

Deployment Overview and Requirements

- Deployment Overview, on page 1
- Prerequisites and Guidelines, on page 4
- Communication Ports, on page 16
- Fabric Connectivity, on page 27
- Node Distribution Across Sites, on page 33
- Services Co-location Use Cases, on page 34
- Pre-Installation Checklist, on page 37

Deployment Overview

Cisco Nexus Dashboard is a central management console for multiple data center sites and a common platform for hosting Cisco data center operation services, such as Nexus Dashboard Insights and Nexus Dashboard Orchestrator. These services are available for all the data center sites and provide real time analytics, visibility, assurance for network policies and operations, as well as policy orchestration for the data center fabrics, such as Cisco ACI or Cisco NDFC.

Nexus Dashboard provides a common platform and modern technology stack for the above-mentioned micro-services-based applications, simplifying the life cycle management of the different modern applications and reducing the operational overhead to run and maintain these applications. It also provides a central integration point for external 3rd party applications with the locally hosted applications.

Each Nexus Dashboard cluster typically consists of 1 or 3 `master` nodes. For 3-node clusters, you can also provision a number of `worker` nodes to enable horizontal scaling and `standby` nodes for easy cluster recovery in case of a master node failure. For maximum number of `worker` and `standby` nodes supported in this release, see the "Verified Scalability Limits" sections of the *Cisco Nexus Dashboard Release Notes*.

Note This document describes initial configuration of the base cluster. After your cluster is up and running, you can configure and deploy additional nodes as described in the *Cisco Nexus Dashboard User Guide*, which is also available directly from the Nexus Dashboard GUI.

Hardware vs Software Stack

Nexus Dashboard is offered as a cluster of specialized Cisco UCS servers (Nexus Dashboard platform) with the software framework (Nexus Dashboard) pre-installed on it. The Cisco Nexus Dashboard software stack

can be decoupled from the hardware and deployed in a number of virtual form factors. For the purposes of this document, we will use "Nexus Dashboard platform" specifically to refer to the hardware and "Nexus Dashboard" to refer to the software stack and the GUI console.



Note Root access to the Nexus Dashboard software is restricted to Cisco TAC only. A special user `rescue-user` is created for all Nexus Dashboard deployments to enable a set of operations and troubleshooting commands. For additional information about the available `rescue-user` commands, see the "Troubleshooting" chapter of the *Nexus Dashboard User Guide*.

This guide describes the initial deployment of the Nexus Dashboard software; hardware setup is described in the *Nexus Dashboard Hardware Setup Guide*, while other Nexus Dashboard operations procedures are described in the *Cisco Nexus Dashboard User Guide*.

Services

Nexus Dashboard is a standard appliance platform to build and deploy services that would allow you to consume all Nexus Dashboard products in a consistent and uniform manner. You can subscribe and consume services like Insights, Orchestrator, Fabric Controller, and Data Broker with the Nexus Dashboard platform providing the necessary capacity and life cycle management operations for these services.

Typically, the Nexus Dashboard platform is shipped with only the software required for managing the lifecycle of these services, but no actual services are packaged with the appliance. If you allow public network connectivity from your data centers, you can download and install the services with a few clicks. However, without public network connectivity, you will need to manually download these services, upload them to the platform, and perform installation operations before you can use them.

If you are ordering the physical Nexus Dashboard servers, you have the option to choose Nexus Dashboard Insights and Nexus Dashboard Orchestrator services to be pre-installed on the hardware before it is shipped to you. For more information, see the *Nexus Dashboard Ordering Guide*. Note that if you are deploying the virtual or cloud form factors of the Nexus Dashboard, there are no changes to service installation and you will need to deploy the services separately after the cluster is ready.

Available Form Factors

This release of Cisco Nexus Dashboard can be deployed using a number of different form factors. Keep in mind however, you must use the same form factor for all nodes, mixing different form factors within the same cluster is not supported.

- Cisco Nexus Dashboard physical appliance (`.iso`)

  This form factor refers to the original physical appliance hardware that you purchased with the Cisco Nexus Dashboard software stack pre-installed on it.

  The later sections in this document describe how to configure the software stack on the existing physical appliance hardware to deploy the cluster. Setting up the original Cisco Nexus Dashboard platform hardware is described in *Cisco Nexus Dashboard Hardware Setup Guide*.

- VMware ESX (`.ova`)

  Virtual form factor that allows you to deploy a Nexus Dashboard cluster using three VMware ESX virtual machines.

- Linux KVM (`.qcow2`)

Virtual form factor that allows you to deploy a Nexus Dashboard cluster using three Linux KVM virtual machines.

- Amazon Web Services (`.ami`)

  Cloud form factor that allows you to deploy a Nexus Dashboard cluster using three AWS instances.

- Microsoft Azure (`.arm`)

  Cloud form factor that allows you to deploy a Nexus Dashboard cluster using three Azure instances.

- In an existing Red Hat Enterprise Linux (RHEL) system

  Beginning with Release 2.2(1), you can run Nexus Dashboard node in an existing Red Hat Enterprise Linux server.

Upgrading From Previous Versions of Nexus Dashboard

If you are already running a Nexus Dashboard, Release 2.0.1 or later, you can upgrade directly to the latest release while retaining the cluster configuration and applications, as described in Upgrading Nexus Dashboard

Upgrading From Application Services Engine

If you are running Cisco Application Services Engine, you must upgrade to Nexus Dashboard release 2.0(2g) as described in *Cisco Nexus Dashboard Deployment Guide, Release 2.0(x)* before upgrading to Nexus Dashboard release 2.1(x) or later.

Cluster Sizing and Availability Guidelines

As mentioned previously, each Nexus Dashboard cluster is first deployed using 1 or 3 `master` nodes. Depending on the type and number of services you choose to run, you may be required to deploy additional worker nodes in your cluster after the initial deployment. For cluster sizing information and recommended number of nodes based on specific use cases, see Cisco Nexus Dashboard Cluster Sizing.



Note

- Single-node clusters are supported for a limited number of services and cannot be extended to a 3-node cluster after the initial deployment.
- Only 3-node clusters support additional `worker` nodes.
- If you deploy a single-node cluster and want to extended it to a 3-node cluster or add `worker` nodes, you will need to redeploy it as a base 3-node cluster.
- For 3-node clusters, at least 2 `master` nodes are required for the cluster to remain operational. In case of 2 `master` node failure, the cluster will enter an offline read-only mode and cannot be used until you recover it as described in the *Cisco Nexus Dashboard User Guide*.

After your initial cluster is up and running, you can configure and deploy additional nodes as described in the *Cisco Nexus Dashboard User Guide*, which is also available directly from the Nexus Dashboard GUI.

Supported Services

For the full list of supported applications and the associated compatibility and interoperability information, see the Nexus Dashboard and Services Compatibility Matrix.

Prerequisites and Guidelines

Network Time Protocol (NTP) and Domain Name System (DNS)

The Nexus Dashboard nodes require valid DNS and NTP servers for all deployments and upgrades.

Lack of valid DNS connectivity (such as if using an unreachable or a placeholder IP address) can prevent the system from deploying or upgrading successfully.

Note Nexus Dashboard acts as both a DNS client and resolver. It uses an internal Core DNS server which acts as DNS resolver for internal services. It also acts as a DNS client to reach external hosts within the intranet or the Internet, hence it requires an external DNS server to be configured.

Additionally, Nexus Dashboard does not support DNS servers with wildcard records.

Nexus Dashboard External Networks

Cisco Nexus Dashboard is deployed as a cluster, connecting each service node to two networks. When first configuring Nexus Dashboard, you will need to provide two IP addresses for the two Nexus Dashboard interfaces—one connected to the Data Network and the other to the Management Network.

Individual services installed in the Nexus Dashboard may utilize the two networks for additional purposes, so we recommend consulting the specific service's documentation in addition to this document for your deployment planning.

Table 1: External Network Purpose

Data Network	Management Network
• Nexus Dashboard node clustering • Service to service communication • Nexus Dashboard nodes to Cisco APIC, Cloud Network Controller, and NDFC/DCNM communication For example, the network traffic for services such as Nexus Dashboard Insights.	• Accessing Nexus Dashboard GUI • Accessing Nexus Dashboard CLI via SSH • DNS and NTP communication • Nexus Dashboard firmware upload • Accessing Cisco DC App Center (AppStore) If you want to use the Nexus Dashboard App Store to install services, https://dcappcenter.cisco.com must be reachable via the Management Network • Intersight device connector

The two networks have the following requirements:

- For all new Nexus Dashboard deployments, the management network and data network must be in different subnets.

- For physical clusters, the management network must provide IP reachability to each node's CIMC via TCP ports 22/443.

  Nexus Dashboard cluster configuration uses each node's CIMC IP address to configure the node.

- For Nexus Dashboard Insights service, the data network must provide IP reachability to the in-band network of each fabric and of the APIC.
- For Nexus Dashboard Insights and AppDynamics integration, the data network must provide IP reachability to the AppDynamics controller.
- For Nexus Dashboard Orchestrator service, the data network can have in-band and/or out-of-band IP reachability for Cisco APIC sites but must have in-band reachability for Cisco NDFC/DCNM sites.
- The data network interface requires a minimum MTU of 1500 to be available for the Nexus Dashboard traffic.

  Higher MTU can be configured if desired.

Note If external VLAN tag is configured for switch ports that are used for data network traffic, you must enable jumbo frames or configure custom MTU equal to or greater than 1504 bytes.

- The table bellow summarize service-specific requirements for the management and data networks.

Note Changing the data subnet requires redeploying the cluster, so we recommend using a larger subnet than the bare minimum required by the nodes and services to account for any additional services in the future. In addition to the requirements listed in this section, ensure that you consult the *Release Notes* for the specific service you plan to deploy.

Allocating persistent IP addresses is done after the cluster is deployed using the External Service Pools configuration in the UI, as described in the *Cisco Nexus Dashboard User Guide*.

We recommend consulting the specific service's documentation for any additional requirements and caveats related to persistent IP configuration.

Table 2: Service-Specific Network Requirements

Nexus Dashboard Service	Management Interface	Data Interface	Total Number of Persistent IPs
Nexus Dashboard Orchestrator	Layer 3 adjacent	Layer 3 adjacent	N/A
Nexus Dashboard Insights without SFLOW/NetFlow (ACI fabrics)	Layer 3 adjacent	Layer 3 adjacent	N/A

Nexus Dashboard Service	Management Interface	Data Interface	Total Number of Persistent IPs
Nexus Dashboard Insights without SFLOW/NetFlow (NDFC/DCNM fabrics)	Layer 3 adjacent	Layer 2 adjacent	6 IPs in data interface network if using IPv4 7 IPs in data interface network if using IPv6
Nexus Dashboard Insights with SFLOW/NetFlow (ACI or NDFC/DCNM fabrics)	Layer 3 adjacent	Layer 2 adjacent	6 IPs in data interface network

Nexus Dashboard Service	Management Interface	Data Interface	Total Number of Persistent IPs
Nexus Dashboard Fabric Controller, Release 12.0.x	Layer 2 adjacent	Layer 2 adjacent	

Nexus Dashboard Service	Management Interface	Data Interface	Total Number of Persistent IPs

			• If **LAN Device Management Connectivity** is set to `Management` (default):
			  • 2 IPs in the management network for SNMP/Syslog and SCP services
			  • If **EPL** is enabled, 1 additional IP in the data network for each fabric
			  • If **IP Fabric for Media** is enabled, 1 additional IP in the management network for telemetry
			• If **LAN Device Management Connectivity** is set to `Data`:
			  • 2 IPs in the data network for SNMP/Syslog and SCP services
			  • If **EPL** is enabled, 1 additional IP in the data network for each fabric
			  • If **IP Fabric for Media** is enabled, 1

Nexus Dashboard Service	Management Interface	Data Interface	Total Number of Persistent IPs
			additional IP in the data network for telemetry

Nexus Dashboard Service	Management Interface	Data Interface	Total Number of Persistent IPs
Nexus Dashboard Fabric Controller, Release 12.1.1 and later	Layer 2 or Layer 3 adjacent	Layer 2 or Layer 3 adjacent	

Nexus Dashboard Service	Management Interface	Data Interface	Total Number of Persistent IPs

			• When operating in Layer 2 mode with LAN deployment type and **LAN Device Management Connectivity** set to `Management` (default)
			  • 2 IPs in the management network for SNMP/Syslog and SCP services
			  • If **EPL** is enabled, 1 additional IP in the data network for each fabric
			  • If **IP Fabric for Media** is enabled, 1 additional IP in the management network for telemetry
			• When operating in Layer 2 mode with LAN deployment type and **LAN Device Management Connectivity** set to `Data`:
			  • 2 IPs in the data network for SNMP/Syslog and SCP services
			  • If **EPL** is

Nexus Dashboard Service	Management Interface	Data Interface	Total Number of Persistent IPs
			enabled, 1 additional IP in the data network for each fabric • If **IP Fabric for Media** is enabled, 1 additional IP in the data network for telemetry

Nexus Dashboard Service	Management Interface	Data Interface	Total Number of Persistent IPs
			• When operating in Layer 3 mode with LAN deployment type: • **LAN Device Management Connectivity** must be set to `Data` • 2 IPs for SNMP/Syslog and SCP services • If **EPL** is enabled, 1 additional IP in the data network for each fabric • All persistent IPs must be part of a separate pool that must not overlap with the management or data subnets. For more information about Layer 3 mode for persistent IPs, see the Persistent IPs section in the User's Guide.

Nexus Dashboard Service	Management Interface	Data Interface	Total Number of Persistent IPs
			• When operating in Layer 2 mode with SAN Controller deployment type: • 1 IP for SSH • 1 IP for SNMP/Syslog • 1 IP for SAN Insights functionality **Note** SAN Controller and IP Fabric for Media are not supported in Layer 3 mode
Nexus Dashboard Data Broker	Layer 3 adjacent	N/A	N/A

- Connectivity between the nodes is required on both networks with the following additional round trip time (RTT) requirements.

Note You must always use the lowest RTT requirement when deploying the Nexus Dashboard cluster and services. For example, if you plan to co-host the Insights and Orchestrator services, site connectivity RTT must not exceed 50ms.

.

Table 3: RTT Requirements

Service	Connectivity	Maximum RTT
Nexus Dashboard Orchestrator	Between nodes	50 ms
	To sites	For APIC sites: 500 ms For NDFC sites: 150 ms
Nexus Dashboard Insights	Between nodes	50 ms
	To sites	50 ms
Nexus Dashboard Fabric Controller	Between nodes	50 ms
	To sites	50 ms

Service	Connectivity	Maximum RTT
Nexus Dashboard Data Broker	Between nodes	150 ms
	To sites	500 ms

Nexus Dashboard Internal Networks

Two additional internal networks are required for communication between the containers used by the Nexus Dashboard:

- **Application overlay** is used for applications internally within Nexus Dashboard

  Application overlay must be a `/16` network and a default value is pre-populated during deployment.

- **Service overlay** is used internally by the Nexus Dashboard.

  Service overlay must be a `/16` network and a default value is pre-populated during deployment.

If you are planning to deploy multiple Nexus Dashboard clusters, they can use the same Application and Service subnets.



Note Communications between containers deployed in different Nexus Dashboard nodes is VXLAN-encapsulated and uses the data interfaces IP addresses as source and destination. This means that the Application Overlay and Service Overlay addresses are never exposed outside the data network and any traffic on these subnets is routed internally and does not leave the cluster nodes.

For example, if you had another service (such as DNS) on the same subnet as one of the overlay networks, you would not be able to access it from your Nexus Dashboard as the traffic on that subnet would never be routed outside the cluster. As such, when configuring these networks, ensure that they are unique and do not overlap with any existing networks or services external to the cluster, which you may need to access from the Nexus Dashboard cluster nodes.

For the same reason, we recommend not using `169.254.0.0/16` (the Kubernetes br1 subnet) for the App or Service subnets.

BGP Configuration and Persistent IPs

Previous releases of Nexus Dashboard allowed you to configure one or more persistent IP addresses for services (such as Nexus Dashboard Insights) that require retaining the same IP addresses even in case they are relocated to a different Nexus Dashboard node. However, in those releases, the persistent IPs had to be part of the management and data subnets and the feature could be enabled only if all nodes in the cluster were part of the same Layer 3 network. Here the services used Layer 2 mechanisms like Gratuitous ARP or Neighbor Discovery to advertise the persistent IPs within it's Layer 3 network

Beginning with Release 2.2(1), the Persistent IPs feature is supported even if you deploy the cluster nodes in different Layer 3 networks. In this case, the persistent IPs are advertised out of each node's data links via BGP, which we refer to as "Layer 3 mode". The IPs must also be part of a subnet that is not overlapping with any of the nodes' management or data subnets. If the persistent IPs are outside the data and management networks, this feature will operate in Layer 3 mode by default; if the IPs are part of those networks, the feature will operate in Layer 2 mode.

BGP can be enabled during cluster deployment or from the Nexus Dashboard GUI after the cluster is up and running.

If you plan to enable BGP and use the persistent IP functionality, you must:

- Ensure that the peer routers exchange the advertised persistent IPs between the nodes' Layer 3 networks.
- Choose to enable BGP at the time of the cluster deployment as described in the subsequent sections or enable it afterwards in the Nexus Dashboard GUI as described in the "Persistent IP Addresses" sections of the *User's Guide*.
- Ensure that the persistent IP addresses you allocate do not be overlap with any of the nodes' management or data subnets.

Communication Ports

The following sections provide a reference for ports required by the Nexus Dashboard cluster and services.

Note All services use TLS or mTLS with encryption to protect data privacy and integrity over the wire.

Nexus Dashboard Ports

The following ports are required by the Nexus Dashboard cluster.

Table 4: Nexus Dashboard Ports (Management Network)

Service	Port	Protocol	Direction `In`—towards the cluster `Out`—from the cluster towards the fabric or outside world	Connection
ICMP	ICMP	ICMP	In/Out	Other cluster nodes, CIMC, default gateway
SSH	22	TCP	In/Out	CLI and CIMC of the cluster nodes
TACACS	49	TCP	Out	TACACS server
DNS	53	TCP/UDP	Out	DNS server
HTTP	80	TCP	Out	Internet/proxy
NTP	123	UDP	Out	NTP server
HTTPS	443	TCP	In/Out	UI, other clusters (for multi-cluster connectivity), fabrics, Internet/proxy

Service	Port	Protocol	Direction `In`—towards the cluster `Out`—from the cluster towards the fabric or outside world	Connection
LDAP	389 636	TCP	Out	LDAP server
Radius	1812	TCP	Out	Radius server
KMS	9880	TCP	In/Out	Other cluster nodes and ACI fabrics
Infra-Service	30012 30021 30500-30600	TCP/UDP	In/Out	Other cluster nodes

Table 5: Nexus Dashboard Ports (Data Network)

Service	Port	Protocol	Direction `In`—towards the cluster `Out`—from the cluster towards the fabric or outside world	Connection
ICMP	ICMP	ICMP	In/Out	Other cluster nodes, CIMC, default gateway
SSH	22	TCP	Out	In-band of switches and APIC
DNS	53	TCP/UDP	In/Out	Other cluster nodes and DNS server
HTTPS	443	TCP	Out	In-band of switches and APIC/NDFC/DCNM.
SSH	1022	TCP/UDP	In/Out	Other cluster nodes
VXLAN	4789	UDP	In/Out	Other cluster nodes
KMS	9880	TCP	In/Out	Other cluster nodes and ACI fabrics

Service	Port	Protocol	Direction `In`—towards the cluster `Out`—from the cluster towards the fabric or outside world	Connection
Infra-Service	3379 3380 8989 9090 9969 9979 9989 15223 30002-30006 30009-30010 30012 30014-30015 30018-30019 30025 30027	TCP	In/Out	Other cluster nodes
Infra-Service	30016 30017	TCP/UDP	In/Out	Other cluster nodes
Infra-Service	30500-30600	TCP/UDP	In/Out	Other cluster nodes

Nexus Dashboard Insights Ports

In addition to the ports required by the Nexus Dashboard cluster nodes, which are listed above, the following ports are required by the Nexus Dashboard Insights service.

Table 6: Nexus Dashboard Insights Ports (Data Network)

Service	Port	Protocol	Direction `In`—towards the cluster `Out`—from the cluster towards the fabric or outside world	Connection
Show Techcollection	2022	TCP	In/Out	Inband of switches and APIC/NDFC/DCNM
Flow Telemetry	5640-5671	UDP	In	Inband of switches
TAC Assist	8884	TCP	In/Out	External
KMS	9989	TCP	In/Out	Other cluster nodes and ACI fabrics
Kafka	30001	TCP	In/Out	Inband of switches and APIC/NDFC/DCNM
SW Telemetry	5695 30000 57500 30570	TCP	In/Out	Other cluster nodes

Nexus Dashboard Fabric Controller Ports

In addition to the ports required by the Nexus Dashboard (ND) cluster nodes, the following ports are required by the Nexus Dashboard Fabric Controller (NDFC) service.



Note The following ports apply to the Nexus Dashboard management network and/or data network interfaces depending on which interface provides IP reachability from the NDFC service to the switches.

Table 7: Nexus Dashboard Fabric Controller Ports

Service	Port	Protocol	Direction `In`—towards the cluster `Out`—from the cluster towards the fabric or outside world	Connection (Applies to both LAN and SAN deployments, unless stated otherwise)
SSH	22	TCP	Out	SSH is a basic mechanism for accessing devices.
SCP	22	TCP	Out	SCP clients archiving NDFC backup files to remote server.
SMTP	25	TCP	Out	SMTP port is configurable through NDFC's **Server Settings** menu. This is an optional feature.
DHCP	67	UDP	In	If NDFC local DHCP server is configured for Bootstrap/POAP purposes. This applies to LAN deployments only. **Note** When using NDFC as a local DHCP server for POAP purposes, all ND master node IPs must be configured as DHCP relays. Whether the ND nodes' management or data IPs are bound to the DHCP server is determined by the LAN Device Management Connectivity in the NDFC Server Settings.
DHCP	68	UDP	Out	
SNMP	161	TCP/UDP	Out	SNMP traffic from NDFC to devices.
HTTPS/HTTP (NX-API)	443/80	TCP	Out	NX-API HTTPS/HTTP client connects to device NX-API server on port 443/80, which is also configurable. NX-API is an optional feature, used by limited set of NDFC functions. This applies to LAN deployments only.
HTTPS (vCenter, Kubernetes, OpenStack, Discovery)	443	TCP	Out	NDFC provides an integrated host and physical network topology view by correlating the information obtained from registered VMM domains, such as VMware vCenter or OpenStack, as well as container orchestrators, such as Kubernetes. This is an optional feature

Note The following ports apply to the External Service IPs, also known as persistent IPs, used by some of the NDFC services. These External Service IPs may come from certain subnet pools, depending on the type of deployment:

- For LAN deployments, these External Service IPs may come from the Nexus Dashboard management subnet pool or the data subnet pool, depending on the configured settings.
- For SAN deployments, these External Service IPs come from the Nexus Dashboard data subnet pool.

Table 8: Nexus Dashboard Fabric Controller Persistent IP Ports

Service	Port	Protocol	Direction `In`—towards the cluster `Out`—from the cluster towards the fabric or outside world	Connection (Applies to both LAN and SAN deployments, unless stated otherwise)
SCP	22	TCP	In	SCP is used by various features to transfer files between devices and the NDFC service. The NDFC SCP service serves as the SCP server for both downloads and uploads. SCP is also used by the POAP client on the devices to download POAP-related files. The SCP-POAP service in NDFC has a persistent IP that is associated with either the management or data subnet. This is controlled by the **LAN Device Management Connectivity** setting in the NDFC Server Settings.
TFTP (POAP)	69	TCP	In	Only used for device zero-touch provisioning via POAP, where devices can send (limited jailed write-only access to NDFC) basic inventory information to NDFC to start secure POAP communication. NDFC Bootstrap or POAP can be configured for TFTP or HTTP/HTTPS. The SCP-POAP service in NDFC has a persistent IP that is associated with either the management or data subnet. This is controlled by the **LAN Device Management Connectivity** setting in the NDFC Server Settings. This applies to LAN deployments only.

Service	Port	Protocol	Direction `In`—towards the cluster `Out`—from the cluster towards the fabric or outside world	Connection (Applies to both LAN and SAN deployments, unless stated otherwise)
HTTP (POAP)	80	TCP	In	Only used for device zero-touch provisioning via POAP, where devices can send (limited jailed write-only access to NDFC) basic inventory information to NDFC to start secure POAP communication. NDFC Bootstrap or POAP can be configured for TFTP or HTTP/HTTPS. The SCP-POAP service in NDFC has a persistent IP that is associated with either the management or data subnet. This is controlled by the **LAN Device Management Connectivity** setting in the NDFC Server Settings. This applies to LAN deployments only.
BGP	179	TCP	In/Out	For Endpoint Locator, per fabric where it is enabled, an EPL service is spawned with its own persistent IP. This service is always associated with the Nexus Dashboard data interface. NDFC EPL service peers with the appropriate BGP entity (typically BGP Route-Reflectors) on the fabric to get BGP updates needed to track endpoint information. This feature is only applicable for VXLAN BGP EVPN fabric deployments. This applies to LAN deployments only.
HTTPS (POAP)	443	TCP	In	Secure POAP is accomplished via the NDFC HTTPS Server on port 443. The HTTPS server is bound to the SCP-POAP service and uses the same persistent IP assigned to that pod. The SCP-POAP service in NDFC has a persistent IP that is associated with either the management or data subnet. This is controlled by the **LAN Device Management Connectivity** setting in the NDFC Server Settings. This applies to LAN deployments only.

Service	Port	Protocol	Direction `In`—towards the cluster `Out`—from the cluster towards the fabric or outside world	Connection (Applies to both LAN and SAN deployments, unless stated otherwise)
Syslog	514	UDP	In	When NDFC is configured as a Syslog server, Syslogs from the devices are sent out toward the persistent IP associated with the SNMP-Trap/Syslog service pod The SNMP-Trap-Syslog service in NDFC has a persistent IP that is associated with either the management or data subnet. This is controlled by the **LAN Device Management Connectivity** setting in the NDFC Server Settings
SCP	2022	TCP	Out	Transport tech-support file from persistent IP of NDFC POAP-SCP pod to a separate ND cluster running Nexus Dashboard Insights. The SCP-POAP service in NDFC has a persistent IP that is associated with either the management or data subnet. This is controlled by the **LAN Device Management Connectivity** setting in the NDFC Server Settings
SNMP Trap	2162	UDP	In	SNMP traps from devices to NDFC are sent out toward the persistent IP associated with the SNMP-Trap/Syslog service pod. The SNMP-Trap-Syslog service in NDFC has a persistent IP that is associated with either the management or data subnet. This is controlled by the **LAN Device Management Connectivity** setting in the NDFC Server Settings
GRPC (Telemetry)	33000	TCP	In	SAN Insights Telemetry Server which receives SAN data (such as storage, hosts, flows, and so on) over GRPC transport tied to NDFC Persistent IP. This is enabled on SAN deployments only.

Service	Port	Protocol	Direction `In`—towards the cluster `Out`—from the cluster towards the fabric or outside world	Connection (Applies to both LAN and SAN deployments, unless stated otherwise)
GRPC (Telemetry)	50051	TCP	In	Information related to multicast flows for IP Fabric for Media deployments as well as PTP for general LAN deployments is streamed out via software telemetry to a persistent IP associated with a NDFC GRPC receiver service pod. This is enabled on LAN and Media deployments only.

Nexus Dashboard Fabric Controller Ports for SAN Deployments

Nexus Dashboard Fabric Controller can be deployed on a single-node or 3-node Nexus Dashboard cluster. The following ports are required for NDFC SAN deployments on single-node clusters.

Table 9: Nexus Dashboard Fabric Controller Ports for SAN Deployments on Single-Node Clusters

Service	Port	Protocol	Direction `In`—towards the cluster `Out`—from the cluster towards the fabric or outside world	Connection (Applies to both LAN and SAN deployments, unless stated otherwise)
SSH	22	TCP	Out	SSH is a basic mechanism for accessing devices.
SCP	22	TCP	Out	SCP clients archiving NDFC backup files to remote server.
SMTP	25	TCP	Out	SMTP port is configurable through NDFC's Server Settings menu. This is an optional feature.

Service	Port	Protocol	Direction `In`—towards the cluster `Out`—from the cluster towards the fabric or outside world	Connection (Applies to both LAN and SAN deployments, unless stated otherwise)
SNMP	161	TCP/UDP	Out	SNMP traffic from NDFC to devices.
HTTPS (vCenter, Kubernetes, OpenStack, Discovery)	443	TCP	Out	NDFC provides an integrated host and physical network topology view by correlating the information obtained from registered VMM domains, such as VMware vCenter or OpenStack, as well as container orchestrators, such as Kubernetes. This is an optional feature.



Note The following ports apply to the External Service IPs, also known as Persistent IPs, used by some of the NDFC services. These External Service IPs may come from the Nexus Dashboard management subnet pool or the data subnet pool depending on the configured settings.

Table 10: Nexus Dashboard Fabric Controller Persistent IP Ports for SAN Deployments on Single-Node Clusters

Service	Port	Protocol	Direction `In`—towards the cluster `Out`—from the cluster towards the fabric or outside world	Connection
SCP	22	TCP	In	SCP is used by various features to transfer files between devices and the NDFC service. The NDFC SCP service functions for both downloads and uploads.
Syslog	514	UDP	In	When NDFC is configured as a Syslog server, syslogs from the devices are sent out towards the persistent IP associated with the SNMP-Trap/Syslog service pod. The SNMP-Trap-Syslog service in NDFC has a persistent IP that is associated with either the management or data subnet. This is controlled by the LAN Device Management Connectivity setting in the NDFC Server Settings.

Service	Port	Protocol	Direction `In`—towards the cluster `Out`—from the cluster towards the fabric or outside world	Connection
SNMP Trap	2162	UDP	In	SNMP traps from devices to NDFC are sent out toward the persistent IP associated with the SNMP-Trap/Syslog service pod. The SNMP-Trap-Syslog service in NDFC has a persistent IP that is associated with either the management or data subnet.
GRPC (Telemetry)	33000	TCP	In	SAN Insights Telemetry Server which receives SAN data (such as storage, hosts, flows, and so on) over GRPC transport tied to NDFC Persistent IP. This is enabled on SAN deployments only.

Fabric Connectivity

The following sections describe how to connect your Nexus Dashboard cluster to your fabrics.

For on-premises APIC or NDFC fabrics, you can connect the Nexus Dashboard cluster in one of two ways:

- The Nexus Dashboard cluster connected to the fabric via a Layer 3 network.
- The Nexus Dashboard nodes connected to the leaf switches as typical hosts.

For Cisco Cloud Network Controller fabrics, you will need to connect via a Layer 3 network.

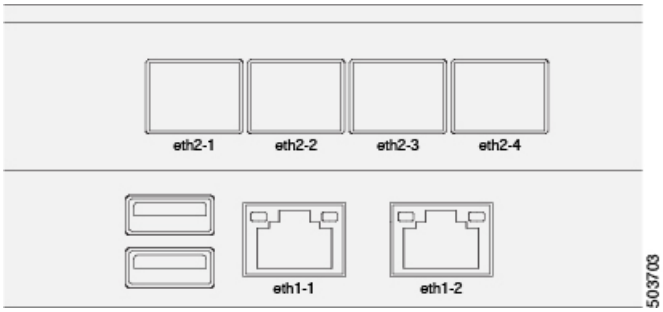
Physical Node Cabling

If you plan to deploy a virtual or cloud form factor cluster, you can skip this section.

The following figure shows the Nexus Dashboard physical node interfaces:

- `eth1-1` and `eth1-2` must be connected to the Management network
- `eth2-1` and `eth2-2` must be connected to the Data network

Figure 1: Node Connectivity



The interfaces are configured as Linux bonds (one for the data interfaces and one for the management interfaces) running in active-standby mode. All interfaces must be connected to individual host ports, PortChannel or vPC are not supported.

When Nexus Dashboard nodes are connected to Cisco Catalyst switches, packets are tagged with `vlan0` if no VLAN is specified. In this case, you must add `switchport voice vlan dot1p` command to the switch interfaces where the nodes are connected to ensure reachability over the data network.

Connecting via External Layer 3 Network

We recommend connecting the Nexus Dashboard cluster to the fabrics via an external Layer 3 network as it does not tie the cluster to any one fabric and the same communication paths can be establish to all sites. Specific connectivity depends on the type of applications deployed in the Nexus Dashboard:

- If you are deploying Nexus Dashboard Orchestrator to manage Cisco ACI fabrics only, you can establish connectivity from the data interface to either the in-band or out-of-band (OOB) interface of each site's APIC or both.
- If you are deploying Nexus Dashboard Orchestrator to manage Cisco NDFC fabrics, you must establish connectivity from the data interface to the in-band interface of each site's NDFC.
- If you are deploying Day-2 Operations applications, such as Nexus Dashboard Insights, you must establish connectivity from the data interface to the in-band network of each fabric and of the APIC.

If you plan to connect the cluster across a Layer 3 network, keep the following in mind:

- For ACI fabrics, you must configure an L3Out and the external EPG for Cisco Nexus Dashboard data network connectivity in the management tenant.

  Configuring external connectivity in an ACI fabric is described in Cisco APIC Layer 3 Networking Configuration Guide.

- For NDFC fabrics, if the data interface and NDFC's inband interface are in different subnets, you must add a route on NDFC to reach the Nexus Dashboard's data network address.

You can add the route from the NDFC UI by navigating to **Administration** > **Customization** > **Network Preference** > **In-Band (eth2)** , then adding the route and saving.

- If you specify a VLAN ID for your data interface during setup of the cluster, the host port must be configured as `trunk` allowing that VLAN.

  However, in most common deployments, you can leave the VLAN ID empty and configure the host port in `access` mode.

The following two figures show two distinct network connectivity scenarios when connecting the Nexus Dashboard cluster to the fabrics via a Layer 3 network. The primary purpose of each depends on the type of application you may be running in your Nexus Dashboard.

Figure 2: Connecting via Layer 3 Network, Day-2 Operations Applications

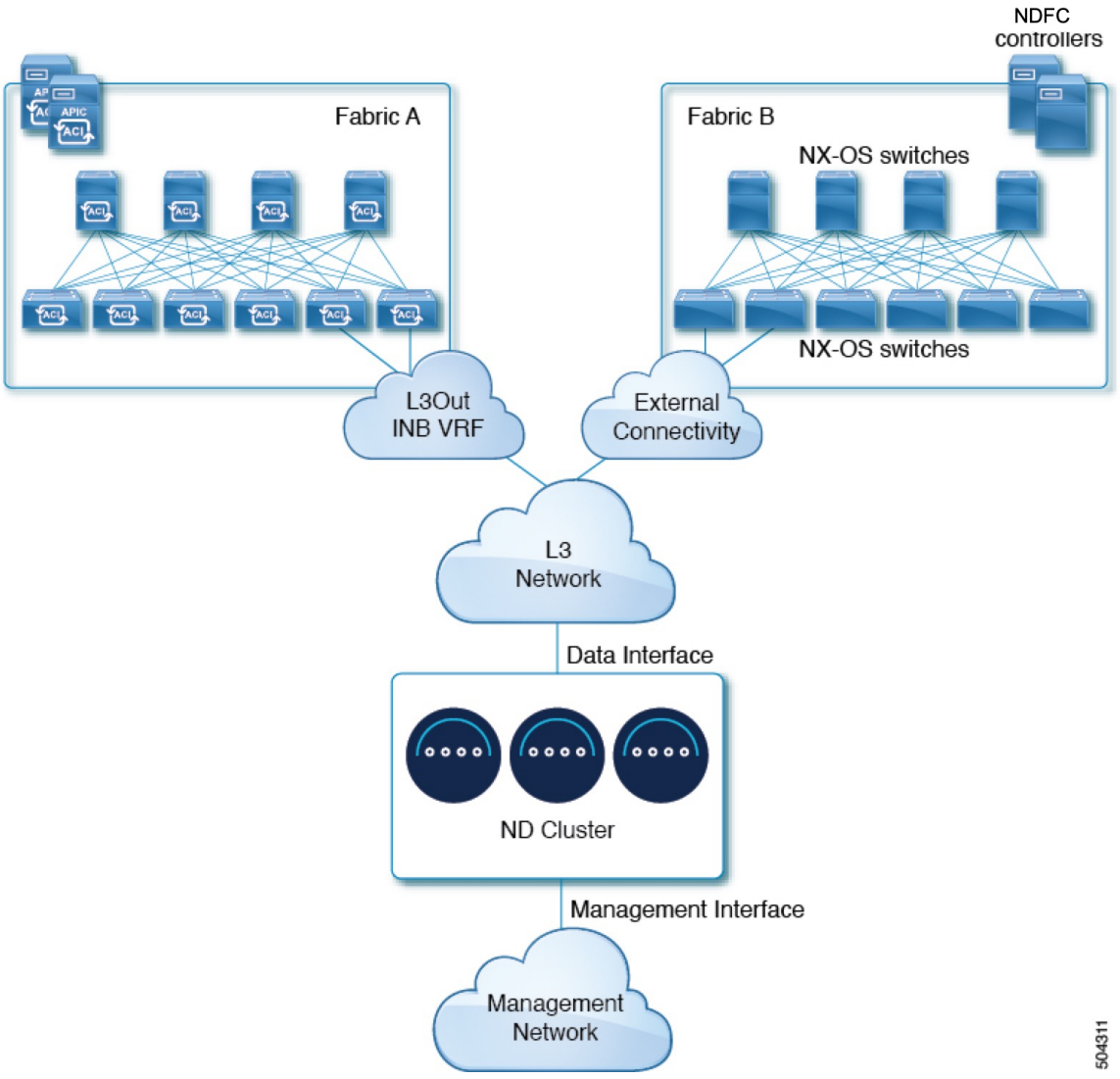
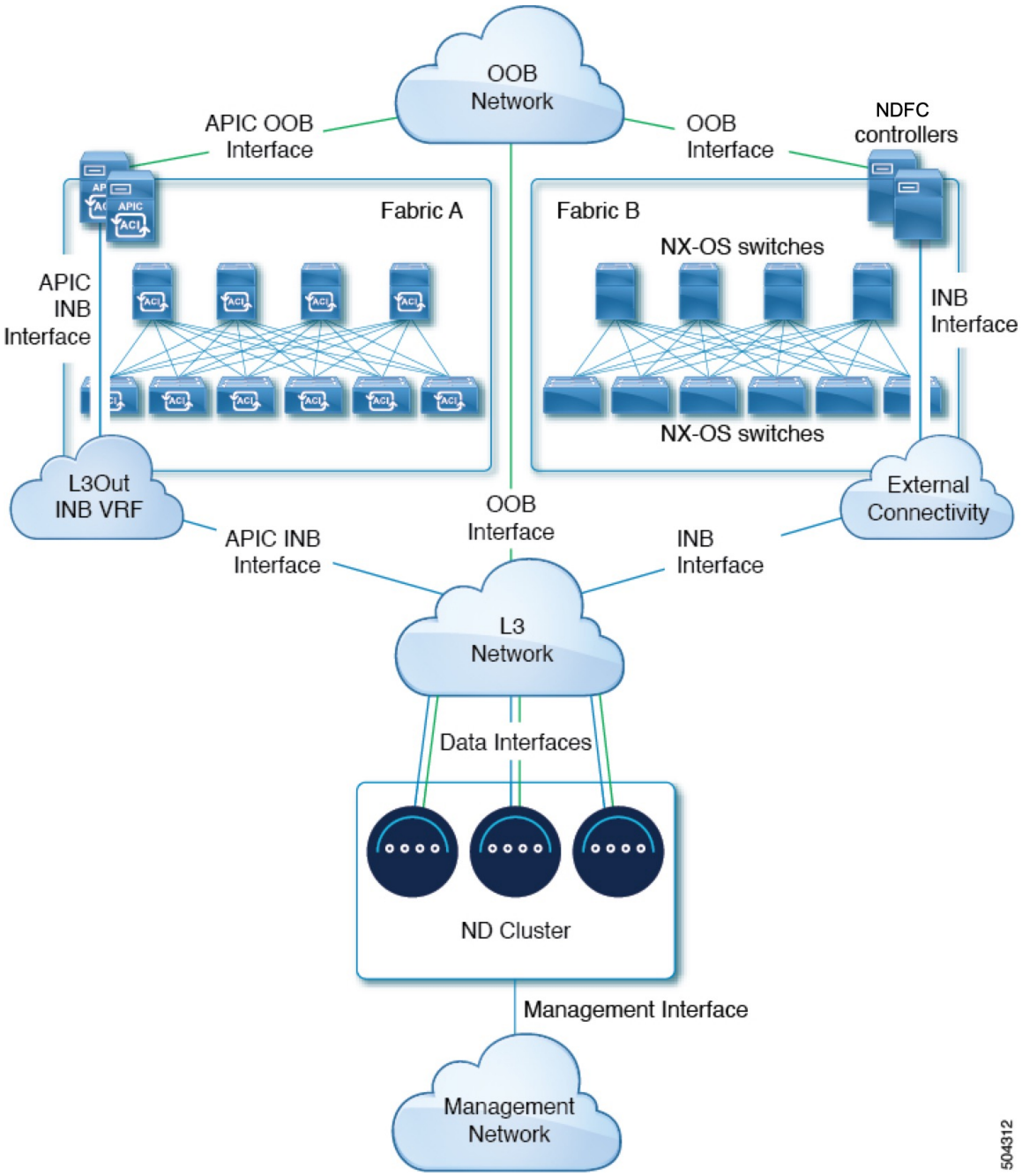


Figure 3: Connecting via Layer 3 Network, Nexus Dashboard Orchestrator



Connecting Nodes Directly to Leaf Switches

You can also connect the Nexus Dashboard cluster directly to one of the fabrics. This provides easy connectivity between the cluster and in-band management of the fabric, but ties the cluster to the specific fabric and requires reachability to other fabrics to be established through external connectivity. This also makes the cluster dependent on the specific fabric so issues within the fabric may impact Nexus Dashboard connectivity. Like in the previous example, connectivity depends on the type of applications deployed in the Nexus Dashboard:

- If you are deploying Nexus Dashboard Orchestrator to manage Cisco ACI fabrics only, you can establish connectivity from the data interface to either the in-band or out-of-band (OOB) interface of each site's APIC.
- If you are deploying Nexus Dashboard Insights, you must establish connectivity from the data interface to the in-band interface of each fabric.

  For ACI fabrics, the data interface IP subnet connects to an EPG/BD in the fabric and must have a contract established to the local in-band EPG in the management tenant. We recommend deploying the Nexus Dashboard in the management tenant and in-band VRF. Connectivity to other fabrics is established via an L3Out.
- If you are deploying Nexus Dashboard Insights with ACI fabrics, the data interface IP address and the ACI fabric's in-band IP address must be in different subnets.

If you plan to connect the cluster directly to the leaf switches, keep the following in mind:

- If deploying in VMware ESX or Linux KVM, the host must be connected to the fabric via trunk port.
- If you specify a VLAN ID for your data network during setup of the cluster, the Nexus Dashboard interface and the port on the connected network device must be configured as `trunk`

  However, in most cases we recommend not assigning a VLAN to the data network, in which case you must configure the ports in `access` mode.
- For ACI fabrics:
  - We recommend configuring the bridge domain (BD), subnet, and endpoint group (EPG) for Cisco Nexus Dashboard connectivity in management tenant.

    Because the Nexus Dashboard requires connectivity to the in-band EPG in the in-band VRF, creating the EPG in the management tenant means no route leaking is required.
  - You must create a contract between the fabric's in-band management EPG and Cisco Nexus Dashboard EPG.
  - If several fabrics are monitored with apps on the Nexus Dashboard cluster, L3Out with default route or specific route to other ACI fabric in-band EPG must be provisioned and a contract must be established between the cluster EPG and the L3Out's external EPG.

The following two figures show two distinct network connectivity scenarios when connecting the Nexus Dashboard cluster directly to the fabrics' leaf switches. The primary purpose of each depends on the type of application you may be running in your Nexus Dashboard.

Figure 4: Connecting Directly to Leaf Switches, Day-2 Operations Applications

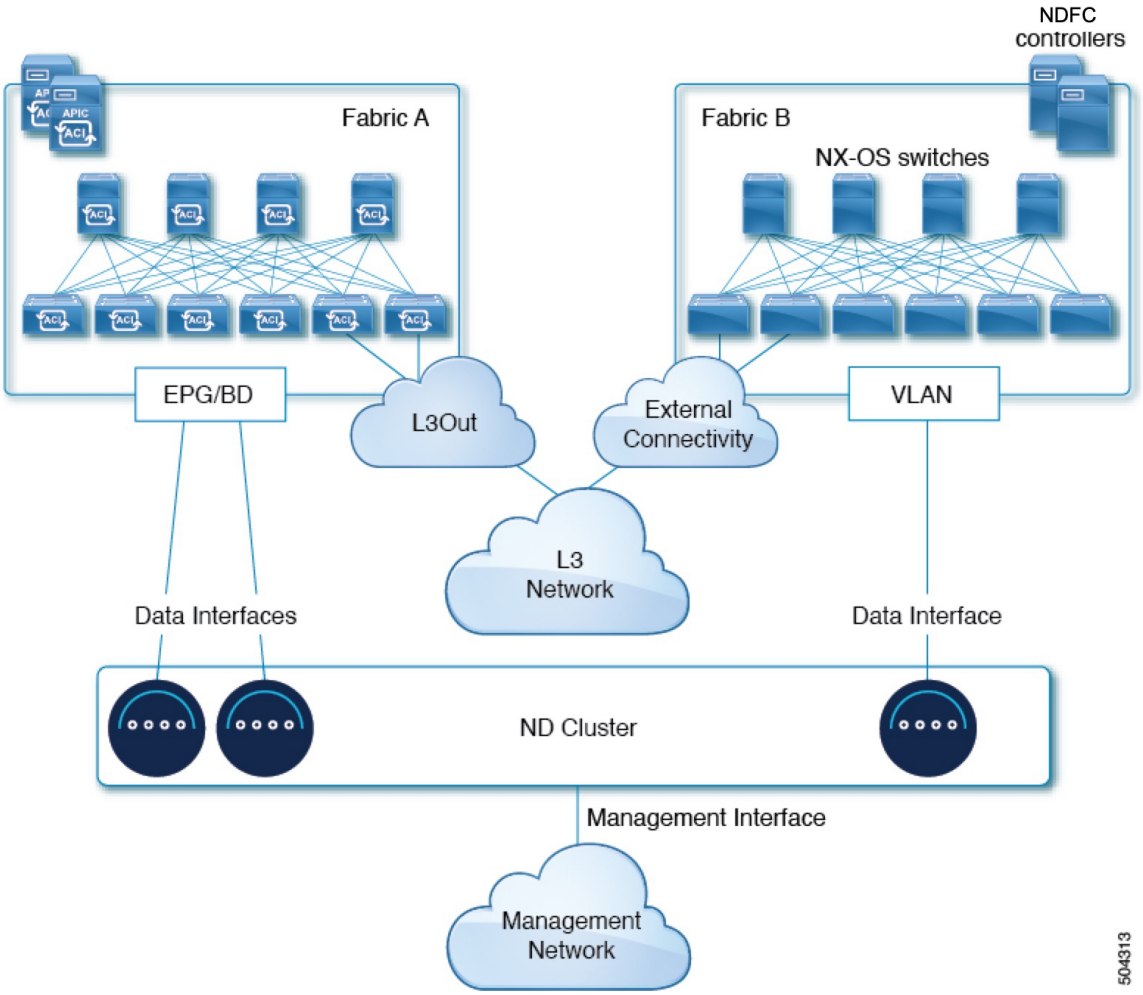
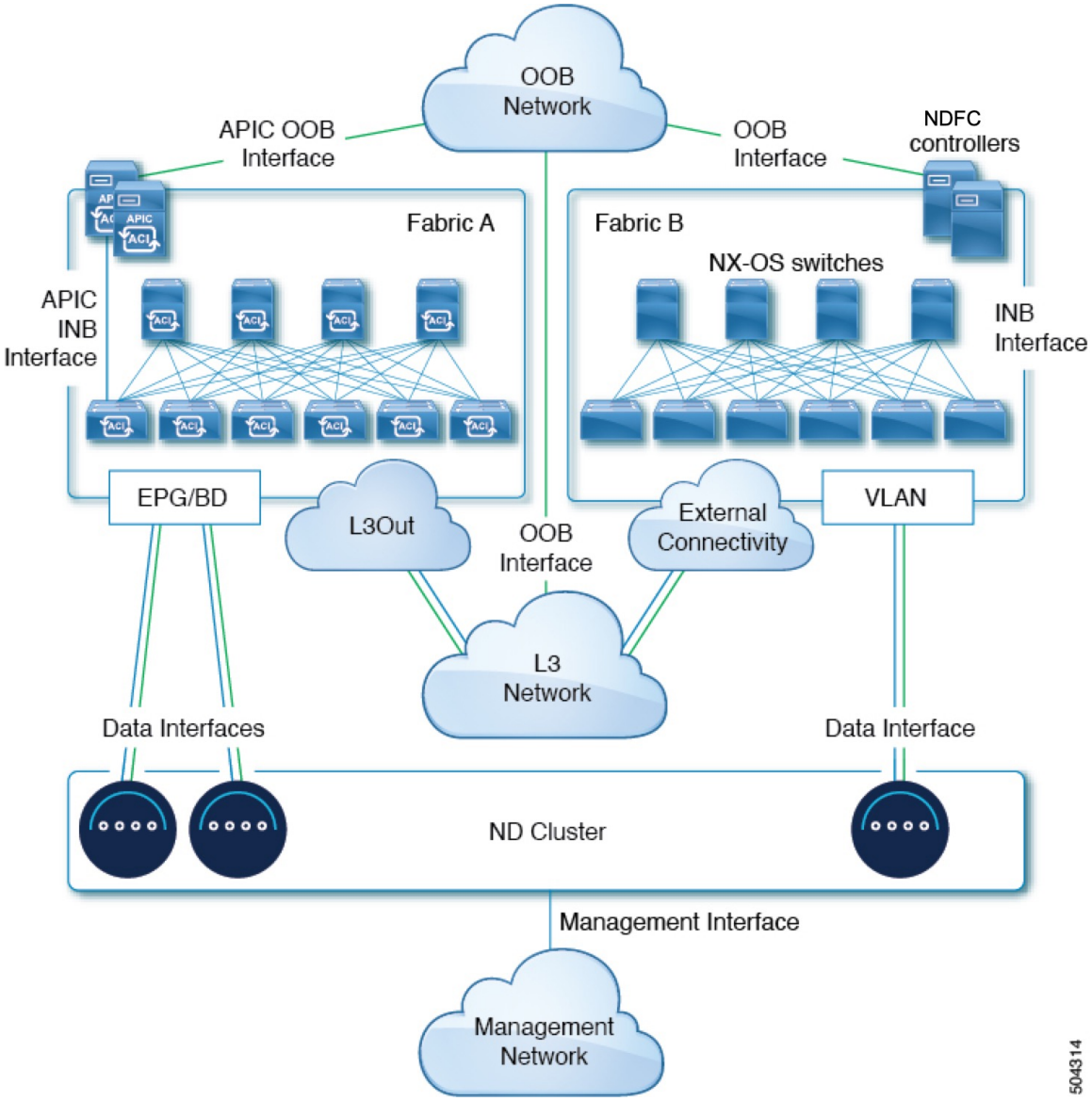


Figure 5: Connecting Directly to Leaf Switches, Nexus Dashboard Orchestrator



Node Distribution Across Sites

Nexus Dashboard supports distribution of cluster nodes across multiple sites. The following node distribution recommendations apply to both physical and virtual clusters.

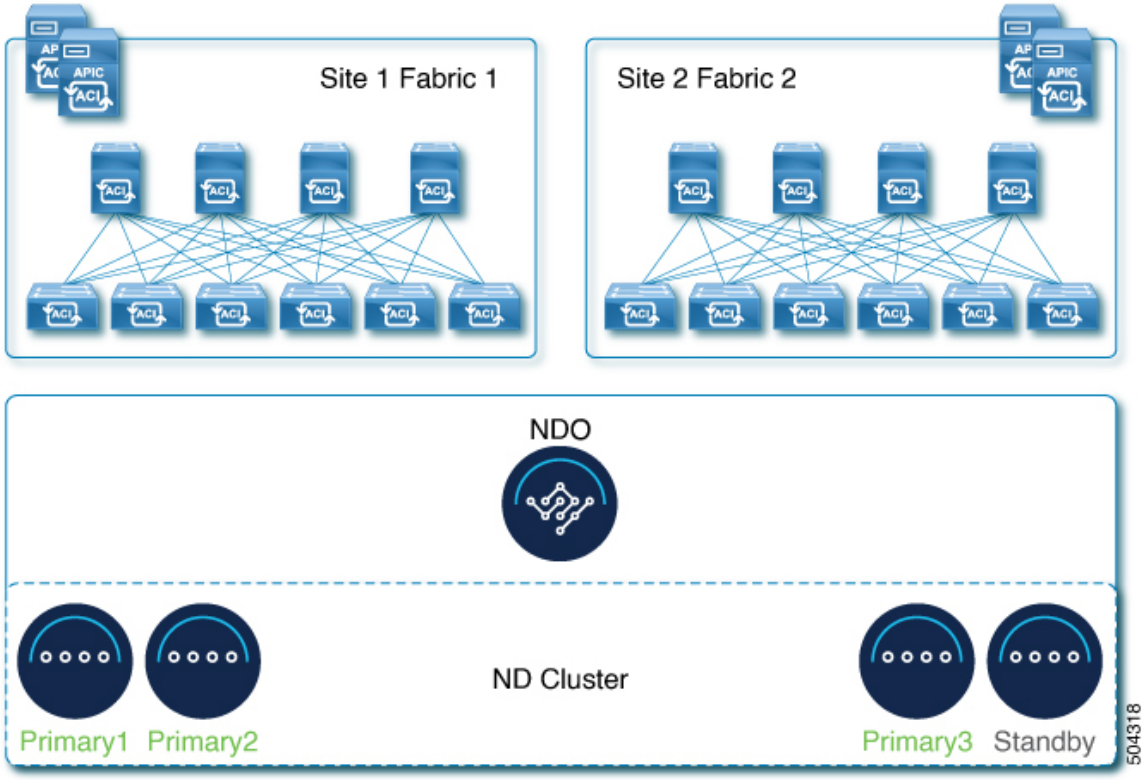
Node Distribution for Nexus Dashboard Insights

For Nexus Dashboard Insights, we recommend centralized, single-site deployment. This service does not gain redundancy benefits from distributed cluster, which could instead expose the cluster to interconnection failures when nodes are in different sites.

Node Distribution for Nexus Dashboard Orchestrator

For Nexus Dashboard Orchestrator, we recommend a distributed cluster. Keep in mind that at least two Nexus Dashboard master nodes are required for the cluster to remain operational, so when deploying a Nexus Dashboard cluster across two sites, we recommend deploying a standby node in the site with the single master node as shown in the following figure:

Figure 6: Node Distribution Across Two Sites for Nexus Dashboard Orchestrator



Node Distribution for Fabric Controller

For Nexus Dashboard Fabric Controller, we recommend a centralized, single-site deployment. This service does not support recovery in case if 2 `master` node are not available and thus gains no redundancy benefits from distributed cluster, which could instead expose the cluster to interconnection failures when nodes are in different sites.

Services Co-location Use Cases

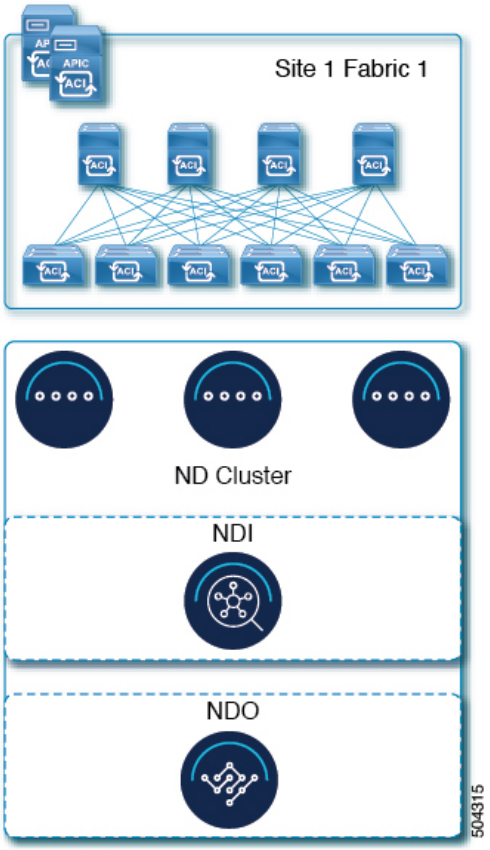
This section describes a number of recommended deployment scenarios for specific single-service or multiple services co-hosting use cases.

Note This release does not support co-hosting services in Nexus Dashboard clusters that are deployed in Linux KVM, AWS, Azure, or RHEL. All services co-hosting scenarios below apply for physical or VMware ESX cluster form factors only.

Single Site, Nexus Dashboard Insights and Orchestrator

In a single site scenario with Nexus Dashboard Insights and Orchestrator services, a single Nexus Dashboard cluster can be deployed with both services co-hosted on it.

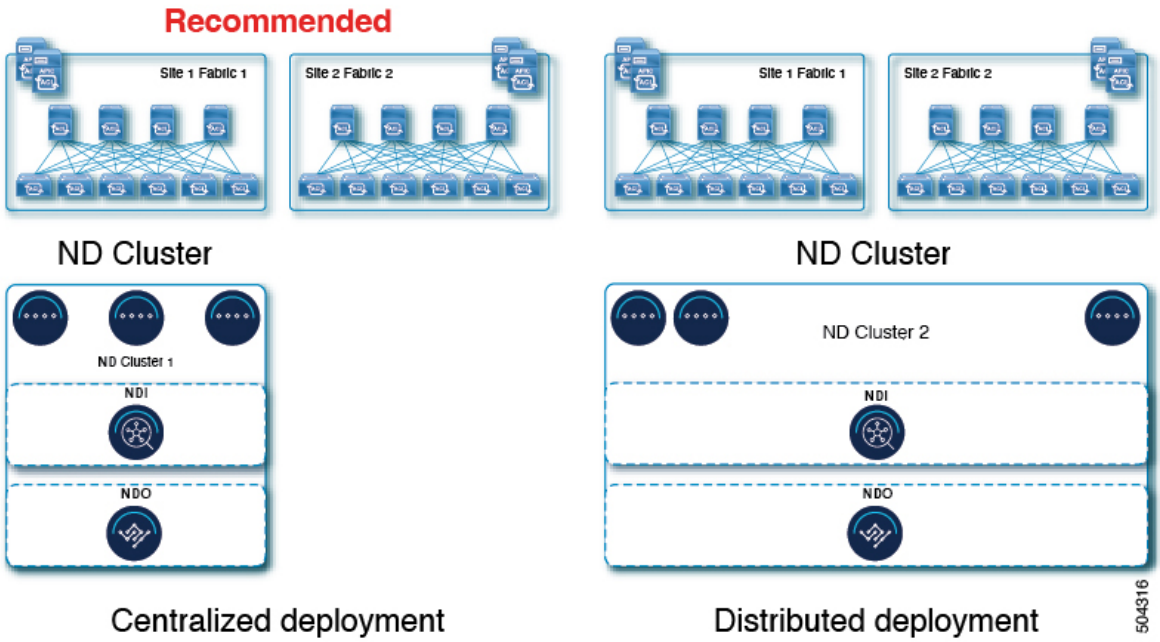
Figure 7: Single Site, Nexus Dashboard Insights and Orchestrator



Multiple Sites, Single Cluster for Nexus Dashboard Insights and Orchestrator

In a multiple sites scenario with Nexus Dashboard Insights and Orchestrator services, a single Nexus Dashboard cluster can be deployed with both services co-hosted on it. In this case, the nodes can be distributed between the sites, however since the Insights service does not gain redundancy benefits from a distributed cluster and could instead be exposed to interconnection failures when nodes are in different sites, we recommend the deployment option on the left:

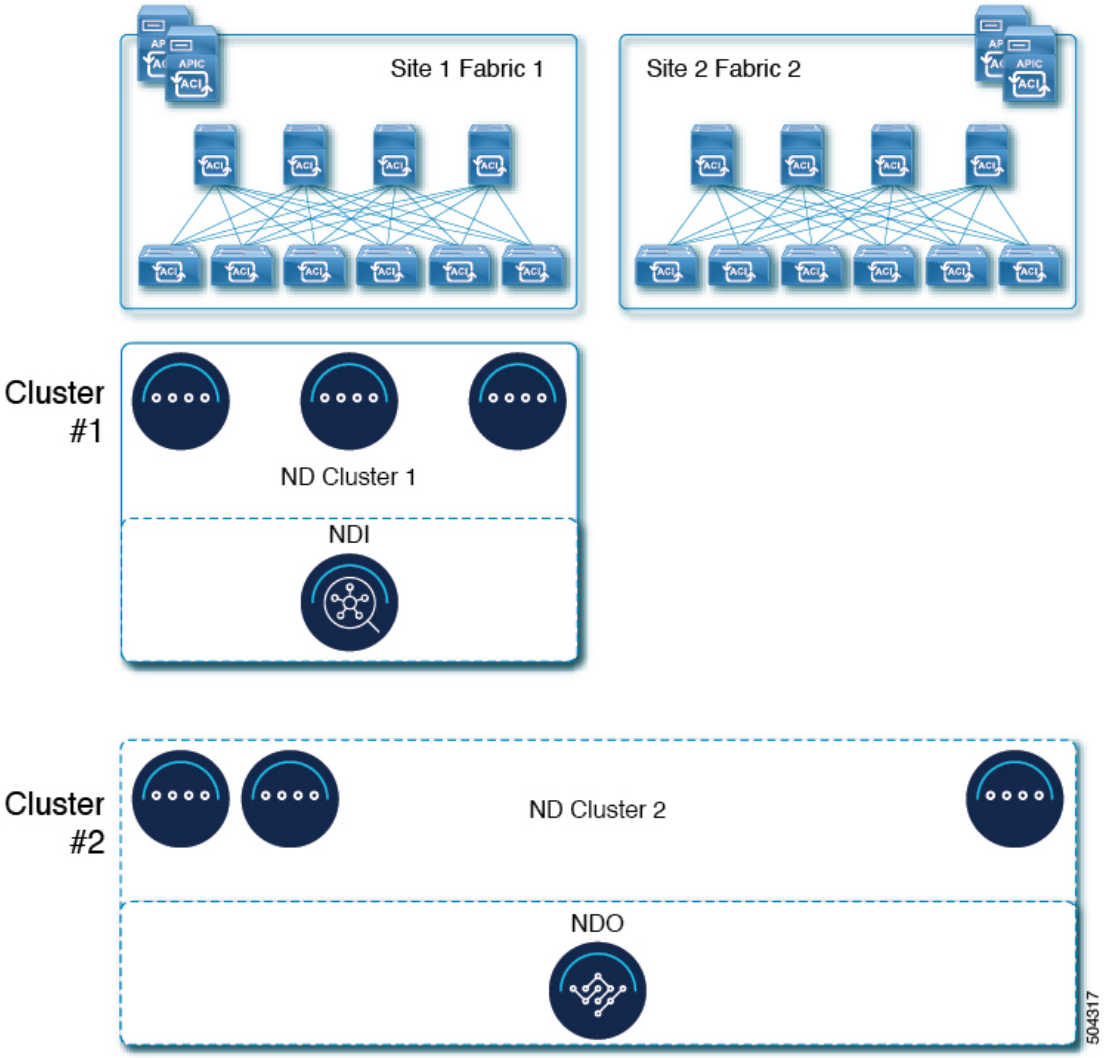
Figure 8: Multiple Sites, Single Cluster for Nexus Dashboard Insights and Orchestrator



Multiple Sites, Multiple Clusters for Nexus Dashboard Insights and Orchestrator

In this case, we recommend deploying two Nexus Dashboard cluster, with one of them dedicated to the Nexus Dashboard Orchestrator service using the virtual or cloud form factor and the nodes distributed across the sites.

Figure 9: Multiple Sites, Multiple Clusters for Nexus Dashboard Insights and Orchestrator



Pre-Installation Checklist

Before you proceed with deploying your Nexus Dashboard cluster, prepare the following information for easy reference during the process:

Table 11: Cluster Details

Parameters	Example	Your Entry
Cluster **Name**	`nd-cluster`	
NTP Server	`171.68.38.65`	
DNS Provider	`64.102.6.247 171.70.168.183`	

Parameters	Example	Your Entry
DNS Search Domain	`cisco.com`	
App Network	`172.17.0.1/16`	
Service Network	`100.80.0.0/16`	

Table 12: Node Details

Parameters	Example	Your Entry
For physical nodes, **CIMC** address and login information of the first node	`10.195.219.84/24` Username: `admin` Password: `Cisco1234`	
For physical nodes, **CIMC** address and login information of the second node	`10.195.219.85/24` Username: `admin` Password: `Cisco1234`	
For physical nodes, **CIMC** address and login information of the third node	`10.195.219.86/24` Username: `admin` Password: `Cisco1234`	
Password used for each node's `rescue-user` and the initial GUI password. We recommend configuring the same password for all nodes in the cluster.	`Welcome2Cisco!`	
Management IP of the first node	`192.168.9.172/24`	
Management Gateway of the first node.	`192.168.9.1`	
Data Network IP of the first node	`192.168.6.172/24`	
Data Network Gateway of the first node	`192.168.6.1`	
(Optional) **Data Network VLAN** of the first node	`101`	
(Optional) **ASN** of the first node	`63331`	

(Optional) IP addresses of the first node's **BGP Peer**(s)	`200.11.11.2`
	or
	`200:11:11::2`	

Parameters	Example	Your Entry
(Optional) ASNs of the first node's **BGP Peer**(s)	`55555`	
Management IP of the second node	`192.168.9.173/24`	
Management Gateway of the second node.	`192.168.9.1`	
Data Network IP of the second node	`192.168.6.173/24`	
Data Network Gateway of the second node	`192.168.6.1`	
(Optional) **Data Network VLAN** of the second node	`101`	
(Optional) **ASN** of the second node	`63331`	

(Optional) IP addresses of the second node's **BGP Peer**(s)	`200.12.12.2`
	or
	`200:12:12::2`	

(Optional) ASNs of the second node's **BGP Peer**(s)	`55555`	
Management IP of the third node	`192.168.9.174/24`	
Management Gateway of the third node.	`192.168.9.1`	
Data Network IP of the third node	`192.168.6.174/24`	
Data Network Gateway of the third node	`192.168.6.1`	
(Optional) **Data Network VLAN** of the third node	`101`	
(Optional) **ASN** of the third node	`63331`	

(Optional) IP addresses of the third node's **BGP Peer**(s)	`200.13.13.2`
	or
	`200:13:13::2`	

(Optional) ASNs of the third node's **BGP Peer**(s)	`55555`	