

The background features a vibrant, abstract design with overlapping, wavy bands of color in shades of blue, green, yellow, orange, and red. On the right side, a bright white light source radiates outwards, creating a starburst effect with sharp, colorful rays that fan across the entire image.

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Let's go

#CiscoLiveAPJC



The bridge to possible

Design, Automate, and Manage VXLAN BGP EVPN Multi-Site with NDFC

Parth Patel, Technical Leader, Technical Marketing Engineer:
Data Center and Provider Connectivity BU
BRKDCN-2128

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Cisco Webex App

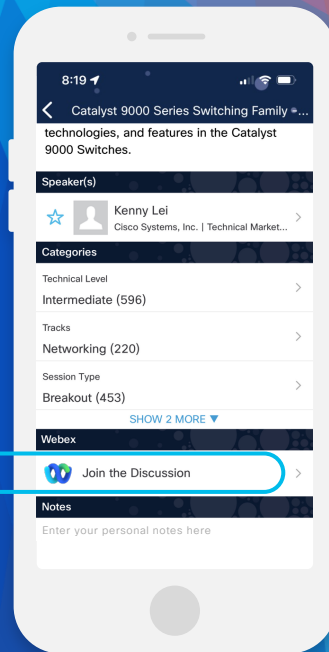
Questions?

Use Cisco Webex App to chat with the speaker after the session

How

- 1 Find this session in the Cisco Live Mobile App
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Webex spaces will be moderated by the speaker until December 22, 2023.



<https://ciscolive.ciscoevents.com/ciscolivebot/#BRKDCN-2128>

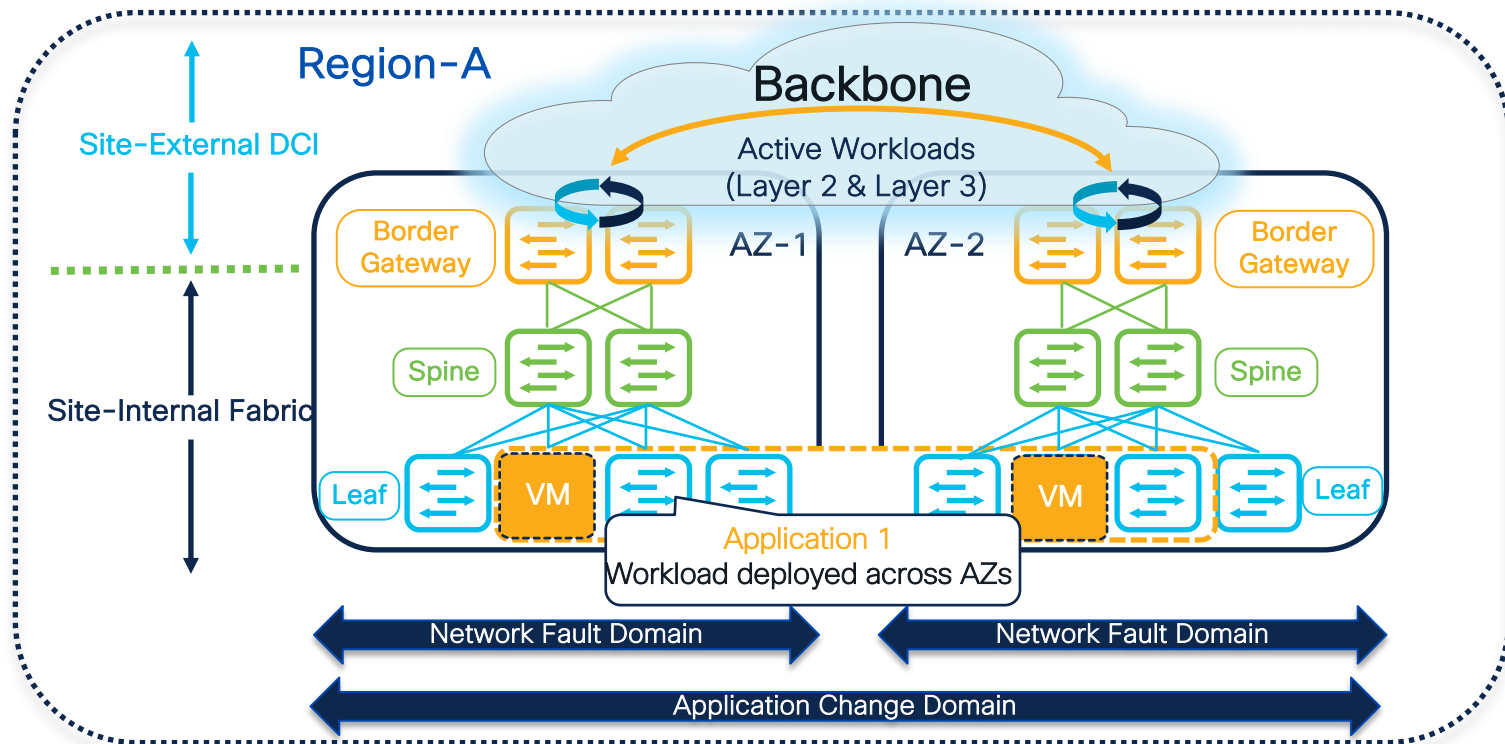
Agenda

- VXLAN EVPN Multi-Site Overview
- Design VXLAN EVPN Multi-Site with NDFC
- Why NDFC?
- Automate and Manage VXLAN EVPN Multi-Site with NDFC
- Conclusion

VXLAN EVPN Multi-Site Architecture

VXLAN EVPN Multi-Site Overview

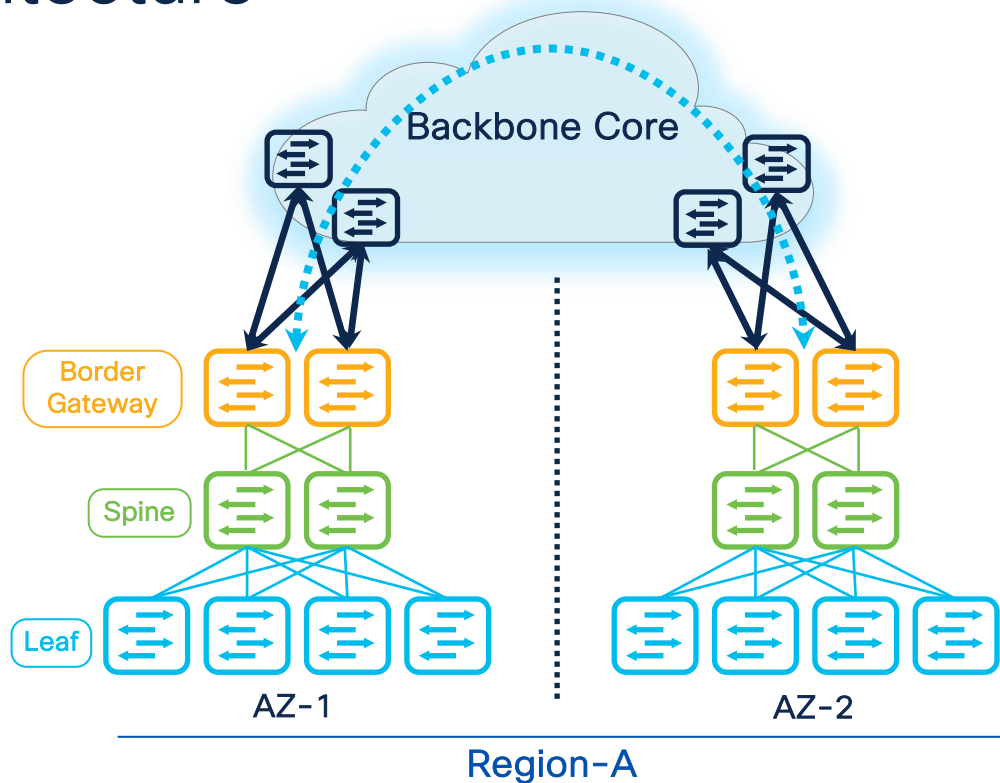
Functional Components



VXLAN Multi-Site Architecture

DCI- BGW to Cloud

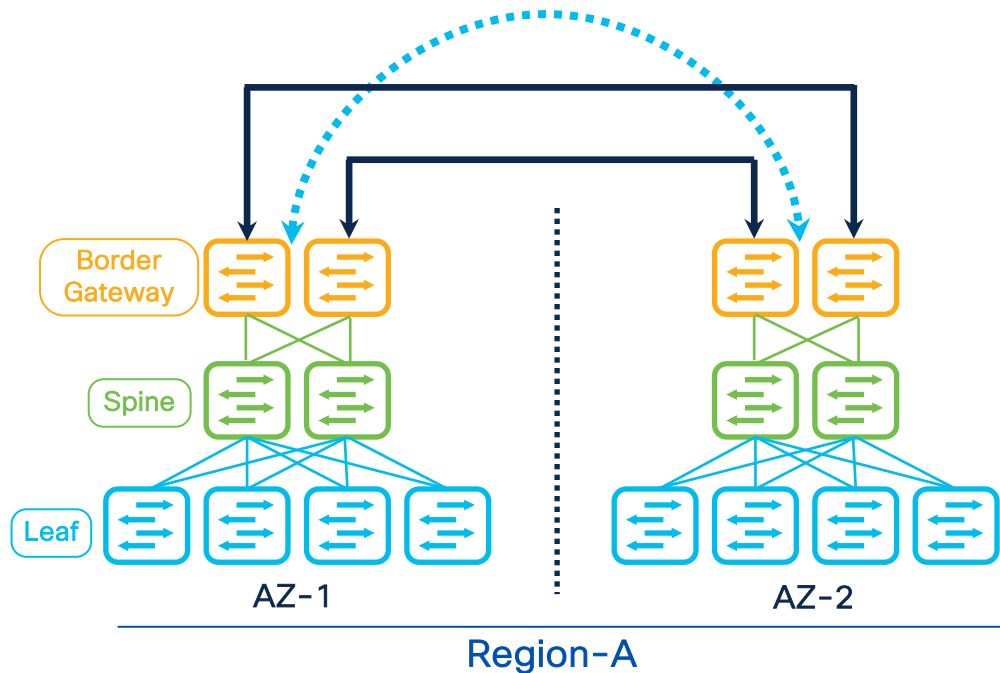
- Scalable design option with horizontal scale-out within and across multiple sites.
- Backbone/Cloud can be any routed service. (flat L3, MPLS-L3VPN)
- **Multi-Site Underlay: eBGP IPv4 Unicast** ↔
 - Site-External DCI BUM: Ingress-Replication or Multicast supported. *Currently NDFC supports only Ingress-Replication.
 - Site-Internal Fabric BUM: Ingress-Replication or Multicast supported independently at each site.
- **Multi-Site Overlay: eBGP EVPN Overlay** ⬅️⋯⋯➡️
 - 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

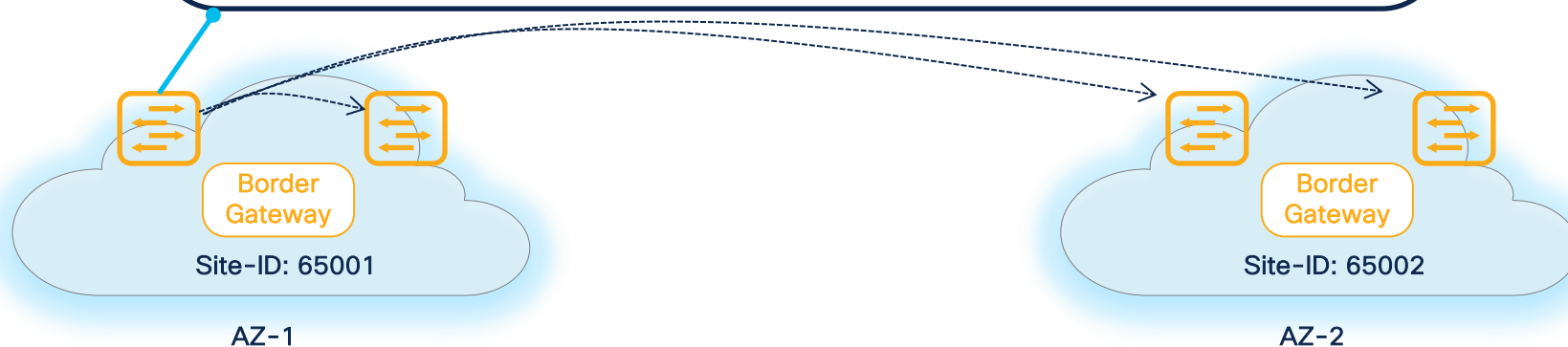
- Available option for connecting 2 sites.
- Minimum topology is the square. An enhanced option is to add links between site local BGWs for improved ECMP and Failure scenarios.
- **Multi-Site Underlay: eBGP IPv4 Unicast** ↔
 - Site-External DCI BUM: Ingress-Replication or Multicast supported. *Currently NDFC supports only Ingress-Replication.
 - Site-Internal Fabric BUM: Ingress-Replication or Multicast supported independently at each site.
- **Multi-Site Overlay: eBGP EVPN Overlay** ⋯→
 - 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.



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



Multi-Destination Traffic Forwarding

BGW Designated Forwarded (DF) Election

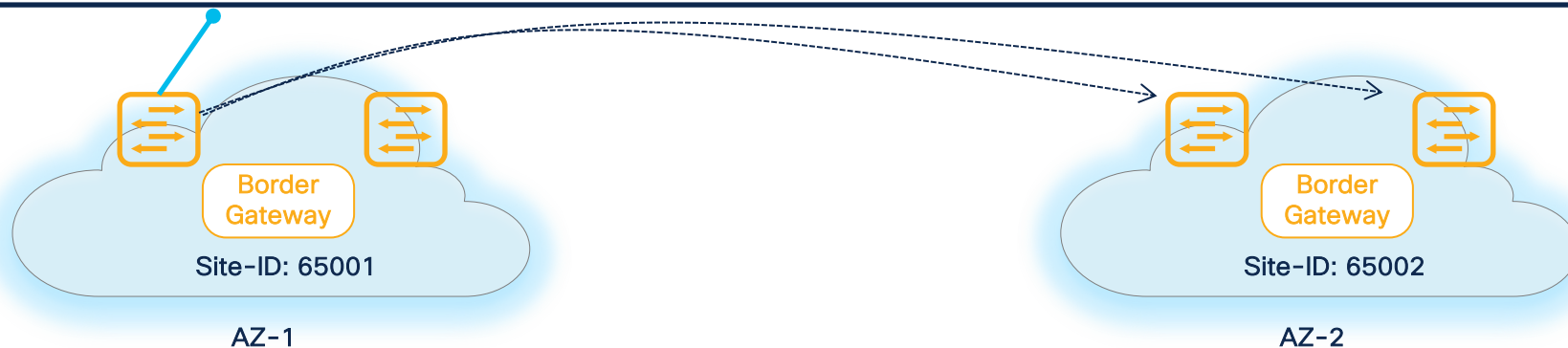
- BGW learns about other BGWs originator IPs on the same site from exchanging EVPN Type 4 routes. The originator IP address used is the BGW NVE source interface's primary IP address.
- Each BGW creates an ordinal list of originator IP in numerical order from lowest to highest. Every BGW is then given 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)

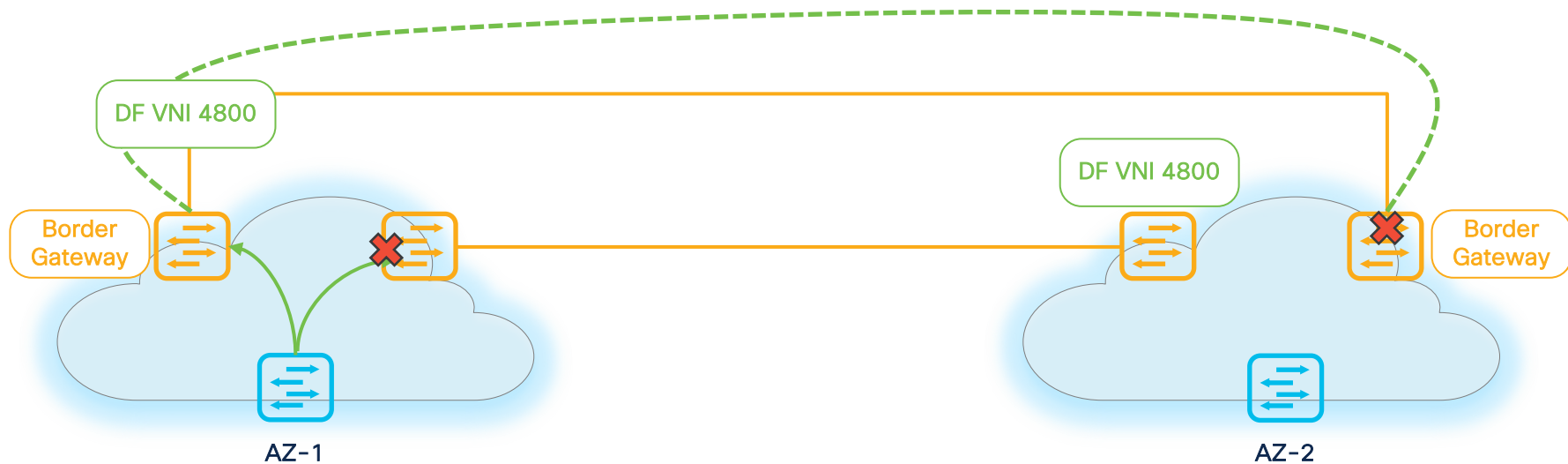
- BGW advertises BGP EVPN Type-3 only towards Site-External DCI
- Receiving BGW switch does not forward it to Site-Internal Fabric
- Command to check: `show bgp l2vpn evpn route-type 3,`
- `show l2route evpn imet all detail`
- **Local: Advertising from Site 1 BGW to Site 2 BGW**
BGP routing table entry 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



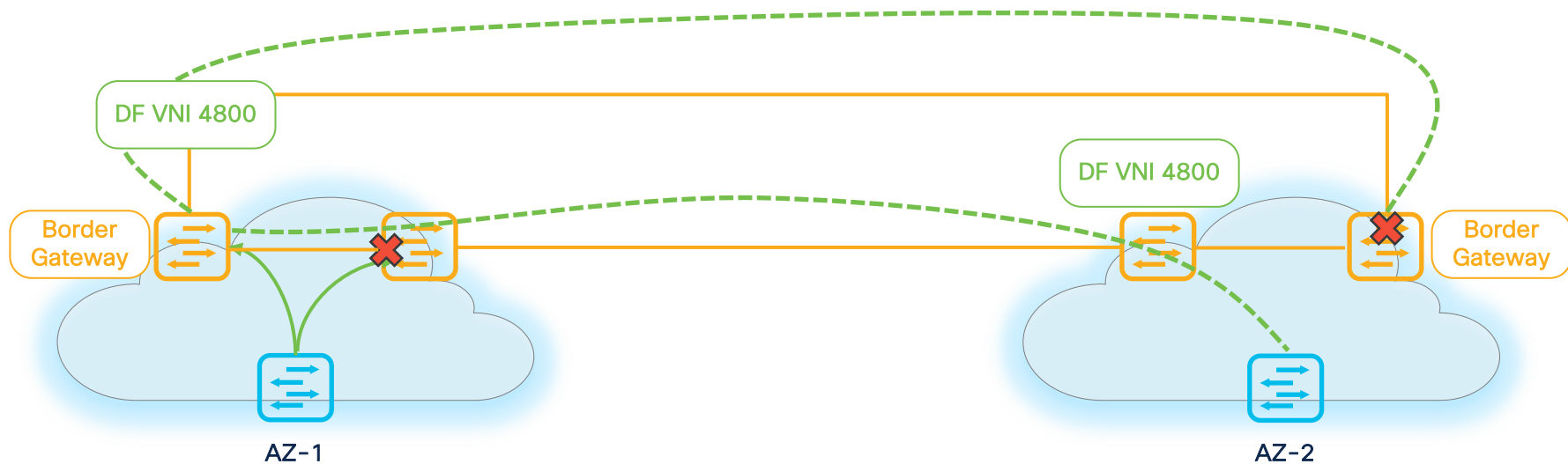
Drop due to Designated Forwarder (DF) rule

Physical connection

BUM packet

VXLAN Multi-Site Architecture

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



Region-A



Drop due to Designated Forwarder (DF) rule

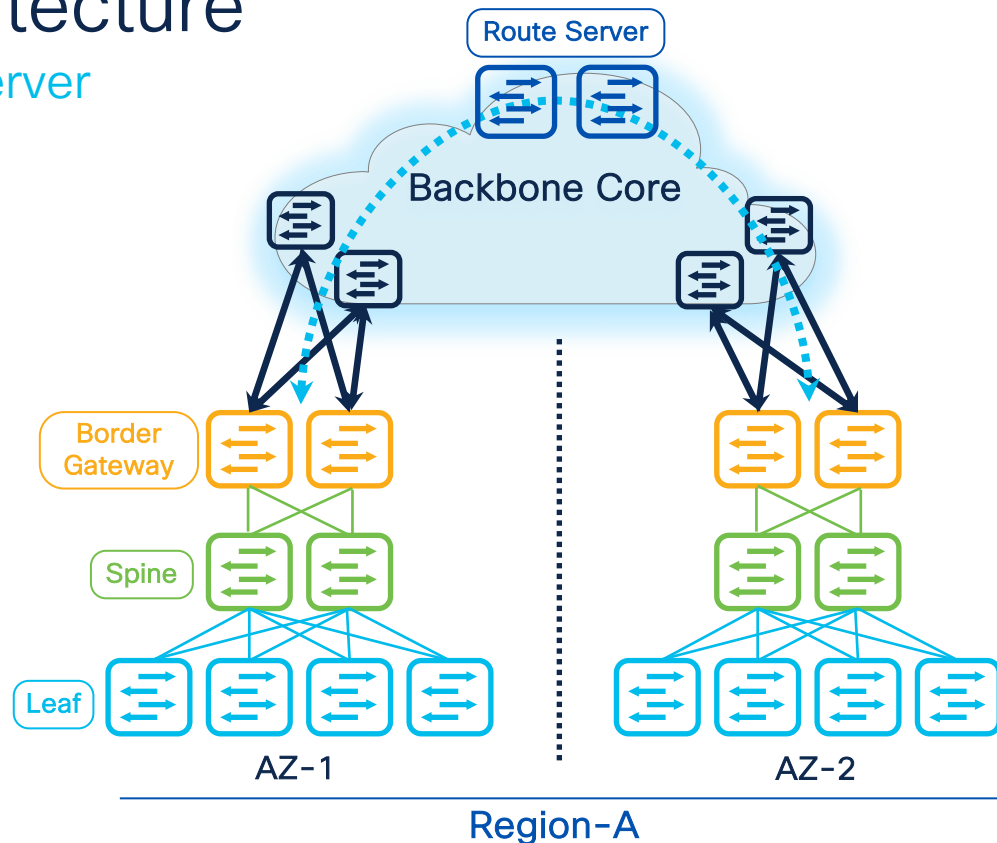
Physical connection

BUM packet

VXLAN Multi-Site Architecture

DCI- BGW to Centralized Router-Server

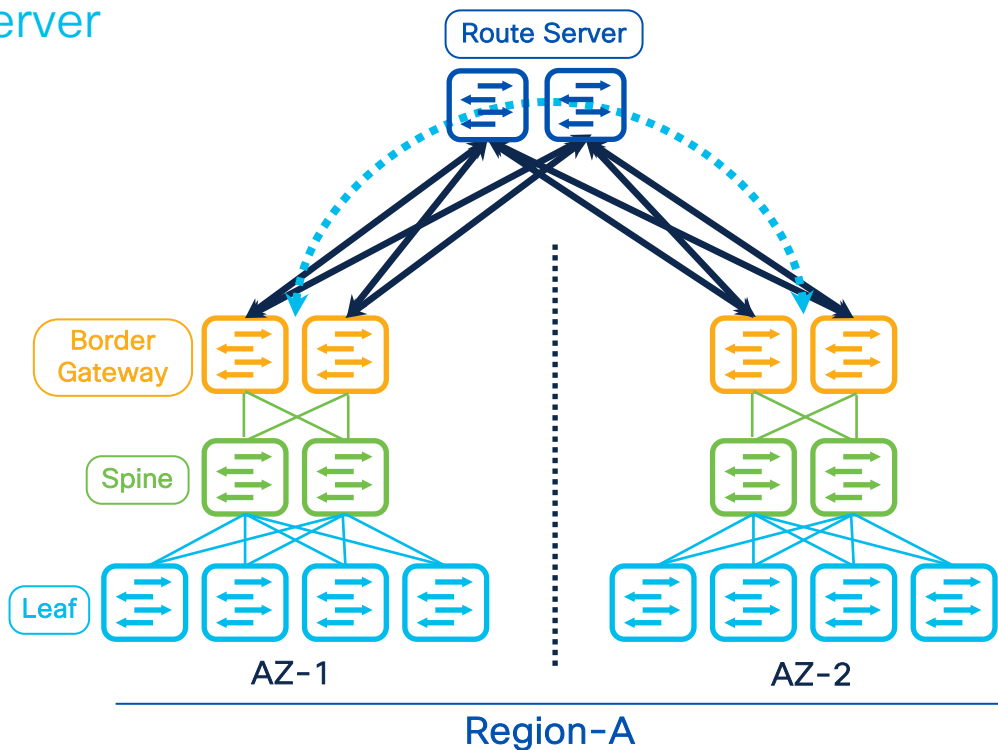
- BGP Route-Server (RS) function can be used in a highly scalable design to act as the central EVPN peering point for the Multi-Site.
- RS does not need to be on the data path.
- **Multi-Site Underlay: eBGP IPv4 Unicast** ↔
 - Site-External DCI BUM: Ingress-Replication or Multicast supported.
*Currently NDFC supports only Ingress-Replication.
 - Site-Internal Fabric BUM: Ingress-Replication or Multicast supported independently at each site.
- **Multi-Site Overlay: eBGP EVPN Overlay** ←.....→
 - 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

- 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 can also be on the data path.
- **Multi-Site Underlay: eBGP IPv4 Unicast** ↔
 - 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** ⬡⬢⬣⬤⬥⬦⬧⬨⬩⬪⬫⬬⬭⬮⬯⬰⬱⬲⬳⬴⬵⬶⬷⬸⬹⬺⬻⬼⬽⬾⬿⬰⬱⬲⬳⬴⬵⬶⬷⬸⬹⬺⬻⬼⬽⬾⬿
 - 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.



Cool! But What's the Catch?

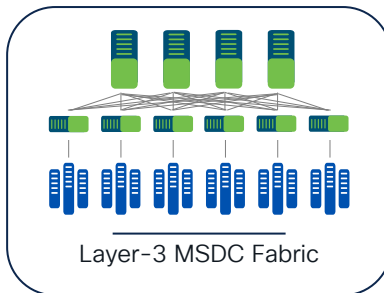
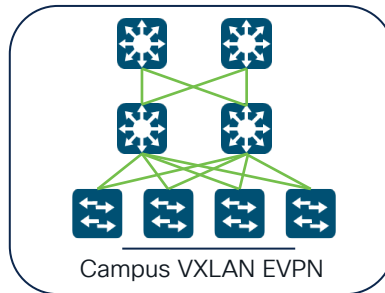
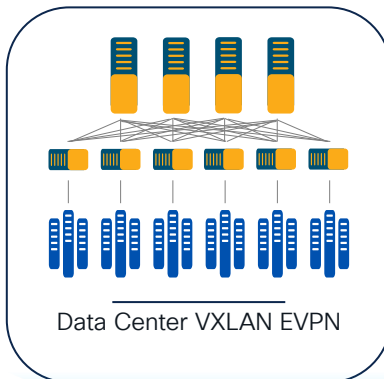
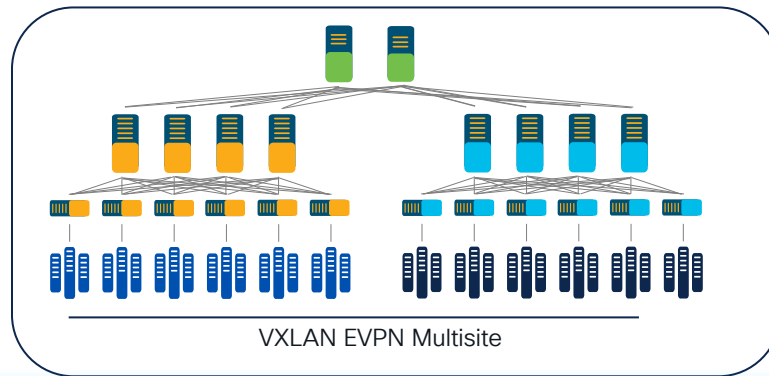
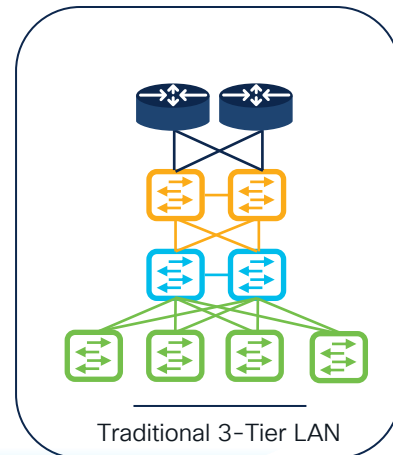
There is always a catch 😊

- 1 This seems really cool! Is it easy to configure?
*There are **lots of moving parts**: OSPF/BGP/VXLAN. **Manual configuration can be challenging.***
- 2 How easy is it to make changes?
*You still rely on traditional **SSH based management to each device**, which can be **cumbersome** and **error prone**.*
- 3 How much Visibility do I have into the network?
*Visibility and Troubleshooting is still performed on a **“switch-by-switch” basis**.*

Why do YOU
need NDFC?

Why NDFC?

Multi-Architecture



Why NDFC?

Multi-Topology, Multi-Protocol



Rich set of control plane and data plane possibilities available



Why NDFC?

Multi-Domain, Multi-Platform



NX-OS Nexus 9000 and 3000



IOS-XE Catalyst 9000



IOS-XR ASR 9000



NX-OS Nexus 7000



IOS-XE ASR 1000



Supported Hardware and Software
might vary depending on NDFC version

[Check compatibility matrix 12.1.3b](#)

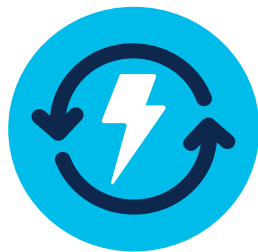
CISCO *Live!*



Manage and Deploy VXLAN EVPN Multi-Site with NDFC

VXLAN EVPN Multi-Site deployment with NDFC

Deploy in a few minutes!



- 1 Deploy your individual DC fabrics (Data Center VXLAN EVPN)
- 2 (Optional) Deploy a fabric for Route-Server (Multi-Site Interconnect Network)
- 3 Deploy a fabric for the Multi-Site (VXLAN EVPN Multi-Site) & import all the previous fabrics into this one
- 4 Recalculate and deploy in the VXLAN EVPN Multi-Site Fabric

VXLAN BGP EVPN Greenfield

Not on VXLAN EVPN Today?



NDFC Fabric Controller
Mode



Build VXLAN fabric
in few minutes



Templates already
embed best practices



IP addresses, overlay pool,
routing profiles, replication
attributes - all taken
care by NDFC

Step 2

Discover

Import switches with POAP or Day-0 config
Define switch Roles (Border, Leaf, Spine, etc)
[Optional] Create vPC pairs



Step 1

Create

Define fabric settings (Underlay, Overlay) -
AS#, Replication Mode, IGP, IP Pools, etc.

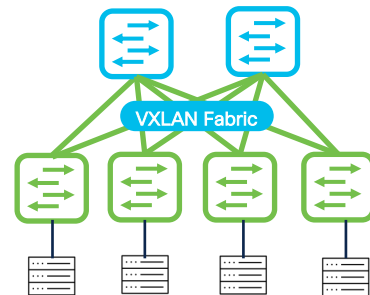


Step 3

Recalculate and Deploy

Generates config based on intent
Preview side by side diffs

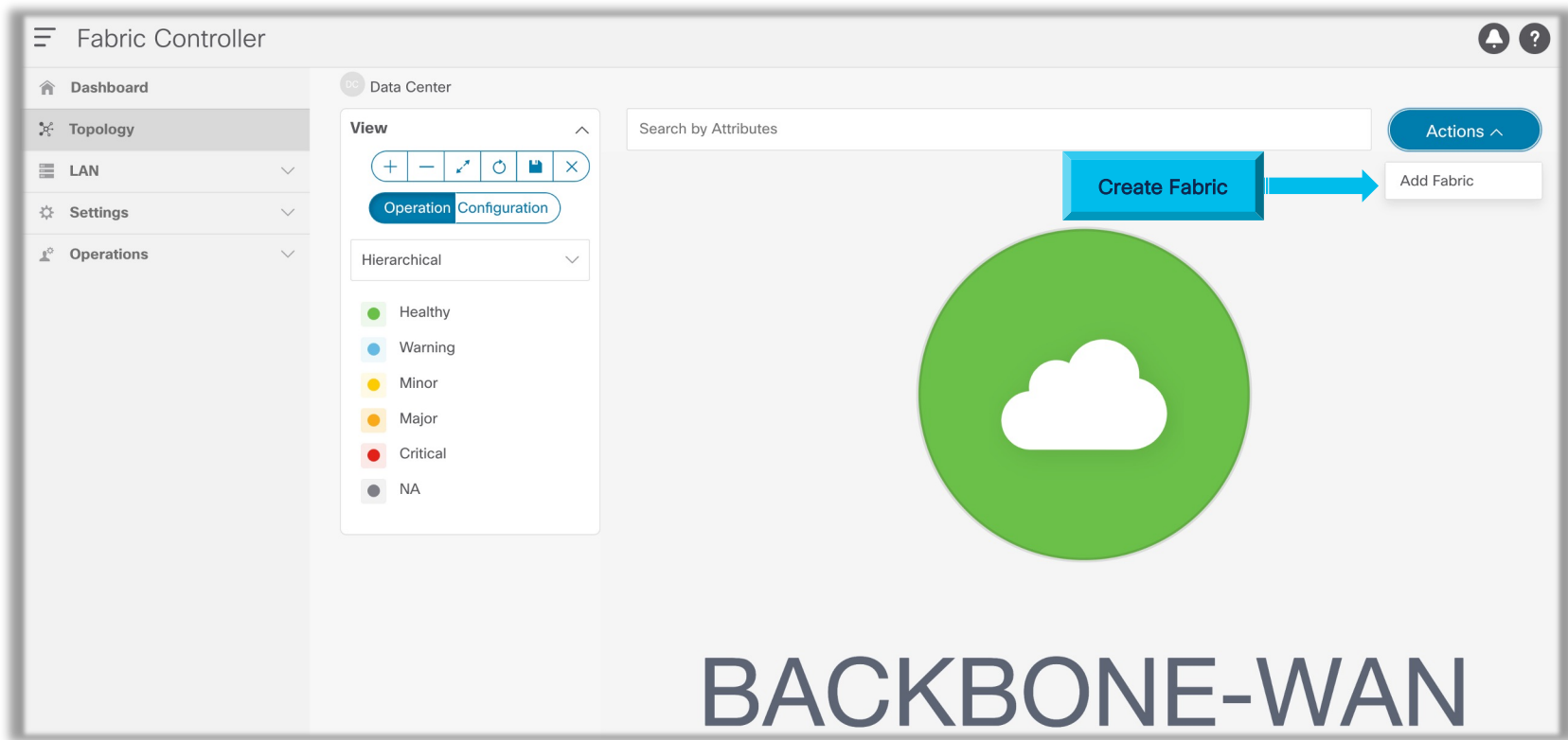
Cisco best practice implemented



Fast, automated process



Step 1 -> Create a Fabric



Step 1 -> Create a Fabric (continued)

The screenshot displays the 'Pick Fabric' configuration page for 'Data Center VXLAN EVPN'. The 'General Parameters' tab is active. The page contains several input fields and checkboxes, with blue callout boxes providing additional information or requirements for each.

- BGP ASN**: A blue box with an arrow pointing to the 'BGP ASN*' field. A red box labeled 'BGP ASN is required' is positioned next to the field.
- VXLANv4 or VXLANv6**: A blue box with an arrow pointing to the 'Enable IPv6 Underlay' and 'Enable IPv6 Link-Local Address' checkboxes.
- Underlay IP > /30 or /31**: A blue box with an arrow pointing to the 'Underlay Subnet IP Mask' field, which is set to '30'.
- IGP > OSPF or ISIS**: A blue box with an arrow pointing to the 'Underlay Routing Protocol*' dropdown menu, which is set to 'ospf'.
- RR > 2 or 4**: A blue box with an arrow pointing to the 'Route-Reflectors*' dropdown menu, which is set to '2'.
- Distributed Anycast Gateway**: A blue box with an arrow pointing to the 'Anycast Gateway MAC*' field, which is set to '2020.0000.00aa'.
- PM Metrics**: A blue box with an arrow pointing to the 'Enable Performance Monitoring' checkbox.

The configuration page includes the following fields and options:

- BGP ASN***: Input field for BGP Autonomous System Number. A red box indicates 'BGP ASN is required'.
- Enable IPv6 Underlay**: Checkbox. If not enabled, IPv4 underlay is used.
- Enable IPv6 Link-Local Address**: Checkbox. If not enabled, Spine-Leaf interfaces will use global IPv6 addresses.
- Fabric Interface Numbering***: Dropdown menu set to 'p2p'. Options: p2p, Numbered(Point-to-Point) or Unnumbered.
- Underlay Subnet IP Mask***: Input field set to '30'. A blue box indicates 'Underlay IP > /30 or /31'.
- Underlay Subnet IPv6 Mask**: Dropdown menu set to 'Select an Option'. Mask for Underlay Subnet IPv6 Range.
- Underlay Routing Protocol***: Dropdown menu set to 'ospf'. Options: ospf, isis, eigrp, static, rip, other.
- Route-Reflectors***: Dropdown menu set to '2'. Number of spines acting as Route-Reflectors.
- Anycast Gateway MAC***: Input field set to '2020.0000.00aa'. A blue box indicates 'Distributed Anycast Gateway'.
- Enable Performance Monitoring**: Checkbox. A blue box labeled 'PM Metrics' points to it.

Step 1 -> Create a Fabric

(continued)

BUM >
Multicast or
Ingress
Replication

L2VNI
Multicast
Group

RP > 2 or
4

General Parameters **Replication** VPC Protocols Advanced Resources Manageability Bootstrap

Replication Mode*

Multicast

Replication Mode for BUM Traffic

Multicast Group Subnet*

239.1.1.0/25

Multicast pool prefix between 8 to 30. A multicast group IP from this pool is used for BUM traffic for each overlay network.

Enable Tenant Routed Multicast (TRM)

☐

For Overlay Multicast Support In VXLAN Fabrics

Default MDT Address for TRM VRFs

Default Underlay Multicast group IP assigned for every overlay VRF.

Rendezvous-Points*

2

Number of spines acting as Rendezvous-Point (RP)

RP Mode*

asm

Multicast RP Mode

Underlay RP Loopback Id*

254

(Min:0, Max:1023)

Step 1 -> Create a Fabric

(continued)

Cisco's Best
Practice
Configuration
Templates

VXLAN Overlay
Mode > CLI or
Config-Profile

General Parameters Replication VPC Protocols **Advanced** Resources Manageability Bootstrap

VRF Template*
Default_VRF_Universal Default Overlay VRF Template For Leafs

Network Template*
Default_Network_Universal Default Overlay Network Template For Leafs

VRF Extension Template*
Default_VRF_Extension_Universal Default Overlay VRF Template For Borders

Network Extension Template*
Default_Network_Extension_Universal Default Overlay Network Template For Borders

Overlay Mode
cli VRF/Network configuration using config-profile or CLI, default is config-profile
config-profile
cli Enable PVLAN on switches except spines and super spines

PVLAN Secondary Network Template
Select an Option Default PVLAN Secondary Network Template

Site Id
65009 For EVPN Multi-Site Support (Min:1, Max: 281474976710655). Defaults to Fabric ASN

Intra Fabric Interface MTU*
9216 (Min:576, Max:9216). Must be an even number

Layer 2 Host Interface MTU*
9216 (Min:1500, Max:9216). Must be an even number

Unshut Host Interfaces by Default
☒

Step 1 -> Create a Fabric (continued)

General Parameters Replication VPC Protocols Advanced **Resources** Manageability Bootstrap

Manual Underlay IP Address Allocation
☐ Checking this will disable Dynamic Underlay IP Address Allocations

Underlay Routing Loopback IP Range*
10.2.0.0/22 **Router ID**

Underlay VTEP Loopback IP Range*
10.3.0.0/22 **VTEP IP**

Underlay RP Loopback IP Range*
10.254.254.0/24 **RP IP**

Underlay Subnet IP Range*
10.4.0.0/16 **P2P Underlay IP**

L2VNI Label → Layer 2 VXLAN VNI Range*
30000-49000 Overlay Network Identifier Range (Min:1, Max:16777214)

L3VNI Label → Layer 3 VXLAN VNI Range*
50000-59000 Overlay VRF Identifier Range (Min:1, Max:16777214)

Network VLAN Range*
2300-2999 Per Switch Overlay Network VLAN Range (Min:2, Max:4094)

VRF VLAN Range*
2000-2299 Per Switch Overlay VRF VLAN Range (Min:2, Max:4094)

Subinterface Dot1q Range*
2-511 Per Border Dot1q Range For VRF Lite Connectivity (Min:2, Max:4093)

VRF_LITE Handoff → VRF Lite Deployment*
Back2Back&ToExternal VRF Lite Inter-Fabric Connection Deployment Options. If 'Back2Back&ToExternal' is selected, VRF Lite IFCs are auto created between border devices of two Easy Fabrics, and between border devices in Easy Fabric and edge routers in External Fabric. The IP address is taken from the 'VRF Lite Subnet IP Range' pool.

Auto Deploy for Peer
☒ Whether to auto generate VRF Lite sub-interface and BGP peering configuration on managed neighbor devices. If set, auto created VRF Lite IFC links will have 'Auto Deploy for Peer' enabled.

VRF_LITE IP Range → VRF Lite Subnet IP Range*
10.33.0.0/16 Address range to assign P2P Interfabric Connections

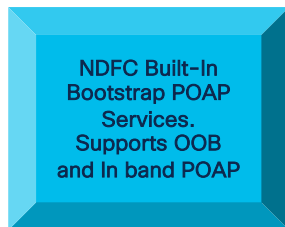
VRF Lite Subnet Mask*
30 (Min:8, Max:31)

L4-L7 Service Network → Service Network VLAN Range*
3000-3199 Per Switch Overlay Service Network VLAN Range (Min:2, Max:4094)

Route Map Sequence Number Range*
1-65534 (Min:1, Max:65534)

Step 1 -> Create a Fabric

(continued)



General Parameters Replication VPC Protocols Advanced Resources Manageability **Bootstrap**

Enable Bootstrap ☒

Automatic IP Assignment For POAP

Enable Local DHCP Server ☒

Automatic IP Assignment For POAP From Local DHCP Server

DHCP Version

DHCPv4

DHCP Scope Start Address*

192.168.101.81

Start Address For Switch POAP

DHCP Scope End Address*

192.168.101.91

End Address For Switch POAP

Switch Mgmt Default Gateway*

192.168.101.254

Default Gateway For Management VRF On The Switch

Switch Mgmt IP Subnet Prefix*

24

(Min:8, Max:30)

Step 2 -> Add Switches

The screenshot displays the Cisco DNA Center interface. At the top left, a breadcrumb shows 'Data Center / DC1'. On the left sidebar, the 'View' section is expanded, showing icons for zooming and a 'Show Logical Links' toggle. Below this are tabs for 'Operation' and 'Configuration', and a 'Hierarchical' view selector. A status legend lists 'Healthy', 'Warning', 'Minor', 'Major', 'Critical', and 'NA'. At the bottom of the sidebar, a 'Multi-select' toggle is shown with '0 selected'. The main workspace features a search bar 'Search by Attributes' and an 'Actions' button. Two large grey circles represent 'NET' and 'VRFs', both with a count of '(0)'. A blue button labeled 'Add Switches' is positioned between the two circles. A context menu is open over this button, listing options: 'Detailed View', 'Edit Fabric', 'Add Switches' (highlighted), 'Recalculate and Deploy', and 'More'.

Step 2 -> Add Switches (continued)

Switch Addition Mechanism*
☒ Discover ☐ Bootstrap(POAP) ☐ Pre-provision

Seed Switch Details

Seed IP*
192.168.101.24
Ex: "2.2.2.20" or "10.10.10.40-60" or "2.2.2.20, 2.2.2.21"

Authentication Protocol*
MD5

Username*
admin

Password*
.....

Max Hops*
2

Preserve Config
☐ Unchecking this will clean up the configuration on switches.

Discover Switches

Close Discover Switches

Switch Mgmt0 IP

Switch Discovery Credentials

Switch Hops based on CDP

VXLAN Greenfield or Brownfield

Step 2 -> Add Switches (continued)

Seed Switch Details

Fabric DC1

Switch 192.168.1.1

Authentication Protocol MD5

Username admin

Password ● Set

Max Hops 2

Preserve config ● Disabled

Switch Inventory Management

[← Back](#)

Discovery Results

Filter by attributes

☐	Switch Name	Serial Number	IP Address	Model	Version	Status	Progress
☒	LEAF3-DC1	9E485UOMX0B	192.168.101.23	N9K-C9300v	9.3(8)	● Manageable	
☒	BORDER-DC1	9C4QW0VHSLO	192.168.101.26	N9K-C9300v	9.3(8)	● Manageable	
☒	SPINE1-DC1	9PHNC61N225	192.168.101.24	N9K-C9300v	9.3(8)	● Manageable	
☒	LEAF1-DC1	9FGRDPPVWNX	192.168.101.21	N9K-C9300v	9.3(8)	● Manageable	
☐	BACKBONE-ROUTER	9WD2A8WRKVQ	192.168.101.27	N9K-C9300v	9.3(8)	● Already Managed In BACKBONE-WAN	

Add Switches

[Close](#) [Add Switches](#)

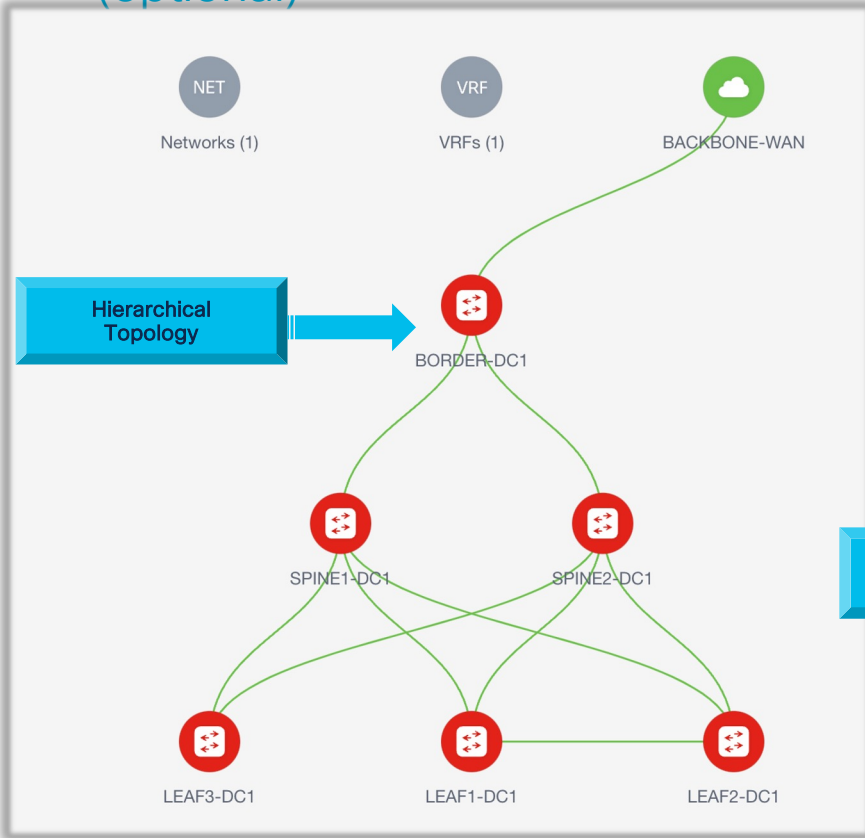
Step 3 -> Set Role

The screenshot displays the Cisco DNA Center interface for a Data Center (DC) environment. The top navigation bar shows 'DC Data Center / DC1'. The left sidebar contains a 'View' section with a 'Configuration' tab selected. Below the tabs, the 'Hierarchical' view is chosen, and a status legend indicates 'In-Sync' (green), 'Pending' (blue), 'In Progress' (yellow), 'Out-of-Sync' (red), and 'NA' (grey). A 'Multi-select' toggle is set to '0 selected'.

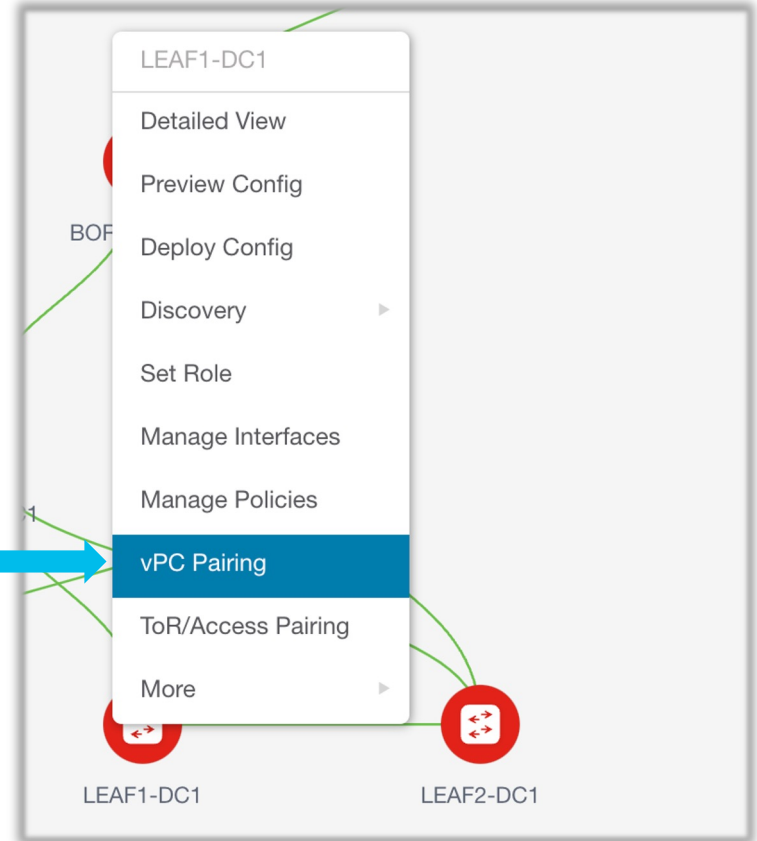
The main workspace shows a network topology with nodes: 'NET' (Networks (1)), 'VRF' (VRFs (1)), and 'BACKBONE-WAN'. A context menu is open for the 'LEAF2-DC1' node, listing actions such as 'Detailed View', 'Preview Config', 'Deploy Config', 'Discovery', 'Set Role' (highlighted), 'Manage Interfaces', 'Manage Policies', 'vPC Pairing', 'ToR/Access Pairing', and 'More'. A secondary menu is open for the 'Set Role' action, showing a list of roles: 'Spine', 'Leaf (current)', 'Border', 'Border Spine', 'Border Gateway', 'Border Gateway Spine', 'Super Spine', 'Border Super Spine', 'Border Gateway Super Spine', and 'ToR'. A blue arrow labeled 'Topology View' points to the 'Hierarchical' view dropdown. Another blue arrow labeled 'Switch Roles' points to the 'Border Gateway Spine' role in the secondary menu.

At the bottom, a row of device icons is shown, labeled from left to right: 'LEAF3-DC1', 'SPINE1-DC1', 'LEAF1-DC1', 'SPINE2-DC1', 'LEAF2-DC1', and 'BORDER-DC1'. The 'LEAF2-DC1' icon is highlighted with a red circle.

Step 4 -> VPC Pairing (optional)



Leaf VPC Pairing



Step 4 -> VPC Pairing (optional)

Select vPC Peer for LEAF1-DC1

☒ Virtual Peerlink

Filter by attributes

	Device	Recommended	Reason	Serial Number	IP Address
☐	SPINE2-DC1	False	Switches have different roles	922ANP25GML	192.168.101.25
☒	LEAF2-DC1	False	N9K-C9300v doesn't support Virtual Fabric Peering	988KWTIDPZ2	192.168.101.22
☐	SPINE1-DC1	False			
☐	BORDER-DC1	False			
☐	LEAF3-DC1	False			

Select vPC Peer for LEAF1-DC1

☐ Virtual Peerlink

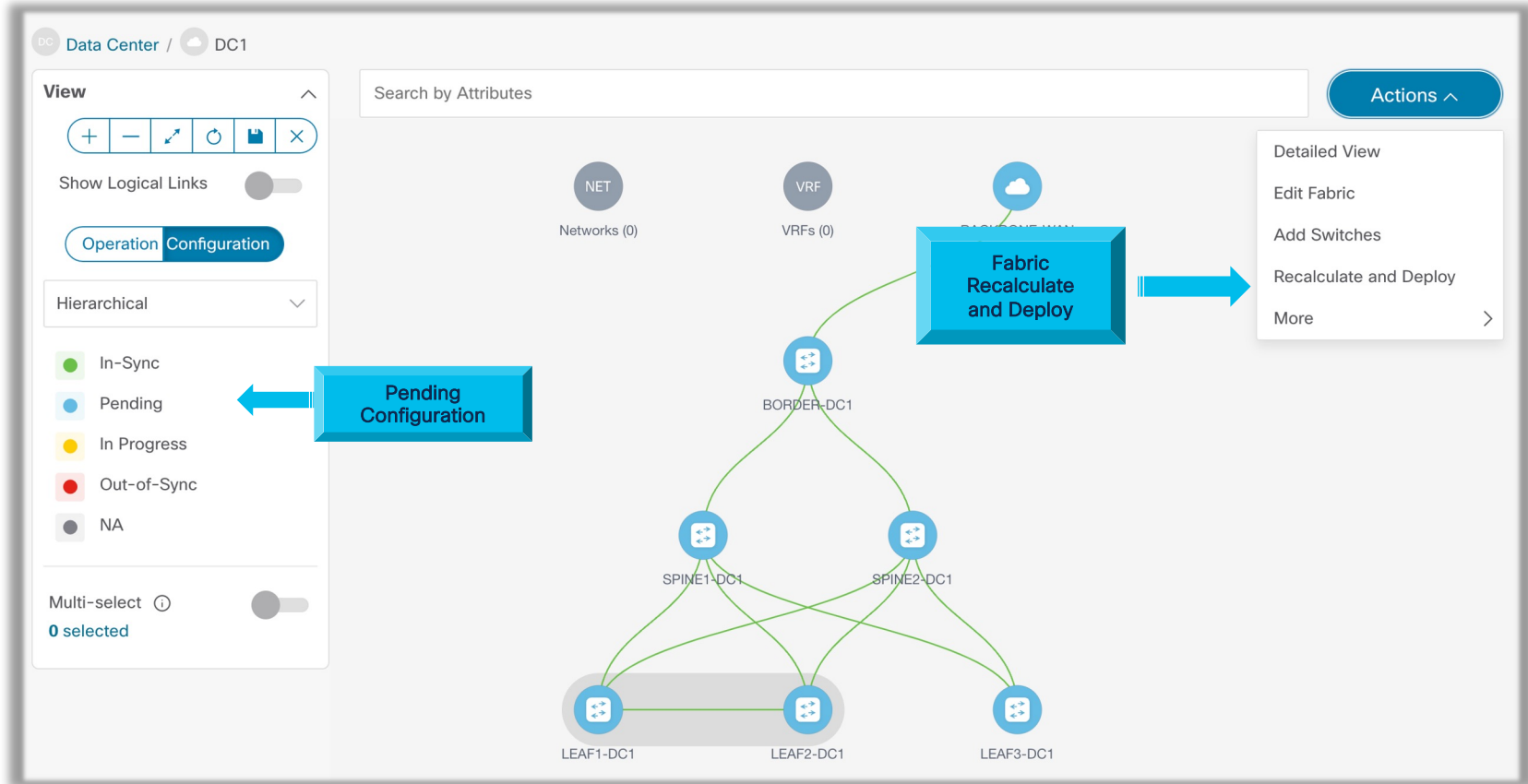
Filter by attributes

	Device	Recommended	Reason	Serial Number	IP Address
☒	LEAF2-DC1	True	Switches are connected and have same role	988KWTIDPZ2	192.168.101.22
☐	SPINE2-DC1	False	Switches have different roles	922ANP25GML	192.168.101.25
☐	SPINE1-DC1	False	Switches have different roles	9PHNC61N225	192.168.101.24
☐	BORDER-DC1	False	Switches have different roles	9C4QW0VHSLO	192.168.101.26
☐	LEAF3-DC1	False	Switches are not connected	9E485UOMX0B	192.168.101.23

Cancel

Save

Step 5 -> Recalculate and Deploy



Step 5 -> Recalculate and Deploy

(continued)

Deploy Configuration - DC1



1
Config Preview

2
Deploy Progress

Filter by attributes

Resync All

Switch Name	IP Address		Number	Fabric Status	Pending Config	Status Description	Progress	Resync Switch
BORDER-DC1	192.168.101.26	Fabric Configuration status		● Out-Of-Sync	357 Lines	Out-of-Sync	<div></div>	Resync
LEAF3-DC1	192.168.101.23		leaf 9E485UOMX0B	● Out-Of-Sync	523 Lines	Out-of-Sync	<div></div>	Resync
LEAF2-DC1	192.168.101.22	leaf	988KWTIDPZ2	● Out-Of-Sync	549 Lines	Out-of-Sync	<div></div>	Resync
LEAF1-DC1	192.168.101.21	leaf	9FGRDPPVWNX	● Out-Of-Sync	549 Lines	Out-of-Sync	<div></div>	Resync
SPINE2-DC1	192.168.101.25	spine	922ANP25GML	● Out-Of-Sync	341 Lines	Out-of-Sync	<div></div>	Resync
SPINE1-DC1	192.168.101.24	spine	9PHNC61N225	● Out-Of-Sync	349 Lines	Out-of-Sync	<div></div>	Resync

Close

Deploy All

Step 5 -> Recalculate and Deploy

(continued)

Pending Config - DC1 - SPINE2-DC1

Pending Config Side-by-Side Comparison

```
feature ngoam
feature nxapi
feature ospf
feature pim
ipv6 switch-packets lla
nv overlay evpn
feature lldp
feature bgp
feature nv overlay
ip pim anycast-rp 10.254.254.1 10.2.0.2
ip pim anycast-rp 10.254.254.1 10.2.0.6
ip pim rp-address 10.254.254.1 group-list 239.1.1.0/25
ip pim ssm range 232.0.0.0/8
ngoam install acl
nxapi http port 80
nxapi https port 443
snmp-server host 10.124.124.250 traps version 2c public udp-port 2162
router bgp 65100
  router-id 10.2.0.2
  neighbor 10.2.0.1
    remote-as 65100
  update-source loopback0
  address-family l2vpn evpn
    send-community both
    route-reflector-client
  exit
..
```

Spine
related
features

Spine RR/RP
function

Spine EVPN
RR Client

Pending Config - DC1 - SPINE2-DC1

Pending Config Side-by-Side Comparison

```
interface ethernet1/1
  no switchport
  ip address 10.4.0.9/30
  description connected-to-LEAF3-DC1-Ethernet1/2
  mtu 9216
  ip router ospf UNDERLAY area 0.0.0.0
  ip ospf network point-to-point
  ip pim sparse-mode
  no shutdown
interface ethernet1/2
  no switchport
  ip address 10.4.0.13/30
  description connected-to-BORDER-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
```

CDP Link &
IGP configs

Step 5 -> Recalculate and Deploy (continued)

Pending Config - DC1 - LEAF1-DC1

Pending Config Side-by-Side Comparison

```
vpc domain 1
ip arp synchronize
peer-gateway
peer-switch
delay restore 150
peer-keepalive destination 192.168.101.22 source 192.168.101.21
auto-recovery reload-delay 360
ipv6 nd synchronize
interface port-channel500
switchport
switchport mode trunk
spanning-tree port type network
description "vpc-peer-link LEAF1-DC1--LEAF2-DC1"
no shutdown
vpc peer-link
interface ethernet1/2
channel-group 500 force mode active
description "PO 500 (vpc-peer-link) member LEAF1-DC1-Ethernet1/2"
no shutdown
```

VPC Best
Practice Configs

Pending Config - DC1 - SPINE2-DC1

Pending Config Side-by-Side Comparison

Running Config

```
12 hostname SPINE2-DC1
13 icam monitor scale
14 interface ethernet1/1

23 interface ethernet1/10
```

Switch running
config v NDFC Intent

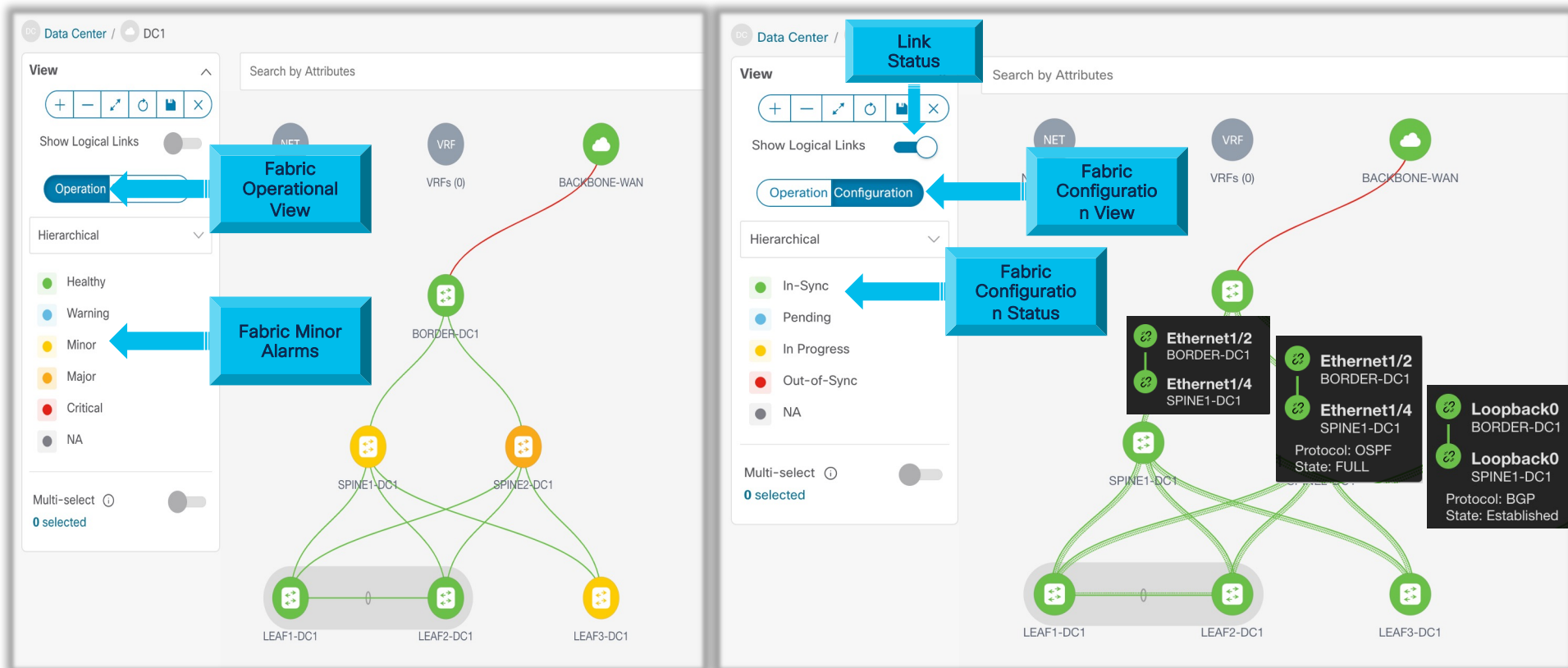
Expected Config

```
8 feature nv overlay
9 feature nxapi
10 feature ospf
11 feature pim
12 hostname SPINE2-DC1

14 interface ethernet1/1
15 description connected-to-LEAF3-DC1-Ethernet1/2
16 ip address 10.4.0.9/30
17 ip ospf network point-to-point
18 ip pim sparse-mode
19 ip router ospf UNDERLAY area 0.0.0.0
20 mtu 9216
21 no shutdown
22 no switchport

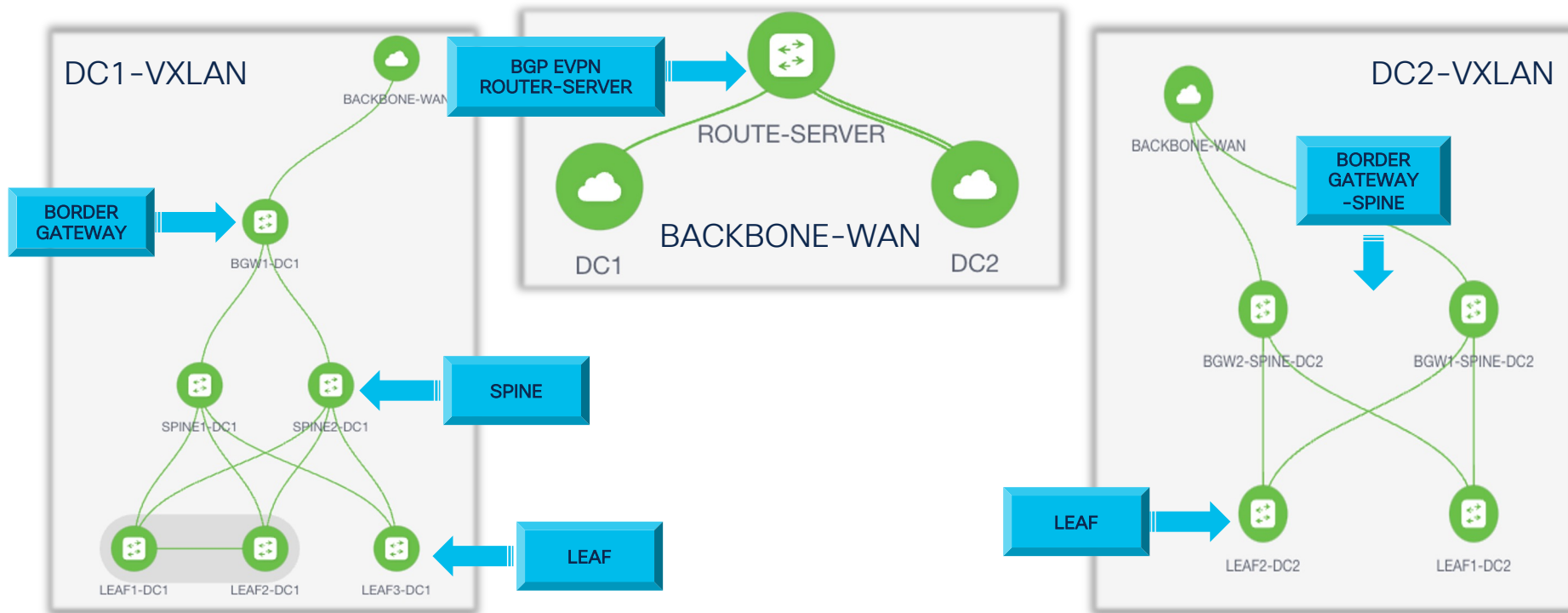
23 interface ethernet1/10
24 mtu 9216
25 no switchport
26 shutdown
```

NDFC VXLAN EVPN Topology View

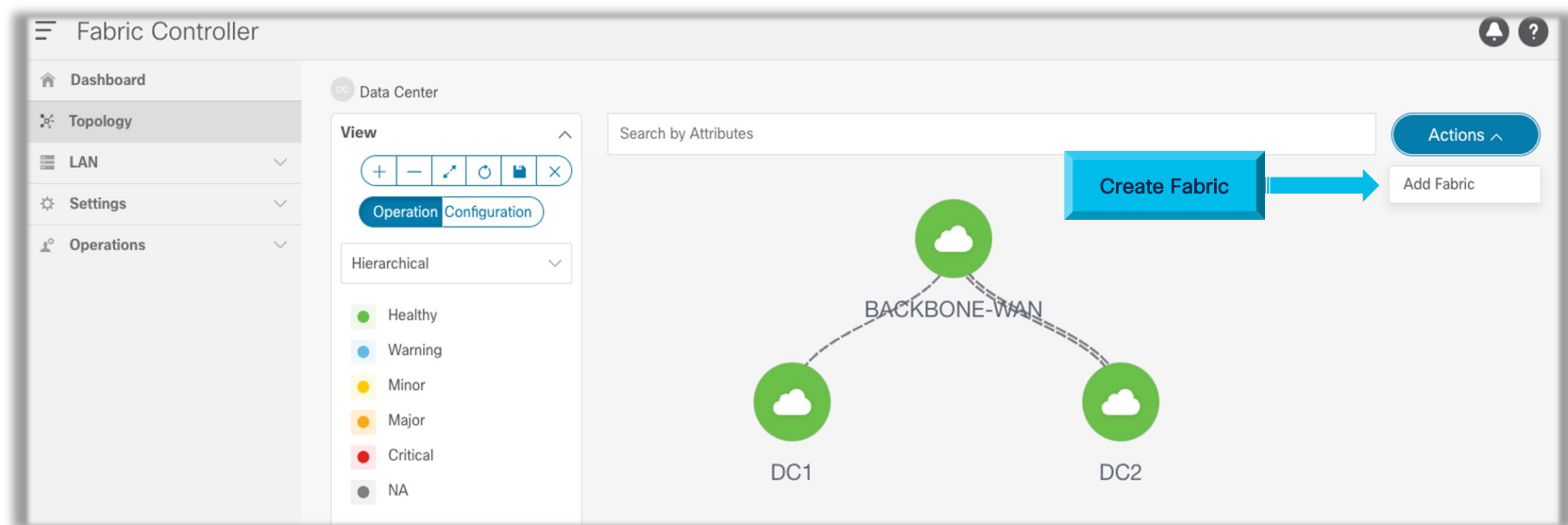


Step 1 & 2 -> Create Individual Fabrics

Set appropriate roles



Step 3 -> Create VXLAN EVPN Multi-Site Fabric



Step 3 -> Create VXLAN EVPN Multi-Site Fabric (continued)

Fabric Name
VXLAN_MULTI-SITE

Pick Fabric
VXLAN EVPN Multi-Site >

General Parameters DCI Resources Configuration Backup

Layer 2 VXLAN VNI Range*
30000-49000

Layer 3 VXLAN VNI Range*
50000-59000

L2VNI Label
(for stretched overlays)

L3VNI Label
(for stretched overlays)

Anycast-Gateway-MAC
2020.0000.00aa

Distributed Anycast
Gateway (for EP Mobility)

Multi-Site Routing Loopback Id*
100

Multi-Site BGP NH for
VXLAN EVPN on BGWs

Border Gateway IP TAG
54321

Routing tag associated with IP address of loopback and DCI interfaces

Step 3 -> Create VXLAN EVPN Multi-Site Fabric (continued)

General Parameters **DCI** Resources Configuration Backup

Multi-Site Overlay IFC Deployment Method*
Centralized_To_Route_Server
Manual, Auto Overlay EVPN Peering to Route Servers, Auto Overlay EVPN Direct Peering to Border Gateways

Multi-Site Route Server List*
9.9.9.9
Multi-Site Router-Server peer list, e.g. 128.89.0.1, 128.89.0.2

Multi-Site Route Server BGP ASN List*
65099
BGP ASN of Route-Server
65000, 65001

Enable 'redistribute direct' on Route Servers
☐
For auto-created Multi-Site overlay IFCs in Route Servers. Applicable only when Multi-Site Overlay IFC Deployment Method is Centralized_To_Route_Server.

Route Server IP TAG

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

Multi-Site Underlay IFC Auto Deployment Flag
☒

BGP Send-community on Multi-Site Underlay IFC
☒
Enable BGP send-community

VXLAN Multi-Site BGW Design Model

BGP EVPN Router-Server Loopback IP for EVPN peering

Auto Deploy Multi-Site Underlay Configs

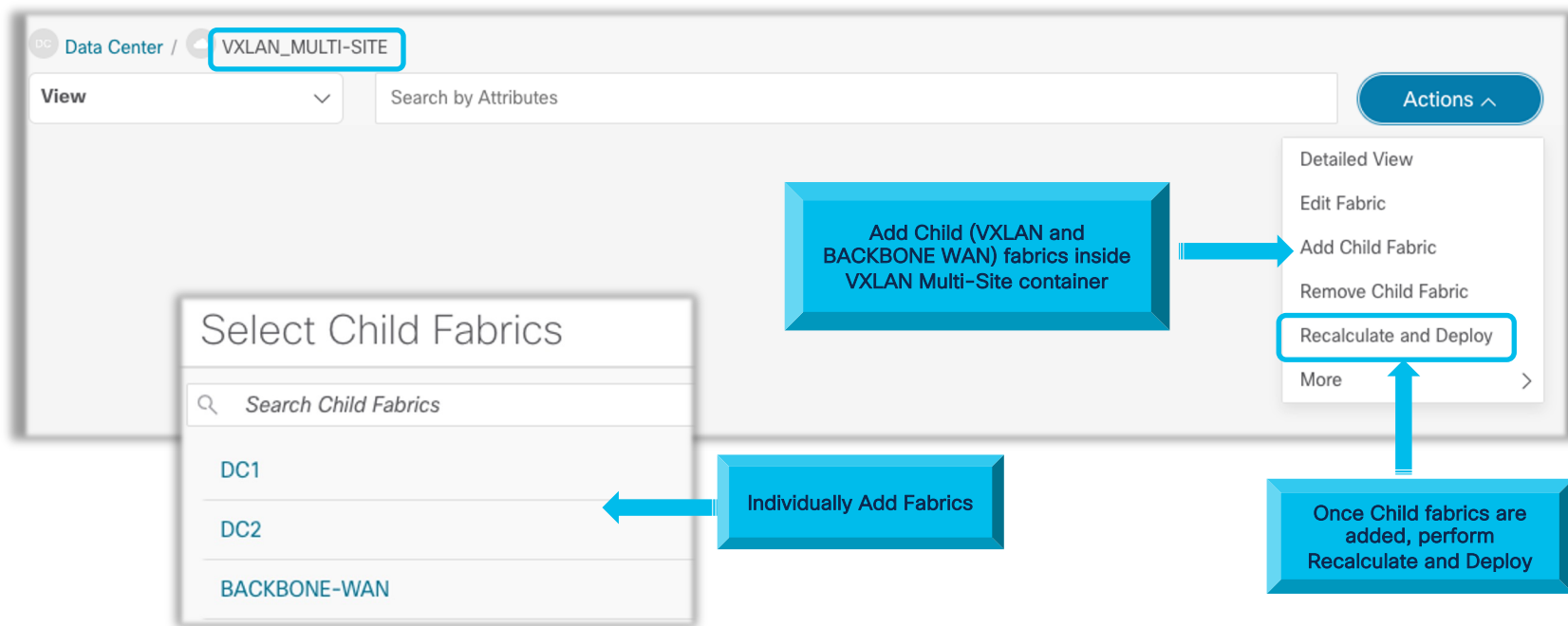
Step 3 -> Create VXLAN EVPN Multi-Site Fabric

(continued)

The diagram illustrates the configuration of a VXLAN EVPN Multi-Site Fabric. On the left, three blue boxes represent configuration inputs, each with an arrow pointing to a corresponding field in the 'Resources' tab of a configuration window on the right.

Configuration Input	Field Name	Value	Description
Multi-Site Loopback IP range allocation on BGWs	Multi-Site Routing Loopback IP Range*	10.10.0.0/24	Typically Loopback100 IP Address Range
DCI Underlay P2P Subnet	DCI Subnet IP Range*	10.10.1.0/24	Address range to assign P2P DCI Links
DCI Underlay P2P Subnet Mask	Subnet Target Mask*	30	Target Mask for Subnet Range (Min:8, Max:31)

Step 3 -> Create VXLAN EVPN Multi-Site Fabric (continued)



Step 4 -> Recalculate & Deploy

In VXLAN EVPN Multi-Site Fabric

Pending Config - VXLAN_MULTI-SITE - ROUTE-SERVER

Pending Config Side-by-Side Comparison

EVPN Overlay Feature

DCI Underlay Routed Port towards BGW

```
nv overlay evpn
feature nv overlay
interface ethernet1/1
no switchport
ip address 10.10.1.10/30 tag 54321
mtu 9216
no shutdown
```

Retain RT coming from BGW EVPN NLRI

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

```
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
route-map unchanged permit 10
set ip next-hop unchanged
```

```
neighbor 10.10.1.9
remote-as 65002
update-source Ethernet1/1
address-family ipv4 unicast
next-hop-self
send-community both
exit
exit
```

eBGP IPv4 Unicast (default) DCI Underlay peering towards BGW

eBGP EVPN DCI Overlay peering towards BGW

```
neighbor 20.2.0.3
remote-as 65002
inherit peer OVERLAY-PEERING
address-family l2vpn evpn
rewrite-evpn-rt-asn
exit
exit
```

Rewrite ASN portion of Auto RT

Step 4 -> Recalculate & Deploy

In VXLAN EVPN Multi-Site Fabric

Pending Config - VXLAN_MULTI-SITE - BGW1-DC1

Pending Config Side-by-Side Comparison

```
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
```

BGW Interface
advertisement for
DC1 reachability

BGW Site
ID

eBGP EVPN DCI Overlay
peering towards RS

Rewrite and Re-
origination function on
BGW

```
neighbor 10.10.1.1
 remote-as 65099
 update-source Ethernet1/3
 address-family ipv4 unicast
 next-hop-self
 send-community both
 exit
```

eBGP IPv4
Unicast (default)
DCI Underlay
peering towards
RS

```
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
```

Rewrite ASN
portion of Auto
RT

```
interface nve1
 multisite border-gateway interface loopback100
 source-interface loopback1
 host-reachability protocol bgp
 no shutdown
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
interface ethernet1/3
 no switchport
 ip address 10.10.1.2/30 tag 54321
 evpn multisite dci-tracking
 mtu 9216
 no shutdown
interface ethernet1/1
 no switchport
 ip address 10.4.0.26/30
 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
```

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

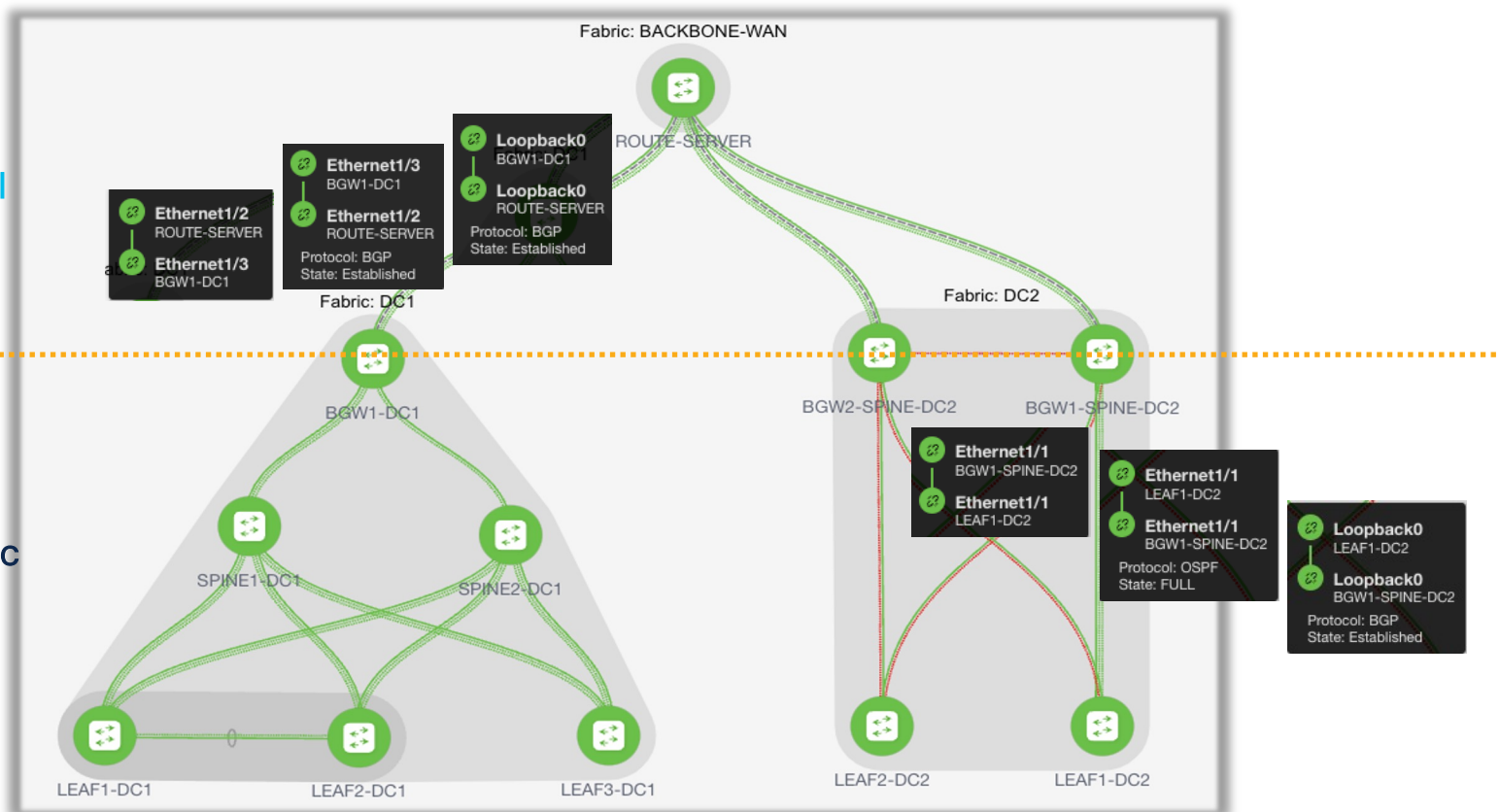
BGW DCI-tracking towards
Site-External underlay

BGW Fabric-tracking towards
Site-Internal underlay

NDFC VXLAN EVPN Multi-Site Topology View

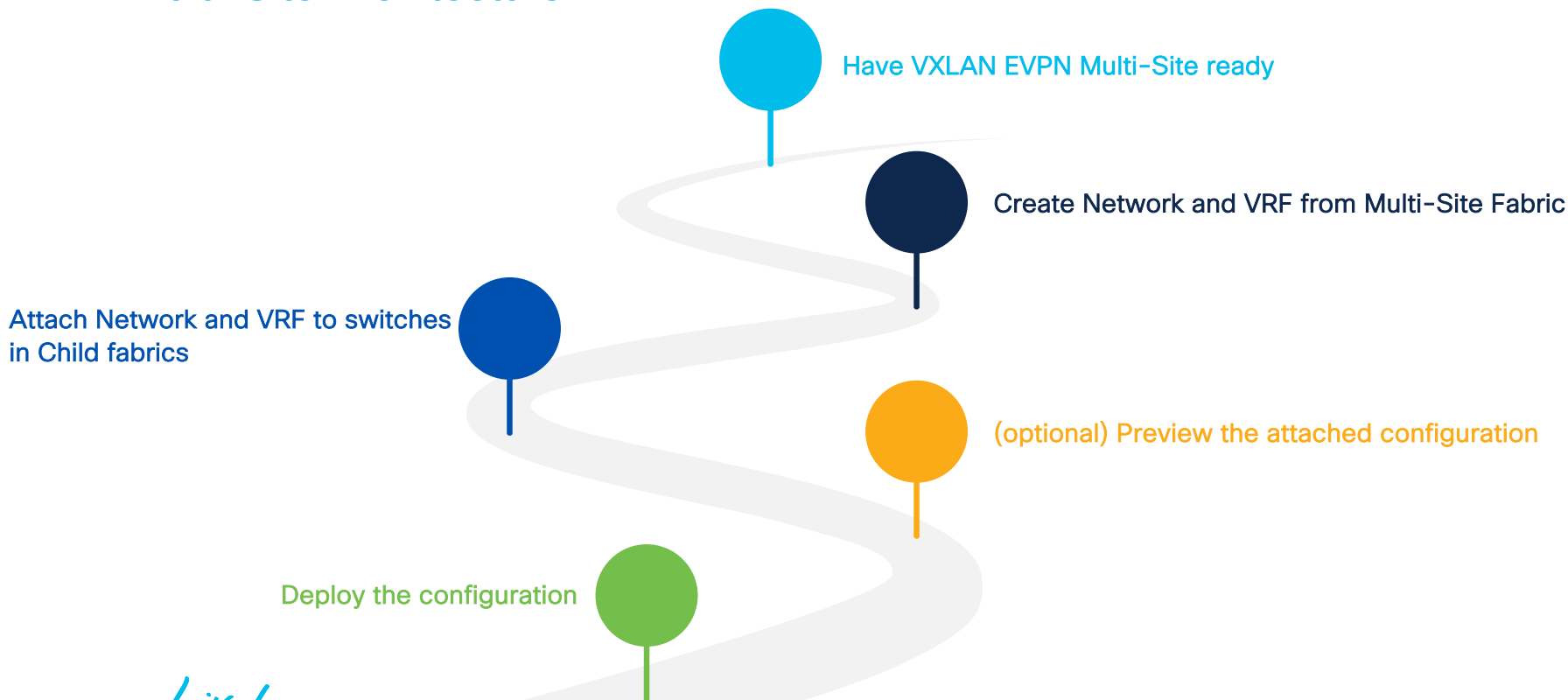
Site-External DCI

Site-Internal Fabric



Deploy VXLAN EVPN Overlays

in Multi-Site Architecture



Step 1 -> Navigate to VXLAN Multi-Site Fabric

Select Multi-Site Fabric

LAN Fabrics

Filter by attributes

	Fabric Name	Fabric Technology	Fabric Type	ASN	Fabric Health
☒	VXLAN_MULTI-SITE Hide child Fabrics ▾	VXLAN Fabric	Multi-Fabric Domain	NA	Healthy
☐	DC1	VXLAN Fabric	Switch Fabric	65001	Healthy
☐	DC2	VXLAN Fabric	Switch Fabric	65002	Healthy
☐	BACKBONE-WAN	External	External	65099	Healthy

*UI Navigation: LAN Fabrics > Select Fabric > Fabric Overview > Networks > Create

Step 2 -> Create VRF and Network

The screenshot shows the 'Create Network' form with several blue callout boxes and arrows pointing to specific fields:

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

Other visible fields and buttons include:

- VRF Name**: MyVRF_50000
- Propose VLAN** button
- Network Template**: Default_Network_Universal
- Network Extension Template**: Default_Network_Extension_Universal
- Generate Multicast IP** button
- General Parameters** and **Advanced** tabs
- Close** and **Create** buttons at the bottom right.

Step 3 -> Attach VRF and Network

☐	Network Name	Network ID	VRF Name	IPv4 Gateway/Suffix	IPv6 Gateway/Prefix	Network Status
☐	MyNetwork_30000	30000	MyVRF_50000	10.10.10.1/24		● NA

Select Network

Network Overview - MyNetwork_30000

Overview Network Attachments

Filter by attributes

☒	Network Name	Network ID	VLAN ID	Switch	Ports	Status	Attachment	Switch Role	Fabric Name	History
☒	MyNetwork_30000	30000		LEAF1-DC1	NA	● NA	Detached	leaf	DC1	Edit
☒	MyNetwork_30000	30000		LEAF3-DC1	NA	● NA	Detached	leaf	DC1	Preview
☒	MyNetwork_30000	30000		LEAF2-DC1	NA	● NA	Detached	leaf	DC1	Deploy
☒	MyNetwork_30000	30000		BGW1-DC1	NA	● NA	Detached	leaf	DC1	One-Click attachment for all fabrics
☒	MyNetwork_30000	30000		LEAF2-DC2	NA	● NA	Detached	leaf	DC2	Quick Attach
☒	MyNetwork_30000	30000		BGW2-SPINE-DC2	NA	● NA	Detached	border gateway spine	DC2	Quick Detach
☒	MyNetwork_30000	30000		BGW1-SPINE-DC2	NA	● NA	Detached	border gateway spine	DC2	
☒	MyNetwork_30000	30000		LEAF1-DC2	NA	● NA	Detached	leaf	DC2	

Selective Network Attachments

Edit for selecting port attachments

Step 3 -> Attach VRF and Network (continued)

Edit Network Attachment - MyNetwork_30000

2 of 7: MyNetwork_30000 - LEAF3-DC1(9V7QX35H97X)

LEAF3-DC1 (9V7QX35H97X)

Detach ☐ Attach ☒

VLAN*

2300

'Interface Attachment(s)'

Filter by attributes

☐	Interface/Ports	Switch	Status	Port Type	Port Description	Neighbor Info
☒	Ethernet1/4	LEAF3-DC1	false	trunk		
☒	Ethernet1/5	LEAF3-DC1	false	trunk		
☒	Ethernet1/6	LEAF3-DC1	false	trunk		
☐	Ethernet1/7	LEAF3-DC1	false	trunk		

Select ports for
the network
attachments

Cancel

Previous

Save & Next Edit

Step 4 -> Preview and Deploy VRF and Network

Filter by attributes									Actions ^
☒	Network Name	Network ID	VLAN ID	Switch	Ports	Status	Attachment	Switch Role	History
☒	MyNetwork_30000	30000	2300	LEAF2-DC2	2 Ports	☐ PENDING	Attached	leaf	Edit
☒	MyNetwork_30000	30000	2300	LEAF1-DC1	Ethernet1/4	☐ PENDING	Deploy pending network attachment config →	gateway	Preview
☒	MyNetwork_30000	30000	2300	BGW1-SPINE-DC2	NA	☐ PENDING		spine	Deploy
☒	MyNetwork_30000	30000	2300	BGW2-SPINE-DC2	NA	☐ PENDING	Attached	border gateway spine	Import
☒	MyNetwork_30000	30000	2300	LEAF3-DC1	3 Ports	☐ PENDING	Attached	leaf	Export
									Quick Attach
									Quick Detach

VRF and Network Configs

Pending Config - VXLAN_MULTI-SITE - BGW1-DC1

```
vlan 2000
  vn-segment 50000
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
```

L3VNI VRF
Configs

```
router bgp 65001
  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
  configure terminal
    interface nvel
      member vni 30000
      multisite ingress-replication
      mcast-group 239.1.1.1
    member vni 50000 associate-vrf
```

VXLAN Tenant

NVE Tunnel
Configs

```
vlan 2300
  vn-segment 30000
evpn
  vni 30000 12
  rd auto
  route-target import auto
  route-target export auto
```

L2VNI
Network
Configs

VRF and Network Configs

Pending Config - VXLAN_MULTI-SITE - LEAF3-DC1

```
vlan 2000
  vn-segment 50000
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
```

L3VNI VRF Configs

```
router bgp 65001
  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
configure terminal
interface nve1
  member vni 30000
  mcast-group 239.1.1.1
  member vni 50000 associate-vrf
```

VXLAN Tenant

NVE Tunnel Configs

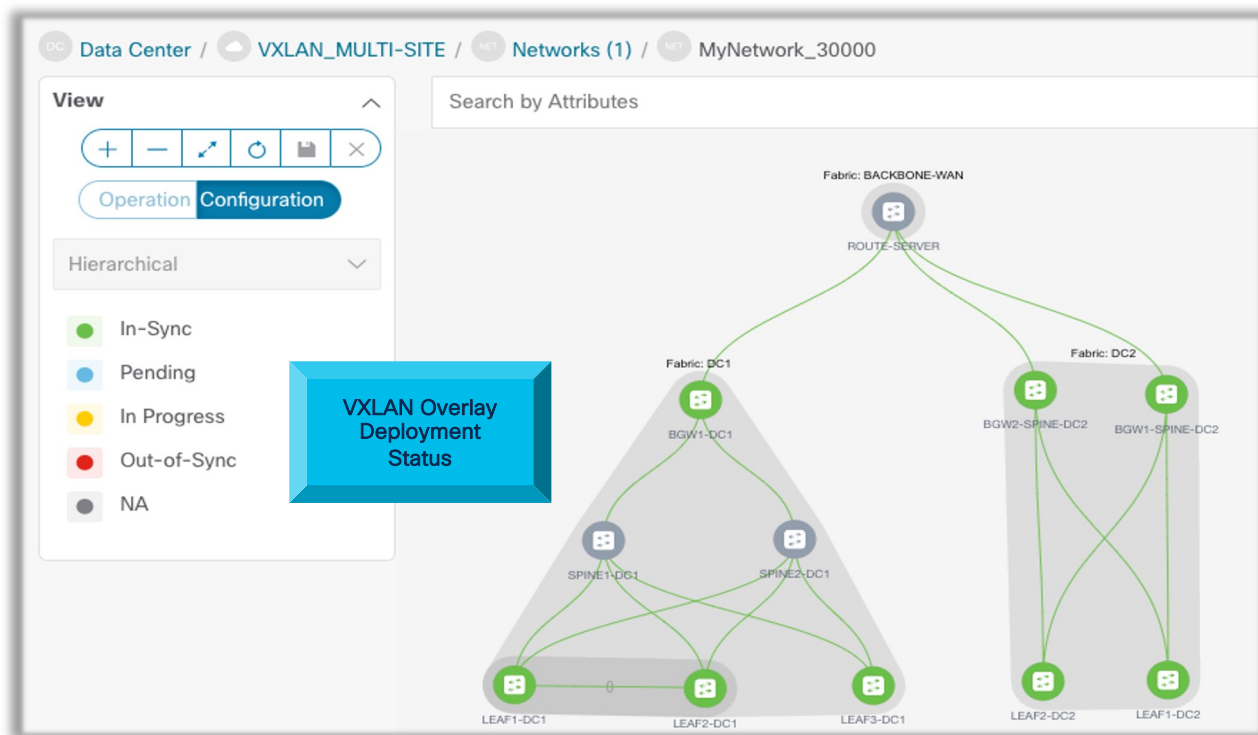
```
vlan 2300
  vn-segment 30000
interface Vlan2300
  vrf member myvrf_50000
  ip address 10.10.10.1/24 tag 12345
  fabric forwarding mode anycast-gateway
  no shutdown
exit
evpn
  vni 30000 l2
  rd auto
  route-target import auto
  route-target export auto
configure terminal
interface ethernet1/4
  switchport trunk allowed vlan add 2300
interface ethernet1/5
  switchport trunk allowed vlan add 2300
interface ethernet1/6
  switchport trunk allowed vlan add 2300
```

L3 SVI Configs

L2VNI Network Configs

VRF and Network Deployment Status

In VXLAN EVPN Multi-Site Fabric



VXLAN EVPN Brownfield Migration

Already using VXLAN?
Want to use NDFC for managing your fabric?



NDFC fully supports
Brownfield



Non-disruptive import
of existing VXLAN
EVPN deployments



Learns topology, all
configuration,
associated resources,
IP subnets, VNIs,
VLANs, etc.



Start Managing fabric
as if provisioned from
NDFC

Step 2

Discover

Import switches with **Preserve Config**
Define switch Roles (Border, Leaf, Spine, etc)



Step 1

Create

Define fabric settings (Underlay, Overlay) -
Match AS#, Replication Mode, IGP, etc.



Step 3

Recalculate and Deploy

Sanity checks for mis-config and Normalizes configuration
to best practices

Manage and Deploy External IP Handoff with NDFC

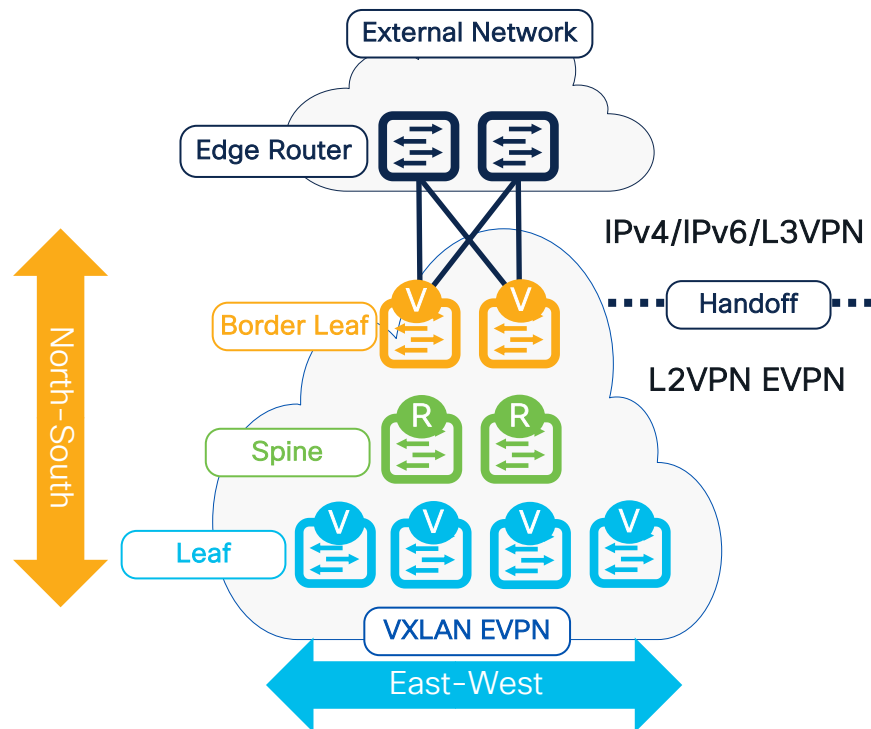
External Handoff Placement

Border Role compared to Leaf Role

- **Leaf VTEP (East-West traffic)**
 - Connectivity to endpoints, the first-hop routing
 - Server-to-server traffic
- **Border Leaf VTEP (North-South traffic)**
 - Transit node
 - Traffic destined from within the VXLAN EVPN Fabric to outside or vice versa
 - Optionally it can have directly attached endpoints
- Separating Roles simplifies operations

V V = VTEP

R = RR/RP



Border Node Design VXLAN EVPN Fabric

Border Node Placement Option

Flexible Design option-1

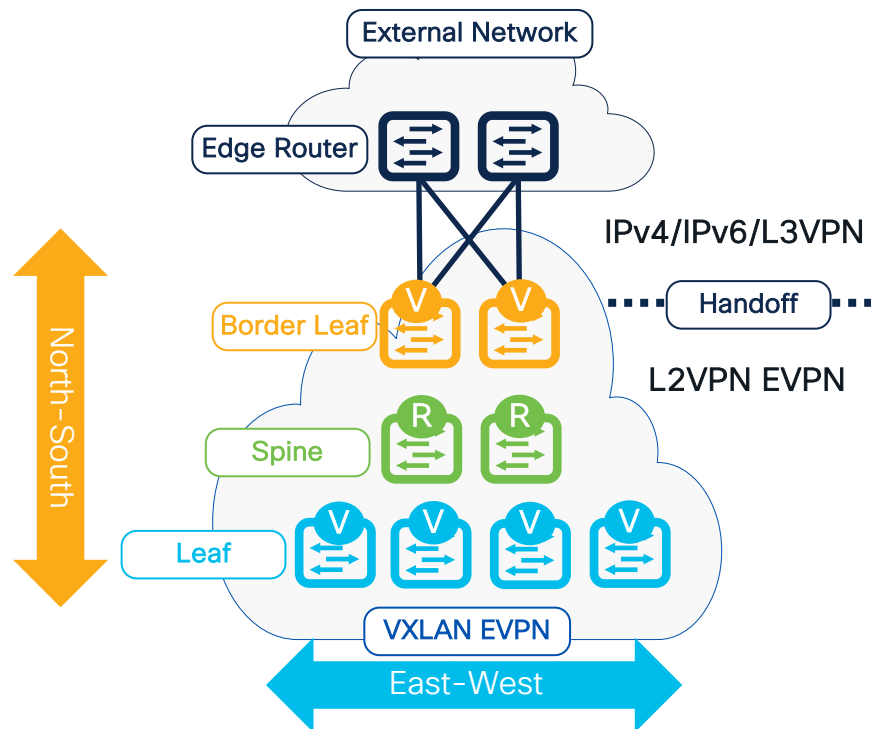
Border as Leaf nodes (Border Leaf)

- ✓ Capacity planning only for north-south traffic flows
- ✓ Clean role separation and uniform reachability from the entire fabric are the major advantages
- ✓ Support for Inter-AS option A (VRF-LITE) and seamless VXLAN-MPLS gateway (Border-PE)

Border Leaf hosts:

VTEP Mainly for

- North-South



Border Node Placement Option

Flexible Design option-2

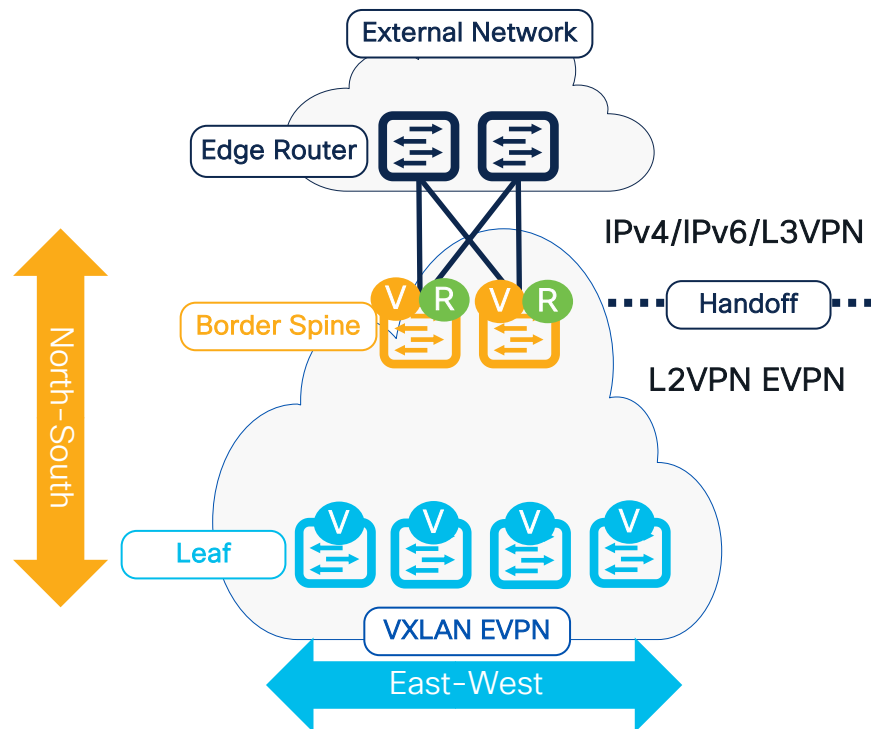
Border as Spine nodes (Border Spine)

- ✓ Leaf endpoints are one-hop away from External Networks
- ✓ Allowance for a scale-out approach to add spines and provide more bandwidth and resiliency
- ✓ Support for Inter-AS option A (VRF-LITE) and seamless VXLAN-MPLS gateway (Border-PE)
- ⚠ Extra functional dependency (Border + Spine)
- ⚠ Capacity planning needs to accommodate all flows

Border Spine hosts:

VTEP for:

- North-South
- East-West
- Route Reflector (RR) (iBGP EVPN)
- Rendezvous Point (RP) (Multicast Underlay BUM)



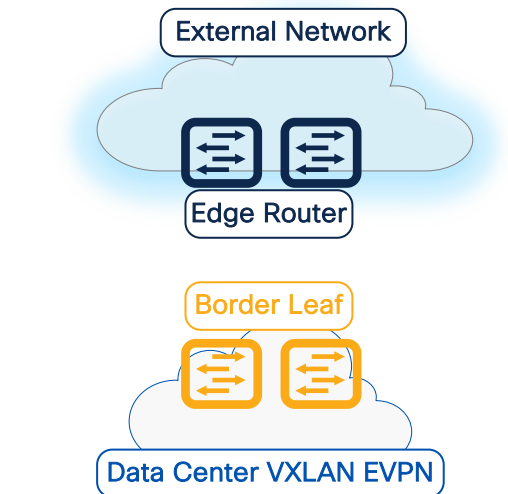
Who can be the External Edge Router?

Edge Router Placement Option

Nexus and Non-Nexus support

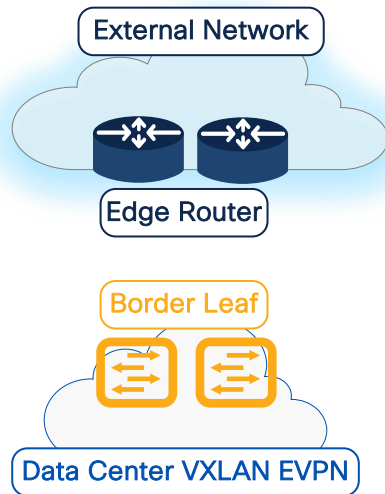


Supported Hardware and Software might vary depending on NDFC version
[Check compatibility matrix 12.1.3b](#)



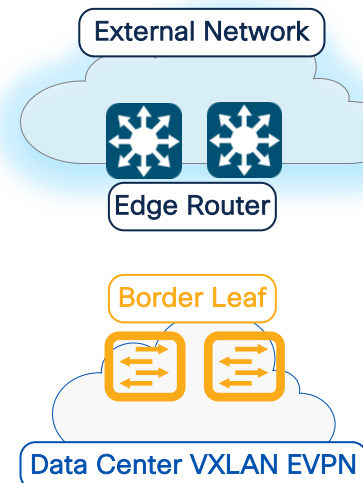
Managed NX-OS as Edge Router

- ✓ - Nexus 9000
- ✓ - Nexus 7000



Managed IOS-XR as Edge Router

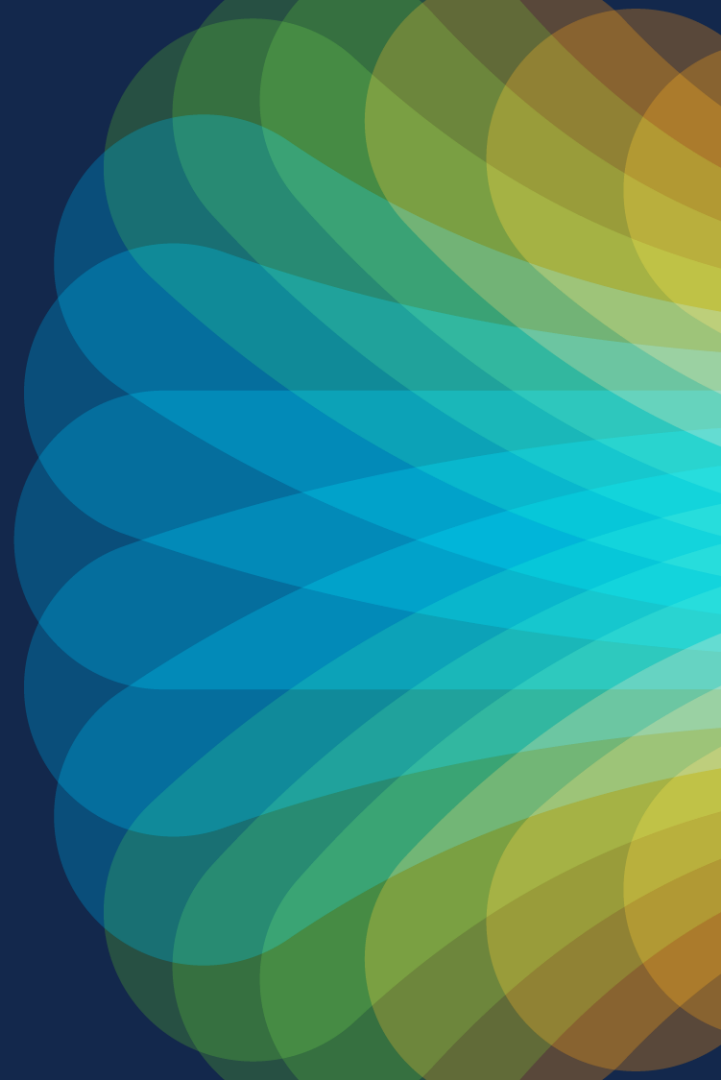
- ✓ - Cisco 8000
- ✓ - ASR 9000
- ✓ - NCS 5500



Managed IOS-XE as Edge Router

- ✓ - Catalyst 9000
- ✓ - Catalyst 8000
- ✓ - ASR 1000
- ✓ - CSR 1000

Border to External Peering Type



External Layer-3 connectivity options

Inter-AS Option A

- ✓ Clear separation of Autonomous Systems
- ✓ Simple, Straight forward, and Commonly used
- ✓ No need for redistribution
- ✓ Easy and Flexible BGP route-filtering mechanisms
- ✓ BGP natural loop avoidance
- ✓ Structured handoff between the VXLAN BGP EVPN fabric and the external routing domain (Backbone, WAN, Campus, etc.)
- ⚠ Not ideal for High scale VRF handoff deployment

Peering Type = Sub-interfaces on physical routed (or L3 Port-channel) interfaces

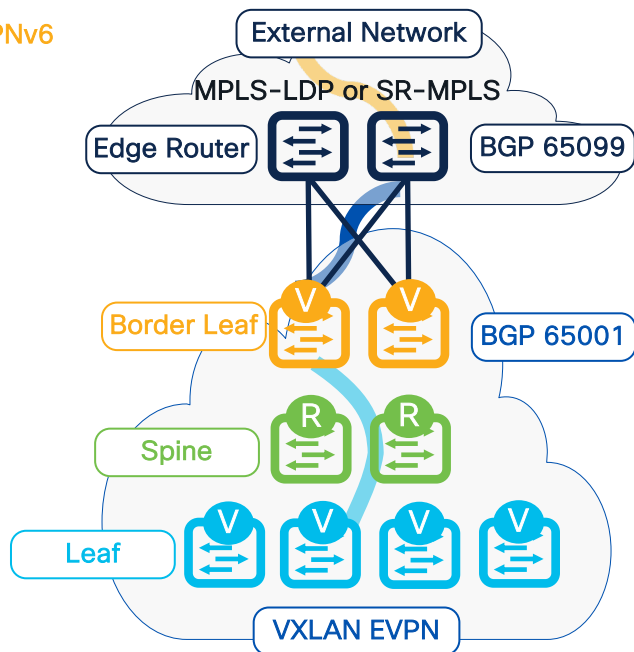
- Sub-interface with dot1q tag to mark the traffic to a specific VRF
- Sub-interface used for eBGP peering and as next-hop
- Per VRF, Per Sub-interface eBGP session

VPNv4/VPNv6

IPv4/IPv6

EVPN

Separated Border + PE (Inter-AS Option A)



External Layer-3 connectivity options

Seamless Protocol Gateway Model (Border-PE)

✔ Combines two different encapsulations and Address Family, using a “single-box (Border-PE)” instead of a “two-box (CE-PE)” model

✔ VXLAN VTEP Border nodes also becomes a MPLS L3VPN Provider Edge (PE), resulting in a role called Border-PE

✔ Best suited for high scale VRF deployment

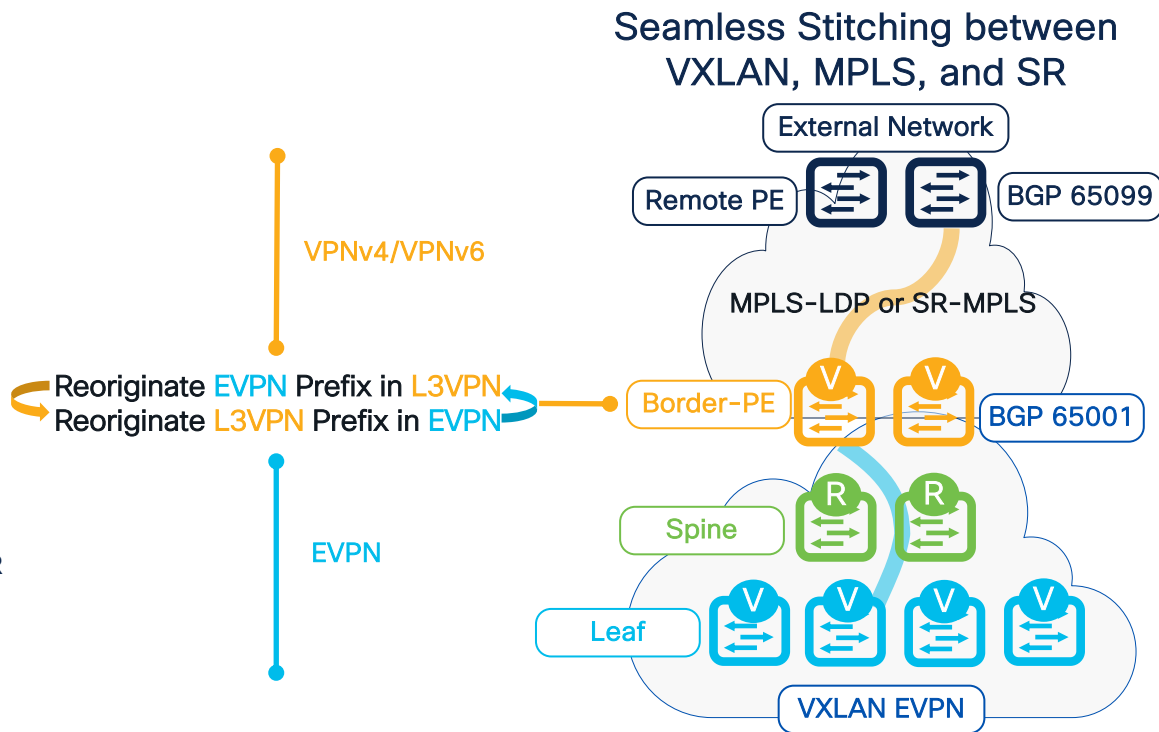
✔ Saves CAPEX and OPEX

✔ Seamless stitching between L2VPN EVPN and VPNv4/v6 Address Family

✔ BGP route-filtering mechanisms available

⚠ Specific Hardware support

- MPLS LDP: Nexus 3600-R, Nexus 9500-R
- SR MPLS: Nexus 9300 FX2/FX3/GX/GX2, Nexus 9500-R



Provision External IP Handoff with NDFC

Enabling VRF-LITE Automated

Border Leaf to Nexus Edge Router



Step 1

Create and Import

Define VXLAN EVPN and External Fabric. Set respective roles (e.g., Border, BGW, Edge)

Uncheck Fabric monitor mode in External Fabric if the Edge router is in managed mode



Step 2

IFC prototypes

Define IFC Type: "Back2Back&ToExternal"

Check: **Auto-Deploy** both

(Optional) Auto Allocation of Unique IP on VRF Extension over VRF LITE IFC

Recalculate config and deploy



Step 3

Deploy Symmetric VRF-Lite Extension

Define Individual VRF extension on the Border leaf

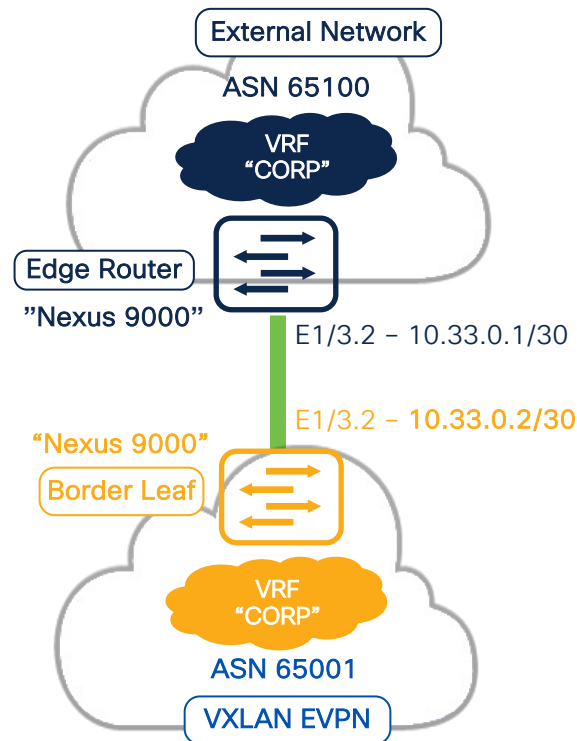
NDFC will add Sub-int and eBGP peering on Border leaf and neighbor Edge router

Deploy on Data Center VXLAN EVPN Fabric and External Network Fabric

VRF-LITE: Border to Nexus Edge

Topology and IFC considerations

- IFC Automated
- Advertise Host (**disabled**)
- Advertise Default-Route (**enabled**)
- Config Static 0/0 Route (**enabled**)



Managing Edge Devices

part of “External Connectivity Network” Fabric

- Create Fabric, Discover Switches, Set Role, and Recalculate & Deploy

The image displays three overlapping screenshots from the Cisco SD-WAN management interface, illustrating the process of managing edge devices.

Left Screenshot: Fabric Configuration

- Fabric Name:** External-Network
- Pick Fabric:** External Connectivity Network >
- General Parameters:**
 - BGP AS #*:** 65100
 - Fabric Monitor Mode:** ☐
 - Enable Performance Monitoring:** ☐

Middle Screenshot: Switch Addition

- Switch Addition Mechanism*:** ☒ Discover, ☐ Move Neighbor Switches
- Seed Switch Details:**
 - Fabric:** External-Network
 - Switch:** 192.168.101.66
 - Password:** Set
- Discovery Results:**
 - Filter by attributes
 - Switch Name: ☒ EDGE-ROUTER

Right Screenshot: Fabric Overview - External-Network

- Overview Switches Links Interfaces Policies Event Analytics History Resources**
- Filter by attributes**

☐	Switch	IP Address	Role	Serial Number	Config Status	Oper Status
☐	EDGE-ROUTER	192.168.101.66	Edge Router	9SB8UV1UL5Z	In-Sync	Healthy

VRF-LITE: Border to Nexus Edge

Defining IFC deployment type

- Review Fabric Settings for VRF-Lite IFC deployment type:

LAN > Fabrics > Select (your DC VXLAN Fabric) > Actions > Edit Fabric > **Resources Tab**

The screenshot shows the 'Resources' tab of the Cisco Fabric Editor. The 'Fabric Name' is 'DC1'. The 'Pick Fabric' dropdown shows 'Data Center VXLAN EVPN'. The 'Resources' tab is selected. The 'Subinterface Dot1q Range' is '2-511'. The 'VRF Lite Deployment' is 'Back2Back&ToExternal'. The 'Auto Deploy for Peer' checkbox is checked. The 'VRF Lite Subnet IP Range' is '10.33.0.0/16'. The 'VRF Lite Subnet Mask' is '30'. The 'Auto Allocation of Unique IP on VRF Extension over VRF Lite IFC' checkbox is checked. Annotations include: 'Per VRF Per Dotq1 association' pointing to the Subinterface Dot1q Range; 'Select Deployment Type' pointing to the VRF Lite Deployment dropdown; 'Deploy VRF-LITE if Edge device is Nexus and managed by NDFC' pointing to the Auto Deploy for Peer checkbox; and 'eBGP peering subnet details' pointing to the VRF Lite Subnet IP Range and Mask fields.

Fabric Name: DC1

Pick Fabric: Data Center VXLAN EVPN >

General Parameters Replication VPC Protocols Advanced **Resources**

Per VRF Per Dotq1 association

Subinterface Dot1q Range*: 2-511

Per Border Dot1q Range For VRF Lite Connectivity (Min:2, Max:4093)

Select Deployment Type

VRF Lite Deployment*: Back2Back&ToExternal

VRF Lite Inter-Fabric Connection Deployment Options. If 'Back2Back&ToExternal' is selected, VRF Lite IFCs are auto created between border devices of two Easy Fabrics, and between border devices in Easy Fabric and edge routers in External Fabric. The IP address is taken from the 'VRF Lite Subnet IP Range' pool.

Deploy VRF-LITE if Edge device is Nexus and managed by NDFC

Auto Deploy for Peer ☒

Whether to auto generate VRF LITE sub-interface and BGP peering configuration on managed neighbor devices. If set, auto created VRF Lite IFC links will have 'Auto Deploy for Peer' enabled.

eBGP peering subnet details

VRF Lite Subnet IP Range*: 10.33.0.0/16

Address range to assign P2P Interfabric Connections

VRF Lite Subnet Mask*: 30

(Min:8, Max:31)

Auto Allocation of Unique IP on VRF Extension over VRF Lite IFC ☒

When enabled, IP prefix allocated to the VRF LITE IFC is not reused on VRF extension over VRF LITE IFC. Instead, unique IP Subnet is allocated for each VRF extension over VRF LITE IFC.

Close Save

VRF-LITE: Border to Nexus Edge

Defining IFC Link on physical interface

- IFC link has been defined
 - Policy should be **ext_fabric_setup**
 - IPs auto selected from VRF-Lite Subnet IP Range

Fabric Overview - DC1

Overview Switches **Links** Interfaces Interface Groups Policies Networks VRFs Services Event Analytics History Resources

Links

Protocol View

Fabric Name == DC1<-->External-Network

☐	Fabric Name	Name	Policy	Info	Admin State	Oper State
☐	DC1<-->External-Network	BORDER-DC1~Ethernet1/3---EDGE-ROUTER-Ethernet1/3	ext_fabric_setup	Link Present	↑ Up	↑ Up

VRF-LITE: Border to Nexus Edge

Defining VRF extensions on Border

- Verify DC VXLAN Fabric VRFs were created and customize if needed
 - LAN > Fabrics > **Double click** (your DC VXLAN Fabric) > **VRFs**

Fabric Overview - DC1

Overview Switches Links Interfaces Interface Groups Policies Networks **VRFs** Services Event Analytics History Resources

Filter by attributes

☒ VRF Name	VRF Status	VRF ID	
☒ CORP	● NA	9999	<div>Create</div> <div>Edit</div> <div>Deploy</div>

Edit VRF if you want to modify route advertisement or other VRF specifics

VRF-LITE: Border to Nexus Edge

Defining VRF extensions on Border

Edit VRF

CORP

VRF ID*

9999

VLAN ID

99

Propose VLAN

VRF Template*

[Default_VRF_Universal >](#)

VRF Extension Template*

[Default_VRF_Extension_Universal >](#)

General Parameters

Advanced

Route Target

VRF VLAN Name

CORP

General Parameters

Advanced

Advertise Host Routes



Advertise Default Route



Config Static 0/0 Route



BGP Neighbor Password

BGP Password Key Encryption Type

Select an Option

Flag to Control Advertisement of /32 and /128 Routes to Edge Routers

Define according to your use case

Flag to Control Advertisement of Default Route Internally

Flag to Control Static Default Route Configuration

VRF Lite BGP neighbor password (Hex String)

VRF Lite BGP Key Encryption Type: 3 - 3DES, 7 - Cisco

VRF-LITE: Border to Nexus Edge

Defining VRF extensions on Border

- **Attach** VRF to Border and extend through VRF-Lite

VRF Overview - CORP

Overview VRF Attachments Networks

Switch Role == border VRF Name == CORP

☒	VRF Name	VRF ID	VLAN ID	Switch	Status	Attachment	Switch Role	Fabric Name	Loopback ID	Loopback IPv4 Addr	History
☒	CORP	9999		BORDER-DC1	NA	Detached	border	DC1			Edit

VRF-LITE: Border to Nexus Edge

Defining VRF extensions on Border

- Attach VRF to Border and extend through VRF-Lite

Extend Options for Border

VRF_LITE	✓
NONE	

Extend Options for Border Gateway

MULTISITE	
MULTISITE + VRF_LITE	
VRF_LITE	✓
NONE	

Edit VRF Attachment - CORP

BORDER-DC1(92VPGGIF4HB)

Detach ☒ Attach

VLAN*

99

Extend*

VRF_LITE

VRF-LITE: Border to Nexus Edge

Defining VRF extensions on Border

Extension

Filter by attributes

Attach-All Detach-All

Action	Attached	Source Switch	Type	IF_NAME	Dest. Switch	Dest. Interface	DOT1Q_ID	IP_MASK	IP_TAG	NEIGHBOR_IP	NEIGHBOR_ASN
Edit	Detached	BORDER-DC1	VRF_LITE	Ethernet1/3	EDGE-ROUTER	Ethernet1/3	2	10.33.0.1/30	10.33.0.2	65100	

Extension Type

Destination Edge router details

Provide Route-MAP if different from NDFC default

Physical Interface MTU

Provide VRF name for External Edge. By default, NDFC uses the same name as Border VRF

MTU: 9216

ENABLE_IFC_NETFLOW: ☐

AUTO_VRF_LITE_FLAG: ☒

PEER_VRF_NAME*: CORP

ROUTE_MAP_IN:

ROUTE_MAP_OUT:

IPV6_ROUTE_MAP_IN:

IPV6_ROUTE_MAP_OUT:

Cancel Save

VRF-LITE: Border to Nexus Edge

Preview and Deploy VRF extensions on Border

Pending Config - DC1 - BORDER-DC1

Pending Config Side-by-Side Comparison

```
vlan 99
 name CORP
 vn-segment 9999
vrf context corp
 description CORP
 vni 9999
 rd auto
 address-family ipv4 unicast
  route-target both auto
  route-target both auto evpn
 ip route 0.0.0.0/0 10.33.0.2
 address-family ipv6 unicast
  route-target both auto
  route-target both auto evpn
exit
interface Vlan99
 description CORP
 vrf member corp
 ip forward
 ipv6 address use-link-local-only
 no ip redirects
 no ipv6 redirects
 mtu 9216
 no shutdown
```

L3VNI VRF
Configs

Default route static
towards External Edge

L3 Tenant
CORP

Advertisement of Default
route towards site internal
VTEP

eBGP External
Edge neighbor

```
router bgp 65001
 vrf corp
  address-family ipv4 unicast
   advertise l2vpn evpn
   redistribute direct route-map fabric-rmap-redirect-subnet
   maximum-paths ibgp 2
   network 0.0.0.0/0
   exit
  address-family ipv6 unicast
   advertise l2vpn evpn
   redistribute direct route-map fabric-rmap-redirect-subnet
   maximum-paths ibgp 2
   exit
 neighbor 10.33.0.2
  remote-as 65100
  address-family ipv4 unicast
   send-community both
  route-map extcon-rmap-filter out
```

Border Physical
Interface
Config

```
interface ethernet1/3.2
 encapsulation dot1q 2
 mtu 9216
 vrf member corp
 ip address 10.33.0.1/30
 no shutdown
interface nve1
 source-interface loopback1
 host-reachability protocol bgp
 no shutdown
 member vni 9999 associate-vrf
```

VRF-LITE: Border to Nexus Edge

Preview and Deploy VRF extensions on External Edge

- Once configurations are deployed on Border Leaf (DC VXLAN EVPN), navigate to **External Network Fabric** and **perform Recalculate and Deploy**

Pending Config - External-Network - EDGE-ROUTER

Pending Config Side-by-Side Comparison

```
vrf context corp
  address-family ipv4 unicast
exit
router bgp 65100
  vrf corp
    address-family ipv4 unicast
    neighbor 10.33.0.1
    remote-as 65001
    address-family ipv4 unicast
    send-community both
configure terminal
interface ethernet1/3.2
  mtu 9216
  vrf member corp
  encapsulation dot1q 2
  ip address 10.33.0.2/30
  no shutdown
```

VRF Configs

eBGP Border
Leaf neighbor

Edge Physical
Interface
Config

Verification and Validation with NDFC

Verification through NDFC

Keeping you away from CLI



Step 1

Verify Network and VRF
attachments

Configuration Status:

Network Status **Deployed**

VRF Status **Deployed**



Step 2

Deployment History

Configuration Execution Status:

Verify Deployment History Status **Success** for
Underlay, Overlay, Interfaces, and more



Step 3

Show commands

Service / features status
(CLI through NDFC)

Attachment deployment status

Job execution perspective

✓

2

Config Preview

Deploy Progress

Filter by attributes

Switch Name	IP Address	Status	Status Description	Progress
LEAF3-DC1	192.168.101.23	● SUCCESS	Deployment completed.	<div>Executed 5 / 5</div>
SPINE1-DC1	192.168.101.24	● COMPLETED	No Commands to execute.	<div></div>
SPINE2-DC1	192.168.101.25	● COMPLETED	No Commands to execute.	<div></div>

Success or Failure deployment details

Multi-Stage Preview and Deployment

Switch Name	IP Address	Status	Status Description	Progress
Edge-router	192.168.101.99	● FAILED	Deployment failed. Check deployment history for more information.	Executed 1 / 12
Edge-Catalyst	192.168.101.101	● COMPLETED	No Commands to execute.	

Role	VRF Status	Status Description	Progress
border gateway	● Deployment In-Pr	Adding diff to deployment queue	

Role	VRF Status	Status Description	Progress
border gateway	● In-Sync	Config compliance sync completed	

Deployment History Tool

Commands execution perspective

Fabric Overview - External-Edge

Overview Switches Links Interfaces Policies Event Analytics **History** Resources

Deployment History

Policy Change History

Filter by attributes

HostName	Entity Name	Entity Type	Source	Commands	Status	Serial Number	Status
Edge-router	Vlan100	INTERFACE	UNDERLAY	Detailed History	● SUCCESS	91UP402KI8R	Successfully deployed
Edge-router	Vlan100	INTERFACE	UNDERLAY	Detailed History	● FAILED	91UP402KI8R	
Edge-router	SWITCH	SWITCH	UNDERLAY	Detailed History	● SUCCESS	91UP402KI8R	

CLI response messages for easier troubleshooting

Command Execution Details for Edge-router(91UP402KI8R)

Config	Status	CLI Response
vrf member eng	● SUCCESS	
ip address 4.4.4.1/24	● SUCCESS	
no ip redirects	● SUCCESS	
no ipv6 redirects	● SUCCESS	
hsrp version 2	● FAILED	Warning: Deleted all L3 config on interface Vlan100 VRF eng does not exist. Create vrf to make interface Vlan100 operational
hsrp 44	● FAILED	Failed to configure hsrp version 2 on Vlan100 due to invalid command.
ip 4.4.4.2	● FAILED	Failed to execute this command, since command#7 (hsrp version 2) failed.

Command Execution Details for Edge-router(91UP402KI8R)

Config	Status	CLI Response
router bgp 65100	● SUCCESS	
address-family ipv4 unicast	● SUCCESS	
network 100.1.1.0/24	● SUCCESS	

Show Commands Tool

Switch Config perspective

Switches

Fabric Name == DC1 x

Switch	IP Address	Role	Serial
BGW1-DC1	192.168.101.25	Gateway	9S92
LEAF1-DC1	192.168.101.21	Leaf	97EV
LEAF2-DC1	192.168.101.22	Leaf	988K
☒ LEAF3-DC1	192.168.101.23	Leaf	9V7C

50 Rows

Actions ^

- Change Mode
- Provision RMA
- Change Serial Number
- Copy Run Start
- Reload
- Restore Switch
- Show Commands
- Exec Commands
- Delete Switch(es)

Add Switches

- Preview
- Deploy
- Discovery
- Set Role
- vPC Pairing
- ToR/Access Pairing
- vPC Overview
- More

NDFC pre-built commands, user commands, or custom-built show templates

Commands*

- show
- current_running_config
- show
- show_bgp_evpn_neighbors
- show_bgp_l2vpn_evpn_summary
- show_bgp_sessions
- show_capture_elam
- show_epld_boot_info
- show_mac_and_arp
- show_sys_state

```
1 #show ip ospf nei
2
3 OSPF Process ID UNDERLAY VRF default
4 Total number of neighbors: 2
5 Neighbor ID    Pri State          Up Time  Address    Interface
6 10.2.0.6       1 FULL/ -       2d22h   10.4.0.29  Eth1/2
7 10.2.0.1       1 FULL/ -       2d22h   10.4.0.21  Eth1/3
8
9 #show bgp l2vpn evpn su
10 BGP summary information for VRF default, address family L2VPN EVPN
11 BGP router identifier 10.2.0.3, local AS number 65001
12 BGP table version is 29, L2VPN EVPN config peers 2, capable peers 2
13 9 network entries and 16 paths using 2436 bytes of memory
14 BGP attribute entries [16/2752], BGP AS path entries [1/10]
15 BGP community entries [0/0], BGP clusterlist entries [6/24]
16
17 Neighbor      V  AS MsgRcvd MsgSent  TblVer  InQ OutQ Up/Down  State/PfxRcd
18 10.2.0.1      4 65001  4252   4240    29    0    0   2d22h  5
19 10.2.0.6      4 65001  4252   4239    29    0    0   2d22h  5
20
21 #show int nve1
22 nve1 is up
23 admin state is up, Hardware: NVE
24 MTU 9216 bytes
25 Encapsulation VXLAN
```

Easily license your NDFC

Software included with switch subscription licenses

Tier-based



NXOS Essentials, Advantage, Premier

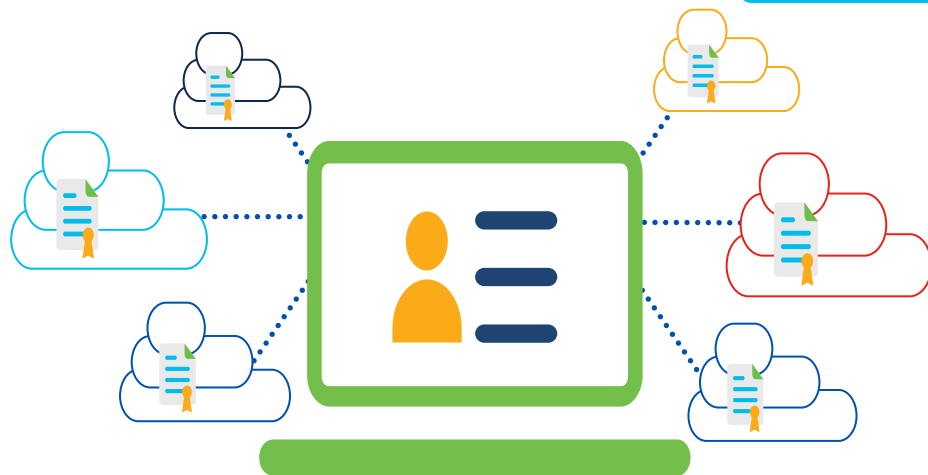
OR



DCN Essentials, Advantage, Premier

Install base (NX-OS)

New purchase (NX-OS)



Increased ease of use
and efficient consumption



Less restrictions with
flexible reporting



Reduced overall licensing
friction for users

NDFC 12.0 is transitioning to a Smart Licensing only release

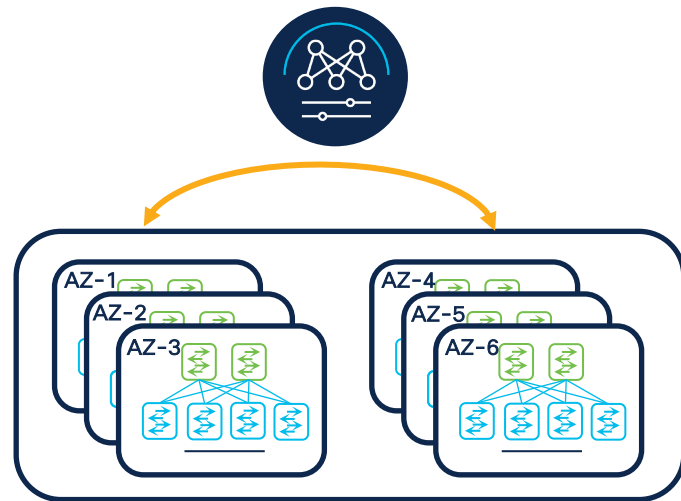
APPENDIX

White Paper and Document References

- VXLAN BGP EVPN
 - <https://www.cisco.com/c/en/us/products/switches/nexus-9000-series-switches/white-paper-listing.html>
- NDFC
 - <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.
- NDFC provides simplified mechanism to extend and provide end-to-end network and policy consistency across regions, all with a single point of orchestration.
- NDFC provides a single plane of glass solution to automate and manage Nexus and Non-Nexus devices



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The bridge to possible

Thank you

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The background is a vibrant, abstract graphic featuring a rainbow color palette. On the left, there are horizontal, wavy bands of color transitioning from red at the top to blue at the bottom. On the right, a bright white light source emits a series of sharp, radiating lines in various colors, creating a sunburst or starburst effect that blends into the wavy bands.

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