The bridge to possible

Building AI/ML Data Center Fabric using VXLAN EVPN for GPUaaS

Contents

Introduction

The rapid growth of Artificial Intelligence (AI) and Machine Learning (ML) workloads is transforming modern data centers, driving an unprecedented demand for scalable, high-performance, and flexible network architectures. Organizations deploying large-scale GPU clusters for AI/ML training and inference require a robust networking foundation that can deliver low latency, high bandwidth, and operational simplicity.

This document presents a design guide for building data center networks for AI/ML use-cases, leveraging Cisco Nexus 9000 Series switches and VXLAN EVPN fabric. The blueprint is based on a real-world deployment of Cisco UCS-C885A-M8-H26 Dense GPU Servers (with NVIDIA GPUs) connected to VXLAN fabric which is built using Nexus 9300 Series ToR switches and orchestrated by Cisco Unified Nexus Dashboard.

By integrating VXLAN EVPN, this architecture delivers a highly scalable, multi-tenant, and programmable network fabric, optimized for the performance and agility requirements of AI/ML clusters. VXLAN EVPN fabric supports seamless east-west traffic flow, workload mobility and network segmentation providing solid foundation for current and future AI/ML initiatives.

Design Concept and Customer Use Case

Design Concept

The proposed network, providing the following benefits for AI/ML data center deployments:

High Performance and Scalability

The architecture supports dense GPU clusters and high-throughput east-west traffic, essential for AI/ML training workloads. The use of 16 spines and 24 leaves ensures non-blocking bandwidth and flexible scale-out up to 4 scalable unit (SU) as the cluster grows.

A Scalable Unit (SU) is a standardized building block of infrastructure—combining a specific number of GPUs – designed to be replicated to grow an AI cluster. In this scenario, we have 32 GPU servers per scalable unit with 8 leaves. Grouping leaves in sets of eight aligns with rail-optimized cabling, ensures non-blocking bandwidth for high-density GPU workloads, and enables seamless expansion as additional servers are added to the AI cluster.

Deploying 16 spine and 24 leaf switches for 96 NVIDIA GPU servers is a deliberate design choice to achieve a high-performance, non-blocking, and 3 scalable fabric optimized for AI/ML workloads. This topology allows the infrastructure to be neatly divided into scalable units, simplifying cable management and enabling straightforward expansion by adding leaves and spines as the cluster grows.

Rail-Optimized Mapping

With 24 leaves, GPU-to-leaf and uplink distribution can be optimized for and minimal latency, aligning with the physical and logical layout of modern GPU clusters.

A rail-optimized topology is a high-performance AI data center network design that connects identical GPU positions across different servers (e.g., GPU 0 to GPU 0) to the same leaf switches, forming dedicated " rails" . This approach minimizes network hops, reduces latency, and maximizes bandwidth for AI training by ensuring parallel communication, such as NCCL, stays within optimized paths.

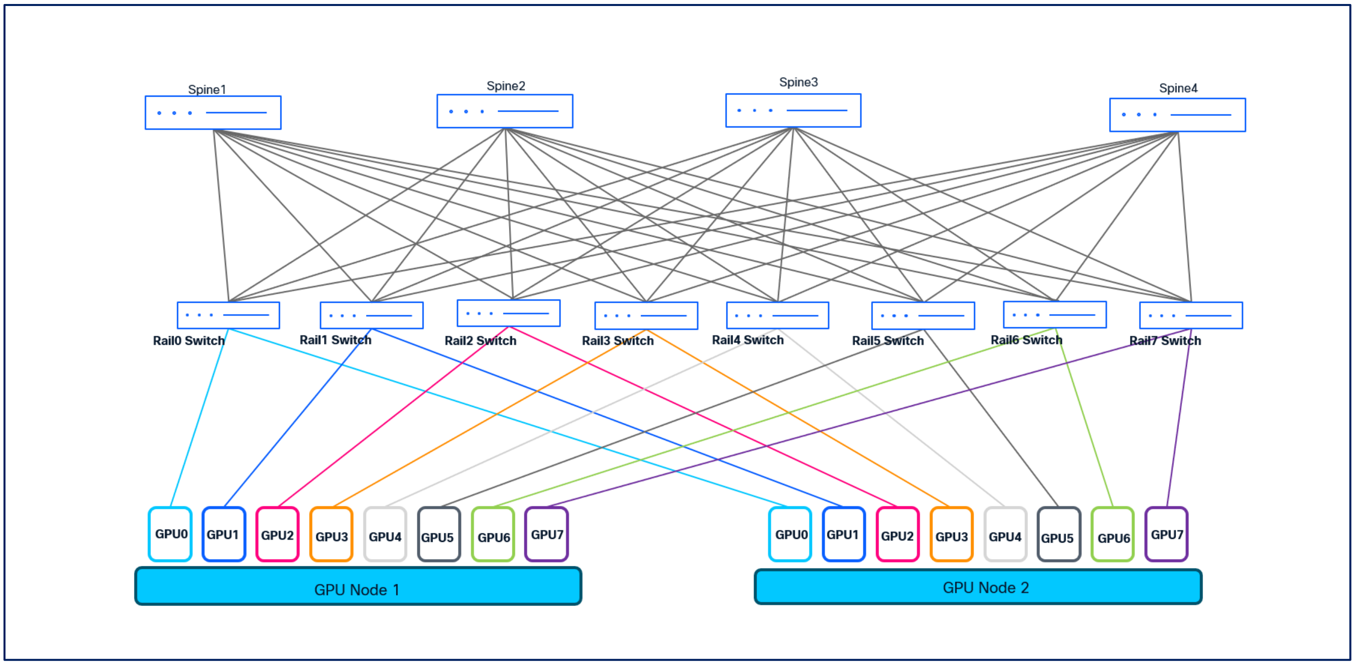


Figure 1. Rail Optimized Design

We choose rail-optimized design for the customer to deliver ultra-low latency, non-blocking connectivity, and operational efficiency for large-scale AI/ML clusters. It enables easy scaling, streamlined troubleshooting, and maximizes the performance of distributed GPU workloads.

Operational Simplicity and Automation: Leveraging Cisco Unified Nexus Dashboard 4.1 enables intent-based fabric provisioning, automated lifecycle management, and unified visibility, reducing operational complexity and human error. From the various data center fabric templates supported by Cisco Unified Nexus Dashboard, eBGP Routed fabric and VXLAN EVPN fabric template are most suitable for building AI/ML fabrics. In this scenario we have used VXLAN EVPN fabric template to support multi-tenancy.

Network Segmentation and Security

VXLAN EVPN allows for logical segmentation of workloads, facilitating secure multi-tenancy and policy-driven traffic management.

Future-Proof Foundation

This design accommodates advancements in AI/ML infrastructure, including faster interconnects (e.g., 400G), additional GPU servers, and integration with hybrid/multi-cloud environments.

Customer Use Case

A leading enterprise deployed a next-generation AI/ML data center leveraging 88 NVIDIA GPU servers (Cisco UCS-C885A-M8-H26) and scalable up to 96 GPU servers (each UCS server houses 8 GPUs which gives the total of 768 GPUs) to accelerate deep learning and analytics workloads. To meet their requirements for high throughput, low latency, and seamless scalability, the customer implemented VXLAN EVPN fabric (spine-leaf architecture) using Cisco Nexus 9300 series ToR switches which is orchestrated and managed by Unified Nexus Dashboard 4.1.

Key outcomes

Consistent Performance: The network delivered predictable, line-rate bandwidth for distributed AI/ML workloads, minimizing job completion times.

Agile Operations: Automated deployment and monitoring via Nexus Dashboard streamlined operations and reduced provisioning time from days to hours.

Secure Multi-Tenancy: VXLAN EVPN enabled the enterprise to securely segment research, production, and development environments within the same physical infrastructure.

This design blueprint empowers organizations to confidently deploy scalable, efficient, and secure AI/ML data center networks leveraging Cisco best practices.

Technology Overview

VXLAN EVPN - VXLAN EVPN provides scalable, multi-tenant Layer 2/3 network virtualization using an Ethernet VPN (EVPN) control plane, enabling flexible workload mobility and efficient traffic engineering across spine-leaf data center fabric.

Rail Optimized Design - Rail optimized design refers to network architectures that align leaf-spine connectivity and cabling with server racks ("rails"), minimizing hop count and maximizing bandwidth for AI/ML clusters, ensuring efficient and deterministic communication paths.

QoS (Quality of Service) - QoS ensures optimal performance for AI/ML and other critical workloads by prioritizing traffic, managing bandwidth allocation, and preventing resource starvation, supporting a predictable and efficient network environment.

RoCEv2 - RoCEv2 (RDMA over Converged Ethernet version 2) enables low-latency, high-throughput data transfer for AI/ML workloads by allowing direct memory access over standard IP-based Ethernet networks, crucial for distributed GPU clusters.

PFC (Priority Flow Control) - Priority Flow Control (PFC) is used to signal the congestion by using pause frames and pause mechanism. With the help of PFC, the device experiencing congestion notifies the upstream devices to slow down which in turn starts buffering the traffic.

ECN (Explicit Congestion Notification) - ECN enables network devices to signal impending congestion to endpoints without dropping packets, allowing intelligent traffic management and minimizing latency spikes for sensitive AI/ML flows.

Both PFC and ECN in conjunction transforms ethernet from lossy to lossless network and make it suitable for Storage and AI/ML use-cases.

CNP (Congestion Notification Packet) - CNP is a mechanism in RoCEv2 networks where switches send congestion notification packets to endpoints, prompting them to reduce transmission rates and alleviate network congestion proactively.

Cisco Intelligent Packet Flow - Cisco Intelligent Packet Flow provides advanced load-balancing to optimize traffic distribution across the fabric, utilizes hardware-accelerated telemetry for real-time visibility, and supports fault-aware recovery to ensure resilient and uninterrupted AI/ML data flows.

The Cisco Intelligent Packet Flow framework is built on four key pillars:

- **Advanced Load-Balancing** - Dynamically distributes traffic flows across all available paths (ECMPs) to optimize bandwidth utilization and minimize congestion.

- **Hardware-Accelerated Telemetry** - Provides real-time, granular visibility into packet flows and network health, leveraging on-switch analytics for rapid detection of hotspots and anomalies.
- **Fault-Aware Recovery** - Quickly identifies and reroutes around network faults or degraded links, ensuring uninterrupted data delivery and high availability.
- **Congestion Management** - Proactively detects congestion points and applies techniques like PFC and ECN to maintain lossless and low-latency operation, critical for latency-sensitive AI/ML workloads.

Building a Non-Blocking, Rail-Optimized Network for AI/ML

For the design illustrated in this design, we implement a scalable, two-tier, spine-leaf architecture to deliver the ultra-low latency and massive bandwidth required for AI/ML workloads. This network is engineered to support 96 GPU servers, each equipped with 8 NVIDIA GPUs and capable of 400 Gbps per GPU, resulting in exceptionally demanding east-west traffic patterns.

To provide both scalability and operational modularity, the network is organized into three scalable units, each comprising 8 leaf switches. Each scalable unit interconnects with 32 servers, except for the final unit, which connects to 24 servers and scalable to 32 servers. Each leaf switch is responsible for connecting to 32 GPUs, following a rail-optimized design: for example, Leaf 1 connects to GPU0 of 32 different servers, Leaf 2 to GPU1 of those servers, and so forth through Leaf 8. This approach is repeated for each scalable unit, maximizing cabling efficiency and ensuring deterministic, high-bandwidth paths between GPUs and across the fabric.

In total, the fabric consists of 24 leaves switches and 16 spine switches. Every leaf switch is equipped with 32 uplinks, creating a fully non-blocking architecture and providing line-rate bandwidth from each server-facing port through to the spine layer. Each leaf uplinks to every spine with 2x400G links, ensuring both high throughput and non-blocking line rate. This dense interconnection enables any-to-any communication across the GPU cluster at full 400 Gbps line rate per server, which is essential for distributed AI/ML training jobs.

This modular, rail-optimized topology not only delivers the required bandwidth and deterministic latency for GPU workloads, but also provides the flexibility to scale out by adding additional scalable units (sets of leaf switches and servers). The design ensures that there are also available ports for connecting storage devices, storage clusters, or for integrating with other segments of the enterprise network, without compromising the non-blocking characteristics of the fabric.

This architecture, leveraging Cisco Nexus 9364D-GX2A leaf switches and managed by Cisco Nexus Dashboard 4.1, creates a robust foundation for current and future AI/ML workloads, supporting high performance, operational simplicity, and seamless scalability.

Components used in this scenario

Table 1. List of Hardware and Software Version

Hardware	Role	Quantity	Software
Nexus 9364D-GX2A	Spine	16	NX-OS 10.5(3)F
Nexus 9364D-GX2A	Leaf	24	NX-OS 10.5(3)F
vND	Unified Nexus Dashboard	1 (3 node cluster)	4.1.1g

Hardware	Role	Quantity	Software
UCS-C885A-M8-H26	Nvidia H200 SXM GPU server	88	-

Cisco Nexus 9364D-GX2A Overview

The Cisco Nexus 9364D-GX2A is a high-performance, high-density 2RU fixed switch purpose-built for next-generation data center deployments, including large-scale AI/ML, HPC, and cloud environments. It is part of the Cisco Nexus 9000 Series and is engineered to deliver line-rate throughput, ultra-low latency, and advanced telemetry and automation capabilities.

Figure 2. Cisco Nexus 9364D-GX2A

Key Features

Ports: 64x400-Gigabit Ethernet QSFP-DD, supporting flexible breakouts (including 4x100G and 2x200G per port).

Switching Capacity: Up to 25.6 Tbps with line-rate performance across all ports.

Form Factor: 2RU with redundant, hot-swappable power supplies and fans.

Software: Runs Cisco NX-OS, supporting VXLAN EVPN, RoCEv2, PFC, hardware-accelerated telemetry, and advanced automation.

Slice Pair Architecture and Buffering

The Nexus 9364D-GX2A is built on SoC (Switch on Chip) ASIC architecture:

Number of Slice Pairs: 4

Total Slices: 8 (2 slices per pair)

Ports per Slice Pair: 16x400G

Buffer per Slice Pair: 30 MB

Total Buffer: 120 MB (30 MB x 4 slice pairs)

Role of Buffering

Each slice pair's buffer is essential for absorbing traffic microbursts and supporting lossless transport such as RoCEv2 with PFC—vital for AI/ML workloads that demand high throughput and minimal congestion loss.

Benefits for AI/ML and Data Center Fabrics

Non-Blocking, Line-Rate Design

All 64 ports operate at full 400G line rate, supporting non-blocking architectures for large-scale GPU clusters and storage fabrics.

Rail-Optimized Topologies

The 16-port-per-slice-pair design aligns well with rail-optimized GPU cluster cabling, ensuring predictable, low-latency data flows.

Deep Buffers for Lossless Networks

Sufficient buffering per slice pair to prevent drops during short-term congestion, maintaining performance in RoCEv2, PFC, and other critical data paths.

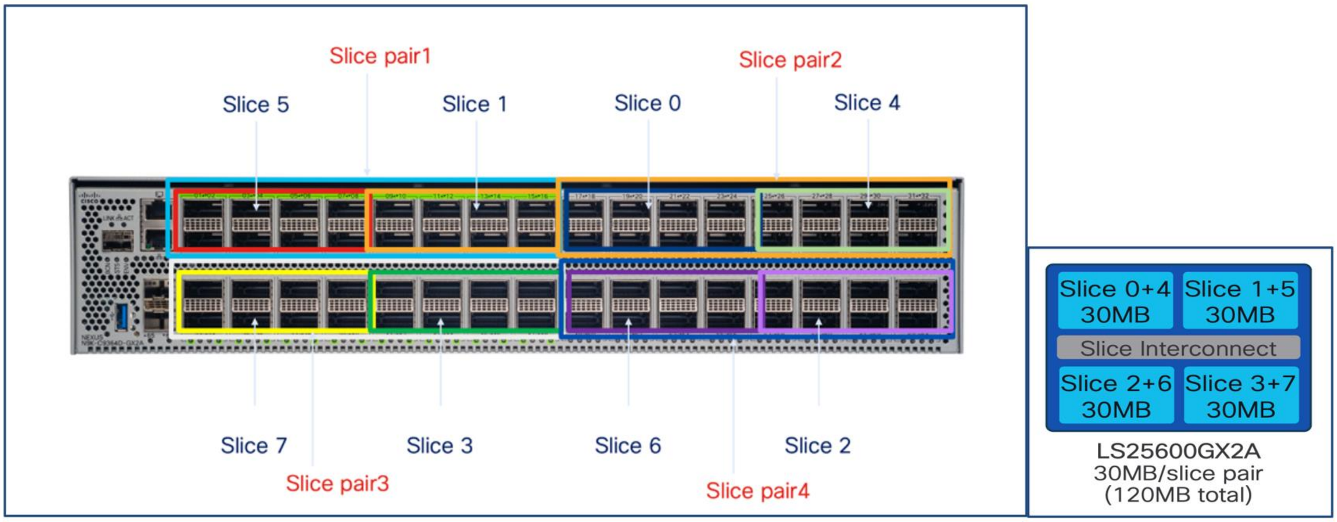
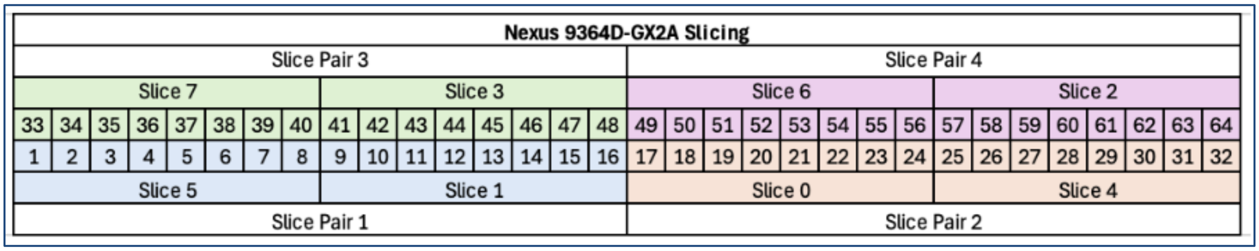


Figure 3. Cisco Nexus 9364D-GX2A Slicing



Nexus 9364D-GX2A Slicing																															
Slice Pair 3																Slice Pair 4															
Slice 7								Slice 3								Slice 6								Slice 2							
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Slice 5								Slice 1								Slice 0								Slice 4							
Slice Pair 1																Slice Pair 2															

Figure 4. Cisco Nexus 9364D-GX2A Port to Slice Mapping

Cable Matrix and Buffer Optimization on Cisco Nexus 9364D-GX2A

To optimize buffer utilization and ensure a balanced load across the Cisco Nexus 9364D-GX2A switch, a structured cable matrix is used for both spine-to-leaf uplinks and GPU-to-leaf downlinks.

Leaf Port Allocation per Slice

Each slice of the 9364D-GX2A consists of 8 ports.

Ports 1–4 of each slice are dedicated to GPU server (downlink) connections.

Ports 5–8 of each slice are used for uplinks to the spine switches.

Spine Uplink Strategy

Each leaf switch is equipped with two uplinks per spine, ensuring a non-blocking fabric.

Uplink ports are distributed across all slices for optimal buffer usage and fairness.

For example, Leaf1 uplinks to Spine1 via Slice5 Port1 and Slice7 Port33.

Leaf2 uplinks to spines using Slice1 Port9 and Slice3 Port41.

This pattern continues for all leaves, distributing connections evenly across slices and spines.

GPU Downlink Strategy

GPU0 of servers in Scalable Unit 1 (SU1) connects to Leaf1 with a round-robin mapping to front-panel ports:

Table 2. GPU to Switch Cable Matrix

GPU Index	Switch Port
Server1 GPU0	Port1
Server2 GPU0	Port2
Server3 GPU0	Port3
Server4 GPU0	Port4
Server5 GPU0	Port9
Server6 GPU0	Port10
Server7 GPU0	Port11
Server8 GPU0	Port12

This pattern is repeated for subsequent servers and GPUs, ensuring even usage of all available ports and associated buffers.

By structuring both uplink and downlink connections in this manner, the design maximizes the switch’s buffer efficiency, supports deterministic low-latency traffic flows, and maintains a fully non-blocking, high-performance network fabric for large-scale AI/ML deployments.

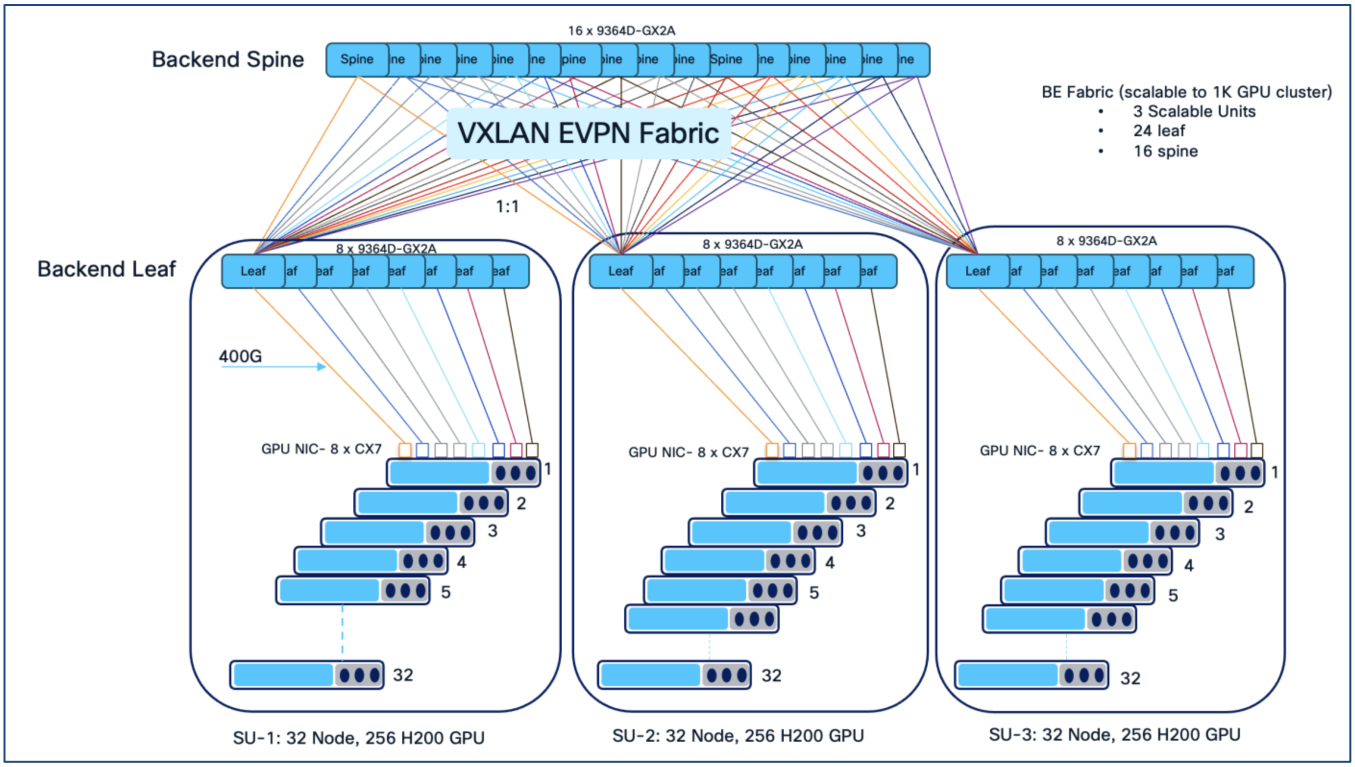


Figure 5. AI/ML Data Center VXLAN EVPN Fabric design

Step-by-step Configuration using Cisco Nexus Dashboard

Deploying and managing a high-performance, non-blocking AI/ML data center fabric requires both robust design and efficient operational tools. Cisco Nexus Dashboard delivers intent-based automation, centralized management, and end-to-end visibility for VXLAN EVPN fabrics—making it the ideal solution for deploying, monitoring, and scaling modern data center networks.

This section provides a detailed, step-by-step guide to configuring your AI/ML-optimized spine-leaf fabric using Cisco Nexus Dashboard. The workflow is tailored to the rail-optimized, non-blocking design described in earlier sections and demonstrates how to:

- Define and onboard Nexus 9000 switches into Nexus Dashboard.
- Create and configure a VXLAN EVPN fabric.
- Automate underlay and overlay network provisioning, including BGP, loopback addressing, and VLAN assignments.
- Configure advanced features such as PFC, QoS, and DLB, all through the Nexus Dashboard interface.

Prerequisites and Preparation

Ensure all Nexus 9000 series switches (spines and leaves) are powered on, reachable via management (OOB as well as inband mgmt is supported), and running a supported NX-OS version.

Nexus Dashboard is installed and operational with proper IP reachability to all switches.

Have a logical design ready (IP addressing, ASN, VLANs, VRFs, etc.).

Procedure

Step 1. Create a new fabric.

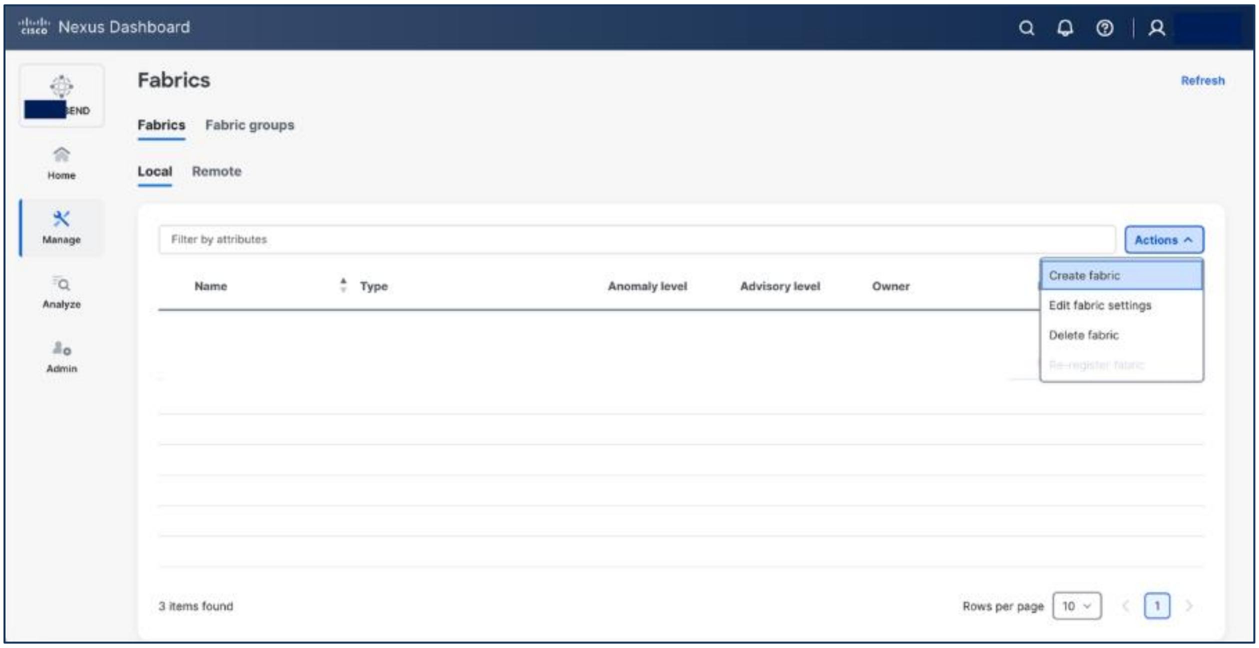
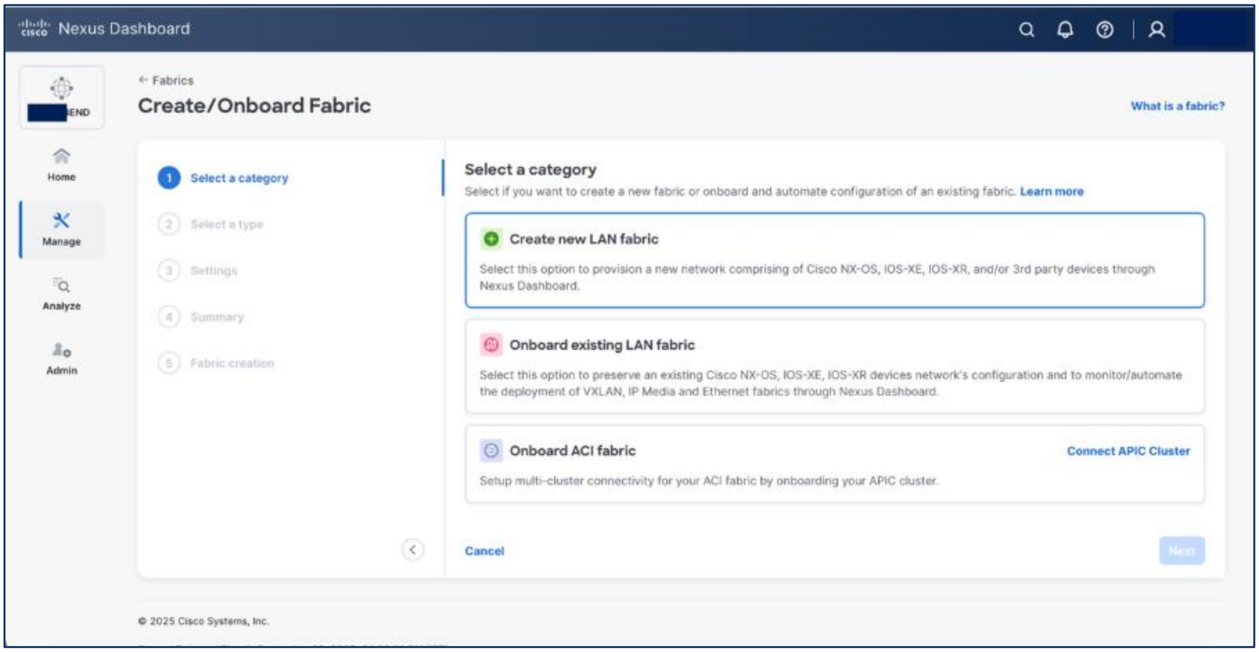


Figure 6. Create New Fabric

Step 2. Select **Create fabric**.



Select a category

Select if you want to create a new fabric or onboard and automate configuration of an existing fabric. Learn more

Create new LAN fabric

Select this option to provision a new network comprising of Cisco NX-OS, IOS-XE, IOS-XR, and/or 3rd party devices through Nexus Dashboard.

Onboard existing LAN fabric

Select this option to preserve an existing Cisco NX-OS, IOS-XE, IOS-XR devices network's configuration and to monitor/automate the deployment of VXLAN, IP Media and Ethernet fabrics through Nexus Dashboard.

Onboard ACI fabric — Connect APIC Cluster

Setup multi-cluster connectivity for your ACI fabric by onboarding your APIC cluster.

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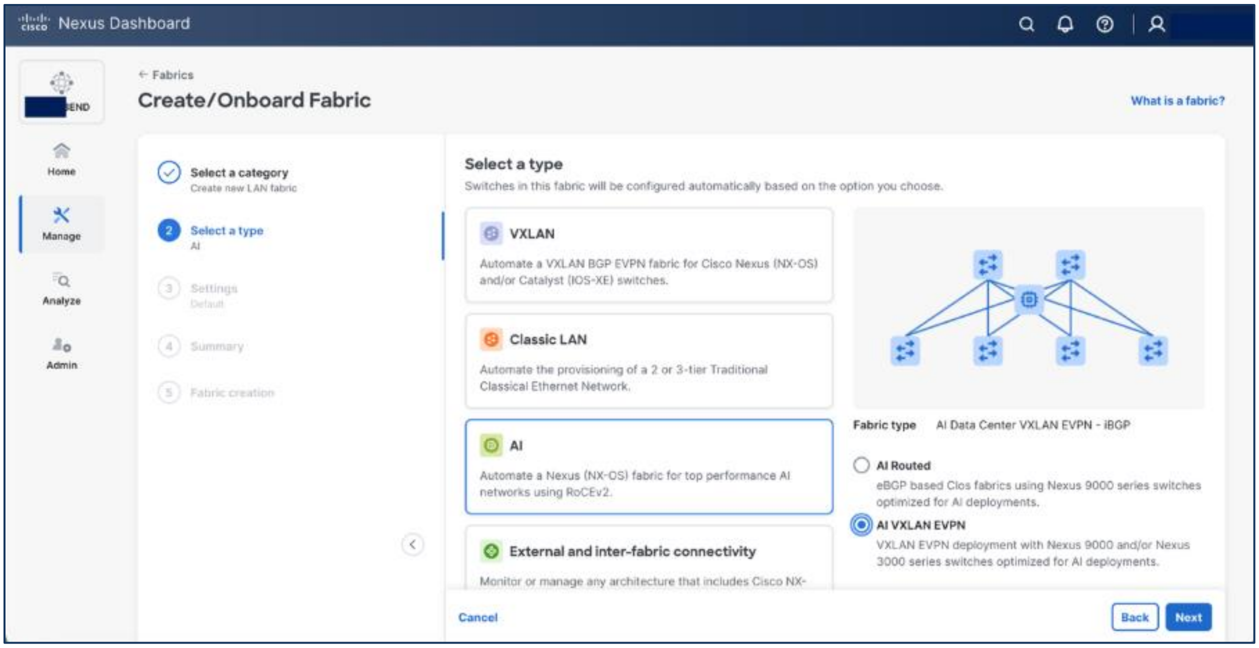
Figure 7. Create new LAN Fabric

Step 3. Select **AI** > **AI VXLAN EVPN** fabric type.



Create/Onboard Fabric

✓ Select a category
Create new LAN fabric

2 Select a type
AI

3 Settings
Default

4 Summary

5 Fabric creation

Select a type

Switches in this fabric will be configured automatically based on the option you choose.

VXLAN
Automate a VXLAN BGP EVPN fabric for Cisco Nexus (NX-OS) and/or Catalyst (IOS-XE) switches.

Classic LAN
Automate the provisioning of a 2 or 3-tier Traditional Classical Ethernet Network.

AI
Automate a Nexus (NX-OS) fabric for top performance AI networks using RoCEv2.

External and inter-fabric connectivity
Monitor or manage any architecture that includes Cisco NX-

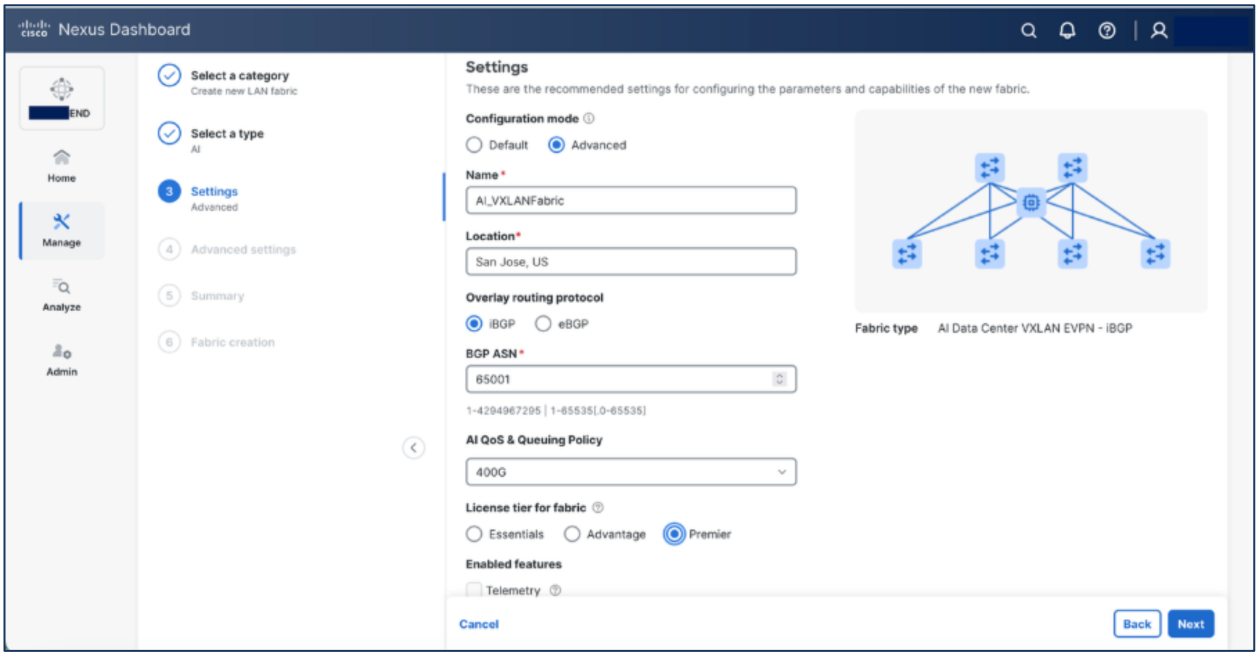
Fabric type AI Data Center VXLAN EVPN - iBGP

○ AI Routed
eBGP based Clos fabrics using Nexus 9000 series switches optimized for AI deployments.

● AI VXLAN EVPN
VXLAN EVPN deployment with Nexus 9000 and/or Nexus 3000 series switches optimized for AI deployments.

Figure 8. New AL/ML Fabric

Step 4. Set the basic parameters.



✓ Select a category
Create new LAN fabric

✓ Select a type
AI

3 Settings
Advanced

4 Advanced settings

5 Summary

6 Fabric creation

Settings

These are the recommended settings for configuring the parameters and capabilities of the new fabric.

Configuration mode
○ Default ● Advanced

Name *
AI_VXLANFabric

Location*
San Jose, US

Overlay routing protocol
● iBGP ○ eBGP

BGP ASN *
65001
1-4294967295 | 1-65535[.0-65535]

AI QoS & Queuing Policy
400G

License tier for fabric
○ Essentials ○ Advantage ● Premier

Enabled features
□ Telemetry

Fabric type AI Data Center VXLAN EVPN - iBGP

Figure 9. Basic Fabric Settings

Select **Advanced** configuration mode to customize the resources and templates.

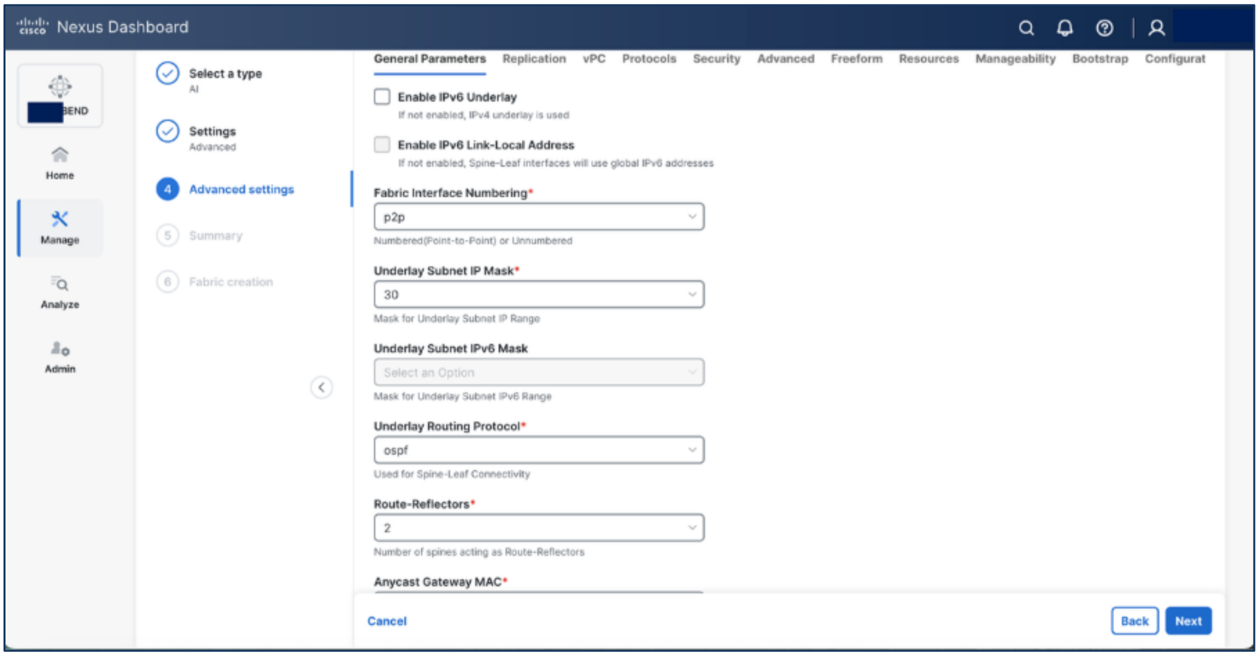
- Specify a name for fabric. Provide the location
- Select iBGP as Overlay Routing Protocol
- Provide a BGP ASN

- Select 400G AI QoS & Queuing Policy, N9364-DGX2A supports 400Gbps.

Note: Edit the existing 400G AI QoS & Queuing template in template library to reflect as given below (These values are based on specific given scenario, you may want to change based on your requirements and Best Job Completion Time (JCT))

```
class type queuing c-out-8q-q3
    bandwidth remaining percent 95  >>> as the network is dedicated for GPU fabric, allocate
maximum bandwidth
    random-detect minimum-threshold 150 kbytes maximum-threshold 7000 kbytes drop-
probability 7 weight 12 ecn
  class type queuing c-out-8q-q-default
    bandwidth remaining percent 5 >>> for control traffic
```

Step 5. Set basic parameters required for a VXLAN EVPN such as IP address, Authentication, BFD, and so on.



□ Enable IPv6 Underlay
If not enabled, IPv4 underlay is used

□ Enable IPv6 Link-Local Address
If not enabled, Spine-Leaf interfaces will use global IPv6 addresses

Fabric Interface Numbering*
p2p
Numbered(Point-to-Point) or Unnumbered

Underlay Subnet IP Mask*
30
Mask for Underlay Subnet IP Range

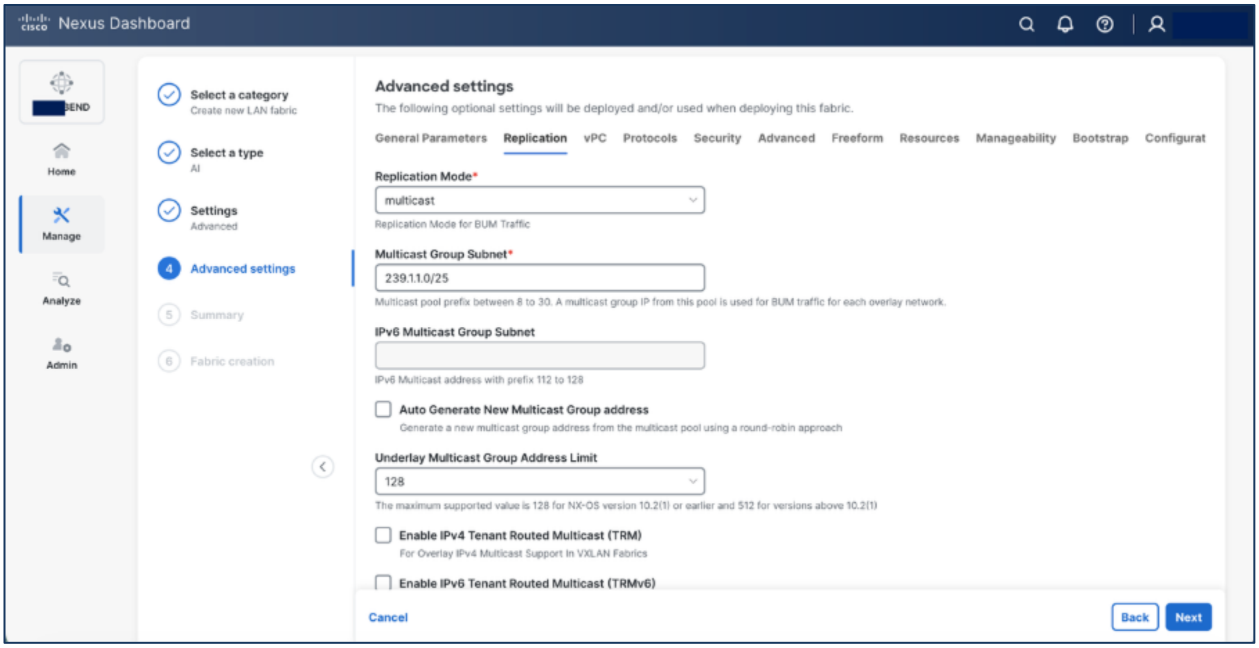
Underlay Subnet IPv6 Mask
Select an Option
Mask for Underlay Subnet IPv6 Range

Underlay Routing Protocol*
ospf
Used for Spine-Leaf Connectivity

Route-Reflectors*
2
Number of spines acting as Route-Reflectors

Anycast Gateway MAC*

Figure 10. Fabric General Parameters



Select a category – Create new LAN fabric
Select a type – AI
Settings – Advanced
4 Advanced settings
5 Summary
6 Fabric creation

Advanced settings

The following optional settings will be deployed and/or used when deploying this fabric.

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.

IPv6 Multicast Group Subnet:
IPv6 Multicast address with prefix 112 to 128

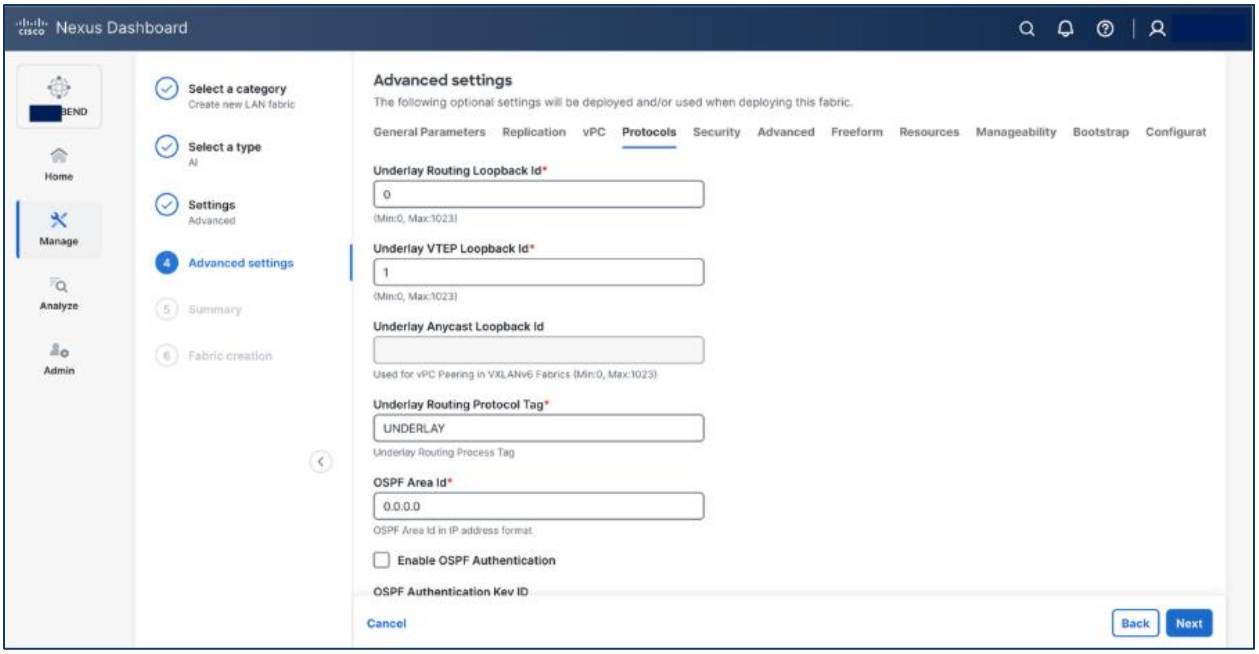
☐ Auto Generate New Multicast Group address
Generate a new multicast group address from the multicast pool using a round-robin approach

Underlay Multicast Group Address Limit: 128
The maximum supported value is 128 for NX-OS version 10.2(1) or earlier and 512 for versions above 10.2(1)

☐ Enable IPv4 Tenant Routed Multicast (TRM)
For Overlay IPv4 Multicast Support In VXLAN Fabrics

☐ Enable IPv6 Tenant Routed Multicast (TRMv6)

Figure 11. Fabric Replication



Select a category – Create new LAN fabric
Select a type – AI
Settings – Advanced
4 Advanced settings
5 Summary
6 Fabric creation

Advanced settings

The following optional settings will be deployed and/or used when deploying this fabric.

Underlay Routing Loopback Id*: 0
(Min:0, Max:1023)

Underlay VTEP Loopback Id*: 1
(Min:0, Max:1023)

Underlay Anycast Loopback Id:
Used for vPC Peering in VXLANv6 Fabrics (Min:0, Max:1023)

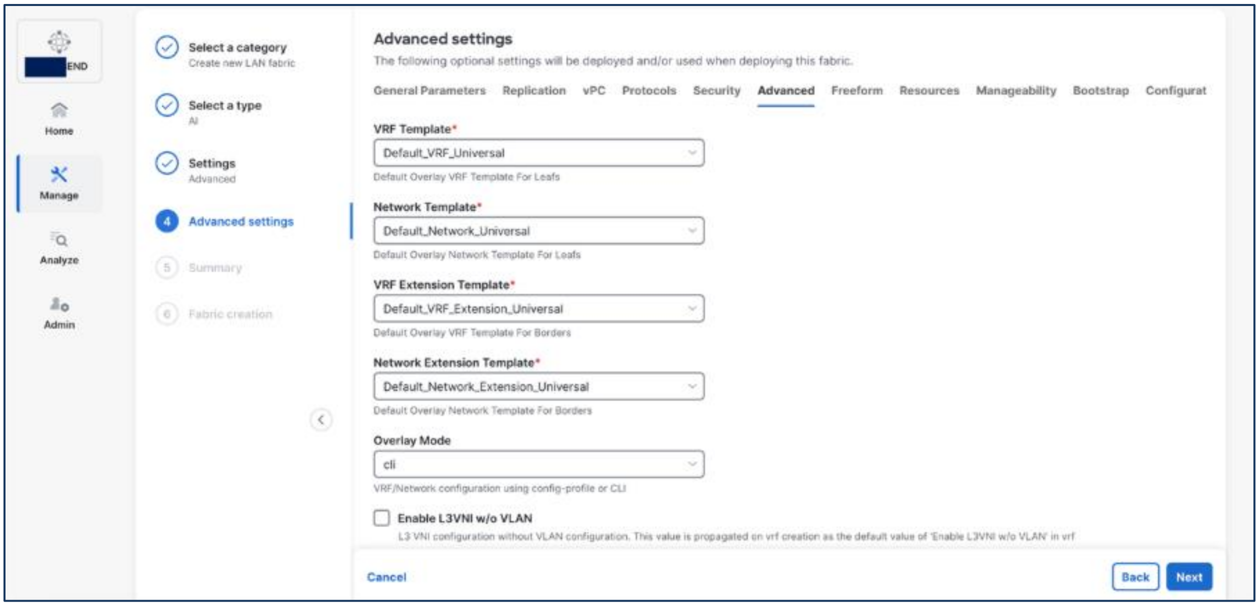
Underlay Routing Protocol Tag*: UNDERLAY
Underlay Routing Process Tag

OSPF Area Id*: 0.0.0.0
OSPF Area Id in IP address format

☐ Enable OSPF Authentication

OSPF Authentication Key ID

Figure 12. Fabric Protocols



[redacted]END

Home

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Select a category
Create new LAN fabric

Select a type
AI

Settings
Advanced

4 Advanced settings

5 Summary

6 Fabric creation

Advanced settings

The following optional settings will be deployed and/or used when deploying this fabric.

General Parameters | Replication | vPC | Protocols | Security | **Advanced** | Freeform | Resources | Manageability | Bootstrap | Configurat

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

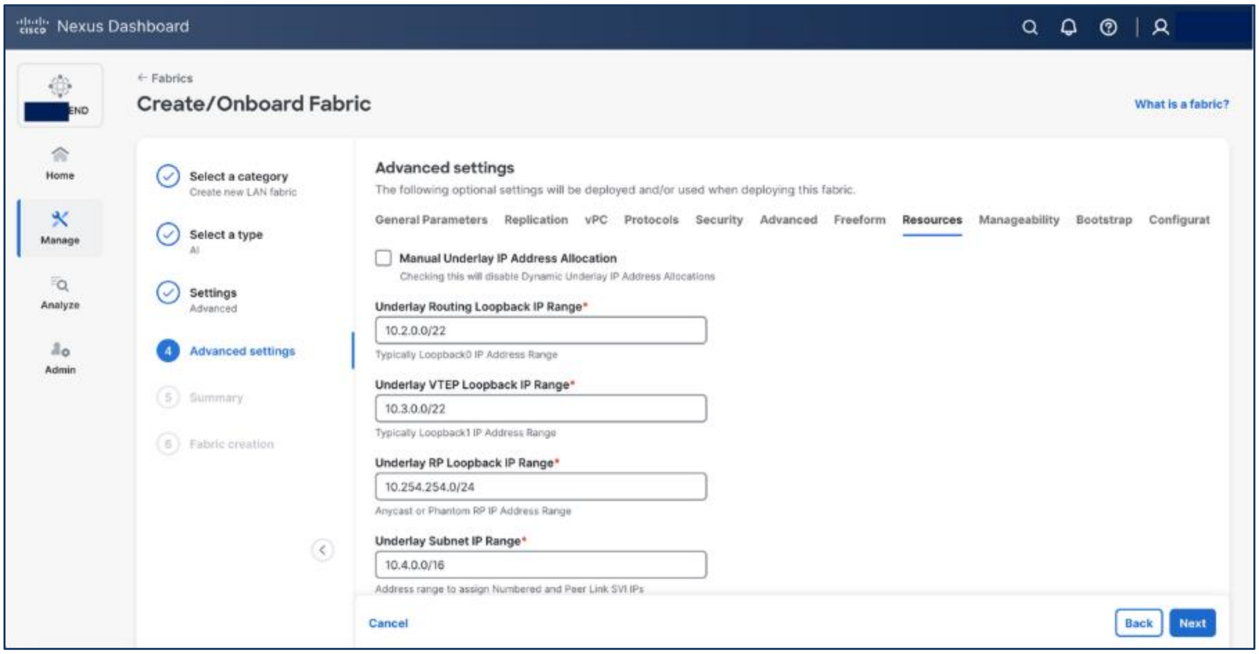
Network Extension Template*
Default_Network_Extension_Universal
Default Overlay Network Template For Borders

Overlay Mode
cli
VRF/Network configuration using config-profile or CLI

☐ **Enable L3VNI w/o VLAN**
L3 VNI configuration without VLAN configuration. This value is propagated on vrf creation as the default value of 'Enable L3VNI w/o VLAN' in vrf

Cancel | Back | Next

Figure 13. Fabric Advanced Settings



Nexus Dashboard

[redacted]END

← Fabrics

Create/Onboard Fabric

What is a fabric?

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Select a category
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Advanced settings

The following optional settings will be deployed and/or used when deploying this fabric.

General Parameters | Replication | vPC | Protocols | Security | Advanced | Freeform | **Resources** | Manageability | Bootstrap | Configurat

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

Underlay Routing Loopback IP Range*
10.2.0.0/22
Typically Loopback0 IP Address Range

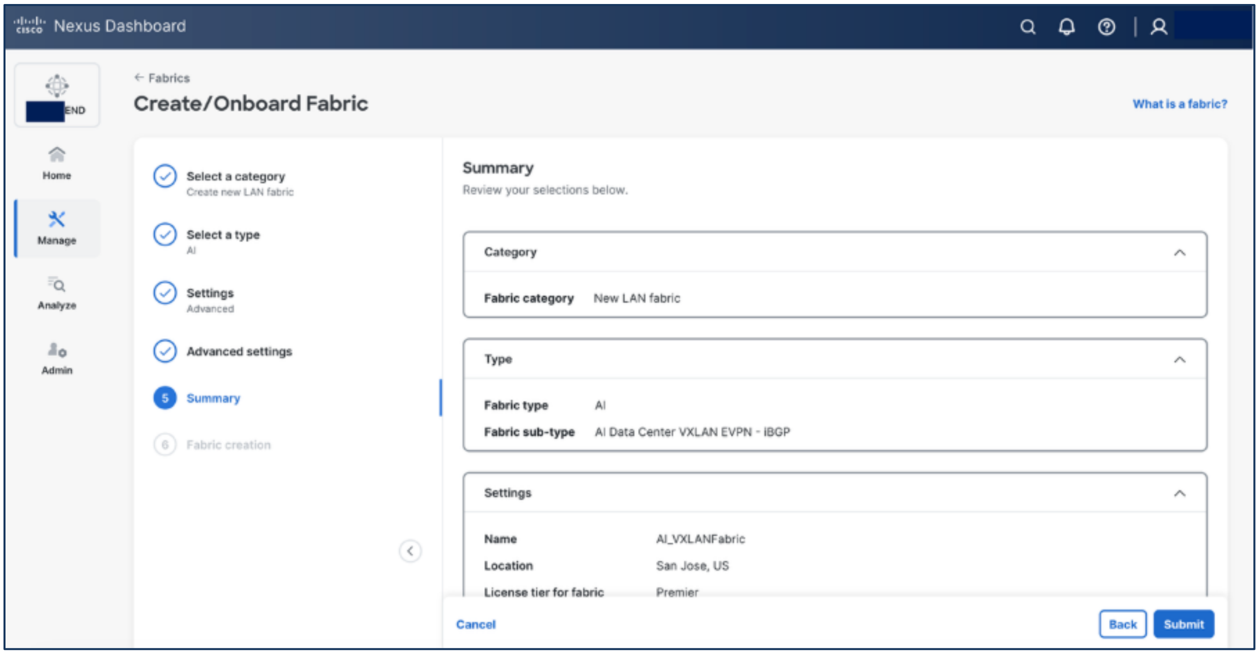
Underlay VTEP Loopback IP Range*
10.3.0.0/22
Typically Loopback1 IP Address Range

Underlay RP Loopback IP Range*
10.254.254.0/24
Anycast or Phantom RP IP Address Range

Underlay Subnet IP Range*
10.4.0.0/16
Address range to assign Numbered and Peer Link SVI IPs

Cancel | Back | Next

Figure 14. Fabric Resources



Create/Onboard Fabric

Summary

Review your selections below.

Category

Fabric category New LAN fabric

Type

Fabric type AI

Fabric sub-type AI Data Center VXLAN EVPN - iBGP

Settings

Name AI_VXLANFabric

Location San Jose, US

License tier for fabric Premier

Figure 15. Fabric Summary

Step 6. Select **Add switches** to onboard the switches into Nexus Dashboard.

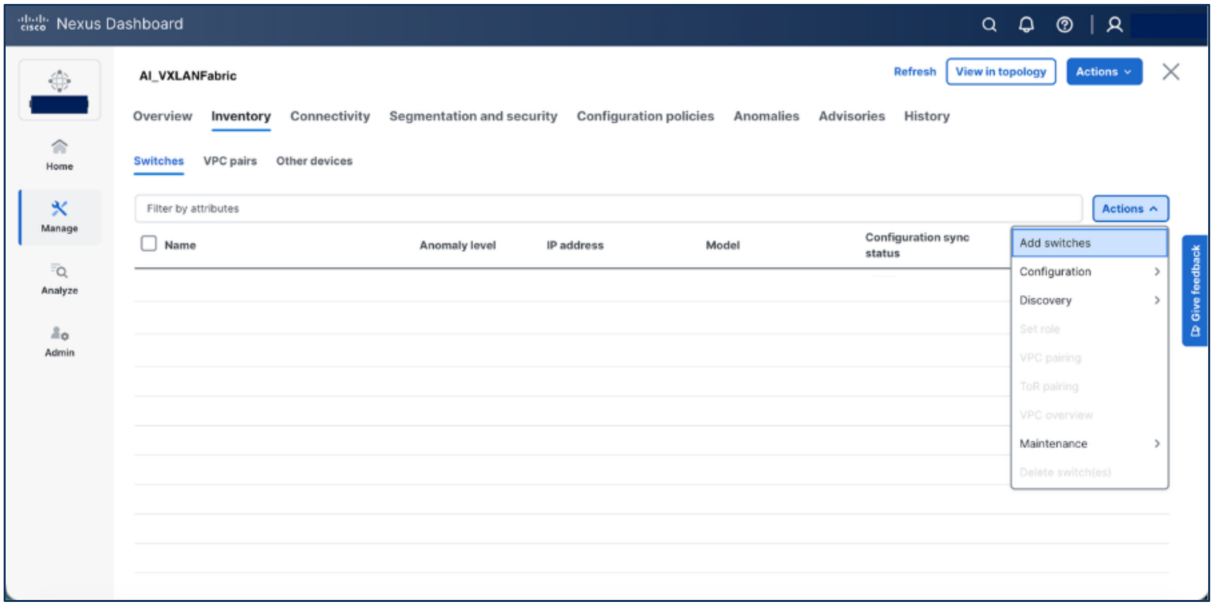
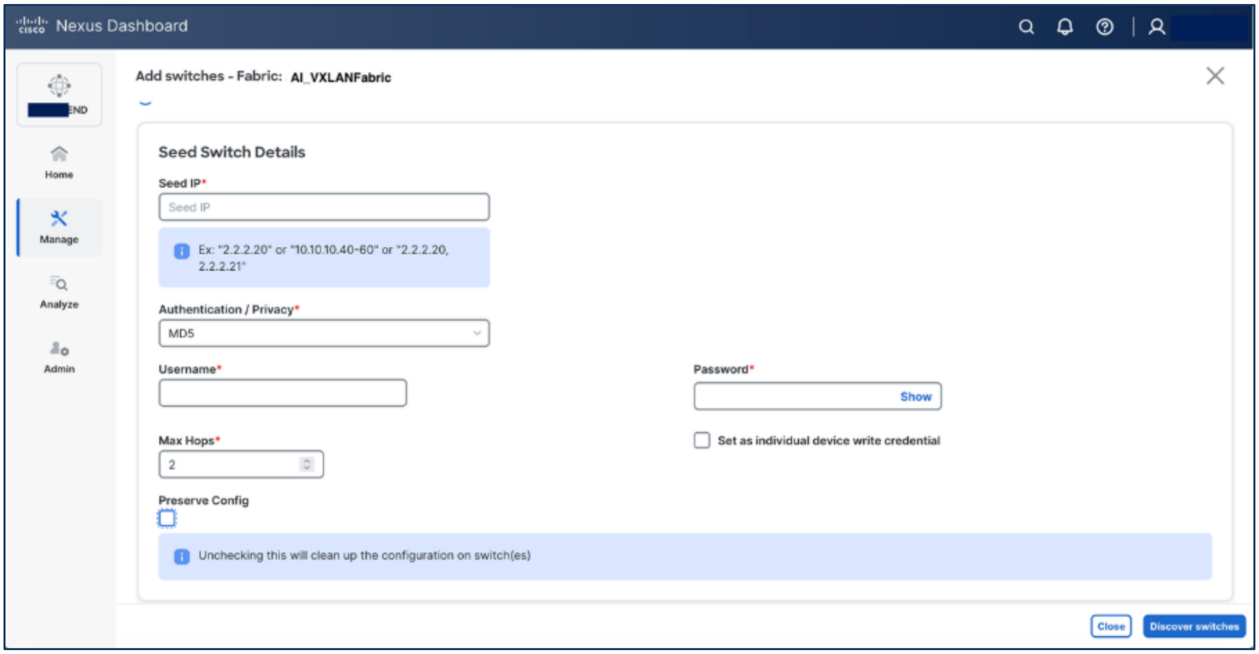


Figure 16. Add switches to Fabric



Nexus Dashboard

[redacted] END

Add switches - Fabric: AI_VXLANFabric

Seed Switch Details

Seed IP*

Seed IP

Ex: "2.2.2.20" or "10.10.10.40-60" or "2.2.2.20, 2.2.2.21"

Authentication / Privacy*

MD5

Username*

Password*

Show

Max Hops*

2

□ Set as individual device write credential

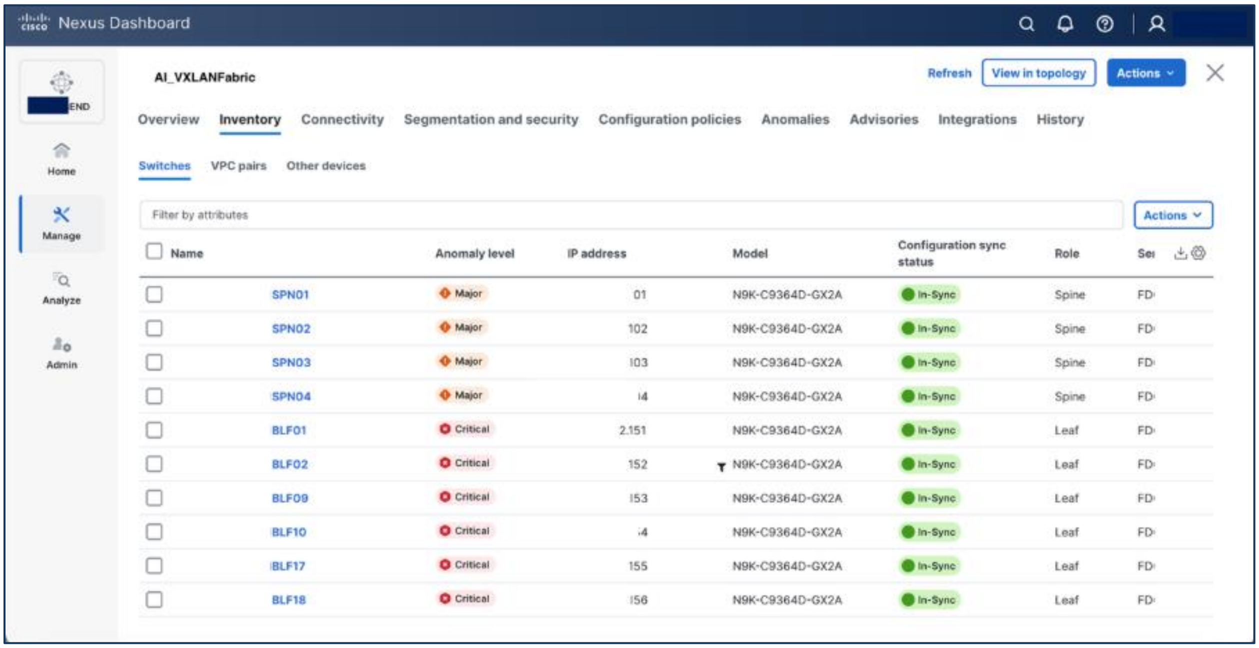
Preserve Config

□

Unchecking this will clean up the configuration on switch(es)

Figure 17. Define Switch discovery Parameters

Step 7. Set roles as required “spine and leaf” and recalculate & deploy



Nexus Dashboard

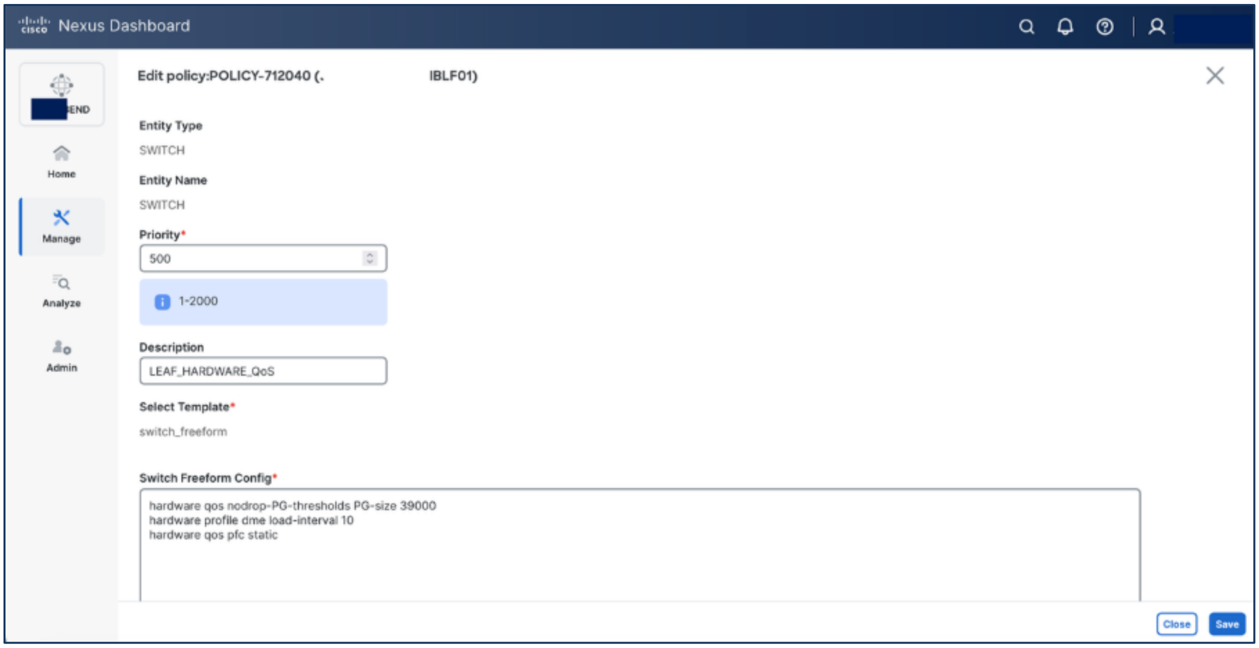
[redacted] END

AI_VXLANFabric

□	Name	Anomaly level	IP address	Model	Configuration sync status	Role	Sei
□	SPN01	Major	01	N9K-C9364D-GX2A	In-Sync	Spine	FD·
□	SPN02	Major	102	N9K-C9364D-GX2A	In-Sync	Spine	FD·
□	SPN03	Major	103	N9K-C9364D-GX2A	In-Sync	Spine	FD·
□	SPN04	Major	i4	N9K-C9364D-GX2A	In-Sync	Spine	FD·
□	BLF01	Critical	2.151	N9K-C9364D-GX2A	In-Sync	Leaf	FD·
□	BLF02	Critical	152	N9K-C9364D-GX2A	In-Sync	Leaf	FD·
□	BLF09	Critical	153	N9K-C9364D-GX2A	In-Sync	Leaf	FD·
□	BLF10	Critical	.4	N9K-C9364D-GX2A	In-Sync	Leaf	FD·
□	BLF17	Critical	155	N9K-C9364D-GX2A	In-Sync	Leaf	FD·
□	BLF18	Critical	156	N9K-C9364D-GX2A	In-Sync	Leaf	FD·

Figure 18. Set Switch Role

Step 8. Set hardware QoS parameters using switch freeform configuration policy.



Edit policy:POLICY-712040 (. IBLF01)

Entity Type
SWITCH

Entity Name
SWITCH

Priority*
500

1-2000

Description
LEAF_HARDWARE_QoS

Select Template*
switch_freeform

Switch Freeform Config*

```
hardware qos nodrop-PG-thresholds PG-size 39000
hardware profile dme load-interval 10
hardware qos pfc static
```

[redacted]

Figure 19. Hardware QoS Parameters

Switch freeform configuration:

hardware qos pfc static

Beginning with Release 10.5(2)F, the **hardware qos pfc static** command is supported on Cisco Nexus-9300-GX2A/GX2B Series switches. However, when this command is configured, breakout ports, SOD, and SPAN/ERSPAN (in Tx direction) are not supported.

The Cisco Nexus command hardware qos pfc static is needed on GX platform to achieve line-rate.

hardware profile dme load-interval

The **hardware profile dme load-interval** command on Cisco Nexus devices is used to configure the duration for collecting and averaging interface statistics, influencing how load and traffic metrics are calculated

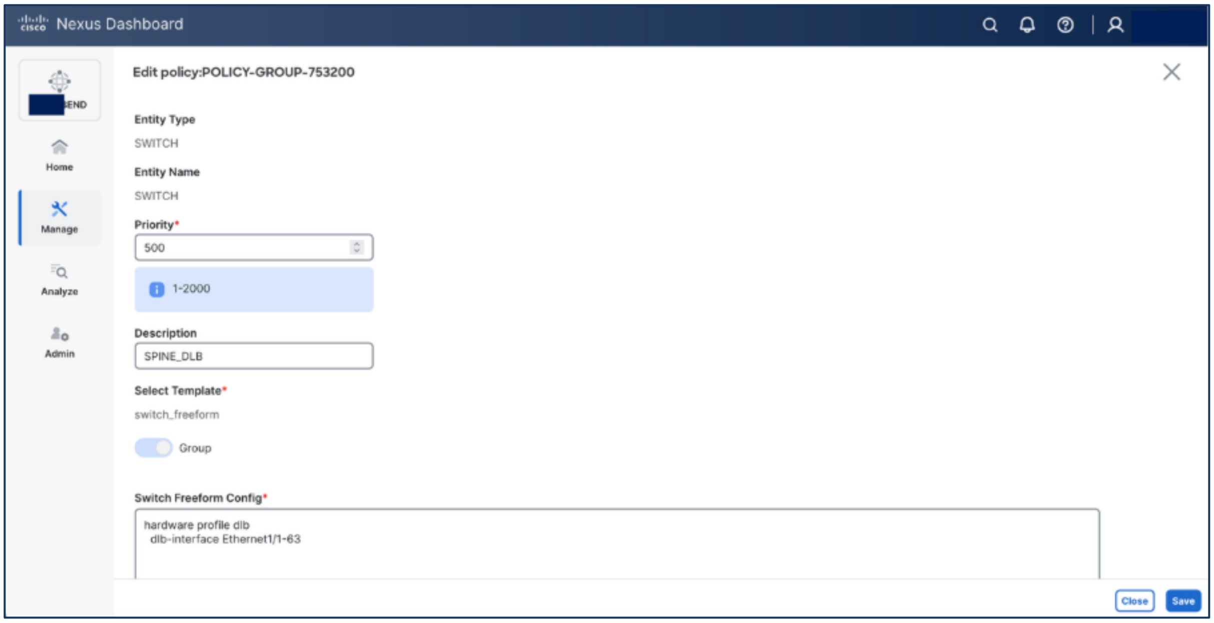
NDI recommends that you must set the DME load interval to 10 when using the Real Time Visualization (RTEV) feature

hardware qos nodrop-PG-thresholds PG-size 39000

The **hardware qos nodrop-pg-thresholds pg-size** command is used to set the packet group size for the no-drop queue in hardware Quality of Service (QoS) policies. A " no-drop" queue is a special buffer used to prevent packet loss for high-priority traffic, and the pg-size value determines how many packets it can hold.

Note: This value is specific to Nexus 9364D-GX2A switch.

Step 9. Configure DLB on Spine using Switch Freeform configuration.



Edit policy:POLICY-GROUP-753200

Entity Type
SWITCH

Entity Name
SWITCH

Priority*
500

1-2000

Description
SPINE_DLB

Select Template*
switch_freeform

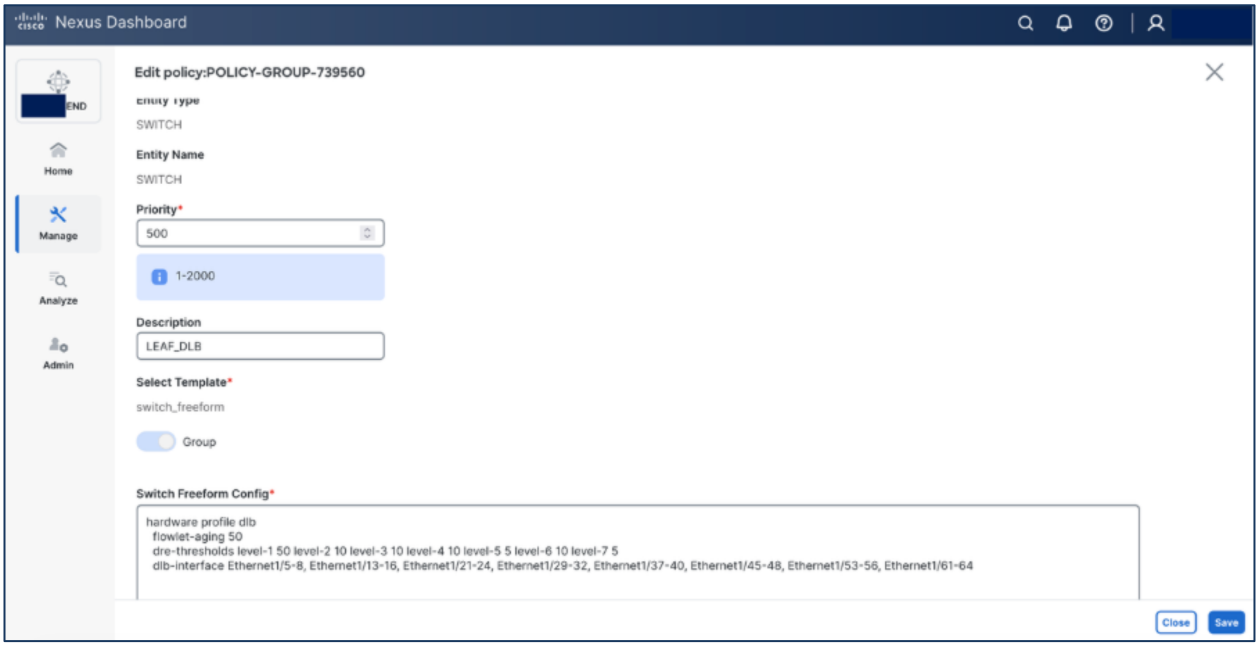
Group

Switch Freeform Config*

```
hardware profile dlb
  dlb-interface Ethernet1/1-63
```

Figure 20. Spine DLB

Step 10. Configure DLB on Leaf using switch freeform configuration.



Edit policy:POLICY-GROUP-739560

Entity Type
SWITCH

Entity Name
SWITCH

Priority*
500

1-2000

Description
LEAF_DLB

Select Template*
switch_freeform

Group

Switch Freeform Config*

```
hardware profile dlb
  flowlet-aging 50
  dre-thresholds level-1 50 level-2 10 level-3 10 level-4 10 level-5 5 level-6 10 level-7 5
  dlb-interface Ethernet1/5-8, Ethernet1/13-16, Ethernet1/21-24, Ethernet1/29-32, Ethernet1/37-40, Ethernet1/45-48, Ethernet1/53-56, Ethernet1/61-64
```

Figure 21. Leaf DLB

Use Case: Multi-Tenant GPU-as-a-Service (GPUaaS)

Consider a scenario where two customers require dedicated GPU resources from a shared AI/ML infrastructure with Cisco VXLAN EVPN Fabric:

Customer A requests access to 16 GPUs.

Customer B requests access to 32 GPUs.

Resource assignments

- For Customer A, select 2 available UCS-C885A-M8-H26 servers (each with 8 GPUs, total 16 GPUs).
- For Customer B, select 4 available UCS-C885A-M8-H26 servers (each with 8 GPUs, total 32 GPUs).
- Using the cable matrix, identify the exact server-to-leaf switch ports for these servers to ensure optimal connectivity.

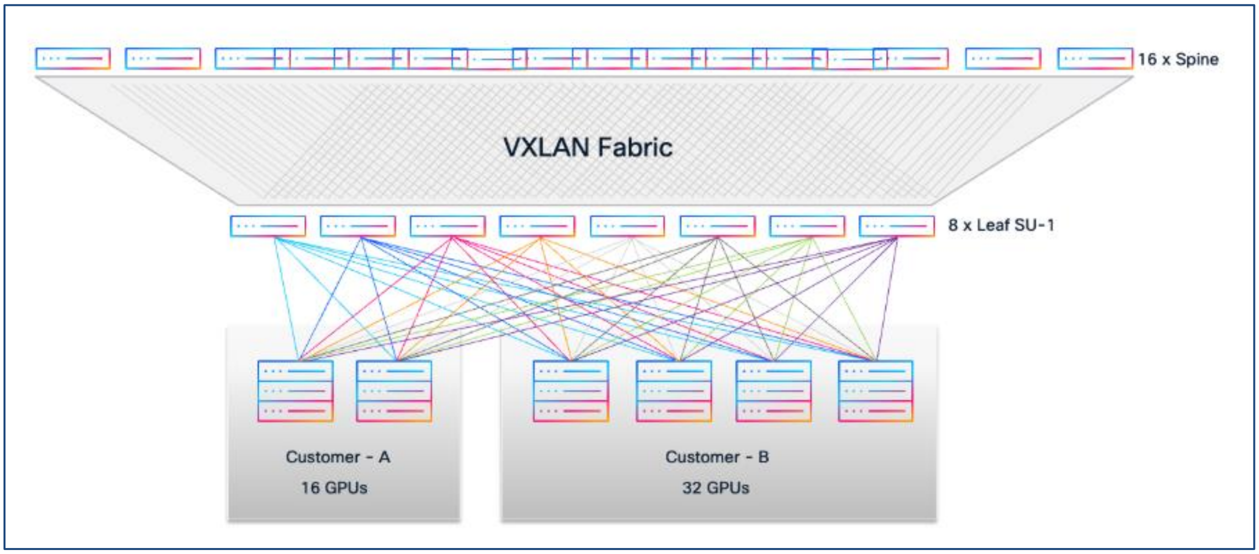


Figure 22. Multi-Tenant Use Case

Network Segmentation and Provisioning

In Cisco Nexus Dashboard, create two distinct VLANs for tenant isolation:

- VLAN 10 for Customer A
- VLAN 20 for Customer B
- Provision two Networks in Nexus Dashboard:
- Attach Network VLAN 10 to the leaf ports connected to Customer A's UCS servers.
- Attach Network VLAN 20 to the leaf ports connected to Customer B's UCS servers.

This approach leverages the Layer 2 VXLAN EVPN fabric to provide secure, isolated Layer 2 domains for each customer, allowing them to consume GPU resources as a service (GPUaaS) without any cross-tenant traffic.

Advanced Telemetry and L3 Segmentation

For enhanced telemetry and traffic analytics, you can deploy Distributed Anycast Gateway (DAG) and introduce L3 segmentation.

Create two VRFs in Nexus Dashboard:

- VRF A for Customer A (assign VLAN 10 to VRF A with a unique SVI IP).
- VRF B for Customer B (assign VLAN 20 to VRF B with a unique SVI IP).

This enables per-customer routing domains and detailed flow visibility, supporting strict multi-tenancy and compliance requirements.

Monitoring Intelligent AI/ML Infrastructure

These are the capability overview of Cisco Nexus Dashboard.

- End-to-End Visibility: Provides comprehensive, real-time visibility into network topology, fabric health, and traffic flows across AI/ML clusters.
- AI/ML Workload Awareness: Correlates network performance metrics with specific AI/ML job traffic for precise troubleshooting and optimization.
- Real-Time Telemetry: Collects high-frequency, hardware-accelerated telemetry data (such as buffer utilization, latency, and microburst detection) from Nexus 9000 switches.
- Intelligent Traffic Analytics: Uses advanced analytics to identify congestion hotspots, dropped packets, and anomalies affecting GPU-to-GPU communication.
- Proactive Alerting: Automatically detects and notifies operators of faults, performance degradation, or configuration drift impacting AI/ML workloads.
- Historical Data and Trend Analysis: Stores and visualizes historical network data to uncover usage patterns, predict future needs, and support capacity planning.
- Integrated Troubleshooting Tools: Offers path tracing, hop-by-hop flow analysis, and root cause identification for rapid resolution of AI/ML connectivity issues.
- Actionable Insights: Delivers actionable recommendations to optimize performance, buffer allocation, and Quality of Service (QoS) for AI/ML environments.

Summary

This white paper presents a validated, scalable, and non-blocking data center blueprint optimized for AI/ML workloads, leveraging Cisco Nexus 9000 switches and VXLAN EVPN fabric. The rail-optimized, modular architecture enables efficient cabling, high throughput, and predictable low-latency connectivity across 96 NVIDIA GPU nodes in three scalable units. By using Cisco Unified Nexus Dashboard, organizations gain automated deployment, real-time observability, and advanced analytics for seamless operations. The design ensures multi-tenant segmentation, robust fault tolerance, and straightforward expansion as AI/ML requirements evolve. Overall, this approach empowers enterprises to harness the full potential of their GPU infrastructure with performance, flexibility, and operational simplicity.

Reference

VXLAN Network with MP-BGP EVPN Control Plane Design Guide

AI/ML Networking Best Practices

Cisco Nexus 9000 Series Quality of Service (QoS) Configuration

RoCEv2 Deployment Guide

Cisco AI/ML Networking solutions

Cisco Dynamic Load Balancing

Cisco Intelligent Packet Flow

Cisco Nexus Architecture

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