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TOR Deployment Using NDFC in VXLAN Fabrics

Note: The documentation set for this product strives to use bias-free language. For this documentation set, bias-free is defined as language that does not imply discrimination based on age, disability, gender, racial identity, ethnic identity, sexual orientation, socioeconomic status, and intersectionality. Exceptions may be present in the documentation due to language that is hardcoded in the user interfaces of the product software, language used based on RFP documentation, or language that is used by a referenced third-party product.

Summary

The addition of TOR support to NDFC has been a major milestone feature. It enables the end-to-end control and configuration of fabric including the TOR layer. The support for managing TOR switches in NDFC brings in an extra level of control at layer-2, which is necessary to have a stable loop free layer-2 network. This document explains how to peer TOR switches to leaf nodes in NDFC Fabric. Leaf nodes will have the VXLAN configuration whereas TOR switches act as a Layer 2 extension towards the hosts or servers.

Prerequisites

This document assumes that the reader is familiar with the configuration of the VXLAN BGP EVPN data center fabric. The VXLAN BGP EVPN fabric can be configured using Cisco Nexus Dashboard Fabric Controller (NDFC). This document focuses on the configuration and deployment of Networks on TOR switches using NDFC.

Introduction

Multisite VXLAN

Multi-Site VXLAN fabric is an interconnection of multiple VXLAN fabric sites over an inter-site network (ISN). Multi-site is used to extend Layer-2 or Layer-3 from one site to another site. VXLAN fabric consists of leaf and spine nodes connected in a CLOS architecture. Each Leaf node acts as a VTEP where it can receive IPv4 or IIPv6 traffic from end devices and encapsulate over a VXLAN tunnel and send it to a destination VTEP. The end host addresses are learned in the fabric using the BGP EVPN control plane. Sometimes a pair of leaf nodes acts as a single VTEP when a virtual port channel (vPC) or Multi Chassis Ether channel is used to connect to the end nodes.

NDFC

Cisco Nexus Dashboard Fabric Controller aka NDFC (formerly known as Data Center Network Manager aka DCNM) runs exclusively as an application service on top of the Cisco Nexus Dashboard Cluster. Nexus Dashboard cluster uses Kubernetes at its core with customized extensions, thereby realizing a secure and scaled-out platform for the deployment of microservices-based applications. Nexus Dashboard Cluster provides Active-Active HA (High Availability) for all applications running on top of that cluster.

Nexus Dashboard Orchestrator

Cisco Nexus Dashboard, Cisco Nexus Dashboard is a single launch point to monitor and scale across different sites, whether it is Cisco Application Centric Infrastructure (ACI) fabric controllers, the Cisco Application Policy Infrastructure Controller (APIC), Cisco Nexus Dashboard Fabric Controller (NDFC), or a Cisco Cloud Network Controller (CNC) running in a public cloud provider environment. Cisco NX-OS with Cisco Nexus Dashboard Fabric Controller (NDFC) is available as a service on the Cisco Nexus Dashboard. With third-party services integrated with Nexus Dashboard, NetOps can achieve command and control over global network fabrics, optimizing performance and attaining insights into the data center and cloud

operations. Using Cisco Nexus Dashboard, DevOps can improve the application deployment experience for multi-cloud applications Infrastructure-as-Code (IaC) integrations. Developers describe in code the networking components and resources needed to run an application in a data center or cloud.

Requirements

Table 1 shows the hardware and software requirements for TOR switch support on NDFC.

Devices	Hardware and Software Requirements
Nexus Hardware	https://www.cisco.com/c/en/us/td/docs/dcn/ndfc/1211/compatibility/cisco-ndfc- compatibility-matrix-guide-1211.html
Nexus Software	https://www.cisco.com/c/en/us/td/docs/dcn/ndfc/1211/compatibility/cisco-ndfc- compatibility-matrix-guide-1211.html
NDFC Release	12.1.1a
Nexus Dashboard Release	2.1.2h

 Table 1.
 Hardware and Software Requirements for TOR Deployment Support using NDFC

TOR Role in Multi-Site VXLAN Fabric:

TOR switches provide L2 connectivity to the end hosts. For extending Layer2, TOR should be configured with VLANs, trunks, and Port-channels. This can be achieved using NDFC and NDO. We have taken an example design in the below network diagram.



Figure 1. Multisite VXLAN Fabric Topology

Design Considerations

The leaf switches and the TOR nodes can be connected either using Single-sided vPC or Double-sided vPC. vPC Peering between the Leaf switches can be either physical peering or Virtual Peering, whereas vPC peering between the TOR nodes is always physical peering. The following sections describe two types of Leaf-TOR topologies – Single-sided and Double-sided vPC.

vPC with Spanning Tree Deployment in NDFC

With TOR switches being at layer 2, user must be cautious about spanning tree protocol configuration. Any misconfiguration could lead to layer 2 loop, which in turn may bring down the entire host connectivity network. Hence having stable and redundant loop free layer 2 network connectivity is necessary while connecting TORs to the leaf layer.

vPC supports RSTP, MSTP and PVST+ layer2 loop free protocols. Customer can choose Spanning-tree protocol according to their need. Please refer reference section at the bottom of the document for spanning-tree scalability support. Similar Spanning-tree protocol should be used on Leaves and TORs. Spanning-tree root should always be on the Leaf switches. For this document MST is used as the Spanning-tree protocol on Leaf and TOR switches.

While configuring MSTP, MSTP Bridge Priority must be the same for vPC nodes. It is recommended to make the Leaf Nodes as the Root Bridge. Out of 2 leaf nodes, One Leaf will act as the Root Bridge. For RSTP it is not mandatory to have them same bridge priority.

Single-sided vPC

In this topology, Leaf nodes form a vPC Pair and have a Port-Channel connecting to TOR as a member link.



Figure 2. Single-sided vPC Topology

Double-sided vPC between Leaf and TOR nodes

In this topology, Leaf and TOR nodes are configured with Physical vPC peer link making it a double-sided vPC.



Figure 3. Double sided vPC Topology

Fabric and vPC configuration using NDFC:

Configuring VXLAN Fabric

To create an EVPN VXLAN fabric, perform the following steps:

Step 1. Create Fabric.

To create fabric, choose **Easy_Fabric** template. This template is used for VXLAN EVPN fabric deployment. Fabric parameters like BGP ASN, underlay properties, replication mode, etc. must be provided while configuring the fabric.

Create Fabric		2 — 3
	Select Fabric Template	×
	Q. Search Fabric Template	
	Easy_Fabric Fabric Template for a VXLAN (99N deployment with Nexus 9000 and 3000 switches.	
	Easy_Fabric_IOS_XE Fabric Template for a VXLAN EVPN deployment with CAT9000 switches.	
	Easy_Fabric_eBGP Fabric Template for an eBGP based Fabric with Nexus 9000 and 3000 switches.	
	External_Fabric Fabric Template for support of Nexus and non-Nexus devices.	
	Fabric_Group Fabric Template that can contain other LAN Classic fabrics	
	LAN_Classic Fabric Template to manage various switches and topologies	
	LAN_Monitor This fabric template is used for NI in Monitor Mode Only.	
	Selec	

Figure 4. Select template

Step 2. Discover Switches.

Use seed IP address to discover the switches. Uncheck preserve config to clear switch configuration and reload the devices. Max hop count allows the discovery of connected switches by the number of hops.

Add Switches - Fabric: Fabric-B	? ×
Switch Addition Mechanism*	
Seed Switch Details Seed IP*	
Ex: "2.2.2.20" or "10.10.10.40-60" or "2.2.2.20, 2.2.2.1" Authentication Protocol*	
Username* Password*	
Max Hops* 1	
Proserve Config Unchecking this will clean up the configuration on switch(es)	
	Close Discriver Switches

Figure 5. Discover and select switches

Step 3. After the switches are discovered, add these switches to the Fabric.

d Sv	witches - Fabric	: Fabric-B						?	
Back									
Discovery Results									
Filter by attributes									
	Switch Name	Serial Number	IP Address	Model	Version	Status	Progress		
	s3-tor-2	FDO23210JCM	172.22.131.101	N9K-C93180YC-FX	9.3(9)	Manageable			
~	s3-tor-3	FDO2123228G	172.22.131.198	N9K-C93180YC-FX	10.2(2.176)	Manageable			
	s3-tor-4	FDO2449037T	172.22.131.55	N9K-C93180YC-FX	10.2(2.176)	Manageable			
	switch	FOC2242R1ZB	0.0.0.0	N3K-C3048TP-1GE	9.2(1)	Not Reachable			
	s3-fanout-1	FDO21110KJE	172.22.131.89	N9K-C93180YC-EX	7.0(3)17(6)	Manageable			
~	s3-tor-1	FDO2449039J	172.22.131.90	N9K-C93180YC-FX	9.3(9)	Manageable			
	s3-fanout-2	FDO21101V67	172.22.131.60	N9K-C93180YC-EX	9.3(6)	Manageable			

Figure 6. Add switches to the fabric

Step 4. Change device role and click Deploy All to generate and push configuration to the devices.

After the devices are added, by default they will be assigned a default role depending on the platform. After assigning Spine and Leaf roles, select the devices that are used as TOR. Change the role to TOR. This will push TOR-relevant configuration to the respective devices.

	abric Overview - Fabric-B				Select Role	×				
Overviev	w Switches Links In	terfaces Interface	Groups Poli	cies Network	Q Search Role					
					Spine					
					Leaf (current)					Actions ~
	Switch	IP Address	Role	Serial Numbe	Border		Model	VPC Role	VPC Peer	Mode
	s3-leaf-1	172.22.131.79	Leaf	FDO23022NK	Border Spine		N9K-C9336C-FX2			Normal
	s3-leaf-2	172.22.131.80	Leaf	FDO230112T	Border Gateway		N9K-C9336C-FX2			Normal
			Border		Border Gateway Spine					
			Gateway Spine	FOX2120P55	Super Spine		N9K-C9504			Normal
			Border	501/0400570	Border Super Spine					
			Spine	FUX2T20PTC	Border Gateway Super Spine		N9K-C9504			
				FDO2449039	ToR		N9K-C93180YC-FX			
			Leaf	FDO23210JC			N9K-C93180YC-FX			Normal
				FDO2123228		Select	N9K-C93180YC-FX			



Configuring Double-sided vPC

To form a double-sided vPC, two vPC domains need to be configured, one between Leaf switches and another one between the TORs. To configure double-sided vPC using the NDFC Web UI, perform the following steps:

Step 1. Click Topology to configure vPC.

After the devices are added to the fabric according to role, navigate to the **Topology** tab to display the overall view.

= Fabric Controller		
🎓 Dashboard	💿 Data Center / 💿 Fabric-B	
jự Topology	View A Search by Attributes	Actions ~
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Fabrics	Show Logical Links	
Switches		
Interfaces	Super-Spine	
Services	Custom Saved	
🌣 Settings 🗸 🗸	In-Sync	
L° Operations V	Pending	
	In Progress s3-spine-1 s3-spine-2	
	Out-of-Sync	
	Multi-select ()	
	0 selected	
	s3-tor-1 s3-tor-2 s3-tor-3	

Figure 8. Topology view in NDFC

Step 2. Configure vPC between Leafs.

To configure Leaf-1 and Leaf-2 as vPC1 Peers, click on one of the leaf switches and select vPC Peering



Figure 9. Select vPC pairing

Select the peer switch to form vPC. If there is no direct physical connectivity between the Leaf switches, Fabric peering can be configured by enabling a Virtual peer link.

vPC Pairing ? -										
Select	Select vPC Peer for s3-leaf-2									
•	Virtual Peerlink									
Filter	by attributes									
	Device	Recommended	Reason	Serial Number	IP Address					
۲	s3-leaf-1	True	Switches are connected and have same role	FDO23022NKH	172.22.131.79					
	s3-spine-1	False	Switches have different roles	FOX2120P55N	172.22.131.62					
	s3-tor-1	False	Switches have different roles	FDO2449039J	172.22.131.90					
	s3-tor-3	False	Switches have different roles	FDO2123228G	172.22.131.198					
	s3-spine-2	False	Switches have different roles	FOX2120PTCM	172.22.131.61					
	s3-tor-2	False	Switches have different roles	FD023210JCM	172.22.131.101					

Figure 10. Select leafs for vPC peering

vPC Pairing is formed between leaf-1 and leaf-2.

n dudu Nexus Dasht	board		Feedback Help \vee admin \vee
= Fabric Controller			()
🎓 Dashboard	Data Center / C Fabric-B		
🔆 Topology	View ^	Search by Attributes	Actions ~
E LAN ^	+ - / 0)		
Fabrics	Show Logical Links		
Switches	Operation Configuration	NET (98)	
Interfaces		Networks (7) VRPs (0)	
Services	Custom Saved V		
Settings	 Healthy 		
1° Operations	Warning	\mathbf{Q}	
Event Analytics	Minor Major	Sugh Seine	
Image Management	Critical		
Programmable Reports	NA	strating systems2	
License Management			
Templates	Multi-select ()		
Backup & Restore			
NX-API Certificates			
		5310F1 \$340F2 \$340r3	

Figure 11. vPC Pairing formed between leaf-1 and leaf-2

Step 3. Configure vPC between TORs.

To configure TOR-1 and TOR-2 as vPC2 Peers, click on one of the TOR switches and select vPC Peering

★ dealer Nexus Dash	poard	Feedb	lack Help \vee admin \vee
= Fabric Controller			
 ➡ Fabric Controller ♠ Dashboard ➡ Topology ➡ LAN ^ Fabrics Switches Interfaces Services O Settings ~ ✓ Operations ^ Event Analytics Image Management Programmable Reports License Management Templates Backup & Restore NX-API Certificates 	Data Center / Pabric-B View Search by Attributes Show Logical Links Search by Attributes Operation Configuration Search by Attributes	Networks EQ Vers EQ	Actions ~
		sbleent sbleend sbleend	

Figure 12. Select vPC pairing for TOR switch

Select the peer switch to form vPC. This forms physical vPC peering between the TOR devices.

Note: Fabric peering between TOR devices is not allowed.

vP	vPC Pairing										
Se	Select vPC Peer for s3-tor-2										
	Filter by attributes										
		Device	Recommended	Reason	Serial Number	IP Address					
	۲	s3-tor-1	True	Switches have same role	FD02449039J	172.22.131.90					
		s3-tor-3	True	Switches have same role	FD02123228G	172.22.131.198					
		s3-leaf-1	False	Already paired with FDO230112T8	FD023022NKH	172.22.131.79					
		s3-leaf-2	False	Already paired with FDO23022NKH	FD0230112T8	172.22.131.80					
	0	s3-spine-1	False	Switches have different roles	FOX2120P55N	172.22.131.62					

Figure 13. Select TOR for vPC peering

vPC Pair is formed between TOR-1 and TOR-2.

n diale Nexus Dashb	shboard	Feedback Help \vee admin \vee
Fabric Controller		4
A Dashboard	💿 Data Center / 💽 Fabric-B	
🗺 Topology	View A Search by Attributes	Actions ~
≣ LAN ^		
Fabrics	Show Logical Links	
Switches	Coordina Confouration	
Interfaces	Networks (0) VRFs (0)	
Services	Custom Saved V	
🔅 Settings 🗸 🗸	Healthy	
1º Operations	N Warning	
Event Analytics	Minor SuperSurve	
Image Management	Major Critical	
Programmable Reports		
License Management		
Templates	Multi-select O	
Backup & Restore		
NX-API Certificates		
	s3-tor-1 s3-tor-2 s3-tor-3	

Figure 14. vPC Pair formed between TOR-1 and TOR-2

Step 4. Configure Peering between Leafs and TORs.

To configure Leaf-TOR peering, click on Leaf Pair and select **TOR pairing**. This configures port-channels on the leaf and TOR switches. It also configures these port-channels as member links of the double-sided vPC.

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Fabrics	Show Logical Links					
Switches	Operation Configuration		NET	VRF	s3-leaf-2	
Interfaces	Custom Sound		Networks (0)	VRFs (0)	Detailed View	
Services	Custom saveu				Preview Config	
🔅 Settings 🗸 🗸	Healthy				Deploy Config	
1º Operations	Warning			9	Discovery >	
Event Analytics	Major		,	Sugar-Squite	Set Role	
Image Management	Critical				Manage Interaces	
Programmable Reports	NA		s3-spin		vPC Pairing	
License Management				\times	TOR Pairing	
Templates	Multi-select ()				More	
Backup & Restore			s3/had-	- A	out 2	
NX-API Certificates				\checkmark	\sim	
			B ————————————————————————————————————		B	
			83-101-1	00.10178	surnin o	

Figure 15. Select TOR peering on Leaf

Select TOR pair from the list of devices to form a double-sided vPC. If there are multiple TOR pairs available, select all.

R Pairing - s3-leaf-2				>
nis switch is a part of a VPC pair with: s3-leaf-1				
Filter by attributes				
Device	Recommended	Reason	Serial Number	
s3-tor-1~s3-tor-2	True		FD02449039J,FD023210JCM	
s3-tor-3	False	Switch(es) are not connected	FD02123228G	

Figure 16. Select TORs and form Leaf to TOR peering

The topology view after double-sided vPC is configured.

♠ duale Nexus Dashl	board	Feedback Help v admin
Fabric Controller		۵. (
🎓 Dashboard	😳 Data Center / 🔿 Fabric-B	
tri Topology	View Search by Attributes	Actions v
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Event Analytics	Operation Configuration	Networks (0) VRFs (0)
Image Management	Custom Saved V	
Programmable Reports	Healthy	
License Management	Warning	0
Templates	Minor	Super Deno
Backup & Restore	 Major 	
NX-API Certificates	Critical	(Q) (Q)
	NA	s3-sahar s3-sahar-2
	Multi-select ①	
	0 selected	(3→8)
		spine
		såter 1 såter 2 såter 3

Figure 17. Topology view after double-sided vPC is configured

Configuring Single-sided vPC

To configure single-sided vPC using the NDFC Web UI, perform the following steps:

Step 1. Click Topology to configure vPC.

After the devices are added to the fabric according to the role, navigate to **Topology** tab to display the overall view.

🎓 Dashboard	Data Center / C Fabric-B	
🛒 Topology	View Search by Attributes	Actions ~
≣ LAN ^		
Fabrics	Show Logical Links	
Switches		
Interfaces	Super-Spine	
Services	Custom Saved	
Settings	In-Sync	
<u>⊥</u> ° Operations ∨	Pending	
	in Progress s3-sgrm-1 s3/sgrm-2	
	Multi-select O	
	sz lad-1 s3-laah2	
	8 8	
	s3-tor-1 s3-tor-2 s3-tor-3	

Figure 18. Topology view

Step 2. Configure vPC between leaf switches.

To configure Leaf-1 and Leaf-2 as vPC1 Peers, click one of the leaf switches and select vPC Pairing.



Figure 19. Select vPC Pairing

Select the peer switch to form vPC. If there is no direct physical connectivity between the leaf switches, then Fabric peering can be configured by enabling virtual peer link.

VPC P	airing				? —	×
Select	vPC Peer for s3-leaf-2					
	Virtual Peerlink					
Filter	by attributes					
	Device	Recommended	Reason	Serial Number	IP Address	
۲	s3-leaf-1	True	Switches are connected and have same role	FDO23022NKH	172.22.131.79	
	s3-spine-1	False	Switches have different roles	FOX2120P55N	172.22.131.62	
	s3-tor-1	False	Switches have different roles	FDO2449039J	172.22.131.90	
	s3-tor-3	False	Switches have different roles	FD02123228G	172.22.131.198	
	s3-spine-2	False	Switches have different roles	FOX2120PTCM	172.22.131.61	
	s3-tor-2	False	Switches have different roles	FDO23210JCM	172.22.131.101	

Figure 20. Select the correct peering leaf switches for vPC peering

vPC Pairing is formed between leaf-1 and leaf-2.

Redback Meip -	$admin \lor$
Fabric Controller Pabricard Data Center / Pabric-B Image Management Peabric Preventer Operations License Management Maior Preventer Operations License Management Num Nuch-select Image Management Image Management Image Management Nuch-select Image Management Image Management Image Management Image Management Image Management Image Management Image Management <th>▲ 3 >>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>></th>	▲ 3 >>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

Figure 21. vPC Pairing formed between leaf-1 and leaf-2

Step 3. Configure peering between leafs and TOR.

To configure TOR pairing between vPC1 and TOR-3 to form a single-sided vPC, navigate to the leaf pair and select TOR pairing. This configures the port channel on leaf switches and TOR-3. Port-channel interfaces on leaf switches are added as vPC member links.

n diada Nexus Dashb	poard	Feedback Help \vee adm	nin 🗸
Fabric Controller		۵.	?
🎓 Dashboard	Data Center / Fabric-B		
★ Topology ■ LAN ^ Fabrics	View Image: Search by Attributes Image: Show Logical Links Image: Show Logical Links Image: Operation Configuration Image: Show Logical Links	Actions >)
NX-API Certificates		a data 2 a data 2 a data 2 a data 2 a data 2 a data 3	

Figure 22. Select TOR Pairing

Select the TOR device with which single-sided vPC must be configured. Multiple TOR devices can be selected to enhance further scaling.

This witch is a part of a VPC pair witch: salewid-1 Complete TOR Pairing as VPC Pair Image:	OR Pairing - s3-leaf-2						
Pier of attributes Recommended Reason Serial Number s3-tor-1-s3-tor-2 True FD02449039J,FD023210JCM s3-tor-3 False Swttch(es) are not connected FD02123228G	This switch is a part of a VPC pair with: s3-leaf-1 Complete TOR Pairing as VPC Pair						
s3-tor-1-s3-tor-2 True FD02449039J,FD023210JCM s3-tor-3 False Switch(es) are not connected FD02123228G	Device	Recommended	Reason	Serial Number			
S3-tor-3 False Switch(es) are not connected FD02123228G	s3-tor-1-s3-tor-2	True		FD02449039J,FD023210JCM			
	✓ s3-tor-3	False	Switch(es) are not connected	FD02123228G			

Figure 23. Select relevant TOR or multiple TORs to form Leaf to TOR peering

Configuring MSTP

On NDFC Web UI, choose **Fabrics > Edit Fabric > Advanced** tab. Enter the Spanning-tree Root Bridge Protocol details. Choose **MST** from the drop-down list. By default, only MST instance 0 will be configured.

Edit Fabric : Fabric-	-В		? – ×
	Select an Option	Configure Cipher Suite	
	MACsec Status Report Timer		
		MACsec Operational Status periodic report timer in minutes	
	Spanning-tree Root Bridge Protocol	Which protocol to use for configuring root bridge? rpvrt+: Rapid	
	mst	Per-VLAN Spanning Tree, mst: Multiple Spanning Tree,	
	rpvst+	антанадаа (авааа), ате поот ни панадаа оу поес	
	mst	Viao ranno. Example: 13-5-7-9-11. Default is 1-3967	
	unmanaged	Anno 1 million Finnenskans (2000) 100 - 2010 - 2010 market av 2010 market	
	MST Instance Range*		
	0	MST instance range, Example: 0-3,5,7-9, Default is 0	
	STP Bridge Priority*		
	0	Stridge priority for the spanning tree in increments of 4096	
	Leaf Freeform Config		
		Additional PD to Fast Hill and An Openment Frame	
		Show Running Configuration	
	Spine Freeform Config		
		Additional CLIs For All Spines As Captured From Show Running Configuration	

Figure 24. Select Spanning-tree Root Bridge Protocol

If multiple instances of MSTP must be configured, then fill in the instance range. In the freeform template field, add the instance to VLAN mappings.

Edit Fabric : Fabric-B				? — ×
	mst V	Which protocol to use for configuring root bridge? rpvst-: Rapid Per-VLAN Spanning Tree, mst: Multiple Spanning Tree, unmanaged (default): STP Root not managed by NDFC		
	Spanning-tree VLAN Range	Vian range, Example: 1,3-5,7,9-11, Default is 1-3967		
	MST Instance Range* 0-2	MST instance range, Example: 0-3,5,7-9, Default is 0		
	STP Bridge Priority* 0 ~	Bridge priority for the spanning tree in increments of 4096		
	Leaf Freeform Config instance 1 ylan 101,1101,2101,3101		Additional CUs For All Leafs As Castured From	
		C	Show Running Configuration	
	Spine Freeform Config		Additional CLIs For All Spines As Captured From	
	ToB Econform Config		Show Running Configuration	
	instance 1 view 101,1101,2101,3101		Additional CLIs For All ToRs As Captured From Show Running Configuration	
		G		Close Save

Figure 25. Multiple MST instance configuration

Overlay Configuration using Orchestrator Service

For multi-site fabric configuration, Nexus Dashboard Orchestrator is used as a central controller to maintain consistency across sites with respect to VLAN, VRF, and network configuration. To configure overlay using Nexus Dashboard Orchestrator Web UI, perform the following steps:

Step 1. On the Nexus Dashboard Orchestrator Web UI, create Schema.

Before creating VRF and Networks, a schema must be created. Schema acts as a collection of templates used to define policies. While designing schemas, supported scalability limits for the number of schemas, templates, and objects

per schema must be considered. On Nexus Dashboard Orchestrator Web UI, choose **Application Management >** Schemas > Add Schema.

Untitled Schema		0 Policies 🔽 Autosave Save 🔿 🗙
Untitled Schema TEMPLATES	Overview	
SITES	General Audit Log Name Description Created Untitled Schema 0 0	Updated Deployed Other 0 0 0
	Sites Template to Site Associations() Health Type Deployment Status • Health • Warning (i) General (i) • Marrier (ii) • Marrier (iii) (iii) (iii) • Deployment Status (iii) (iii) (iii) • Marrier (iii) • Marrier (iii) (iii) (iii) • Description • Description (iiii)	Consistency 0 Verticat (0) Foliat (0) Unverticat (0) N/A (0)
	Application Management • Application Profiles (0) • Filters (0)	O Total Policies

Figure 26. Schema creation on Nexus Dashboard Orchestrator

Step 2. Create Template.

A template is a collection of objects like VRFs, Networks, and so on. A template represents the atomic unit of change for objects. Any changes applied to a template are always pushed immediately to all the site(s) mapped to the template. From Nexus Dashboard Orchestrator Web UI, navigate to the schema created in the previous step and add a template. Use **Networking** template for creating VRF and Networks.

Test						0 Policies 🧧	Autosave (Si		
Test Templates	Overview								
SITES	General			/ Audit Log					
	Name Test	Description Select a Template type	_	Created	Deleted	Updated X	Deployed 0	Other 0	
	Sites Health		۲	0		Consistenc	у		
	O Total			夺 夺 夺		То	Verified Failed N/A	(0) (0) ed (0) (0)	
	Application Mar • Application Prof • Filters (0)	ACI Multi-cloud • On-prem ACI site to site • On-prem ACI site to cloud site • Cloud to cloud site	Networking • On-prem DCNM site to site	SR-MPLS • Non-stretched template for on- prem ACI site local only	Cloud Local • Non-stretched template for cloud site local BDP-IPv4 connected site		Tot	0 tal Policies	
	Topology				Add				

Figure 27. Select Networking to create template

While creating a template, choose the appropriate tenant. For NDFC, dcnm-default is the only supported template.

Test		0 Policies 🖌 Autosave Save 💍	×
🜪 Test	TEMPLATE Version 1		×
TEMPLATE TEMPLATE Networking SITES	Tenant	Template Settings Display Name* TEMPLATE	^
	V75's Networks	Description Template Type Networking	
		Tenant Settings Select a Tenant * Select or find an item here Common tension for an with all other tenses dcmm-default-tn Default tenser for DOM alsos Infin Infanta tenser for sea with all other tensets TOR-TEST	^

Figure 28. Select tenant in the template

Step 3. Create VRF.

In the template page, create vrf object, by providing vrf name.

Test					Autosave		☆	ହ	Ō	×
🥐 Test	0	TEMPLATE Version 1		Deploy to sites		LATE				×
TEMPLATE TEMPLATE Networking SITES		Filiante common Filiante	IMPORT V SELECT	CREATE OBJECT	Template Settin Display Name* TEMPLATE	igs				^
		0 VRFs		Network	Description					
		Networks			Template Type Networking					Â
					Display name common Name common					
					Description Common tenant	for use with	all other te	mants		

Figure 29. Create VRF objects

Step 4. Create Network.

In the template page, create network object, by adding Network Name, gateway address and associated vrf.

Test			1 Policy	Z Autosave Save 🛧 😋 (ó ×
Test TEMPLATES ⊕	TEMPLATE Tenart: common		Deploy to sites	TEMPLATE	×
Retworking SITES O	PLTERS	IMPORT ~ SELECT	CREATE OBJECT VRF Network	Template Settings Display Name* TEMPLATE	^
	♥ VRFs ↓ sddvf1 ♥ Networks			Description Template Type Networking Tenant Settings Display name common Name common Description Common tenant for use with all other tenants	^

Figure 30. Create Network objects

Test					is 🔽 Autosave 🛛 Save 🛧 🧟 (ð ×
🕐 Test					Description	
TEMPLATES	Tenant: common					
REMPLATE Networking	FILTERS			SELECT 💿 CREATE OBJECT	DCNM Properties Network ID	^
SITES						
	🕕 VRFs 🗸				Layer2 Only	
	sddv-vrf1	Add Subnet		×	sddv-vrf1 Network Profile * Default Network Universal	
		Gateway IP	Туре		Network Extension Profile *	
	Networks 🗸	101.1.1/16	primary	o 11	VLAN ID	
	Untitled Network 1			Add	VLAN Name	
					* Gateway IP Add Subnet	

Figure 31. Add subnet to the Network

Step 5. Associate sites.

Before VRF and Network configurations is pushed to the TORs, sites must be associated with the template. Navigate to the template and add sites. Select the fabrics to which VRF/Network configuration must be pushed.

Test					🗹 Autosave 🛛 Save 🛧 🤤 🔿	
Test	TEMPLATE Version 7			Deploy to sites	TEMPLATE TEMPLATE	×
TEMPLATE Networking	FILTERS		IMPORT ~ SELECT	CREATE OBJECT	Template Settings Display Name* TEMPLATE	^
	● VRFs ~ sddv-vrf1	Add Sites		×	Description Template Type Networking	
	1 Networks 🗸	Name	Assign To Template		Tenant Settings Display name common Name	^
	sddc- sddc- network101	Fabric-B (DCRM) 12:1.1e	Select Templates TEMPLATE	<u>~</u>	common Description Common tenant for use with all other tenants	
			s	ave		

Figure 32. Associate sites

Step 6. Push VRF, VLAN, and Network configurations from Nexus Dashboard Orchestrator to the sites.

In the previous steps, the template is created and associated with the sites. Also, VRF and Network objects are created as part of the template. In this step, VRF, VLAN, and Network configurations is associated with the switch ports and this configuration is deployed to devices. Navigate to **Schema> Sites > Template**, select the VRF to be deployed

Test		s 🔽 Autosave 🛛 Save 🛧 🥝	0 ×
🕐 Test	Fabric-B Version 20	VRF sddc-vrf1	×
TEMPLATES	TEMPLATE Last Deployed: Jun 16, 2022 03:04 pm Tenant: common		
REMPLATE Networking	FLITPS	0 1 0 1 0	0
SITES		Template Properties	^
Fabric-B (DCNM) 12.1.1e		Display Name * sddc-vrf1	
• TEMPLATE O	10 VRFs V	Deproyed Name: sodc-vr11	
	sddc-wf1	VRF ID 52676	
		Site Local Properties	^
		Tenant Routed Multicast	
	networks V	RP External	
		Static Leaf Nodes	
	souc- souc- network1 network2 network3	Node/Switch	
	connected connected	🕣 Add Static Leaf	

Figure 33. Select VRF to be attached to the node

Select the leaf pair and spine, and add the forwarding vlan for the selected VRF. This creates an SVI on leaf and spine for forwarding Layer-3 traffic.

Test				Autosave Save 🛧	Ō	
🕐 Test	Fabric-B Version 20			VRF sddc-vrf1		×
TEMPLATES	TEMPLATE Tenant: common		Last Deployed: Jun 16, 2022 US:04 pm	0		0
REMPLATE Networking	FILTERS					
sites 🕀				Template Properties		^
Fabric-B (DCNM) 12.1.10				Display Name * sddc-vrf1		
♥ TEMPLATE ⊘···	😡 VRFs 🗸			Deployed Name: sddc-vrf1 Description		
	sddc-vrf1	Add Static Leaf	×	N/A VRF ID () 52676		
		Leaf		Site Local Properties Tenant Routed Multicast		^
	🕚 Networks 🗸	s3-leaf-1 - s3-leaf-2 VLAN 3101	× ×	RP External		
	sddc-network1 sddc-network2 connected connected		Save	Node/Switch		

Figure 34. Select Leaf pair for VRF attachment

Select the network to be deployed.

Test	4 Poteies	🗹 Autosave 🛛 Save 🖈 😧 🗘 🗙
Test	Fabric-B Version 21 Last Deployed: Jan 16, 2022 03.04 pm	Streetwork1 X
TEMPLATE Networking	Tenant: common	0 1 0 1 0 1 0
SITES Fabric-B (DCNM) 12.1.1e TEMPLATE Y	© VRFs ↓ Pada-wrt1	Common Properties ^ Display Name * addnetwork1 Description N/A Network ID 0 4/062
	connected	Site Local Properties
	sddc- network1 sddc- network3	DHCP Loopback ID DHCP Servers Server Address
		Add DiricP Server Static Ports Peth Leaf VLAN Ports Add Static Port

Figure 35. Select network to be configured on the node

Select leaf pairs, and associate vlan and vPC/interface from TOR to the end host. Here vlan 101 is part of VRF sddc-vrf1 and used for host connectivity. This step creates VLAN 101 on TORs and Leaves switches and also allows it on Host ports (Ports on TOR connected to host) and the Trunk ports connecting Leafs and TOR switches. For scaled network, multiple TOR interfaces can also be configured.

Test						4 Policies	🖌 Autosave	Save	☆	ଦ୍ର	Q	×
🕐 Test		- Fabric	-B Version 21				N NETW	DRK				×
TEMPLATES		TEMPLATE Tenant: co	mmon			Last Deployed: Jun 16, 2022 03:04 pm	suu					
REMPLATE Networking		FILTERS										
SITES							Common Pro	perties				^
Fabric-B (DCNM) 12.1.1e	^		Add Static Port				\times	1				
• TEMPLATE		VRFs						ddc-network1				
			Path									
		Sddc-vrf	Leaf			VLAN P	orts					
			Leaf									
		conne	s3-leaf-1 ~ s3-leaf-2					Multicast				^
			VLAN									
		Networ	101		0			away Border				
			Ports					sk ID				
		sddc- network1	(\$3-tor-1-\$3-tor-2) VPG2 X		~							
				(Cancel)	Save							
			🕒 Add Path					ss				
								ierver				
							Submit					

Figure 36. Select ports for deployment

Appendix

Verifying vPC from Leaf toward TOR Switch

s3-leaf-1# show vpc			s3-leaf-2# show vpc	
Legend:			Legend:	
(*) - local vP	C is down, forwarding via vPC	peer-link	(*) - local vPC is down, forwarding via vPC peer-link	
vPC domain id	: 1		vPC domain id : 1	
Peer status	: peer adjacency formed o	k	Peer status : peer adjacency formed ok	
vPC keep-alive status	: peer is alive		vPC keep-alive status : peer is alive	
Configuration consistency stat	us : success		Configuration consistency status : success	
Per-vlan consistency status	: success		Per-vlan consistency status : success	
Type-2 consistency status	: success		Type-2 consistency status : success	
vPC role	: secondary		vPC role : primary	
Number of vPCs configured	: 2		Number of vPCs configured : 2	
Peer Gateway	: Enabled		Peer Gateway : Enabled	
Dual-active excluded VLANs	: -		Dual-active excluded VLANs : -	
Graceful Consistency Check	: Enabled		Graceful Consistency Check : Enabled	
Auto-recovery status	: Enabled, timer is off.(timeout = 360s)	Auto-recovery status : Enabled, timer is off. (timeout = 360s)	
Delay-restore status	: Timer is off. (timeout =	150s)	Delay-restore status : Timer is off. (timeout = 150s)	
Delay-restore SVI status	: Timer is off.(timeout =	10s)	Delay-restore SVI status : Timer is off. (timeout = 10s)	
Operational Layer3 Peer-router	: Disabled		Operational Layer3 Peer-router : Disabled	
Virtual-peerlink mode	: Disabled		Virtual-peerlink mode : Disabled	
vPC Peer-link status			vPC Peer-link status	
id Port Status Active vla	ns		id Port Status Active vlans	
	2101 2101 2600			
1 P0500 up 1,101,1101	,2101,3101,3600		1 P0500 up 1,101,1101,2101,3101,3600	
vPC status			vPC status	
Id Port Status Con	sistency Reason	Active vlans	Id Port Status Consistency Reason Active vlans	
1 Po1 up suc	cess success	101,1101,2101	1 Pol up success success 101,1101,2101	
2 Po2 up suc	cess success	101,1101,2101	2 Po2 up success success 101,1101,2101	
Please check "show vpc consist consistency reason of down vpc any vpc. s1-lesf-1#	ency-parameters vpc <vpc-num> and for type-2 consistency r</vpc-num>	" for the easons for	Please check "show vpc consistency-parameters vpc <vpc-num>" for the consistency reason of down vpc and for type-2 consistency reasons for any vpc.</vpc-num>	
so-real-1#			33-1441-5#	

Verifying vPC from TOR toward Leaf Switch

s3-tor-1# show vpc			s3-to	or-2# show vpc			
Legend:			Leger	nd:			
(*) - local vPC i	s down, forwarding via vPC.	peer-link		(*)	- local vPC i	is down, forwarding via	vPC peer-link
vPC domain id	: 2		vPC o	domain id		: 2	
Peer status	: peer adjacency formed ok	c c c c c c c c c c c c c c c c c c c	Peer	status		: peer adjacency form	ed ok
vPC keep-alive status	: peer is alive		vPC }	keep-alive stat	us	: peer is alive	
Configuration consistency status	: success		Confi	iguration consi	stency status	: success	
Per-vlan consistency status	: success		Per-v	vlan consistend	y status	: success	
Type-2 consistency status	: success		Type-	-2 consistency	status	: success	
vPC role	: secondary		vPC 1	role		: primary	
Number of vPCs configured	: 2		Numbe	er of vPCs conf	igured	: 2	
Peer Gateway	: Disabled		Peer	Gateway		: Disabled	
Dual-active excluded VLANs			Dual-	-active exclude	d VLANs	: -	
Graceful Consistency Check	: Enabled		Grace	eful Consistend	y Check	: Enabled	
Auto-recovery status	: Enabled, timer is off.(t	timeout = 360s)	Auto-	-recovery statu	15	: Enabled, timer is o	ff.(timeout = 360s)
Delay-restore status	: Timer is off.(timeout =	30s)	Delay	y-restore statu	15	: Timer is off.(timeo	ut = 30s)
Delay-restore SVI status	: Timer is off.(timeout =	10s)	Delay	y-restore SVI s	status	: Timer is off.(timeo	ut = 10s)
Operational Layer3 Peer-router	: Disabled		Opera	ational Layer3	Peer-router	: Disabled	
Virtual-peerlink mode	: Disabled		Virtu	ual-peerlink mo	ode	: Disabled	
vPC Peer-link status			vPC 1	Peer-link statu	15		
id Port Status Active vlans			id	Port Status	Active vlans		
					1 101 1101 01		
1 P0500 up 1,101,1101,21	.01		1	P0500 up	1,101,1101,21	101	
vPC status			vPC a	status			
Id Port Status Consis	tency Reason	Active vlans	Id	Port	Status Consis	stency Reason	Active vlans
1 De1		101 1101 2101	1				101 1101 0101
1 POI up succes	s success	101,1101,2101	1	POI	up succes	ss success	101,1101,2101
2 Po2 up sugge		101 1101 2101	2	Po2			101 1101 2101
z FOZ up succes	a success	101,1101,2101	^	FOZ	up succes	sa success	101,1101,2101
Please check "show vpc consistence	v-parameters vpc <vpc-num>"</vpc-num>	for the	Pleas	se check "show	vpc consistenc	v-parameters vpc <vpc-< td=""><td>num>" for the</td></vpc-<>	num>" for the
consistency reason of down vpc an	d for type-2 consistency re	asons for	const	istency reason	of down vpc an	nd for type-2 consisten	cy reasons for
any vpc.			any v	VPC.			•
				•			
s3-tor-1#			s3-to	or-2#			
			///				

2 + 24			-2.5-					
3-tor-3# snow vpc			s3-to	r-4# show v	pc			
(*) - local vPC is	s down, forwarding via vPC	peer-link	reden	ia:	(*) - local	vPC is do	wn, forwarding	via vPC peer-link
PC domain id	. 3		VPC d	lomain id				
Per etatue	: peer adjacency formed o	ŀ	Peer	Peer status			eer adjacency fo	armed ok
PC keep-alive status	· peer adjacency formed o		TRC k	een-alive s	*****	· P	eer is alive	Lund Ox
onfiguration consistency status	· peer is allve		Confi	guration co	neistancy e	tatue · P		
er-vlan consistency status	. success		Ber-W	Jan consist	angy status	cacus . s	uccess	
er-vian consistency status	: success		Per-V	2 and consistent	ency status		uccess	
-ppe-z consistency status	. success		Type-	2 CONSISCEN	cy scacus		access	
when of wPCs configured	: primary		VPC I	ore and appear of	onfigurad		econdary	
umber of VPCs configured	: Z		Numbe	Coherrow	onrigurea	: 2	i anh lad	
eer Gateway	: Disabled		Peer	Gateway	and the state	: 0	isabled	
ual-active excluded vLANS			Duar-	active excit	uded VLANS			
racerul consistency Check	: Enabled times is for	- 200-)	Grace	rui consiste	ency Check	: E	nabled time	
uto-recovery status	: Enabled, timer is off. (cimeout = 360s)	Auto-	recovery sta	atus	: E	nabled, timer is	orr. (timeout = 360s)
elay-restore status : Timer is off. (timeout = 30s)		305)	Delay	-restore sta	atus	: 1	imer is off. (tir	meout = 30s)
elay-restore SVI status	: Timer is off. (timeout =	108)	Delay	-restore SV	1 status	: 1	imer is off. (tir	meout = 10s)
elay-restore Orphan-port status	: Timer is off. (timeout =	: 0s)	Delay	-restore Or	phan-port s	tatus : T	imer is off. (tir	meout = 0s)
Operational Layer3 Peer-router : Disabled			Opera	tional Layer	r3 Peer-rou	ter : D	isabled	
'irtual-peerlink mode	: Disabled		Virtu	al-peerlink	mode	: D	isabled	
VPC Peer-link status			VPC P	eer-link sta	atus			
d Port Status Active vlans			id	Port Stat	tus Active	vlans		
Po500 up 1,101,1101,21	01		1	Po500 up	1,101,1	101,2101		
				-				
PC status			vPC s	tatus				
d Port Status Consis	tency Reason	Active vlans	Id	Port	Status	Consistenc	y Reason	Active vlans
Pol up succes	success	101,1101,2101	1	Pol	up	success	success	101.1101.2101
···· ··· ··· ···		,,-=-=			-1			
	61100A66	101 1101 2101	2	Po2	110	e11000000	e1100000	101 1101 2101
. Poz up succes	success	101,1101,2101	ŕ	F02	up	success	success	101,1101,2101
lesse shash "show me sensisters	-parameters vpc <vpc-num></vpc-num>	" for the	Pleas	e check "she	ow vpc cons	istency-pa	rameters vpc <vp< td=""><td>c-num>" for the</td></vp<>	c-num>" for the
lease check show vpc consistenc		easons for	consi	stency reaso	on of down	vpc and fo	r type-2 consist	ency reasons for
onsistency reason of down vpc and	i for type-2 consistency r	easons for		-		-	-	-
consistency reason of down vpc and ny vpc.	i for type-2 consistency r	easons for	any v	pc.				
nesse check show vpc consistency onsistency reason of down vpc and ny vpc.	1 for type-2 consistency r		any v	pc.				

Verifying Spanning Tree Configuration

In this sample configuration, MSTP is enabled on all four switches. Both the vPC leaf nodes are configured with same Bridge priority. Both leaf1 and leaf 2 act as root bridge for TOR1 and TOR2.

```
s3-leaf-1# sh spanning-tree
MST0000
  Spanning tree enabled protocol mstp
            Priority 0

Priority 0

1dress 0023.04ee.be01
  Root ID
             This bridge is the root
             Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
 Bridge ID Priority 0
Address 00
                               (priority 0 sys-id-ext 0)
                        0023.04ee.be01
            Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Interface
                Role Sts Cost
                                  Prio.Nbr Type
------ ---- ---- -----
                                                 _____
            Desg FWD 200 128.4096 (vPC) P2p
Root FWD 100 128.4595 (vPC peer-link) Network P2p
Po1
Po500
s3-leaf-1#
```

```
s3-leaf-2# sh spanning-tree
MST0000
 Spanning tree enabled protocol mstp
           Priority
 Root ID
                      0
            Address
                      0023.04ee.be01
            This bridge is the root
            Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
 Bridge ID Priority
                       0
                             (priority 0 sys-id-ext 0)
                      0023.04ee.be01
            Address
            Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Interface
               Role Sts Cost
                                Prio.Nbr Type
        _____
                                               _____
                           ----
                            128.4096 (vPC) P2p
Po1
              Desg FWD 200
Po500
               Desg FWD 100
                                 128.4595 (vPC peer-link) Network P2p
s3-leaf-2#
```

```
s3-tor-1# sh spanning-tree
MST0000
 Spanning tree enabled protocol mstp
  Root ID
            Priority
                        0
            Address
                        0023.04ee.be01
            Cost
                        0
            Port
                        4595 (port-channel500)
            Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
 Bridge ID Priority
                        32768 (priority 32768 sys-id-ext 0)
                        0023.04ee.be02
            Address
            Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Interface
               Role Sts Cost
                                  Prio.Nbr Type
 _____
                          _____
                                                 _____
Po1
              Root FWD 200 128.4096 (vPC) P2p
                                  128.4595 (VPC) Edge P2p
128.4595 (VPC peer-link) Network P2p
                Desg FWD 200
Root FWD 100
Po2
Po500
s3-tor-1#
```

```
s3-tor-2# sh spanning-tree
MST0000
 Spanning tree enabled protocol mstp
 Root ID
            Priority
                        0
                        0023.04ee.be01
            Address
             Cost
                         4096 (port-channel1)
            Port
            Hello Time 2
                                Max Age 20 sec Forward Delay 15 sec
                           sec
 Bridge ID Priority
                        32768
                               (priority 32768 sys-id-ext 0)
                        0023.04ee.be02
            Address
            Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
                                   Prio.Nbr Type
Interface
                Role Sts Cost
                          _____
Po1
                Root FWD 200
                                   128.4096 (vPC) P2p
                 Desg FWD 200
                                   128.4097 (vPC) Edge P2p
Po2
Po500
                Desg FWD 100
                                   128.4595 (vPC peer-link) Network P2p
s3-tor-2#
```

Note: Po2 is the port channel connecting to the end hosts/servers.

Additional References

Spanning Tree Scalability Guide

https://www.cisco.com/c/en/us/td/docs/switches/datacenter/nexus9000/sw/93x/scalability/guide-935/cisco-nexus-9000-series-nx-os-verified-scalability-guide-935.html#fntarg_d54e3032

VXLAN Multisite Design Guide:

https://www.cisco.com/c/en/us/products/collateral/switches/nexus-9000-series-switches/white-paperc11-739942.html

NDFC Deployment Guide

https://www.cisco.com/c/en/us/td/docs/dcn/whitepapers/cisco-nexus-dashboard-fabric-controllerdeployment-guide.html

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