

Design, Automate, and Simplifying VXLAN EVPN Multi-Site Architectures with Nexus Dashboard Federation

cisco Live !

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Cisco Webex App

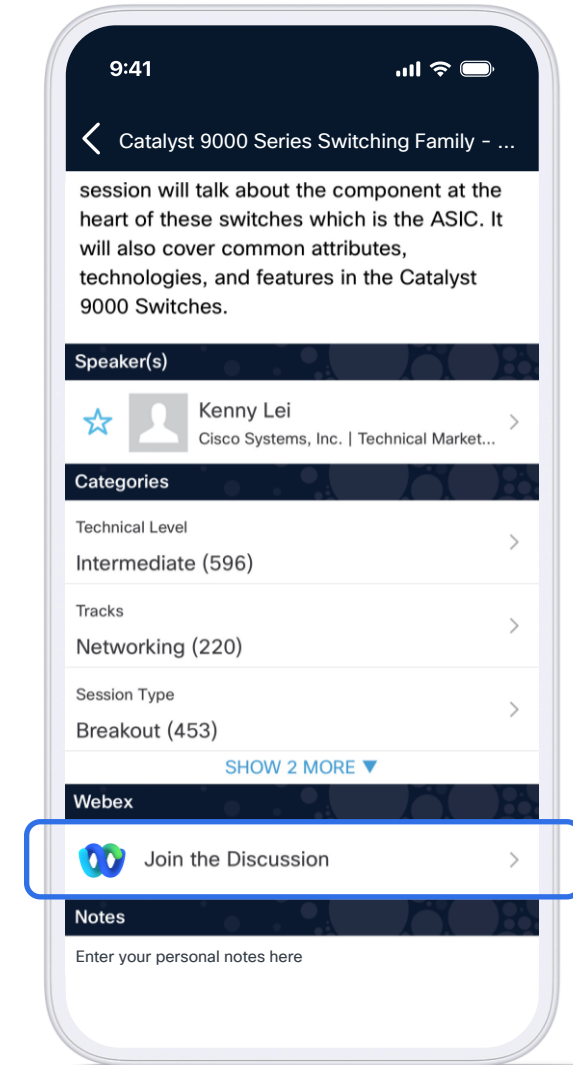
Questions?

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- 1 Find this session in the Cisco Live Mobile App
- 2 Click “Join the Discussion”
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<https://cislive.ciscoevents.com/cislivebot/#BRKDCN-2988>

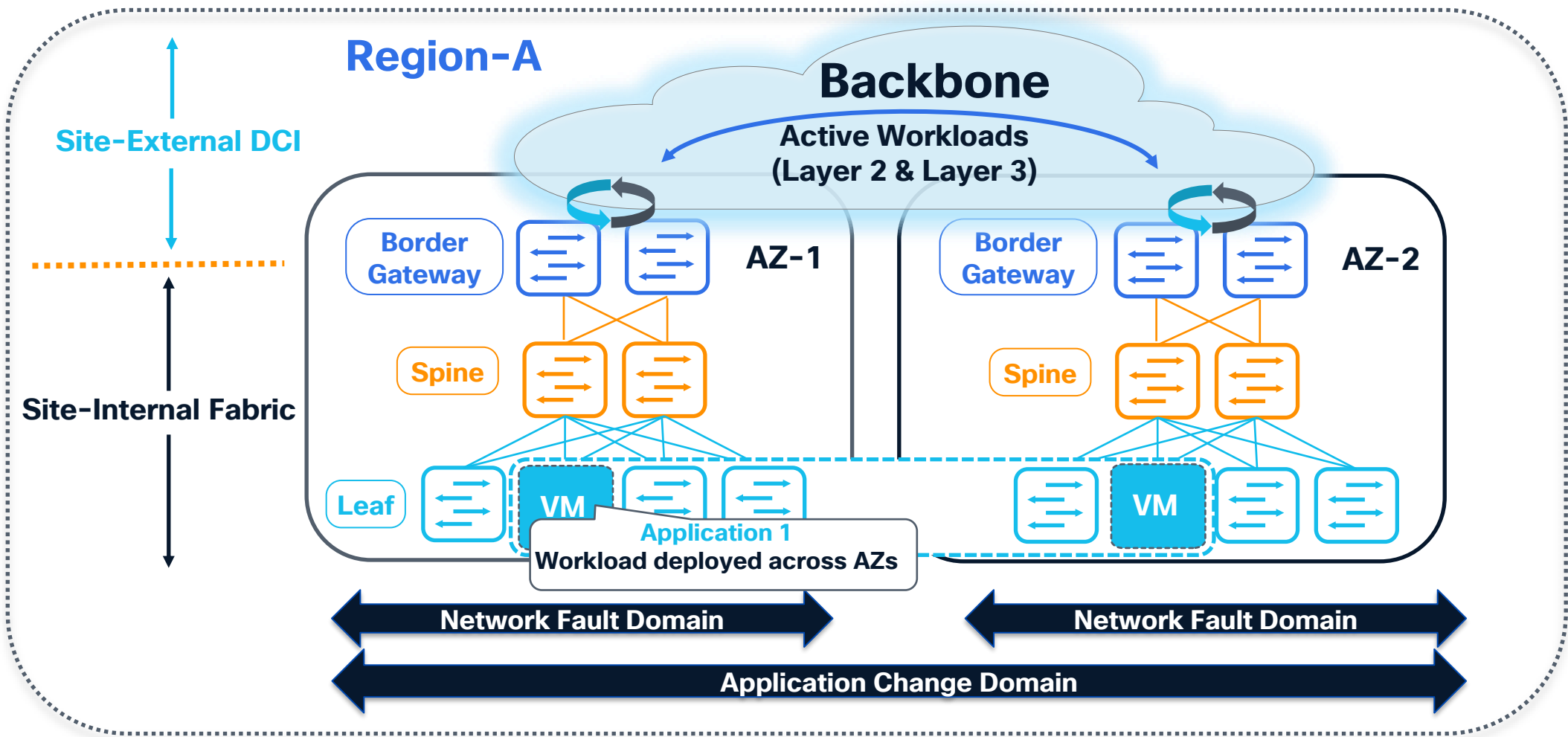
Agenda

- 01 Design VXLAN Multi-Site with Nexus Dashboard**
- 02 Introduction to Nexus Dashboard Federation**
- 03 Automate VXLAN Multi-Site with Nexus Dashboard Federation**
- 04 Conclusion**

VXLAN Multi-Site Design Options

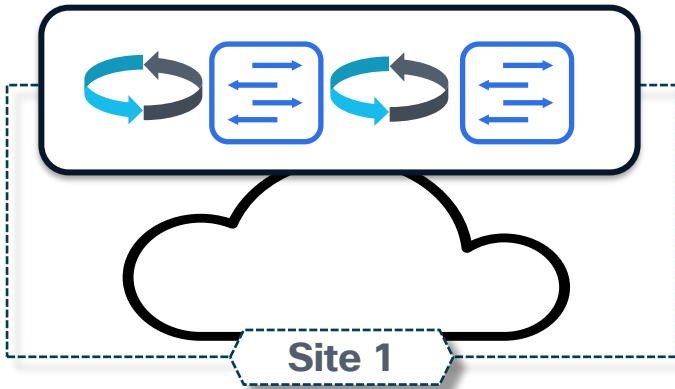
VXLAN EVPN Multi-Site Overview

Functional Components



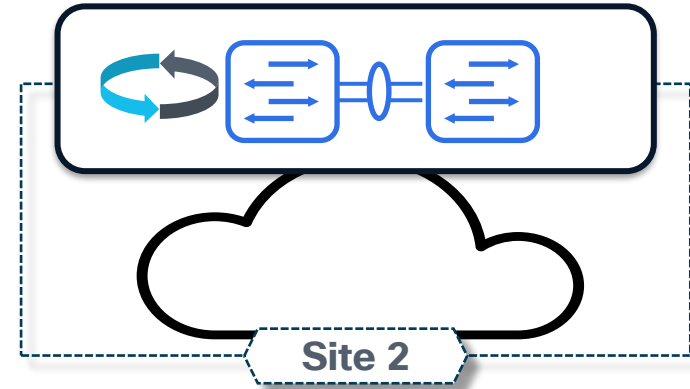
Border Gateway

When to use What



Anycast Border Gateway

- Up to 6 BGW
 - Simple Failure Scenarios
- Any Deployments
 - No End-Point or Network Services Connectivity on BGW
- Greenfield Deployments



VPC Border Gateway

- 2 BGW with Physical Peer-Link
- Small Deployments
 - End-Point or Network Services Connectivity on BGW
- Migration Use-Cases (Brownfield)
 - Classic Ethernet / FabricPath to VXLAN EVPN

BGW Node Placement Option

Flexible Design option-1

Dedicated Border Gateway

- ✓ Flexible scale-out approach for VXLAN EVPN Multi-Site DCI
- ✓ Flexible Anycast or VPC BGW models
- ✓ Capacity planning only for DCI traffic flows
- ✓ Clean role separation and uniform reachability from the entire fabric are the major advantages

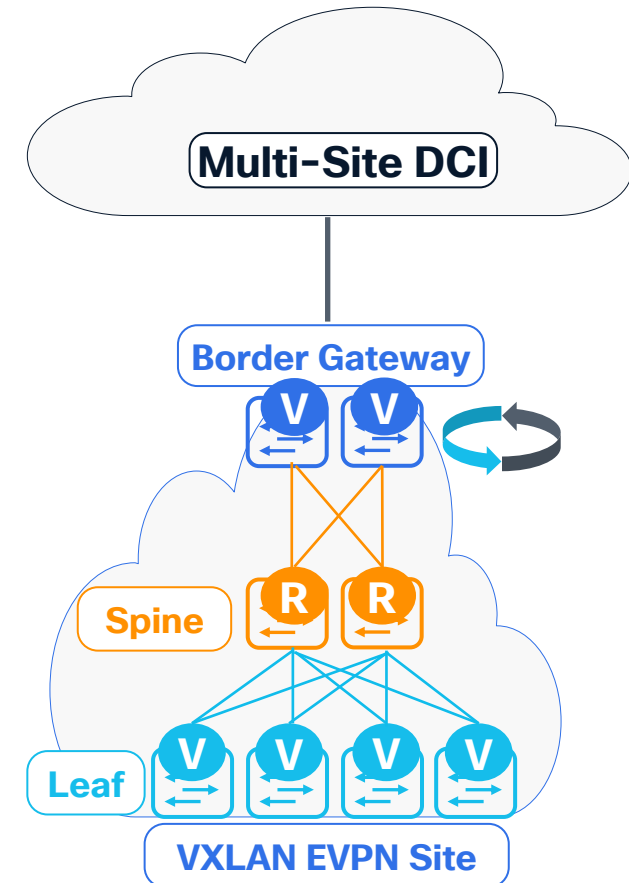
Border Gateway hosts:

VTEP for:

- East-West (DCI Packet Re-Originatation L2/L3)

V V = VTEP

R = RR/RP



BGW Node Placement Option

Flexible Design option-2

BGW on Spine nodes (**Border Gateway Spine**)

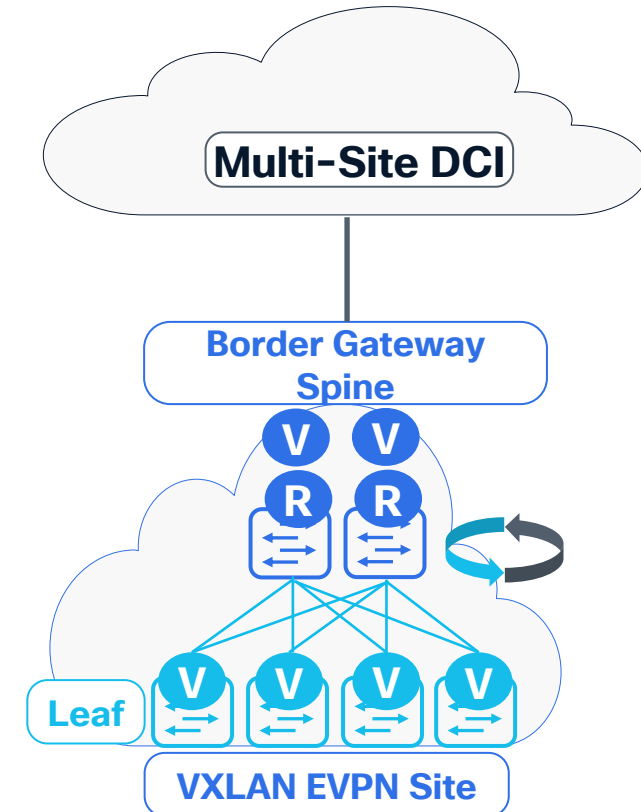
- ✓ Flexible scale-out approach for VXLAN EVPN Multi-Site DCI
- ✓ Anycast BGW only
- ⚠ Extra functional dependency (BGW + Spine)
- ⚠ Capacity planning needs to accommodate all flows

Border Gateway Spine hosts:
VTEP for:

- East-West (DCI Packet Re-Originatation L2/L3)
- Route Reflector (RR) (Site-Internal iBGP EVPN)
- Rendezvous Point (RP) (Site-Internal Multicast Underlay BUM)

V V = VTEP

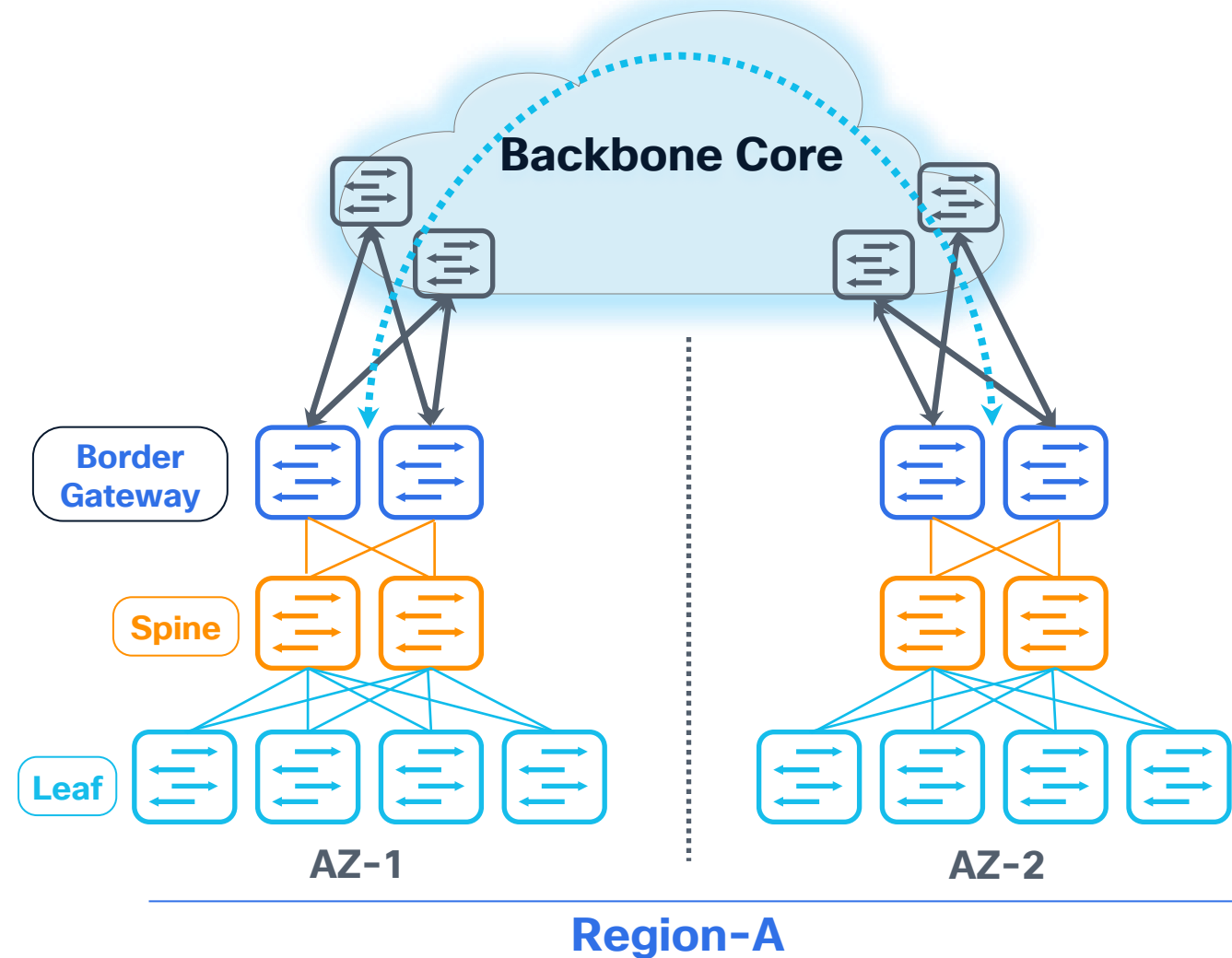
R = RR/RP



VXLAN Multi-Site Architecture

DCI- BGW to Cloud

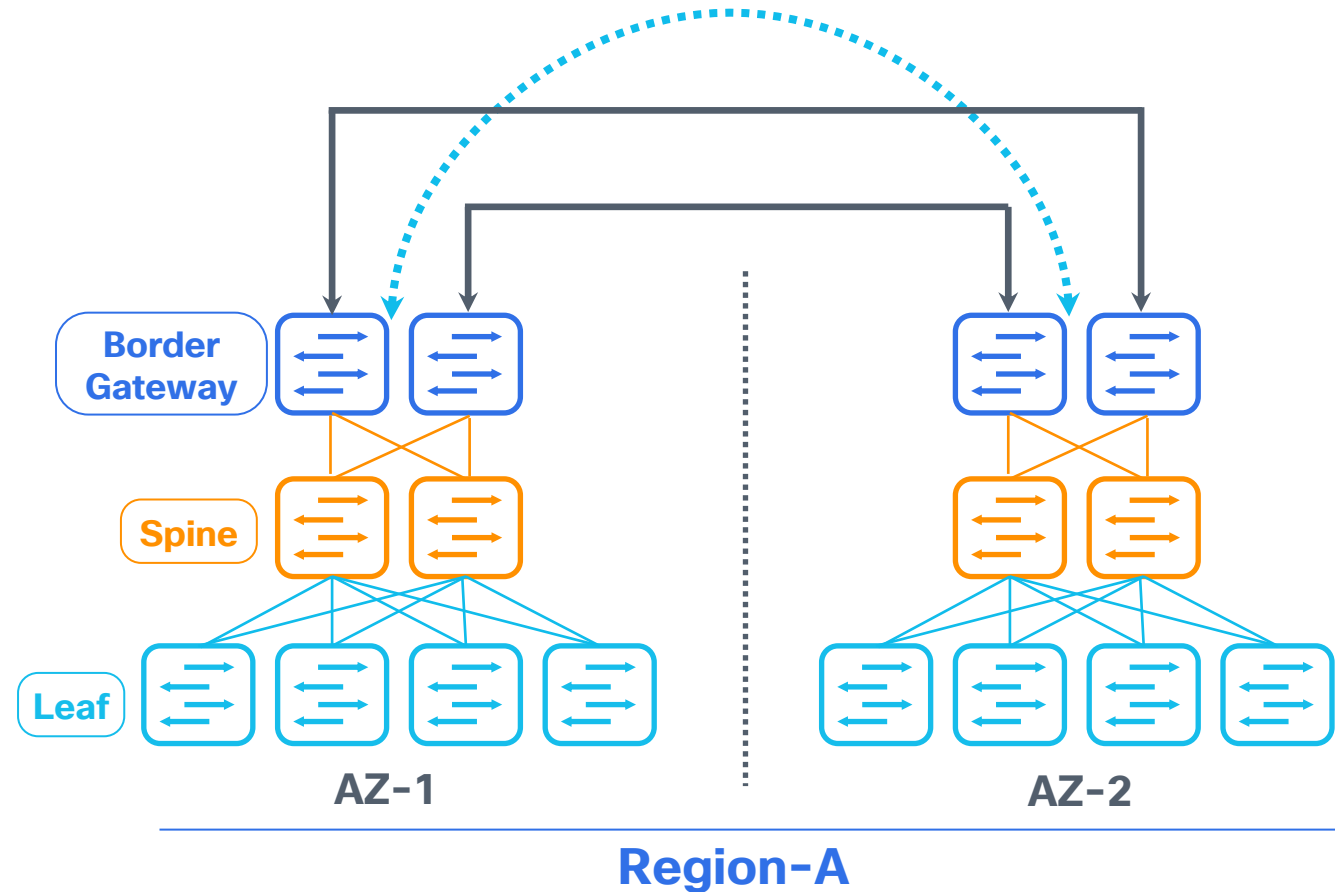
- Scalable design option with horizontal scale-out within and across multiple sites.
- Backbone/Cloud can be any routed service. (flat L3, MPLS-L3VPN)
- **Multi-Site Underlay: eBGP IPv4 Unicast** $\longleftrightarrow$
 - **Advertise Lo0 (Overlay Control Plane), Lo1 (BUM, External networks), and Lo100 (Multi-Site Inter-Site Transit communication)**
 - Site-External DCI BUM: Ingress-Replication or Multicast supported. *Currently NDFC supports only Ingress-Replication.
 - Site-Internal Fabric BUM: Ingress-Replication or Multicast supported independently at each site.
- **Multi-Site Overlay: eBGP EVPN Overlay** $\longleftrightarrow$
 - Full-mesh BGP EVPN peering across all BGWs.
 - Ensure that PIP / VIP of all BGWs are known by every BGW and MTU must accommodate VXLAN encapsulated traffic.



VXLAN Multi-Site Architecture

DCI- BGW Back-to-Back

- Available option for connecting 2 or 3 sites.
- Minimum topology is the square. An enhanced option is to add links between site local BGWs for improved ECMP and Failure scenarios.
- **Multi-Site Underlay: eBGP IPv4 Unicast** $\longleftrightarrow$
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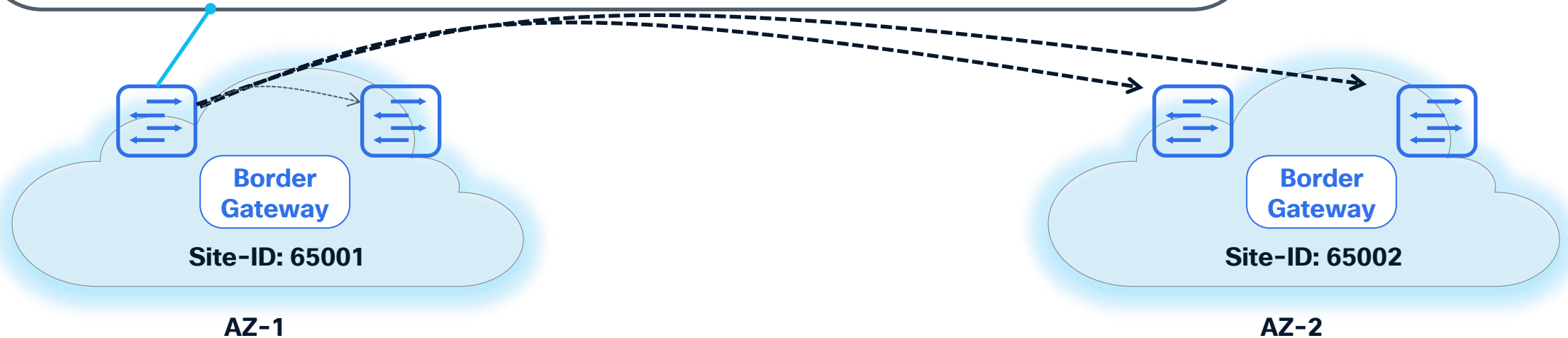


Multi-Destination Traffic Forwarding

EVPN Route-Type 4 (Ethernet Segment Route)

- BGW advertises BGP EVPN Type-4 update to all of their BGP EVPN peers (Site-Internal and Site-External)
- BGW will use this information for DF (Designated Forwarded) election on per VLAN/VNI
- EVPN Type-4 update will also carry ES Import Route-Target Extended Community
- Remote site BGWs will not install the route due to different RT and Site ID
- Command to check: `show bgp l2vpn evpn route-type 4`
 - BGP routing table entry for [4]:[0300.0000.00fd.e900.0309]:[32]:[10.1.1.1]/136
 - [4] = EVPN Route-Type 4
 - [03]= ESI Type MAC-based
 - [0000.0000.fde9] = ESI system MAC for Site-ID and RT {fde9 = 65001}
 - [000309] = ESI local discriminator
 - [32] = IP Address Length
 - [10.1.1.1] = Sender (BGW Primary IP) used for DF election process

evpn multisite border-gateway 65001
delay-restore time 300



Multi-Destination Traffic Forwarding

BGW Designated Forwarded (DF) Election

BGW learns about other BGWs originator IPs on the same site from exchanging EVPN Type 4 routes. The originator IP address used is the BGW NVE source interface's primary IP address.

Each BGW creates an ordinal list of originator IP in numerical order from lowest to highest. Every BGW is then given an ordinal value based on its position in the ordinal list starting from position 0. The BGW with the lowest originator IP would get an ordinal value of 0. The ordinal value decides which BGW will be the DF for a VLAN/VNI.

DF election Formula uses “mod” operation:

$I = V \bmod N$ {I = ordinal value, V = VLAN #, N = # BGWs in a site}

If there are 4 BGWs in one site. The ordinal list of the BGWs will be arranged as shown below.

Ordinal List = 10.1.1.1, 10.1.1.2, 10.1.1.3, 10.1.1.4 {I=0, I=1, I=2, I=3}

The DF for VLAN 48 will be: “ $I = 48 \bmod 4 = 0 = 10.1.1.1$ ”

The DF for VLAN 49 will be: “ $I = 49 \bmod 4 = 1 = 10.1.1.2$ ”

The DF for VLAN 50 will be: “ $I = 50 \bmod 4 = 2 = 10.1.1.3$ ”

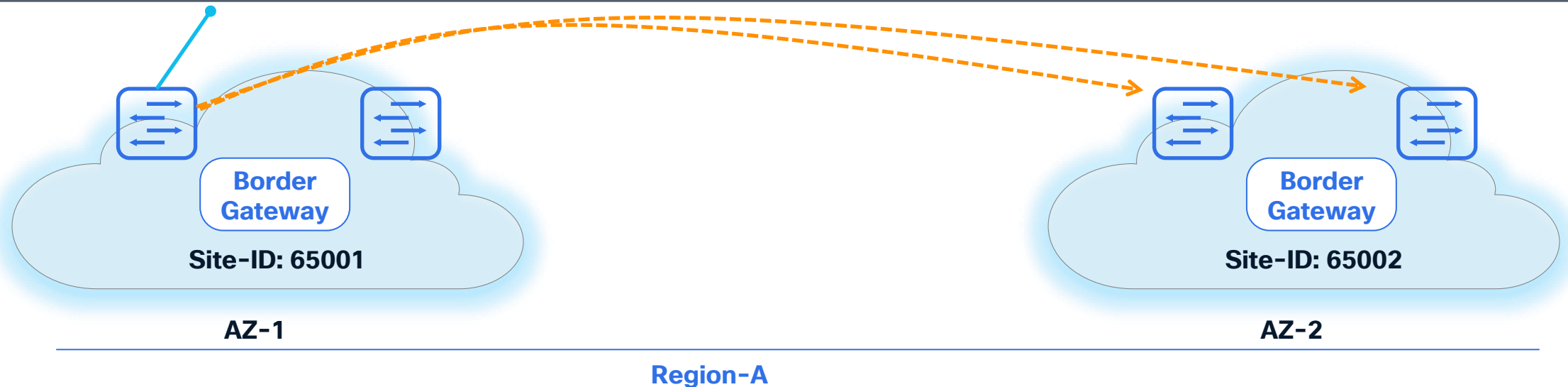
The DF for VLAN 51 will be: “ $I = 51 \bmod 4 = 3 = 10.1.1.4$ ”

Multi-Destination Traffic Forwarding

EVPN Route-Type 3 (Inclusive Multicast Ethernet Tag Route)

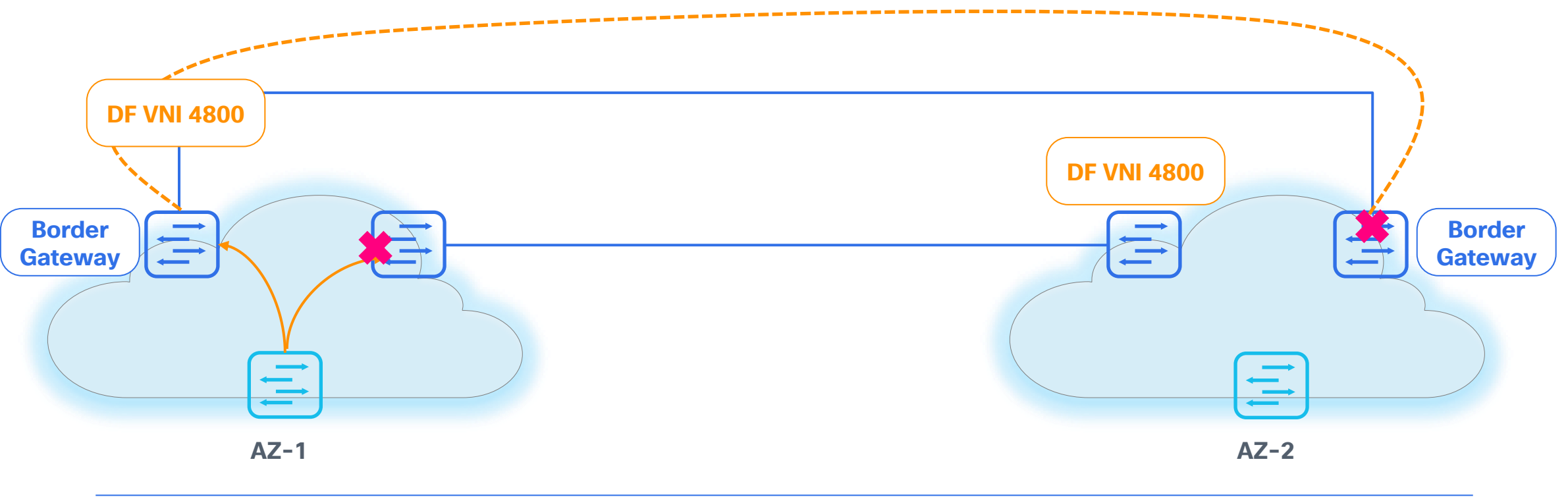
- BGW advertises BGP EVPN Type-3 only towards Site-External DCI
- Receiving BGW switch does not forward it to Site-Internal Fabric
- Command to check: `show bgp l2vpn evpn route-type 3,`
`show l2route evpn imet all detail`
- **Local: Advertising from Site 1 BGW to Site 2 BGW**
BGP routing table entry for [3]:[0]:[32]:[10.3.0.4]/88
AS-Path: NONE, path locally originated
Extcommunity: RT:65001:10000 ENCAP:8
PMSI Tunnel Attribute:
 flags: 0x00, Tunnel type: Ingress Replication
 Label: 10000, Tunnel Id: 10.3.0.4
 Path-id 1 advertised to peers: 20.2.0.4

- **Remote: Learning from Site 2 BGW to Site 1 BGW**
BGP routing table entry for
[3]:[0]:[32]:[20.3.0.4]/88
Path type: external, path is valid, is best path
Imported to 1 destination(s)
Imported paths list: L2-10000
AS-Path: 65002 , path sourced external to AS
Extcommunity: RT:65001:10000 ENCAP:8
PMSI Tunnel Attribute:
 flags: 0x00, Tunnel type: Ingress Replication
 Label: 10000, Tunnel Id: 20.3.0.4



VXLAN Multi-Site Architecture

DCI- BGW Back-to-Back BUM (w/o Local L3 link)



Region-A

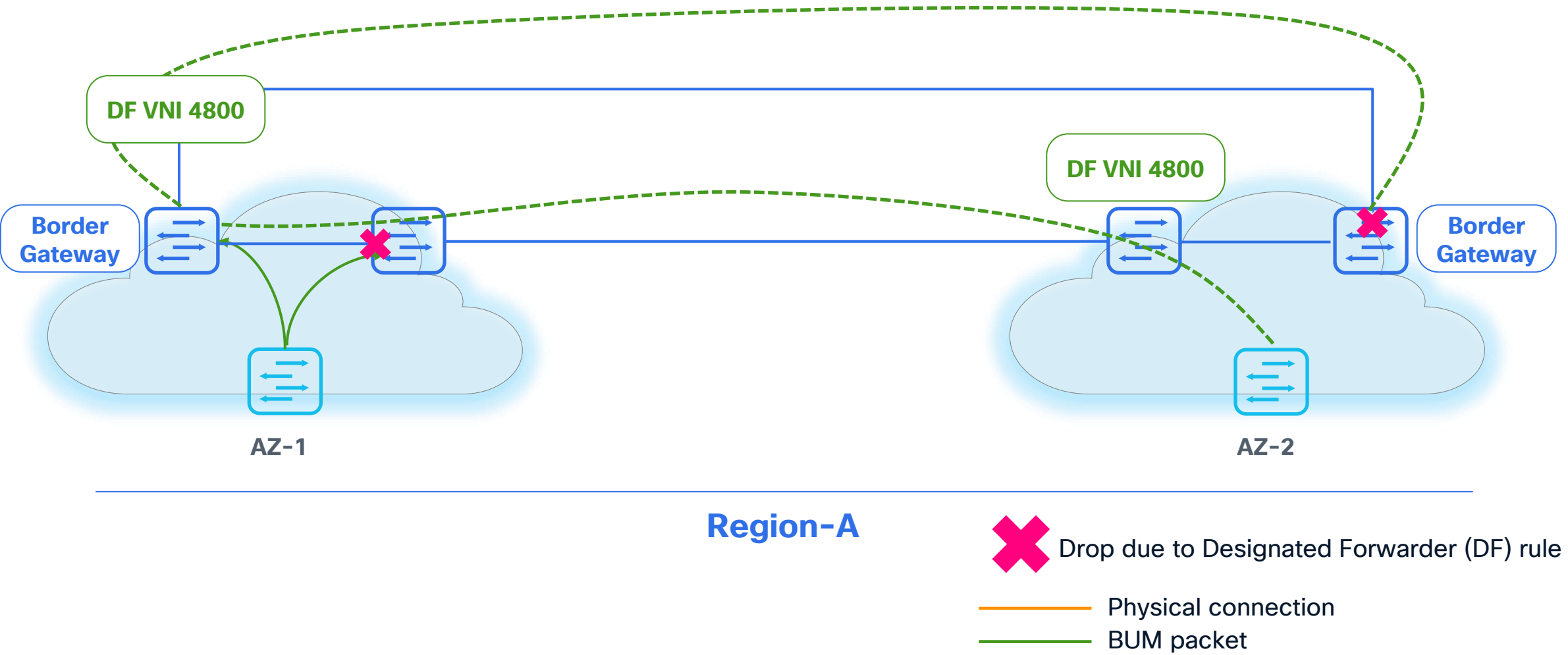
 Drop due to Designated Forwarder (DF) rule

 Physical connection

 BUM packet

VXLAN Multi-Site Architecture

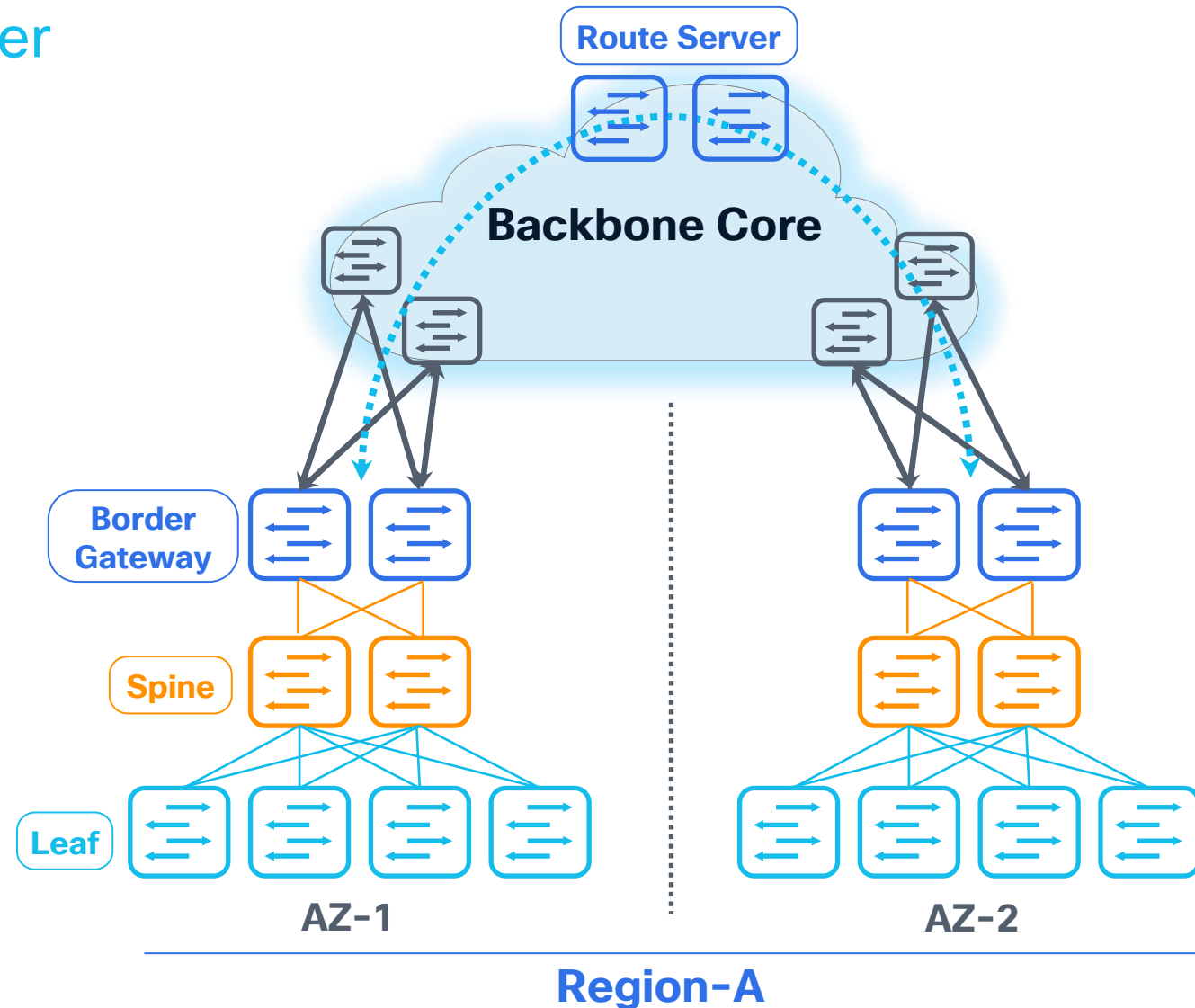
DCI- BGW Back-to-Back BUM (with Local L3 link)



VXLAN Multi-Site Architecture

DCI- BGW to Centralized Router-Server

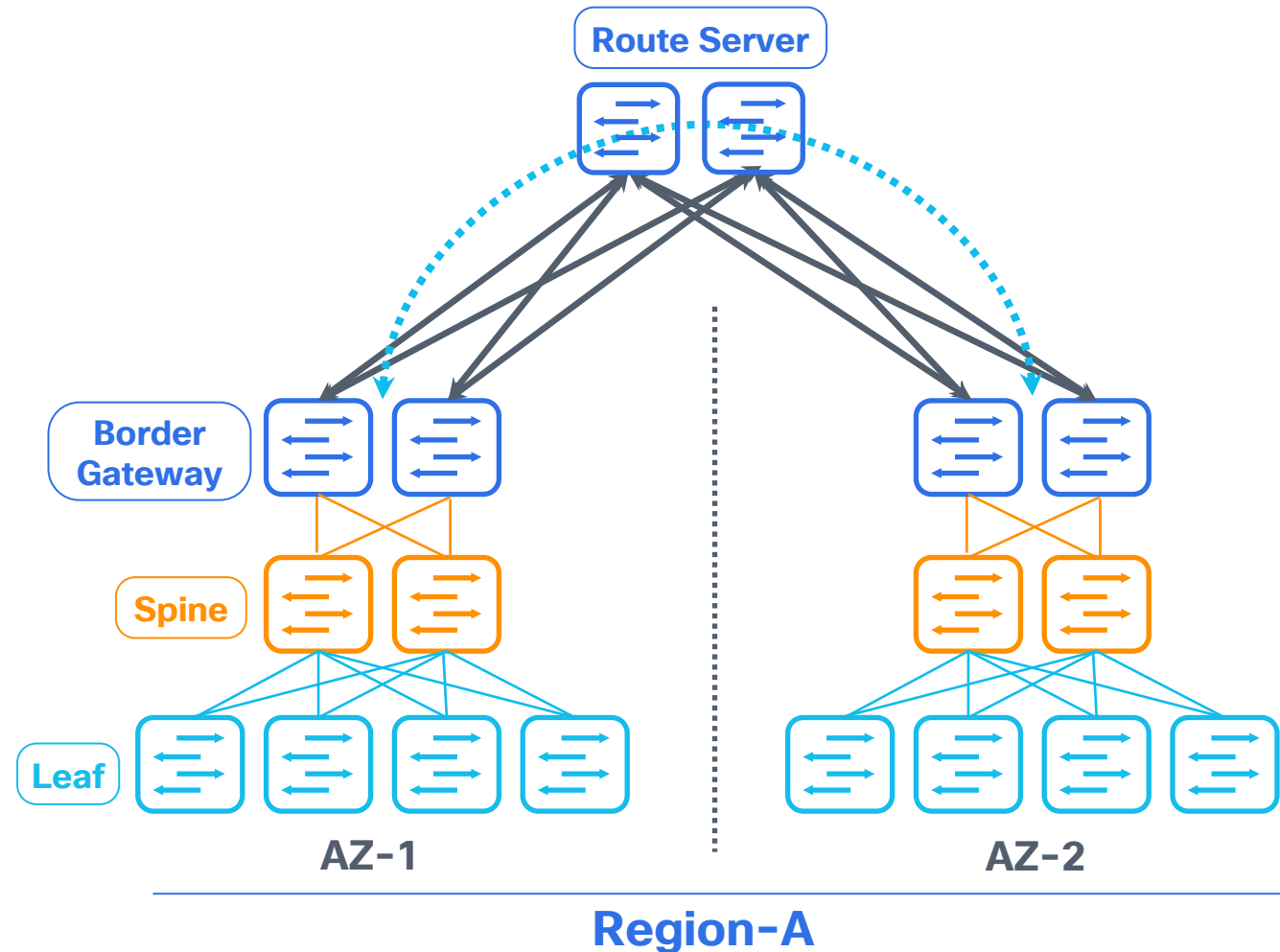
- BGP Route-Server (RS) function can be used in a highly scalable design to act as the central EVPN peering point for the Multi-Site.
- RS does not need to be on the data path.
- **Multi-Site Underlay: eBGP IPv4 Unicast** ↔
 - Advertise **Lo0 (Overlay Control Plane)**, **Lo1 (BUM, External networks)**, and **Lo100 (Multi-Site Inter-Site Transit communication)**
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 - Site-Internal Fabric BUM: Ingress-Replication or Multicast supported independently at each site.
- **Multi-Site Overlay: eBGP EVPN Overlay** ↔
 - BGP EVPN peering only between BGWs and RS.
- **Route-Server (RS) must support...**
 - EVPN AFI and Router-Server function per RFC 7947
 - Next-hop-unchanged, Retain RT, and RT Rewrite function
- Ensure that PIP / VIP of all BGWs are known by every BGW and MTU must accommodate VXLAN encapsulated traffic.



VXLAN Multi-Site Architecture

DCI- BGW to Centralized Router-Server

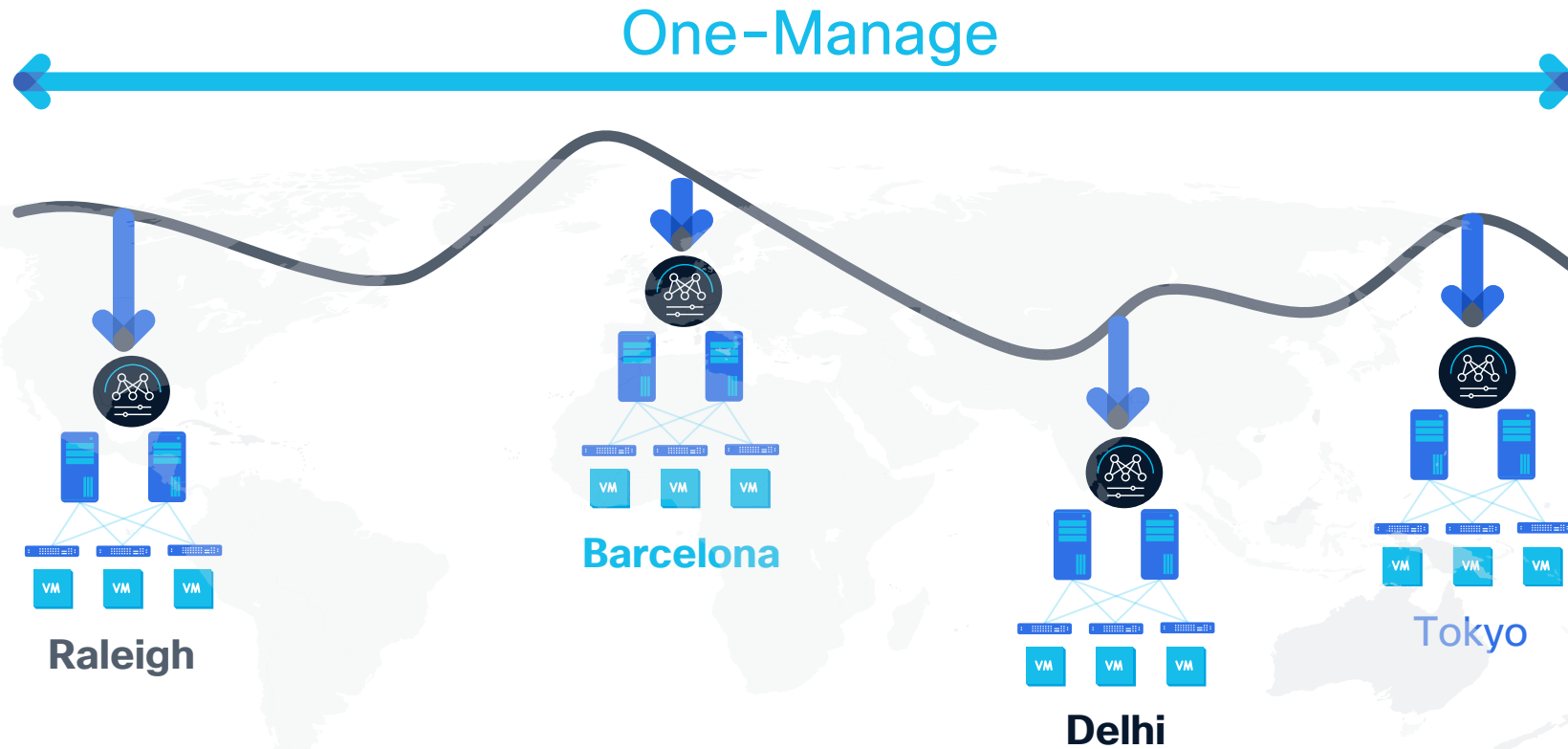
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- Ensure that PIP / VIP of all BGWs are known by every BGW and MTU must accommodate VXLAN encapsulated traffic.



Nexus Dashboard Federation

One-Manage

Multi-Cluster Nexus Dashboard Deployments



Single sign-on for clusters
(With remote authentication)



One view dashboard to see summary of
fabrics, switch details etc.



VXLAN EVPN Fabric

- Unified view and automation workflows for Multi-Site deployments
- Federation of MSDs
- L2/L3 Network stretch



No. of Clusters: 10

No. of Fabrics in Multi-Cluster Group: 100

No. of Switches in Multi-Cluster: 3500

Benefits

End-to-End connectivity and policy
between loosely coupled DC sites

Disaster Recovery, IP Mobility
and Active-Active use cases

Network
policy consistency

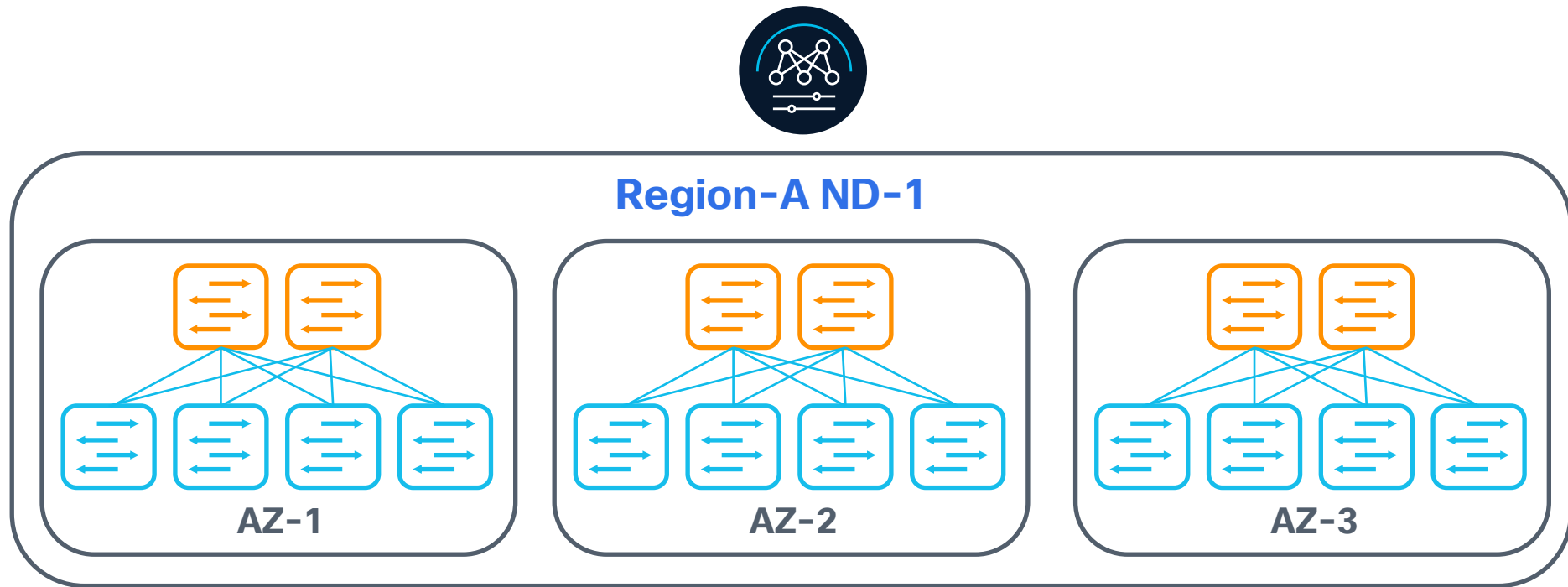
Change control domains
separation

Flexible geo-redundancy for ND

Single point of Orchestration

ND-managed VXLAN Multi-Site

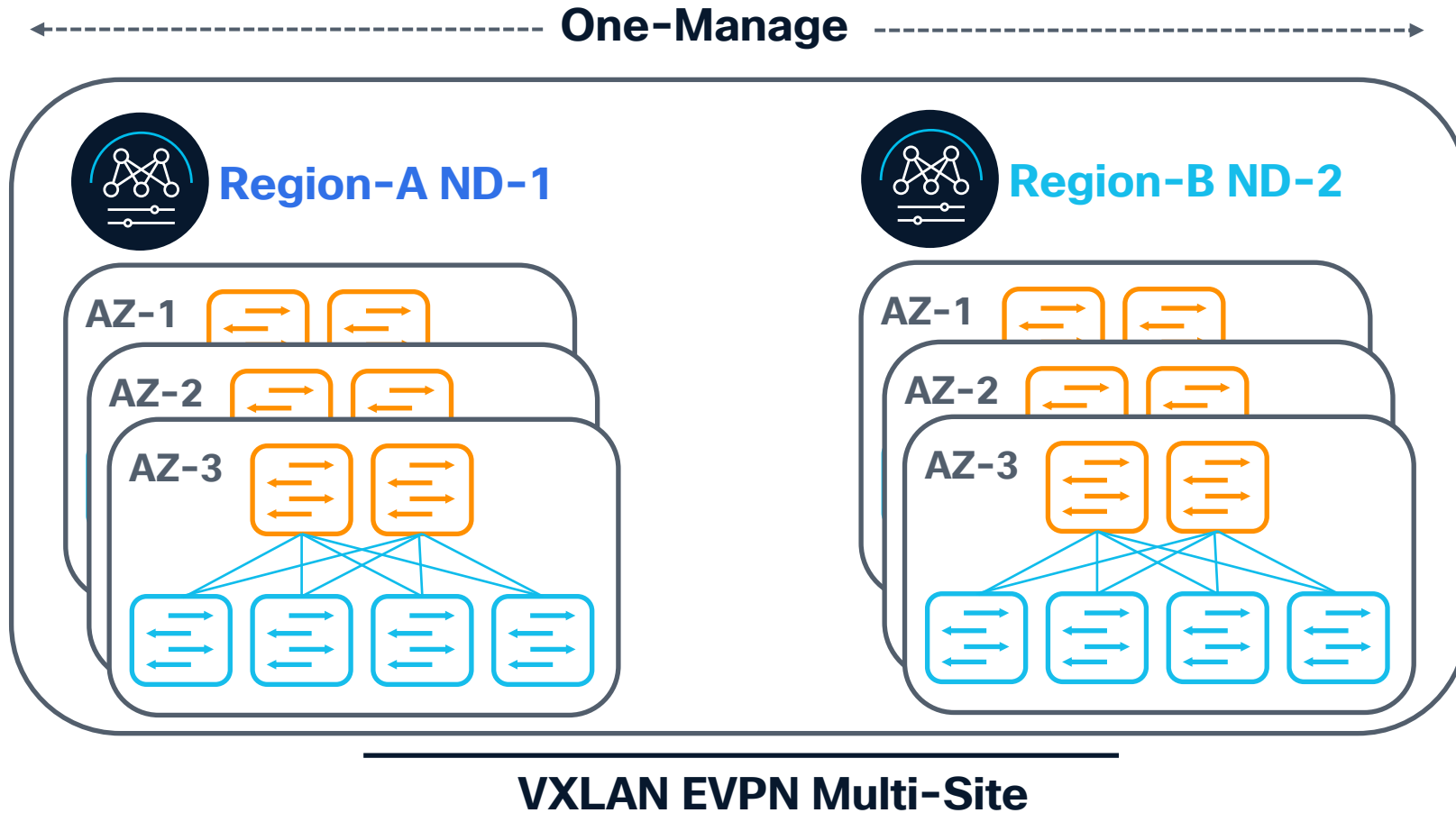
Use-case: Managing multiple DCs in a single instance of ND



VXLAN EVPN Multi-Site

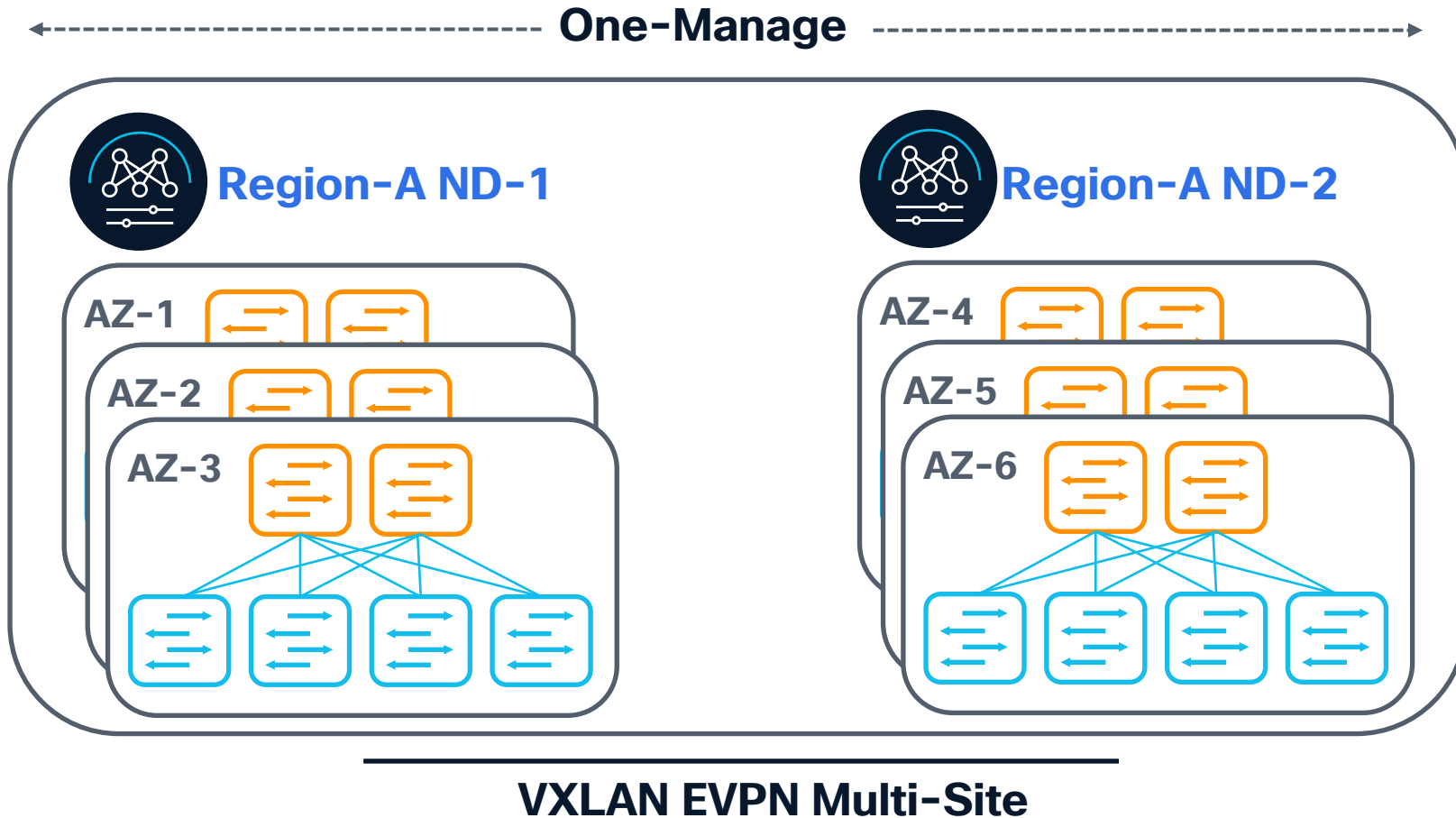
ND-managed VXLAN Multi-Site

Use-case 1: Managing multiple DCs with multiple instances of ND



ND-managed VXLAN Multi-Site

Use-case 2: Managing single large-scale DC with 500+ switches





Automate **VXLAN Multi-Site with** **Nexus Dashboard Federation**

One-Manage: Configuration Steps

Step 1 – Create Individual ND clusters and fabrics

Step 2 – Create ND Federation across Multiple ND clusters

Step 3 – Create Multi-Cluster Fabric from ND Federation and Add Member ND/Fabrics

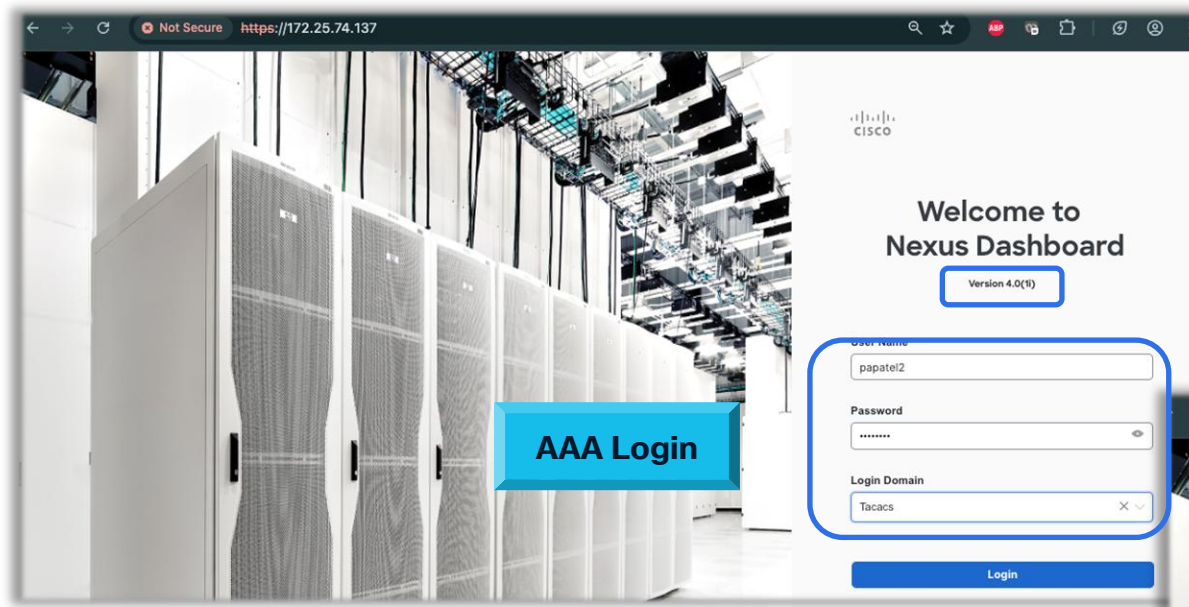
Step 4 – Recalculate and Deploy Multi-Site DCI Configs across BGWs/RS

Step 5 – Create, Attach, and Deploy VXLAN Overlays across Multi-Cluster Fabric

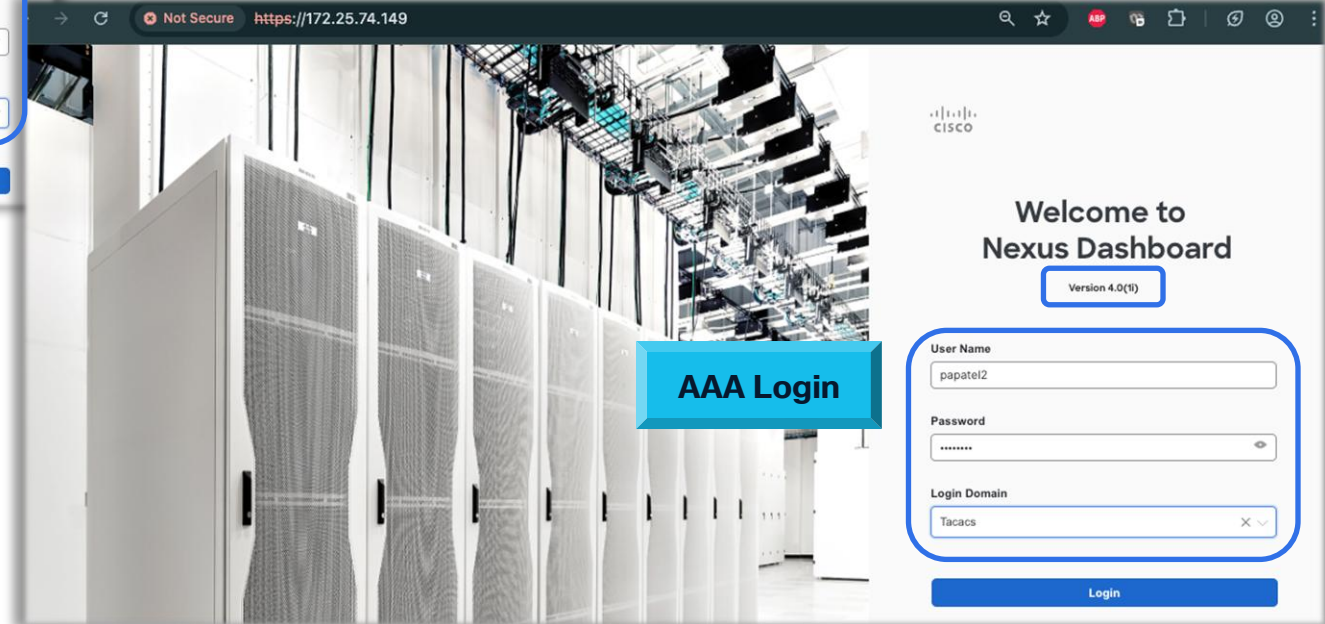
Nexus Dashboard Federation: Multi-Site DCI

Step 1 -> Create Individual ND Clusters and Fabrics

ND-1

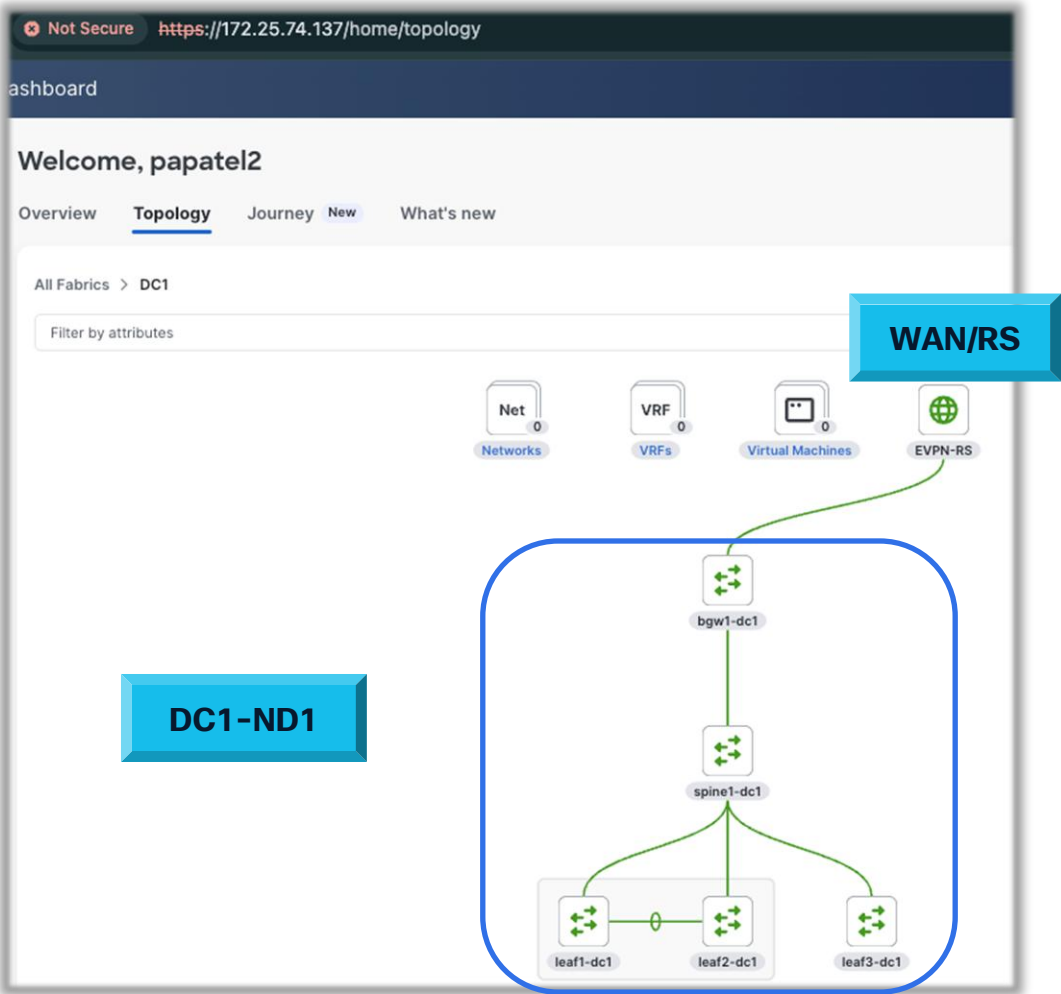
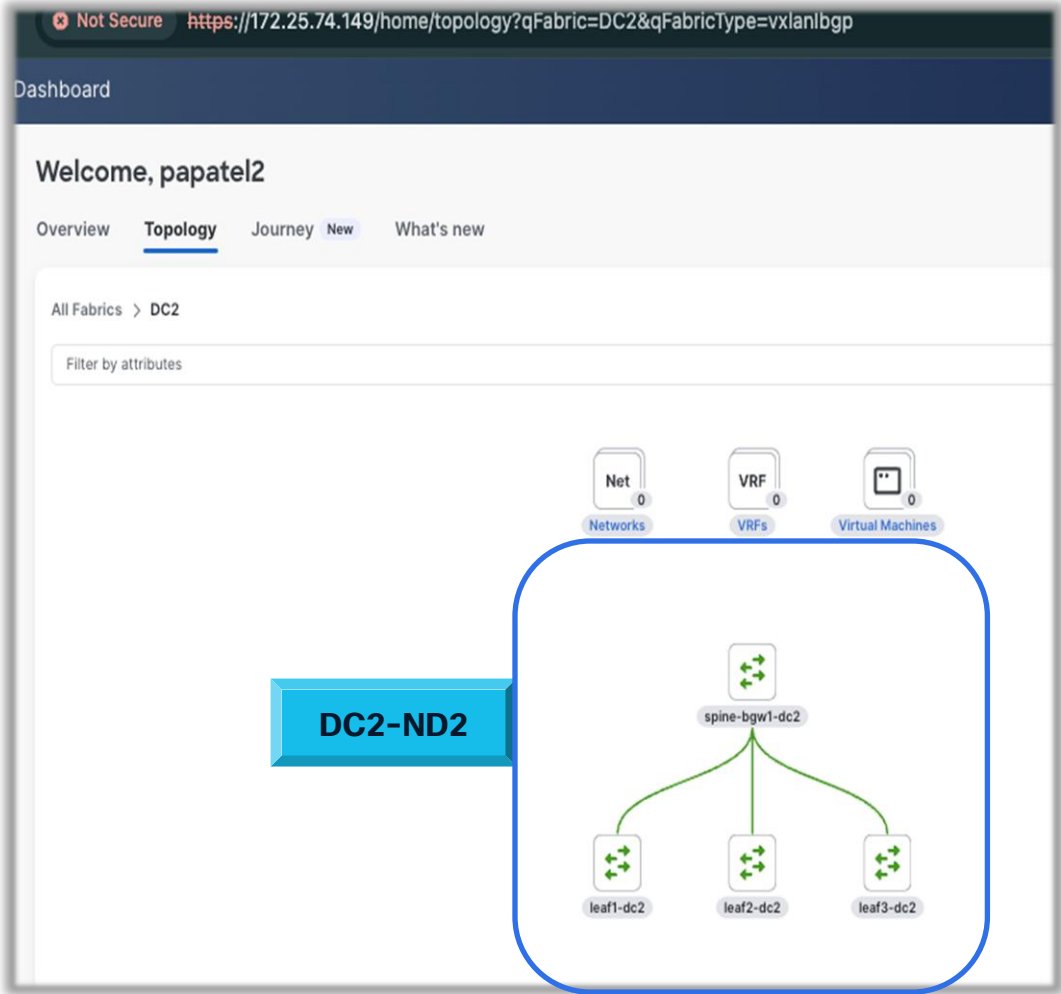


ND-2



Step 1 -> Create Individual ND Clusters and Fabrics

ND-1



Step 2 -> Create Federation

Login to either ND-1 or ND-2 admin console to start ND Federation. In this case, we will use ND-1 as the Federation Manager/Primary.

The image displays three sequential screenshots of the Cisco Nexus Dashboard configuration interface, illustrating the steps to create a federation.

First Screenshot: System Settings
The 'System Settings' page is shown with tabs for 'General', 'Fabric management', 'Multi-cluster connectivity' (highlighted with a blue box), and 'Flow collection'. Below the tabs, a large blue box with a white cube icon and the text 'No Clusters Connected' is visible. A blue button labeled 'Connect Cluster' is highlighted with a blue box.

Second Screenshot: Connect Cluster
The 'Connect Cluster' page is shown with a back arrow and the title 'Connect Cluster'. A progress indicator on the left shows three steps: '1 Select type' (highlighted with a blue box), '2 Settings', and '3 Summary'. The 'Select type' section contains two options: 'Nexus Dashboard' (highlighted with a blue box) and 'APIC'. The 'Nexus Dashboard' option is described as 'Unified platform to transform data-center network operations with simplicity, automation, and analytics.'

Third Screenshot: Settings
The 'Settings' page is shown with the title 'Settings' and a subtitle 'Provide the details of the remote Nexus Dashboard you are attempting to connect.' The form contains the following fields: 'Hostname/IP address' (with the value '172.25.74.149'), 'Username' (with the value 'papatel2'), 'Password' (with masked characters and a 'Show' link), and 'Login Domain' (with a dropdown menu showing 'Tacacs'). The entire settings section is highlighted with a blue box.

ND Federation All Cluster View

One-View

System Settings

GeneralFabric managementMulti-cluster connectivityFlow collection

Create a site to connect clusters together.

Filter by attributes

Name	Connectivity status	Version
parth-denali-1 Primary Local	Up	4.0.1i
parth-denali-2	Up	4.0.1i

Welcome, papatel2

OverviewTopology

Global One-View

SWIM
Data Center VXLAN EVPN - iBGP

ECL-G
Enhanced Classic LAN

External-Network
External and Inter-Fabric Connectivity

CE-Site-1
Enhanced Classic LAN

DC2
Data Center VXLAN EVPN - iBGP

CC
Data Center VXLAN EVPN - iBGP

Anomaly Level Critical
7 total critical anomalies, out of which 7 occurred in the last week

Advisory Level Healthy
No advisories found

Clusters	Fabrics	Inter-Fabric	Switches
2	9	2	23

ND Federation All Cluster View

One-View

Clusters

2

Nexus Dashboard Clusters

You have 2 ND clusters with a total of 9 fabrics between them. 2 of critical.

See More in Local Cluster's System Status

All Clusters

Filter by attributes

Name	Type
parth-denali-1	ND
parth-denali-2	ND

Fabrics

9

Fabrics Onboarded

You have 9 fabrics onboarded across all of your clusters. 3 Fabric(s) have an anomaly score of critical.

See More in Manage

All Fabrics

Filter by attributes

Fabric Name	Type	Cluster Name
CC	Data Center VXLAN EVPN - IBGP	parth-denali-1
CE-Site-1	Enhanced Classic LAN	parth-denali-1
DC1	Data Center VXLAN EVPN - IBGP	parth-denali-1
DC2	Data Center VXLAN EVPN - IBGP	parth-denali-2
ECL-G	Enhanced Classic LAN	parth-denali-2
EVPN-RS	External and Inter-Fabric Connectivity	parth-denali-1
External-Network	External and Inter-Fabric Connectivity	parth-denali-1
Fab1	Data Center VXLAN EVPN - IBGP	parth-denali-1
SWIM	Data Center VXLAN EVPN - IBGP	parth-denali-1

Switches

23

Switches

You have 23 switches in this clusters. All of your switches are connected to Nexus Dashboard.

See More in Manage

All Switches

Filter by attributes

Name	Fabric	Cluster	Anomaly level	Advisory level	IP Address	Model	Configura... Sync Status	Type	Role	Serial Number	Software Version	Discovery Status
S1-LEAF-1-DDD36RU38	SWIM	parth-denali-1	Major	Healthy	10.18.190.88	N9K-C93600CD-GX	InSync	Data Center VXLAN EVPN - IBGP	leaf	FDO2314199J	10.3(3)	Ok
S1-LEAF-2-DDD36RU37	SWIM	parth-denali-1	Major	Healthy	10.18.190.89	N9K-C93600CD-GX	InSync	Data Center VXLAN EVPN -	leaf	FDO23141951	10.4(1)	Ok

5 Data Center VXLAN EVPN - IBGP
Fabrics Onboarded

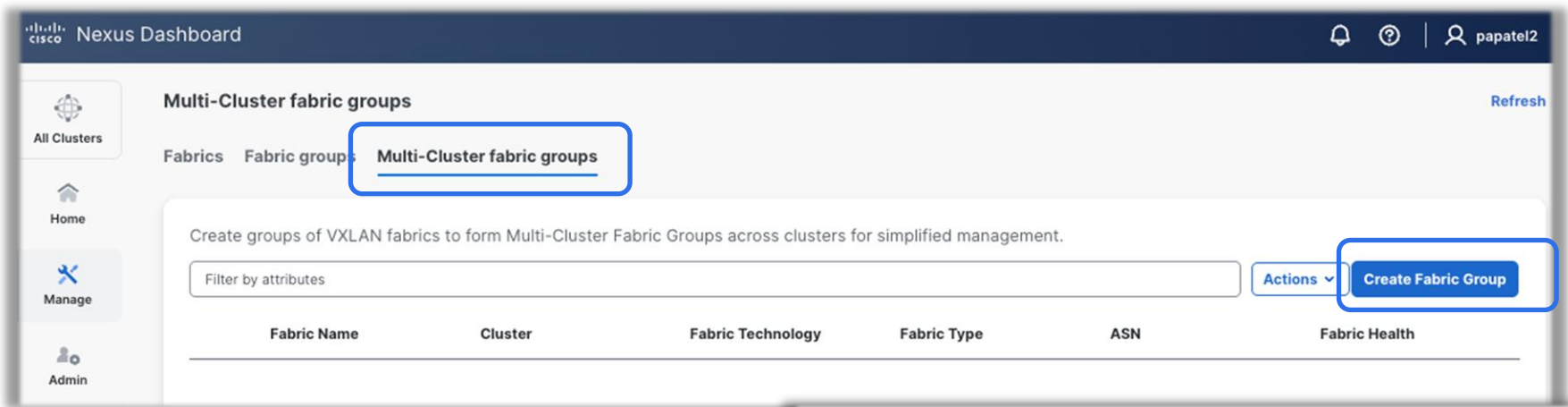
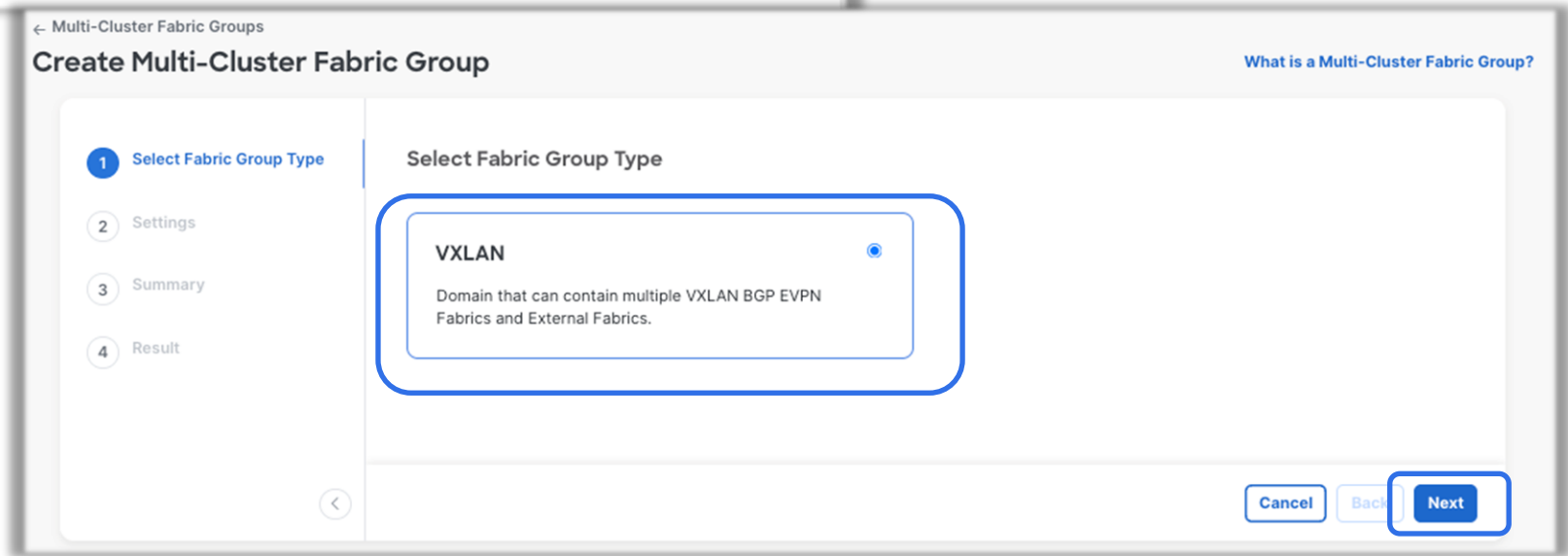
2 Enhanced Classic LAN
Fabrics Onboarded

2 External And Inter-Fabric Connectivity
Fabrics Onboarded

3 Critical
Highest anomaly level

Step 3 -> Create Multi-Cluster Fabric Group

VXLAN Multi-Site across Multi-Cluster ND



Step 3 -> Create Multi-Cluster Fabric Group

Fabric Group Name*

Multi-Site-Argentina

Fabric Group Type

VXLAN EVPN Multi-Site

General Parameters

DCI

Security

Resources

Configuration Backup

Layer 2 VXLAN VNI Range*

30000-49000

Overlay Network Identifier Range (Min:1, Max:16777214)

Layer 3 VXLAN VNI Range*

50000-59000

Overlay VNI Identifier Range (Min:1, Max:16777214)

☐ Enable Downstream VNI

When enabled, allows different VXLAN fabric to have different VNI for the same vrf or network.

Layer 2 VXLAN VNI Global Range

Unique Range for L2VNI when Downstream VNI is enabled (Min:1, Max:16777214). This range should not have conflict with any VNI already used in member fabric

Layer 3 VXLAN VNI Global Range

Unique Range for L3VNI when Downstream VNI is enabled (Min:1, Max:16777214). This range should not have conflict with any VNI already used in member fabric

☐ Enable IPv6 Underlay for VXLAN Fabric

If not enabled, IPv4 underlay is used in child VXLAN fabric

Anycast-Gateway-MAC

2020.0000.00aa

Shared MAC address for all leafs

Multi-Site VTEP VIP Loopback Id*

100

(Min:0, Max:1023)

Border Gateway IP TAG

54321

Routing tag associated with IP address of loopback and DCI interfaces. Tag value 0-4294967295

General Parameters

DCI

Security

Resources

Configuration Backup

Multi-Site Overlay IFC Deployment Method*

Centralized_To_Route_Server

Manual, Auto Overlay EVPN Peering to Route-Servers, Auto Border Gateway

Multi-Site Route Server List*

9.9.9.9

Multi-Site Route-Server peer list (typically loopback IP address on Route-Server for Multi-Site EVPN peer underlay, e.g. fd00::b10:1, fd00::b10:2)

Multi-Site Route Server BGP ASN List*

65099

1-4294967295 | 1-65535[0-65535], e.g. 65000, 65001

☐ Enable 'redistribute direct' on Route Servers

For auto-created Multi-Site overlay IFCs in Route Servers. Applicable only when Multi-Site

Route Server IP T

Routing tag associated with Route Server IP for redistribute direct. This is the IP used in eBGP E

☒ BGP Neighbor Description on Multi-Site Overlay IFC

Generate BGP neighbor description for auto-created Multi-Site overlay IFCs

☒ Multi-Site Underlay IFC Auto Deployment Flag

☒ BGP Send-community on Multi-Site Underlay IFC

For auto-created Multi-Site Underlay IFCs

☐ BGP log neighbor change on Multi-Site Underlay IFC

For auto-created Multi-Site Underlay IFCs

☐ BGP BFD on Multi-Site Underlay IFC

For auto-created Multi-Site Underlay IFCs

Delay Restore time

300

Multi-Site underlay and overlay control plane convergence time (Min:30, Max:1000) in seconds

General Parameters

Security

Resources

Configuration Backup

Multi-Site VTEP VIP Loopback IP Range*

10.10.0.0/24

Typically Loopback100 IP Address Range

DCI Subnet IP Range*

10.10.1.0/24

Address range to assign P2P DCI Links

Subnet Target Mask*

30

Target Mask for Subnet Range (Min:8, Max:31)

Stretched VNI Namespace

DSVNI Feature

DCI Design Option

Auto IP Allocation

BGW BGP Flags

Anycast Gateway

Step 4 -> Add Fabrics inside Multi-Cluster Fabric Group

Add Child fabrics (DC1, DC2, EVPN-RS) one-by-one inside the Multi-Cluster Fabric Group

Multi-Cluster Fabric Group - Multi-Site-Argentina

Refresh

View in topology

Actions

Overview

Inventory

Connectivity

Segmentation and security

Configuration Policies

History

Child Fabrics

Switches

Filter by attributes

Actions

Fabric Name

Fabric Technolo...

Fabric Type

ASN

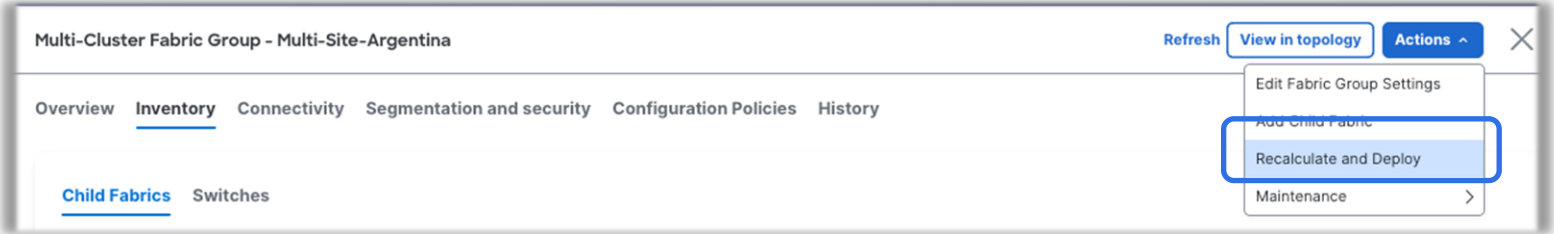
Cluster

Add Child Fabric

Filter by attributes

	Fabric Name	Cluster Name	Fabric Technology	Fabric Type	ASN	Fabric Health	
☐	CC	parth-denali-1	VXLAN EVPN	Data Center VXLAN EVPN	65555	Critical	
☐	External-Network	parth-denali-1	Custom	Custom Network	65000	Minor	
☒	DC1	parth-denali-1	VXLAN EVPN	Data Center VXLAN EVPN	65001	Major	
☐	EVPN-RS	parth-denali-1	Custom	Custom Network	65099	Minor	
☐	Fab1	parth-denali-1	VXLAN EVPN	Data Center VXLAN EVPN	65001	Major	
☐	SWIM	parth-denali-1	VXLAN EVPN	Data Center VXLAN EVPN	65001	Critical	
☐	DC2	parth-denali-2	VXLAN EVPN	Data Center VXLAN EVPN	65002	Critical	
☐	Test	parth-denali-2	VXLAN EVPN	VXLAN EVPN Multi-Site		Healthy	

Step 5 -> Perform R&D for DCI Config



Deploy Fabric Group Configuration - Multi-Site-Argentina

1 Config Preview 2 Deploy Progress

Filter by attributes Resync All

Cluster Name	Fabric Name	Switch Name	IP Address	Role	Serial Number	Fabric Status	Pending Config	Status Description	Progress	Resync Switch
parth-denali-2	DC2	spine-bgw1-dc2	192.168.100.77	border gateway spine	9N19GSLKTYD	Out-Of-Sync	58 Lines	Out-of-Sync	<div></div>	Resync
parth-denali-1	EVPN-RS	evpn-route-server	192.168.100.76	core router	9VSEXGYXSVN	Out-Of-Sync	48 Lines	Out-of-Sync	<div></div>	Resync
parth-denali-1	DC1	bgw1-dc1	192.168.100.75	border gateway	9MJ16AJ90Y0	Out-Of-Sync	57 Lines	Out-of-Sync	<div></div>	Resync

Multi-Site DCI Config Preview

Pending Config - Multi-Site-Argentina - **evpn-route-server**

Pending Config Side-by-Side Comparison

```
interface ethernet1/2
  no switchport
  ip address 10.10.1.2/30 tag 54321
  mtu 9216
  negotiate auto
  no shutdown
router bgp 65099
  address-family ipv4 unicast
    maximum-paths 64
    maximum-paths ibgp 64
    network 9.9.9.9/32
  exit
  address-family ipv6 unicast
    maximum-paths 64
    maximum-paths ibgp 64
  exit
  address-family l2vpn evpn
    retain route-target all
  exit
  template peer OVERLAY-PEERING
    update-source loopback0
    ebgp-multihop 5
    address-family l2vpn evpn
      route-map unchanged out
      send-community both
    exit
  exit
```

**DCI Underlay Routed
Port towards BGW**

**Retain RT coming from
BGW EVPN NLRI**

**EVPN NH unchanged on RS for BGW-to-
BGW VTEP termination**

```
neighbor 10.10.1.1
  remote-as 65001
  update-source Ethernet1/2
  address-family ipv4 unicast
    next-hop-self
    send-community both
  exit
  exit
neighbor 10.2.0.4
  remote-as 65001
  inherit peer OVERLAY-PEERING
  address-family l2vpn evpn
    rewrite-evpn-rt-asn
  exit
  exit
neighbor 20.2.0.1
  remote-as 65002
  inherit peer OVERLAY-PEERING
  address-family l2vpn evpn
    rewrite-evpn-rt-asn
```

**eBGP IPv4 Unicast (default) DCI
Underlay peering towards BGW**

**eBGP EVPN DCI Overlay peering
towards BGW**

Rewrite ASN portion of Auto RT

Multi-Site DCI Config Preview

Pending Config - Multi-Site-Argentina - bgw1-dc1

Pending Config Side-by-Side

**BGW Interface
advertisement for DCI
reachability**

```
route-map rmap-redist-direct permit 10
  match tag 54321
evpn multisite border-gateway 65001
  delay-restore time 300
router bgp 65001
  address-family ipv4 unicast
    redistribute direct route-map rmap-redist-direct
    maximum-paths 64
    maximum-paths ibgp 64
  exit
  address-family ipv6 unicast
    maximum-paths 64
    maximum-paths ibgp 64
  exit
  neighbor 10.10.1.2
    remote-as 65099
    update-source Ethernet1/2
    address-family ipv4 unicast
      next-hop-self
      send-community both
    exit
  exit
```

BGW Site ID

**eBGP IPv4 Unicast
(default) DCI Underlay
peering towards RS**

**eBGP EVPN DCI
Overlay peering
towards RS**

Pending Config

```
neighbor 9.9.9.9
  remote-as 65099
  update-source loopback0
  ebgp-multihop 5
  peer-type fabric-external
  address-family l2vpn evpn
    send-community both
    rewrite-evpn-rt-asn
configure terminal
interface nve1
  multisite border-gateway interface loopback100
interface loopback100
  ip address 10.10.0.1/32 tag 54321
  ip router ospf UNDERLAY area 0.0.0.0
  ip pim sparse-mode
  no shutdown
```

**Rewrite and Re-origination
function on BGW**

**Rewrite ASN
portion of Auto RT**

**BGW VTEP Interface
Lo1 = NVE PIP
Lo100 = NVE Multi-Site
Anycast VIP**

**BGW DCI-tracking towards
Site-External underlay**

**BGW Fabric-tracking towards
Site-Internal underlay**

```
interface ethernet1/2
  no switchport
  ip address 10.10.1.1/30 tag 54321
  evpn multisite dci-tracking
  mtu 9216
  negotiate auto
  no shutdown
interface ethernet1/1
  no switchport
  ip address 10.4.0.14/30
  evpn multisite fabric-tracking
  description connected-to-spine1-dc1-Ethernet1/3
  mtu 9216
  ip router ospf UNDERLAY area 0.0.0.0
  ip ospf network point-to-point
  ip pim sparse-mode
  no shutdown
  negotiate auto
```

Multi-Site Route-Target Problem

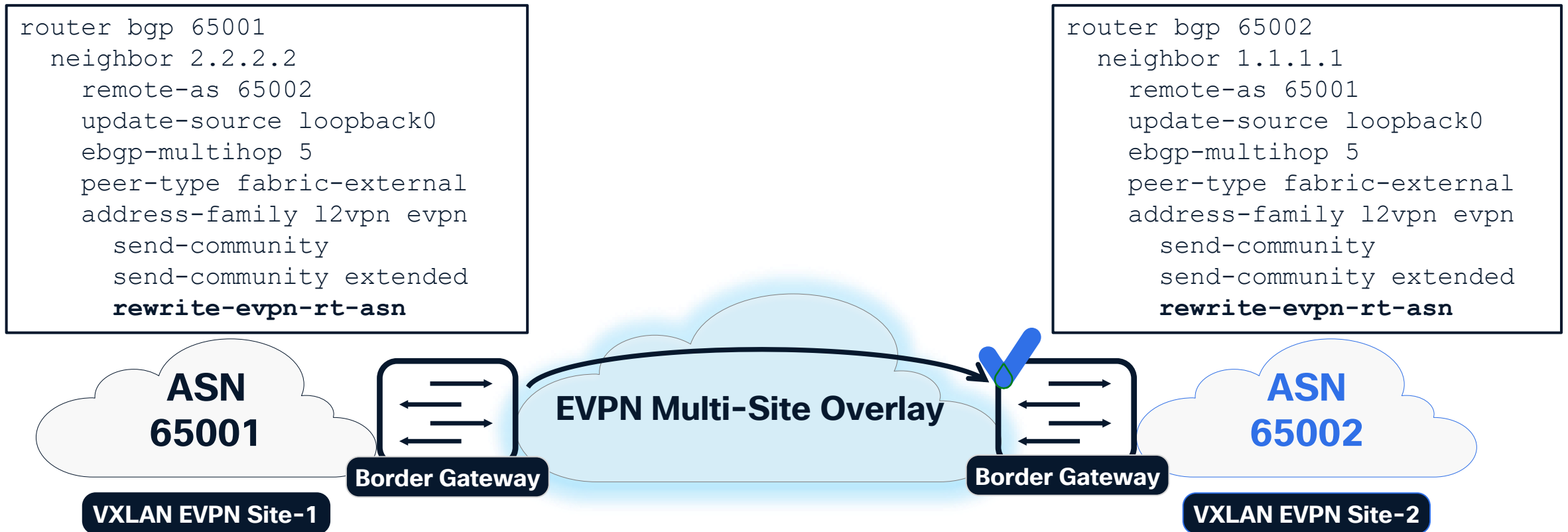
```
vrf context myvrf_50000
vni 50000
rd auto
address-family ipv4 unicast
route-target both auto
route-target both auto evpn {65001:50000}
address-family ipv6 unicast
route-target both auto
route-target both auto evpn {65001:50000}
evpn
vni 30000 12
rd auto
route-target import auto {65001:30000}
route-target export auto {65001:30000}
```

```
vrf context myvrf_50000
vni 50000
rd auto
address-family ipv4 unicast
route-target both auto
route-target both auto evpn {65002:50000}
address-family ipv6 unicast
route-target both auto
route-target both auto evpn {65002:50000}
evpn
vni 30000 12
rd auto
route-target import auto {65002:30000}
route-target export auto {65002:30000}
```



EVPN Route-Target Re-Write

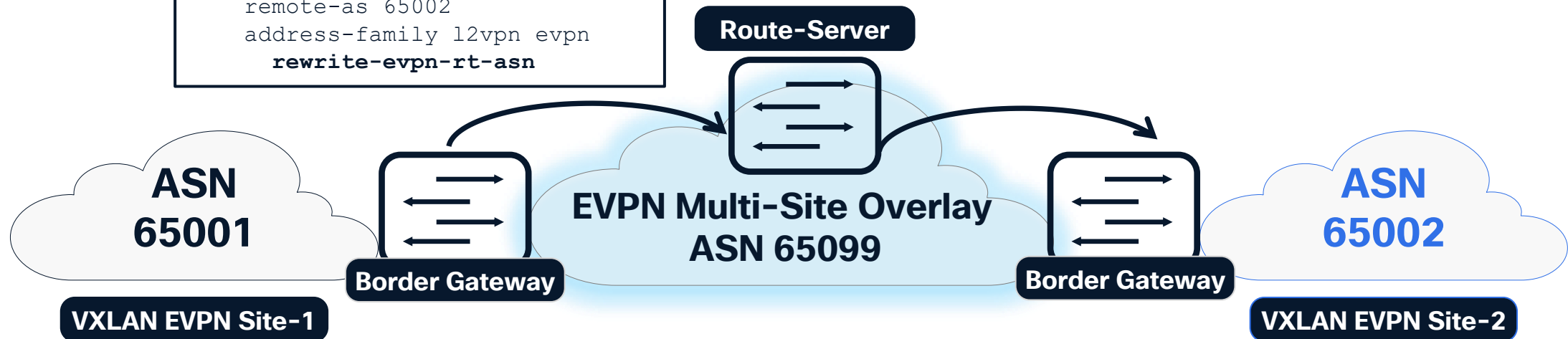
The "rewrite-evpn-rt-asn" command modifies the incoming EVPN advertisements by swapping the remote AS portion in the RT with the local ASN, provided the update is coming from a neighbor that is locally configured.



Route-Server in DCI

EVPN Route-Target Re-Write by Route-Server

```
router bgp 65099
  address-family l2vpn evpn
    retain route-target all
  template peer OVERLAY-PEERING
    update-source loopback0
    ebgp-multihop 5
    address-family l2vpn evpn
      send-community
      send-community extended
      route-map unchanged out
  neighbor 20.2.0.4
    inherit peer OVERLAY-PEERING
    remote-as 65002
    address-family l2vpn evpn
      rewrite-evpn-rt-asn
```



Peer-Type Fabric-External

EVPN Split-Horizon and Route Re-Originaton

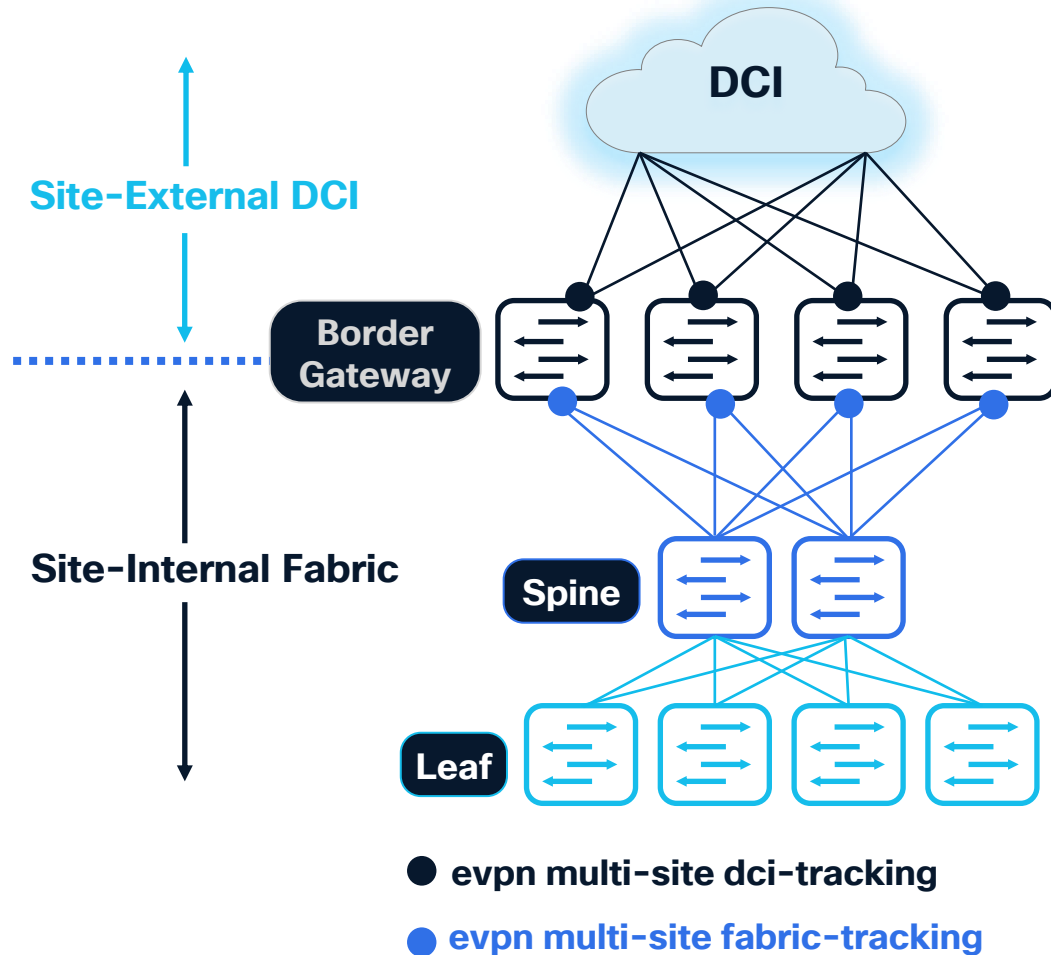
```
router bgp 65001
  neighbor 2.2.2.2
    remote-as 65002
    update-source loopback0
    ebgp-multihop 5
    peer-type fabric-external
    address-family l2vpn evpn
      send-community
      send-community extended
      rewrite-evpn-rt-asn
```

- The command is defined towards Site-External EVPN peering. It provides the capability of VXLAN packet re-origination and implements VPN split horizon mechanism.
- EVPN route coming from Site-External peer-type must not be re-advertised back into the VPN. The route is only advertised towards Site-Internal VTEPs



Failure Detection on BGWs

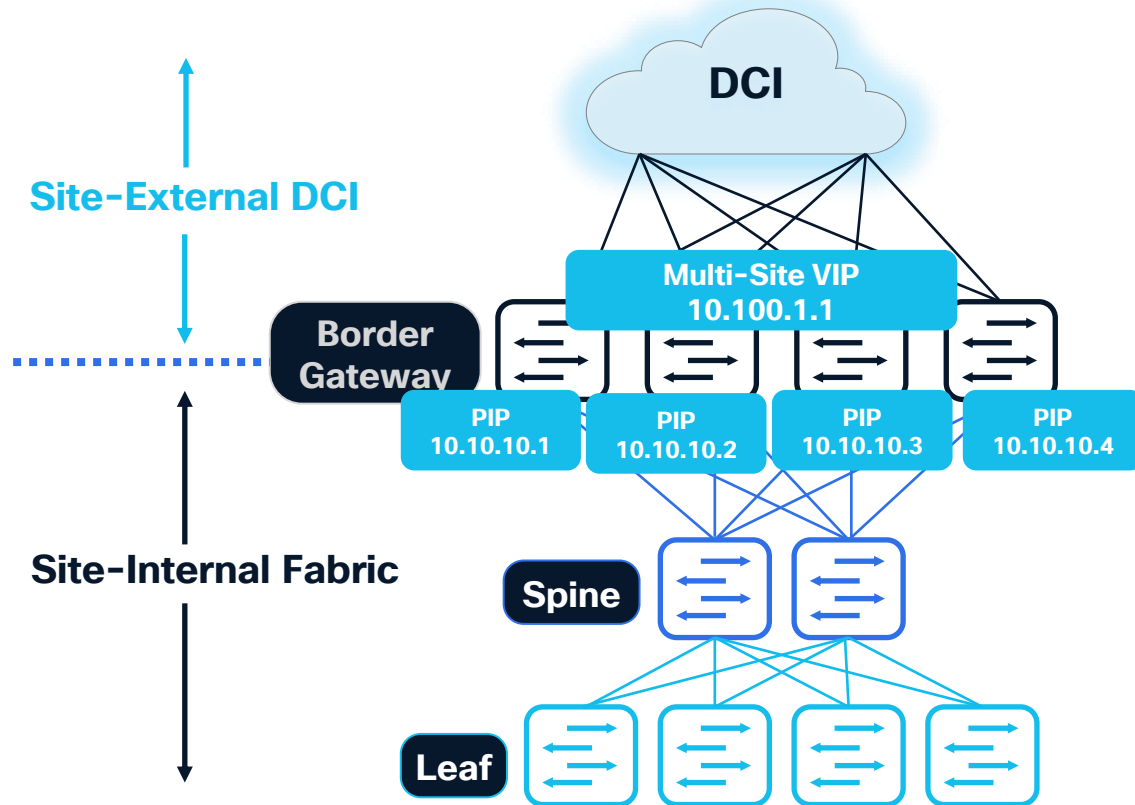
Use of Interface Tracking



- Because of the critical role played by the BGWs, it is critical to consider the required behavior during different failure scenarios.
- Tracking the state of the interfaces connecting the BGWs to the spines (“fabric-tracking”) and to the ISN (“dci-tracking”)
- The “dci-tracking” configuration is also required on Layer-3 interfaces locally connecting Anycast BGW nodes, needed for example, back-to-back topologies.
- Allows to define via configuration how the BGW is connected in the topology and to take proper action depending on the specific failure.
- The BGW node that gets isolated from the fabric or from the ISN needs to stop receiving traffic flows if it can not forward them to the destination.

Failure Detection on BGWs

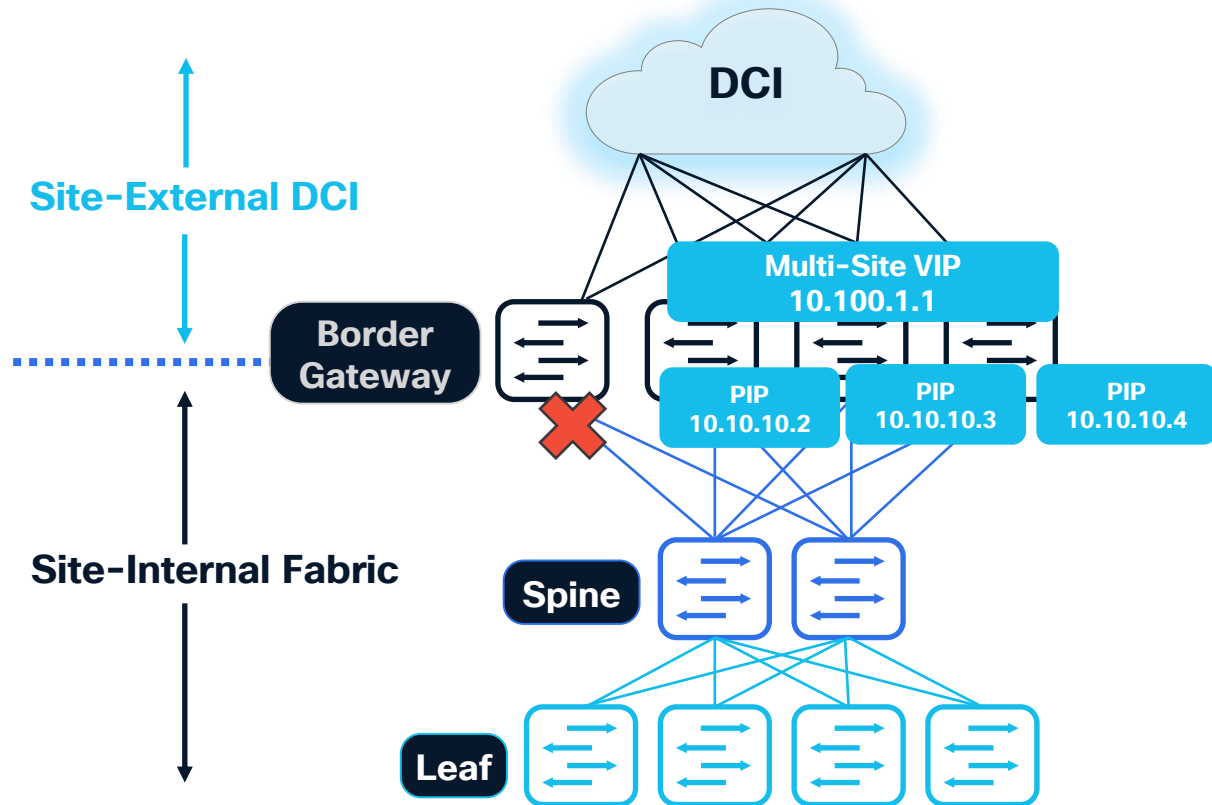
Fabric Isolation



- The Site-Internal interfaces on BGW nodes are constantly tracked to determine their status ('evpn multisite fabric-tracking' command)

Failure Detection on BGWs

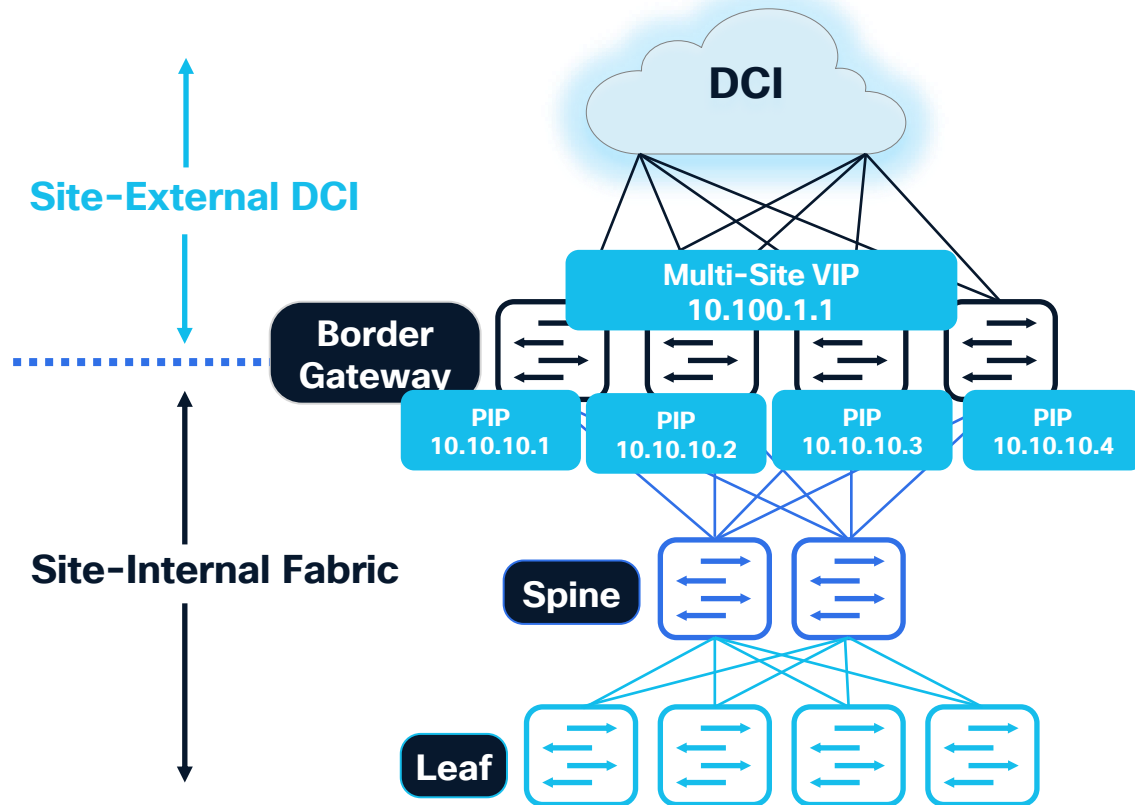
Fabric Isolation



- The Site-Internal interfaces on BGW nodes are constantly tracked to determine their status ('evpn multisite fabric-tracking' command)
- **If all the Site-Internal interfaces are detected as down on a BGW:**
 - 1) The BGW will isolate itself from Multi-Site traffic. Hence, it will shutdown Lo100 aka VIP and stop advertising to remote sites. So, the traffic from remote site will never come to this BGW as it will no longer be part of the ECMP.
 - 2) The BGW site external BGP session will be up and running but it will withdraw all EVPN routes (Type 2,3,4,5)
 - 3) The remaining BGWs withdraw all BGP EVPN Route Type 4 (Ethernet segment) routes received from the now isolated BGW because reachability is missing.
- As a result, the BGW becomes isolated from both the Site-Internal and Site-External networks.
- Seamless BGW node re-insertion using a "delay-restore" timer for the Multi-Site VIP address

Failure Detection on BGWs

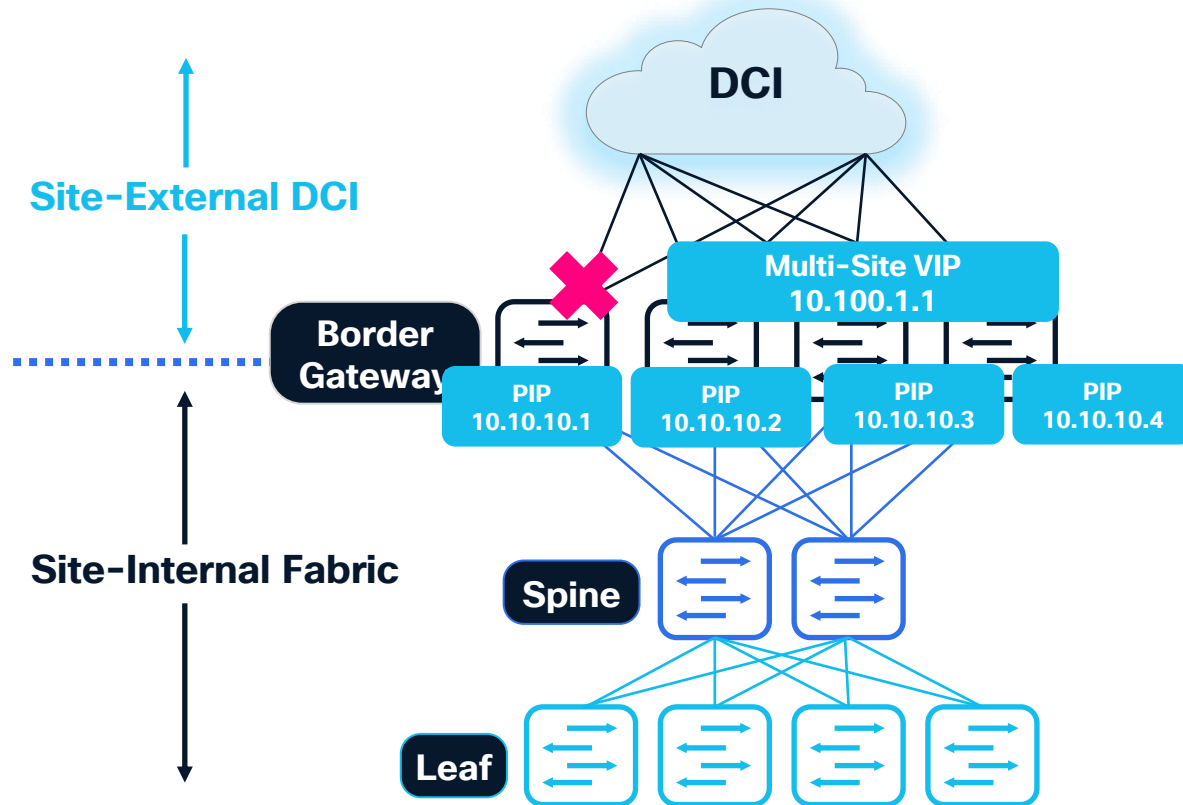
DCI Isolation



- The Site-External interfaces on BGW nodes are constantly tracked to determine their status ('evpn multisite dci-tracking' command)

Failure Detection on BGWs

DCI Isolation



- The Site-External interfaces on BGW nodes are constantly tracked to determine their status ('evpn multisite dci-tracking' command)
- **If all the Site-External interfaces are detected as down on a BGW:**
 - 1) The BGW will stop advertising Multi-Site VIP aka Lo100 towards Site-Internal network. Hence, all traffic destined to remote sites will be re-routed to remaining BGWs due to ECMP.
 - 2) The isolated BGW will also withdraw EVPN Type-4 as new DF election is triggered amongst the remaining BGWs.
 - 3) The isolated BGW do not need to withdraw Type-2,3, and 5 routes as DCI interfaces and remote BGP EVPN peering are down.
- As a result, the BGW continues to operate as a Site-Internal VTEP as it's PIP remains up. Hence, if any external network is connected to this BGW, traffic from local site can still be sent to this BGW.
- Seamless BGW node reinsertion using a "delay-restore" timer for the Multi-Site VIP address

Step 6 -> Create, Attach, and Deploy VXLAN Overlays

Navigate to Multi-Cluster Fabric Group > Networks > Create

The screenshot shows the 'Create Network' form with several blue callout boxes highlighting specific features:

- Auto Generated Name**: Points to the 'Network Name' field containing 'MyNetwork_30000'.
- L2 or L3 Network**: Points to the 'Layer 2 Only' checkbox, which is currently unchecked.
- VXLAN Overlay VRF**: Points to the 'VRF Name' field containing 'MyVRF_50000' and the 'Create VRF' button.
- Auto Generated L2VNI Label**: Points to the 'Network ID' field containing '30000'.
- Network SVI**: Points to the 'IPv4 Gateway/NetMask' field containing '10.10.10.1/24'.

Other visible fields and buttons include:

- 'VLAN ID' field with a 'Propose VLAN' button.
- 'Network Template' dropdown set to 'Default_Network_Universal'.
- 'Network Extension Template' dropdown set to 'Default_Network_Extension_Universal'.
- 'General Parameters' and 'Advanced' tabs.
- 'Close' and 'Create' buttons at the bottom right.

Step 6 -> Create, Attach, and Deploy VXLAN Overlays

VRFs

Networks

Security Groups

Contracts

Security Associations

Protocol Definitions

Select Network

☒

Network Name

☒

MyNetwork_30000

Network ID

30000

VRF Name

MyVRF_50000

IPv4 Gateway/Prefix

10.10.10.1/24

IPv6 Gateway/Prefix

Network Status

NA

VLAN ID

2300

VLAN Name

Actions

Create

Edit

Multi-Attach

Multi-Detach

Deploy

Import

Export

Delete

Multi-Attach of Networks

1

Select Switches

2

Select Interfaces

3

Summary

Select Switches to attach all Selected Networks (1)

Total No. of Attachment : 7

Filter by attributes

☒

Cluster Name

☒

parth-denali-1

☒

parth-denali-1

☒

parth-denali-1

☒

parth-denali-2

☒

parth-denali-2

☒

parth-denali-2

☒

parth-denali-2

☒

parth-denali-2

☒

Fabric Name

☒

DC1

☒

DC1

☒

DC1

☒

DC2

☒

DC2

☒

DC2

☒

DC2

☒

Switch

☒

bgw1-dc1

☒

leaf1-dc1

☒

leaf3-dc1

☒

leaf1-dc2

☒

leaf2-dc2

☒

leaf3-dc2

☒

spine-bgw1-dc2

☒

IP Address

☒

192.168.100.75

☒

192.168.100.71

☒

192.168.100.73

☒

192.168.100.78

☒

192.168.100.79

☒

192.168.100.80

☒

192.168.100.77

☒

Serial Number

☒

9MJi6AJ90Y0

☒

9HHS3S8BIO7

☒

96NYE15D501

☒

923KAU3N5OS

☒

97X9L2HUMPW

☒

9TPRLI533YZ

☒

9N19GSLKTYD

☒

Model Number

☒

N9K-C9300v

☒

N9K-C9300v

☒

N9K-C9300v

☒

N9K-C9300v

☒

N9K-C9300v

☒

N9K-C9300v

☒

N9K-C9300v

☒

Role

☒

border gateway

☒

leaf

☒

leaf

☒

leaf

☒

leaf

☒

leaf

☒

border gateway spine

☐

Network Name

☐

MyNetwork_30000

☐

Switch Name

☐

leaf1-dc1

☐

leaf1-dc2

☐

leaf3-dc1

☐

leaf3-dc2

☐

leaf2-dc2

☐

spine-bgw1-dc2

☐

bgw1-dc1

☐

Peer Switch Name

☐

leaf2-dc1

☐

☐

☐

☐

☐

☐

☐

ToR Switches

☐

☐

☐

☐

☐

☐

☐

☐

Interfaces List

☐

leaf2-dc1(eth1/6)

☐

eth1/6

☐

eth1/4-5

☐

☐

☐

☐

☐

☐

Action

☐

View Interfaces

☐

View Interfaces

☐

View Interfaces

☐

View Interfaces

☐

View Interfaces

☐

View Interfaces

☐

View Interfaces

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BRKDCN-2988

CISCO

Step 6 -> Create, Attach, and Deploy VXLAN Overlays

✓

Select Switches

✓

Select Interfaces

3

Summary

Summary

Networks Selected
1

Devices Selected
7

Network Attachments
7

[Device Interface Association
4](#)

Device Interface De-Association
0

☐ Deploy Later

☒ Proceed to Full Switch Deploy(Recommended)

☐ Proceed to Individual Network Deploy

Filter by attributes

Resync All

Cluster Name	Fabric Name	Switch Name	IP Address	Role	Serial Number	Fabric Status	Pending Config	Status Description	Progress	Resync Switch	
parth-denali-2	DC2	leaf2-dc2	192.168.100.79	leaf	97X9L2HUMPW	Out-Of-S	53 Lines	Out-of-Sync	<div></div>	Resync	
parth-denali-2	DC2	leaf1-dc2	192.168.100.78	leaf	923KAU3N5OS	Out-Of-S	61 Lines	Out-of-Sync	<div></div>	Resync	
parth-denali-2	DC2	leaf3-dc2	192.168.100.80	leaf	9TPRLI533YZ	Out-Of-S	53 Lines	Out-of-Sync	<div></div>	Resync	
parth-denali-1	DC1	leaf3-dc1	192.168.100.73	leaf	96NYE15D501	Out-Of-S	72 Lines	Out-of-Sync	<div></div>	Resync	
parth-denali-1	DC1	bgw1-dc1	192.168.100.75	border gateway	9MJi6AJ90Y0	Out-Of-S	51 Lines	Out-of-Sync	<div></div>	Resync	
parth-denali-1	DC1	leaf2-dc1	192.168.100.72	leaf	9K4FDX6S4UU	Out-Of-S	66 Lines	Out-of-Sync	<div></div>	Resync	
parth-denali-1	DC1	leaf1-dc1	192.168.100.71	leaf	9HHS3S8BIO7	Out-Of-S	58 Lines	Out-of-Sync	<div></div>	Resync	
parth-denali-2	DC2	spine-bgw1-dc2	192.168.100.77	border gateway spine	9N19GSLKTYD	Out-Of-S	48 Lines	Out-of-Sync	<div></div>	Resync	

Close

Deploy All

Multi-Site Overlay Config Preview

Pending Config - Multi-Site-Argentina - bgw1-dc1

Pending Config Side-by-Side Comparison

```
vlan 2000
  vn-segment 50000
configure terminal
vrf context myvrf_50000
  vni 50000
  rd auto
  address-family ipv4 unicast
    route-target both auto
    route-target both auto evpn
  address-family ipv6 unicast
    route-target both auto
    route-target both auto evpn
exit
interface Vlan2000
  vrf member myvrf_50000
  ip forward
  ipv6 address use-link-local-only
  no ip redirects
  no ipv6 redirects
  mtu 9216
  no shutdown
exit
```

L3VNI VRF Configs

Pending Config Side-by-Side Comparison

VXLAN Tenant

```
router bgp 65001
  vrf myvrf_50000
    address-family ipv4 unicast
      advertise l2vpn evpn
      redistribute direct route-map fabric-rmap-redirect-subnet
      maximum-paths ibgp 2
    exit
    address-family ipv6 unicast
      advertise l2vpn evpn
      redistribute direct route-map fabric-rmap-redirect-subnet
      maximum-paths ibgp 2
```

```
configure terminal
interface nve1
  member vni 50000 associate-vrf
  member vni 30000
  multisite ingress-replication
  mcast-group 239.1.1.1
interface loopback2
  vrf member myvrf_50000
  ip address 10.5.0.2/32 tag 12345
vlan 2300
  vn-segment 30000
configure terminal
evpn
  vni 30000 l2
  rd auto
  route-target import auto
  route-target export auto
```

NVE Tunnel Configs

L2VNI Network Configs

BRKDCN-2988

Multi-Site Overlay Config Preview

Pending Config - Multi-Site-Argentina - leaf1-dc2

Pending Config Side-by-Side Comparison

```
vlan 2000
  vn-segment 50000
configure terminal
vrf context myvrf_50000
  vni 50000
  rd auto
  address-family ipv4 unicast
    route-target both auto
    route-target both auto evpn
  address-family ipv6 unicast
    route-target both auto
    route-target both auto evpn
exit
interface Vlan2000
  vrf member myvrf_50000
  ip forward
  ipv6 address use-link-local-only
  no ip redirects
  no ipv6 redirects
  mtu 9216
  no shutdown
exit
```

L3VNI VRF Configs

Pending Config Side-by-Side Comparison

```
interface Vlan2000
  vrf member myvrf_50000
  ip forward
  ipv6 address use-link-local-only
  no ip redirects
  no ipv6 redirects
  mtu 9216
  no shutdown
exit
router bgp 65002
  vrf myvrf_50000
    address-family ipv4 unicast
      advertise l2vpn evpn
      redistribute direct route-map fabric-rmap-redist-subnet
      maximum-paths ibgp 2
    exit
    address-family ipv6 unicast
      advertise l2vpn evpn
      redistribute direct route-map fabric-rmap-redist-subnet
      maximum-paths ibgp 2
```

VXLAN Tenant

NVE Tunnel Configs

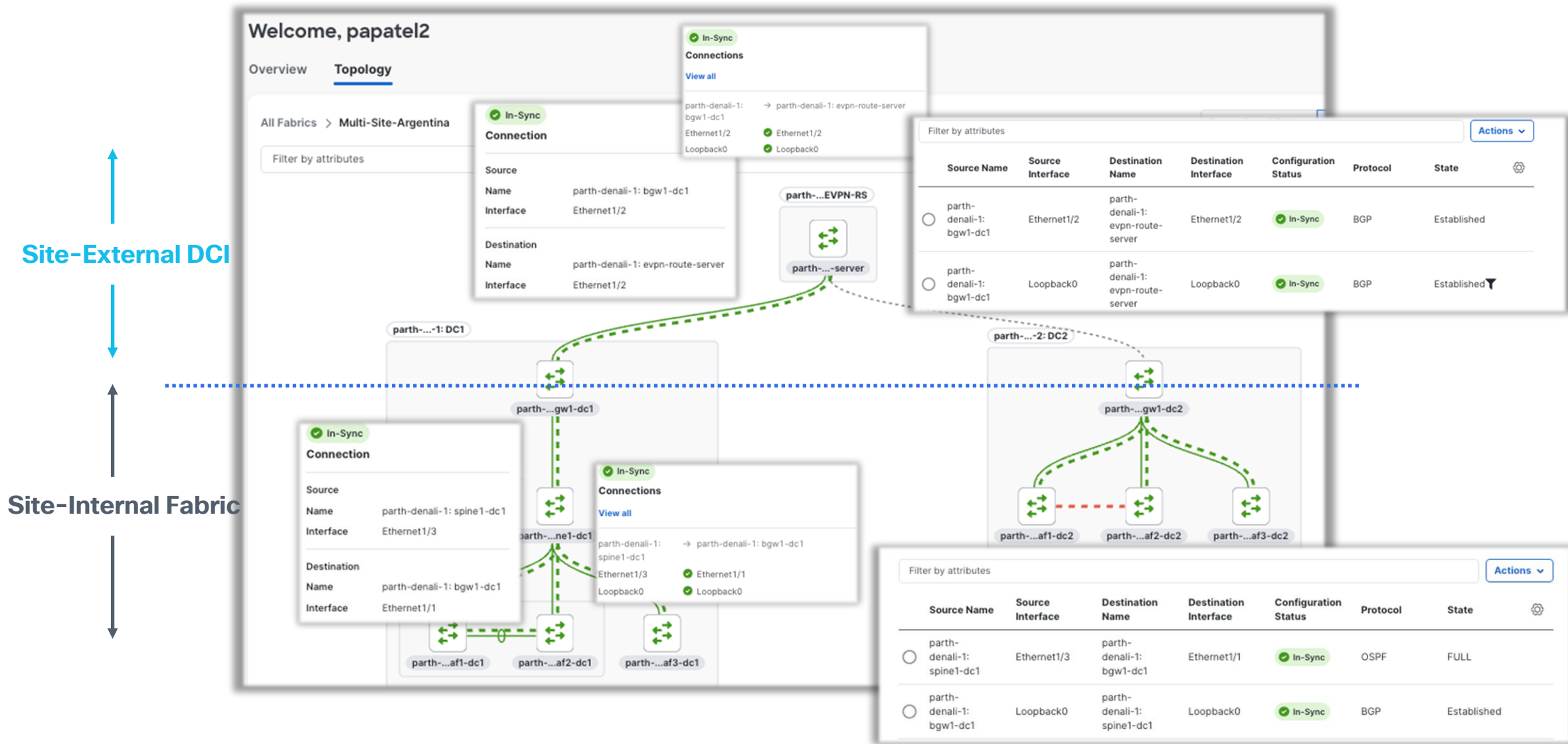
```
interface nve1
  member vni 50000 associate-vrf
  member vni 30000
  mcast-group 239.1.1.1
vlan 2300
  vn-segment 30000
configure terminal
interface Vlan2300
  vrf member myvrf_50000
  ip address 10.10.10.1/24 tag 12345
  fabric forwarding mode anycast-gateway
  no shutdown
exit
evpn
  vni 30000 l2
  rd auto
  route-target import auto
  route-target export auto
```

L3 SVI Configs

L2VNI Network Configs

```
interface ethernet1/6
  switchport
  switchport mode trunk
  mtu 9216
  spanning-tree port type edge trunk
  negotiate auto
  shutdown
  switchport trunk allowed vlan 2300
```

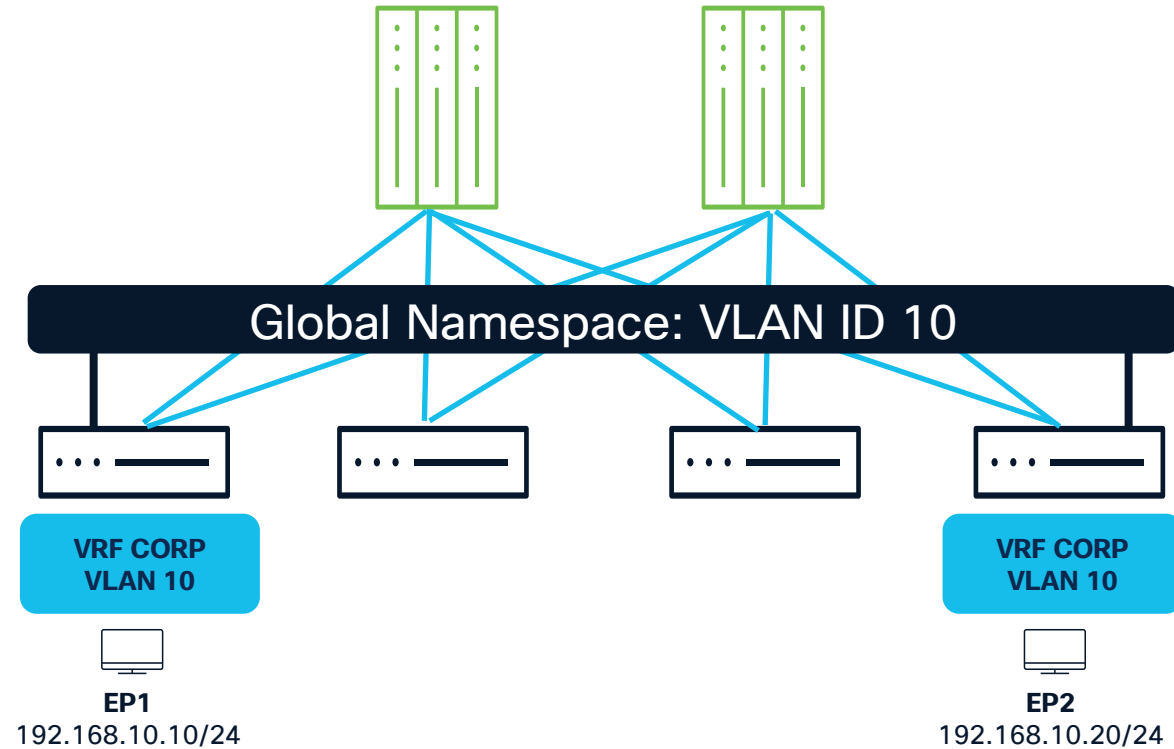
One-Manage Multi-Site Topology View



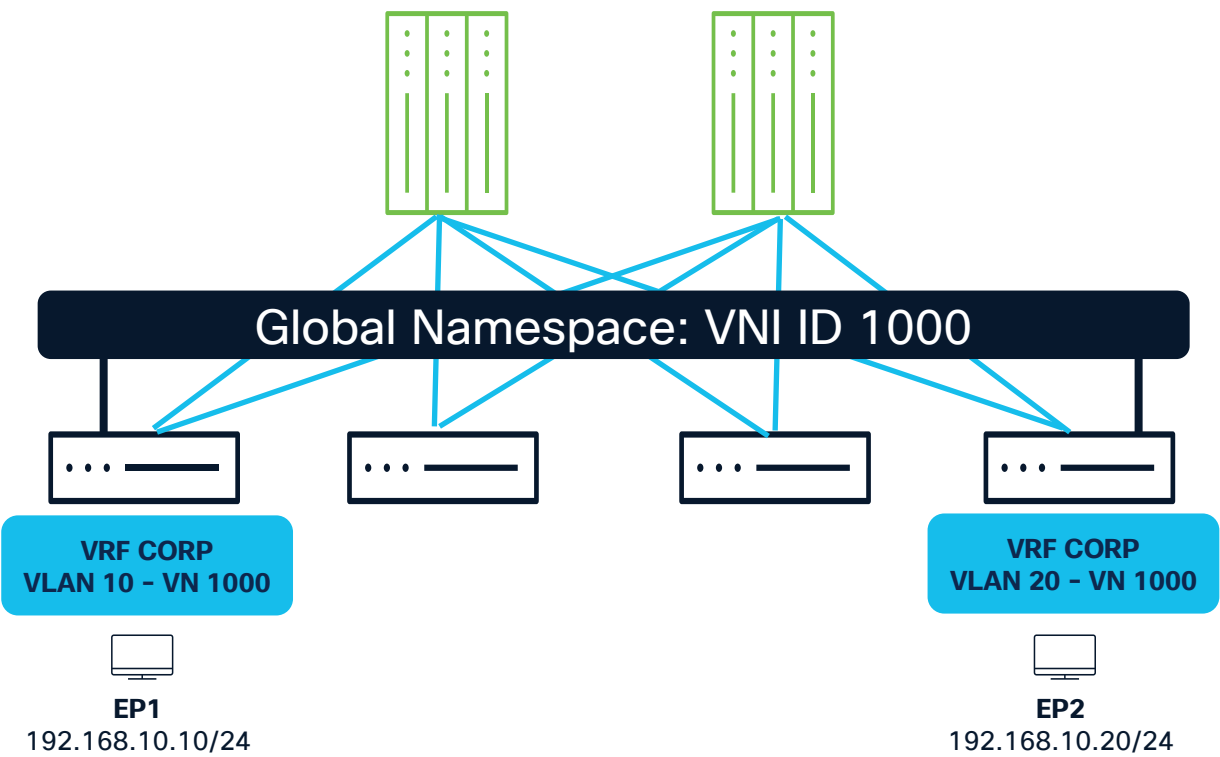


VXLAN Multi-Site Asymmetric VNI

Network Namespace in Classic Ethernet

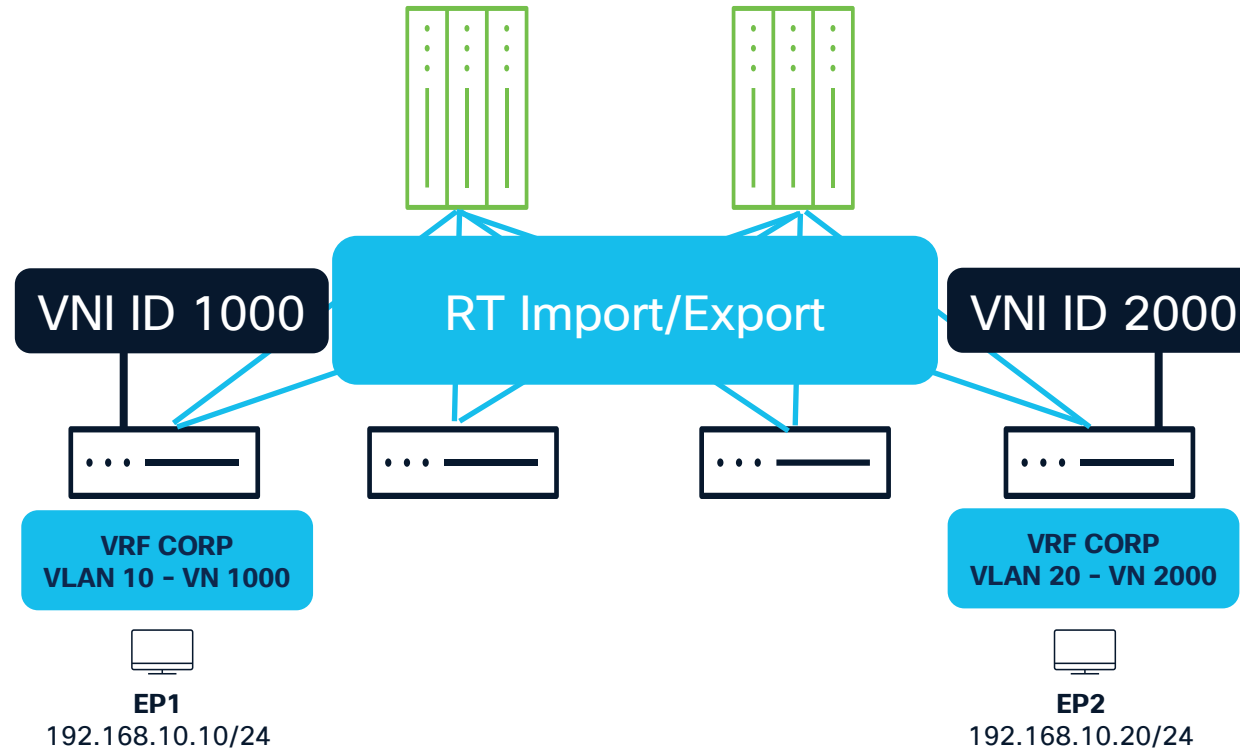


Overlay Namespace in VXLAN EVPN



Symmetric VNI Allocation

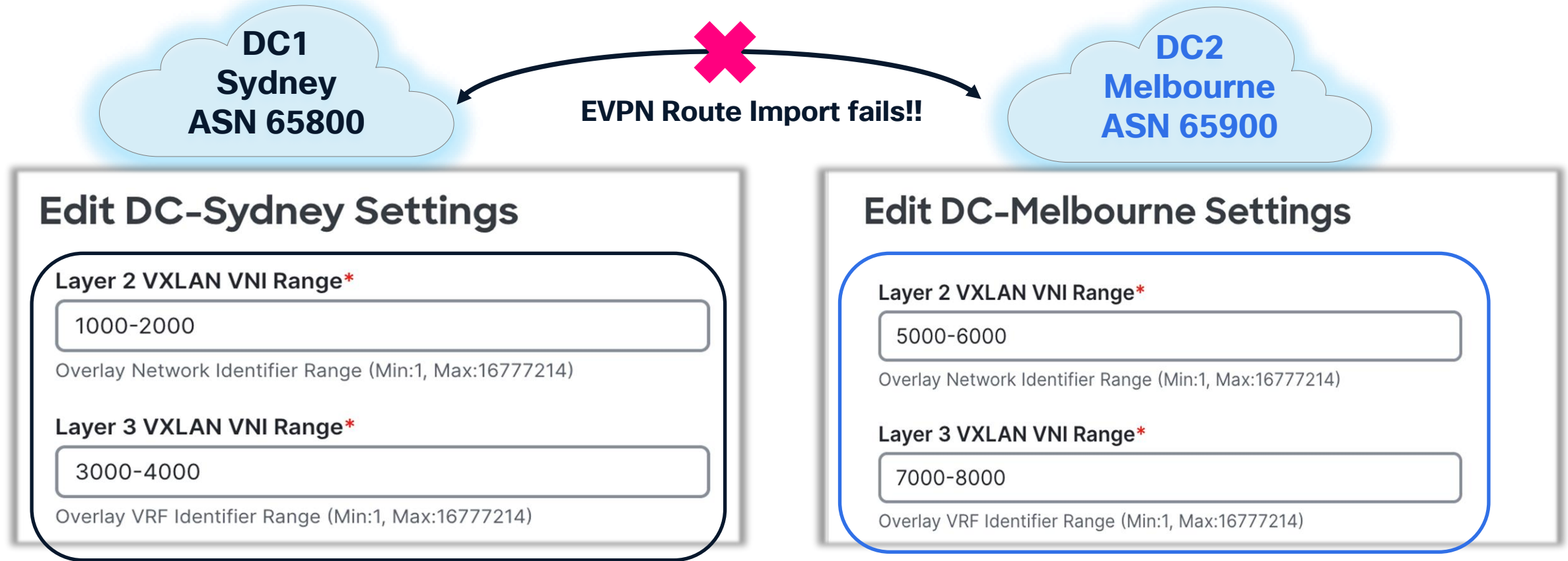
Overlay Namespace in VXLAN EVPN



Asymmetric VNI Allocation

Downstream VNI in VXLAN Multi-Site

Unique VNI Allocation Per-VXLAN Site



NXOS MAC RT Auto == ASN:L2VNI (4-byte BGP AS uses 23456 as 2-byte field)

NXOS IP RT Auto == ASN:L3VNI (4-byte BGP AS uses 23456 as 2-byte field)

NXOS MAC RT Auto == ASN:L2VNI (4-byte BGP AS uses 23456 as 2-byte field)

NXOS IP RT Auto == ASN:L3VNI (4-byte BGP AS uses 23456 as 2-byte field)

Downstream VNI in VXLAN Multi-Site

Nexus Dashboard Implementation

VRF overview - CISCO

OverviewVRF AttachmentsNetworks

Filter by attributes

☐	VRF name	VRF ID	VLAN ID	Model	Switch	Configuration status	Attachment	Switch Role	Fabric name	Loopback ID	Loopback IPV4	
☐	CISCO	3000	2000	9YM7600LXIJ	DC-Sydney-Leaf	DEPLOYED	Attached	leaf	DC-Sydney	2	10.5.0.1	
☐	CISCO	3000	2000	968WHIYU9C3	DC-Sydney-BGW	DEPLOYED	Attached	border gateway spine	DC-Sydney	2	10.5.0.2	

ActionsRefresh

VRF CISCO in DC-Sydney corresponds to L3VNI 3000. The Auto RT will be 65800:3000 for Type-5 EVPN Routes

Asymmetric VNI

VRF overview - CISCO

OverviewVRF AttachmentsNetworks

Filter by attributes

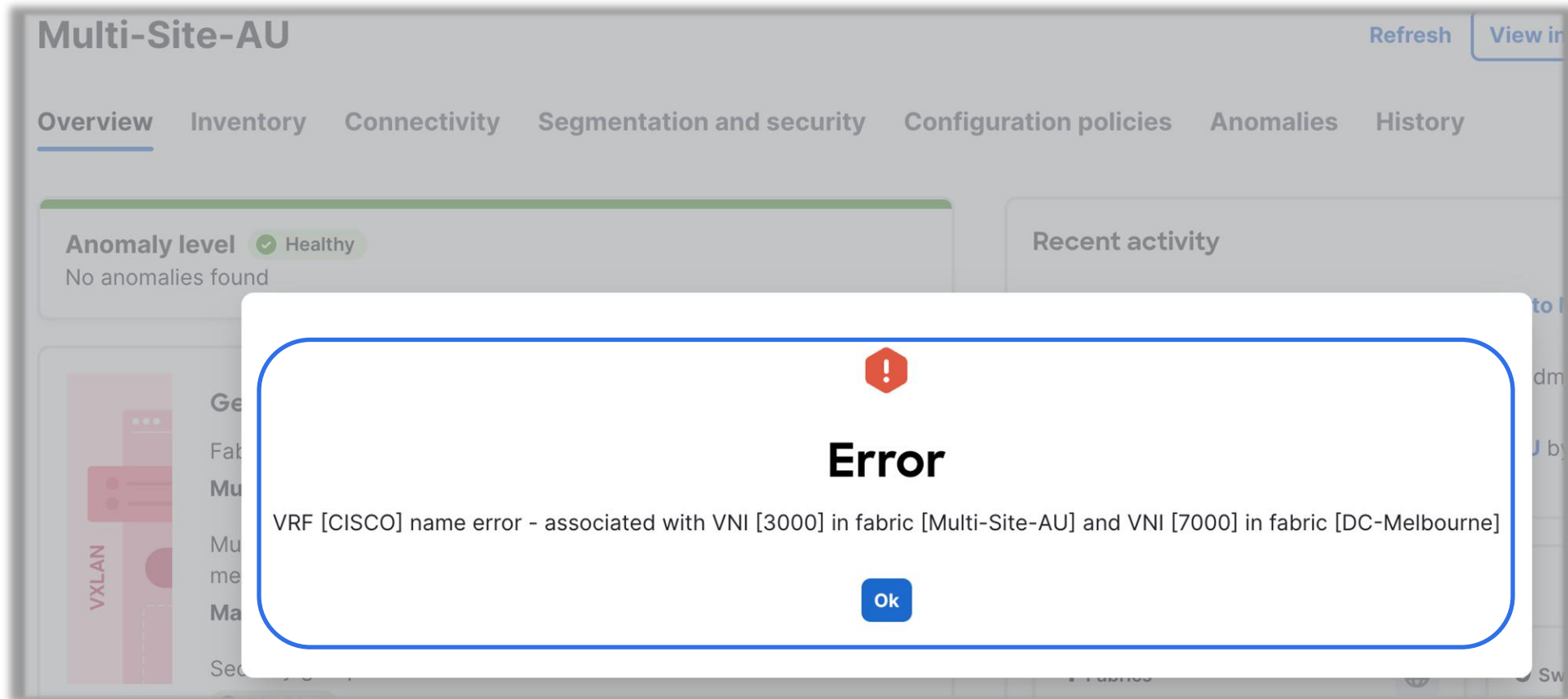
☐	VRF name	VRF ID	VLAN ID	Model	Switch	Configuration status	Attachment	Switch Role	Fabric name	Loopback ID	Loopback IPV4 Addi	
☐	CISCO	7000	2000	9W686V5LKZ	DC-Melbourne-Leaf	DEPLOYED	Attached	leaf	DC-Melbourne	2	10.6.0.1	
☐	CISCO	7000	2000	9R1I0H1FF8V	DC-Melbourne-BGW	DEPLOYED	Attached	border gateway spine	DC-Melbourne	2	10.6.0.2	

ActionsRefresh

VRF CISCO in DC-Melbourne corresponds to L3VNI 7000. The Auto RT will be 65800:7000 for Type-5 EVPN Routes

Downstream VNI in VXLAN Multi-Site

Nexus Dashboard Implementation



During VXLAN Multi-Site Fabric Group, Nexus Dashboard detects conflict across the fabrics and VXLAN Extension fails!

Downstream VNI in VXLAN Multi-Site

Nexus Dashboard Implementation

VRF	Fabric Group VNI	Sydney VNI	Melbourne VNI
CISCO	10050000	3000	7000

Edit Multi-Site-AU Settings

Name *

Multi-Site-AU

Type *

vxlan

General Parameters

DCI

Security

Resources

Configuration Backup

Layer 2 VXLAN VNI Range

Overlay Network Identifier Range (Min:1, Max:16777214)

Layer 3 VXLAN VNI Range

Overlay VRF Identifier Range (Min:1, Max:16777214)

☒ Enable Downstream VNI

When enabled, allows different VXLAN fabric to have different VNI for the same vrf or network

Layer 2 VXLAN VNI Global Range*

10030000-10049000

Unique Range for L2VNI when Downstream VNI is enabled (Min:1, Max:16777214). This range should not have conflict with any VNI already used in member fabric

Layer 3 VXLAN VNI Global Range*

10050000-10059000

Unique Range for L3VNI when Downstream VNI is enabled (Min:1, Max:16777214). This range should not have conflict with any VNI already used in member fabric

Enable the Downstream VNI Knob at the Fabric Group level before adding any child fabrics!

Downstream VNI in VXLAN Multi-Site

Nexus Dashboard Implementation

Pending Config - Multi-Site-AU - DC-Sydney-BGW

Pending Config Side-by-Side Comparison

```
configure terminal
ip extcommunity-list standard CISCO seq 10 permit rt 23456:3000
route-map ms-fabric-to-external-rmap permit 1
  match extcommunity CISCO
  set extcomm-list CISCO delete
```

EXT Community to tag and remove RT before advertising the EVPN routes to remote DC

```
vlan 2000
  name CISCO
  vn-segment 3000
vrf context cisco
  description CISCO
  vni 3000
  rd auto
```

Auto RT to match EVPN Routes with local VTEP/Leaf

```
address-family ipv4 unicast
  route-target both auto
  route-target both auto evpn
  route-target import 23456:10050000
  route-target export 23456:10050000
  route-target import 23456:10050000 evpn
  route-target export 23456:10050000 evpn
```

Custom RT/DSVNI RT to match EVPN Routes with Remote VTEP/BGW

```
neighbor 20.2.0.2
  description multi-site overlay session to DC-Melbourne-BGW
  remote-as 65900
  update-source loopback0
  ebgp-multihop 5
  peer-type fabric-external
  address-family l2vpn evpn
  send community both
  route-map ms-fabric-to-external-rmap out
  rewrite evpn rt asn
exit
```

BGP RMAP towards Remote VTEP/BGW

Pending Config - Multi-Site-AU - DC-Melbourne-BGW

Pending Config Side-by-Side Comparison

```
configure terminal
ip extcommunity-list standard CISCO seq 10 permit rt 23456:7000
route-map ms-fabric-to-external-rmap permit 1
  match extcommunity CISCO
  set extcomm-list CISCO delete
```

```
vlan 2000
  name CISCO
  vn-segment 7000
vrf context cisco
  description CISCO
  vni 7000
  rd auto
```

```
address-family ipv4 unicast
  route-target both auto
  route-target both auto evpn
  route-target import 23456:10050000
  route-target export 23456:10050000
  route-target import 23456:10050000 evpn
  route-target export 23456:10050000 evpn
```

```
neighbor 10.2.0.2
  description multi-site overlay session to DC-Sydney-BGW
  remote-as 65800
  update-source loopback0
  ebgp-multihop 5
  peer-type fabric-external
  address-family l2vpn evpn
  send community both
  route-map ms-fabric-to-external-rmap out
  rewrite evpn rt asn
exit
```

Appendix

VXLAN BGP EVPN

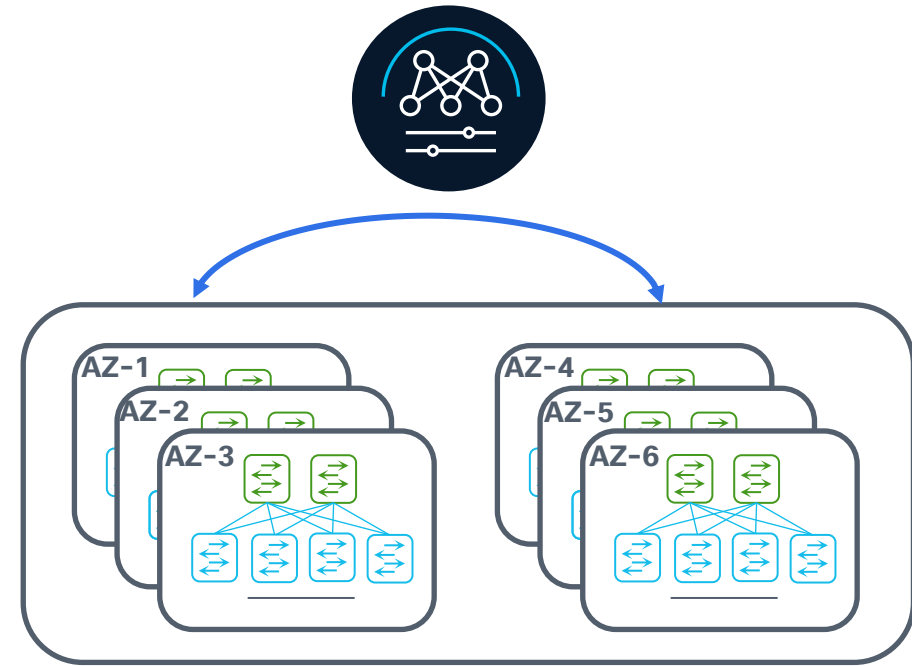
<https://www.cisco.com/c/en/us/products/switches/nexus-9000-series-switches/white-paper-listing.html>

Nexus Dashboard

<https://www.cisco.com/c/en/us/products/cloud-systems-management/prime-data-center-network-manager/white-paper-listing.html>

Conclusion

Key points to remember



- VXLAN EVPN Multi-Site maintains clear change and fault domain separation to deploy large-scale and highly available DC architectures.
- ND provides simplified mechanism to extend and provide end-to-end network and policy consistency across regions, all with a single point of orchestration.
- ND provides a single plane of glass solution to automate and manage Nexus and Non-Nexus devices.

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