rd 10.10.33.33:500
Route Distinguisher: 10.10.33.33:500 (default for vrf EVPN-ELAN-500)
*>i [1] [0000.1111.1111.1111] [0]/120

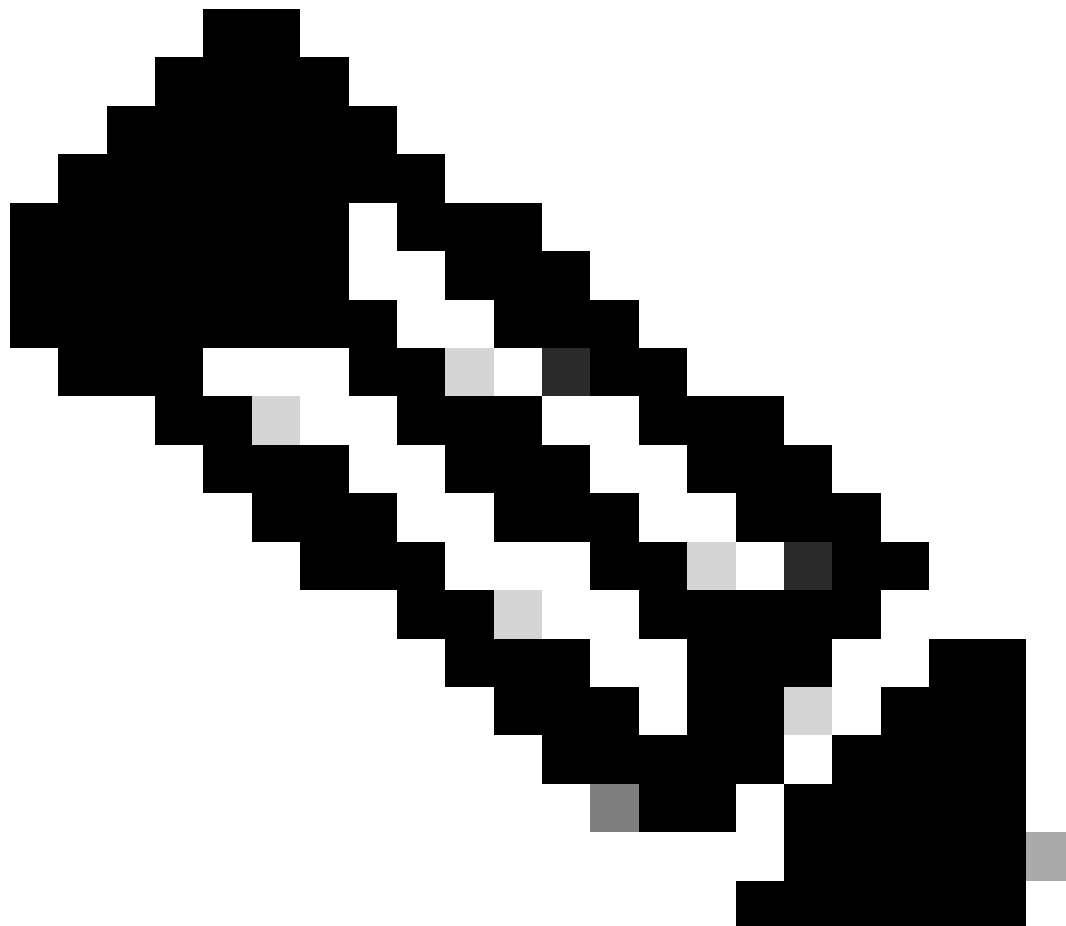
```

10.10.11.11 C:500

	100	0 i
*>i [1] [0000.1111.1111.1111] [4294967295]/120		
10.10.11.11	100	0 i
*> [1] [0000.2222.2222.2222] [0]/120		
0.0.0.0		0 i
*>i [3] [0] [32] [10.10.11.11]/80		

10.10.11.11 C:500

```
*> [3][0][32][10.10.33.33]/80      100      0 i
      0.0.0.0                        0
```



Note: When PE3 receives Route-type 1 or 3 with extended community color 500 , PE3 initiates ODN SRTE policy 500 which is destined to PE1

Each EVI route is attached with the colo- extended community and is attached to the SRTE policy:

<#root>

```
RP/0/RSP0/CPU0:ASR9910-3-PE3#show bgp l2vpn evpn rd 10.10.33.33:500 [1][0000.1111.1111.1111][0]/12
Not advertised to any peer
Local
```

```
10.10.11.11 C:500 (bsid:24020) (
metric 20) from 10.10.11.11 (10.10.11.11)
```

Received Label 24015

Origin IGP, localpref 100, valid, internal, best, group-best, import-candidate, imported, rib-ins
Received Path ID 0, Local Path ID 1, version 534
Extended community: Color:500 RT:100:500

SR policy color 500, up, registered, bsid 24020, if-handle 0x00000360

Source AFI: L2VPN EVPN, Source VRF: default, Source Route Distinguisher: 10.10.11.11:500

The per-ESI route is not colored:

RP/0/RSP0/CPU0:ASR9910-3-PE3# show bgp l2vpn evpn rd 10.10.33.33:500 [1][0000.1111.1111.1111.1111][4294
Local

10.10.11.11 (metric 20) from 10.10.11.11 (10.10.11.11)

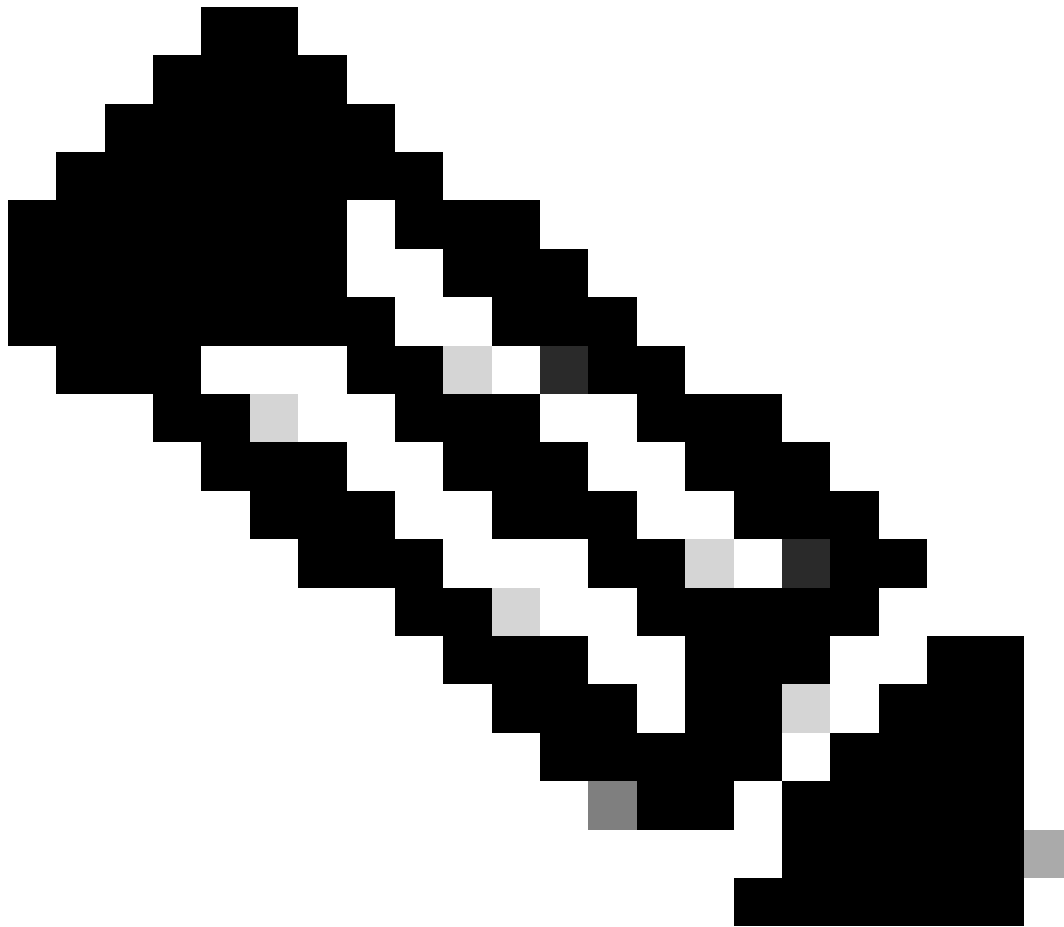
Received Label 0

Origin IGP, localpref 100, valid, internal, best, group-best, import-candidate, imported, rib-ins

Received Path ID 0, Local Path ID 1, version 539

Extended community: EVPN ESI Label:0x01:24017 RT:100:100 RT:100:400 RT:100:500 RT:300:300

Source AFI: L2VPN EVPN, Source VRF: default, Source Route Distinguisher: 10.10.11.11:1



Note: The per-ESI route is not colored, as it is associated with multiple EVI and all the EVIs do not take the SRTE path.

Route Type -3 is colored:

<#root>

RP/0/RSP0/CPU0:ASR9910-3-PE3#show bgp l2vpn evpn rd 10.10.33.33:500 [3][0][32][10.10.11.11]/80
Local

10.10.11.11 C:500 (bsid:24020)

(metric 20) from 10.10.11.11 (10.10.11.11)
Origin IGP, localpref 100, valid, internal, best, group-best, import-candidate, imported
Received Path ID 0, Local Path ID 1, version 524
Extended community: Color:500 RT:100:500
PMSI: flags 0x00, type 6, label

24016

, ID 0x0a0a0b0b

SR policy color 500, up, registered, bsid 24020, if-handle 0x00000360

Source AFI: L2VPN EVPN, Source VRF: default, Source Route Distinguisher: 10.10.11.11:500

Route Type 2 is not colored:

```
RP/0/RSP1/CPU0:ASR9906-1-PE1# show bgp l2vpn evpn rd 10.10.11.11:500 [2][0][48][bce7.12a3.b716][0]/104
Local
 10.10.33.33 (metric 10) from 10.10.33.33 (10.10.33.33)
   Received Label 24010
   Origin IGP, localpref 100, valid, internal, best, group-best, import-candidate, imported, rib-ins
   Received Path ID 0, Local Path ID 1, version 302
   Extended community: SoO:10.10.33.33:500 0x060e:0000.0000.01f4 RT:100:500
   EVPN ESI: 0000.2222.2222.2222.2222
   Source AFI: L2VPN EVPN, Source VRF: default, Source Route Distinguisher: 10.10.33.33:500
```

<#root>

```
RP/0/RSP0/CPU0:ASR9910-3-PE3#show segment-routing traffic-eng policy color 500
SR-TE policy database
-----
Color: 500, End-point: 10.10.11.11
Name: srte_c_500_ep_10.10.11.11
Status:
```

Admin: up Operational: up for 6d22h

```
Candidate-paths:
Preference: 200 (BGP ODN) (active)
Requested BSID: dynamic
Constraints:
  Protection Type: protected-preferred
  Maximum SID Depth: 10
```

Dynamic (valid)

Metric Type: TE, Path Accumulated Metric: 20

16001 [Prefix-SID, 10.10.1.1]

16005 [Prefix-SID, 10.10.5.5]

16011 [Prefix-SID, 10.10.11.11]

Preference: 100 (BGP ODN) (inactive)

Requested BSID: dynamic
PCC info:
Symbolic name: bgp_c_500_ep_10.10.11.11_discr_100
PLSP-ID: 1
Constraints:
Protection Type: protected-preferred
Maximum SID Depth: 10
Dynamic (pce) (inactive)
Metric Type: NONE, Path Accumulated Metric: 0

Attributes:
Binding SID: 24020
Forward Class: Not Configured
Steering labeled-services disabled: no
Steering BGP disabled: no
IPv6 caps enable: yes
Invalidation drop enabled: no
Max Install Standby Candidate Paths: 0

Unicast traffic for the EVI 500 is sent via SRTE, which can be confirmed by output:

<#root>

```
RP/0/RSP0/CPU0:ASR9910-3-PE3#show evpn internal-label vpn-id 500 private
VPN-ID      Encap  Ethernet Segment Id      EtherTag      Label
-----
500          MPLS   0000.1111.1111.1111      0             None
Multi-paths resolved: FALSE (Remote single-active)
Multi-paths Internal label: None
EAD/ES      10.10.11.11             0
Path Version:2, Originating PE:::
```

```
EAD/EVI      SR-TE BSID 24020

10.10.11.11      24015
```

Path Version:4, Originating PE:::

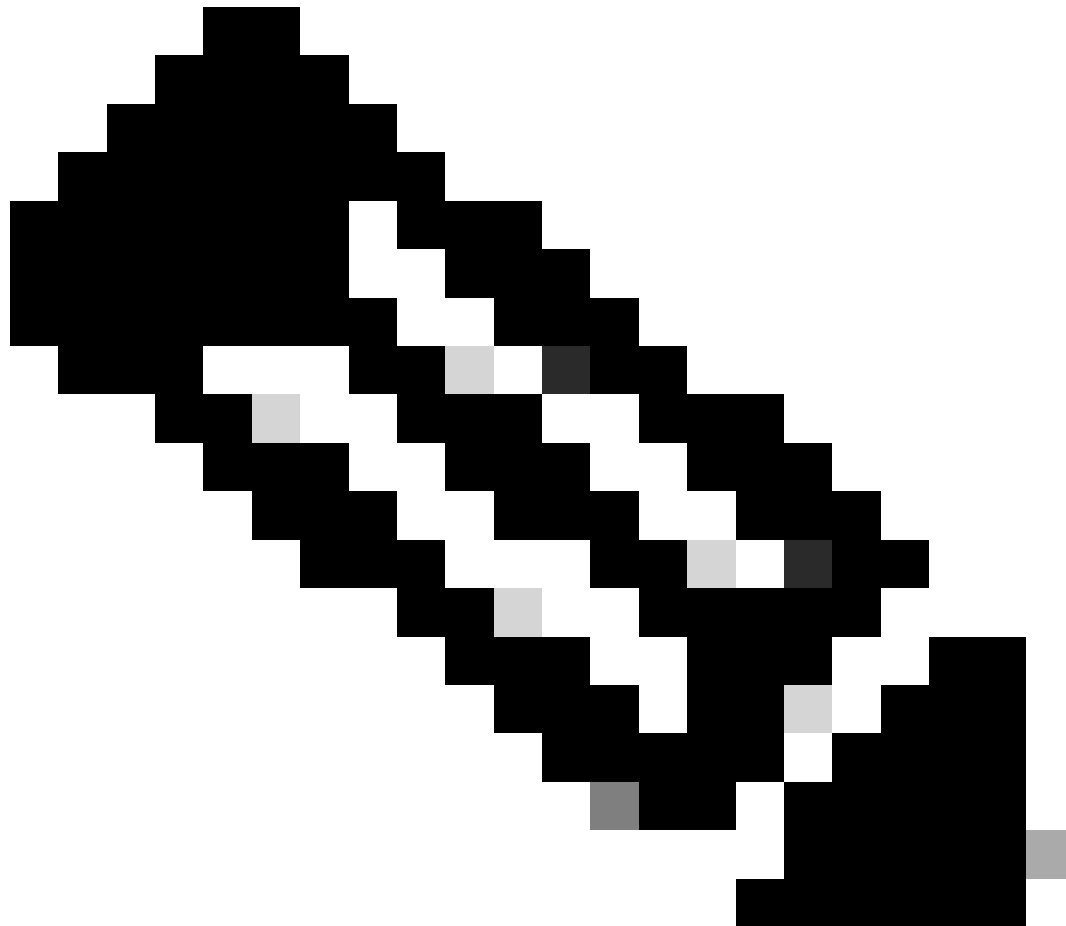
Num EAD objects linked: 2
Source: MPLS
Local CW: Unknown
Local MTU: 0
Local ignore MTU mismatch: Enabled
Next path version: 5
Object: EVPN LABEL
Base info: version=0xdbdb000a, flags=0x4000, type=10, reserved=0
EVPN Internal-Label event history [Num events: 16]

Time	Event	Flags	Flags
====	=====	=====	=====
Jan 28 19:53:08.224	LSD Label Req (Add/Del)	00000de1	00005dd8 - -
Jan 28 21:29:09.888	Modify Redundant	00000000	00000000 - -
Jan 28 21:29:09.888	Int-Lbl Multi-Path Resolution	01010100	0100020e - -
Jan 28 21:29:09.888	LSD Label Req (Add/Del)	00000add	00100001 - -
Jan 28 21:29:09.888	LSD Label Got	01f40000	01005dd8 - -
Jan 28 23:27:01.632	LSD Label Req (Add/Del)	00000de1	00005dd8 - -

```

Jan 29 01:06:15.808 Modify Redundant          00000000 00000000 - -
Jan 29 01:06:15.808 Int-Lbl Multi-Path Resolution 01010100 0100020e - -
Jan 29 01:06:15.808 LSD Label Req (Add/Del)      00000add 00100001 - -
Jan 29 01:06:15.808 LSD Label Got                01f40000 01005dd8 - -
Jan 29 03:00:44.416 LSD Label Req (Add/Del)      00000del 00005dd8 - -
Jan 29 04:45:32.032 Modify Redundant          00000000 00000000 - -
Jan 29 04:45:32.032 Int-Lbl Multi-Path Resolution 01010100 0100020e - -
Jan 29 04:45:32.032 LSD Label Req (Add/Del)      00000add 00100001 - -
Jan 29 04:45:32.032 LSD Label Got                01f40000 01005dd8 - -
Jan 29 06:34:24.000 LSD Label Req (Add/Del)      00000del 00005dd8 - -
-----

```



Note: 24015 - is the per-EVI label advertised by PE1.

RP/0/RSP0/CPU0:ASR9910-3-PE3#show mpls forwarding labels 24020

Local Label	Outgoing Label	Prefix or ID	Outgoing Interface	Next Hop	Bytes Switched
24020	Pop	No ID	srte_c_500_e	point2point	4182

```
RP/0/RSP0/CPU0:ASR9910-3-PE3#show 12vpn forwarding bridge-domain EVPN-ELAN-500:EVPN-ELAN-500 evpn inclu
Bridge-Domain Name      BD-ID  XCID      TEP-id      Next Hop      Label/VNI      Encap
```

SRTE BSID 24020

24016	10	bound	Root
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A pixelated, black and white representation of a stylized, abstract shape, possibly a letter or a logo, composed of many small squares. The shape is elongated and tapers towards the right, with a complex, jagged left edge. It features several small, light gray squares interspersed within the black pixelated structure, particularly along the diagonal and in the lower right section. The overall effect is that of a low-resolution digital graphic or a stylized font character.

Note: 24016 - BUM label advertised in route type -3 by PE1.

Conclusion

EVPN over SR-TE brings together the benefits of EVPN's robust service delivery with the traffic engineering and operational simplicity of SR-TE, resulting in an agile, scalable, and efficient network architecture.