



Overview and Initial Setup of Cisco NDFC LAN, Release 12.2.2

Table of Contents

New and Changed Information	1
Overview	2
Know your Web UI	2
Dashboard	3
Overview	3
Viewing vCenter VMs	4
Viewing Kubernetes Pods	4
Endpoint Locator Dashboard	6
Topology	12
Layout Selection	14
Tooltips	16
Contextual Menus	17
Filtering	18
Link Aggregation	19
Navigating to a Fabric Group	21
Intra-Fabric Navigation	22
Overlays	24
Network Overlays	24
VRF Overlays	25
Security Group Overlays	26
VM Overlays	27
Multi-Node Selection	28
Searching Topology	29
Initial Setup	30
Server Settings	30
Feature Management	32
LAN Credentials Management	35
Copyright	38

New and Changed Information

The following table provides an overview of the significant changes up to this current release. The table does not provide an exhaustive list of all changes or of the new features up to this release.

Release Version	Feature	Description
NDFC release 12.2.1	Support AAA remote authentication passthrough	<p>With this feature enabled, when you log on to NDFC, NDFC copies the default user login credentials to the LAN switch settings in Admin > Switch Credentials > LAN Credentials Management > Default Credentials. When you log on to NDFC for the first time, you are no longer prompted to enter the LAN switch credentials, as NDFC automatically copies the user login credentials to the LAN switch credentials.</p> <p>You can still set per device login credentials to handle devices not using authentication, authorization, and accounting (AAA). Configure AAA remote authentication passthrough by navigating to Admin > System Settings > LAN-Fabric and checking the checkbox for the Enable AAA Passthrough feature. For more information, see Server Settings.</p>

Overview

The following topics give overview information on the Nexus Dashboard Fabric Controller.

Know your Web UI

When you launch the Cisco Nexus Dashboard Fabric Controller Web UI for the first time, the **Feature Management** page opens. After you choose a deployment type, the left pane displays menus relevant to the personality.

The top pane displays the following UI elements:

- **Home** icon - Click to view One view on the Nexus Dashboard setup.
- **Nexus Dashboard** - Click to view One view on the Nexus Dashboard setup.
- **Help** - Click on **Help** to see a drop-down list with the following options:
 - **About Nexus Dashboard** - Displays the version of the Cisco Nexus Dashboard on which Cisco Nexus Dashboard Fabric Controller is deployed.
 - **Welcome Screen** - Displays What's New information. You can choose to see this page every time you launch the Web UI.
 - **Help Center** - Click to view the Help Center page. You can access various product documents from this page.

Scroll to the end of the page to view the services installed on Nexus Dashboard. Click on the Service to view **Help Center**.

- **User Role** - Displays the role of the user who is currently logged in, for example, **admin**. Click on the username to see a drop-down list with the following options:
 - **User Preferences** - Allows you to view the Welcome screen on every login.
 - **Change Password** - Allows you to change the password for the current logged-in user.

If you are a network administrator user, you can modify the passwords of other users.

- **Logout** - Allows you to terminate the Web UI and return to the login screen.
- **Cisco Persona** - Specifies the deployment persona - **Fabric Controller** or **SAN Controller** or **Fabric discovery**.
- **View Alarms** - Click the bell icon to view the **Alarms**. You can also view this page from **Analyze > Event Analytics > Alarms** from the left pane.
- **Help** icon - Click to view help pages or information about Cisco NDFC.
 - Select **Help** to view the context-sensitive help for the UI page.
 - Select **About NDFC** to view the version number and copyright information.

General icons on UI:

- **Hamburger** icon - Click on a **Hamburger** icon adjacent to the product name on the home screen to minimize the menu items on the home screen or to view menu items in details.
- **Refresh** icon - Click the refresh icon to refresh and reload the page.

Dashboard

The intent of the **Dashboard** is to enable network and storage administrators to focus on particular areas of concern around the health and performance of data center switching. This information is provided as 24-hour snapshots.

The functional view of LAN switching consists of seven dynamic dashlets that display information in the context of the selected scope by default.

The various scopes that are available on the Cisco Nexus Dashboard Fabric Controller Web UI are described in the following topics.

Overview

From the left menu bar, choose **Dashboard > Overview**. The **Overview** window displays the default dashlets. The dashlets display donuts summary.

The following are the default dashlets that appear in the **Overview** dashboard window:

Dashlet	Description
Fabric Health	Displays the fabric health summary of problems, and number in the donut depicting total number of fabrics. Displays fabric health status with Critical , and Healthy . The Fabric Health status is based on the severity of the highest outstanding alarm for the fabric or its member switches.
Events Analytics	Displays events with Critical , Error , and Warning severity.
Switches Configuration	Displays the switches inventory summary information such as the switch models and the corresponding count.
Switches	
Switch Health	Displays the switches health summary Critical , and Healthy with the corresponding count. The Switch Health status is based on the severity of the highest outstanding alarm for the switch or its interfaces.
Switch Roles	Displays the switches roles summary and the corresponding count. Displays the number of access, spine and leaf devices.
Switch Hardware Version	Displays the switches models and the corresponding count.
Switch Software Version	Displays the switches software version and the corresponding count.
Performance Collector	Displays the performance collections on the switch.
Reports	Displays switch reports.

Viewing vCenter VMs

vCenter VMs UI Path: **Dashboard > vCenter VMs**



You can view the Virtual Machine details for the added vCenter cluster in the dashboard and topology window by navigating to **Dashboard > vCenter VMs**.

The vCenter VMs tab displays the following details of VMs:

- VM Name, its IP address and MAC address
- Name of the compute where the VM is hosted
- Switch name that is connected to a VM, switch's IP address, MAC address, and interface
- Port channel ID and vPC ID (if connected to a VPC)
- VLAN VM configured on
- Power state of the VM
- Physical NIC of the Compute host

You can search and filter VMs by using the **Filter by attributes** search field.

VM Name	IP Address	MAC Address	VLAN	Physical NIC	Host	Fabric	Virtual Switch Name	Switch	Switch Interface	VPC ID	Port Channel	State
27			12	vmnic11		vc	vSwitch2	DCNM-FO	Ethernet1/39	0		DISCONNECTED
27				vmnic10		vc	vSwitch1	DCNM-FO	Ethernet1/40	0		DISCONNECTED
28			12	vmnic11		vc	vSwitch2	DCNM-FO	Ethernet1/37	0		DISCONNECTED
28				vmnic10		vc	vSwitch1	DCNM-FO	Ethernet1/38	0		DISCONNECTED
27w			12	vmnic11		vc	vSwitch2	DCNM-FO	Ethernet1/39	0		DISCONNECTED
27w				vmnic10		vc	vSwitch1	DCNM-FO	Ethernet1/40	0		DISCONNECTED
28w			12	vmnic11		vc	vSwitch2	DCNM-FO	Ethernet1/37	0		DISCONNECTED
28w				vmnic10		vc	vSwitch1	DCNM-FO	Ethernet1/38	0		DISCONNECTED
29w			12	vmnic11		vc	vSwitch2	DCNM-FO	Ethernet1/35	0		DISCONNECTED
29w				vmnic10		vc	vSwitch1	DCNM-FO	Ethernet1/36	0		DISCONNECTED

- To view VMs in the **Fabric** window, navigate to **LAN > Fabrics**, then double-click on the required fabric. In the **Fabric Overview** window, choose **Virtual Infrastructure > Virtual Machine VMs**.
- To view VMs in the **Switch** window, navigate to **LAN > Switches**, then double-click on the required switch. In the **Switch Overview** window, choose **Virtual Infrastructure > Virtual Machine VMs**.

Viewing Kubernetes Pods

Kubernetes Pods UI Path: **Dashboard > Kubernetes Pods**

You can view Kubernetes pods on Fabrics window, navigate **LAN > Fabrics**, double-click on required fabric, it navigates to **Fabric Overview** window, click **Virtual Infrastructure > Kubernetes Pods**.

You can view Kubernetes pods on Switch window, navigate **LAN > Switches**, double-click on required switch, it navigates to **Switch Overview** window, click **Virtual Infrastructure > Kubernetes Pods**.

You can search and filter kubernetes pods by using **filter by attributes** search field.

The screenshot shows a dashboard with tabs for 'Overview', 'vCenter VMs', and 'Kubernetes Pods'. A search bar at the top is labeled 'Filter by attributes'. Below it is a table with 16 columns: Pod Name, Pod IP, Phase, Reason, Application, Namespa..., Node Name, Node IP, Cluster Type, Physical NIC, Physical Switch, Switch Interface, Cluster Name, Port Channel, VLAN, and Fabric. The table contains 8 rows of pod data, all with a 'Running' phase.

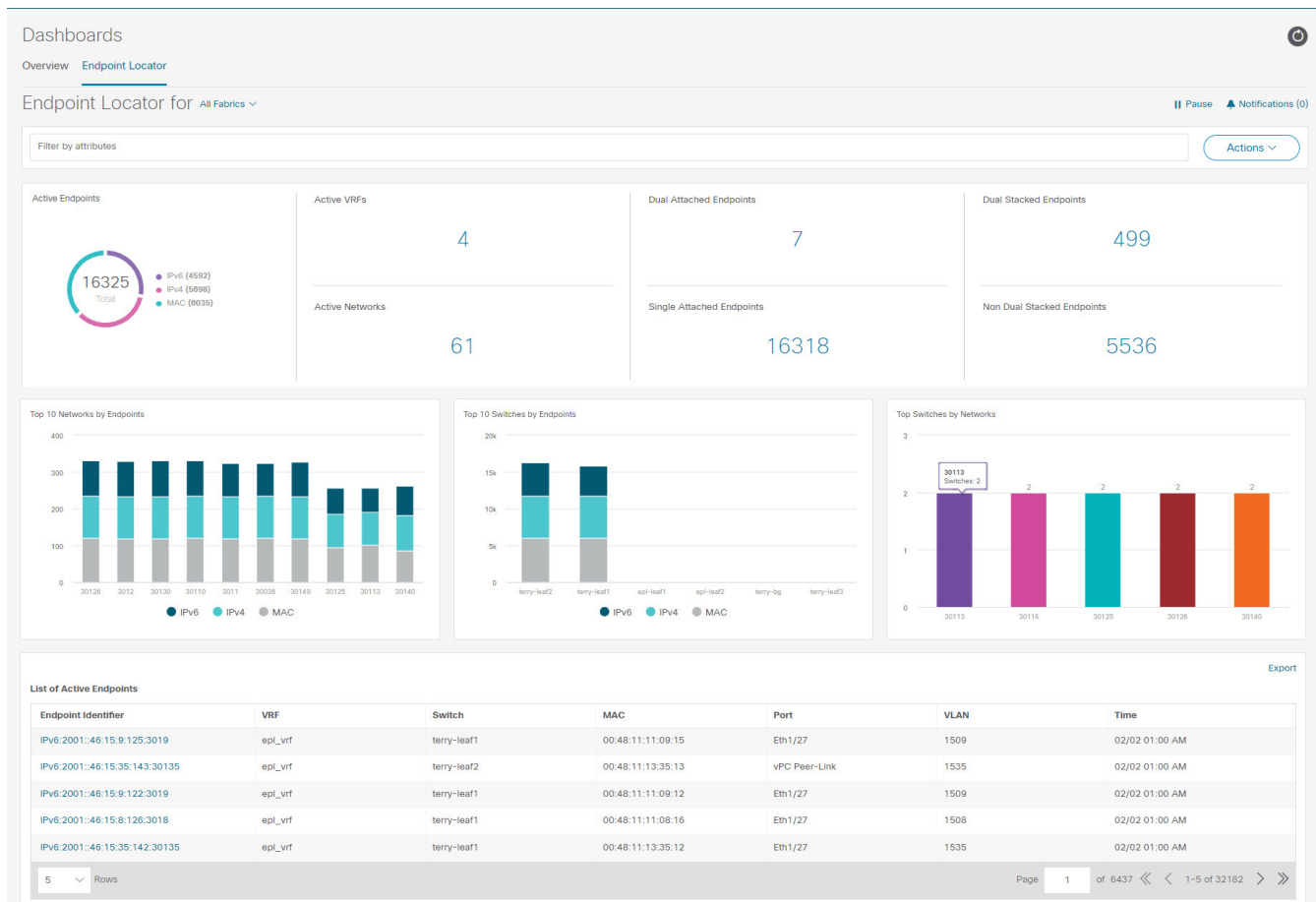
Pod Name	Pod IP	Phase	Reason	Application	Namespa...	Node Name	Node IP	Cluster Type	Physical NIC	Physical Switch	Switch Interface	Cluster Name	Port Channel	VLAN	Fabric
weave-net-9tffmi	192.168.126.1	Running			kube-system	centos7-k8s-w1	192.168.126.1	Kubernetes	vmnic7	L6-FXP	Ethernet1/1	192.168.126.1		126	corefab
etcd-vm-k8s-master	192.168.126.1	Running			kube-system	vm-k8s-master	192.168.126.1	Kubernetes	vmnic7	L6-FXP	Ethernet1/1	192.168.126.1		126	corefab
kube-proxy-8dtx6	192.168.126.1	Running		kube-proxy	kube-system	centos7-k8s-w2	192.168.126.1	Kubernetes	vmnic7	L6-FXP	Ethernet1/1	192.168.126.1		126	corefab
kube-proxy-slsfv	192.168.126.1	Running		kube-proxy	kube-system	centos7-k8s-w1	192.168.126.1	Kubernetes	vmnic7	L6-FXP	Ethernet1/1	192.168.126.1		126	corefab
coredns-66bff467f8-8jxm6	10.32.0.3	Running		kube-dns	kube-system	vm-k8s-master	192.168.126.1	Kubernetes	vmnic7	L6-FXP	Ethernet1/1	192.168.126.1		126	corefab
kube-apiserver-vm-k8s-master	192.168.126.1	Running			kube-system	vm-k8s-master	192.168.126.1	Kubernetes	vmnic7	L6-FXP	Ethernet1/1	192.168.126.1		126	corefab
kube-proxy-pgm48	192.168.126.1	Running		kube-proxy	kube-system	vm-k8s-master	192.168.126.1	Kubernetes	vmnic7	L6-FXP	Ethernet1/1	192.168.126.1		126	corefab

The following table describes the fields and description on the window.

Field	Description
Pod Name	Specifies the name of the Kubernetes pod.
Pod IP	Displays the IP address of the Kubernetes pod.
Phase	Specifies the phase (state) of the pod.
Reason	Specifies the reason.
Applications	Specifies the applications of the pod.
Namespace	Specifies the namespace of the pod.
Node Name	Specifies the node name of the pod.
Node IP	Specifies the node IP address.
Cluster Type	Displays the type of cluster.
Physical NIC	Displays the physical NIC of the node.
Physical Switch	Specifies the physical switch connected to cluster node.
Switch Interface	Specifies the switch interface connected to cluster node.
Cluster Name	Specifies the name of the cluster.
Port Channel	Specifies the port channel (if cluster node is connected to a VPC).
VLAN	Specifies the VLAN.
Fabric	Specifies the fabric name.

Endpoint Locator Dashboard

To explore endpoint locator details from the Cisco Nexus Dashboard Fabric Controller Web UI, choose **Dashboard > Endpoint Locator**. The **Endpoint Locator** dashboard is displayed.



Due to an increase in scale, the system may take some time to collect endpoint data and display it on the dashboard. On bulk addition or removal of endpoints, the endpoint information displayed on the EPL dashboard takes a few minutes to refresh and display the latest endpoint data.

- You can initiate a search by using the available options in the **filter by attributes** search bar field.

You can also filter and view the endpoint locator details for a specific Switch, VRF, Network, and Type by using the respective drop-down lists. You can select MAC type of endpoints as a filter attribute. The name of the network is also displayed in the **Network** drop-down list. By default, the selected option is **All** for these fields. You can display endpoint data for a specific device by entering the host IP address, MAC address, or the name of the virtual machine in the **Search Host IP/MAC/VM Name** field.

- You can click **All fabrics** drop-down list to view endpoint locator details for all fabrics or required fabric.

An alarm is generated if there are any endpoint related anomalies. Click the Pause icon to temporarily stop the near real-time collection and display of data. By default **Run** is chosen. Click **Notification** icon to view the notification details.

- Click **Actions > Endpoint Search**. For more information, refer to [Endpoint Search](#).

- Click **Actions** > **Endpoint Life**. For more information, refer to [Endpoint Life](#).
- Click **Actions Resync** to syncing to the data currently in the Route Reflector (RR). However, historical data is preserved. We recommend not clicking **Resync** multiple times as this is a compute-intensive activity.

In certain scenarios, the datapoint database may go out-of-sync and information, such as the number of endpoints, is not displayed correctly due to network issues such as:

- Endpoint moves under the same switch between ports and the port information needs some time to be updated.
 - An orphan endpoint is attached to the second VPC switch and is no longer an orphan endpoint.
 - NX-API not enabled initially and then enabled at a later point in time.
 - NX-API failing initially due to misconfiguration.
 - Change in Route Reflector (RR).
 - Management IPs of the switches are updated.
- Click **Notifications** icon to display a list of the most recent notifications.

The **Endpoint Locator Notifications** window appears.

Information such as the time at which the notification was generated, the description of the notification, severity level is displayed.

Notifications are generated for events such as duplicate IP addresses, duplicate MAC-Only addresses, VRF disappears from a fabric, all endpoints disappear from a switch, endpoint moves, endpoints on a fabric going to zero, when endpoints are attached to a switch, when a new VRF is detected, and when the RR BGP connectivity status changes. The RR connected status indicates that the Nexus Dashboard Fabric Controller can connect to the RR through BGP (Nexus Dashboard Fabric Controller and RR are BGP neighbors). The RR disconnected status indicates that the RR is disconnected and the underlying BGP is not functioning.

You can initiate a search by using the available options in the **filter by attributes** search bar field.

The top pane of the window displays the following information:

The top pane of the window displays the number of active endpoints, active VRFs, active networks, dual attached endpoints, single attached endpoints and dual stacked endpoints, for the selected scope. Support for displaying the number of dual attached endpoints, single attached endpoints and dual stacked endpoints has been added. A dual attached endpoint is an endpoint that is behind at least two switches. A dual stacked endpoint is an endpoint that has at least one IPv4 address and one IPv6 address.

- Historical analysis of data is performed and a statement mentioning if any deviation has occurred or not over the previous day is displayed at the bottom of each tile.

Click any tile in the top pane of the EPL dashboard to go to the [Endpoint History](#) window.

The 'middle pane' of the window displays the following information:

- **Top 10 Networks by Endpoints** - A pie chart is displayed depicting the top ten networks that

have the most number of endpoints. Hover over the pie chart to display more information. Click on the required section to view the number of IPv4, IPv6, and MAC addresses.

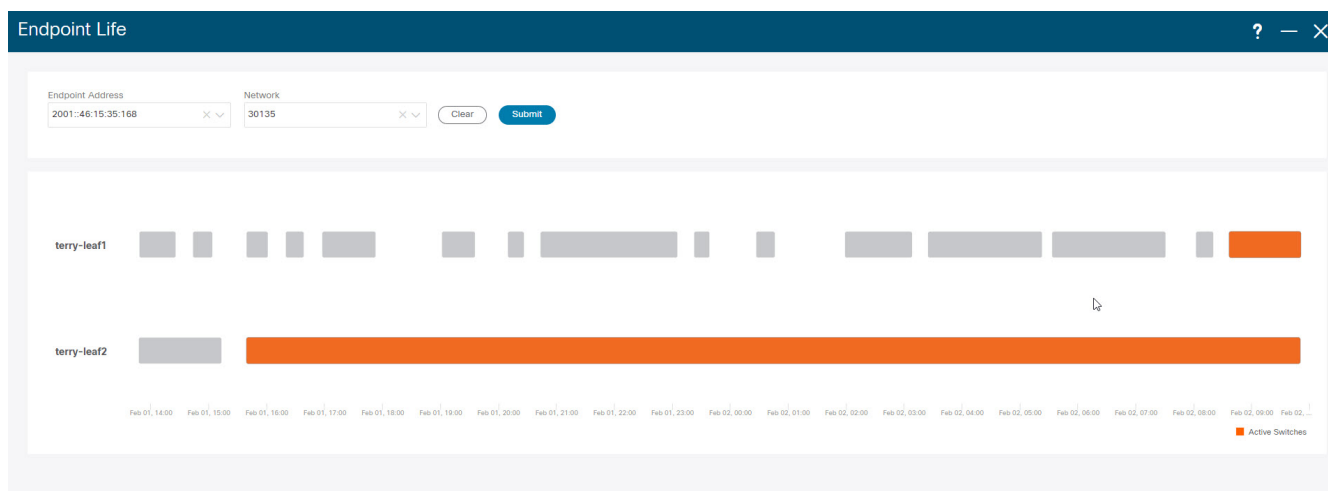
- **Top 10 Switches by Endpoints** - A pie chart is displayed depicting the top ten switches that are connected to the most number of endpoints. Hover over the pie chart to display more information. Click on the required section to view the number of IPv4, IPv6, and MAC addresses.
- **Top Switches by Networks** - Bar graphs are displayed depicting the number of switches that are associated with a particular network. For example, if a vPC pair of switches is associated with a network, the number of switches associated with the network is 2.

The 'bottom pane' of the window displays the list of active endpoints.

If a virtual machine has been configured, the name of the VM is displayed in the **Node Name** field. Note that it can take up to 15 minutes for the name of the VM to be reflected in the EPL dashboard. Until then, the EPL dashboard displays **No DATA** in the **Node Name** field.

Click **Export** to download the list of active endpoints in .csv format.

Click on required endpoint identifier, a slide-in pane appears and the related details are displayed. Click **Endpoint Life**. The **Endpoint Life** window appears for selected endpoint identifier. For more information, refer to [Endpoint Life](#).



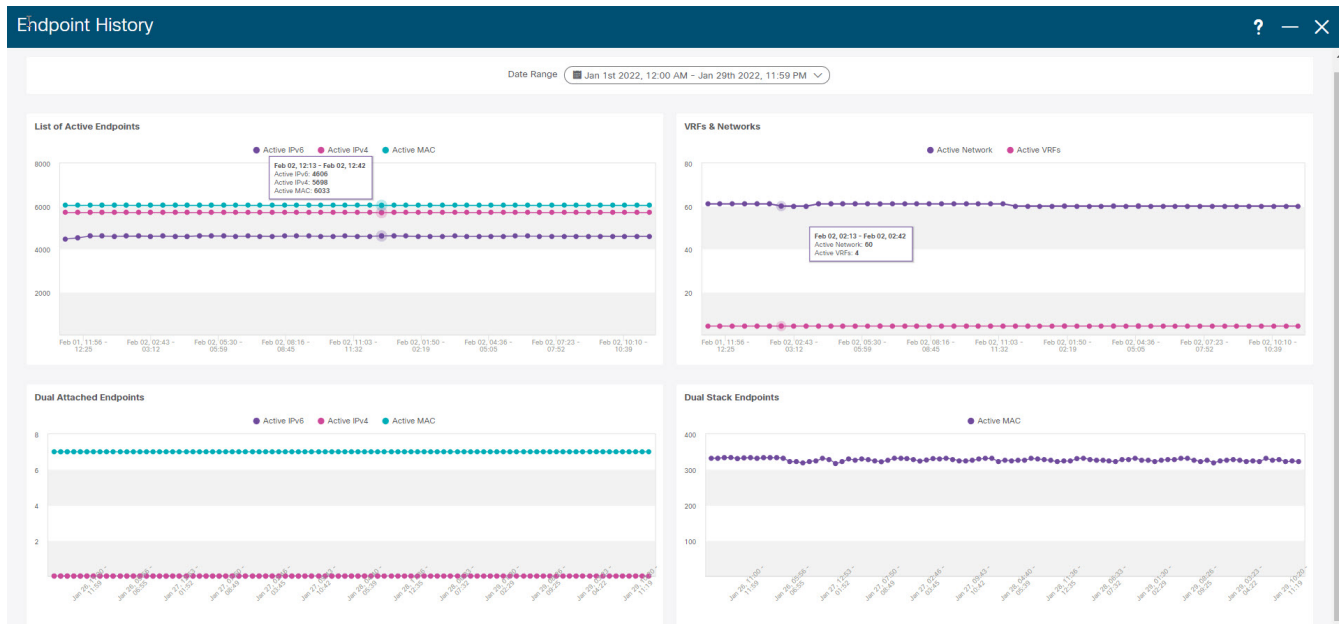
Click the search icon in the **Endpoint Identifier** column to search for specific IP addresses.

Consider a scenario in which EPL is first enabled and the **Process MAC-Only Advertisements** checkbox is selected. Then, EPL is disabled and enabled again without selecting the **Process MAC-Only Advertisements** checkbox. As the cache data in elasticsearch is not deleted on disabling of EPL, the MAC endpoint information is still displayed in the EPL dashboard. The same behavior is observed when a Route-Reflector is disconnected. Depending on the scale, the endpoints are deleted from the EPL dashboard after some time. In certain cases, it may take up to 30 minutes to remove the older MAC-only endpoints. However, to display the latest endpoint data, you can click **Resync**.

Endpoint History

Click any tile in the top pane of the EPL dashboard to go to the **Endpoint History** window. A graph depicting the number of active endpoints, VRFs and networks, dual attached endpoints and dual stacked MAC endpoints at various points in time is displayed. The graphs that are displayed here depict all the endpoints and not only the endpoints that are present in the selected fabric. Endpoint

history information is available for the last 30 days amounting to a maximum of 100 GB storage space.



Hover over the graph at specific points to display more information. The points in the graph are plotted at 30-minute intervals. You can also display the graph for a specific requirement by clicking the color-coded points at the bottom of each graph. For example, click on all color-coded points other than **active (IPv4)** in the Active Endpoints window displayed above such that only **active (IPv4)** is highlighted and the other points are not highlighted. In such a scenario, only the active IPv4 endpoints are displayed on the graph. You can also click on the required color-coded points at the bottom of the graph to display the graph for a specific requirement. For example, hover over **active (IPv4)** to display only the active IPv4 endpoints on the graph.

Click on any point in the graph to display a window that has detailed information about that point of time. For example, click on a specific point in the **Active Endpoints** graph to display the **Endpoints** window. This window has information about the endpoints along with the name of the switch and the VRF associated with the endpoint. Click **Download** to download the data as a CSV file.

Jan 1, 2022 12:00 AM to Jan 30, 2022 12:28 AM

Filter by attributes

Download

Endpoints	Switch Name	VRF
MAC:00:48:11:15:06:18:3016	terry-leaf2	
MAC:00:48:11:10:37:14:30137	terry-leaf1	
MAC:00:48:11:15:42:13:30142	terry-leaf2	
MAC:00:48:11:12:09:15:3019	terry-leaf2	
MAC:00:48:11:15:43:12:30143	terry-leaf1	
MAC:00:48:11:13:49:17:30149	terry-leaf1	
MAC:00:48:11:13:47:13:30147	terry-leaf1	
MAC:00:48:11:12:49:12:30149	terry-leaf2	
MAC:00:48:11:10:27:17:30127	terry-leaf2	
MAC:00:48:11:11:23:10:30123	terry-leaf1	

10 Rows

Page 1 of 1207 << < 1-10 of 12066 > >>

Endpoint Search

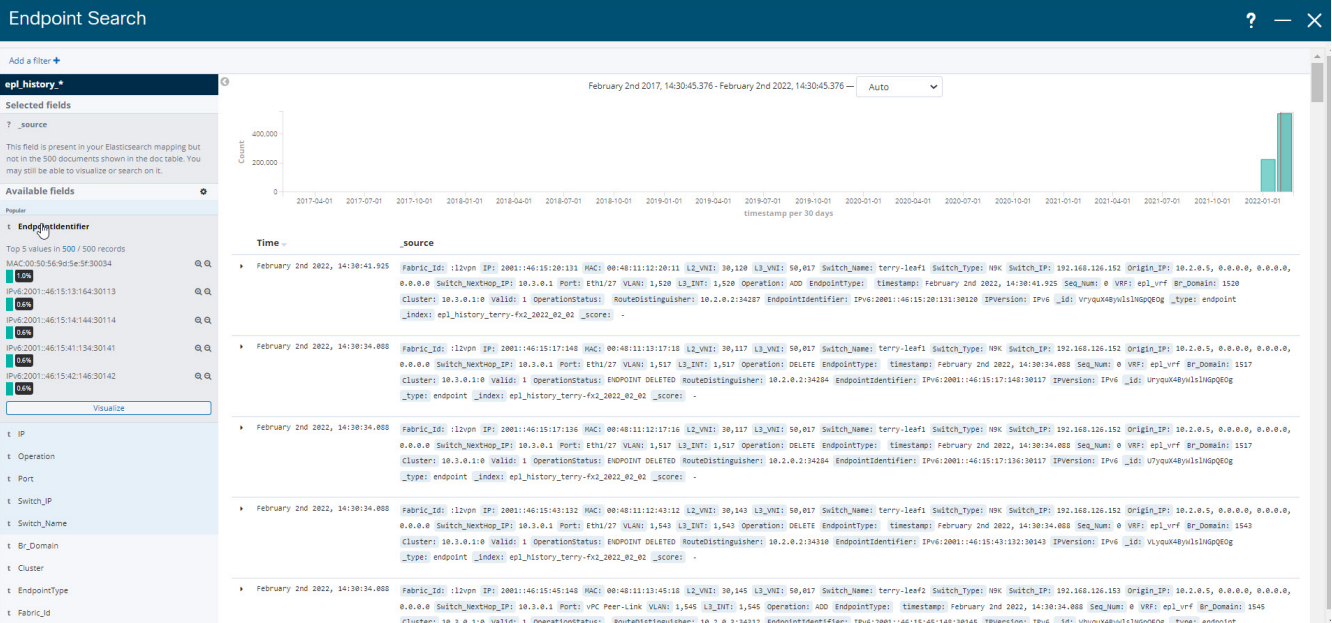
UI Path: **DashboardEndpoint > Locator**.

On **Endpoint Locator** window, click **Actions > Endpoint Search** to view a real-time plot displaying endpoint events for the period specified in a date range.



You cannot change time on the clock icon. Ignore the tooltip to change the time.

The results displayed here are dependent on the fields listed under **Selected fields** located in the menu on the left. You can add any field listed under **Available fields** to **Selected fields** to initiate a search using the required fields.



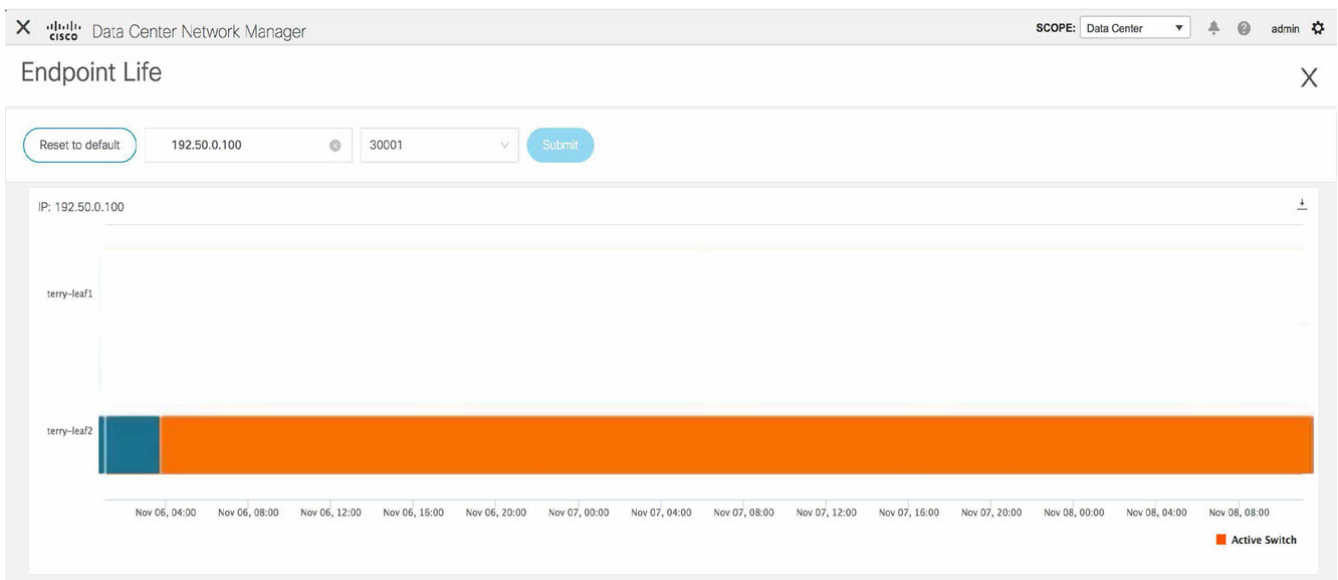
Endpoint Life

Click **Actions > Endpoint Life** to display a time line of a particular endpoint in its entire existence within the fabric.

Specify the IP or MAC address of an endpoint and the VXLAN Network Identifier (VNI) to display the list of switches that an endpoint was present under, including the associated start and end dates. Click **Submit**.

Initiate a search by using an IPv4 or IPv6 address to display the **Endpoint Life** graph for IPv4/IPv6 endpoints. Initiate a search by using a MAC address to display the **Endpoint Life** graph for MAC-Only endpoints.

The window that is displayed is essentially the endpoint life of a specific endpoint. The bar that is orange in color represents the active endpoint on that switch. If the endpoint is viewed as active by the network, it will have a band here. If an endpoint is dual-homed, then there will be two horizontal bands reporting the endpoint existence, one band for each switch (typically the vPC pair of switches). In case the endpoints are deleted or moved, you can also see the historical endpoint deletions and moves on this window.

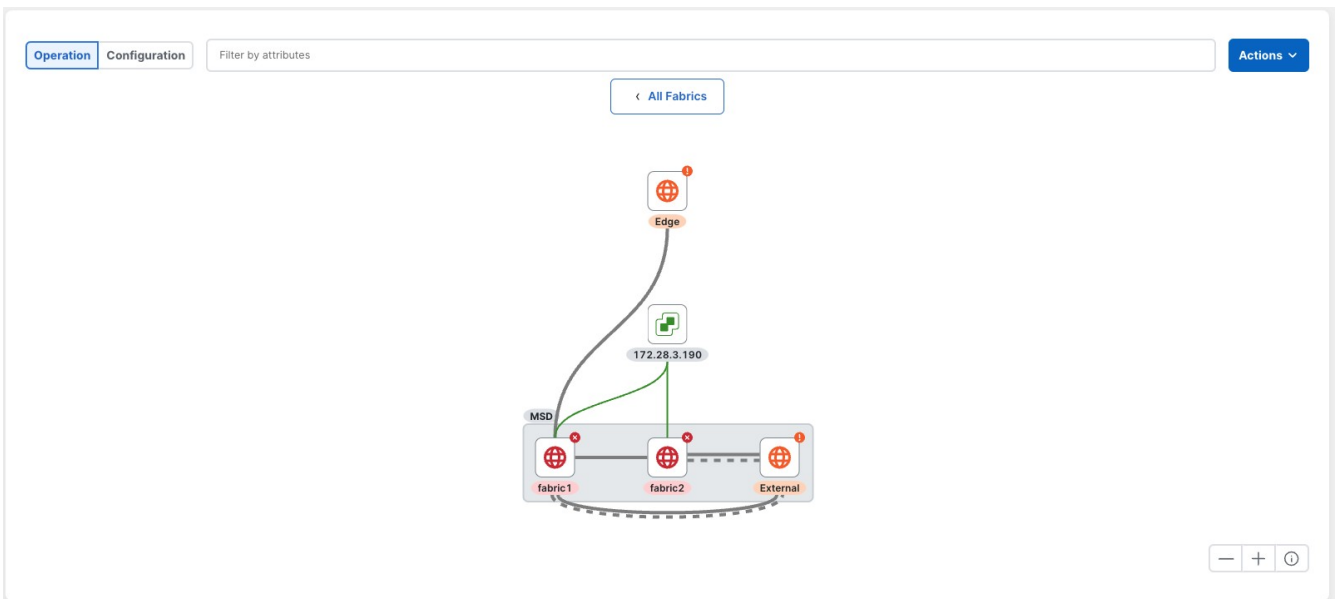


Topology

To view topology information for your Nexus Dashboard Fabric Controller, in the NDFC GUI, navigate to **Overview > Topology**.

Beginning with NDFC release 12.2.2, the **Topology** page in NDFC has been redesigned with enriched features geared towards providing cleaner navigation. The graphical elements and the way that information is presented looks different in NDFC release 12.2.2, but the basic functionality that existed for **Topology** in the previous release is essentially unchanged.

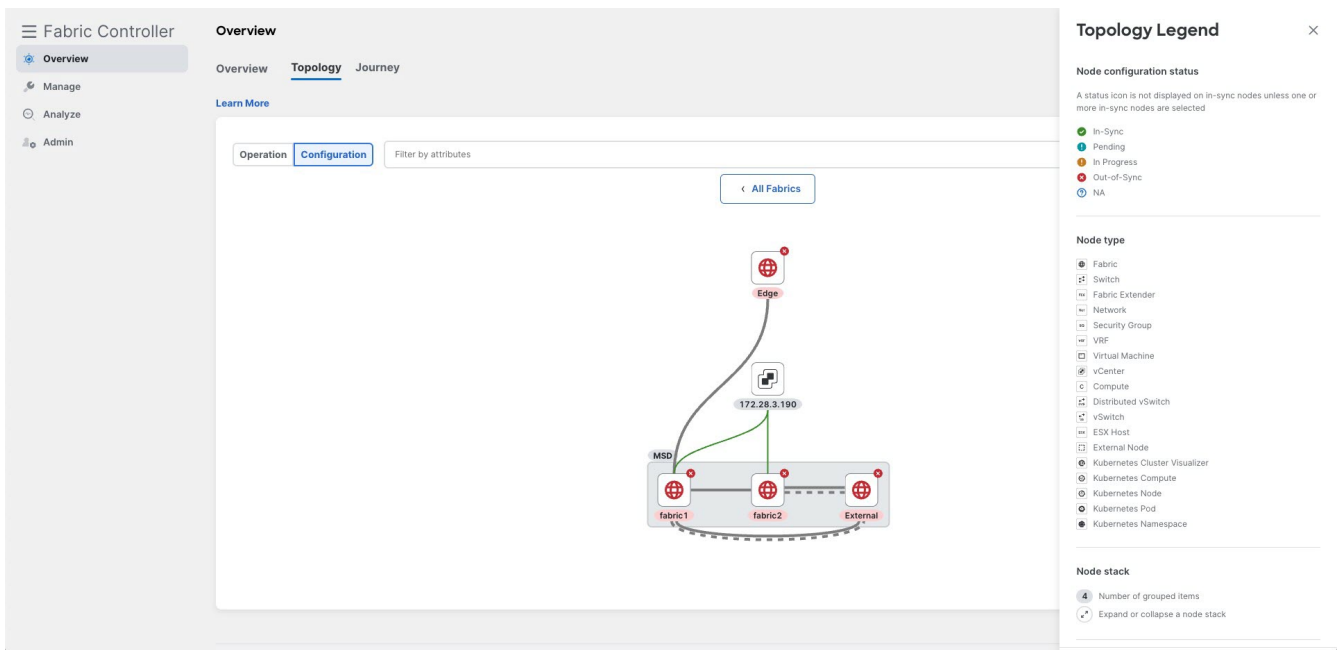
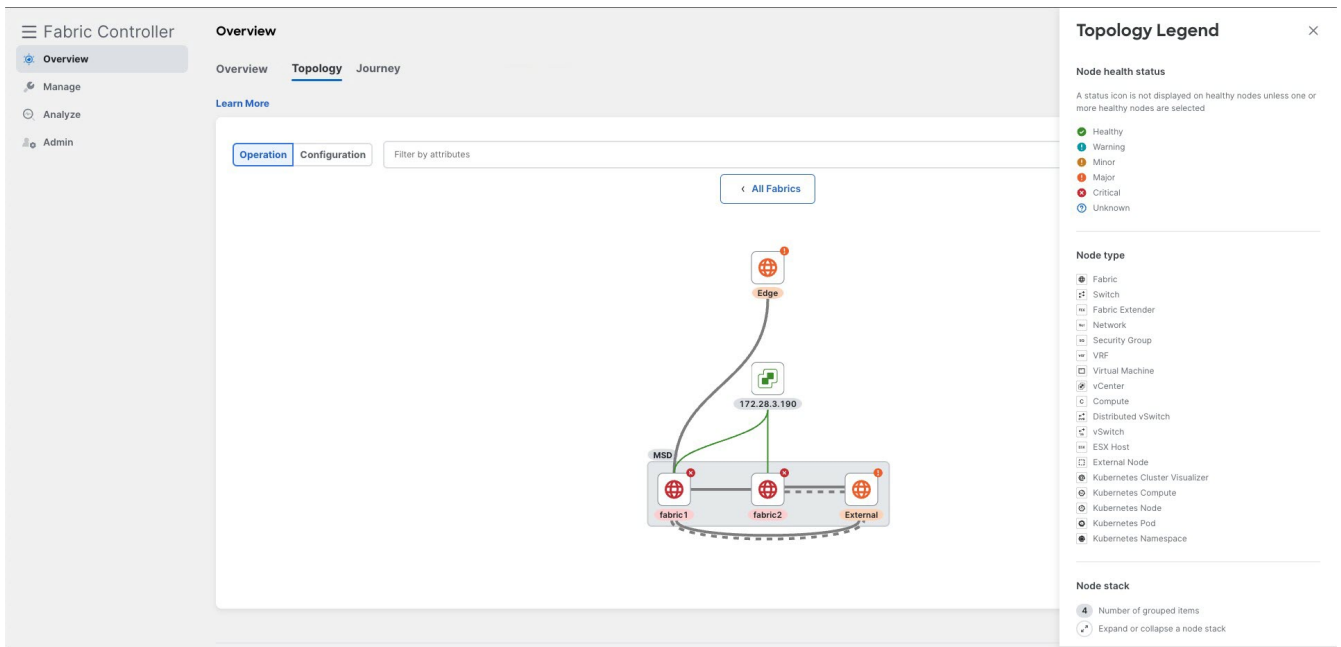
The starting point for Topology is the **All Fabrics** view, where you can see all of the individual fabrics and fabric groups in your NDFC, alongside vCenter and Kubernetes Cluster Visualizers that you might have configured in your network.



There are two menu options at the top left of the screen:

- **Operation:** View your configured network statuses
- **Configuration:** View your current network statuses

The definitions of the depicted colours change when toggling between these two buttons. You can access the colour legend, along with additional information, by clicking on the (i) at the bottom right corner of the screen:



Zoom controls are also in the bottom right corner, where you can zoom in using + and zoom out using -.

The **Actions** dropdown in the upper right corner contains contextual actions relative to the view where you are in the graph. For example, if you are in the **All Fabrics** view, then the options available through the **Actions** dropdown relate to the objects in this view. Similarly, if you have navigated to a view of a single fabric in the topology (for example, **All Fabrics > MSD > fab1**), then the options available through the **Actions** dropdown relate to that single fabric.

Typically, **Actions** dropdown, you will find layout options (changing the layout, editing or saving your desired layout), an option to aggregate the depicted links, and other contextual actions specific to the type of node.

The following sections provide more information on specific areas in the **Topology** page:

- [Layout Selection](#)
- [Tooltips](#)

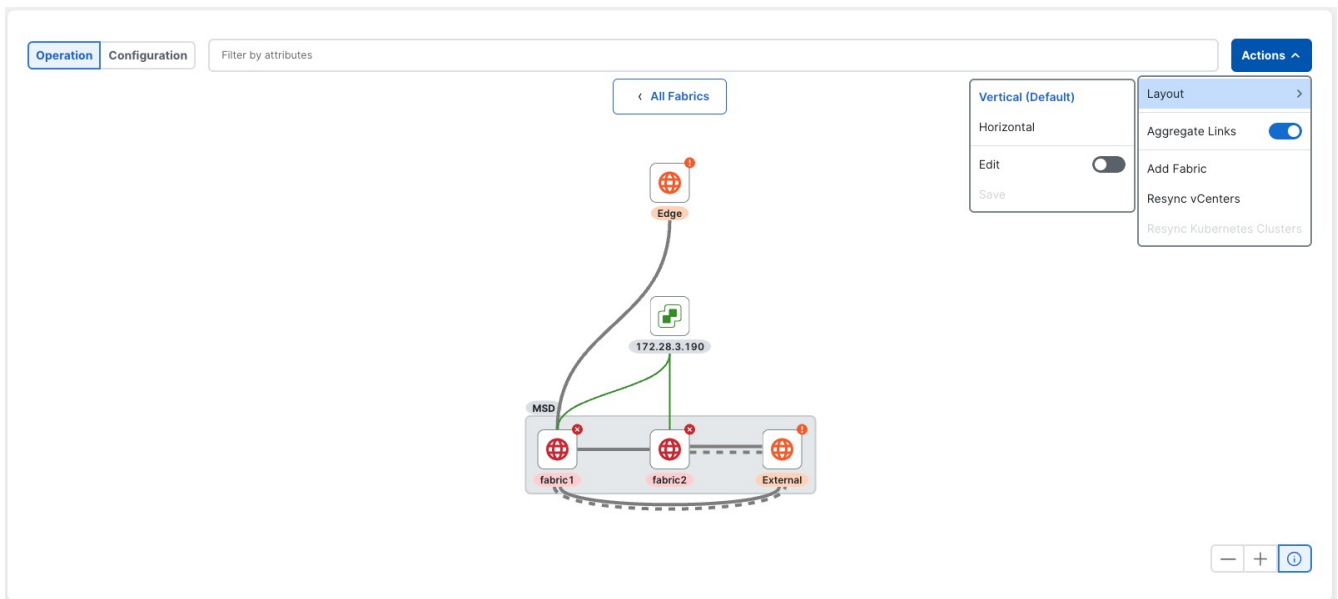
- Contextual Menus
- Filtering
- Link Aggregation
- Navigating to a Fabric Group
- Intra-Fabric Navigation
- Overlays
- Network Overlays
- VRF Overlays
- Security Group Overlays
- VM Overlays
- Multi-Node Selection

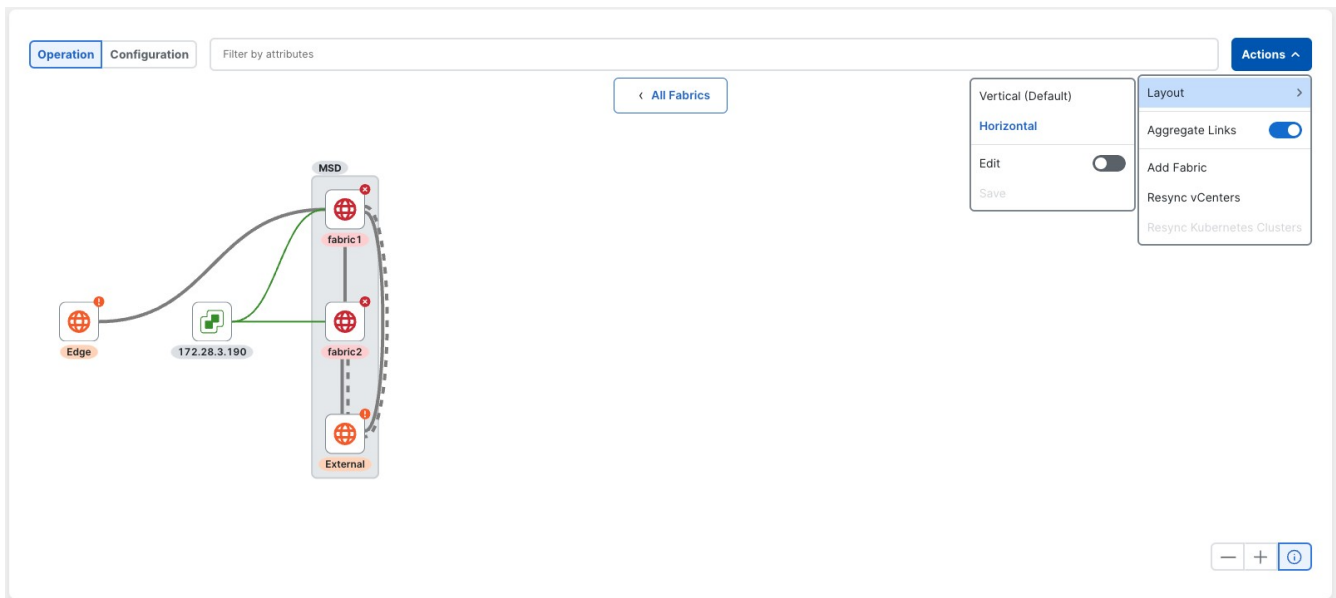
Layout Selection

There are two types of predefined layouts:

- Vertical (default)
- Horizontal

The next figures show examples of both types of layouts.





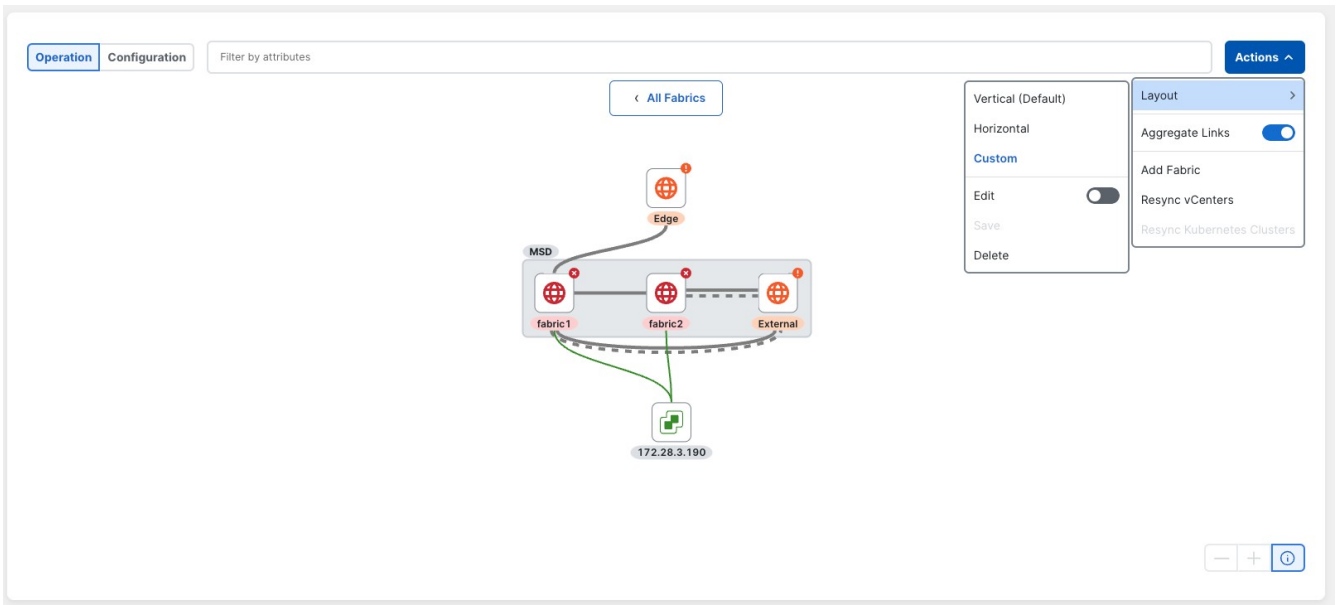
The vertical layout only allows scrolling along the vertical axis, while the horizontal only allows scrolling along the horizontal axis. In whichever layout that you choose, the other axis will remain constant according to your screen size. When zooming in and out, certain elements might shift around to allow for all elements to be shown in the screen for that layout.

If you find that neither of these layouts provide the view that you want, click **Actions > Layout**, then toggle on the **Edit** option to go into a freeform edit mode. Move elements around on the screen in the Edit mode until you are satisfied with the result, then click **Save** to save this layout. This saved layout will then get loaded every time you come back into this view.

Note the following guidelines when you are in freeform edit mode:

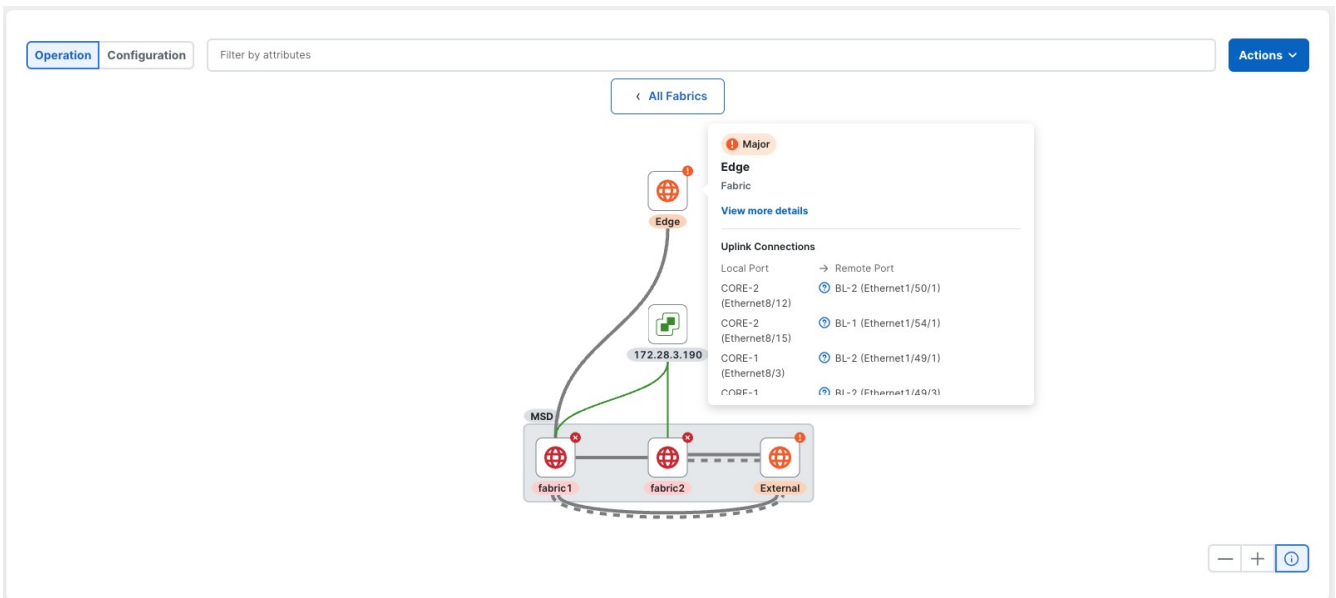
- You can only save one freeform layout edit at a time; if you click **Edit** again, then move elements around and click **Save** again, the previously saved freeform layout is overwritten.
- **Tooltips** are disabled when you are in freeform edit mode. Click **Actions > Layout**, then toggle off the **Edit** option to re-enable tooltips.

Once you have saved a freeform layout, the **Custom** menu option appears and is selected under the **Actions > Layout** menu. A **Delete** option also becomes available, which you can use when you don't want to use your freeform layout anymore. Note that the zoom controls are disabled when you are in a **Custom** layout.

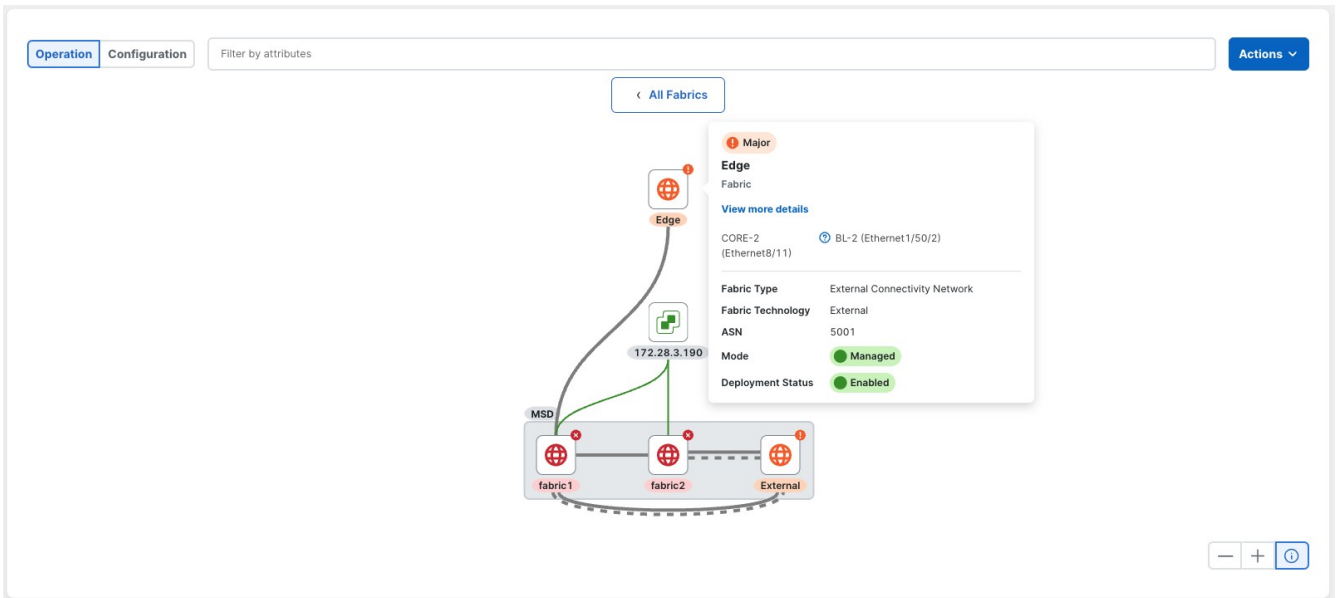


Tooltips

Single-click on an element to access a general summary of that element.

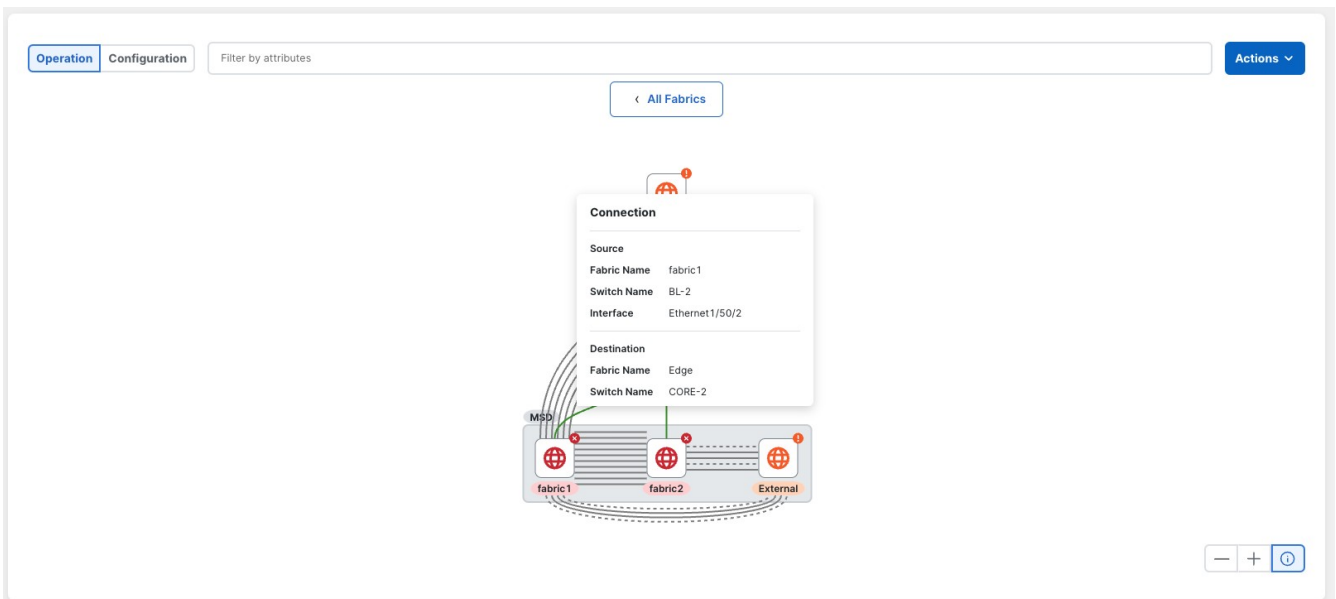


For example, single-clicking on a node provides tooltips that contain information about the existing connections, as well as a summary of general information. The content of the tooltips is scrollable.



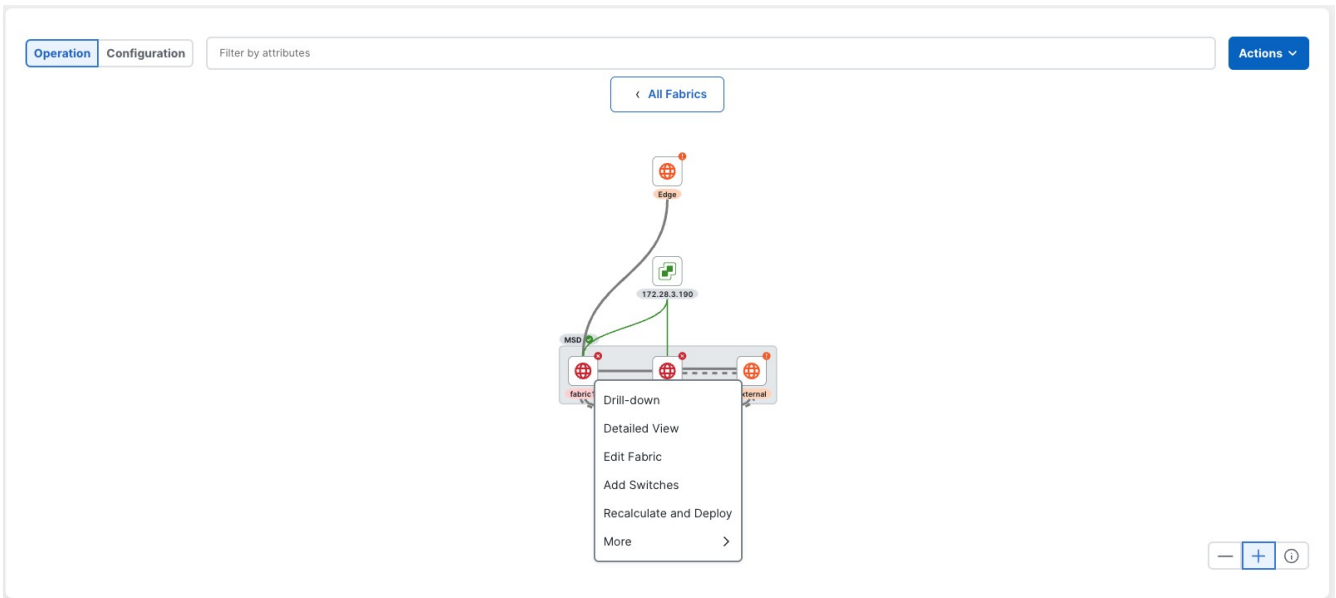
You can also get a more detailed view by clicking **View more details** on the top of the content.

When clicking on a link, you will get information related to the connected interfaces and the name of the connected devices.



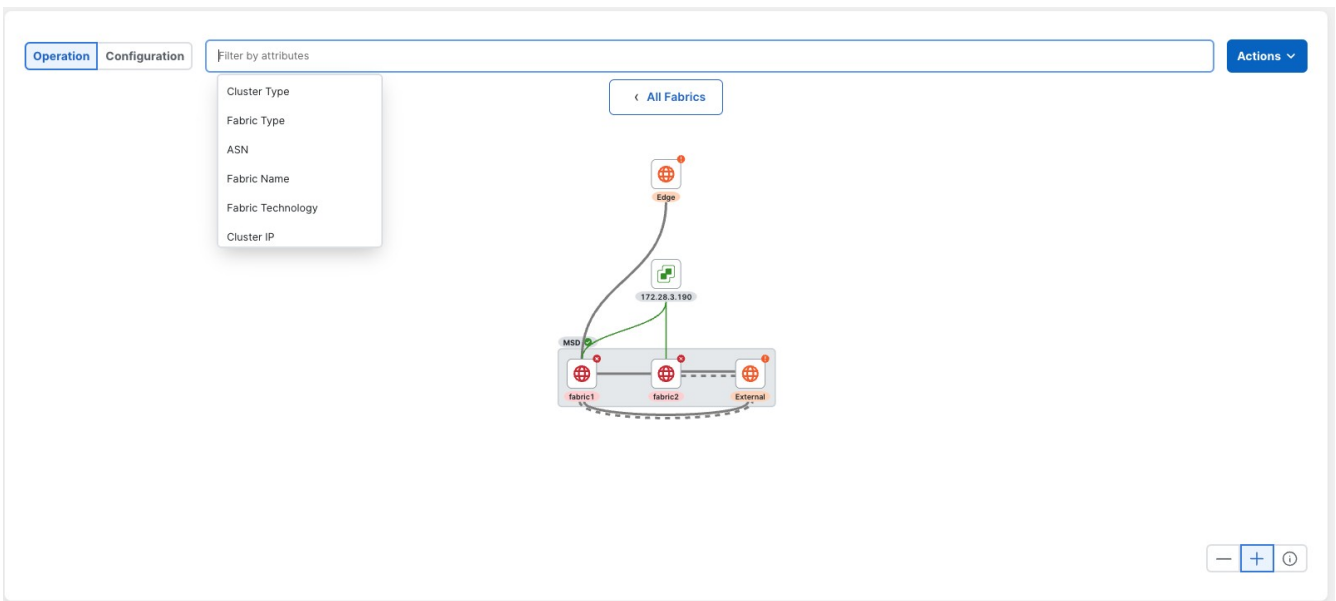
Contextual Menus

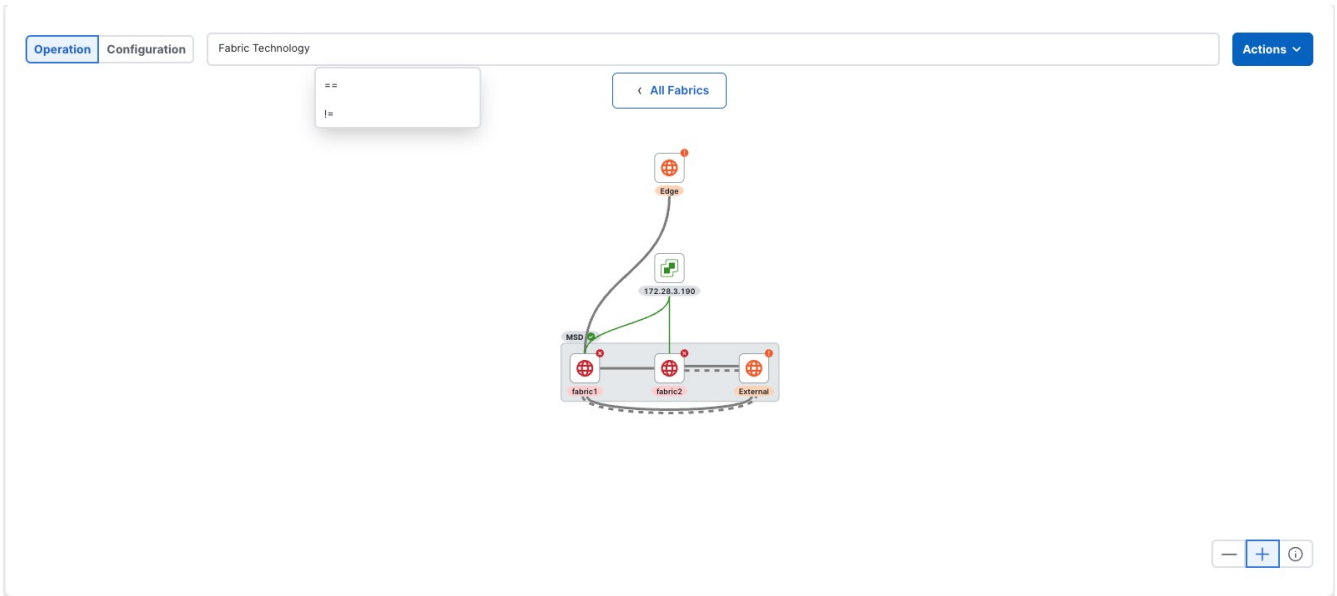
When you right-click on any of the rendered elements, a contextual menu opens.



Filtering

The filter bar at the top of an element showcases possible filters and operators that can be applied to the view that you are in, as shown in the next figure. The filters change according to the view that you are in.

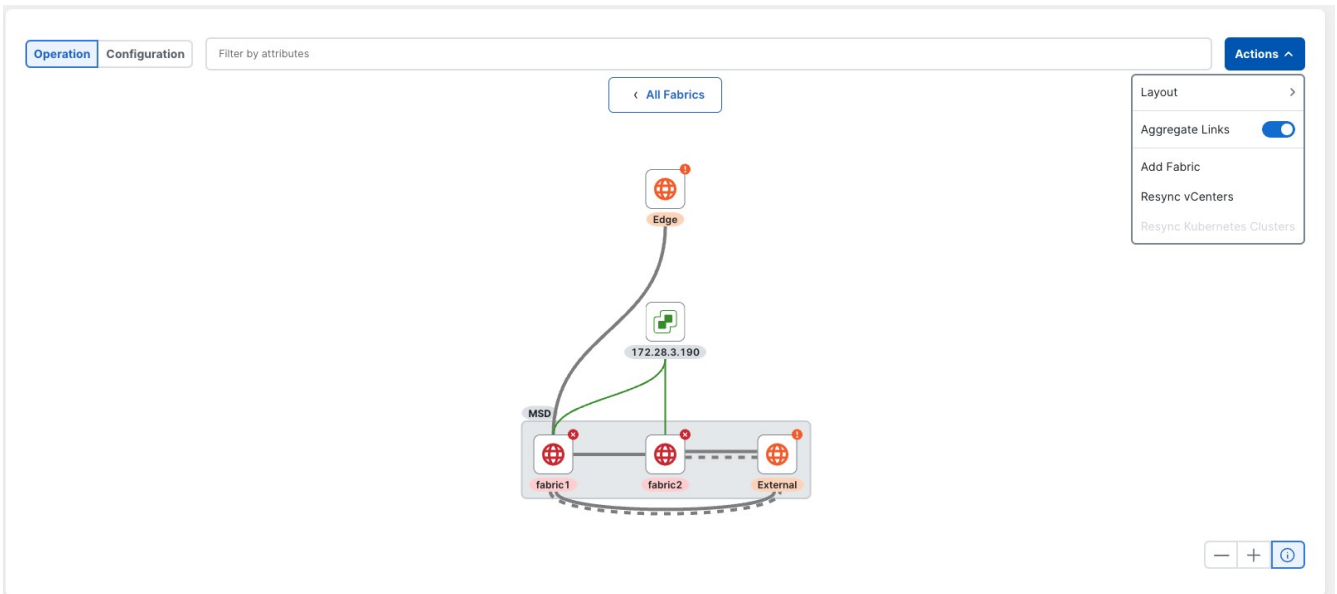




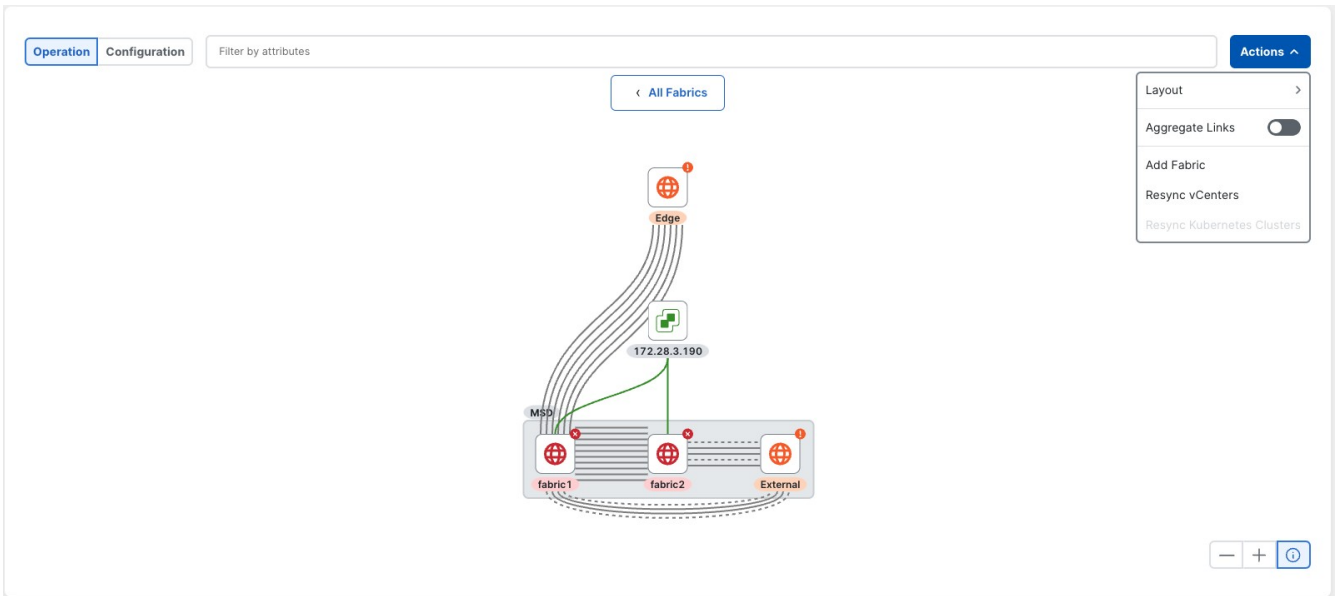
Link Aggregation

In the **Actions** dropdown, a toggle is available for **Aggregate Links**, which is enabled by default. This action transforms all individual full lines into one thick full line, while all individual dotted lines become one thick dotted line. The colour of this aggregated link is based on the least-healthy status of all its constituents.

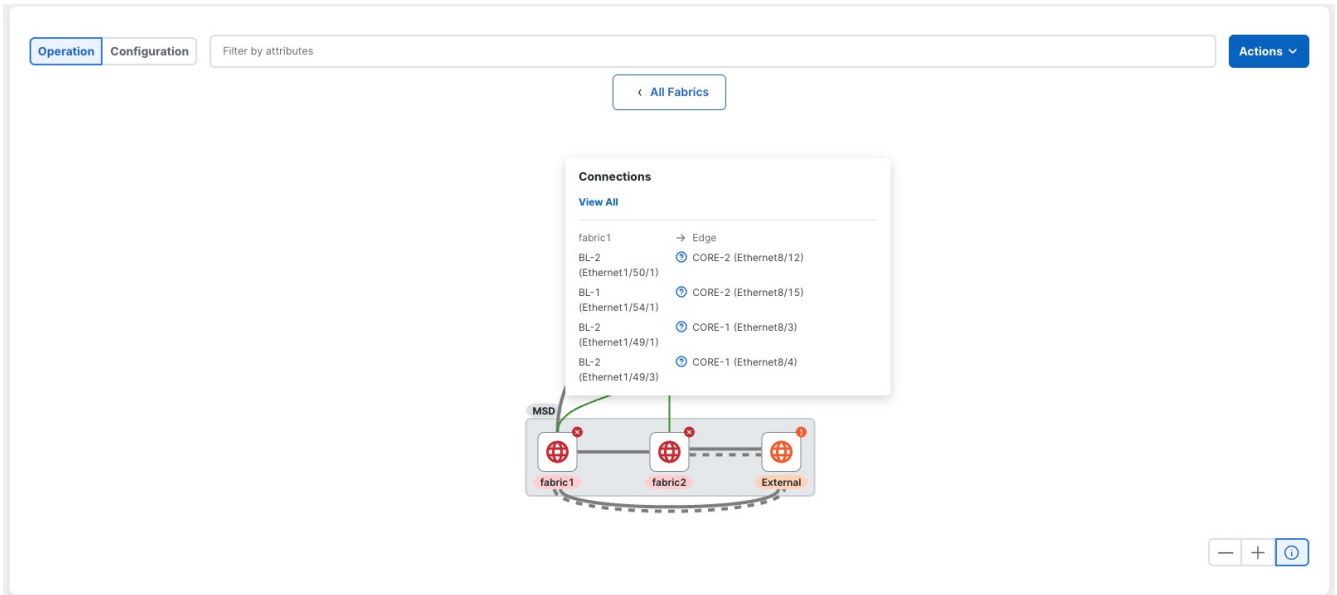
This figure shows an example scenario where the **Aggregate Links** option is enabled:



This figure shows an example scenario where the **Aggregate Links** option is disabled:



You can view a summary of all the connections by clicking on the line:



To access the actions for each of the aggregated links, click **View All** that is shown at the top of the depicted content. A side panel appears where all of the links are presented in a table.

Fabric Controller Overview

Overview **Topology** Journey

Learn More

Operation Configuration Filter by attributes

Connections

Filter by attributes Actions

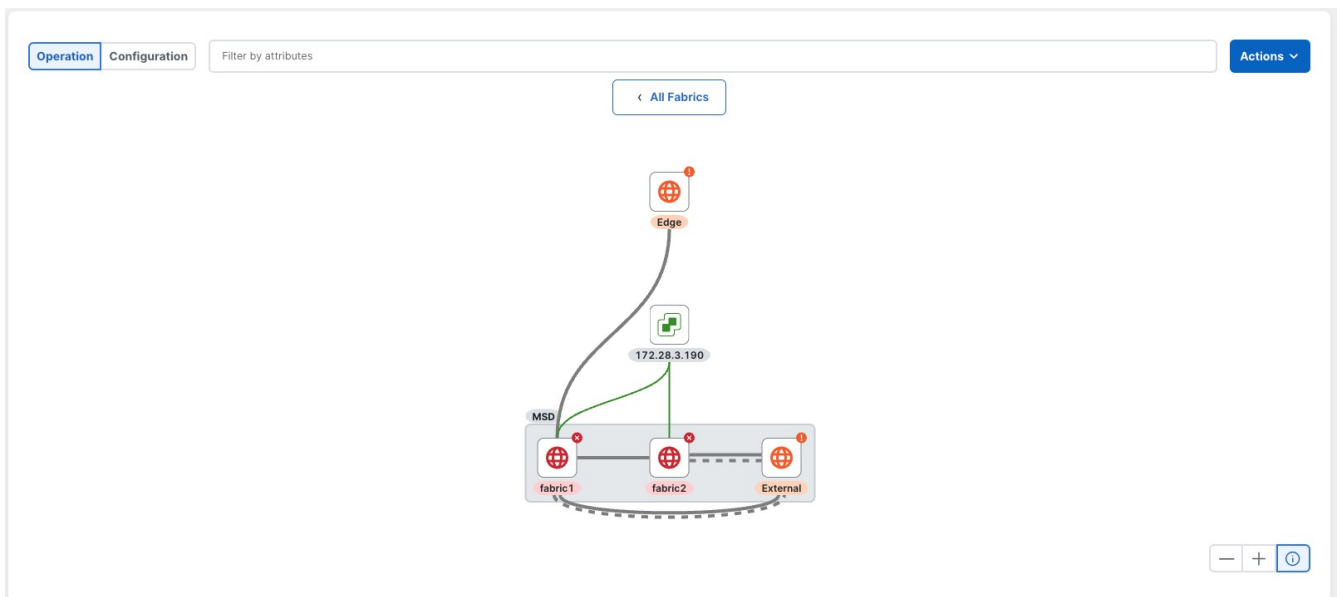
Source Name	Source Interface	Destination Name	Destination Interface	Health Status
<input type="radio"/> BL-2	Ethernet1/50/1	CORE-2	Ethernet8/12	<input type="radio"/> Unknown
<input type="radio"/> BL-1	Ethernet1/54/1	CORE-2	Ethernet8/15	<input type="radio"/> Unknown
<input type="radio"/> BL-2	Ethernet1/49/1	CORE-1	Ethernet8/3	<input type="radio"/> Unknown
<input type="radio"/> BL-2	Ethernet1/49/3	CORE-1	Ethernet8/4	<input type="radio"/> Unknown
<input type="radio"/> BL-1	Ethernet1/54/2	CORE-2	Ethernet8/16	<input type="radio"/> Unknown
<input type="radio"/> BL-2	Ethernet1/50/2	CORE-2	Ethernet8/11	<input type="radio"/> Unknown

6 items found Rows per page 10 < 1 >

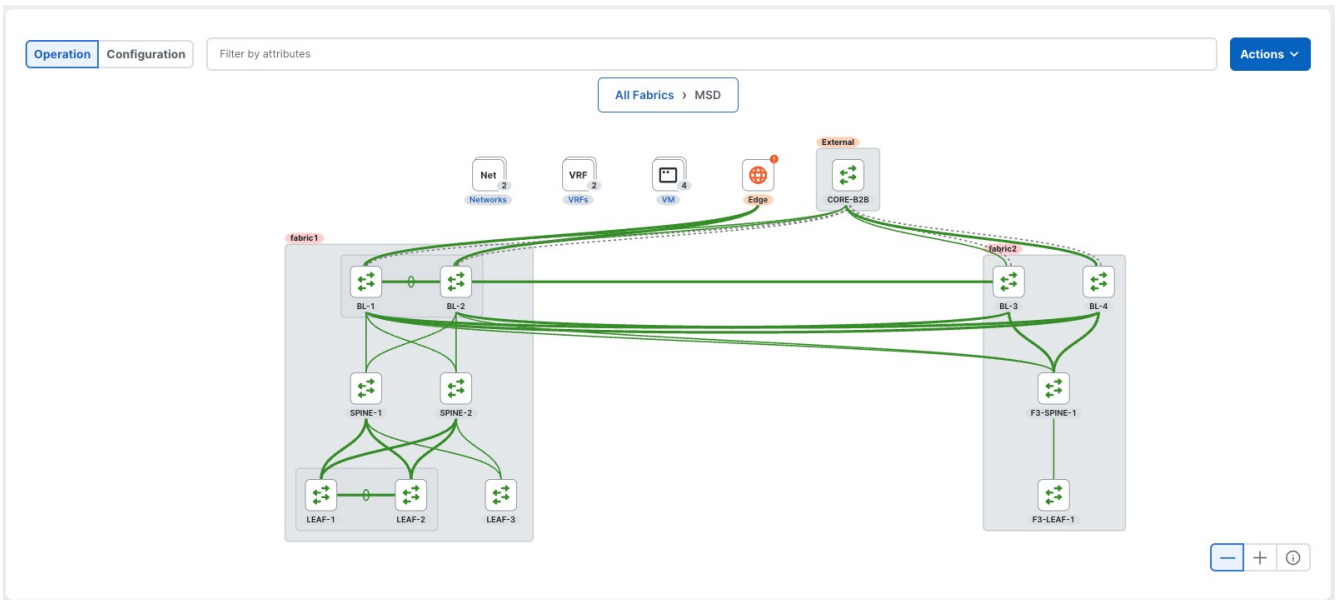
If you click on the circle in a row of the table to select that element, then the **Actions** on the right top corner is enabled.

Navigating to a Fabric Group

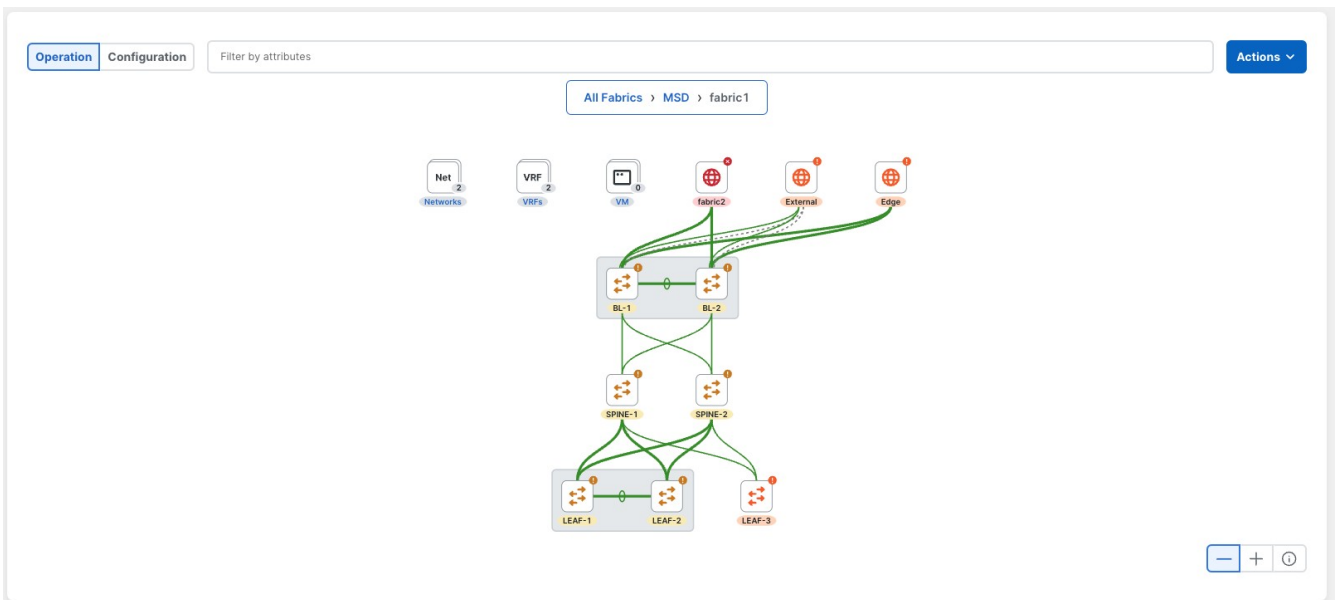
A fabric group is depicted as a grey box encapsulating all of its child fabrics.



If you double-click on the grey area, a view showcasing all of its child fabrics up to switch level is opened.



Double-click in the grey areas representing the fabric children to navigate to that fabric.

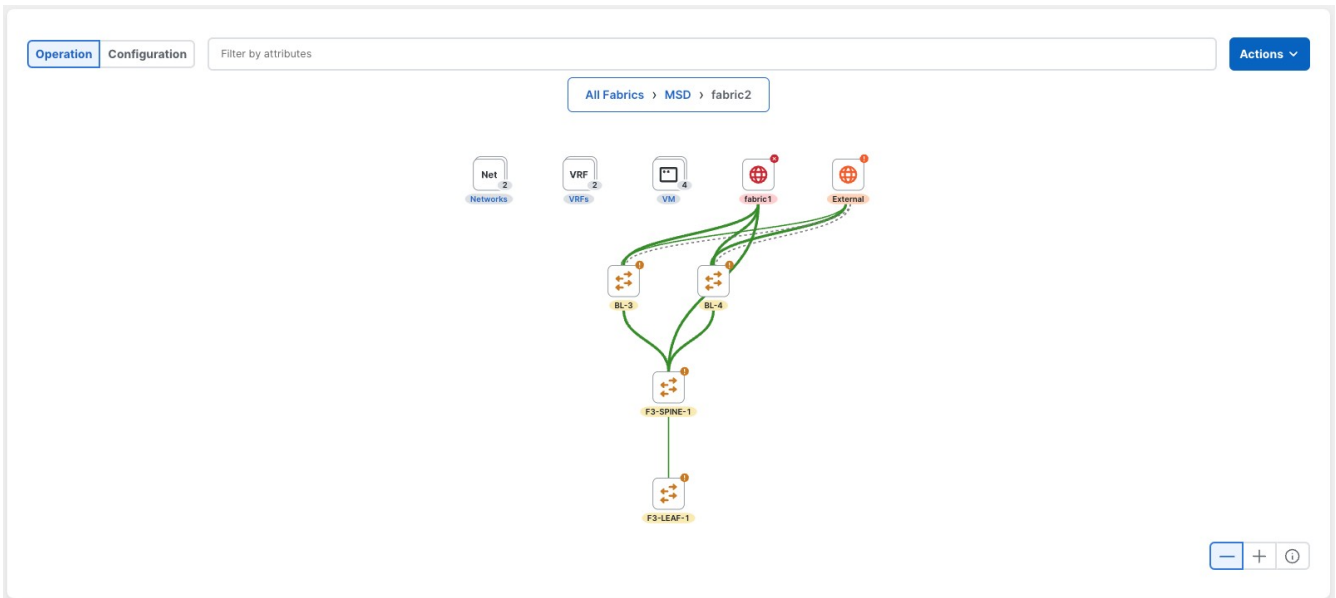


The breadcrumbs shown in the blue box in the middle top changes according to the selections made.

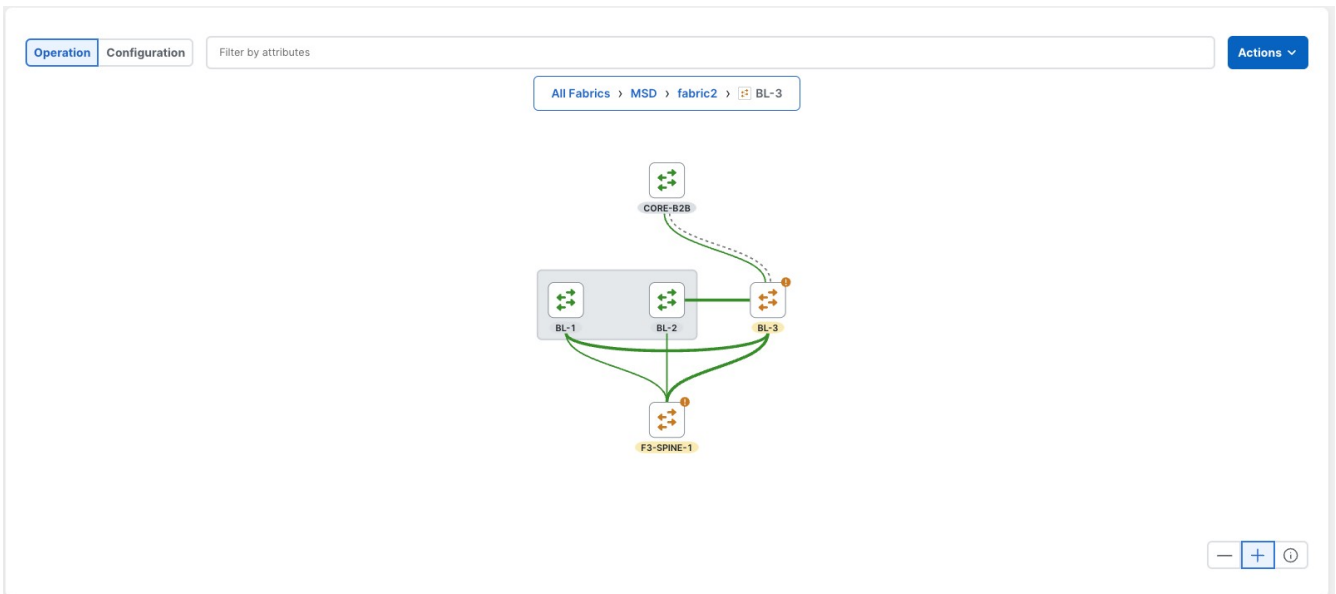
To go back to a previous view, single-click on any of the elements highlighted in blue.

Intra-Fabric Navigation

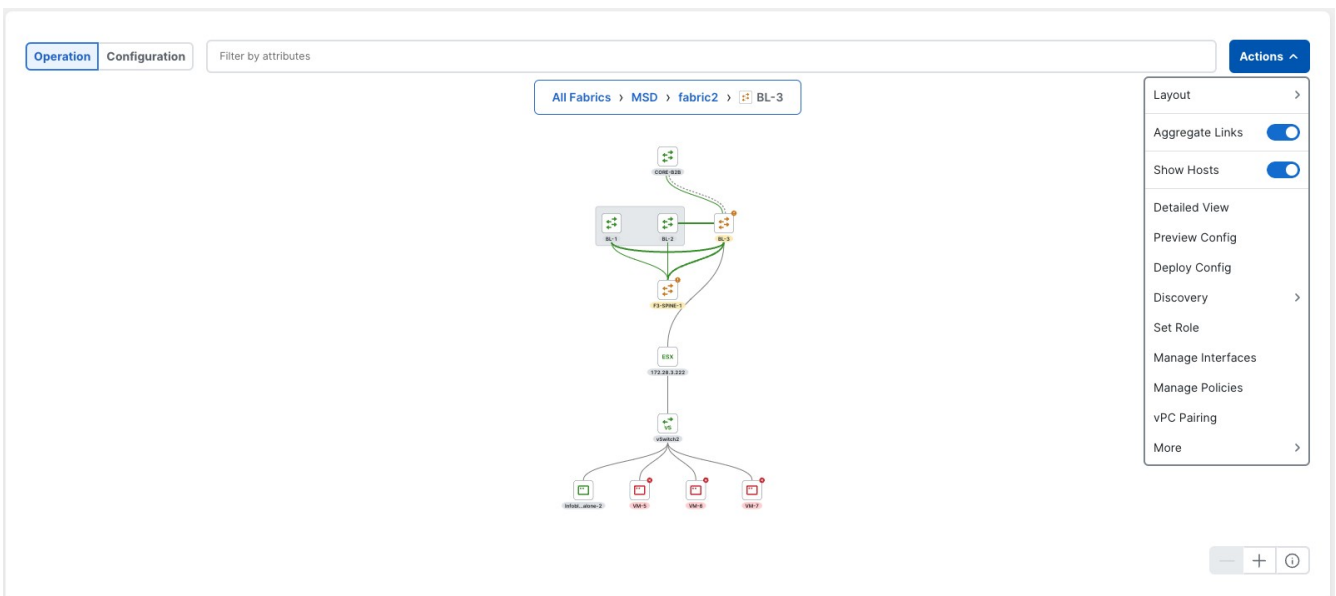
While in the **All Fabrics** view, you can double click on any of the nodes with a globe icon to open their topology up to the switch level.



To see the topology for a given switch, double-click on any of the nodes.



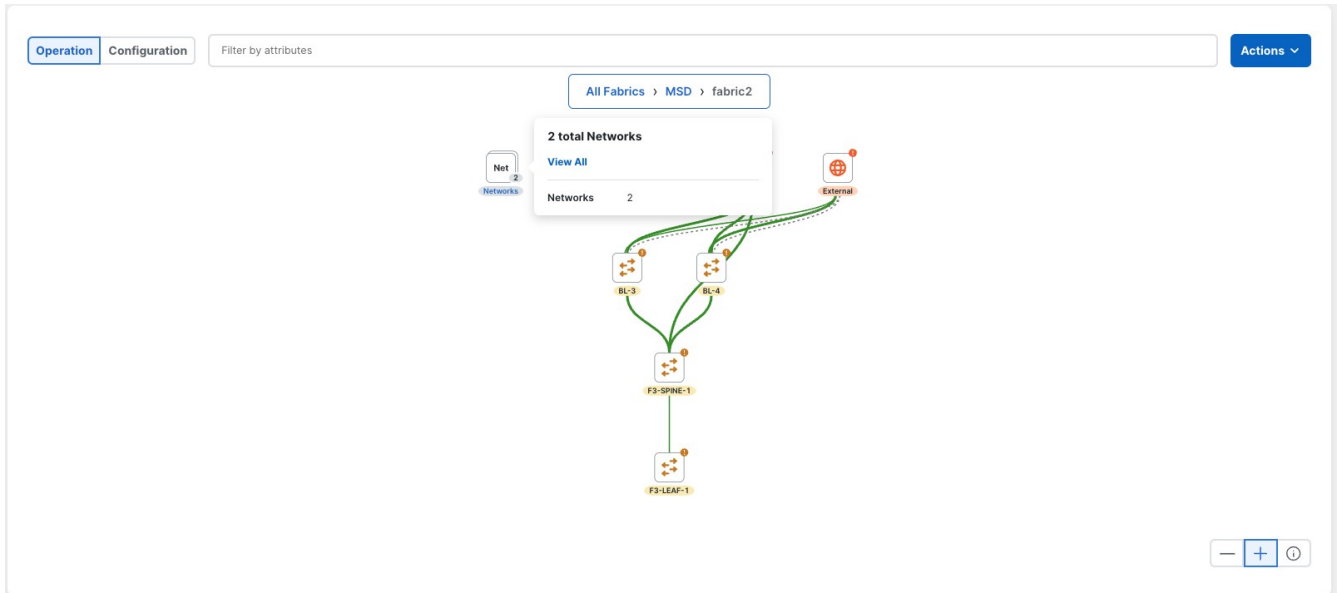
To display other connected devices in this view, click **Actions**, then toggle the **Show Hosts** option.



Overlays

Overlays are depicted as nodes with a number badge to their right that shows the total number of elements, while the text is a link that opens a side panel with the data displayed in a table.

You can open the same side panel by double-clicking on these nodes, or opening the tooltip and clicking on **View All** shown at the top of the section.



Network Overlays

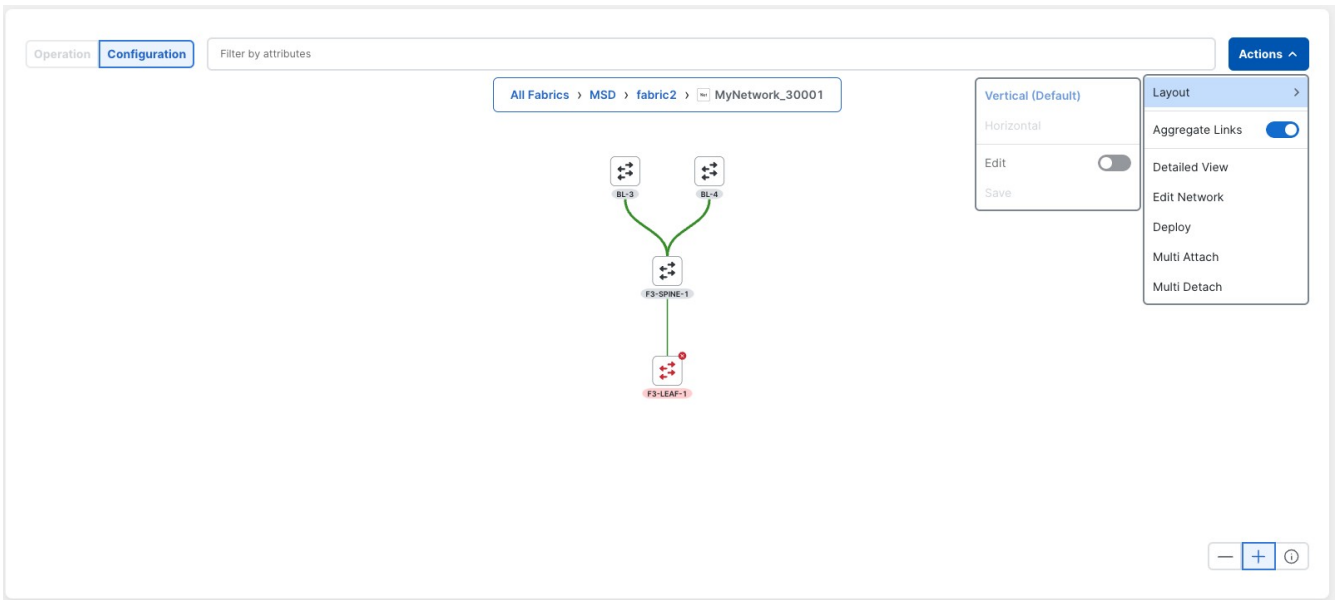
To access all of the networks, click the number on the network overlay node to open the side panel. The first column displays an icon that is used to access the topology of each network.

The screenshot shows the Fabric Controller interface. The main panel is in 'Overview' mode, and a side panel titled 'Networks' is open. The side panel displays a table with the following data:

Network Name	Network ID	Network Status
MyNetwork_30001	30001	OUT-OF-SYNC
See in Topology Network_30000	30000	OUT-OF-SYNC

The side panel also includes a filter by attributes, an Actions dropdown, and pagination controls showing '2 items found' and 'Rows per page 50'.

Click that icon to render the topology for this network. You are placed in the **Configuration** mode by default with the layout selection disabled.



VRF Overlays

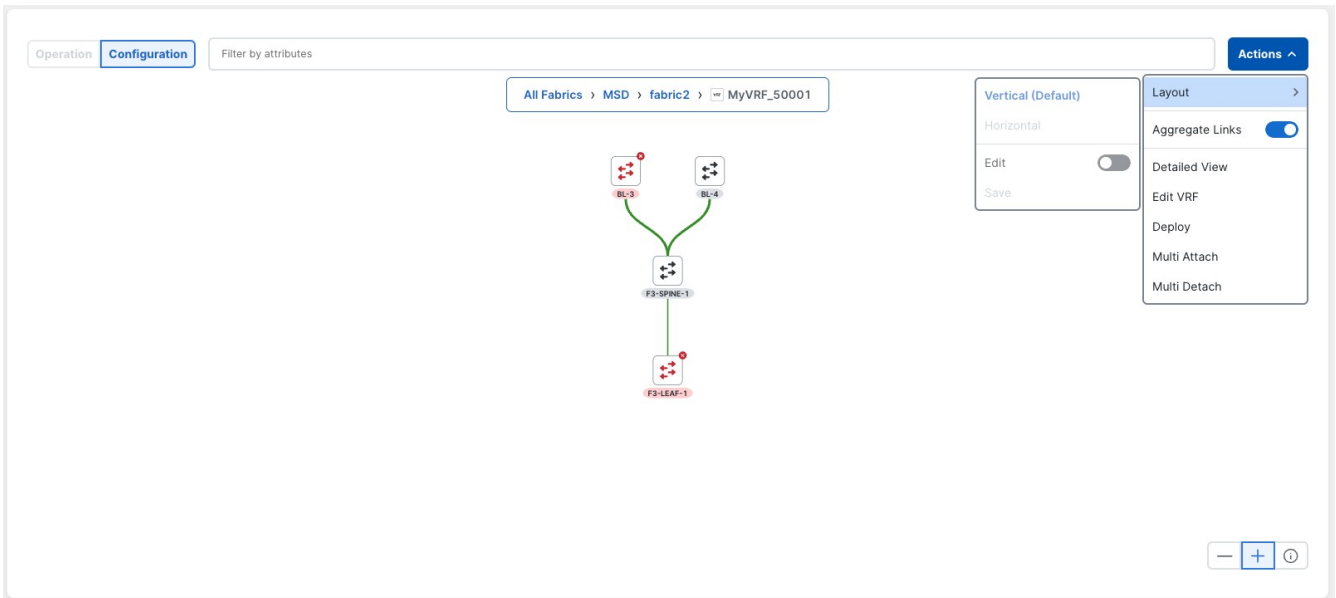
To access all of the VRFs, click the number on the VRF overlay node to open the side panel. The first column displays an icon that is used to access the topology of each VRF.

The **VRFs** panel displays the following table:

<input type="checkbox"/>	VRF Name	VRF Status	VRF ID
<input type="checkbox"/>	MyVRF_50001	OUT-OF-SYNC	50001
<input type="checkbox"/>	See in Topology VRF_50000	OUT-OF-SYNC	50000

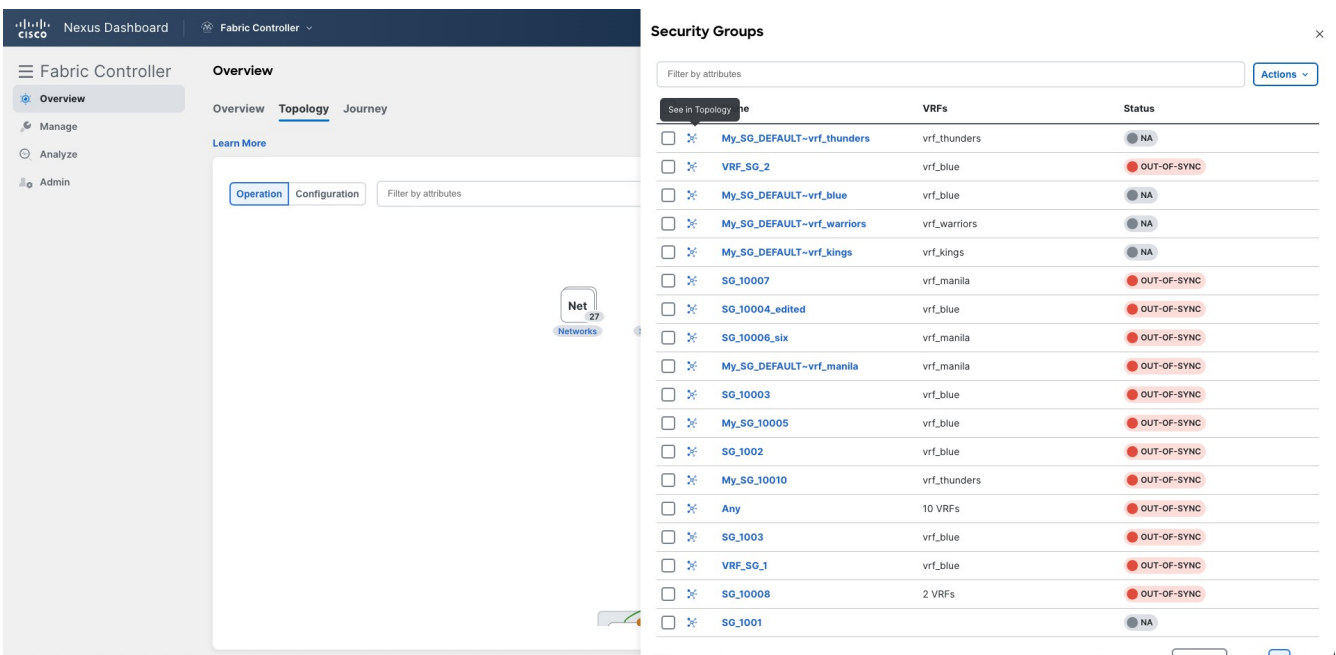
At the bottom of the panel, it indicates **2 items found** and **Rows per page 50**.

Click that icon to render the topology for this VRF. You are placed in the **Configuration** mode by default with the layout selection disabled.

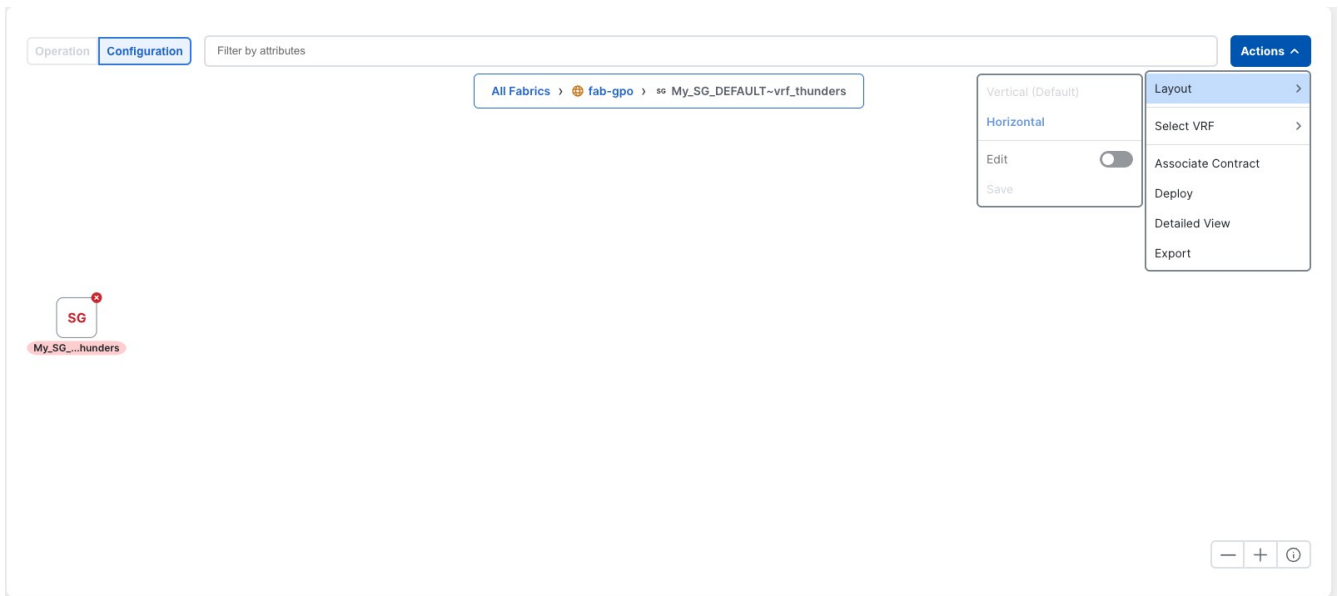


Security Group Overlays

To access all of the security groups, click the number on the security group overlay node to open the side panel. The first column displays an icon that is used to access the topology of each security group.

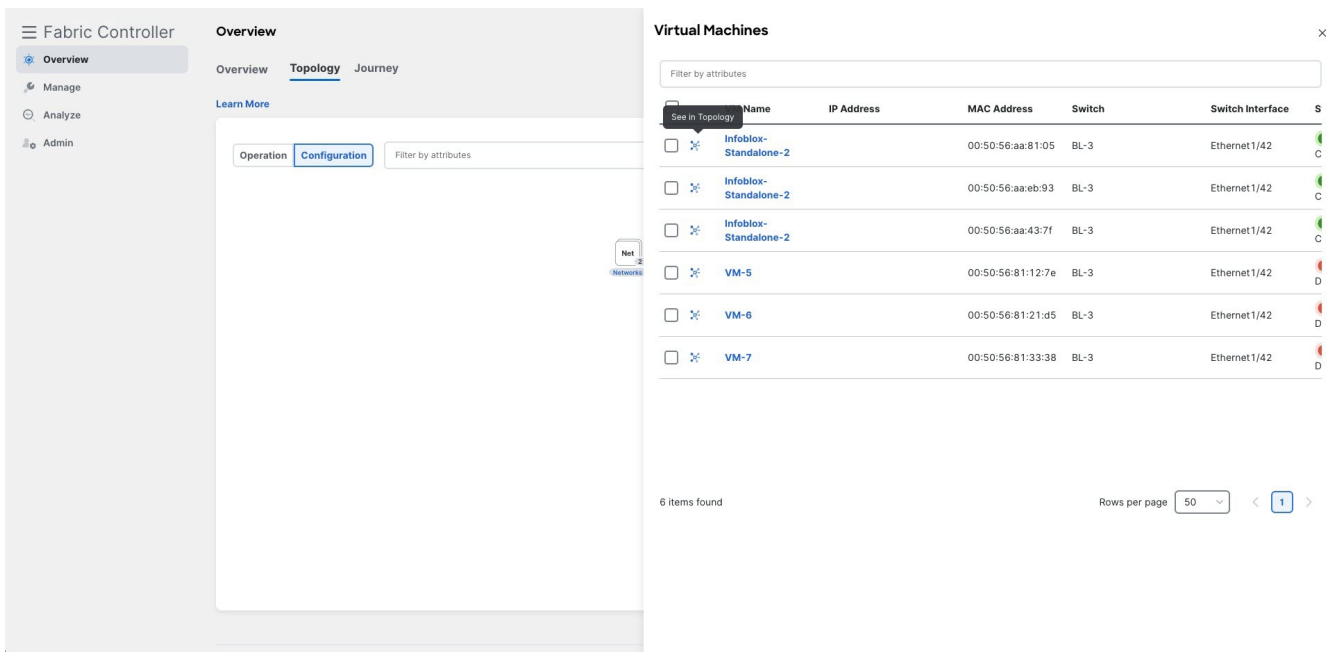


Click that icon to render the topology for this security group. You are placed in the **Configuration** mode by default with the layout selection disabled and the layout changed to horizontal.

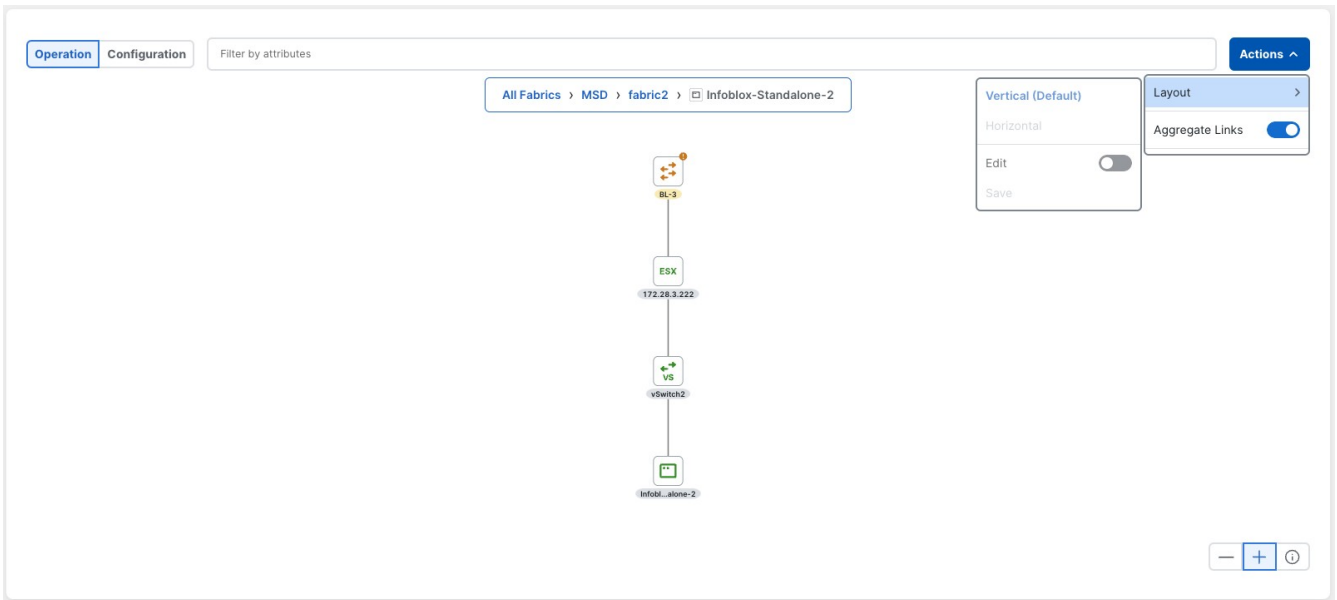


VM Overlays

To access all of the VMs, click the number on the VM overlay node to open the side panel. The first column displays an icon that is used to access the topology of each VM.



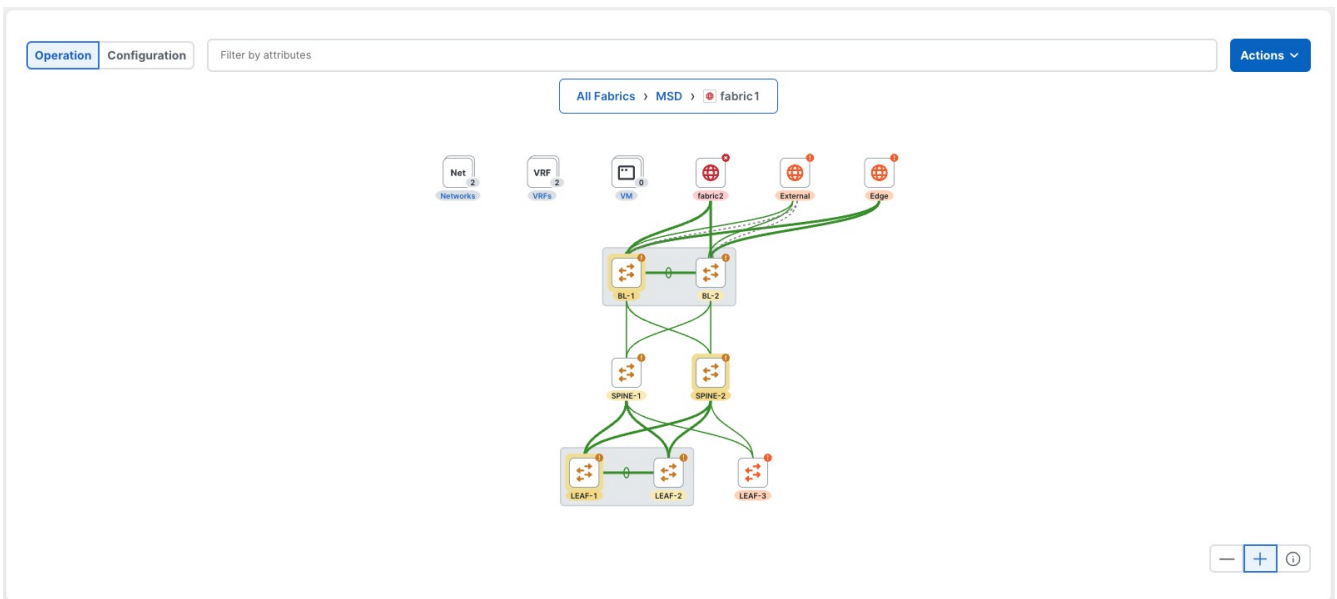
Click that icon to render the topology for this VM, with the layout selection disabled.



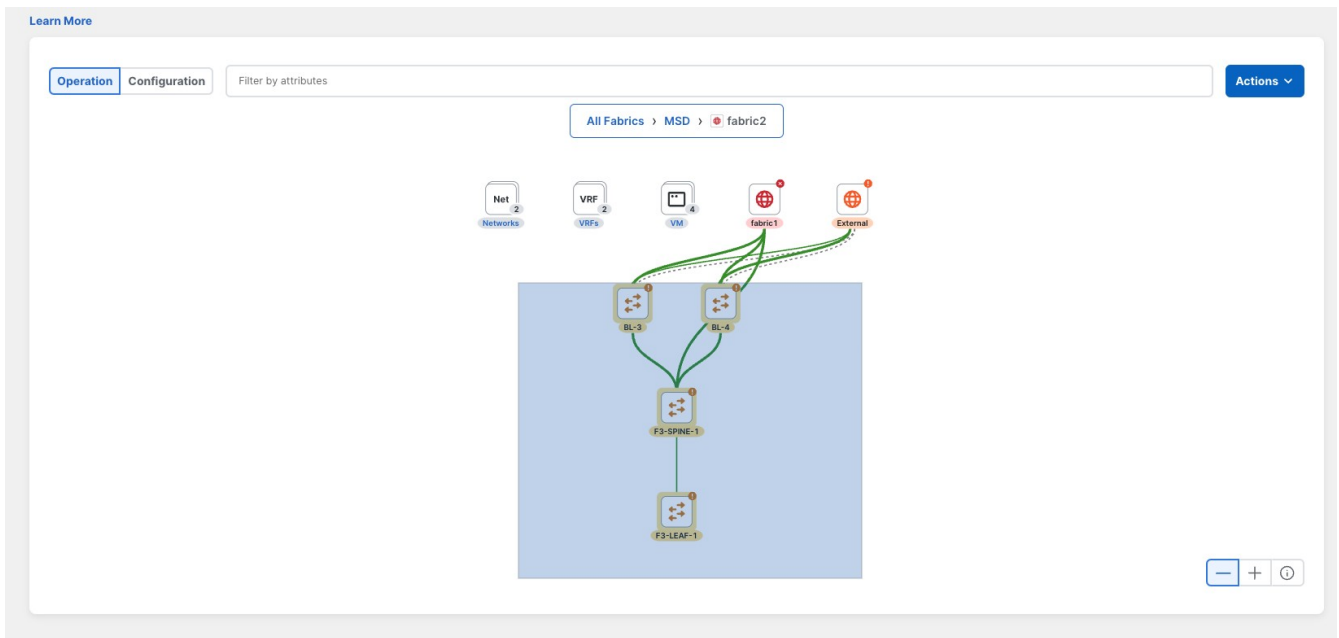
Multi-Node Selection

You can select multiple nodes using either of these methods:

- By pressing ctrl as you click on each node that you want to select:

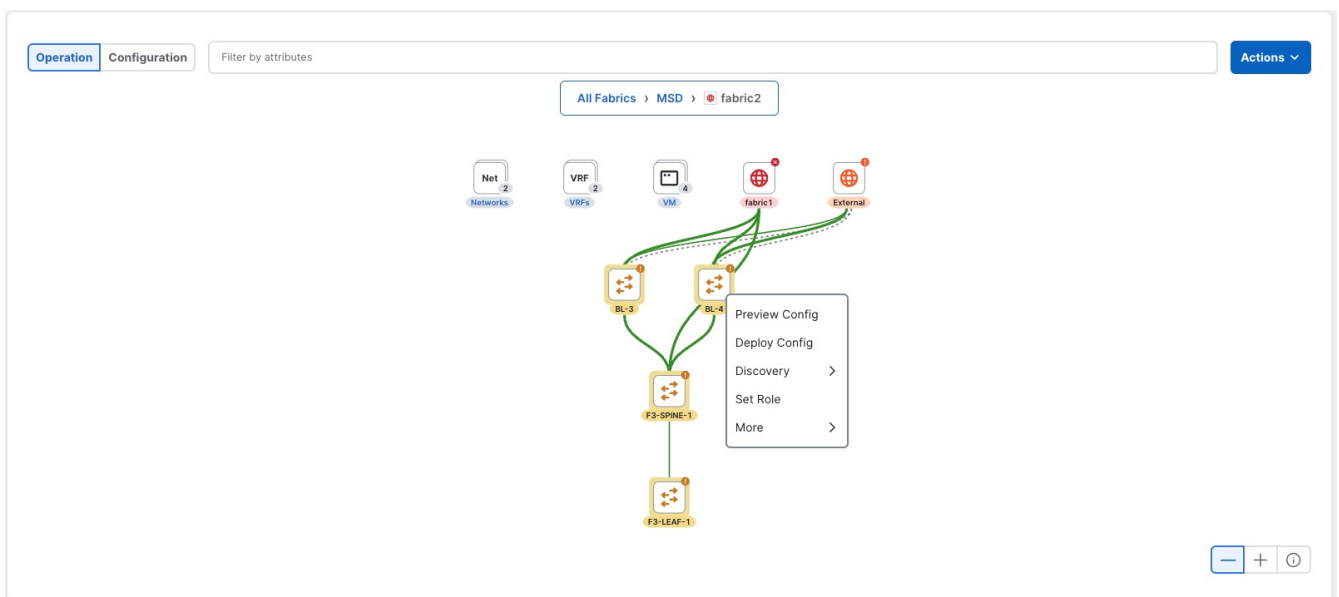


- Or by clicking in an area, then, with the mouse still clicked, dragging the mouse across the area with the elements that you want to select:



The selected nodes will have a highlighted background.

To access actions for your selection, right-click on any of the selected elements.



Searching Topology

Use a combination of search attributes and search criteria in the search bar for an effective search. As you enter a combination of search attribute and search criteria in the search bar, the corresponding devices are highlighted in the topology.

You can apply the search criteria such as equals (=), does not equal (!=), contains (**contains**), and does not contain (**!contains**).

The search attributes that you can use for LAN fabrics are ASN, Fabric Type, Fabric Name, and Fabric technology. The fabric type attributes that you can use for search include switch fabric, multi-fabric domain, external, and LAN monitor. The fabric technology attributes that you can use for search include fabricpath fabric, VXLAN fabric, VLAN fabric, external, LAN classic, IPFM classic, IPFM fabric, switch group, multi-fabric domain, eBGP VXLAN fabric, eBGP routed fabric, MSO site group, meta fabric, LAN monitor fabric, and IOS-XE VXLAN fabric.

For IPFM fabrics, the following fields are available to search on: switch or hostname, switch or host IP address, switch MAC, and switch serial number. In the Generic Multicast mode, also, you can search the receiver-interface name or IP addresses in this window.

Initial Setup

The following topics provide initial setup information for the LAN operational mode in the Cisco Nexus Dashboard Fabric Controller.

Server Settings

The following topics provide initial setup information for the LAN operational mode in the Cisco Nexus Dashboard Fabric Controller.

Server Settings

You can set the parameters that are populated as default values.

To set the parameters of the Nexus Dashboard Fabric Controller server from the Cisco Nexus Dashboard Fabric Controller Web UI, perform the following steps:

1. Navigate to the **Admin > System Settings** page.
2. Click on the **Server Settings** tab.

NDFC classifies server settings by different tabs.

3. Modify the settings on any of the tabs in **Server Settings** based on your requirements.
4. Click **Save** to apply the settings.

Each microservice of an enabled feature has additional tabs and properties other than those listed below.

Each field has a short description. If there is an error when configuring any of the features in **Server Settings**, the corresponding tab displays in red. The **Save** button is disabled until you resolve those errors.

NDFC services perform comprehensive checks on the NDFC server. If there are any errors, those errors are displayed on the NDFC UI.



- You can modify the properties in **Server Settings** without the support of Cisco TAC.
- If the Nexus Dashboard is rebooted, NDFC services are down for a period of time.

Enable AAA Passthrough Feature

This feature is available in NDFC release 12.2.1. In the **LAN-Fabric** area in Server Settings, check the checkbox for the **Enable AAA Passthrough feature** to enable the authentication, authorization, and accounting (AAA) passthrough feature. When enabled, the AAA passthrough feature allows NDFC to automatically copy the NDFC user login credentials to the LAN switch credentials settings for that user. When a local user logs in, that user can set the default credentials. The local user workflow

remains intact even after the local user enables the AAA passthrough feature.

NDFC maintains the LAN switch credentials settings in **Admin > Switch Credentials > LAN Credentials Management > Default Credentials**. When the user logs in to NDFC for the first time, NDFC does not display the message to enter the LAN switch credentials, as NDFC automatically copies the NDFC user login information to the LAN switch credentials.

You can still set per device login credentials to handle devices not using AAA. The default setting is disabled (check box is unchecked).

LAN Device Management Connectivity under Admin

You can change persistent IP addresses that are assigned for mandatory pods such as POAP-SCP and SNMP trap.

This setting determines the Persistent IPs usage for the PODs required for Nexus Dashboard Fabric Controller. When you select the Fabric Controller persona for the first time, there is a pre-check to determine if Persistent IPs are allocated on Nexus Dashboard. If Persistent IPs are not allocated, then you will see an error.

You can provide Persistent IPs in either the management network or the data network in Nexus Dashboard. Based on this selection, you must specify the option under LAN Device Management Connectivity, which can be found under **Server Settings** in the NDFC application page. By default, management is selected, but if you provide Persistent IPs under the Nexus Dashboard data network, then you must select **Data** as the option.



When you change the LAN Device Management connectivity from management to data or vice versa, some of the devices might have a **SSH Unreachable** critical error for a short time, but the connectivity will eventually be restored.

SMTP Host under SMTP

This setting is used as an email out-of-band notification for programmable reports and alarms.

You can receive NDFC alarms and reports through email notification. The SMTP Host address must be reachable through the Nexus Dashboard management interface. If the Nexus Dashboard management interface and SMTP Host are part of different IP subnets, then you must create a static route entry in the Nexus Dashboard Cluster configuration.

You can enter other texts for SMTP fields. To initiate alarms to an external receiver, provide the IP address of the SNMP listener and the port that it is listening on.

Disable Deployment Across all Fabrics Under LAN Fabric

This setting disables deployments for all the fabrics that are defined in the NDFC instance. You will not be able to enable the deployment on a per fabric level. For example, if you have three fabrics, then all three fabrics will be disabled from the configuration point of view. You can continue to stage various configurations if necessary. Later, you can enable the deployment action by unchecking this server setting.

Collect Non-Link Physical Interfaces for LAN Switches Under PM

This setting enables collection of non-link physical information for LAN switches. Enable this

checkbox when you want to view information for physical interfaces on LAN switches that are connected to non-NDFC managed devices. The default is not enabled.

Collect Temperature for LAN Switches Under PM

This setting enables NDFC to collect switch temperate details and show it in the Fabric Overview and the Metric areas. By the default temperature data is not collected. After you enable this setting, you can view the temperature information of the fabric switches as well.

Feature Management

In Cisco DCNM Release 11.x, you must choose the install mode while installing the DCNM. From Release 12.0.1a, Cisco Nexus Dashboard Fabric Controller allows you to install the service on the Nexus Dashboard. After you launch the Nexus Dashboard Fabric Controller UI, you will see three different Install modes on the Feature Management page.

Nexus Dashboard Fabric Controller 12 allows you to dynamically enable the feature set and scale applications. Choose **Admin > System Settings > Feature Management** to choose the installer type and enable or disable few features on the selected deployment.

When you launch Nexus Dashboard Fabric Controller for the first time from Cisco Nexus Dashboard, the Feature Management screen appears. You can perform only Backup and Restore operations before you choose the feature set.

On the Feature Management page, you can choose one of the following install modes:

- Fabric Discovery
- Fabric Controller
- SAN Controller

After you select a Feature Set, from the next login, Dashboard page opens when you launch Cisco Nexus Dashboard Fabric Controller from Nexus Dashboard.

Choosing Feature Set

When you launch Cisco Nexus Dashboard Fabric Controller 12 for the first time, none of the feature set is enabled. During this state, you can perform Backup and Restore to restore the DCNM 11.5(x) data on Nexus Dashboard Fabric Controller 12. Nexus Dashboard Fabric Controller will read the data from the backup file and select the installer type accordingly.

To deploy feature-set from Cisco Nexus Dashboard Fabric Controller Web UI perform the following steps:

1. Choose **Admin > System Settings > Feature Management**.
2. Select a persona to view the default set of features.

For information about the features available in Cisco NDFC personas, see [Features with each Persona](#).

3. In the table below, select the check box against the feature name available with the feature set.
4. Click **Apply**.

The feature-set will be deployed. The selected applications will be enabled. A message appears that the feature set is installed, and you must refresh to take effect.

5. Refresh the browser to deploy Nexus Dashboard Fabric Controller with the selected feature set and applications.

The left pane shows the features supported specifically with the deployed feature set.

Features with each Persona

Fabric Controller

Features available for Fabric Controller Persona

Feature Name	Description
Kubernetes Visualizer	Network Visualization of K8s Clusters
Endpoint Locator	Tracking Endpoint IP-MAC Location with Historical Information
IPAM Integration	Integration with IP Address Management (IPAM) Systems
Openstack Visualizer	Network Visualization of Openstack Clusters
Performance Monitoring	Monitor Environment and Interface Statistics
IP Fabric for Media	Media Controller for IP Fabrics
PTP Monitoring	Monitor Precision Timing Protocol (PTP) Statistics
VMM Visualizer	Network visualization of Virtual Machines
Fabric Builder	Easy Fabric Functionality for NX-OS and Other devices

Kubernetes Visualizer

After enabling this feature, reload to view left pane **Virtual Management > Virtual Infrastructure Manager**. This feature allows you to visualize Kubernetes cluster as Container Orchestrator with the Cisco NDFC. See the "Kubernetes Cluster" section in [Virtual Infrastructure Manager](#) for more information.

Endpoint Locator

This feature allows real-time tracking of endpoints within a data center. The tracking includes tracing the network life history of an endpoint and getting insights into the trends that are associated with endpoint additions, removals, moves, and so on. See the "Monitoring Endpoint Locator" section in [Endpoint Locator](#) for more information.

IPAM Integration

IPAM Integrator allows read-only access to the IPAM and NDFC servers. See [IPAM Integrator](#) for more information.

Openstack Visualizer



Ensure that the vCenter cluster or Kubernetes cluster feature must be enabled to add an OpenStack cluster. See the "OpenStack Cluster" section in [Virtual Infrastructure Manager](#)

Performance Monitoring

This feature is supported for IPFM fabrics. Enabling performance monitoring will monitor the performance of fabric. See [IPFM Fabrics](#) for more information.

IP Fabric for Media

You can enable this feature to configure fabrics related to IP Fabric for Media (IPFM). See [IPFM Fabrics](#) for more information.



You can either enable Fabric builder or IP Fabric for Media feature on NDFC. Enabling both features on single NDFC is not supported, it displays error message *Features Fabric Builder and IP Fabric for Media are mutually exclusive. Please select only one at a time*

PTP Monitoring

PTP is a time synchronization protocol for nodes that are distributed across a network. On a local area network, it achieves clock accuracy in the sub-nanosecond range, making it suitable for measurement and control systems. See the "PTP Monitoring" section in [About Switch Overview for LAN Operational Mode Setups](#) for more information.

VMM Visualizer

Enable this feature to configure network visualization of Virtual Machines on fabrics. See [Virtual Infrastructure Manager](#) for more information.

Fabric Builder

To configure fabrics and functionalities for NX-OS and other devices, enable this feature. See [Understanding LAN Fabrics](#) for more information.



If you are using a Virtual Nexus Dashboard Cluster before you begin, ensure that the Persistent IP address and required settings are enabled.

Changing across Feature-Set

Nexus Dashboard Fabric Controller 12 allows you to switch from one feature set to another. Choose **Admin > System Settings > Feature Management**. Select the desired feature set and applications in the table below. Click **Save & Continue**. Refresh the browser to begin using Cisco Nexus Dashboard Fabric Controller with the new feature set and applications.

There are a few features/applications supported with specific deployments. When you change the feature set, some of these features are not supported in the new deployment. The following table provides details about the pre-requisites and criteria based on which you can change the feature set.

Supported Switching between deployments

From/To	Fabric Discovery	Fabric Controller	SAN Controller
---------	------------------	-------------------	----------------

Fabric Discovery	-	Only monitor mode fabric is supported in Fabric Discovery deployment. When you change the feature set, the fabric can be used in the Fabric Controller deployment.	Not supported
Fabric Controller	You must delete the existing fabrics before changing the fabric set.	If you're changing from Easy Fabric to IPFM fabric application, you must delete the exiting fabrics.	Not supported
SAN Controller	Not supported	Not supported	-

LAN Credentials Management

While changing the device configuration, Cisco Nexus Dashboard Fabric Controller uses the device credentials provided by you. However, if you do not provide the LAN switch credentials, Cisco Nexus Dashboard Fabric Controller prompts you to open the **Admin > Switch Credentials > LAN Credentials Management** page to configure the LAN credentials.

Cisco Nexus Dashboard Fabric Controller uses two sets of credentials to connect to the LAN devices:

- **Discovery Credentials**

Cisco Nexus Dashboard Fabric Controller uses these credentials during discovery and periodic polling of the devices.

NDFC uses discovery credentials with SSH and SNMPv3 to discover the hardware or software inventory from the switches. You can discover one inventory per switch. These discovery credentials are read-only and you cannot make configuration changes on the switches.

- **Configuration Change Credentials**

Cisco Nexus Dashboard Fabric Controller uses these credentials when a user changes the device configuration.

LAN Credentials

You can use the write option on the LAN credentials page to do configuration changes on the switch. One credential is allowed per user for a single switch. A user role must access NDFC to use the write option for the switches to push configurations on it through an SSH connection.

For a user role created on NX-OS switches, an SNMPv3 user is created with the same password. Ensure that the SSH and SNMPv3 credentials match for the discovery of the credentials. If SNMP authentication fails, discovery of credentials stops displaying an error message. If SNMP authentication succeeds and SSH authentication fails, discovery of credentials continues, and the switch status displays a warning message for the SSH error.

If the user role created on the NX-OS switches uses AAA authentication, the SNMPv3 user is not

created. Using this AAA authentication to discover or import a switch in NDFC, the controller detects that the local SNMPv3 user is not created on the switch. NDFC runs the exec command on the switch to create an SNMPv3 user with the same password on the switch. The SNMPv3 user role is temporary. Once the user role expires, the continual discovery of switches from NDFC creates the SNMPv3 user.

LAN credentials management allows you to specify configuration-change credentials. Before changing any LAN switch configuration, you must enter the LAN credentials for the switch. If you do not provide the credentials, the configuration change action is rejected.

These features get the device-write credentials from the LAN credentials feature.

- Upgrade (ISSU)
- Maintenance mode (GIR)
- Patch (SMU)
- Template deployment
- POAP-write erase reload, rollback
- Interface creation, deletion, or configuration
- VLAN creation, deletion, or configuration
- VPC wizard

You must specify the configuration-change credentials irrespective of whether the devices were discovered initially or not. This is a one-time operation. After the credentials are set, the credentials are used for any configuration-change operation.

Default Credentials

You use default credentials to connect all the devices that the user has access to. You can override the default credentials by specifying credentials for each of the devices in the **Devices** table.

Cisco Nexus Dashboard Fabric Controller tries to use individual switch credentials in the devices, to begin with. If the credentials (username/password) columns are empty in the devices, the default credentials are used.

Switch Table

The **Devices** table lists all the LAN switches that the user has access to. You can specify the switch credentials individually, which will override the default credentials. In most cases, you need to provide only the default credentials.

The LAN credentials for the Nexus Dashboard Fabric Controller **Devices** table has the following fields.

Field	Description
Device Name	Displays the switch name.
IP Address	Specifies the IP address of the switch.
Credentials	Specifies whether the default or switch-specific custom credentials are used.

Username	Specifies the username that Nexus Dashboard Fabric Controller uses to login.
Fabric	Displays the fabric to which the switch belongs.

The following table describes the action items, in the **Actions** menu drop-down list, that appear on the **LAN Credentials Management** page.

Action Item	Description
Edit	Choose a device name and click Edit . Specify a username and password. You can edit local or custom- specific credentials.
Clear	Choose a device name and click Clear . A confirmation dialog box appears. Click Yes to clear the switch credentials from the NDFC server.
Validate	Choose a device name and click Validate . A confirmation message appears, indicating if the operation was successful or a failure.

Robot Credentials

When you specify default credentials, you can enable the robot feature, enabling the robot flag.

The robot role is similar to an earlier role in DCNM. The robot user role helps with switch and device accounting. You can track all the changes done on NDFC with a general user account. If the user role changes on NDFC that impacts the change on the device, this is termed an out-of-band change. These changes are logged on the device as the changes made by a general user account. Therefore, you can track and distinguish between out-of-band changes and changes made on the device. This general user account is termed as a robot user role for the changes logged on the device.

For example, a user role of network-admin on NDFC has access to enter LAN device credentials to push configurations on the switches. With the network-admin user role, you can check the robot flag while creating the LAN credentials.

The username for the LAN credentials is displayed as a change logged on the device. If a username for the LAN credentials is changed to a controller and the robot flag is checked, the credentials for the device changes from default to robot. This user role pushes configurations on the switches in NDFC. These changes are logged in the **History** tab of the fabric as the changes made by the network-admin user role. The account log on the switch displays as the controller. The appropriate user-role details are logged on NDFC and the device.

In NDFC, the robot user role is considered the admin role for all the fabrics and the devices. If the default credential is not set on a fabric, you can use the robot user role, if it is set for different devices. If another user role with write access logs in to NDFC, this user role is not prompted to update the credentials as the robot user role is already set. The credentials are set in the following order: individual switch, robot, and then the default credentials.

On the **Admin > Switch Credentials > LAN Credentials Management** page, you can choose to either use default credentials or robot credentials while changing device configurations, unless you set custom credentials.

To set the default credentials, perform the following steps:

1. Choose the required **Device Name** and click **Set**.

The **Set credentials** dialog box appears.

2. Enter the appropriate details.
3. Choose the **Robot** checkbox to set the robot credentials.

You can choose the appropriate roles to push configurations to devices without adding device credentials.



If you enable the **Enable AAA Passthrough feature**, you cannot set the robot flag.

4. Click **Save** to apply the settings.
5. On the **Admin > Switch Credentials > LAN Credentials Management > Default Credentials** page, choose the required **Device Name** and click **Clear**.

A confirmation message appears.

6. Click **Yes** to clear the default device credentials.

Copyright

THE SPECIFICATIONS AND INFORMATION REGARDING THE PRODUCTS IN THIS MANUAL ARE SUBJECT TO CHANGE WITHOUT NOTICE. ALL STATEMENTS, INFORMATION, AND RECOMMENDATIONS IN THIS MANUAL ARE BELIEVED TO BE ACCURATE BUT ARE PRESENTED WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED. USERS MUST TAKE FULL RESPONSIBILITY FOR THEIR APPLICATION OF ANY PRODUCTS.

THE SOFTWARE LICENSE AND LIMITED WARRANTY FOR THE ACCOMPANYING PRODUCT ARE SET FORTH IN THE INFORMATION PACKET THAT SHIPPED WITH THE PRODUCT AND ARE INCORPORATED HEREIN BY THIS REFERENCE. IF YOU ARE UNABLE TO LOCATE THE SOFTWARE LICENSE OR LIMITED WARRANTY, CONTACT YOUR CISCO REPRESENTATIVE FOR A COPY.

The Cisco implementation of TCP header compression is an adaptation of a program developed by the University of California, Berkeley (UCB) as part of UCB's public domain version of the UNIX operating system. All rights reserved. Copyright © 1981, Regents of the University of California.

NOTWITHSTANDING ANY OTHER WARRANTY HEREIN, ALL DOCUMENT FILES AND SOFTWARE OF THESE SUPPLIERS ARE PROVIDED "AS IS" WITH ALL FAULTS. CISCO AND THE ABOVE-NAMED SUPPLIERS DISCLAIM ALL WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, WITHOUT LIMITATION, THOSE OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT OR ARISING FROM A COURSE OF DEALING, USAGE, OR TRADE PRACTICE.

IN NO EVENT SHALL CISCO OR ITS SUPPLIERS BE LIABLE FOR ANY INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES, INCLUDING, WITHOUT LIMITATION, LOST PROFITS OR LOSS OR DAMAGE TO DATA ARISING OUT OF THE USE OR INABILITY TO USE THIS MANUAL, EVEN IF CISCO OR ITS SUPPLIERS HAVE BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

Any Internet Protocol (IP) addresses and phone numbers used in this document are not intended to

be actual addresses and phone numbers. Any examples, command display output, network topology diagrams, and other figures included in the document are shown for illustrative purposes only. Any use of actual IP addresses or phone numbers in illustrative content is unintentional and coincidental.

The documentation set for this product strives to use bias-free language. For the purposes of 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.

Cisco and the Cisco logo are trademarks or registered trademarks of Cisco and/or its affiliates in the U.S. and other countries. To view a list of Cisco trademarks, go to this URL: <http://www.cisco.com/go/trademarks>. Third-party trademarks mentioned are the property of their respective owners. The use of the word partner does not imply a partnership relationship between Cisco and any other company. (1110R)

© 2017–2024 Cisco Systems, Inc. All rights reserved.