Operations

Operations

Access the Software Upgrade Workflow

Table 1: Feature History

Feature Name	Release Information	Description
Software Upgrade Workflow	Cisco IOS XE Catalyst SD-WAN Release 17.8.1a Cisco vManage Release 20.8.1 Cisco SD-WAN Release 20.8.1	You can now upgrade software images on edge devices using the **Workflows** menu in Cisco SD-WAN Manager.
Schedule the Software Upgrade Workflow	Cisco IOS XE Catalyst SD-WAN Release 17.9.1a Cisco vManage Release 20.9.1 Cisco SD-WAN Release 20.9.1	Upgrade the software of Cisco edge devices using a **scheduler** which helps in scheduling the upgrade process at your convenience.
Software Upgrade Workflow Support for Additional Platforms	Cisco vManage Release 20.9.1	Added support for Cisco Enterprise NFV Infrastructure Software (NFVIS) and Cisco Catalyst Cellular Gateways.
Software Upgrade Scheduling Support for Additional Platforms	Cisco vManage Release 20.10.1	Added support for software upgrade scheduling for Cisco Catalyst Cellular Gateways.

Before You Begin

To check if there is an in-progress software upgrade workflow:

From the Cisco SD-WAN Manager toolbar, click the **Task-list** icon. Cisco SD-WAN Manager displays a list of all running tasks along with the total number of successes and failures.

Access the Software Upgrade Workflow

1. In the Cisco SD-WAN Manager menu, click **Workflows** > **Workflow Library**.

   Note In the Cisco vManage Release 20.8.1, the **Workflow Library** is titled **Launch Workflows**.

2. Start a new software upgrade workflow: **Library** > **Software Upgrade**.

   OR

   Alternatively, resume an in-progress software upgrade workflow: **In-progress** > **Software Upgrade**.

3. Follow the on-screen instructions to start a new software upgrade workflow.

   Note Click **Exit** to exit from an in-progress software upgrade workflow. You can resume the in-progress workflow at your convenience.

Note In a multi-node cluster setup, if the control connection switches to a different node during a device upgrade from Cisco SD-WAN Manager, the upgrade may be impacted due to NetConf session timeout. The device then establishes control connection to a different node. You need to re-trigger the upgrade activity.

Verify the Status of the Software Upgrade Workflow

To check the software upgrade workflow status:

1. From the Cisco SD-WAN Manager toolbar, click the **Task-list** icon.

   Cisco SD-WAN Manager displays a list of all running tasks along with the total number of successes and failures.

2. Click the **+** icon to view the details of a task.

   Cisco SD-WAN Manager opens a pane displaying the status of the task and details of the device on which the task was performed.

ACL Log

Use the ACL Log screen to view logs for access lists (ACLs) configured on a router. Routers collect ACL logs every 10 minutes.

Set ACL Log Filters

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Logs** > **ACL Log**.

Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **ACL Log**.

2. Click the **Filter**.
3. In the VPN field, choose the entity, for which you are collecting ACL logs, from the drop-down list. You can choose only one VPN.
4. Click **Search** to search for logs that match the filter criteria.

Cisco SD-WAN Manager displays a log of activities in table format.

Application Performance and Site Monitoring

Note To achieve simplification and consistency, the Cisco SD-WAN solution has been rebranded as Cisco Catalyst SD-WAN. In addition, from Cisco IOS XE SD-WAN Release 17.12.1a and Cisco Catalyst SD-WAN Release 20.12.1, the following component changes are applicable: **Cisco vManage** to **Cisco Catalyst SD-WAN Manager**, **Cisco vAnalytics** to **Cisco Catalyst SD-WAN Analytics**, **Cisco vBond** to **Cisco Catalyst SD-WAN Validator**, and **Cisco vSmart** to **Cisco Catalyst SD-WAN Controller**. See the latest Release Notes for a comprehensive list of all the component brand name changes. While we transition to the new names, some inconsistencies might be present in the documentation set because of a phased approach to the user interface updates of the software product.

Table 2: Feature History

Feature Name	Release Information	Description
Application Performance and Site Monitoring	Cisco IOS XE Catalyst SD-WAN Release 17.10.1a Cisco vManage Release 20.10.1	You can monitor and optimize the application health and performance on all sites or a single site using Cisco SD-WAN Manager.

Overview of Application Performance and Site Monitoring

The **Application Health** window displays the following:

- All applications running in all sites: table view and heat map view.
- All applications running at a specific site: table view and heat map view.
- Single application running in all sites: table view and heat map view.
- Single application running at a specific site: aggregated line chart and per path table view.

Applications Health Metrics

The applications health is calculated as follows:

Table 3:

Health	QoE
Good	QoE >= 8
Fair	QoE 5~8
Poor	QoE < 5

View Application Health in Table View

The **Application Health** window displays the following in table view:

- All applications for all sites: A selected list of applications that are enabled using the performance monitoring feature or the CLI add-on template from all the sites.
- All applications for a single site: A selected list of applications that are enabled using the performance monitoring feature or the CLI add-on template from a single site.
- All the sites of a single application: All the sites of a selected application that is enabled using the performance monitoring feature or the CLI add-on template, sorted by the status in the health column.

In the table, the **Health** column shows the application health. Place the cursor over the icon in the column to display **Good**, **Fair**, or **Poor** health status. The health of the application is measured by QoE.

Click the application name to view further application specific details. For a single application on all sites, click a specific **Site ID** to navigate to single site monitoring.

Click the toggle button to switch to application heatmap view.

View Application Health in Heatmap View

The **Application Health** window displays the following in heatmap view:

- All applications for all sites: A list of all applications health for different time selections.
- All applications for a single site: A selected list of applications that are enabled using the performance monitoring feature or the CLI add-on template from a single site.
- All the sites of a single application: A list of sites and health of each site at different time intervals for a single application.

In the heatmap view, the grid of colored squares displays the application health as **Good**, **Fair**, or **Poor**. You can hover over a square or click it to display the additional details of an application at a specific time and click **View details** to view specific application details. Click the time interval drop-down list to change the time interval.

Click the **Toggle** button to switch to the application table view.

Configure Application Performance and Site Monitoring Using Cisco Catalyst SD-WAN Manager

You can enable application performance and site monitoring using Cisco SD-WAN Manager by configuring **Performance Monitoring** under **System Profile** in a configuration group. Configure the parameters in **Application Performance Monitoring** tab to enable monitoring. For more information see, Performance Monitoring Feature Configuration.

The application performance and site monitoring feature needs NBAR to be enabled on all LAN interfaces for application recognition.

If Application-Aware Routing (AAR) policy is configured then NBAR is automatically enabled. If AAR policy is not configured, then NBAR must be enabled on all LAN interfaces using a CLI add-on template. Use the **ip nbar protocol-discovery** configuration to enable NBAR on all LAN interfaces.

All Sites and Single Site View

All Applications All Sites View

The default setting for the applications window is the all sites view. You can view information for all sites by clicking the **All Sites** button on the top of the page, and clicking the radio button next to **All Sites**.

The all sites view displays information for all applications of all sites for the last one hour.

In the table, the **Health** column shows the application health. Place the cursor over the icon in the column to display **Good**, **Fair**, or **Poor** health status. The health of the application is measured by Quality of Experience (QoE).

Click the toggle button to switch to the application heatmap view.

In the heatmap view, the grid of colored squares displays the application health as **Good**, **Fair**, or **Poor**. You can hover over a square or click it to display additional details of an application at a specific time and click **View details** to view specific application details. Click the time interval drop-down list to change the time interval.

All Applications Single Site View

You can also view the health of all the applications on a single site. To enter single site view, click the **All Sites** button on the top of the page, and click the radio button next to **Single Site** to select the site of interest.

Single Application All Site View

For a single application on all sites, click a specific **Site ID** to navigate to single site monitoring. Click the application name to view further application specific details.

Single Application Single Site View

For a single application on a single site, a line graph shows the application health over a period of time. Select the time from the drop-down list to select 1, 3, 6, 12, or 24 hours. The table displays a list of paths that has processed application traffic over a time period. Select individual paths and view the individual QoE lines on the line graph. At a time five paths can be selected, and five line charts are displayed. You can also drag the top handles to focus on a particular point in time. When you change the time, the table automatically refreshes to show the health information for that time interval.

Change the Device Rollback Timer

By default, when you attach a Cisco IOS XE Catalyst SD-WAN device to a configuration template, if the router is unable to successfully start after 5 minutes, it returns to, or rolls back to, the previous configuration. For a configuration that you have created from the CLI, you can change the device's rollback timer:

1. From the Cisco SD-WAN Manager menu, choose **Configuration** > **Templates**.

2. Click **Device Templates**, and choose a device template.

Note In Cisco vManage Release 20.7.x and earlier releases, **Device Templates** is titled **Device**.

3. Click **...**, and click **Change Device Values**.

   The right pane displays the device's configuration, and the **Config Preview** tab is selected.

4. In the left pane, click the name of a device.
5. Click **Configure Device Rollback Timer**. The **Configure Device Rollback Time** pop up page is displayed.
6. From the **Devices** drop-down list, select a device.
7. To enable the rollback timer, in the **Set Rollback slider** drag the slider to the left to enable the rollback timer. When you do this, the slider changes in color from gray to green.
8. To disable the rollback timer, click **Enable Rollback slider**. When you disable the timer, the **Password** field dialog box appears. Enter the password that you used to log in to Cisco SD-WAN Manager.
9. In the **Device Rollback Time** slider, drag the slider to the desired value. The default time is 5 minutes. You can configure a time from 6 to 15 minutes.
10. To exclude a device from the rollback timer setting, click **Add Exception** and select the devices to exclude.
11. The table of the **Configure Device Rollback Time** dialog box lists all the devices to which you are attaching the template and their rollback time. To delete a configured rollback time, click the **Trash** icon of the device name.
12. Click **Save**.
13. Click **Configure Devices** to push the configuration to the devices. The **Status** column displays whether the configuration was successfully pushed. Click **(+)** to display details of the push operation.

Run Site-to-Site Speed Test

Before You Begin

Ensure that **Data Stream** is enabled under **Administration** > **Settings** in Cisco SD-WAN Manager.

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.1 and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

2. To choose a device, click the device name in the **Hostname** column.
3. Click **Troubleshooting** in the left pane.
4. In the **Connectivity** area, click **Speed Test**.
5. Specify the following:
   - **Source Circuit**: From the drop-down list, choose the color of the tunnel interface on the local device.

- **Destination Device**: From the drop-down list, choose the remote device by its device name and system IP address.
- **Destination Circuit**: From the drop-down list, choose the color of the tunnel interface on the remote device.

6. Click **Start Test**.

   The speed test sends a single packet from the source to the destination and receives the acknowledgment from the destination.

The right pane shows the results of the speed test—circuit speed, download speed, and upload speed between the source and destination. The download speed shows the speed from the destination to the source, and the upload speed shows the speed from the source to the destination in Mbps. The configured downstream and upstream bandwidths for the circuit are also displayed.

When a speed test completes, the test results are added to the table in the lower part of the right pane.

From Cisco vManage Release 20.10.1, the **Speed Test** option is also accessible as follows:

- On the **Monitor** > **Devices** page, click **…** adjacent to the device name and choose **Speed Test**.
- On the **Monitor** > **Applications** page, click **…** adjacent to the application name and choose **Speed Test**.
- On the **Site Topology** page, click a device name, and then click **Speed Test** in the right navigation pane.

Cluster Management

Note To achieve simplification and consistency, the Cisco SD-WAN solution has been rebranded as Cisco Catalyst SD-WAN. In addition, from Cisco IOS XE SD-WAN Release 17.12.1a and Cisco Catalyst SD-WAN Release 20.12.1, the following component changes are applicable: **Cisco vManage** to **Cisco Catalyst SD-WAN Manager**, **Cisco vAnalytics** to **Cisco Catalyst SD-WAN Analytics**, **Cisco vBond** to **Cisco Catalyst SD-WAN Validator**, and **Cisco vSmart** to **Cisco Catalyst SD-WAN Controller**. See the latest Release Notes for a comprehensive list of all the component brand name changes. While we transition to the new names, some inconsistencies might be present in the documentation set because of a phased approach to the user interface updates of the software product.

Table 4: Feature History

Feature Name	Release Information	Description
Cisco SD-WAN Manager Persona-based Cluster Configuration	Cisco IOS XE Catalyst SD-WAN Release 17.6.1a Cisco SD-WAN Release 20.6.1 Cisco vManage Release 20.6.1	You can add Cisco SD-WAN Manager servers to a cluster by identifying servers based on personas. A persona defines what services run on a server.

A Cisco SD-WAN Manager cluster consists of at least three Cisco SD-WAN Manager servers. These servers manage the Cisco Catalyst SD-WAN edge devices in a network. Cisco SD-WAN Manager servers in a cluster perform specific functions based on the services that are running on them. In this way, a cluster distributes the workload among Cisco SD-WAN Manager servers while sharing information between these servers. For scaling recommendations, see *Server Recommendations* for your release in Cisco Catalyst SD-WAN Controller Compatibility Matrix and Server Recommendations.

Use the **Administration** > **Cluster Management** window to create a Cisco SD-WAN Manager cluster and perform related tasks.

From Cisco vManage Release 20.6.1, each Cisco SD-WAN Manager server has a *persona*. The persona is determined when the Cisco SD-WAN Manager server first boots up after Cisco SD-WAN Manager is installed and defines which services run on the server. The persona of a server lasts for the lifetime of the server and cannot be changed. A server must have a persona before it can be added to a cluster. For more information on personas, see Cisco Catalyst SD-WAN Manager Persona and Storage Device.

The role that a server has in a cluster depends on its persona. A Cisco SD-WAN Manager server can have any of the following personas:

- Compute+Data: Includes all services that are required for Cisco SD-WAN Manager, including services that are used for the application, statistics, configuration, messaging, and coordination
- Compute: Includes services that are used for the application, configuration, messaging, and coordination
- Data: Includes services that are used for the application and statistics

Collect Device Statistics

Enable or disable the collection of statistics for devices in the overlay network. By default, the collection of statistics is enabled for all the devices in the overlay network.

1. From the Cisco SD-WAN Manager menu, choose **Administration** > **Settings**.
2. To modify the settings for collecting device statistics, click **Statistics Setting**, and click **Edit**.

   Tip To view the configured settings, click **View**.

   By default, for every group of statistics (such as **Aggregated DPI** and **AppHosting**), collection of statistics is enabled for all devices.
3. To enable the collection of a group of statistics for all devices, click **Enable All** for the particular group.
4. To disable the collection of a group of statistics for all devices, click **Disable All** for the particular group.
5. To enable the collection of a group of statistics for all devices only for consumption by Cisco SD-WAN Analytics, click **vAnalytics only** for the particular group.
6. To enable or disable the collection of a group of statistics for specific devices in the overlay network, click **Custom** for the particular group.

   In the **Select Devices** dialog box, depending on whether statistics collection is enabled or disabled for a device, the device is listed among **Enabled Devices** or **Disabled Devices** respectively.

   a. To enable statistics collection for one or more devices, choose the devices from **Disabled Devices** and move them to **Enabled Devices**.

   Tip To choose all **Disabled Devices**, click **Select All**.

b. To disable statistics collection for one or more devices, choose the devices from **Enabled Devices** and move them to **Disabled Devices**.

Tip To choose all **Enabled Devices**, click **Select All**.

c. To save your selections, click **Done**.

To discard your selections, click **Cancel**.

7. To apply the modified settings, click **Save**.

   To discard your changes, click **Cancel**.

   To revert to the default settings, click **Restore Factory Default**.

Configure the Time Interval to Collect Device Statistics

1. From the Cisco SD-WAN Manager menu, choose **Administration** > **Settings**.
2. To modify the time interval at which device statistics are collected, find **Statistics Configuration** and click **Edit**.

Tip To view the configured time interval, click **View**.

3. Enter the desired **Collection Interval** in minutes.
   - Default value: 30 minutes
   - Minimum value: 5 minutes
   - Maximum value: 180 minutes
4. To apply the modified settings, click **Save**.

   To discard your changes, click **Cancel**.

   To revert to the default settings, click **Restore Factory Default**.

Create a Custom Banner

To create a custom banner that is displayed after you log in to the Cisco SD-WAN Manager:

1. From **Banner**, click **Edit**.
2. In **Enable Banner**, click **Enabled**.
3. In **Banner Info**, enter the text string for the login banner or click **Select a File** to download a file that contains the text string.
4. Click **Save**.

Create Customized VNF Image

Before you begin

You can upload one or more qcow2 images in addition to a root disk image as an input file along with VM-specific properties, bootstrap configuration files (if any), and generate a compressed TAR file. Through custom packaging, you can:

- Create a custom VM package along with image properties and bootstrap files (if needed) into a TAR archive file.
- Tokenize custom variables and apply system variables that are passed with the bootstrap configuration files.

Ensure that the following custom packaging requirements are met:

- Root disk image for a VNF–qcow2
- Day-0 configuration files–system and tokenized custom variables
- VM configuration–CPU, memory, disk, NICs
- HA mode–If a VNF supports HA, specify Day-0 primary and secondary files, NICs for a HA link.
- Additional Storage–If more storage is required, specify predefined disks (qcow2), storage volumes (NFVIS layer)

Step 1 From the Cisco SD-WAN Manager menu, choose **Maintenance** > **Software Repository** .

Step 2 Click **Virtual Images** > **Add Custom VNF Package**.

Step 3 Configure the VNF with the following VNF package properties and click **Save**.

Table 5: VNF Package Properties

Field	Mandatory or Optional	Description
Package Name	Mandatory	The filename of the target VNF package. It’s the Cisco NFVIS image name with .tar or .gz extensions.
App Vendor	Mandatory	Cisco VNFs or third-party VNFs.
Name	Mandatory	Name of the VNF image.
Version	Optional	Version number of a program.
Type	Mandatory	Type of VNF to choose. Supported VNF types are: Router, Firewall, Load Balancer, and Other.

Step 4 To package a VM qcow2 image, click **File Upload**, and browse to choose a qcow2 image file.

Step 5 To choose a bootstrap configuration file for VNF, if any, click **Day 0 Configuration** and click **File Upload** to browse and choose the file.

Include the following Day-0 configuration properties:

Table 6: Day-0 Configuration

Field	Mandatory or Optional	Description
Mount	Mandatory	The path where the bootstrap file gets mounted.
Parseable	Mandatory	A Day-0 configuration file can be parsed or not. Options are: **Enable** or **Disable**. By default, **Enable** is chosen.
High Availability	Mandatory	High availability for a Day-0 configuration file to choose. Supported values are: Standalone, HA Primary, HA Secondary.

Note If any bootstrap configuration is required for a VNF, create a *bootstrap-config* or a *day0-config* file.

Step 6 To add a Day-0 configuration, click **Add**, and then click **Save**. The Day-0 configuration appears in the **Day 0 Config File** table. You can tokenize the bootstrap configuration variables with system and custom variables. To tokenize variables of a Day-0 configuration file, click **View Configuration File** next to the desired Day-0 configuration file. In the **Day 0 configuration file** dialog box, perform the following tasks:

Note The bootstrap configuration file is an XML or a text file, and contains properties specific to a VNF and the environment. For a shared VNF, see the topic and additional references in Cisco SD-WAN Cloud OnRamp for Colocation Solution Guide for the list of system variables that must be added for different VNF types..

a) To add a system variable, in the **CLI configuration** dialog box, select, and highlight a property from the text fields. Click **System Variable**. The **Create System Variable** dialog box appears.
b) Choose a system variable from the **Variable Name** drop-down list, and click **Done**. The highlighted property is replaced by the system variable name.
c) To add a custom variable, in the **CLI configuration** dialog box, choose and highlight a custom variable attribute from the text fields. Click **Custom Variable**. The **Create Custom Variable** dialog box appears.
d) Enter the custom variable name and choose a type from **Type** drop-down list.
e) To set the custom variable attribute, do the following:

- To ensure that the custom variable is mandatory when creating a service chain, click **Type** next to **Mandatory**.
- To ensure that a VNF includes both primary and secondary day-0 files, click **Type** next to **Common**.

f) Click **Done**, and then click **Save**. The highlighted custom variable attribute is replaced by the custom variable name.

Step 7 To upload extra VM images, expand **Advance Options**, click **Upload Image**, and then browse to choose an extra qcow2 image file. Choose the root disk, Ephemeral disk 1, or Ephemeral disk 2, and click **Add**. The newly added VM image appears in the **Upload Image** table.

Note Ensure that you don’t combine ephemeral disks and storage volumes when uploading extra VM images.

Step 8 To add the storage information, expand **Add Storage**, and click **Add volume**. Provide the following storage information and click **Add**. The added storage details appear in the **Add Storage** table.

Table 7: Storage Properties

Field	Mandatory or Optional	Description
Size	Mandatory	The disk size that is required for the VM operation. If the size unit is GiB, the maximum disk size can be 256 GiB.
Size Unit	Mandatory	Choose size unit. The supported units are: MIB, GiB, TiB.
Device Type	Optional	Choose a disk or CD-ROM. By default, disk is chosen.
Location	Optional	The location of the disk or CD-ROM. By default, it’s local.
Format	Optional	Choose a disk image format. The supported formats are: qcow2, raw, and vmdk. By default, it’s raw.
Bus	Optional	Choose a value from the drop-down list. The supported values for a bus are: virtio, scsi, and ide. By default, it’s virtio.

Step 9 To add VNF image properties, expand **Image Properties** and enter the following image information.

Table 8: VNF Image Properties

Field	Mandatory or Optional	Description
SR-IOV Mode	Mandatory	Enable or disable SR-IOV support. By default, it’s enabled.
Monitored	Mandatory	VM health monitoring for those VMs that you can bootstrap. The options are: enable or disable. By default, it’s enabled.
Bootup Time	Mandatory	The monitoring timeout period for a monitored VM. By default, it’s 600 seconds.

Field	Mandatory or Optional	Description
Serial Console	Optional	The serial console that is supported or not. The options are: enable or disable. By default, it’s disabled.
Privileged Mode	Optional	Allows special features like promiscuous mode and snooping. The options are: enable or disable. By default, it’s disabled.
Dedicate Cores	Mandatory	Facilitates allocation of a dedicated resource (CPU) to supplement a VM's low latency (for example, router and firewall). Otherwise, shared resources are used. The options are: enable or disable. By default, it’s enabled.

Step 10 To add VM resource requirements, expand **Resource Requirements** and enter the following information.

Table 9: VM Resource Requirements

Field	Mandatory or Optional	Description
Default CPU	Mandatory	The CPUs supported by a VM. The maximum numbers of CPUs supported are 8.
Default RAM	Mandatory	The RAM supported by a VM. The RAM can range 2–32.
Disk Size	Mandatory	The disk size in GB supported by a VM. The disk size can range 4–256.
Max number of VNICs	Optional	The maximum number of VNICs allowed for a VM. The number of VNICs can from range 8–32 and by default, the value is 8.
Management VNIC ID	Mandatory	The management VNIC ID corresponding to the management interface. The valid range is from 0 to maximum number of VNICs.
Number of Management VNICs ID	Mandatory	The number of VNICs.

Field	Mandatory or Optional	Description
High Availability VNIC ID	Mandatory	The VNIC IDs where high availability is enabled. The valid range is from 0–maximum number of VNICs. It shouldn't conflict with management VNIC Id. By default, the value is 1.
Number of High Availability VNICs ID	Mandatory	The maximum number of VNIC IDs where high availability is enabled. The valid range is 0–(maximum number of VNICs-number of management VNICs-2) and by default, the value is 1.

Step 11 To add day-0 configuration drive options, expand **Day 0 Configuration Drive options** and enter the following information.

Table 10: Day-0 Configuration Drive Options

Field	Mandatory or Optional	Description
Volume Label	Mandatory	The volume label of the Day-0 configuration drive. The options are: V1 or V2. By default, the option is V2. V2 is the config-drive label config-2. V1 is config-drive label cidata.
Init Drive	Optional	The Day-0 configuration file as a disk when mounted. The default drive is CD-ROM.
Init Bus	Optional	Choose an init bus. The supported values for a bus are: virtio, scsi, and ide. By default, it's ide.

The Software Repository table displays the customized VNF image, and image is available for choosing when creating a custom service chain.

Customize the Monitor Overview Dashboard

Table 11: Feature History

Feature Name	Release Information	Description
Customizable Monitor Overview Dashboard in Cisco SD-WAN Manager	Cisco vManage Release 20.9.1	You can customize the **Monitor Overview** dashboard. You can specify which dashlets to view and sort them based on your personal preferences.
Time Filter in Monitor Overview and Monitor Security Dashboards in Cisco SD-WAN Manager	Cisco vManage Release 20.10.1	You can filter the data on the **Monitor Overview** and **Monitor Security** dashboards for a specified time range.
View Sites in Global Topology View	Cisco vManage Release 20.11.1	You can view all sites or a single site in the global topology view for geographical regions worldwide by clicking the inverted-drop-shaped icon on the **Monitor Overview** dashboard.
View Top Alarms	Cisco vManage Release 20.11.1	You can view alarm details for a single site on the **Monitor Overview** dashboard. Click **View Details** to open the **Monitor** > **Logs** > **Alarms** window and view the alarm details.
View WAN Edge Management	Cisco vManage Release 20.11.1	You can view the WAN Edge Management dashlet on the **Monitor Overview** dashboard.
Security Dashboard Enhancements	Cisco IOS XE Catalyst SD-WAN Release 17.11.1a Cisco vManage Release 20.11.1	This feature enhances the security dashboard in Cisco SD-WAN Manager. The security dashboard introduces a **Actions** drop-down list that enables you to edit the security dashboard, reset the security dashboard, and view the **SecureX** ribbon in the security dashboard. Additionally, you can access the Cisco Talos portal from Cisco SD-WAN Manager. A hyperlink of the Cisco Talos portal is added to the security dashboard.
Global Network View with Network-Wide Path Insight Integration	Cisco Catalyst SD-WAN Manager Release 20.12.1	Network-Wide Path Insight is now integrated with the global network view. This feature also introduces enhancements to the geomap view by providing real-time monitoring of the health of each site. **Global Topology View** is now called as **Global Network View** in Cisco Catalyst SD-WAN Manager.
Security Dashboard Enhancements	Cisco Catalyst SD-WAN Manager Release 20.12.1	This feature enhances the security dashboard to provide greater flexibility while troubleshooting security threats down to a device level in Cisco Catalyst SD-WAN.

Add a Dashlet

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Overview**.
2. From the **Actions** drop-down list, choose **Edit Dashboard**.
3. Click **Add Dashlet**.

> **Note** The **Add Dashlet** option is available only if additional dashlets are available to be added. It is not available on the default dashboard.

4. Choose the dashlets that you want to add.
5. Click **Add**.
6. Click **Save**.

You can customize the following dashlets:

- **Transport Health**
- **Site BFD Connectivity**
- **Transport Interface Distribution**
- **WAN Edge Inventory**
- **Application-Aware Routing**

Delete a Dashlet

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Overview**.
2. From the **Actions** drop-down list, choose **Edit Dashboard**.
3. Click the **Delete** icon adjacent to the corresponding dashlet name.
4. To confirm the deletion of the dashlet, click **Yes**.
5. Click **Save**.

Rearrange Dashlets

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Overview**.
2. From the **Actions** drop-down list, choose **Edit Dashboard**.
3. Drag and drop the dashlets according to your requirements.
4. Click **Save**.

Filter the Dashboard Data

Minimum release: Cisco vManage Release 20.10.1

You can view the data on the **Monitor Overview** and **Monitor Security** dashboards based on a specified time range. A time filter option is available on these dashboards. On the **Monitor Overview** dashboard, the time filter option is applicable to the following dashlets:

- **Site Health**
- **Tunnel Health**
- **WAN Edge Health**
- **Application Health**
- **Transport Health**
- **Top Alarms**
- **Top Applications**

This feature is available in both single-tenant and multitenant deployments. In multitenant deployments, this feature is available only in the tenant dashboard.

Time filter values: 1 hour, 3 hours, 6 hours, 12 hours, 24 hours, 7 days.

Only in the **Transport Health** dashlet, the data is available up to 7 days. In the **Site Health**, **Tunnel Health**, **WAN Edge Health**, **Application Health**, and **Top Applications** dashlets, the data is available up to 24 hours.

Default: 24 hours

To filter the data, do the following:

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Overview** or **Monitor** > **Security**.
2. From the time filter drop-down list, choose a value.

   The dashlets display the data based on the chosen time.

You also can apply the time filter at the dashlet level. To do this, click **View Details** in the corresponding dashlet, and choose a time filter value in the right navigation pane. The time filter value applied at the dashboard level, and not at the dashlet level, is preserved after closing the navigation pane.

Restore Default Settings

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Overview**.
2. From the **Actions** drop-down list, choose **Reset to Default View**.
3. Click **Apply**.

Decommission a Cloud Router

Decommissioning a cloud router (such as a Cisco Cloud Services Router 1000V) removes the device's serial number from Cisco SD-WAN Manager and generates a new token for the device. To do so:

1. From the Cisco SD-WAN Manager menu, choose **Configuration** > **Devices**.
2. Click **WAN Edge List**, and select a cloud router.
3. Click **…**, and click **Decommission WAN Edge**.

4. To confirm the decommissioning of the router, click **OK**.

Delete a Software Image from the Repository

To delete a software image from the Cisco SD-WAN Manager software repository:

Step 1 From the Cisco SD-WAN Manager menu, choose **Maintenance** > **Software Repository**.

Step 2 For the desired software image, click **...** and choose **Delete**.

If a software image is being downloaded to a router, you cannot delete the image until the download process completes.

Determine the Status of Network Sites

A site is a particular physical location within the Cisco Catalyst SD-WAN overlay network, such as a branch office, a data center, or a campus. Each site is identified by a unique integer, called a site ID. Each device at a site is identified by the same site ID.

To determine the status of network sites:

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Overview**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Dashboard** > **Main Dashboard**.

2. Locate the **Site BFD Connectivity** dashlet, which displays the state of data connections of a site. When a site has multiple edge devices, this dashlet displays the state of the entire site and not for individual devices. The **Site BFD Connectivity** dashlet displays three states:

   - Full WAN Connectivity: Total number of sites where all BFD sessions on all devices are in the up state.
   - Partial WAN Connectivity: Total number of sites where a TLOC or a tunnel is in the down state. These sites still have limited data plane connectivity.
   - No WAN Connectivity: Total number of sites where all BFD sessions on all devices are in the down state. These sites have no data plane connectivity.

   Click any of these to view more details. The details are displayed in a pop-up window.

3. For the desired row, click **...** and choose **Device Dashboard**, **SSH Terminal**, or **Real Time**. You will be redirected to the appropriate window based on your selection.

Enable Reverse Proxy

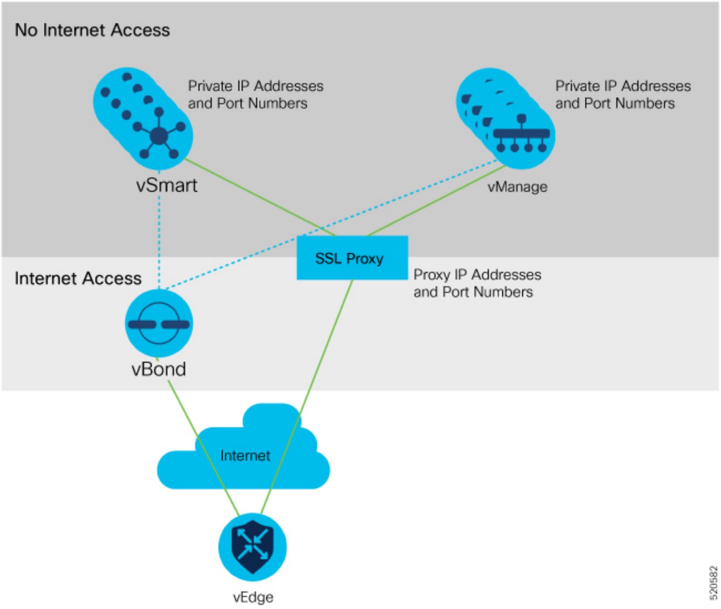
Table 12: Feature History

Feature Name	Release Information	Description
Support for Reverse Proxy with Cisco IOS XE Catalyst SD-WAN devices and Cisco Catalyst SD-WAN Multitenancy	Cisco IOS XE Release 17.6.1a Cisco SD-WAN Release 20.6.1 Cisco vManage Release 20.6.1	With this feature, you can deploy a reverse proxy in your overlay network between Cisco IOS XE Catalyst SD-WAN devices and Cisco SD-WAN Manager and Cisco SD-WAN Controllers. Also, this feature enables you to deploy a reverse proxy in both single-tenant and multitenant deployments that include Cisco vEdge devices or Cisco IOS XE Catalyst SD-WAN devices. In a multitenant deployment, the Service Provider manages reverse proxy and the associated configuration.

In a standard overlay network, Cisco Catalyst SD-WAN edge devices initiate direct connections to the Cisco SD-WAN Controllers (Cisco SD-WAN Manager and Cisco SD-WAN Controllers) and exchange control plane information over these connections. The WAN edge devices are typically located in branch sites and connect to the Cisco SD-WAN Controllers over the internet. As a result, Cisco SD-WAN Manager and Cisco SD-WAN Controllers are also connected directly to the internet.

For security, or other reasons, you may not want the Cisco SD-WAN Controllers to have direct internet connections. In such a scenario, you can deploy a reverse proxy between the Cisco SD-WAN Controllers and the WAN edge devices. The reverse proxy acts as an intermediary to pass control traffic between the Cisco SD-WAN Controllers and the WAN edge devices. Instead of communicating directly with Cisco SD-WAN Manager and the Cisco SD-WAN Controllers, the WAN edge devices communicate with the reverse proxy, and the reverse proxy relays the traffic to and from Cisco SD-WAN Manager and Cisco SD-WAN Controllers.

The following figure illustrates a reverse proxy deployed between a WAN edge device and Cisco SD-WAN Manager and the Cisco SD-WAN Controllers.


No Internet Access
Private IP Addresses and Port Numbers
Private IP Addresses and Port Numbers
vSmart
vManage
SSL Proxy
Internet Access
Proxy IP Addresses and Port Numbers
vBond
Internet
vEdge
520582

You can deploy a reverse proxy in both single-tenant and multi-tenant Cisco Catalyst SD-WAN deployments.

Restrictions for Enabling Reverse Proxy Support

- In a multitenant Cisco Catalyst SD-WAN overlay network, you can deploy a reverse proxy device with only a three-node Cisco SD-WAN Manager cluster. Deployment of the reverse proxy is only supported with a TLS-based control plane for Cisco SD-WAN Manager and Cisco SD-WAN Controllers.
- You cannot deploy a reverse proxy with a Cisco vEdge 5000 router.
- You cannot deploy a reverse proxy with IPv6 control connections.

Provision Certificates on the Reverse Proxy

Before exchanging traffic, the reverse proxy and the WAN edge devices must authenticate each other.

On the reverse proxy you must provision a certificate that is signed by the CA that has signed the certificate of the Cisco SD-WAN Controllers. This certificate is used by the reverse proxy to verify the WAN edge devices.

To generate a Certificate Signing Request (CSR) for the reverse proxy and have it signed by Cisco, do as follows:

1. Run the following command on the reverse proxy:

```
proxy$ openssl req -new -days 365 -newkey rsa:2048 -nodes -keyout Proxy.key -out Proxy.csr
```

When prompted, enter values as suggested in the following table:

Property	Description
Country Name (2 letter code)	Any country code. Example: US
State or Province Name	Any state or province. Example: CA
Locality Name	Any locality. Example: San Jose
Organization Name	Use either "vIPtela Inc" or "Viptela LLC". Starting from Cisco IOS XE Catalyst SD-WAN Release 17.10.1a, you can use "Cisco Systems" string as the Organization Name for enterprise certificates. Example: Viptela LLC
Organizational Unit Name	Use the “organization” name configured on the overlay. Example: cisco-sdwan-12345
Common Name	Host name ending with “.viptela.com”. Example: proxy.viptela.com

Property	Description
Email Address	Use any valid email address. Example: someone@example.com

2. Get the CSR signed by Cisco.

   - If you use Symantec/Digicert as the CA for the Cisco SD-WAN Controllers, open a case with Cisco TAC to sign the CSR.
   - If you use Cisco Public Key Infrastructure (PKI) as the CA for the Cisco SD-WAN Controllers, submit the CSR on the Cisco Network Plug and Play (PnP) application and retrieve the signed certificate.

Enable Reverse Proxy

1. From the Cisco SD-WAN Manager menu, choose **Administration** > **Settings**.
2. For the **Reverse Proxy** setting, click **Edit**.
3. For **Enable Reverse Proxy**, click **Enabled**.
4. Click **Save**.

Configure Reverse Proxy Settings on Cisco SD-WAN Controllers

1. From the Cisco SD-WAN Manager menu, choose **Configure** > **Devices**.
2. Click **Controllers**.
3. For the desired Cisco SD-WAN Manager instance or Cisco SD-WAN Controller, click **…** and click **Add Reverse Proxy**.

   The **Add Reverse Proxy** dialog box appears.
4. To map a private IP address and port number to a proxy IP address and port number, do as follows:

   a. Click **Add Reverse Proxy**.

   b. Enter the following details:

Private IP	The private IP address is the IP address of the transport interface in VPN 0.
Private Port	This is the port used to establish the connections that handle control and traffic in the overlay network. The default port number is 12346.
Proxy IP	Proxy IP address to which private IP address must be mapped.
Proxy Port	Proxy port to which the private port must be mapped.

   c. If the Cisco SD-WAN Manager instance or Cisco SD-WAN Controller has multiple cores, repeat **Step 4 a** and **Step 4 b** for each core.
5. To delete a private IP address-port number to proxy IP address-port number mapping, find the mapping and click the trash icon.

6. To save the reverse proxy settings, click **Add**.

   To discard the settings, click **Cancel**.

7. In the Security feature template attached to the Cisco SD-WAN Manager instance or Cisco SD-WAN Controller, choose TLS as the transport protocol.

After you configure reverse proxy settings on a Cisco SD-WAN Manager instance or a Cisco SD-WAN Controller, WAN edge devices in the overlay network are provisioned with a certificate for authentication with the reverse proxy.

1. When a reverse proxy is deployed, Cisco Catalyst SD-WAN Validator shares the details of the reverse proxy with the WAN edge devices.
2. On learning about the reverse proxy, a WAN edge device initiates the installation of a signed certificate from Cisco SD-WAN Manager.
3. After the certificate is installed, the WAN edge device uses the certificate for authentication with the reverse proxy and connects to the reverse proxy.

Disable Reverse Proxy

Note Before you disable reverse proxy, delete any private IP address-port number to proxy IP address-port number mappings that you have configured for Cisco SD-WAN Manager instances and Cisco SD-WAN Controller. See *Configure Reverse Proxy Settings on Cisco Catalyst SD-WAN Controllers* for information about deleting the mappings.

1. From the Cisco SD-WAN Manager menu, choose **Administration** > **Settings**.
2. For the **Reverse Proxy** setting, click **Edit**.
3. For **Enable Reverse Proxy**, click **Disabled**.
4. Click **Save**.

Monitor Private and Proxy IP Addresses of Cisco SD-WAN Controllers and WAN Edge Devices

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

2. Click on the hostname of a Cisco SD-WAN Manager instance, Cisco SD-WAN Controller, or a WAN edge device.
3. In the left pane, click **Real Time**.
4. From the **Device Options** drop-down list, choose **Control Connections**.

   In the table that appears, the entries in the Private IP and Private Port columns are the private IP address and port number of the transport interface in VPN 0. The entries in the Public IP and Public Port columns are the proxy IP address and port number.

Monitor Reverse Proxy Using CLI

Example: Monitor Private and Proxy IP Address and Port Numbers of WAN Edge Devices on Cisco SD-WAN Controllers

The following is a sample output from the execution of the **show control connections** command on a Cisco SD-WAN Controller. In the command output, for a WAN edge device, the entries in the PEER PRIVATE IP and PEER PRIV PORT columns are the configured TLOC IP address and port number of the WAN edge interface. The entries in the PEER PUBLIC IP and PEER PUB PORT columns are the corresponding IP address and port number of the reverse proxy interface. The same command can also be executed on a Cisco SD-WAN Manager instance to obtain a similar output.

```
vsmart1# show control connections
                                                                  PEER                PEER

      PEER    PEER PEER            SITE       DOMAIN PEER         PRIV    PEER        PUB

INDEX TYPE    PROT SYSTEM IP       ID         ID     PRIVATE IP   PORT    PUBLIC IP   PORT
    ORGANIZATION   REMOTE COLOR     STATE UPTIME
-------------------------------------------------------------------------------------------
0     vbond   dtls 172.16.1.2         0          0      10.1.1.2     12346   10.1.1.2
12346   EXAMPLE-ORG    default         up     53:08:18:50
0     vmanage tls  172.16.1.6         1          0      10.2.100.6   45689   10.2.100.6
45689   EXAMPLE-ORG    default         up     53:08:18:32
1     vedge   tls  1.1.100.1       100        1      10.3.1.2     57853   10.2.100.1  53624
   EXAMPLE-ORG    biz-internet    up     53:08:18:44
1     vedge   tls  1.1.101.1       101        1      10.4.1.2     55411   10.2.100.1  53622
   EXAMPLE-ORG    biz-internet    up     53:08:18:48
1     vbond   dtls 172.16.1.2         0          0      10.1.1.2     12346   10.1.1.2
12346   EXAMPLE-ORG    default         up     53:08:18:51

vsmart1#
```

Example: View Mapping of SD-WAN Controller Private IP Address and Port Number to Proxy IP Address and Port Number on Cisco Catalyst SD-WAN Validator

The following is a sample output from the execution of the **show orchestrator reverse-proxy-mapping** command on a Cisco SD-WAN Validator. In the command output, the entries in the PROXY IP and PROXY PORT columns are the proxy IP address and port number. The entries in the PRIVATE IP and PRIVATE PORT columns are the private IP address and port number of the transport interface in VPN 0.

```
vbond# show orchestrator reverse-proxy-mapping



                                                  PRIVATE             PROXY

UUID                                  PRIVATE IP  PORT     PROXY IP   PORT

-----------------------------------------------------------------------------

14c35ae4-69e3-41c5-a62f-725c839d25df  10.2.100.4  23456    10.2.1.10  23458

14c35ae4-69e3-41c5-a62f-725c839d25df  10.2.100.4  23556    10.2.1.10  23558

6c63e80a-8175-47de-a455-53a127ee70bd  10.2.100.6  23456    10.2.1.10  23457

6c63e80a-8175-47de-a455-53a127ee70bd  10.2.100.6  23556    10.2.1.10  23557

6c63e80a-8175-47de-a455-53a127ee70bd  10.2.100.6  23656    10.2.1.10  23657

6c63e80a-8175-47de-a455-53a127ee70bd  10.2.100.6  23756    10.2.1.10  23757
```

```
6c63e80a-8175-47de-a455-53a127ee70bd  10.2.100.6  23856    10.2.1.10  23857

6c63e80a-8175-47de-a455-53a127ee70bd  10.2.100.6  23956    10.2.1.10  23957

6c63e80a-8175-47de-a455-53a127ee70bd  10.2.100.6  24056    10.2.1.10  24057

6c63e80a-8175-47de-a455-53a127ee70bd  10.2.100.6  24156    10.2.1.10  24157


vbond#
```

Example: View Mapping of SD-WAN Controller Private IP Address and Port Number to Proxy IP Address and Port Number on a WAN Edge Device

The following is a sample output from the execution of the **show sdwan control connections** command on a Cisco IOS XE Catalyst SD-WAN device. In the command output, check the entry in the PROXY column for a Cisco SD-WAN Manager instance or a Cisco SD-WAN Controller. If the entry is Yes, the entries in the PEER PUBLIC IP and PEER PUBLIC PORT are the proxy IP address and port number.

```
Device# show sdwan control connections

                                                              PEER            PEER
                           CONTROLLER

PEER    PEER PEER            SITE       DOMAIN PEER           PRIV  PEER        PUB
                           GROUP

TYPE    PROT SYSTEM IP       ID         ID     PRIVATE IP     PORT  PUBLIC IP   PORT
ORGANIZATION    LOCAL COLOR     PROXY STATE UPTIME      ID

------------------------------------------------------------------------------------------

vsmart  tls  172.16.1.4         1          1      10.2.100.4    23558 10.2.1.10   23558
EXAMPLE-ORG     biz-internet    Yes   up     52:08:44:25 0

vbond   dtls 0.0.0.0         0          0      10.1.1.2      12346 10.1.1.2    12346
EXAMPLE-ORG     biz-internet    -     up     52:08:50:47 0

vmanage tls  172.16.1.6         1          0      10.2.100.6    23957 10.2.1.10   23957
EXAMPLE-ORG     biz-internet    Yes   up     66:03:04:50 0



Device#
```

On a Cisco vEdge device, you can obtain a similar output by executing the command **show control connections**.

Example: View Signed Certificate Installed on a WAN Edge Device for Authentication with Reverse Proxy

The following is a sample output from the execution of the **show sdwan certificate reverse-proxy** command on a Cisco IOS XE Catalyst SD-WAN device.

```
Device# show sdwan certificate reverse-proxy

Reverse proxy certificate

------------------
```

```
Certificate:

    Data:

        Version: 1 (0x0)

        Serial Number: 1 (0x1)

        Signature Algorithm: sha256WithRSAEncryption

        Issuer: C = US, CN = 6c63e80a-8175-47de-a455-53a127ee70bd, O = Viptela

        Validity

            Not Before: Jun  2 19:31:08 2021 GMT

            Not After : May 27 19:31:08 2051 GMT

        Subject: C = US, ST = California, CN = C8K-9AE4A5A8-4EB0-E6C1-1761-6E54E4985F78, O
 = ViptelaClient
        Subject Public Key Info:

            Public Key Algorithm: rsaEncryption

                RSA Public-Key: (2048 bit)

                Modulus:

                    00:e2:45:49:53:3a:56:d4:b8:70:59:90:01:fb:b1:

                    44:e3:73:17:97:a3:e9:b7:55:44:d4:2d:dd:13:4a:

                    a8:ef:78:14:9d:bd:b5:69:de:c9:31:29:bd:8e:57:

                    09:f2:02:f8:3d:1d:1e:cb:a3:2e:94:c7:2e:61:ea:

                    e9:94:3b:28:8d:f7:06:12:56:f3:24:56:8c:4a:e7:

                    01:b1:2b:1b:cd:85:4f:8d:34:78:78:a1:26:17:2b:

                    a5:1b:2a:b6:dd:50:51:f8:2b:13:93:cd:a6:fd:f8:

                    71:95:c4:db:fc:a7:83:05:23:68:61:15:05:cc:aa:

                    60:af:09:ef:3e:ce:70:4d:dd:50:84:3c:9a:57:ce:

                    cb:15:84:3e:cd:b2:b6:30:ab:86:68:17:94:fa:9c:

                    1a:ab:28:96:68:8c:ef:c8:f7:00:8a:7a:01:ca:58:

                    84:b0:87:af:9a:f6:13:0f:aa:42:db:8b:cc:6e:ba:

                    c8:c1:48:d2:f4:d8:08:b1:b5:15:ca:36:80:98:47:

                    32:3a:df:54:35:fe:75:32:23:9f:b5:ed:65:41:99:

                    50:b9:0f:7a:a2:10:59:12:d8:3e:45:78:cb:dc:2a:

                    95:f2:72:02:1a:a6:75:06:87:52:4d:01:17:f2:62:

                    8c:40:ad:29:e4:75:17:04:65:a9:b9:6a:dd:30:95:

                    34:9b
                Exponent: 65537 (0x10001)

    Signature Algorithm: sha256WithRSAEncryption

         99:40:af:23:bb:cf:7d:59:e9:a5:83:78:37:02:76:83:79:02:

         b3:5c:56:e8:c3:aa:fc:78:ef:07:23:f8:14:19:9c:a4:5d:88:

         07:4d:6e:b8:0d:b5:af:fa:5c:f9:55:d0:60:94:d9:24:99:5e:
         33:06:83:03:c3:73:c1:38:48:45:ba:6a:35:e6:e1:51:0e:92:

         c3:a2:4a:a2:e1:2b:da:cd:0c:c3:17:ef:35:52:e1:6a:23:20:

         af:99:95:a2:cb:99:a7:94:03:f3:78:99:bc:76:a3:0f:de:04:

         7d:35:e1:dc:4d:47:79:f4:c8:4c:19:df:80:4c:4f:15:ab:f1:

         61:a2:78:7a:2b:6e:98:f6:7b:8f:d6:55:44:16:79:e3:cd:51:

         0e:27:fc:e6:4c:ff:bb:8f:2d:b0:ee:ed:98:63:e9:c9:cf:5f:

         d7:b1:dd:7b:19:32:22:94:77:d5:bc:51:85:65:f3:e0:93:c7:

         3c:79:fc:34:c7:9f:40:dc:b1:fc:6c:e5:3d:af:2d:77:b7:c3:

         88:b3:89:7c:a6:1f:56:35:3b:35:66:0c:c8:05:b5:28:0b:98:

         19:c7:b0:8e:dc:b7:3f:9d:c1:bb:69:f0:7d:20:95:b5:d1:f0:

         06:35:b7:c4:64:ba:c4:95:31:4a:97:03:0f:04:54:6d:cb:50:

         2f:31:02:59


Device#
```

On a Cisco vEdge device, you can obtain a similar output by executing the command **show certificate reverse-proxy**.

Enterprise Certificates

In Cisco IOS XE SD-WAN Release 16.11.1 and Cisco SD-WAN Release 19.1, enterprise certificates were introduced. Enterprise certificates replace the controller certificates authorization used previously.

Note When using enterprise certificates for Cisco SD-WAN Controllers, ensure that you use root certificates with an RSA key that is at least 2048 bit.

Note For purposes of certificate management, the term *controller* is used to collectively refer to Cisco SD-WAN Manager, the Cisco Catalyst SD-WAN Controller, and the Cisco Catalyst SD-WAN Validator.

Note For more information about enterprise certificates, see the Cisco Catalyst SD-WAN Controller Certificates and Authorized Serial Number File Prescriptive Deployment Guide.

Use the Certificates page to manage certificates and authenticate WAN edge and controller devices in the overlay network.

Two components of the Cisco Catalyst SD-WAN solution provide device authentication:

- Signed certificates are used to authenticate devices in the overlay network. Once authenticated, devices can establish secure sessions between each other. It is from Cisco SD-WAN Manager that you generate these certificates and install them on the controller devices—Cisco SD-WAN Manager, Cisco SD-WAN Validators, and Cisco SD-WAN Controllers.
- The WAN edge authorized serial number file contains the serial numbers of all valid vEdge and WAN routers in your network. You receive this file from Cisco Catalyst SD-WAN, mark each router as valid or invalid, and then from Cisco SD-WAN Manager, send the file to the controller devices in the network.

Install the certificates and the WAN edge authorized serial number file on the controller devices to allow the Cisco Catalyst SD-WAN overlay network components to validate and authenticate each other and thus to allow the overlay network to become operational.

Generate Admin-Tech Files

Table 13: Feature History

Feature Name	Release Information	Description
Admin-Tech Enhancements	Cisco IOS XE Catalyst SD-WAN Release 17.2.1r	This feature enhances the admin-tech file to include **show tech-support memory**, **show policy-firewall stats platform**, and **show sdwan confd-log netconf-trace** commands in the admin-tech logs. The admin-tech tar file includes memory, platform, and operation details.
Generate System Status Information for a Cisco SD-WAN Manager Cluster Using Admin Tech	Cisco IOS XE Catalyst SD-WAN Release 17.6.1a Cisco vManage Release 20.6.1	You can collect system status information for a Cisco SD-WAN Manager cluster. Prior to this feature, Cisco Catalyst SD-WAN was only able to generate an admin-tech file for a single device.
View Generated Admin-Tech Files at Any Time	Cisco IOS XE Catalyst SD-WAN Release 17.6.1a Cisco vManage Release 20.6.1	You can view a list of generated admin-tech files and determine which files to copy from your device to Cisco SD-WAN Manager. You can then download the selected admin-tech files to your local device, or delete the downloaded admin-tech files from Cisco SD-WAN Manager, the device, or both.

Feature Name	Release Information	Description
Additional Diagnostics Information Added to Admin-Tech File	Cisco IOS XE Catalyst SD-WAN Release 17.7.1a Cisco vManage Release 20.7.1	You can access additional diagnostics information collected from the application server, the configuration database, the statistics database, and other internal services.
Upload an Admin-Tech File to a TAC Case	Cisco IOS XE Catalyst SD-WAN Release 17.7.1a Cisco vManage Release 20.7.1	You can upload an admin-tech file to a TAC case from Cisco SD-WAN Manager.

Perform the following steps to generate admin-tech file.

1. From the Cisco SD-WAN Manager menu, choose **Tools** > **Operational Commands**.
2. Click **Generate Admin Tech for vManage** to generate an admin-tech file for all the nodes in a Cisco SD-WAN Manager cluster.
3. For a single device, click **. . .** for the desired device and choose **Generate Admin Tech**.
4. In the **Generate admin-tech File** window, limit the contents of the admin-tech tar file if desired:

   a. The **Include Logs** check box is checked by default. Uncheck this check box to omit any log files from the compressed tar file.

   Note The log files are stored in the /var/log/directory on the local device.

   b. Check the **Include Cores** check box to include any core files.

   Note The core files are stored in the /var/crash directory on the local device.

   c. Check the **Include Tech** check box to include any files related to device processes (daemons), memory details and operations.

5. Click **Generate**.

   Cisco SD-WAN Manager creates the admin-tech file.

   The file name has the format *date-time*-admin-tech.tar.gz.

Note Starting from Cisco vManage Release 20.7.1, the admin-tech file includes additional diagnostics information collected from the application server, the configuration database, the statistics database, and other internal services.

For more information on admin tech and technical support commands, see request admin-tech and show tech-support.

View Admin-Tech Files

You can perform any of the following operations after the admin-tech file is generated:

- View the list of the generated admin-tech files.
- Copy the selected admin-tech files from your device to Cisco SD-WAN Manager.
- Download the selected admin-tech files to your local device.
- Delete the selected admin-tech files from Cisco SD-WAN Manager, the device, or both.

1. From the Cisco SD-WAN Manager menu, choose **Tools** > **Operational Commands**.
2. For the desired device, click **. . .** and choose **View Admin Tech List**.

   A tar file appears that contains the admin-tech contents of the device that you selected earlier. This file has a name similar to `*ip-address*-*hostname*-20210602-032523-admin-tech.tar.gz`, where the numeric fields are the date and the time.

   You can view the list of the generated admin-tech files and decide which files that you want to copy to Cisco SD-WAN Manager.
3. Click the **Copy** icon to copy the admin-tech file from the device to Cisco SD-WAN Manager.

   A hint appears letting you know that the file is being copied from the device to Cisco SD-WAN Manager.
4. After the file is copied from the device to Cisco SD-WAN Manager, you can click the **Download** icon to download the file to your local device.

   You can view the admin-tech file size after the file is copied to Cisco SD-WAN Manager.
5. After the admin-tech file is successfully copied to Cisco SD-WAN Manager, you can click the **Delete** icon and choose which files to delete from Cisco SD-WAN Manager, the device, or both.

For more information on admin tech and technical support commands, see request admin-tech and show tech-support.

Upload an Admin-Tech File to a TAC Case

From Cisco vManage Release 20.7.1, Cisco IOS XE Catalyst SD-WAN Release 17.7.1a, and Cisco SD-WAN Release 20.7.1, you can upload an admin-tech file directly from Cisco SD-WAN Manager when opening a TAC case.

Before You Begin

Ensure that you have generated admin-tech files from Cisco SD-WAN Manager.

Upload an Admin-Tech File to a TAC Case

Perform the following steps to upload an admin-tech file to a TAC case:

1. From the Cisco SD-WAN Manager menu, choose **Tools** > **Operational Commands**.
2. After you generate **Admin-Tech** files, click **Show Admin Tech List**.

The **List of Admin-techs** window is displayed.

3. From the list of Admin-tech files, select the admin-tech file and click **Upload**.
4. In the **SR Number** and **Token** fields, enter the details.
5. Choose the **VPN** from the VPN options. The options are VPN 0 and VPN 512.
6. Click **Upload**.

   The selected admin-tech file is uploaded to the relevant service request.

How to Load a Custom Cisco SD-WAN Manager Application Server Logo

To change the Cisco SD-WAN Manager web application server logo and load a new custom logo, use the **request nms application-server update-logo** command.

The logo image is located in the upper left corner of all Cisco SD-WAN Manager web application server screens. You can load two files, a larger version, which is displayed on wider browser screens, and a smaller version, which is displayed when the screen size narrows. Both files must be PNG files located on the local device, and both must be 1 MB or smaller in size. For best resolution, it is recommended that the image for the large logo be 180 x 33 pixels, and for the small logo 30 x 33 pixels.

Log In to the Cisco Catalyst SD-WAN Manager Web Application Server

The Cisco SD-WAN Manager runs as a web application server through which you log in to a running Cisco SD-WAN Manager.

In an overlay network with a single Cisco SD-WAN Manager, to log in to the server, use HTTPS, and specify the IP address of the server. Enter a URL in the format https://*ip-address*:8443, where 8443 is the port number used by Cisco SD-WAN Manager. On the login page, enter a valid username and password, and then click **Log In**. You have five chances to enter the correct password. After the fifth incorrect attempt, you are locked out of the device, and you must wait for 15 minutes before attempting to log in again.

In an overlay network that has a cluster of Cisco SD-WAN Managers, the cluster allows you to log in to one of the Cisco SD-WAN Managers that is operating in the role of a web application server. Use HTTPS, specifying the IP address of one of the Cisco SD-WAN Managers, in the format https://*ip-address*:8443. The cluster software load-balances login sessions among the individual Cisco SD-WAN Managers that are acting as web application servers. You cannot control which of the individual Cisco SD-WAN Managers you log in to.

With a Cisco SD-WAN Manager cluster, if you enter invalid login credentials, it might take some time for you to see an invalid login error message, and the amount of time increases as the size of the cluster increases. This delay happens because each Cisco SD-WAN Manager attempts sequentially to validate the credentials. If none of the Cisco SD-WAN Manager servers validate you, only then do you see an invalid login error message.

To determine which Cisco SD-WAN Manager you are logged in to, look in the Cisco SD-WAN Manager toolbar, which is located at the top of the screen. To view more information about this particular Cisco SD-WAN Manager server, enter the name of the server in the Search filter of the **Monitor** > **Devices**.

Cisco vManage Release 20.6.x and earlier: To determine which Cisco SD-WAN Manager you are logged in to, look in the Cisco SD-WAN Manager toolbar, which is located at the top of the screen. To view more information about this particular Cisco SD-WAN Manager server, enter the name of the server in the Search filter of the **Monitor** > **Network**.

Information about Monitoring Multicloud Services using Cisco vManage

Table 14: Feature History Table

Feature Name	Release Information	Release Information
Cisco SD-WAN Manager Support for Monitoring Multicloud Services	Cisco IOS XE Catalyst SD-WAN Release 17.6.1a Cisco vManage Release 20.6.1	You now have four new views on the Cisco SD-WAN Manager UI that enable you to monitor your multicloud network.
Monitoring MultiCloud Services for Real Time Data in Cisco SD-WAN Manager	Cisco IOS XE Catalyst SD-WAN Release 17.10.1a Cisco vManage Release 20.10.1	This feature provides enhancements to monitoring dashboard for all the Cloud and Interconnect connections. This feature also gives you the flexibility to specify which dashlets to view and sort them based on your preferences.

This feature enables you to monitor Cisco SD-WAN connectivity to different cloud resources using the Cisco vManage UI. This feature introduces the following views in the UI using which you can visually monitor the approximate geographical locations of Edge devices, cloud types, and information about cloud sites and accounts for different cloud providers:

- Geographical View
- Cloud and Interconnect Dashboard
- Cloud Gateway Summary View
- Interconnect Gateway Summary View

By default, the **Monitor Overview** dashboard displays all the available dashlets that help you monitor the different components and services of a Cisco SD-WAN overlay network. The customizable dashboard feature enables you to do the following:

- Add dashlets
- Delete dashlets
- Rearrange dashlets
- Restore default settings

Note Starting from Cisco vManage Release 20.10.1, the Multicloud dashlets on the **Monitor Overview** dashboard are displayed as soon as the Cloud or Interconnect provider accounts are associated with Cisco vManage.

Geographical View

The geographical view shows the approximate geographic locations of the Cisco Catalyst 8000V instances in multicloud deployments. The approximate locations are based on the publicly available information from the cloud and interconnect types. The locations are provided for the Google Cloud, AWS, and Azure cloud platforms as well as software-defined cloud interconnects.

To view the geographical locations of multicloud Cisco Catalyst 8000V instances:

1. From the Cisco vManage menu, choose **Monitor** > **Geography**.
2. On the map, click a Cisco Catalyst 8000V instance to see the cloud or interconnect type, site-id, and system-ip of that instance.

Cloud and Interconnect Dashboard

The cloud and interconnect dashboard displays a separate panel for each cloud instance and software-defined cloud interconnect. A pie chart shows the sites that are connected to the cloud or the software-defined cloud interconnect and their reachability. The sites are Cisco Catalyst SD-WAN devices of a particular site-id that have a BFD session to the cloud or interconnect Cisco Catalyst 8000V. Each cloud or interconnect panel also displays the following information:

- Number of Cisco Catalyst SD-WAN edge devices
- Registered multicloud accounts
- Gateways
- Tags
- Host VPCs
- Tunnels
- VPN connections

To view information on the cloud and interconnect dashboard:

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Multicloud**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Dashboard** > **Multicloud**.

2. To view information about the Cisco Catalyst SD-WAN edge devices, click the number of **WAN Edge**s to see information about the Cisco Catalyst SD-WAN edge devices. The window that is displayed shows the health (aggregate of the CPU, memory, and hardware state), BFD status, configuration status, reachability, hostname, system IP, chassis number, cloud or interconnect gateway name, device model and version of the device.

   - From **Monitor** > **Multicloud**, when you click on the non-zero number of Cloud or Interconnect Edge devices, the **Monitor** > **Devices** page opens. The Filter criteria on the left pane of the **Devices** window allows you to choose the fields to be displayed from the available options.
   - To view the cloud or software-defined cloud interconnect gateway name, region, account name, health, and description of the all the gateways that are specific to a cloud type, click on the non-zero number of Cloud or Interconnect **Gateways**.
   - To view the details of Cloud or Interconnect Edge devices, click on the non-zero number of Cloud or Interconnect **Edge**.
   - To view the Connected Sites health, BFD status and site ID, click on the non-zero number of **Connected Sites**.

Cloud Gateway Summary View

Note Geographical locations and traffic statistics are not available when the solution is branch connect-AWS.

The cloud gateway summary view displays the following information:

- Cloud type
- Account name
- Region
- Cloud gateway devices
- Associated branch devices—branch devices that have a BFD session set up with the cloud gateway devices.
- Associated VPCs and vNETs—VPCs and vNETs that are mapped to a VPN that belongs to the same region as the cloud gateway.
- Traffic statistics—tunnel statistics from the cloud gateway devices to the workload VPCs. When a device is selected, you can choose to view the following traffic statistics and also for the time duration listed:
    - Kbps
    - Packets
    - Octets
    - Errors
    - Drops
    - Pps

  If no device is selected, an aggregation of statistics of all the devices in the cloud gateway is displayed.

To go to the cloud gateway summary view:

1. From the Cisco SD-WAN Manager menu, choose **Configuration** > **Cloud OnRamp for Multicloud**.
2. Choose **Cloud**.
3. In the cloud gateway summary table, click the cloud gateway name for which you want to view the details. You can also view details about the connected sites on this page.

Interconnect Gateway Summary View

The interconnect gateway summary view displays the following information:

- Cisco Catalyst SD-WAN edge device type
- Account name
- Region
- Interconnect gateway devices

- Associated branch devices
- Interconnect connectivity

To go to the interconnect gateway summary view:

1. From the Cisco SD-WAN Manager menu, choose **Configuration** > **Cloud OnRamp for Multicloud**.
2. Choose **Interconnect**.
3. Click the interconnect gateway name for which you want to view the details.

Manage Data Collection for Cisco Catalyst SD-WAN Telemetry

Table 15: Feature History

Feature Name	Release Information	Description
Manage Data Collection for Cisco Catalyst SD-WAN Telemetry	Cisco IOS XE Catalyst SD-WAN Release 17.6.1a Cisco SD-WAN Release 20.6.1 Cisco vManage Release 20.6.1	This feature allows you to disable data collection for Cisco Catalyst SD-WAN telemetry using Cisco SD-WAN Manager. Data collection for telemetry is enabled by default.

From Cisco vManage Release 20.6.1, Cisco SD-WAN Manager has a new option to enable or disable data collection for Cisco Catalyst SD-WAN telemetry from **Administration** > **Settings** > **Data Collection**. Before this release, the **Data Collection** section only had the option to enable or disable data collection, and not data collection for Cisco Catalyst SD-WAN telemetry. The two options are described below:

Data Collection: This option is used to establish a connection to Cisco Catalyst SD-WAN Data Collection Service (DCS) hosted on the cloud. The connection from Cisco SD-WAN Manager to DCS is used to collect required data from the controllers and the network, for different features such as Cisco SD-WAN Analytics and Cisco Catalyst SD-WAN telemetry.

SD-WAN Telemetry Data Collection: This option is used to enable or disable telemetry data collection from the controllers and the network. It is enabled by default when **Data Collection** is enabled for Cisco Catalyst SD-WAN. For Cisco-provided cloud-hosted controllers, this option is enabled at the time of provisioning the controllers. For an on-premises controller, establishing the connection to Cisco Catalyst SD-WAN Data Collection Service (DCS) through the **Data Collection** setting is a mandatory prerequisite for enabling Cisco Catalyst SD-WAN telemetry.

Manage Service Groups

Table 16: Feature History

Feature Name	Release Information	Description
Support for Cisco VM Image Upload in qcow2 Format	Cisco IOS XE Catalyst SD-WAN Release 17.7.1a Cisco vManage Release 20.7.1	You can now upload a virtual machine image to Cisco SD-WAN Manager in qcow2 format. Earlier, you could upload only a prepackaged image file in tar.gz format.

Create Service Chain in a Service Group

A service group consists of one or more service chains.

Table 17: Feature History

Feature Name	Release Information	Feature Description
Monitor Service Chain Health	Cisco IOS XE Catalyst SD-WAN Release 16.12.1b	This feature lets you configure periodic checks on the service chain data path and reports the overall status. To enable service chain health monitoring, NFVIS version 3.12.1 or later should be installed on all CSP devices in a cluster.

From the Cisco SD-WAN Manager menu, choose **Configuration** > **Cloud OnRamp for Colocation**

a) Click **Service Group** and click **Create Service Group**. Enter the service group name, description, and colocation group.

The service group name can contain 128 alphanumeric characters.

The service group description can contain 2048 alphanumeric characters.

For a multitenant cluster, choose a colocation group or a tenant from the drop-down list. For a single-tenant cluster, the colocation group **admin** is chosen by default.

b) Click **Add Service Chain**.

c) In the **Add Service Chain** dialog box, enter the following information:

Table 18: Add Service Chain Information

Field	Description
Name	The service chain name can contain 128 alphanumeric characters.
Description	The service chain description can contain alphanumeric 2048 characters.
Bandwidth	The service chain bandwidth is in Mbps. The default bandwidth is 10 Mbps and you can configure a maximum bandwidth of 5 Gbps.

Field	Description
Input Handoff VLANS and Output Handoff VLANS	The Input VLAN handoff and output VLAN handoff can be comma-separated values (10, 20), or a range from 10–20.
Monitoring	A toggle button that allows you to enable or disable service chain health monitoring. The service chain health monitoring is a periodic monitoring service that checks health of a service chain data path and reports the overall service chain health status. By default, the monitoring service is disabled. A service chain with subinterfaces such as, SCHM (Service Chain Health Monitoring Service) can only monitor the service chain including the first VLAN from the subinterface VLAN list. The service chain monitoring reports status based on end-to-end connectivity. Therefore, ensure that you take care of the routing and return traffic path, with attention to the Cisco Catalyst SD-WAN service chains for better results. **Note** • Ensure that you provide input and output monitoring IP addresses from input and output handoff subnets. However, if the first and last VNF devices are VPN terminated, you don't need to provide input and output monitoring IP addresses. For example, if the network function isn’t VPN terminated, the input monitoring IP can be 192.0.2.1/24 from the inbound subnet, 192.0.2.0/24. The inbound subnet connects to the first network function and the output monitoring IP can be, 203.0.113.11/24 that comes from outbound subnet, 203.0.113.0/24 of the last network function of a service chain. • If the first or last VNF firewall in a service chain is in transparent mode, you can't monitor these service chains.
Service Chain	A topology to choose from the service chain drop-down list. For a service chain topology, you can choose any of the validated service chains such as, Router - Firewall - Router, Firewall, Firewall - Router. See the Validated Service Chains topic in Cisco Catalyst SD-WAN Cloud OnRamp Colocation Solution Guide. You can also create a customized service chain. See Create Custom Service Chain, on page 40.

d) In the **Add Service Chain** dialog box, click **Add**.
Based on the service chain configuration information, a graphical representation of the service group with all the service chains and the VNFs automatically appear in the design view window. A VNF or PNF appears with a "V" or "P" around the circumference for a virtual a physical network function. It shows all the configured service chains within each service group. A check mark next to the service chain indicates that the service chain configuration is complete.

After you activate a cluster, attach it with the service group and enable monitoring service for the service chain, when you bring up the CSP device where CCM is running. Cisco SD-WAN Manager chooses the same CSP device to start the monitoring service. The monitoring service monitors all service chains periodically in a round robin fashion by setting the monitoring interval to 30 minutes. See Monitor Cloud OnRamp Colocation Clusters, on page 51.

e) In the design view window, to configure a VNF, click a VNF in the service chain.
The **Configure VNF** dialog box appears.

f) Configure the VNF with the following information and perform the actions, as appropriate:

Note The following fields are available from Cisco vManage Release 20.7.1:

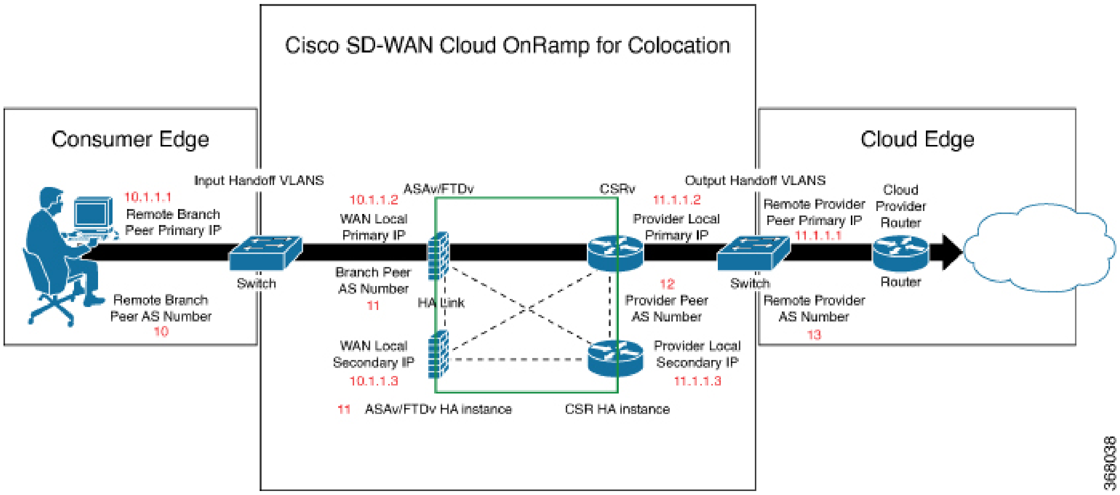
- **Disk Image/Image Package (Select File)**
- **Disk Image/Image Package (Filter by Tag, Name and Version)**
- **Scaffold File (Select File)**
- **Scaffold File (Filter by Tag, Name and Version)**

Table 19: VNF Properties of Router and Firewall

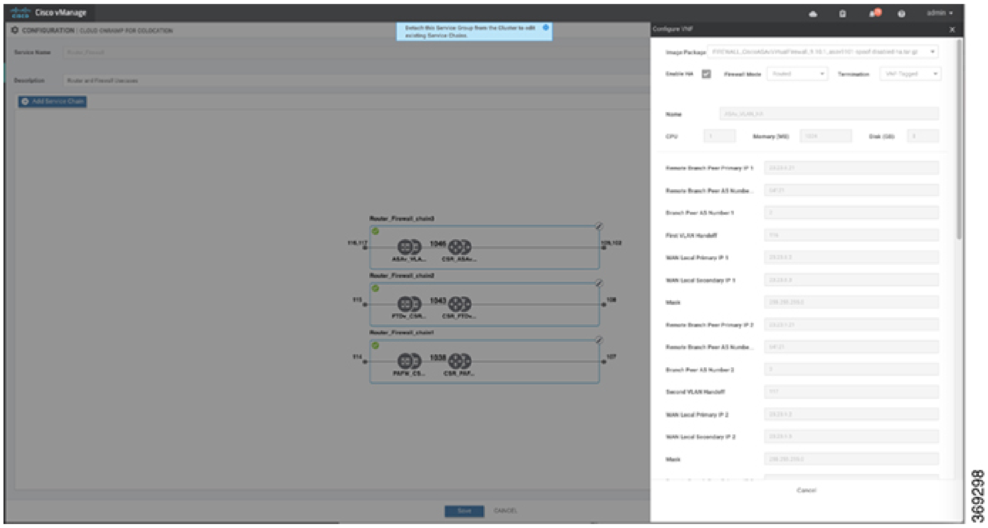
Field	Description
Image Package	Choose a router, firewall package.
Disk Image/Image Package (Select File)	Choose a tar.gz package or a qcow2 image file.
Disk Image/Image Package (Filter by Tag, Name and Version)	(Optional) Filter an image or a package file based on the name, version, and tags that you specified when uploading a VNF image.
Scaffold File (Select File)	Choose a scaffold file. **Note** • This field is mandatory if a qcow2 image file has been chosen. It is optional if a tar.gz package has been chosen. • If you choose both a tar.gz package and a scaffold file, then all image properties and system properties from the scaffold file override the image properties and system properties, including the Day-0 configuration files, specified in the tar.gz package.
Scaffold File (Filter by Tag, Name and Version)	(Optional) Filter a scaffold file based on the name, version, and tags that you specified when uploading a VNF image.
Click **Fetch VNF Properties**. The available information for the image is displayed in the **Configure VNF** dialog box.	
Name	VNF image name
CPU	(Optional) Specifies the number of virtual CPUs that are required for a VNF. The default value is 1 vCPU.
Memory	(Optional) Specifies the maximum primary memory in MB that the VNF can use. The default value is 1024 MB.

Field	Description
Disk	(Optional) Specifies disk in GB required for the VM. The default value is 8 GB.
A dialog box with any custom tokenized variables from Day-0 that requires your input appears. Provide the values.	

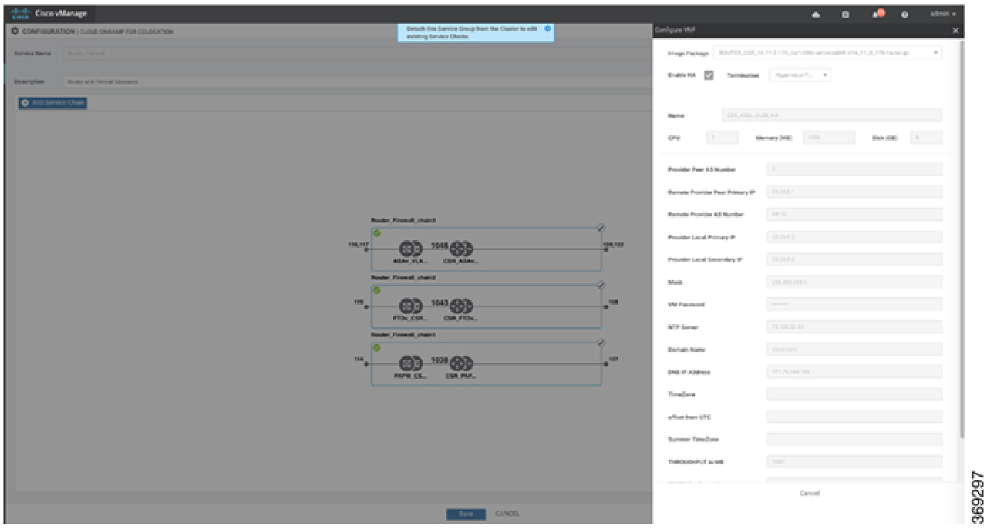
In the following image, all IP addresses, VLAN, and autonomous system within the green box are system-specific information that is generated from the VLAN, IP pools provided for the cluster. The information is automatically added into the Day-0 configurations of VMs.



The following images are a sample configuration for VNF IP addresses and autonomous system numbers, in Cisco SD-WAN Manager.


Cisco vManage
CONFIGURATION | CLOUD ONRAMP FOR COLOCATION
Detach this Service Group from the Cluster to edit existing Service Chains.
Add Service Chain
Configure VNF
admin
Cancel
Save
CANCEL
369298

Service Name	[illegible]
Description	Router and Firewall Usecases
Image Package	[illegible]
Enable HA	☑
Firewall Mode	[illegible]
Termination	VNF Tagged
Name	[illegible]
CPU	[illegible]
Memory (MB)	[illegible]
Disk (GB)	[illegible]
Remote Branch Peer Primary IP 1	[illegible]
Remote Branch Peer AS Numbe...	[illegible]
Branch Peer AS Number 1	[illegible]
First VLAN Handoff	[illegible]
WAN Local Primary IP 1	[illegible]
WAN Local Secondary IP 1	[illegible]
Mask	[illegible]
Remote Branch Peer Primary IP 2	[illegible]
Remote Branch Peer AS Numbe...	[illegible]
Branch Peer AS Number 2	[illegible]
Second VLAN Handoff	[illegible]
WAN Local Primary IP 2	[illegible]
WAN Local Secondary IP 2	[illegible]
Mask	[illegible]



If you're using a multitenant cluster and a comanged scenario, configure theCisco Catalyst SD-WAN VM by entering the values for the following fields and the remaining fields, as required for the service chain design:

Note To join the tenant overlay network, the provider should provide correct values for the following fields.

Field	Description
Serial Number	The authorized serial number of a Cisco Catalyst SD-WAN device. The service provider can get the device serial number from the tenant before creating the service chain.
OTP	The OTP of the Cisco Catalyst SD-WAN device that is available after authenticating it with Cisco SD-WAN Control Components. The service provider can get the OTP for the corresponding serial number from the tenant before creating the service chain.
Site Id	The identifier of the site in the tenant Cisco Catalyst SD-WAN overlay network domain in which the Cisco Catalyst SD-WAN device resides, such as a branch, campus, or data center. The service provider can get the site Id from the tenant before creating the service chain.
Tenant ORG Name	The tenant organization name that is included in the Certificate Signing Request (CSR). The service provider can get the organization name from the tenant before creating the service chain.
System IP connect to Tenant	The IP address to connect to the tenant overlay network. The service provider can get the IP address from the tenant before creating the service chain.
Tenant vBond IP	The IP address of the tenant Cisco SD-WAN Validator. The service provider can get the Cisco SD-WAN Validator IP address from the tenant before creating the service chain.

For edge VMs such as first and last VM in a service chain, you must provide the following addresses as they peer with a branch router and the provider router.

Table 20: VNF Options for First VM in Service Chain

Field	Mandatory or Optional	Description
Firewall Mode	Mandatory	Choose Routed or Transparent mode. **Note** Firewall mode is applicable to firewall VMs only.
Enable HA	Optional	Enable HA mode for the VNF.

Termination	Mandatory	Choose one of the following modes:
		• L3 mode selection with subinterfaces that are in trunk mode
		`<type>selection</type> <val help="L3 Mode With Sub-interfaces(Trunked)" display="VNF-Tagged">vlan</val>`
		• L3 mode with IPSEC termination from a consumer-side and rerouted to the provider gateway
		`<val help="L3 Mode With IPSEC Termination From Consumer and Routed to Provider GW" display="Tunneled">vpn</val>`
		• L3 mode with access mode (nontrunk mode)
		`<val help="L3 Mode In Access Mode (Non-Trunked)" display="Hypervisor-Tagged">routed</val>`

g) Click **Configure**. The service chain is configured with the VNF configuration.
h) To add another service chain, repeat the procedure from Steps b-g.
i) Click **Save**.

The new service group appears in a table under the **Service Group**. To view the status of the service chains that are monitored, use the **Task View** window, which displays a list of all running tasks along with the total number of successes and failures. To determine the service chain health status, use the **show system:system status** command on the CSP device that has service chain health monitoring enabled.

Create Custom Service Chain

You can customize service chains,

- By including extra VNFs or add other VNF types.
- By creating new VNF sequence that isn't part of the predefined service chains.

Step 1 Create a service group and service chains within the service group. See Create Service Chain in a Service Group, on page 35.

Step 2 In the **Add Service Chain** dialog box, enter the service chain name, description, bandwidth, input VLAN handoff, output VLAN handoff, monitoring health information of a service chain, and service chain configuration. Click **Add**.

For the service chain configuration, choose **Create Custom** from the drop-down. An empty service chain in the design view window is available.

Step 3 To add a VNF such as a router, load balancer, firewall, and others, click a VNF icon and drag the icon to its proper location within the service group box. After adding all required VNFs and forming the VNF service chain, configure each of the VNFs. Click a VNF in the service group box. The **Configure VNF** dialog box appears. Enter the following parameters:

a) Choose the software image to load from the **Disk Image/Image Package** (**Select File**) drop-down list.

Note You can select a qcow2 image file from Cisco vManage Release 20.7.1.

b) Choose a scaffold file from the **Scaffold File** (**Select File**) drop-down list if you have chosen a qcow2 image file.

Note This option is available from Cisco vManage Release 20.7.1.

c) Optionally, filter an image, a package file, or a scaffold file based on the name, version, and tags that you specified when uploading a VNF image.

Note This option is available from Cisco vManage Release 20.7.1.

d) Click **Fetch VNF Properties**.
e) In the **Name** field, enter a name of the VNF.
f) In the **CPU** field, enter the number of virtual CPUs required for the VNF.
g) In the **Memory** field, enter the amount of memory in megabytes to be allocated for the VNF.
h) In the **Disk** field, enter the amount of memory for storage in gigabytes to be allocated for the VNF.
i) Enter VNF-specific parameters, as required.

Note These VNF details are the custom variables that are required for Day-0 operations of the VNF.

j) Click **Configure**.
k) To delete the VNF or cancel the VNF configuration, click **Delete** or **Cancel** respectively.

The customized service chains are added to a service group.

Note You can customize a VNF sequence with only up to four VNFs in a service chain.

Manage Software Repository

Table 21: Feature History

Feature Name	Release Information	Description
Software Upgrade Using a Remote Server	Cisco IOS XE Catalyst SD-WAN Release 17.7.1a Cisco vManage Release 20.7.1	This feature enables you to register a remote server with Cisco SD-WAN Manager, and add locations of software images on the remote server to the Cisco SD-WAN Manager software repository. When you upgrade device or controller software, the device or controller can download the new software image from the remote server.

Register Remote Server

Register a remote server with Cisco SD-WAN Manager so that you can add locations of software images on the remote server to the Cisco SD-WAN Manager software repository and upgrade device or controller software using these software images. In multitenant Cisco Catalyst SD-WAN deployment, only the provider can register a remote server and perform software upgrade using images on the remote server.

1. From the Cisco SD-WAN Manager menu, choose **Maintenance** > **Software Repository**.
2. Click **Add Remote Server**.
3. In the **Add Remote Server** slide-in page, configure the following:

Server Info	• **Server Name**: Enter a name for the server. • **Server IP or DNS Name**: Enter the IP address or the DNS name of the server. • **Protocol**: Choose HTTP or FTP. • **Port**: Enter the access port number.
Credentials	• **User ID**: Enter the user ID required to access the server. The username can contain only the following characters: a-z, 0-9, ., _, and -. • **Password**: Enter the password required to access the server. The password can contain only the following characters: a-z, A-Z, 0-9, _, *, ., +, =, %, and -. **Note** Special characters such as /, ?, :, @, and SPACE, which are used in URLs and are needed for proper parsing of fields so files can be fetched properly with the relevant protocol, are not supported in the username and the password. The use of the valid characters is supported starting from Cisco vManage Release 20.9.1.

Image Info	• **Image Location Prefix**: Enter the folder path where the uploaded images must be stored • **VPN**: Enter the VPN ID, either the transport VPN, management VPN, or service VPN

4. Click **Add** to add the remote server.

Manage Remote Server

1. From the Cisco SD-WAN Manager menu, choose **Maintenance** > **Software Repository**.
2. For the desired remote server, click **…**
3. To view the remote server settings, click **View Details**.
4. To edit the remote server settings, click **Edit**. Edit any of the following settings as necessary and click **Save**.

Note You cannot edit the remote server settings if you have added locations of any software images on the remote server to the Cisco SD-WAN Manager software repository. If you wish to edit the remote server settings, remove the software image entries from the software repository and then edit the settings.

Server Info	• **Server Name**: Enter a name for the server. • **Server IP or DNS Name**: Enter the IP address or the DNS name of the server. • **Protocol**: Choose HTTP or FTP. • **Port**: Enter the access port number.
Credentials	• **User ID**: Enter the user ID required to access the server. The username can contain only the following characters: a-z, 0-9, ., _, and -. • **Password**: Enter the password required to access the server. The password can contain only the following characters: a-z, A-Z, 0-9, _, *, ., +, =, %, and -. **Note** Special characters such as /, ?, :, @, and SPACE, which are used in URLs and are needed for proper parsing of fields so files can be fetched properly with the relevant protocol, are not supported in the username and the password. The use of the valid characters is supported starting from Cisco vManage Release 20.9.1.
Image Info	• **Image Location Prefix**: Enter the folder path where the uploaded images must be stored. • **VPN**: Enter the VPN ID, either the transport VPN, management VPN, or service VPN.

5. To delete the remote server, click **Remove**. Confirm that you wish to remove the remote server in the dialog box.

Note Before deleting a remote server, remove any entries for software images on the remote server that you have added to the Cisco SD-WAN Manager software repository.

Add Software Images to Repository

Before you begin

Before you can upgrade the software on an edge device, Cisco Catalyst SD-WAN Controller, or Cisco SD-WAN Manager to a new software version, you need to add the software image to the Cisco SD-WAN Manager software repository. The repository allows you to store software images on the local Cisco SD-WAN Manager server and on a remote file server.

The Cisco SD-WAN Manager software repository allows you to store images in three ways:

- On the local Cisco SD-WAN Manager server, to be downloaded over a control plane connection—Here, the software images are stored on the local Cisco SD-WAN Manager server, and they are downloaded to the Cisco Catalyst SD-WAN devices over a control plane connection. The receiving device generally throttles the amount of data traffic it can receive over a control plane connection, so for large files, the Cisco SD-WAN Manager server might not be able to monitor the software installation on the device even though it is proceeding correctly.
- On the local Cisco SD-WAN Manager server, to be downloaded over an out-of-band connection—Here, the software images are stored on the local Cisco SD-WAN Manager server, and they are downloaded to the Cisco Catalyst SD-WAN devices over an out-of-band management connection. For this method to work, you specify the IP address of the out-of-band management interface when you copy the images to the software repository. This method is recommended when the software image files are large, because it bypasses any throttling that the device might perform and so the Cisco SD-WAN Manager server is able to monitor the software installation.
- On a remote server—Here, the software images remain on a remote file server that is reachable through an FTP or HTTP URL. As part of the software upgrade process, the Cisco SD-WAN Manager server sends this URL to the Cisco Catalyst SD-WAN device, which then establishes a connection to the file server over which to download the software images.

Step 1 From the Cisco SD-WAN Manager menu, choose **Maintenance** > **Software Repository**.

Step 2 Click **Add New Software**.

Step 3 Choose the location to store the software image:

a) To store the software image or on the local Cisco SD-WAN Manager server and have it be downloaded to Cisco Catalyst SD-WAN devices over a control plane connection, choose **vManage**. The **Upload Software to vManage** dialog box opens.

1. Drag and drop the software image file to the dialog box, or click **Browse** to select the software image from a directory on the local Cisco SD-WAN Manager server.
2. Click **Upload** to add the image to the software repository.

Note NFVIS upgrade images require the local Cisco SD-WAN Manager server.

b) To store the software image on a remote server, choose **Remote Server**. The **Location of Software on Remote Server** dialog box opens.

1. In the **Controller Version** field, enter the controller version.
2. In the **Version** field, enter the version number of the software image.
3. In the **FTP/HTTP URL** field, enter the FTP or HTTP URL of the software image.
4. Click **Add** to add the image to the software repository.

c) To store the image on a remote Cisco SD-WAN Manager server and have it be downloaded to Cisco Catalyst SD-WAN devices over an out-of-band management connection, choose **Remote Server - vManage** . The **Upload Software to Remote Server - vManage** dialog box opens.

1. In the **vManage Hostnamr/IP Address** field, enter the IP address of an interface on the Cisco SD-WAN Manager server that is in a management VPN (typically, VPN 512).
2. Drag and drop the software image file to the dialog box, or click **Browse** to select the software image from a directory on the local Cisco SD-WAN Manager server.
3. Click **Upload**.

View Software Images

From the Cisco SD-WAN Manager menu, choose **Maintenance** > **Software Respository**.

The **Software Repository** window displays the images avaialable in the repository.

The **Software Version** column lists the version of the software image, and the **Controller Version** column lists the version of Cisco SD-WAN Control Components that is equivalent to the software version. The Cisco SD-WAN Control Components version is the minimum supported version. The software image can operate with the listed Cisco SD-WAN Control Components version or with a higher version.

The **Software Location** column indicates where the software images are stored, either in the repository on the Cisco SD-WAN Manager server, or in a repository in a remote location.

The **Available Files** column lists the names of the software image files.

The **Updated On** column shows when the software image was added to the repository.

The **...** option for a desired software version provides the option to delete the software image from the repository.

In Cisco vManage Release 20.6.1 and earlier releases, when two or more software images have the same software version but are uploaded with different filenames, the images are listed in a single row. The **Available Files** column lists the different filenames. This listing scheme is disadvantageous when deleting software images as the delete operation removes all the software images corresponding to a software version.

From Cisco vManage Release 20.7.1, when two or more software images have the same software version but are uploaded with different filenames, each software image is listed in a separate row. This enables you to choose and delete specific software images.

Upload VNF Images

The VNF images are stored in the Cisco SD-WAN Manager software repository. These VNF images are referenced during service chain deployment, and then they are pushed to Cisco NFVIS during service chain attachment.

Step 1 From the Cisco SD-WAN Manager menu, choose **Maintenance** > **Software Repository**.

Step 2 To add a prepackaged VNF image, click **Virtual Images**, and then click **Upload Virtual Image**.

Step 3 Choose the location to store the virtual image.

- To store the virtual image on the local Cisco SD-WAN Manager server and download it to CSP devices over a control plane connection, click **vManage**. The **Upload VNF’s Package to vManage** dialog box appears.

  a. Drag and drop the virtual image file or the qcow2 image file to the dialog box or click **Browse** to choose the virtual image from the local Cisco SD-WAN Manager server. For example, CSR.tar.gz, ASAv.tar.gz, or ABC.qcow2

  b. If you upload a file, specify the type of the uploaded file: **Image Package** or **Scaffold**. Optionally, specify a description of the file and add custom tags to the file. The tags can be used to filter images and scaffold files when creating a service chain.

  c. If you upload a qcow2 image file, specify the service or VNF type: **FIREWALL** or **ROUTER**. Optionally, specify the following:

  - Description of the image
  - Version number of the image
  - Checksum
  - Hash algorithm

  You can also add custom tags to the file that can be used to filter images and scaffold files when creating a service chain.

  Note
  - It is mandatory to upload a scaffold file if you choose a qcow2 image file.
  - The option to select a qcow2 image file is available from Cisco vManage Release 20.7.1. In Cisco vManage Release 20.6.1 and earlier releases, you can select only a tar.gz file.

  d. Click **Upload** to add the image to the virtual image repository. The virtual image repository table displays the added virtual image, and it available for installing on the CSP devices.

- To store the image on a remote Cisco SD-WAN Manager server and then download it to CSP devices, click **Remote Server - vManage**. The **Upload VNF’s Package to Remote Server-vManage** dialog box appears.

  a. In the **vManage Hostname/IP Address** field, enter the IP address of an interface on Cisco SD-WAN Manager server that is in the management VPN (typically, VPN 512).

  b. Drag and drop the virtual image file or the qcow2 image file to the dialog box, or click **Browse** to choose the virtual image from the local Cisco SD-WAN Manager server.

  c. If you upload a file, specify the type of the uploaded file: **Image Package** or **Scaffold**. Optionally, specify a description of the file and add custom tags to the file. The tags can be used to filter images and scaffold files when creating a service chain.

d. If you upload a qcow2 image file, specify the service or VNF type: **FIREWALL** or **ROUTER**. Optionally, specify the following:

- Description of the image
- Version number of the image
- Checksum
- Hash algorithm

You can also add custom tags to the file that can be used to filter images and scaffold files when creating a service chain.

Note

- It is mandatory to upload a scaffold file if you choose a qcow2 image file.
- The option to select a qcow2 image file is available from Cisco vManage Release 20.7.1. In Cisco vManage Release 20.6.1 and earlier releases, you can select only a tar.gz file.

e. Click **Upload** to add the image to the virtual image repository. The virtual image repository table displays the added virtual image, and it is available for installing on the CSP devices.

You can have multiple VNF entries such as a firewall from same or from different vendors. Also, you can add different versions of VNF that are based on the release of the same VNF. However, ensure that the VNF name is unique.

View the Status of Network Devices

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

2. Locate the WAN edge router that you want to view the status for. You can either scroll through the list of devices in the device table or enter a keyword in the search bar.

3. Click the relevant WAN edge router under the **Hostname** column. The **System Status** screen opens by default.

View VNF Images

Step 1 From the Cisco SD-WAN Manager menu, choose **Maintenance** > **Software Repository**.

Step 2 Click **Virtual Images**.

Step 3 To filter the search results, use the filter option in the search bar.

The Software Version column provides the version of the software image.

The Software Location column indicates where the software images are stored. Software images can be stored either in the repository on the Cisco SD-WAN Manager server or in a repository in a remote location.

The **Version Type Name** column provides the type of firewall.

The **Available Files** column lists the names of the VNF image files.

The **Update On** column displays when the software image was added to the repository.

Step 4 For the desired VNF image, click **...** and choose **Show Info**.

Delete VNF Images

Step 1 From the Cisco SD-WAN Manager menu, choose **Maintenance** > **Software Repository**.

Step 2 Click **Virtual Images**. The images in the repository are displayed in a table.

Step 3 For the desired image, click **...** and choose **Delete**.

Note If you're downloading a VNF image to a device, you can’t delete the VNF image until the download process completes.

Note If the VNF image is referenced by a service chain, it can’t be deleted.

Software Upgrade

Use the Software Upgrade window to download new software images and to upgrade the software image running on a Cisco Catalyst SD-WAN device.

From a centralized Cisco SD-WAN Manager, you can upgrade the software on Cisco Catalyst SD-WAN devices in the overlay network and reboot them with the new software. You can do this for a single device or for multiple devices simultaneously.

When you upgrade a group of Cisco Catalyst SD-WAN Validator, Cisco Catalyst SD-WAN Controllers, and Cisco IOS XE Catalyst SD-WAN devices or Cisco vEdge devices in either a standalone or Cisco SD-WAN Manager cluster deployment, the software upgrade and reboot is performed first on the Cisco Catalyst SD-WAN Validator, next on the Cisco Catalyst SD-WAN Controller, and finally on the Cisco IOS XE Catalyst SD-WAN devices or Cisco vEdge devices. Up to 40 Cisco IOS XE Catalyst SD-WAN devices or Cisco vEdge devices can be upgraded and rebooted in parallel, depending on CPU resources.

Introduced in the Cisco vManage Release 20.8.1, the software upgrade workflow feature simplifies the software upgrade process for the Cisco Catalyst SD-WAN edge devices through a guided workflow and displays the various device and software upgrade statuses. For more information on creating a Software Upgrade Workflow, see Software Upgrade Workflow.

Note

- You cannot include Cisco SD-WAN Manager in a group software upgrade operation. You must upgrade and reboot the Cisco SD-WAN Manager server by itself.
- You can create a software upgrade workflow only for upgrading the Cisco Catalyst SD-WAN edge devices.
- It is recommended that you perform all software upgrades from Cisco SD-WAN Manager rather than from the CLI.
- For software compatibility information, see Cisco SD-WAN Controller Compatibility Matrix and Server Recommendations.

Monitor Cflowd and SAIE Flows for Cisco IOS XE Catalyst SD-WAN Devices

Table 22: Feature History

Feature Name	Release Information	Description
Flexible NetFlow Support for IPv6 and Cache Size Modification	Cisco IOS XE Catalyst SD-WAN Release 17.4.1a Cisco vManage Release 20.4.1	Configure Cflowd traffic flow monitoring on Cisco IOS XE Catalyst SD-WAN devices.
Log Packets Dropped by Implicit ACL	Cisco IOS XE Catalyst SD-WAN Release 17.5.1a Cisco vManage Release 20.5.1	To enable logging of dropped packets, check the **Implicit ACL Logging** check box and to configure how often the packet flows are logged, enter the value in the **Log Frequency** field.
Flexible NetFlow Enhancement	Cisco IOS XE Catalyst SD-WAN Release 17.6.1a Cisco vManage Release 20.6.1	Configure Cflowd traffic flow monitoring to collect ToS, sampler ID, and remarked DSCP values in netflow records.
Flexible NetFlow for VPN0 Interface	Cisco IOS XE Catalyst SD-WAN Release 17.7.1a Cisco vManage Release 20.7.1	Configure this feature using the CLI template and also add-on CLI template.
Flexible NetFlow Export Spreading	Cisco IOS XE Catalyst SD-WAN Release 17.9.1a Cisco Catalyst SD-WAN Control Components Release 20.9.x Cisco vManage Release 20.9.1	This feature enables export spreading to prevent export storms that occur when a burst of packets are sent to external collector. The export of the previous interval is spread during the current interval to prevent export storms. When NetFlow packets are sent over a low-bandwidth circuit, the export spreading functionality is enabled to avoid packet drops.

Feature Name	Release Information	Description
Flexible NetFlow Export of BFD Metrics	Cisco IOS XE Catalyst SD-WAN Release 17.10.1a Cisco Catalyst SD-WAN Control Components Release 20.10.1	With this feature, you can export Bidirectional Forwarding Detection (BFD) metrics to an external collector for generating BFD metrics of loss, latency, and jitter. This feature provides enhanced monitoring and faster collection of network state data.
Real-Time Device Options for Monitoring Cflowd and SAIE Flows	Cisco IOS XE Catalyst SD-WAN Release 17.10.1a Cisco vManage Release 20.10.1	With this feature, you can apply filters for monitoring specific Cflowd and SD-WAN Application Intelligence Engine (SAIE) applications or application families running within a VPN on the selected Cisco IOS XE Catalyst SD-WAN device. This feature was already available on Cisco vEdge devices and is being extended to Cisco IOS XE Catalyst SD-WAN devices in this release.

Minimum releases: Cisco IOS XE Catalyst SD-WAN Release 17.10.1a and Cisco vManage Release 20.10.1

For more information on monitoring Cflowd traffic flows, see Traffic Flow Monitoring with Cflowd.

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.
2. Click **...** adjacent to the Cisco IOS XE Catalyst SD-WAN device name and choose **Real Time**.
3. From the **Device Options** drop-down list, choose one of the following options:
   - **cFlowd Flows/DPI**
   - **cFlowd ipv6 Flows/DPI**
4. Click **Show Filters**.

   You can search for Cflowd flow records based on the selected filters.

Note The filters are displayed only if you selected one of the Cflowd flows with the DPI device options.

Table 23: Filters for Cflowd with DPI Device Options

Field	Description
VPN ID	Enter the VPN ID.
Source IP	Enter the source IPv4 or IPv6 address.
Destination IP	Enter the destination IPv4 or IPv6 address.
Application	Enter the name of the application for which you are configuring Cflowd and SAIE monitoring.

Field	Description
Application Family	Enter the name of the application family for which you are configuring Cflowd and SAIE monitoring.

5. Click **Search** or **Reset All** to reset all the search filters.

Monitor Cloud OnRamp Colocation Clusters

Table 24: Feature History

Feature Name	Release Information	Description
Network Assurance –VNFs: Stop/Start/Restart	Cisco IOS XE Catalyst SD-WAN Release 17.3.1a Cisco vManage Release 20.3.1	You can now stop, start, or restart VNFs on Cisco CSP devices from the **Colocation Cluster** tab.

You can view the cluster information and their health states. Reviewing this information can help you to determine which Cisco CSP device is responsible for hosting each VNF in a service chain. To view information about a cluster, perform the following steps:

Step 1 From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

Cisco vManage Release 20.6.1 and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

Step 2 To monitor clusters, click **Colocation Cluster**.

Cisco vManage Release 20.6.1 and earlier: Click **Colocation Clusters**.

All clusters with relevant information are displayed in a tabular format. Click a cluster name. You can monitor cluster by clicking **Config. View** and **Port Level View**.

- **Config. View**: The primary part of the window displays the CSP devices and switch devices that form the cluster. In the right pane, you can view the cluster information such as the available and total CPU resources, available and allocated memory, and so on, based on colocation size.

  The detail part of the window contains:

  - Search: To filter the search results, use the Filter option in the search bar.
  - A table that lists information about all devices in a cluster (Cisco CSP devices, PNFs, and switches).

    Click a Cisco CSP device. VNF information is displayed in a tabular format. The table includes information such as VNF name, service chains, number of CPUs, memory consumption, and other core parameters that define performance of a network service chain. See View Information About VNFs.

    To start, stop, or reboot a VNF, for the desired VNF, click **...** and choose one of the following operations:

    - **Start**.

- **Stop**.
- **Restart**.

Note Ensure that service chain provisioning is complete and VMs are deployed, before issuing start, stop, restart operations on any of the VNFs in the service chain.

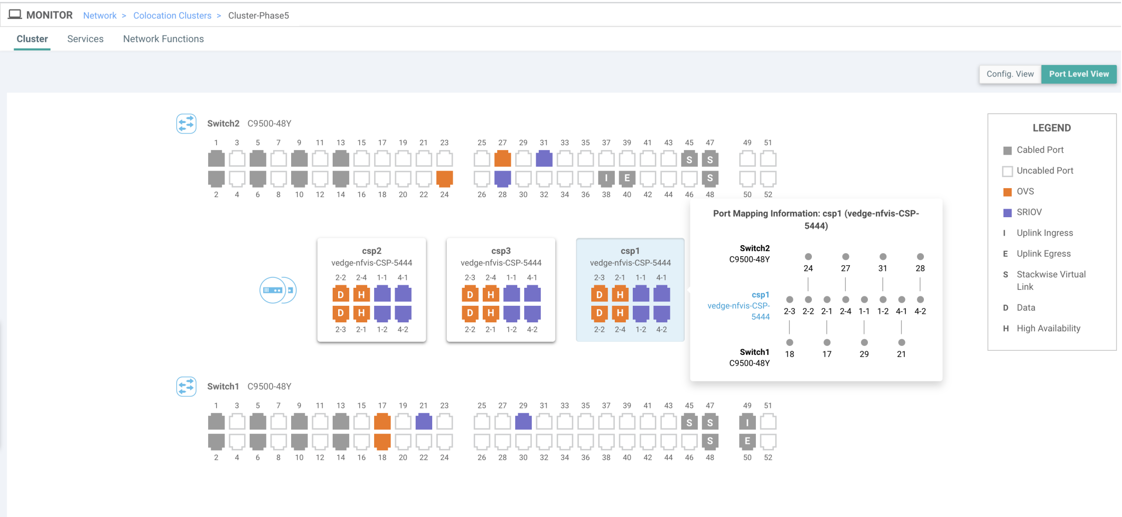
After you choose an operation on a VNF, wait until the operation is complete before you issue another operation. You can view the progress of an operation from the **Task View** window.

- **Port Level View**: After you activate the cluster, to view the port connectivity details, click **Port Level View**.

  You can view detailed port connectivity information for the switches and CSP devices in a color coded format based on the SR-IOV and OVS modes.

  To view the mapping of ports between the Catalyst 9500 switches and CSP devices, click or hover over a CSP device.

Figure 1: Monitor Port Connectivity Details of a Cluster



Step 3 Click **Services**.

Here, you can view the following:

- Complete information of a service chain. The first two columns display the name and description of the service chain in the service group and the remaining columns mention about the VNF, PNF statuses, monitoring service enablement, and the overall health of a service chain. You can also view the colocation user group associated with a service chain. The various health statuses and their representations are:
  - Healthy—An up arrow in green. A service chain is in 'Healthy' status when all the VNF, PNF devices are running and are in healthy state. Ensure that you configure the routing and policy correctly.
  - Unhealthy—A down arrow in red. If one of the VNFs or PNFs are in unhealthy state, the service chain is reported to be in 'Unhealthy' status. For example, after deploying a service chain, if one of the network function IP address changes on the WAN or LAN side, or the firewall policy isn't configured to let the traffic pass through, then unhealthy state is reported. This is because the network function or overall service chain is Unhealthy or both are in Unhealthy state.

  - Undetermined—Down arrow in yellow. This state is reported when the health of the service chain can’t be determined. This state is also reported when there’s no status such as healthy or unhealthy available for the monitored service chain over a time period. You can’t query or search a service chain with undetermined status.

    If a service chain consists of a single PNF and PNF is outside the reachability of Cisco SD-WAN Manager, it can’t be monitored. If a service chain consists of a single network function, the firewall that has VPN termination on both sides which can’t be monitored, then it’s reported as Undetermined.

    Note If the status of a service chain is undetermined, you can’t choose the service chain to view the detailed monitoring information.

- If you had configured a service chain by enabling the monitoring field, then click a service group that is in Healthy or Unhealthy state. The primary part of the service chain monitoring window contains the following elements:

  Graphical display that plots the latency information of the service chain, VNFs, PNFs.

  The detail part of the service chain monitoring window contains:

  - Search: To filter the search results, use the Filter option in the search bar.
  - A table that lists information about all service chains, VNFs, PNFs, their health status, and types.
    - Check the service chain, VNF, PNF check boxes for the service chains, VNFs, PNFs you want to choose.
    - To change the sort order of a column, click the column title.

  The status details column indicates the monitored data path and it provides the per hop analysis.

- Click **Diagram** and view the service group with all the service chains and VNFs in the design view window.
- Click a VNF. You can view CPU, memory, and disk allocated to the VNF in a dialog box.
- Choose a service group from the **Service Groups** drop-down. The design view displays the selected service group with all the service chains and VNFs.

Step 4 Click **Network Functions**.

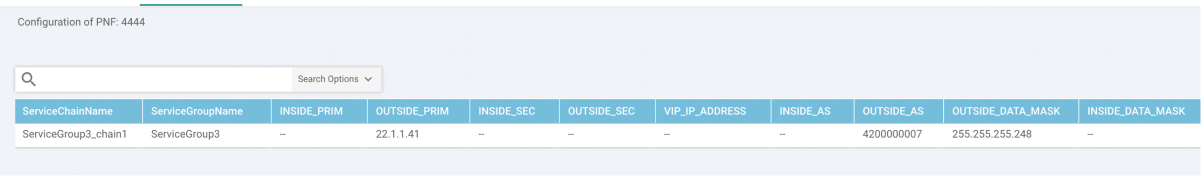
Here, you can view the following:

- All the virtual or physical network functions in a tabular format. Use the **Show** button, and choose to display either a VNF or PNF.

  VNF information is displayed in a tabular format. The table includes information such as VNF name, service chains, colocation user groups, CPU use, memory consumption, and other core parameters that define performance of network service. To view more information about the VNF, click a VNF name. See View Information About VNFs.

- PNF information is displayed in tabular format. The table includes information such as the serial number and PNF type. To view and note configuration of a specific PNF, click the desired PNF serial number. Ensure that you manually note all the configuration of the PNFs and then configure the PNF devices. For example, the following are some of the PNF configuration where you position the PNF at various locations in the service chain. See *Cloud OnRamp for Colocation Solution Guide* to configure the PNFs manually.

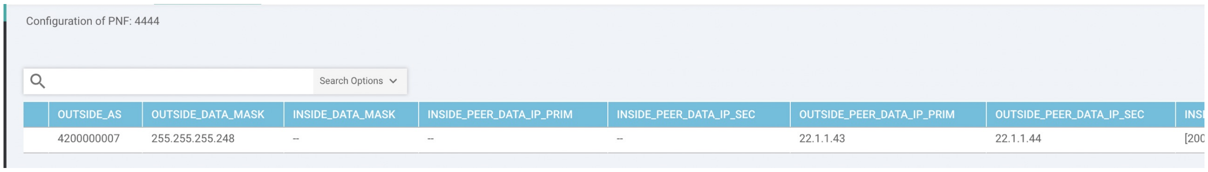
Figure 2: PNF in the First Position with Service Chain Side Parameters



Configuration of PNF: 4444

ServiceChainName	ServiceGroupName	INSIDE_PRIM	OUTSIDE_PRIM	INSIDE_SEC	OUTSIDE_SEC	VIP_IP_ADDRESS	INSIDE_AS	OUTSIDE_AS	OUTSIDE_DATA_MASK	INSIDE_DATA_MASK
ServiceGroup3_chain1	ServiceGroup3	--	22.1.1.41	--	--	--	--	4200000007	255.255.255.248	--

Figure 3: PNF in the First Position with Outside Neighbor Information

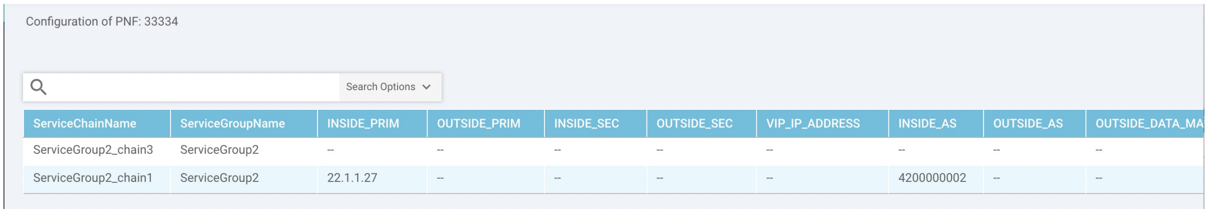


Configuration of PNF: 4444

	OUTSIDE_AS	OUTSIDE_DATA_MASK	INSIDE_DATA_MASK	INSIDE_PEER_DATA_IP_PRIM	INSIDE_PEER_DATA_IP_SEC	OUTSIDE_PEER_DATA_IP_PRIM	OUTSIDE_PEER_DATA_IP_SEC	INSI
	4200000007	255.255.255.248	--	--	--	22.1.1.43	22.1.1.44	[200

Figure 4: PNF Shared Across Two Service Chains

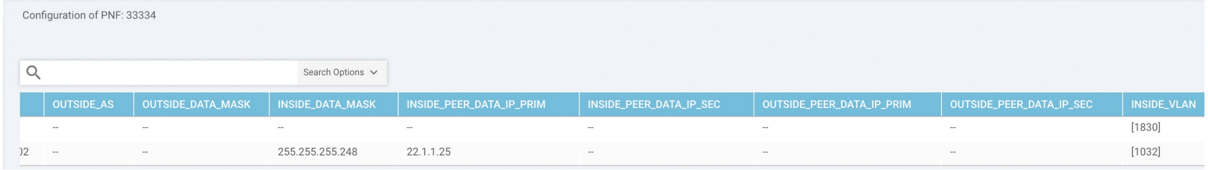
The ServiceGroup2_chain3 is a PNF-only service chain and therefore no configuration gets generated. The PNF is in the last position of the ServiceGroup2_chain1, so only INSIDE variables gets generated.



Configuration of PNF: 33334

ServiceChainName	ServiceGroupName	INSIDE_PRIM	OUTSIDE_PRIM	INSIDE_SEC	OUTSIDE_SEC	VIP_IP_ADDRESS	INSIDE_AS	OUTSIDE_AS	OUTSIDE_DATA_MA
ServiceGroup2_chain3	ServiceGroup2	--	--	--	--	--	--	--	--
ServiceGroup2_chain1	ServiceGroup2	22.1.1.27	--	--	--	--	4200000002	--	--

Figure 5: PNF Shared Across Two Service Chains with Outside Neighbor Information



Configuration of PNF: 33334

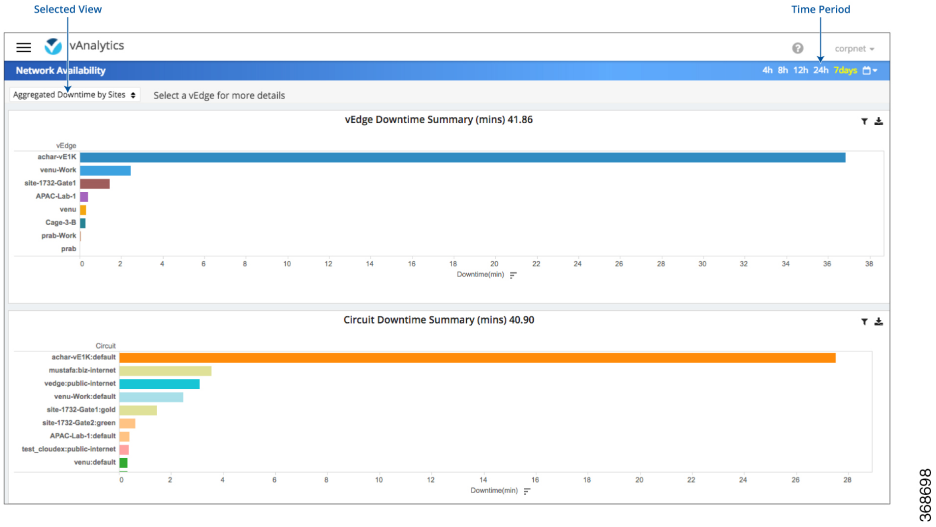
	OUTSIDE_AS	OUTSIDE_DATA_MASK	INSIDE_DATA_MASK	INSIDE_PEER_DATA_IP_PRIM	INSIDE_PEER_DATA_IP_SEC	OUTSIDE_PEER_DATA_IP_PRIM	OUTSIDE_PEER_DATA_IP_SEC	INSIDE_VLAN
	--	--	--	--	--	--	--	[1830]
)2	--	--	255.255.255.248	22.1.1.25	--	--	--	[1032]

Monitor Network Performance

Use the Network screens to monitor the health of data tunnels and the availability of network devices and circuits.

Screen Elements

- Title bar—Includes the title of the screen.
- Health—Displays latency, loss, and jitter performance.
- Availability—Displays downtime information for the Cisco Catalyst SD-WAN edge devices and circuits.



Display Network Availability

To display downtime for Cisco Catalyst SD-WAN edge devices and circuit at each site:

1. Select an edge device or circuit view to see the respective downtime.

2. Adjust length of time: Day, Week, Month, or Custom Period.

3. Select **Aggregated Downtime by Sites**.

4. Click on individual data elements to see downtime information for a specific site.

5. Click a Cisco Catalyst SD-WAN edge device or circuit to display details about that downtime event.

Display Network Health

Use the Network Health screen to monitor the performance of tunnels over time in your overlay network over time.

The tunnel statistics may be displayed in one of three views: by edge device, by tunnel, or by carrier.

To display performance through Cisco Catalyst SD-WAN edge device view:

1. Click **vEdge**.

2. Select an individual color to filter the view.

3. Select a Cisco vEdge device to display latency, loss, and jitter on all the tunnels on that device.

To display graphs for latency, loss, and jitter on each tunnel in your overlay network:

1. Click **Tunnel**. Select an individual carrier, color, or both to filter the view.

2. Hover over a point on a line to open a hover box with details for that point in time.

3. Click a local Cisco Catalyst SD-WAN device to display average latency, loss, or jitter on all the tunnels on that device.

4. Click a remote Cisco Catalyst SD-WAN device to display latency, loss, or jitter on the tunnels between two Cisco Catalyst SD-WAN devices.

To display performance by carrier on a geographical map of the overlay network:

1. Click **Carrier**. Circles on the map represent each carrier. The legend to the right indicates the color of each carrier.
2. Select **Latency**, **Loss**, or **Jitter** to change the data displayed.
3. Click on individual data elements to select specific carriers to view.
4. Hover over a carrier's circle to display a hover box with details for that location.
5. Click a circle on the map to display loss, latency, or jitter of all the tunnels terminating on that location.
6. Click a carrier on the graph to see performance by individual edge devices on that carrier.

Onboard Cisco Catalyst 8000V Edge Software Hosted by a Cloud Service, Using PAYG Licensing

To onboard a Cisco Catalyst 8000V platform hosted by a cloud service, using pay as you go (PAYG) licensing, perform these steps.

You can also use Cisco Cloud onRamp for Multi-Cloud to onboard a Cisco Catalyst 8000V platform using PAYG licensing. For information to integrate public cloud infrastructure into the Cisco Catalyst SD-WAN fabric, see Cloud OnRamp Configuration Guide, Cisco IOS XE Release 17.x.

Note This procedure is applicable to Cisco Catalyst 8000V hosted by Amazon Web Services (AWS).

1. From the Cisco SD-WAN Manager menu, choose **Configuration** > **Devices**, and click **Add PAYG WAN Edges**.
2. In the **Add PAYG WAN Edges** dialog box, enter the number of PAYG devices to onboard into Cisco Catalyst SD-WAN, select the **Validate** check box, and click **Add**.

   The **Task View** page opens, showing the progress as Cisco SD-WAN Manager creates logical devices.

   Note Validating causes Cisco SD-WAN Manager to publish the list of devices to the Cisco Catalyst SD-WAN Validator and Cisco Catalyst SD-WAN Controller controllers in the network.

3. After the **Task View** page shows the logical devices have been created successfully, choose **Configuration** > **Devices** to view the new logical devices on the **Devices** page.

   Note The **Chassis Number** column shows the unique identifier for each logical device.

4. For the logical devices that you have created, click **…** and choose **Generate Bootstrap Configuration**.

5. (Optional) Attach a device template to the logical devices that you have created.

6. In the **Generate Bootstrap Configuration** dialog box, click **Cloud-Init** and then click **OK**.

   The **Generate Bootstrap Configuration** dialog box shows the content of the bootstrap configuration, which includes the UUID of the logical device, and includes the configuration details provided by the device template if you have attached one.

Note The UUID corresponds to the identifier in the **Chassis Number** column in the **Devices** table.

7. There are different methods for loading the bootstrap configuration onto a C8000V instance on a cloud service. The method you use depends on the cloud service. We recommend to click **Download** in the **Generate Bootstrap Configuration** dialog box to save a copy of the bootstrap configuration.

8. In the cloud services portal, create a PAYG instance of the Cisco Catalyst 8000V. When configuring the instance, use the bootstrap configuration that you created in Cisco SD-WAN Manager. The details of how to load the Cisco Catalyst SD-WAN bootstrap configuration onto the instance are specific to the cloud services provider.

Note On AWS, the workflow for bringing up an instance includes a user data step that enables loading the bootstrap configuration.

9. On the cloud service platform, start the Cisco Catalyst 8000V instance using the bootstrap configuration from an earlier step.

   When the Cisco Catalyst 8000V instance boots up, it joins the Cisco Catalyst SD-WAN overlay automatically. In Cisco SD-WAN Manager, on the **Devices** page, this Cisco Catalyst 8000V instance shows a green medal icon in the **State** column and **In Sync** in the **Device Status** column.

Note On the **Devices** page, for logical devices that have not joined the Cisco Catalyst SD-WAN overlay, the **State** column shows a dotted-circle icon.

Reboot a Device

Use the Device Reboot screen to reboot one or more Cisco Catalyst SD-WAN devices.

Reboot Devices

1. From the Cisco SD-WAN Manager menu, choose **Maintenance** > **Device Reboot**.
2. Click **WAN Edge**, **Controller**, or **vManage** depending on the device type that you want to reboot..
3. Check the check boxes next to the device or devices that you want to reboot.
4. Click **Reboot**.

View Active Devices

To view a list of devices on which the reboot operation was performed:

1. From the Cisco SD-WAN Manager toolbar, click the **Tasks** icon. Cisco SD-WAN Manager displays a list of all running tasks along with the total number of successes and failures.

2. Click a row to see details of a task. Cisco SD-WAN Manager opens a pane displaying the status of the task and details of the device on which the task was performed.

Reload a Security Application

The **Reload Services** option in the **Maintenance** > **Device Reboot** window lets you to recover a security application from an inoperative state. Ensure that you use this service as an initial recovery option. See Determine Security Applications in Inoperative State, on page 59.

Ensure that a security application has already been installed on the device that you choose to reload services for. To reload one or more security applications:

1. From the Cisco SD-WAN Manager menu, choose **Maintenance** > **Device Reboot**.

2. Under **WAN Edge**, check the check box for the Cisco Catalyst SD-WAN device you want to choose.

3. Click **Reload Services**.

   The **Reload Container** dialog box appears.

4. If the security application version is correct, check the check box against the version of the security application.

5. Click **Reload**.

   The security application stops, is uninstalled, reinstalled, and restarted.

Reset a Security Application

The **Reset Services** option in the **Maintenance** > **Device Reboot** window enables you to recover a security application from an inoperative state.

Use the **Reset Services** option when the virtual network configuration of a security application changes, such as, the virtual port group configuration on a device.

- Ensure that a security application is already been installed on the device that you choose to reset services for.

- Ensure that the chosen security application is in a running state.

To reset one or more security applications:

1. Click **WAN Edge** and check against a Cisco Catalyst SD-WAN device to reload the security application.

2. Click **Reset Services**.

   The **Reset Container** dialog box opens.

3. If the security application version is correct, check the check box against the version of the device.

4. Click **Reset**.

   The security application is stopped, and then restarted.

Determine Security Applications in Inoperative State

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

2. Choose a device by clicking its name in the **Hostname** column.

3. In the left pane, click **Real Time**.

   The real time device information appears in the right pane.

4. From the **Device Options** drop-down list, choose **App Hosting Details**.

   A table appears with the device-specific application hosting information. In the table, if the state of the device is ACTIVATED, DEPLOYED, or STOPPED, perform a reload or reset operation on the security application.

   If the state of the device is RUNNING, the security application is in an operative state.

5. From the **Device Options** drop-down list, choose **Security App Dataplane Global**.

   A table appears with the device-specific application data plane information. In the table, if the **SN Health** of the device is yellow or red, perform a reload or reset operation on the security application.

   If the **SN Health** of the device is green, the security application is in an operative state.

Rediscover Network

Use the **Rediscover Network** window to locate new devices in the overlay network and synchronize them with Cisco SD-WAN Manager.

1. From the Cisco SD-WAN Manager menu, choose **Tools** > **Rediscover Network**.

2. Choose a device or devices by checking the check box next to the device model. To find the device you are looking for scroll through the device table. Alternatively, choose a device group from the **Device Groups** drop-down list to see devices that belong to a specific device group.

3. To confirm resynchronization of the device data, click **Rediscover**.

4. In the **Rediscover Network** dialog box, click **Rediscover**.

Replace a Cisco IOS XE Catalyst SD-WAN Device

You might replace a Cisco IOS XE Catalyst SD-WAN device if the device has failed completely or when a component of the device, such as one of the power supplies, has failed.

In general terms, to replace one Cisco IOS XE Catalyst SD-WAN device with another, copy the configuration from the device that you are removing to the new device and then add the new device into the network.

A. Copy the configuration from the device that you are replacing

1. From the Cisco SD-WAN Manager menu, choose **Configuration** > **Devices**.

2. In the list of devices, locate the device to be replaced. In the row of the device, click **…** and choose **Running Configuration**.

Note If Cisco SD-WAN Manager cannot reach the device, skip to step 4 for instructions on logging in to the device directly to copy the configuration information.

3. Copy the text of the configuration and paste it into a text editor.

   The configuration information is useful especially if you choose the manual deployment method for onboarding the new replacement device.

4. If the device is not reachable by Cisco SD-WAN Manager, log in to the device directly and use the following commands on the device to display the configuration information. Copy the configuration information from the output.

   - Display the running configuration and save the output to a text file.

     ```
     show running-config | redirect bootflash:sdwan/ios.cli
     ```

   - Display the SD-WAN running configuration and save the output to a text file.

     ```
     show sdwan running-config | redirect bootflash:sdwan/sdwan.cli
     ```

B. Remove the device from the overlay network

1. From the Cisco SD-WAN Manager menu, choose **Configuration** > **Certificates**.
2. In the list of devices, locate the device to be replaced. In the row of the device, in the **Validate** column, click **Invalid**, then **OK**.

Note This step causes any control connections to the device to be lost.

3. Click **Send to Controllers**.
4. From the Cisco SD-WAN Manager menu, choose **Configuration** > **Devices**.
5. In the list of devices, locate the device to be replaced. In the row of the device, click **...** and choose **Delete WAN Edge**.

C. Add the replacement device to the Cisco SD-WAN Manager inventory

1. Obtain the chassis number and serial number of the replacement device.

Note You can use the **show sdwan certificate serial** command on the device to display this information.

2. Add the new device to the inventory using one of the methods described in the Cisco Catalyst SD-WAN Getting Started Guide.

Note The methods for adding a new device to the inventory are relevant to onboarding devices in general. They are not unique to replacing a device.

D. Apply a device template to the new device, using the same device template that was applied to the device that is being replaced

1. From the Cisco SD-WAN Manager menu, choose **Configuration** > **Templates**.
2. In the row for the template that was used for the device being replaced, click **…** and choose **Export CSV**. The CSV file shows the parameters for each device to which the template is attached.
3. Review the exported CSV file.
   - If the new device is identical to the device being replaced, you do not need to update any of the parameters in the CSV file.
   - If the new device is not identical to the device being replaced, then optionally, you can update parameter values in the CSV file to match the new device, as required. For example, if the replacement device uses a different interface numbering, as compared with the device being replaced, you can update the parameter that specifies interface numbering.
4. To attach the template to the replacement device, do the following:
   a. From the Cisco SD-WAN Manager menu, choose **Configuration** > **Templates**.
   b. Click **Device Templates**.

Note In Cisco vManage Release 20.7.x and earlier releases, **Device Templates** is called **Device**.

   c. In the row for the template that was used for the device being replaced, click **…** and choose **Attach Devices**.
   d. In the **Attach Devices** window, move the replacement device to the **Selected Devices** pane and click **Attach**.
   e. Optionally, you can update parameters in the template before applying it to the device, using one of the following methods:
      - In the row of the replacement device, click **…** and choose **Edit Device Template**. Edit any parameters, as needed.
      - Upload the CSV file that you downloaded and edited to update the parameters for the replacement device. To upload the CSV file, click **Upload** (up arrow button) and navigate to the CSV file.

E. Onboard the new device

Use one of the following methods to onboard the new device.

Note The methods for onboarding a new device to the inventory are relevant to onboarding devices in general. They are not unique to replacing a device.

- Plug and Play (PnP)

  For information, see the Plug and Play Onboarding Workflow section of the Cisco Catalyst SD-WAN Getting Started Guide, and see the Cisco Catalyst SD-WAN: WAN Edge Onboarding guide.

- Bootstrap

  For information, see the Non-PnP Onboarding section of the Cisco Catalyst SD-WAN Getting Started Guide, and see the bootstrap deployment section of the Cisco Catalyst SD-WAN: WAN Edge Onboarding guide.

- Manual deployment

  Note To configure the new device, you can use the configuration files that you saved earlier in part A.

  Note The manual deployment method requires installing a root certificate authority (CA) for the new device.

  For information, see the Cisco Catalyst SD-WAN: WAN Edge Onboarding guide.

  For information about installing a root CA, see the Enterprise Certificates section of the Cisco Catalyst SD-WAN Getting Started Guide.

Restore Cisco SD-WAN Manager

This article describes how to restore the vManage NMS in case the server on which the vManage NMS virtual machine (VM) is running fails. This article provides procedures for restoring a vManage NMS using two different VMware interfaces, vSphere Client and vSphere Web Client.

Caution When you restore vManage, any vManage certificates are reset to their original state. Any changes to the certificates are lost as a result of restoring vManage; and you would have to reconfigure any certificates that you had customized earlier.

The vManage NMS database is the repository for the overlay network device configurations, events, alarms, and monitoring information. The vManage NMS database is stored on a separate virtual hard disk on the vManage NMS server; specifically, it is stored on hard disk 2. Hard disk 1 contains the Viptela operating system software.

We recommend that you set up periodic crash-consistent backups of the vManage NMS database. (In a crash-consistent backup, all the VM's data are captured at exactly the same time.) Then, if the vManage NMS server fails, you simply create a new vManage NMS instance and attach the vManage NMS database backup to that instance.

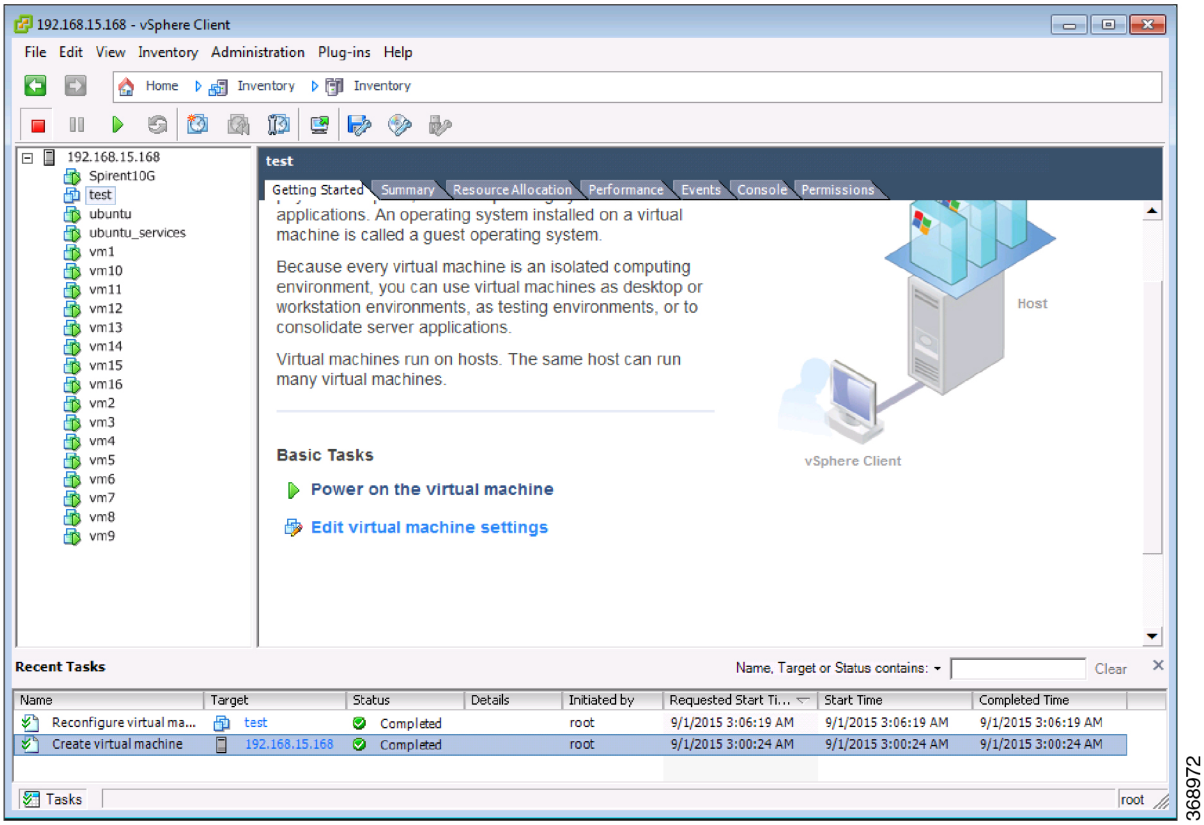
The procedures in this article each encompass both of the following scenarios:

- If you have a backup of the vManage NMS database, you create a new vManage NMS and attach the disk that contains your backup database.
- If you do not have a backup of the vManage database, you create a new vManage NMS and create a new virtual hard disk for the database.

Restore vManage NMS Using vSphere Client

1. Create a vManage VM instance. See Launch vSphere Client and Create a vManage VM Instance, in Create a vManage VM Instance .

2. In the left navigation bar of the vSphere Client screen, select the vManage VM instance you just created, and click Edit virtual machine settings.



applications. An operating system installed on a virtual machine is called a guest operating system.

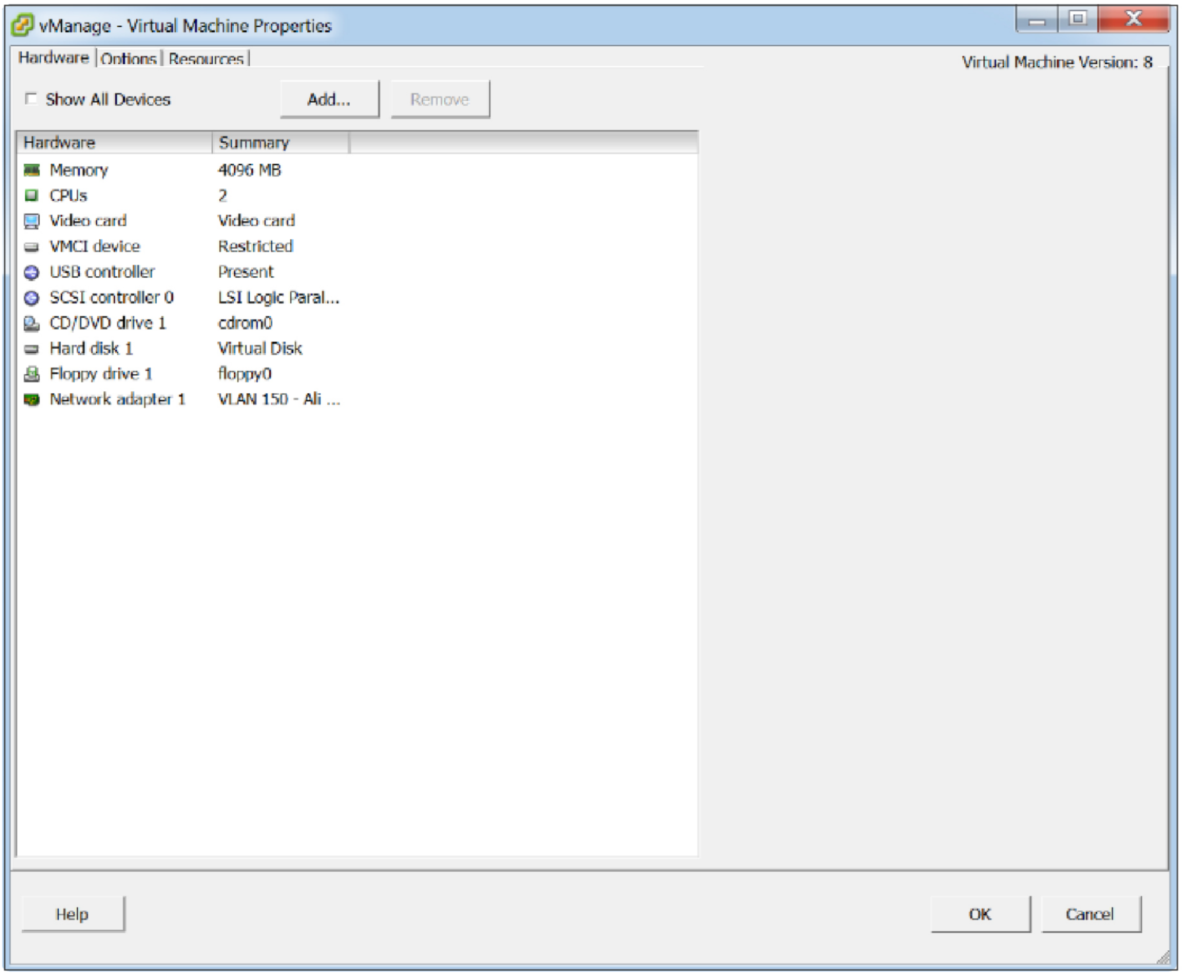
Because every virtual machine is an isolated computing environment, you can use virtual machines as desktop or workstation environments, as testing environments, or to consolidate server applications.

Virtual machines run on hosts. The same host can run many virtual machines.

Name	Target	Status	Details	Initiated by	Requested Start Ti...	Start Time	Completed Time
Reconfigure virtual ma...	test	Completed		root	9/1/2015 3:06:19 AM	9/1/2015 3:06:19 AM	9/1/2015 3:06:19 AM
Create virtual machine	192.168.15.168	Completed		root	9/1/2015 3:00:24 AM	9/1/2015 3:00:24 AM	9/1/2015 3:00:24 AM

The vManage - Virtual Machine Properties screen is displayed.

3. Click Add to add a new virtual disk, and click OK.

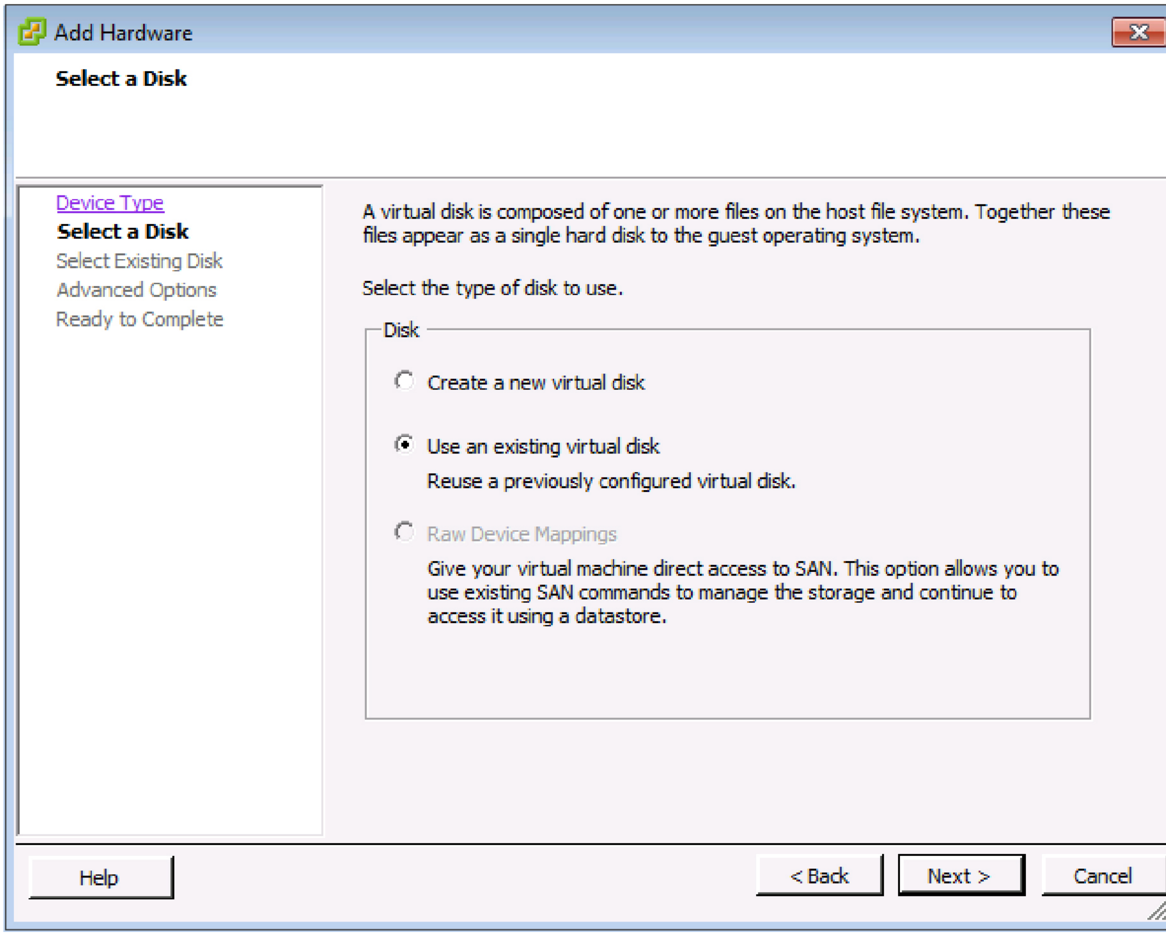


Hardware	Summary
Memory	4096 MB
CPUs	2
Video card	Video card
VMCI device	Restricted
USB controller	Present
SCSI controller 0	LSI Logic Paral...
CD/DVD drive 1	cdrom0
Hard disk 1	Virtual Disk
Floppy drive 1	floppy0
Network adapter 1	VLAN 150 - Ali ...

The Add Hardware window opens with the Select a Disk screen displayed. If you have a backup of the vManage NMS database, complete Step 4. If you do not have a backup database, skip to Step 5.

1. If you have a backup of the vManage NMS database, complete the following steps:

   a. In the Select a disk screen, select Use an existing virtual disk, and click Next.



Add Hardware

Select a Disk

A virtual disk is composed of one or more files on the host file system. Together these files appear as a single hard disk to the guest operating system.

Select the type of disk to use.

Disk

○ Create a new virtual disk

● Use an existing virtual disk

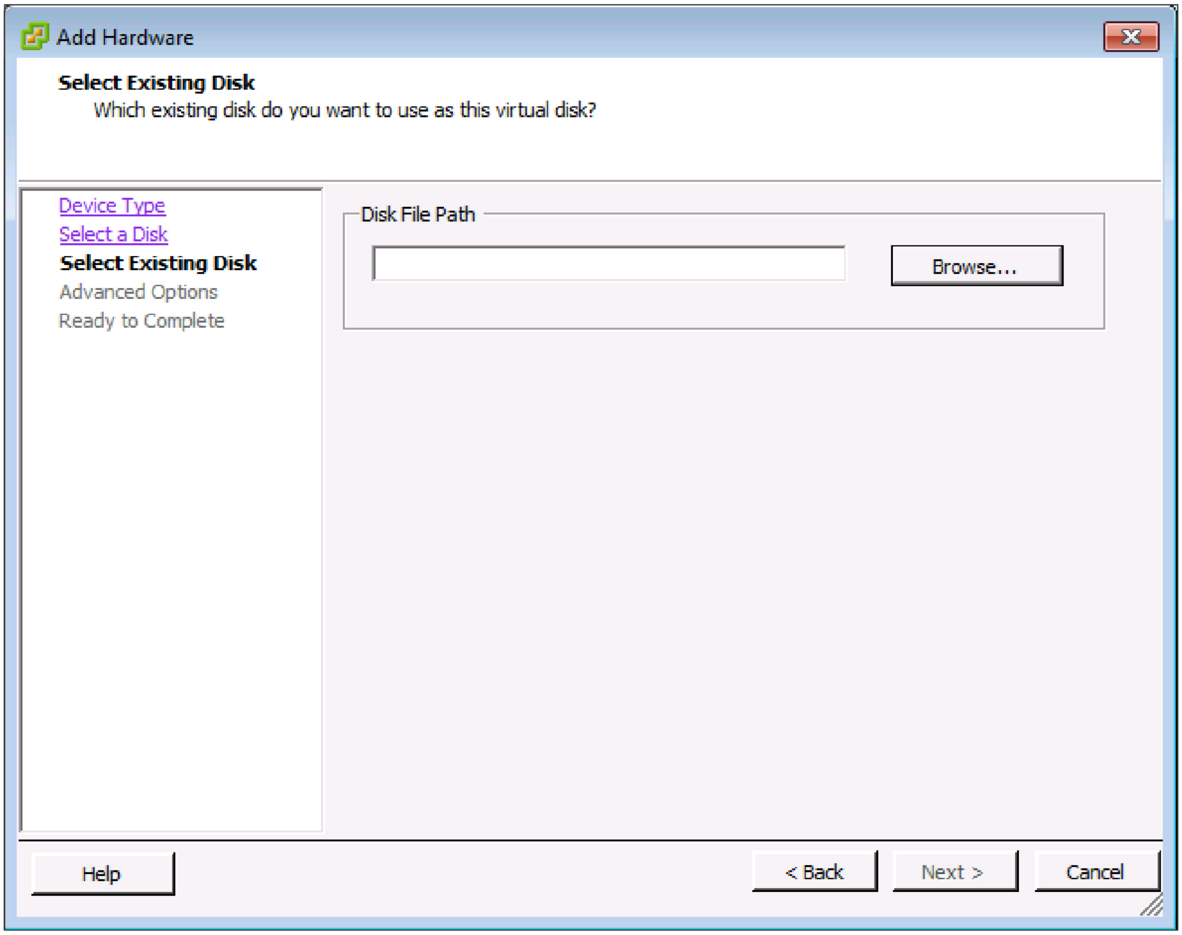
Reuse a previously configured virtual disk.

○ Raw Device Mappings

Give your virtual machine direct access to SAN. This option allows you to use existing SAN commands to manage the storage and continue to access it using a datastore.

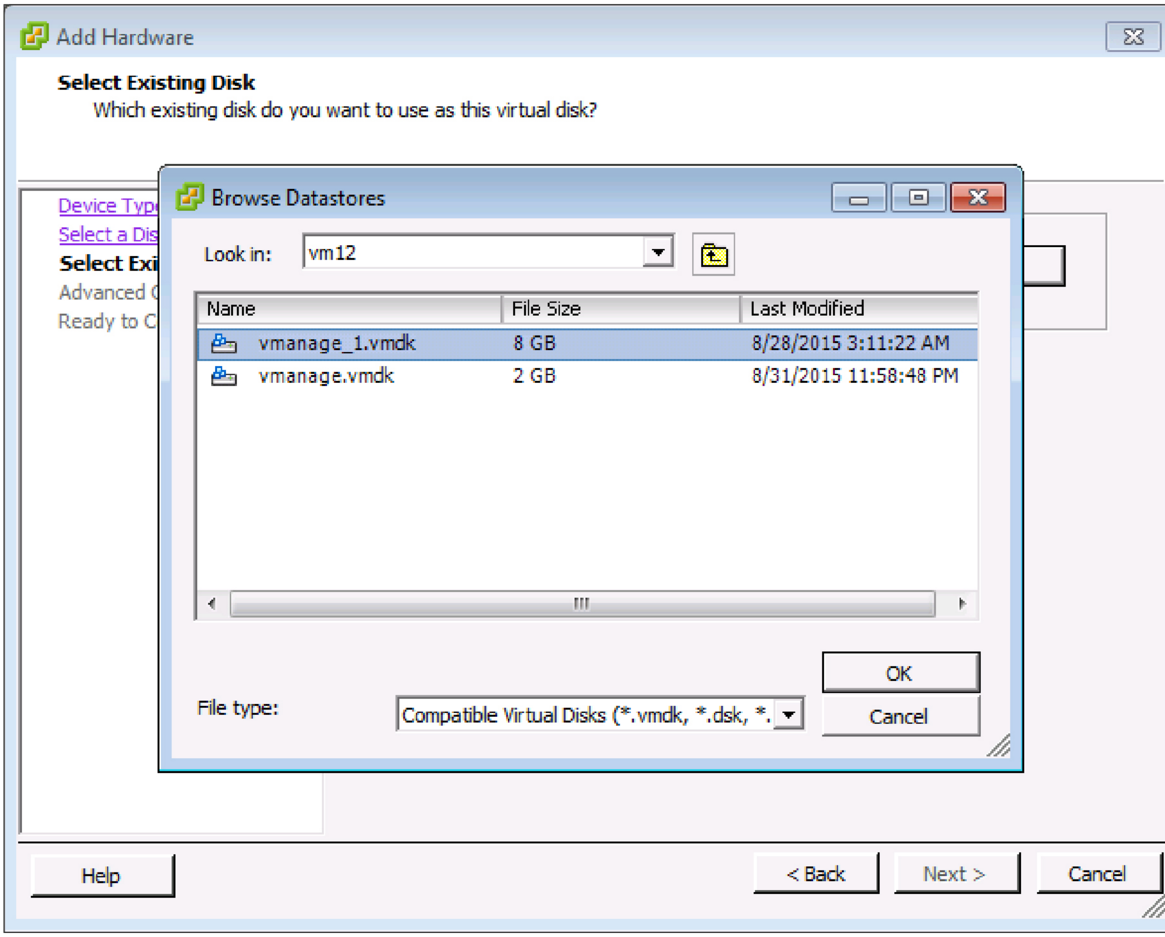
The Select Existing Disk screen is displayed.

b. Click Browse.



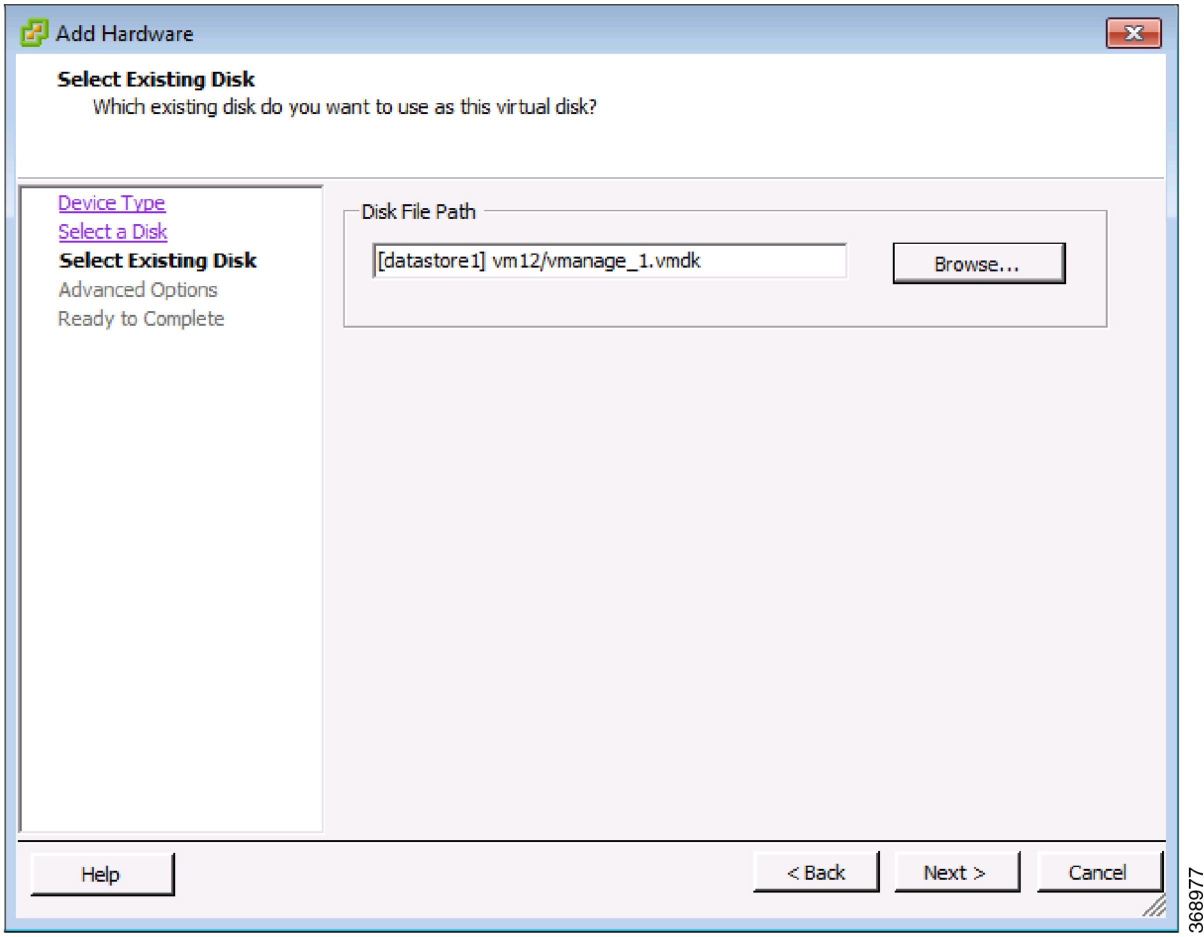
The Browse Datastores window opens and displays the datastores on the server

c. Navigate to the location of your backup database, and click OK.



Name	File Size	Last Modified
vmanage_1.vmdk	8 GB	8/28/2015 3:11:22 AM
vmanage.vmdk	2 GB	8/31/2015 11:58:48 PM

d. In the Select Existing Disk screen, click Next.


Add Hardware

Select Existing Disk

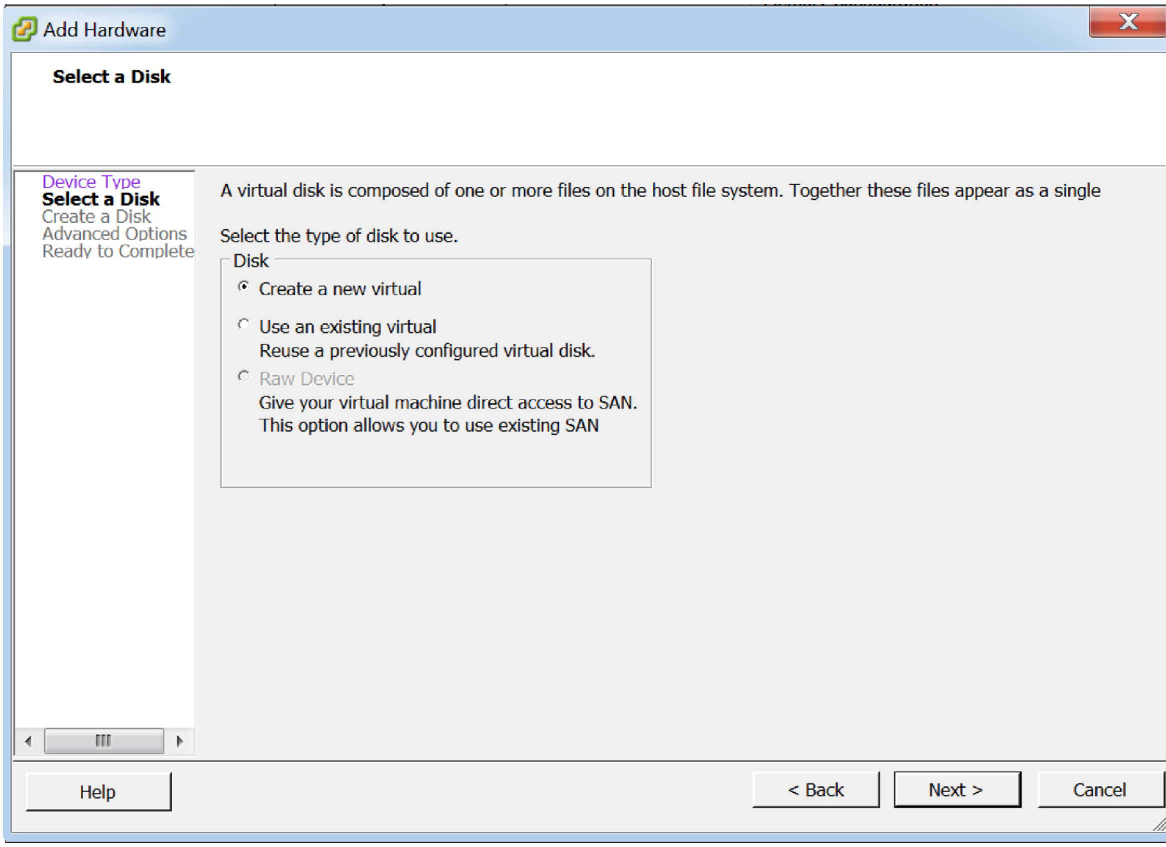
Which existing disk do you want to use as this virtual disk?

Disk File Path: [datastore1] vm12/vmanage_1.vmdk

The Advanced Options screen is displayed. Skip Step 5 and proceed to Step 6.

2. If you do not have an existing vManage NMS database, you must create a new virtual disk for the vManage database:

   a. In the Select a Disk screen, select Create a new virtual disk and click Next.


Add Hardware

Select a Disk

A virtual disk is composed of one or more files on the host file system. Together these files appear as a single

Select the type of disk to use.

Disk

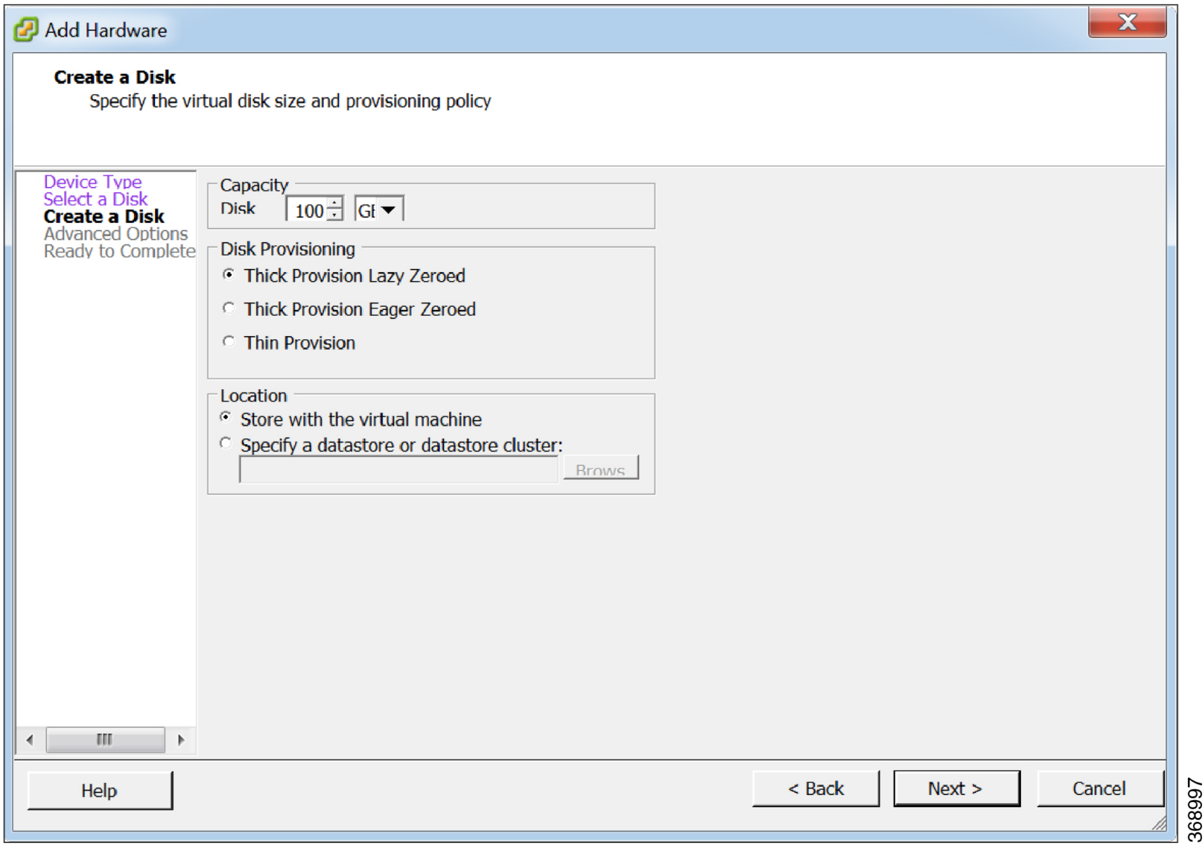
● Create a new virtual

○ Use an existing virtual
Reuse a previously configured virtual disk.

○ Raw Device
Give your virtual machine direct access to SAN.
This option allows you to use existing SAN

The Create a Disk screen is displayed.

a. Enter a disk capacity for the vManage database of 100 GB, and click Next.



Add Hardware

Create a Disk

Specify the virtual disk size and provisioning policy

Device Type
Select a Disk
Create a Disk
Advanced Options
Ready to Complete

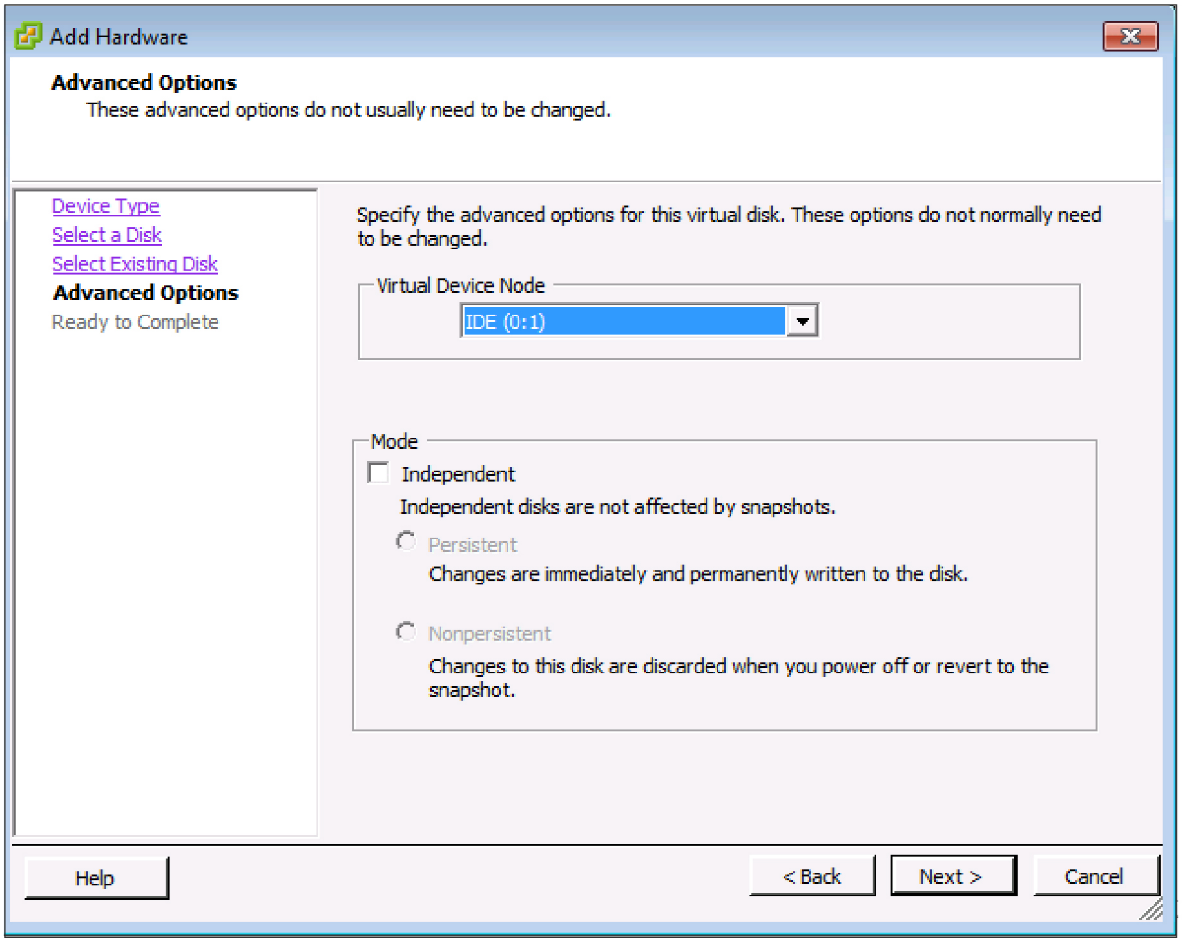
Capacity
Disk 100 GB

Disk Provisioning
● Thick Provision Lazy Zeroed
○ Thick Provision Eager Zeroed
○ Thin Provision

Location
● Store with the virtual machine
○ Specify a datastore or datastore cluster:

The Advanced Options screen is displayed.

3. In the Advanced Options screen, select IDE for the virtual device node, and click Next.



Advanced Options

These advanced options do not usually need to be changed.

Specify the advanced options for this virtual disk. These options do not normally need to be changed.

Virtual Device Node: IDE (0:1)

Mode

□ Independent

Independent disks are not affected by snapshots.

○ Persistent

Changes are immediately and permanently written to the disk.

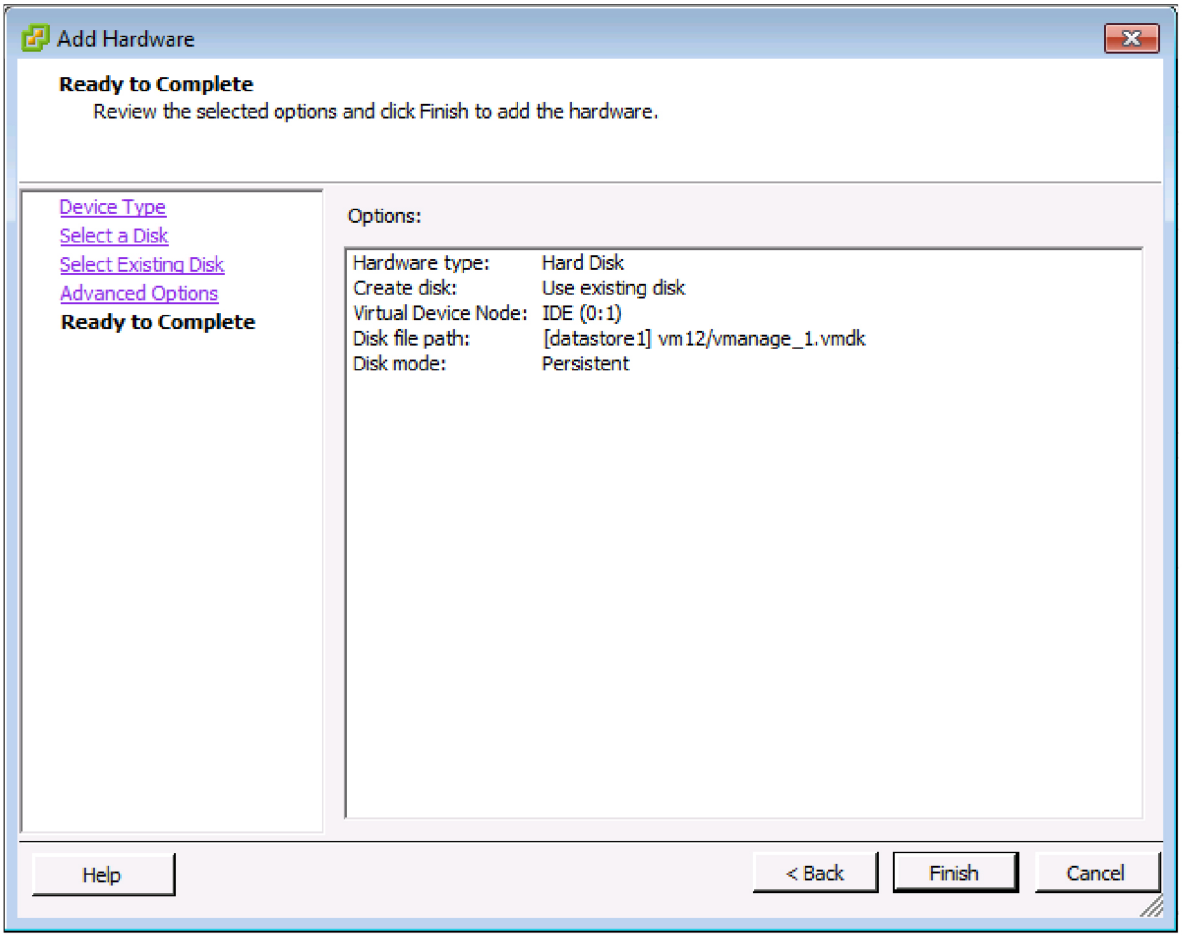
○ Nonpersistent

Changes to this disk are discarded when you power off or revert to the snapshot.

368974

The Ready to Complete screen is displayed.

4. Click Finish.



Add Hardware

Ready to Complete

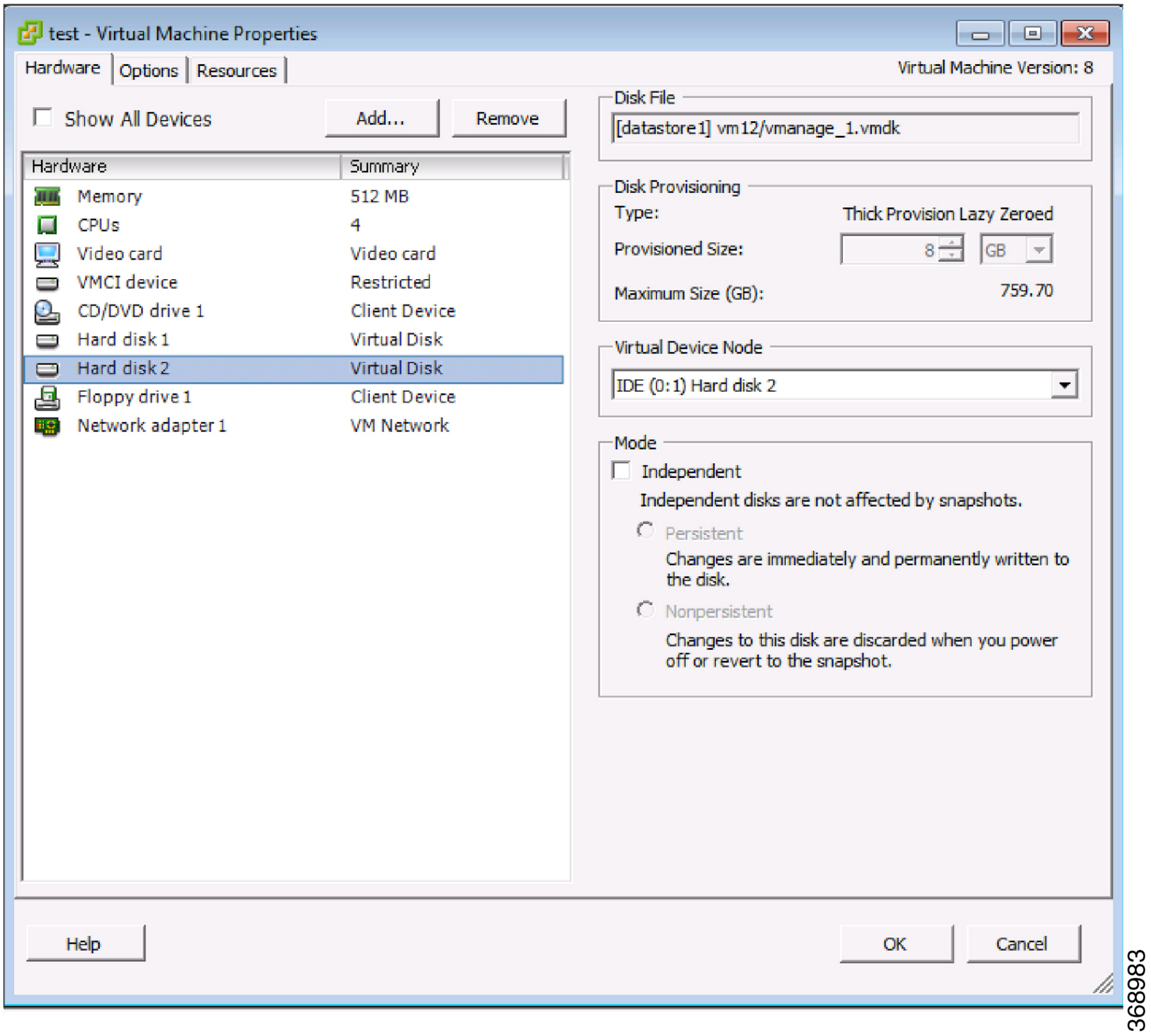
Review the selected options and click Finish to add the hardware.

Options:

Hardware type:	Hard Disk
Create disk:	Use existing disk
Virtual Device Node:	IDE (0:1)
Disk file path:	[datastore1] vm12/vmanage_1.vmdk
Disk mode:	Persistent

The data volume is added to the vManage NMS.

5. To verify that the new disk has been created, in the vManage Virtual Machine Properties screen, select the Hardware tab. Hard disk 2—the virtual disk that stores the vManage database—is shown in the hardware list.



test - Virtual Machine Properties

Hardware | Options | Resources

Virtual Machine Version: 8

□ Show All Devices   Add...   Remove

Hardware	Summary
Memory	512 MB
CPUs	4
Video card	Video card
VMCI device	Restricted
CD/DVD drive 1	Client Device
Hard disk 1	Virtual Disk
Hard disk 2	Virtual Disk
Floppy drive 1	Client Device
Network adapter 1	VM Network

Disk File

[datastore1] vm12/vmanage_1.vmdk

Disk Provisioning

Type: Thick Provision Lazy Zeroed

Provisioned Size: 8 GB

Maximum Size (GB): 759.70

Virtual Device Node

IDE (0:1) Hard disk 2

Mode

□ Independent

Independent disks are not affected by snapshots.

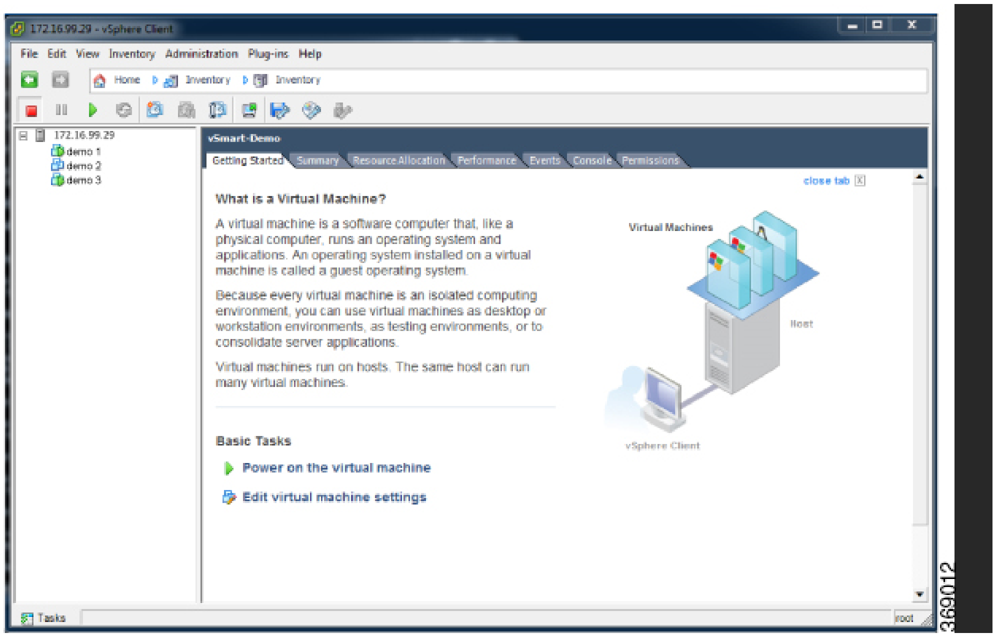
○ Persistent

Changes are immediately and permanently written to the disk.

○ Nonpersistent

Changes to this disk are discarded when you power off or revert to the snapshot.

6. In the left navigation bar of the vSphere Client, select the vManage VM instance you just created, and click Power on the virtual machine.



172.16.99.29 - vSphere Client
File Edit View Inventory Administration Plug-ins Help
Home Inventory Inventory
172.16.99.29
demo 1
demo 2
demo 3
vSmart-Demo
Getting Started Summary Resource Allocation Performance Events Console Permissions
close tab

What is a Virtual Machine?

A virtual machine is a software computer that, like a physical computer, runs an operating system and applications. An operating system installed on a virtual machine is called a guest operating system.

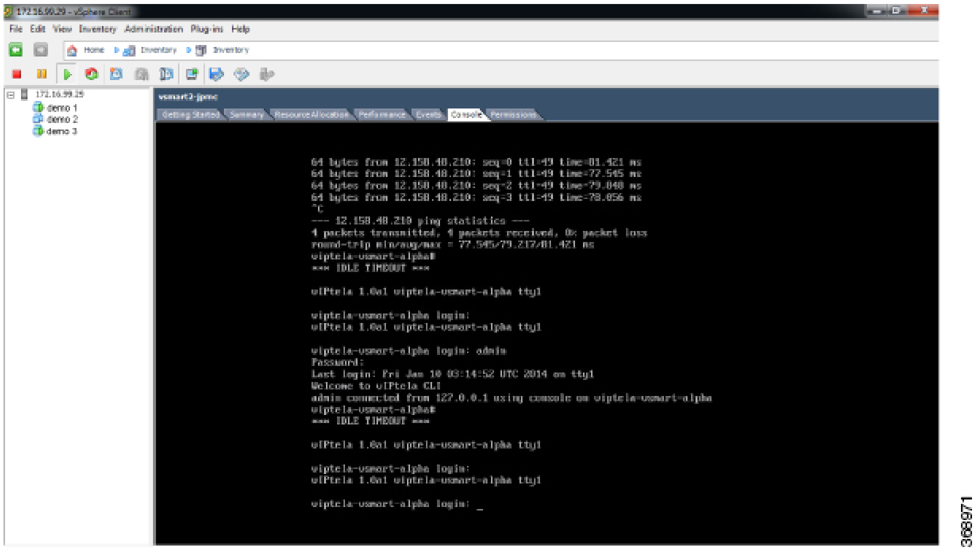
Because every virtual machine is an isolated computing environment, you can use virtual machines as desktop or workstation environments, as testing environments, or to consolidate server applications.

Virtual machines run on hosts. The same host can run many virtual machines.

Basic Tasks

The vManage virtual machine is powered on.

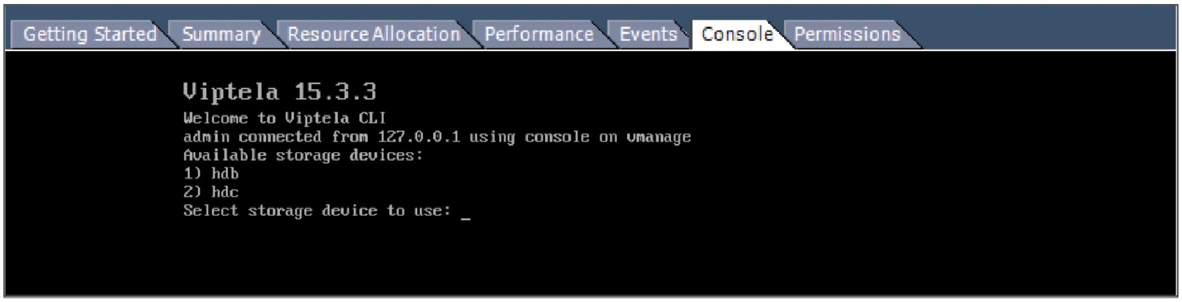
7. Select the Console tab to connect to the vManage console. The vManage console is displayed.



172.16.99.29 - vSphere Client
File Edit View Inventory Administration Plug-ins Help
Home Inventory Inventory
172.16.99.29
demo 1
demo 2
demo 3
vsmart2-jpmc
Getting Started Summary Resource Allocation Performance Events Console Permissions
368971

```
64 bytes from 12.158.48.210: seq=0 ttl=49 time=81.421 ms
64 bytes from 12.158.48.210: seq=1 ttl=49 time=77.545 ms
64 bytes from 12.158.48.210: seq=2 ttl=49 time=79.848 ms
64 bytes from 12.158.48.210: seq=3 ttl=49 time=78.056 ms
^C
--- 12.158.48.210 ping statistics ---
4 packets transmitted, 4 packets received, 0% packet loss
round-trip min/avg/max = 77.545/79.217/81.421 ms
viptela-vsmart-alpha#
*** IDLE TIMEOUT ***

vIPtela 1.0a1 viptela-vsmart-alpha tty1

viptela-vsmart-alpha login:
vIPtela 1.0a1 viptela-vsmart-alpha tty1

viptela-vsmart-alpha login: admin
Password:
Last login: Fri Jan 10 03:14:52 UTC 2014 on tty1
Welcome to vIPtela CLI
admin connected from 127.0.0.1 using console on viptela-vsmart-alpha
viptela-vsmart-alpha#
*** IDLE TIMEOUT ***

vIPtela 1.0a1 viptela-vsmart-alpha tty1

viptela-vsmart-alpha login:
vIPtela 1.0a1 viptela-vsmart-alpha tty1

viptela-vsmart-alpha login: _
```

8. At the vManage login prompt, log in with the default username, which is **admin**, and the default password, which is **admin**. The system prompts you to select the storage device to use.



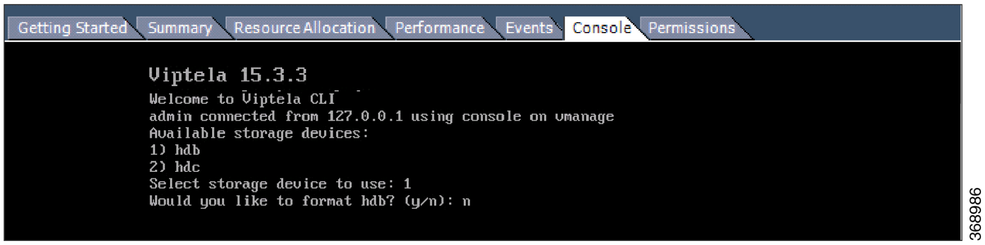
```
Viptela 15.3.3
Welcome to Viptela CLI
admin connected from 127.0.0.1 using console on vmanage
Available storage devices:
1) hdb
2) hdc
Select storage device to use: _
```

1. Select the appropriate storage device.
2. In response to the question

   `Would you like to format x?`

   :

   - If you attached an existing disk with a backup of the vManage database, type **n**.



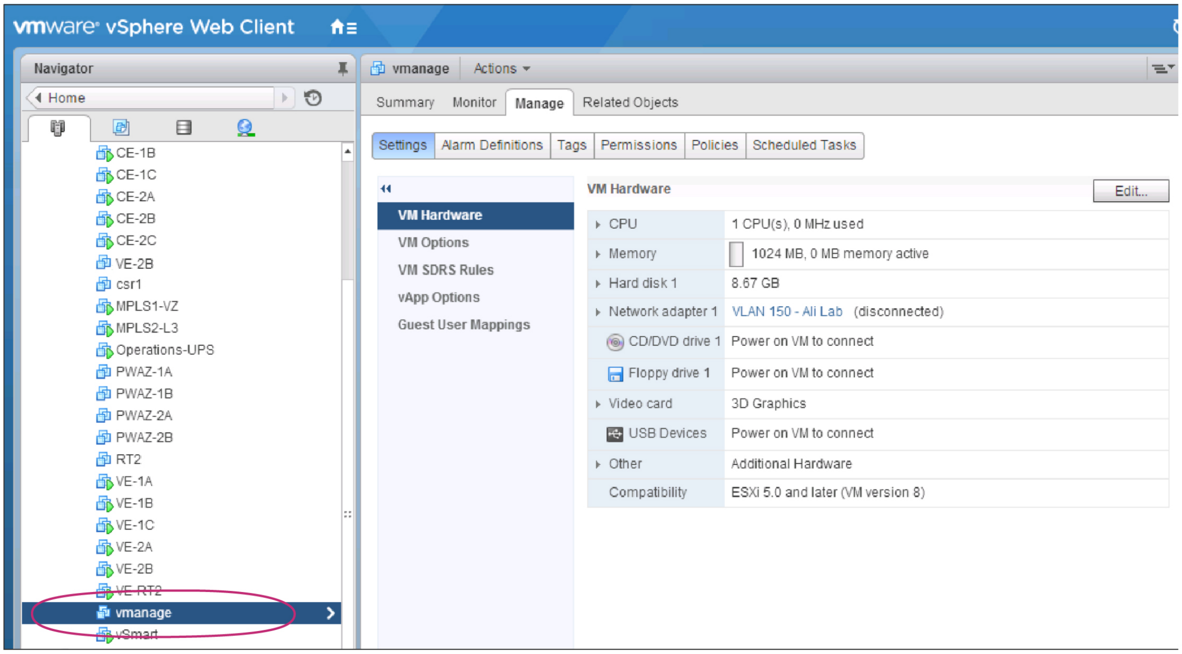
```
Viptela 15.3.3
Welcome to Viptela CLI
admin connected from 127.0.0.1 using console on vmanage
Available storage devices:
1) hdb
2) hdc
Select storage device to use: 1
Would you like to format hdb? (y/n): n
```

   - If you created a new virtual disk for the vManage database, type **y**.

3. Configure the vManage NMS. See vManage NMS Initial Configuration .
4. Generate a certificate for the new vManage NMS. See Generate vManage Certificate .
5. Add the serial number of the new vManage NMS to all the vBond orchestrators in the overlay network, as described later in this article.

Restore vManage NMS Using vSphere Web Client

1. Create a vManage VM instance. See Launch vSphere Client and Create a vManage VM Instance, in Create a vManage VM Instance .
2. Log in to the vSphere Web Client.
3. Select the VM instance for your vManage NMS.



VM Hardware

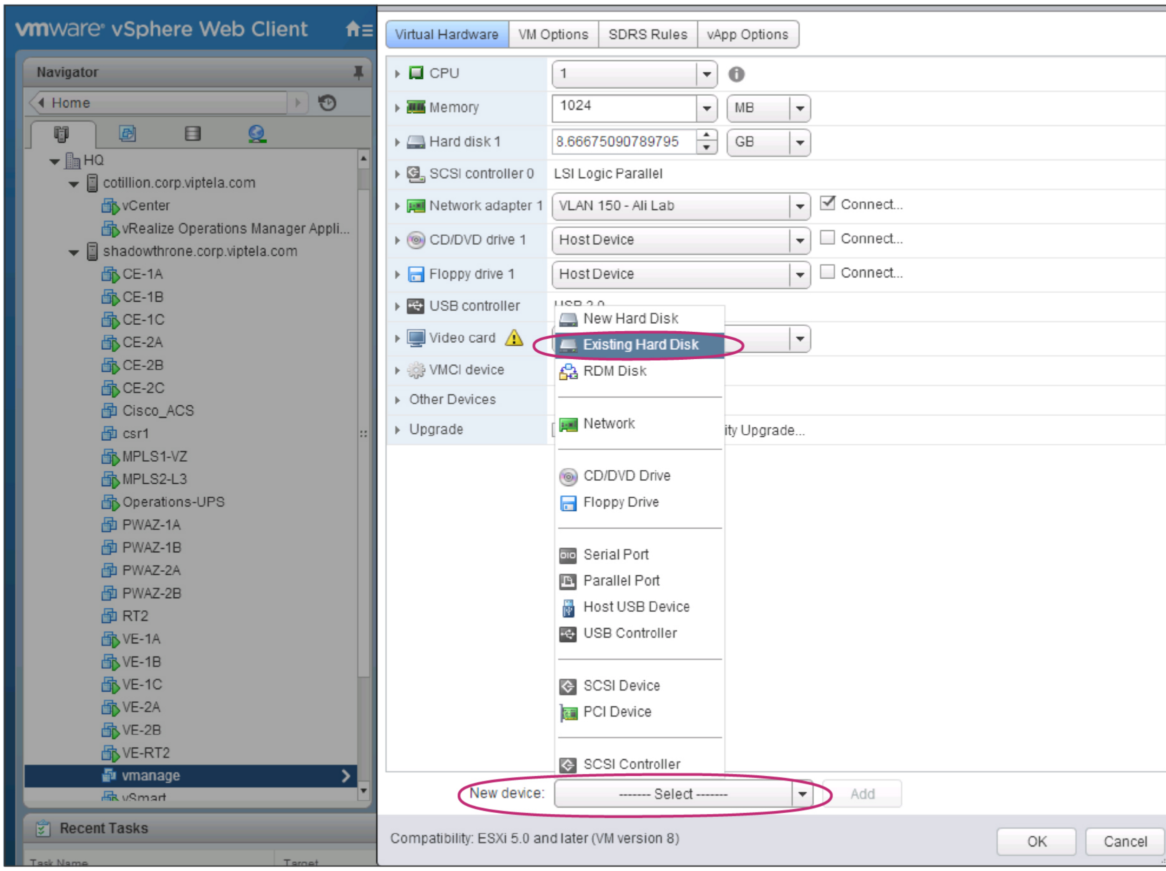
CPU	1 CPU(s), 0 MHz used
Memory	1024 MB, 0 MB memory active
Hard disk 1	8.67 GB
Network adapter 1	VLAN 150 - Ali Lab (disconnected)
CD/DVD drive 1	Power on VM to connect
Floppy drive 1	Power on VM to connect
Video card	3D Graphics
USB Devices	Power on VM to connect
Other	Additional Hardware
Compatibility	ESXi 5.0 and later (VM version 8)

368979

4. Click the Manage tab, and click Edit. The Edit Settings screen is displayed with the Virtual Hardware tab selected.

5. If you have a backup of the vManage NMS database, attach it to the new vManage VM. If you do not have a backup database, skip to step 6 and create a new virtual disk for the database.

   a. In the New device field at the bottom of the screen, click Select. A pop-up menu opens.



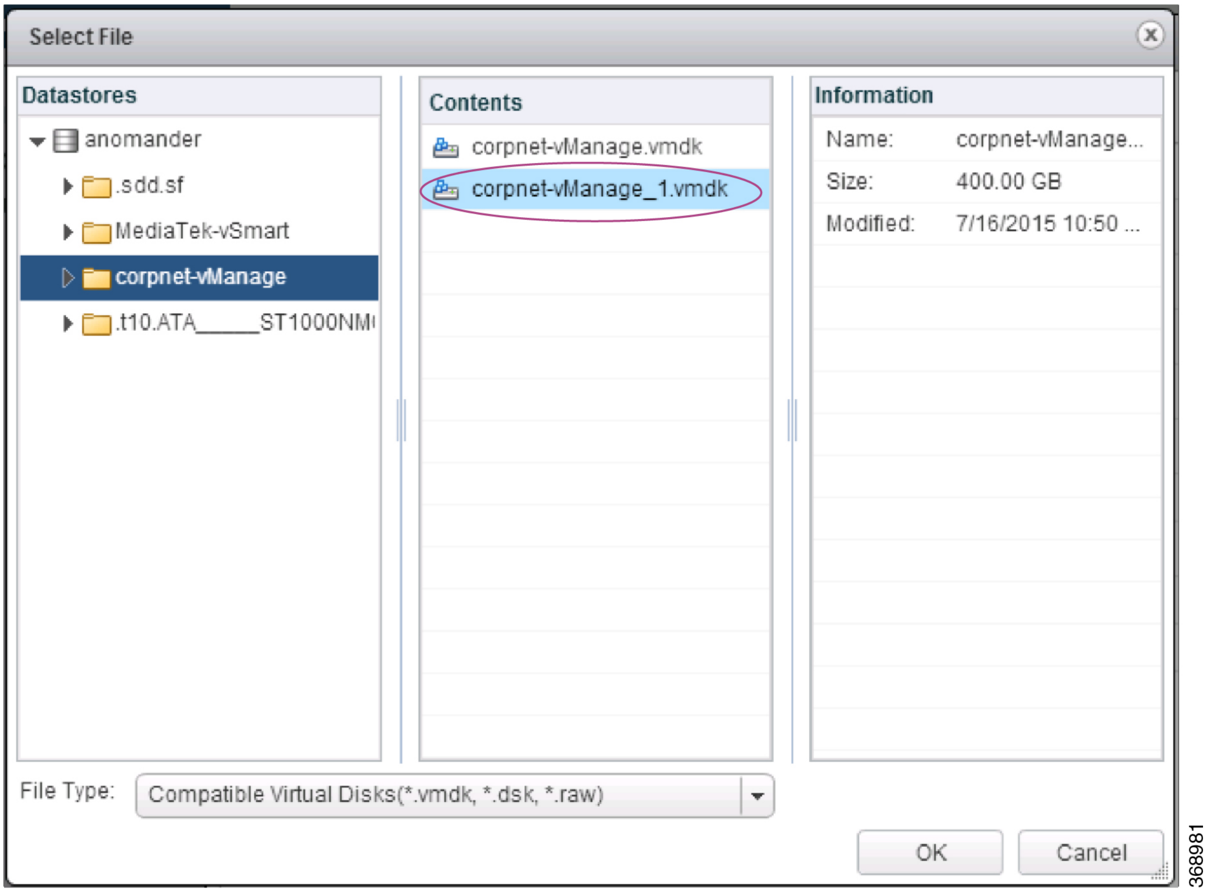
CPU	1		
Memory	1024	MB	
Hard disk 1	8.66675090789795	GB	
SCSI controller 0	LSI Logic Parallel		
Network adapter 1	VLAN 150 - Ali Lab		☑ Connect...
CD/DVD drive 1	Host Device		□ Connect...
Floppy drive 1	Host Device		□ Connect...
USB controller	USB 2.0		
Video card			
VMCI device			
Other Devices			
Upgrade			ity Upgrade...

New device: ------- Select -------

Compatibility: ESXi 5.0 and later (VM version 8)

b. From the pop-up menu, select Existing Hard Disk. The Select File window is displayed.

c. In the Select File window, under Datastores, navigate to and select the appropriate .vmdk file, and click



Name: corpnet-vManage...

Size: 400.00 GB

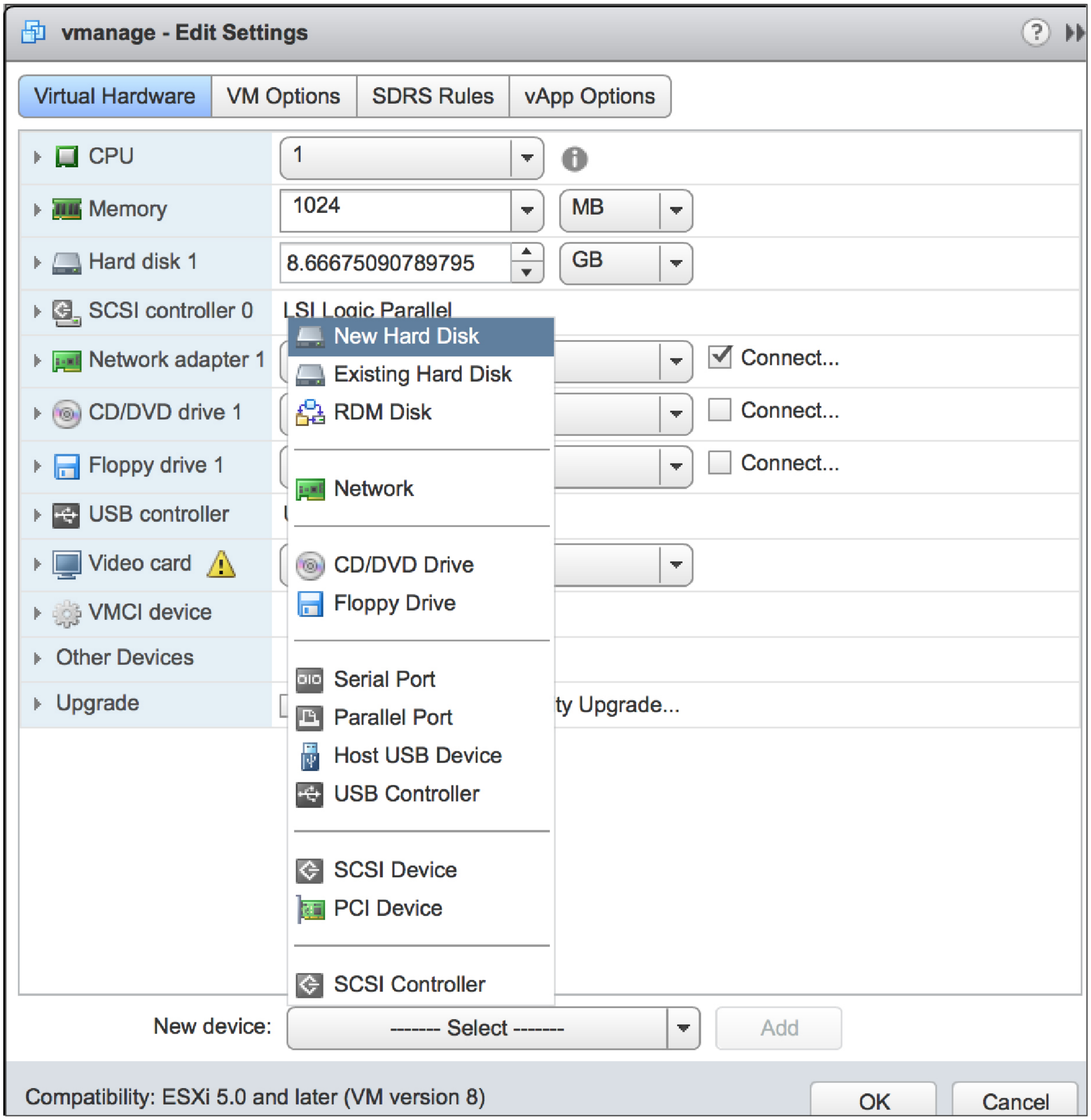
Modified: 7/16/2015 10:50 ...

File Type: Compatible Virtual Disks(*.vmdk, *.dsk, *.raw)

6. If you do not have an existing vManage NMS database, create a new virtual disk for the vManage NMS database:

   a. In the New device field at the bottom of the screen, click Select. A pop-up menu opens.

   b. From the pop-up menu, select New Hard Disk.



vmanage - Edit Settings

CPU: 1

Memory: 1024 MB

Hard disk 1: 8.66675090789795 GB

SCSI controller 0: LSI Logic Parallel

Network adapter 1: ☑ Connect...

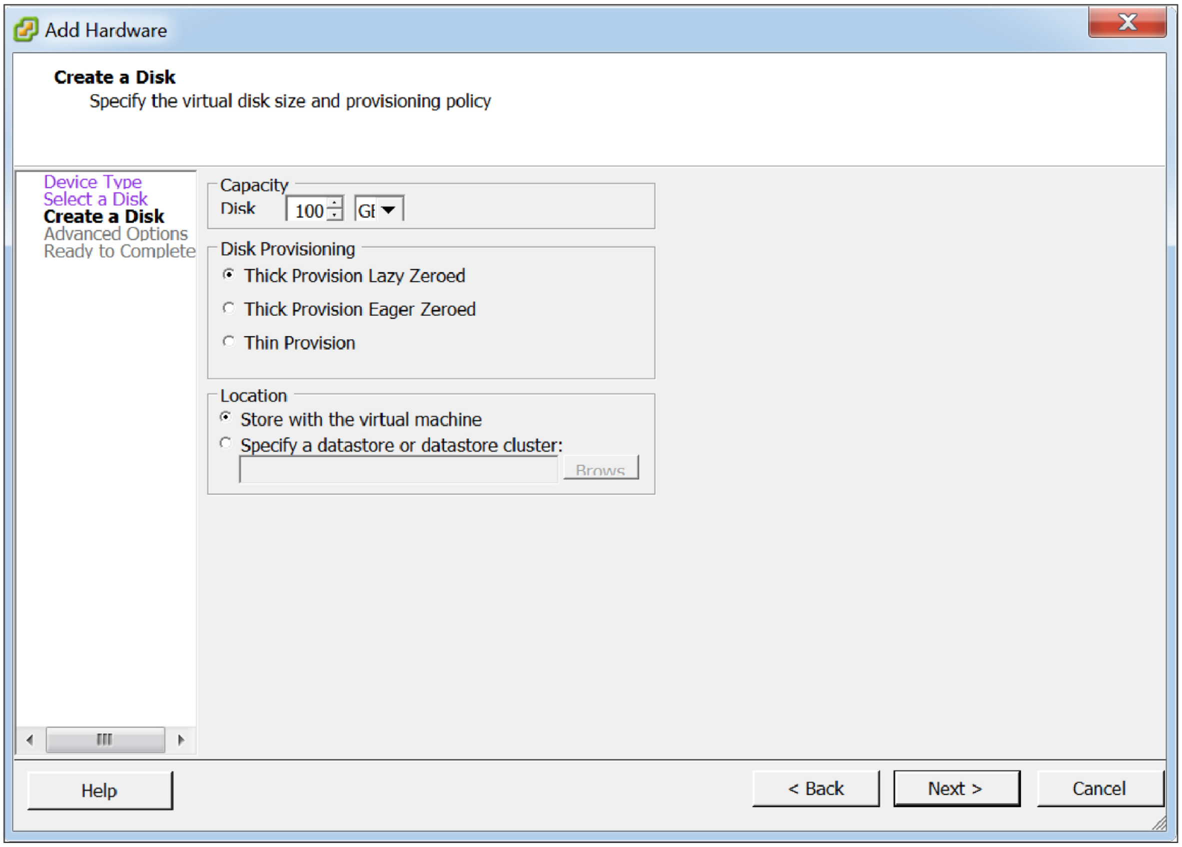
CD/DVD drive 1: □ Connect...

Floppy drive 1: □ Connect...

New device: ------- Select -------

Compatibility: ESXi 5.0 and later (VM version 8)

c. In the New Hard Disk field, enter a size for the new virtual disk of 100 GB.



Add Hardware

Create a Disk

Specify the virtual disk size and provisioning policy

Device Type
Select a Disk
Create a Disk
Advanced Options
Ready to Complete

Capacity

Disk 100 GB

Disk Provisioning

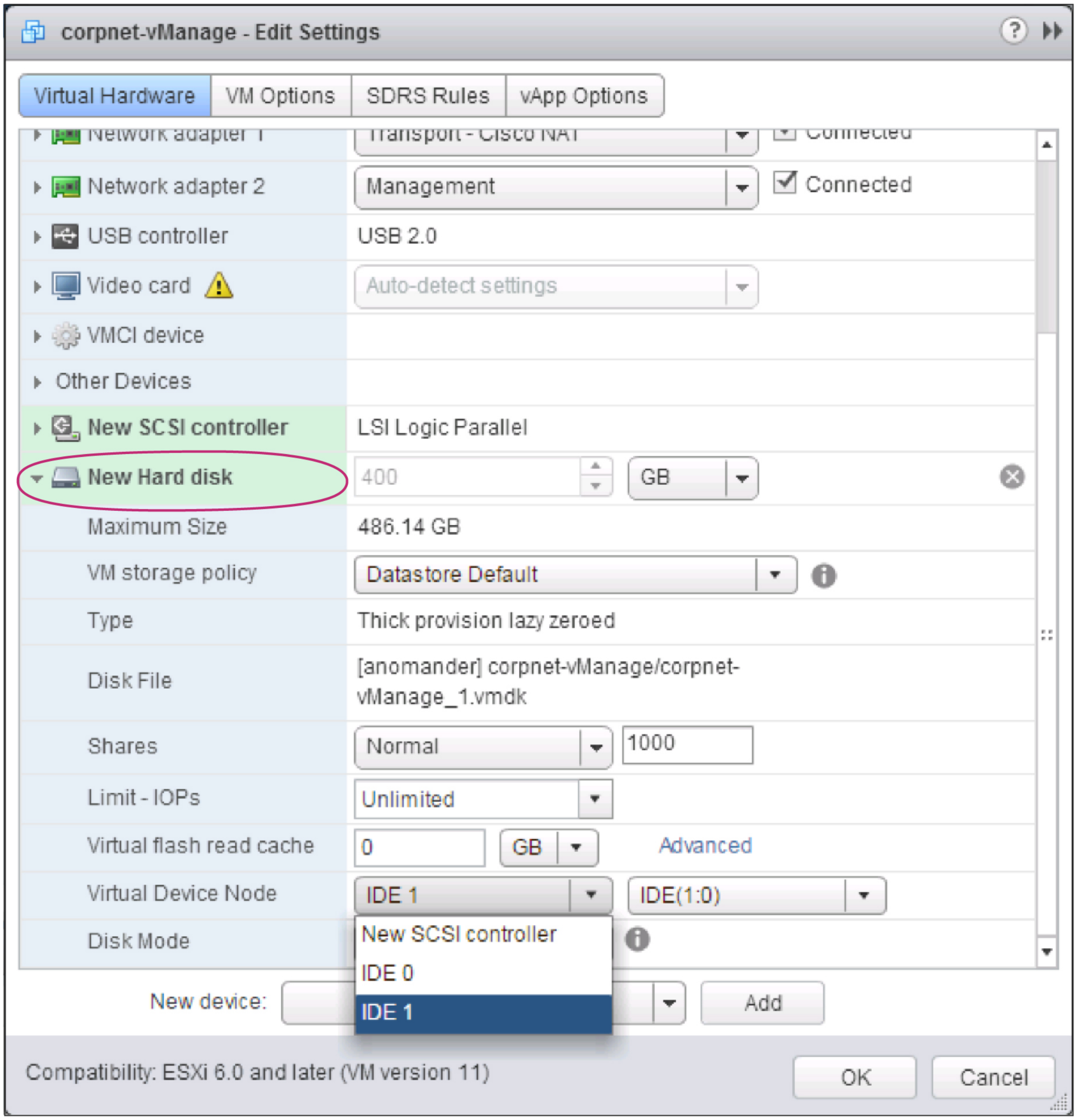
● Thick Provision Lazy Zeroed
○ Thick Provision Eager Zeroed
○ Thin Provision

Location

● Store with the virtual machine
○ Specify a datastore or datastore cluster:

d. Click OK.

7. From the New Hard Disk section, under Virtual Device Node, select IDE 1, and click OK.



corpnet-vManage - Edit Settings

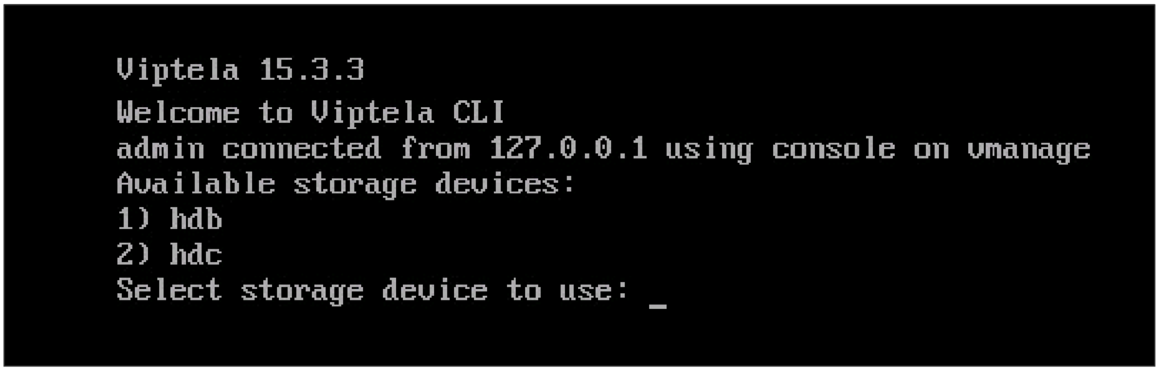
Virtual Hardware | VM Options | SDRS Rules | vApp Options

Network adapter 1	Transport - Cisco NAT	☑ Connected
Network adapter 2	Management	☑ Connected
USB controller	USB 2.0	
Video card ⚠	Auto-detect settings	
VMCI device		
Other Devices		
New SCSI controller	LSI Logic Parallel	
New Hard disk	400 GB	
Maximum Size	486.14 GB	
VM storage policy	Datastore Default	
Type	Thick provision lazy zeroed	
Disk File	[anomander] corpnet-vManage/corpnet-vManage_1.vmdk	
Shares	Normal	1000
Limit - IOPs	Unlimited	
Virtual flash read cache	0 GB	Advanced
Virtual Device Node	IDE 1	IDE(1:0)
Disk Mode		

1. From the vSphere Web Client Navigator, select the datacenter that is hosting the VM and then select Open Console from the menu. The vManage console is displayed.

2. At the vManage login prompt, log in with the default username, which is **admin**, and the default password, which is **admin**. The system prompts you to select the storage device to use.

3. Select the appropriate storage device:



```
Viptela 15.3.3
Welcome to Viptela CLI
admin connected from 127.0.0.1 using console on vmanage
Available storage devices:
1) hdb
2) hdc
Select storage device to use: _
```

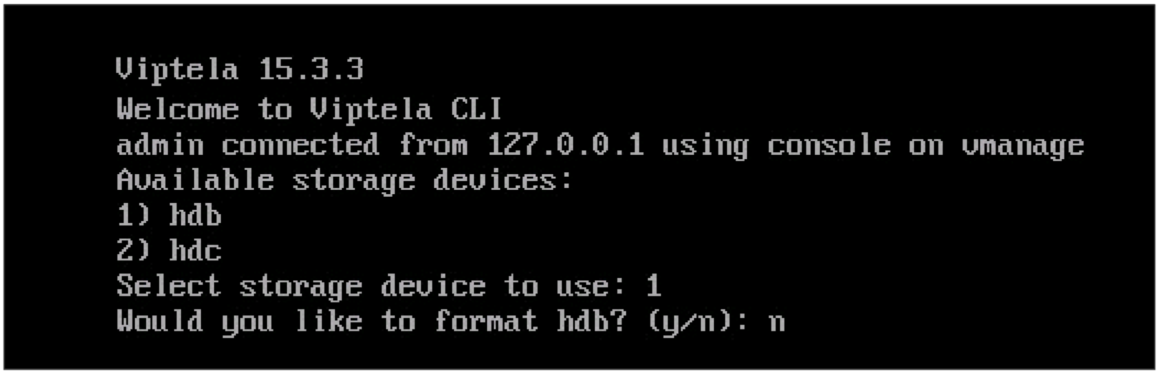
368985

1. In response to the question

   `Would you like to format *x*?`

   :

   - If you attached an existing disk with a backup of the vManage database, type n.

   ```
   Viptela 15.3.3
   Welcome to Viptela CLI
   admin connected from 127.0.0.1 using console on vmanage
   Available storage devices:
   1) hdb
   2) hdc
   Select storage device to use: 1
   Would you like to format hdb? (y/n): n
   ```

   368987

   - If you created a new virtual disk for the vManage database, type yto reformat the disk.

2. Configure the vManage NMS. See vManage NMS Initial Configuration .
3. Generate a certificate for the new vManage NMS. See Generate vManage Certificate .
4. Add the serial number of the new vManage NMS to all the vBond orchestrators in the overlay network, as described below.

Add vManage NMS Serial Number to vBond Orchestrators

When you generate a certificate for a new vManage NMS with a new database, the serial number from the certificate is automatically sent to the vBond orchestrators. However, when you create a new vManage NMS and attach an existing database, you must manually send the new serial number to each vBond orchestrator to overwrite the serial number of the previous vManage NMS.

If you have the management IP address for the vBond orchestrator, you can use vManage NMS to send the serial number to each vBond orchestrator. Otherwise, you must use the CLI.

If you have the management IP address for the vBond orchestrator:

1. From the Cisco vManage menu, choose **Configuration** > **Devices**.

2. Click **Controllers**.
3. Choose the desired Cisco vBond orchestrator.
4. For the desired Cisco vBond orchestrator, click **...** and choose **Edit**.
5. Enter the management IP address, username, and password for the vBond orchestrator.
6. Click **Save**.
7. From the Cisco vManage menu, choose **Configuration** > **Certificates**.
8. In the Certificates window, click **Controllers**.
9. Click **Send to vBond** to send the new Cisco vManage certificate to the Cisco vBond orchestrator.

If you do not have the management IP address for the vBond orchestrator:

1. Find the serial number for the new vManage NMS:
    a. From the Cisco vManage menu, choose **Configuration** > **Certificates**.
    b. In the Certificates window, click **Controllers**.
    c. Choose the Cisco vManage instance and make a note of the serial number that is displayed in the **Certificate Serial** column.
2. From the Cisco vManage menu, choose **Tools** > **SSH Terminal**.
3. Choose the desired Cisco vBond orchestrator instance in the left pane, and enter the user name and password to log in to it.
4. Enter the following command to send the certificate serial number for the new Cisco vManage instance to the Cisco vBond orchestrator, where number is the serial number that you noted in Step 1:

    request vsmart add serial-num *number*

Restrict Network Access for a Device

Table 25: Feature History

Feature Name	**Release Information**	**Description**
Geofencing	Cisco IOS XE Catalyst SD-WAN Release 17.6.1a Cisco vManage Release 20.6.1	If the location of the device goes beyond its geographical boundary, you can restrict network access to the device using Cisco SD-WAN Manager operational commands. For more information, see the Cisco Catalyst SD-WAN Monitor and Maintain Configuration Guide.
Added Support for Configuring Geofencing Using a **Cisco System** Feature Template	Cisco IOS XE Catalyst SD-WAN Release 17.7.1a Cisco vManage Release 20.7.1	You can configure the geographical boundary of a device using a **Cisco System** feature template.

Feature Name	Release Information	Description
Added Support for LTE Advanced NIM Modules	Cisco IOS XE Catalyst SD-WAN Release 17.8.1a	Added support for Long-Term Evolution (LTE) Advanced Network Interface Modules (NIMs) for Cisco ISR 4000 routers.

Make Your Device Invalid

You can make your device invalid should your device go beyond its target location.

1. From the Cisco Catalyst SD-WAN menu, choose **Tools** > **Operational Commands**.
2. For the desired device, click **…** and choose **Make Device Invalid**.
3. Confirm that you want to make the device invalid and click **OK**.

Bring Your Device Back to Valid State

1. From the Cisco Catalyst SD-WAN menu, choose **Configuration** > **Certificates**.
2. Choose the invalid device and look for the **Validate** column.
3. Click **Valid**.
4. Click **Send to Controllers** to complete the action.

Stop Data Traffic

You can stop data traffic to your device should your device exceed its target location.

1. From the Cisco Catalyst SD-WAN menu, choose **Tools** > **Operational Commands**.
2. For the desired device, click **…** and choose **Stop Traffic**.
3. Confirm that you want to stop data traffic to your device and click **OK**.

Perform a Factory Reset

If your device is outside its target boundary, you may need to perform a factory reset of your device.

Note The **Factory Reset** operational command is supported only for Cisco ISR 1000 series and Catalyst 8K devices.

For more information on geofencing, see the *Cisco IOS XE Catalyst SD-WAN Systems and Interfaces Configuration Guide*.

1. From the Cisco Catalyst SD-WAN menu, choose **Tools** > **Operational Commands**.
2. For the desired device, click **…** and choose **Factory Reset**.
3. Choose one of the following options:
    - **Retain License**: Wipes all the device settings and partitions except for licenses. **Retain License** is a sub option to the factory-reset option.

- **Full Wipe** factory-reset: Wipes all the device settings and partitions.

Note After a full-wipe operation, the device can only be booted up using a USB or TFTP.

4. Click **Reset**.

Run a Report

Table 26: Feature History

Feature Name	Release Information	Description
Reports	Cisco vManage Release 20.10.1 Cisco IOS XE Catalyst SD-WAN Release 17.10.1a	You can schedule a report, download it as a PDF document, and receive it as an email. The **Reports** menu has been added to Cisco SD-WAN Manager.

Before You Begin

Ensure that the email settings are configured in Cisco SD-WAN Manager for scheduling reports. This step is required only if you want to schedule the report to be emailed.

Configure Email Settings

1. From the Cisco SD-WAN Manager menu, choose **Administration** > **Settings**.
2. Click **Edit** adjacent to the **Alarm Notifications** option.
3. Click **Enabled**.
4. Check the **Email Settings** check box.
5. Choose the security level for sending the email notifications. The security level can be **None**, **SSL**, or **TLS**.
6. In the **SMTP Server** field, enter the name or the IP address of the SMTP server to receive the email notifications.
7. In the **SMTP Port** field, enter the SMTP port number. For no security, the default port is 25; for SSL it is 465; and for TLS it is 587.
8. In the **From address** field, enter the full email address to include as the sender in email notifications.
9. In the **Reply to address** field, enter the full email address to include in the Reply-To field of the email. This address can be a no-reply address, such as noreply@cisco.com.
10. Check the **Use SMTP Authentication** check box to enable SMTP authentication to the SMTP server.

Enter the username and password to use for SMTP authentication. The default user email suffix is appended to the username. The password that you type is hidden.

11. Click **Save**.

Run a Report

1. From the Cisco SD-WAN Manager menu, choose **Reports**.
2. Click **Report Templates**.

Note In the **Executive Summary Report** section, click the header to view a sample report. Use the scroll bar to review the entire report. The following data is presented:

- Data metrics and summaries
- Graphical representation of the data (including heat maps, pie charts, and bar charts)

3. In the **Executive Summary Report** section, click **Create Report** to configure parameters to build a report.

Field	Description
Enter Report Name	Enter a name for the report
Site	Click **Edit** adjacent to this field, and choose the sites for which you want to generate the report.
Time Frame	Choose the time range for which you want to generate the report. Values: 7 Days, 30 days Default: 30 days
Email Report	Check this check box if you want to schedule the report to be emailed.
Enter Email	Enter up to a maximum of five email addresses.
Schedule	Click one of the schedule options. Values: Run Now, Run Later (One-Time), Run Recurring • If you click **Run Later (One-Time)**, enter the **Start Date** and **Start Time**. • If you click **Run Recurring**, choose the frequency from the **Repeats** drop-down list, and enter the **Start Date** and **Start Time**.

4. Click **Create Report**.

Run a Traceroute

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.1 and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

2. To choose a device, click the device name in the **Hostname** column.
3. Click **Troubleshooting** in the left pane.
4. In the **Connectivity** area, click **Trace Route**.
5. In the **Destination IP** field, enter the IP address of the corresponding device in the network.
6. From the **VPN** drop-down list, choose a VPN to use to reach the device.
7. From the **Source/Interface for VPN** drop-down list, choose the interface to use to send the traceroute probe packets.
8. Click **Advanced Options**.
9. In the **Size** field, enter the size of the traceroute probe packets, in bytes.
10. Click **Start** to trigger a traceroute to the requested destination.

The lower part of the right pane displays the following information:

- Raw output of the path the traceroute probe packets take to reach the destination.
- Graphical depiction of the path the traceroute probe packets take to reach the destination.

From Cisco vManage Release 20.10.1, the **Trace Route** option can be accessed using one of these methods:

- Choose **Monitor** > **Devices**, click **…** adjacent to the device name, and choose **Trace Route**.
- In the **Site Topology** page, click a device or tunnel name, and then click **Trace Route** in the right navigation pane.

Security Monitoring

Table 27: Feature History

Feature Name	Release Information	Description
Enhanced Security Monitoring on Cisco Catalyst SD-WAN	Cisco IOS XE Catalyst SD-WAN Release 17.5.1a Cisco vManage Release 20.5.1	You can view traffic, CPU, memory usage, health and reachability of UTD.

View Traffic, CPU, and Memory Usage

1. From the Cisco SD-WAN Manager **Monitor** > **Devices** page, select the device.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager **Monitor** > **Network** page, select the device.

2. Under **Security Monitoring** in the left pane, select one of the UTD features **Intrusion Prevention**, **URL Filtering**, and so on.
3. By default, the traffic counter graph is displayed.

   You can also customize the time range to see traffic usage for specific time ranges such as **Real Time**, **1h**, **3h** or even specify a **Custom** time range. By default, a time range of **24h** is displayed. The time range cannot be more than 365 days.
4. To view CPU or memory usage, do the following:
   - To view CPU usage, click **UTD Stats: CPU Usage**.
   - To view memory usage, click **UTD Stats: Memory Usage**.

View the Health and Reachability of UTD

1. From the Cisco SD-WAN Manager **Monitor** > **Devices** page, select the device.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager **Monitor** > **Network** page, select the device.
2. Under **Security Monitoring** in the left pane, select one of the UTD features such as **Intrusion Prevention**, **URL Filtering**, and so on.
3. For all features, the health of UTD is displayed as one of the following:
   - Down: For example: UTD is not configured.
   - Green: UTD is healthy.
   - Yellow: For example: High memory usage.
   - Red: For example: One or more Snort instances are down.

   If you configured UTD on the device and the status is not green, contact Cisco TAC for assistance.
4. Depending on the UTD feature that you choose, the following additional information is displayed:

UTD Feature	Status
Intrusion Prevention	Package Version IPS Last Updated Reason for last update status
URL Filtering	Cloud Reachability
Advanced Malware Protection	AMP Cloud Reachability Status TG Cloud Reachability Status
Umbrella DNS Redirect	Umbrella Registered VPNs DNSCrypt

SSH Terminal

Use the SSH Terminal screen to establish an SSH session to a router. From an SSH session, you can issue CLI commands on a router.

Establish an SSH Session to a Device

To establish an SSH session to a device:

1. From the Cisco SD-WAN Manager menu, choose **Tools** > **SSH Terminal**.
2. Select the device on which you wish to collect statistics:
   a. Select the device group to which the device belongs.
   b. If needed, sort the device list by its status, hostname, system IP, site ID, or device type.
   c. Click the device to select it.
3. Enter the username and password to log in to the device.

You can now issue CLI commands to monitor or configure the device.

Upgrade Cisco Catalyst SD-WAN Manager Cluster

Table 28: Feature History

Feature Name	Release Information	Description
Cisco SD-WAN Manager Cluster Upgrade	Cisco IOS XE Catalyst SD-WAN Release 17.3.1a Cisco vManage Release 20.3.1	This feature outlines the upgrade procedure for Cisco vManage servers in a cluster to Cisco vManage Release 20.3.1. To upgrade Cisco vManage nodes in a Cluster, use the **Tools** > **SSH Terminal** screen.

This section describes how to upgrade Cisco SD-WAN Manager in a cluster.

You can upgrade directly from Cisco vManage 20.3.1 or later releases to Cisco vManage Release 20.6.1. To upgrade from earlier releases, first upgrade to Cisco vManage 20.4.2 or Cisco vManage Release 20.5.1.

If you are upgrading a Cisco SD-WAN Manager cluster deployment from Cisco vManage Release 20.3.1 or later to Cisco vManage Release 20.5.1 or later, you must do it through the CLI.

Before You Begin

Before you upgrade Cisco SD-WAN Manager nodes to Cisco vManage Release 20.6.1 or later releases, verify the following:

- Ensure that the internal user account vmanage-admin is not locked for any server that you are upgrading.

  You can check the status of this admin account by pushing a template to the devices that are connected to the server. The push fails if the account is locked. In such a scenario, you can unlock the account by using the **request aaa unlock-user vmanage-admin** command.

- Ensure that PKI keys have been exchanged between the servers that you are upgrading.

  To do so, ensure that the control connections are in the UP state on the servers and restart the application server.

- Ensure that the out-of-band IP address of each server is reachable.
- Ensure that the Cisco SD-WAN Manager UI is accessible on all servers in the cluster.
- Ensure that DCA is running on all nodes in the cluster.

  To do so, use the **request nms data-collection-agent status** command and ensure that the status value shows **running** for each node.

  To start DCA, if needed, use the **request nms data-collection-agent start** command.

Note If these prerequisites are not met or if another error occurs during the upgrade, the activation of the image fails and a file named upgrade-context.json is created in the /opt/data/extra-packages/*image-version* folder on each node in the cluster. You can provide this file to your Cisco representative for assistance with resolving the issue.

If you are upgrading to Cisco vManage Release 20.6.1 or later releases from a six-node Cisco SD-WAN Manager cluster deployment in which not all services are running on all nodes, contact your Cisco support representative before performing the upgrade.

1. Take snapshots of all the Cisco SD-WAN Manager servers. Take a backup of the configuration database and save it in a location outside of the Cisco SD-WAN Manager server using the following command:

   request nms configuration-db backup path *path_and_filename*
2. Ensure that Cisco vManage Release 18.3 or later is installed.
3. For upgrades from Cisco vManage Release 20.3.1 or later, copy the current image to each Cisco SD-WAN Manager server in the cluster and install the image on each Cisco SD-WAN Manager server by using the following command. Do not activate the image at this time.

   request software install *path*
4. For upgrades from Cisco vManage Release 20.3.1 or later, activate the current image on each Cisco SD-WAN Manager server using the following command. All servers reboot simultaneously.

   request software activate *version*
5. You must upgrade the configuration database when upgrading from one of the following:
   - Cisco SD-WAN Manager Release 18.4.x or 19.2.x to Cisco SD-WAN Manager 20.3.x or 20.4.x
   - Cisco SD-WAN Manager Release 20.3.x or 20.4.x to Cisco SD-WAN Manager Release 20.5.x or 20.6.x
   - Any Cisco SD-WAN Manager release to Cisco vManage Release 20.10.1 or later

Note

- Starting from Cisco vManage Release 20.1.1, before upgrading the configuration database, ensure that you verify the database size. We recommend that the database size is less than or equal to 5 GB. To verify the database size, use the following diagnostic command:

  request nms *configuration-db diagnostics*
- When you upgrade the configuration database, ensure that you have activated the current image on each Cisco SD-WAN Manager server in the cluster as described in the previous step. In addition, ensure that all services except the application server and configuration-db services are running on these servers by entering the **request nms all status** command on each server.

To upgrade the configuration database, do the following:

a. To determine which node to upgrade, enter the **request nms configuration-db status** command on each node. In the output look for the following:

```
Enabled: true
Status: not running
```

Note

After activating a new image on a Cisco SD-WAN Manager host server, the server reboots. After the reboot, for approximately 30 minutes, the output of the **request nms configuration-db status** command shows **Enabled: false** even on a node that has the configuration database enabled, while NMS services are being migrated to a containerized form.

b. On the node to upgrade, as determined in the previous step, enter the following:

request nms configuration-db upgrade

Note

- Enter this command on one node only.
- Do not enter this command if you are upgrading from Cisco vManage Release 20.5.x to Cisco vManage Release 20.6.1 or later.

6. Enter your login credentials, if prompted. Login credentials are prompted in releases earlier than Cisco vManage Release 20.3.1 if all the Cisco SD-WAN Manager servers establish control connection with each other. After a successful upgrade, all the configuration database services are UP across the cluster, and the application server is started.

You can check the database upgrade logs at the following location: *vmanage-server*:/var/log/nms/neo4j-upgrade.log.

For information about how to upgrade Cisco SD-WAN Manager clusters by using the Cisco SD-WAN Manager GUI, see the *Upgrade the Software Image on a Device* section in Cisco Catalyst SD-WAN Monitor and Maintain Configuration Guide.

View Application Health Dashlet

Minimum supported release: Cisco vManage Release 20.10.1

You can view a summary of the health of all applications on the **Application Health** dashlet on **Monitor Overview** dashboard.

You can view the usage of applications across all sites in a graphical format. The graph indicates whether the application performance is **Good**, **Fair**, or **Poor** based on the application Quality of Experience (QoE).

Starting from Cisco Catalyst SD-WAN Manager Release 20.12.1, a bar graph displays the application bandwidth usage information and changes in bandwidth from the last time period for each application. You can filter the applications based on the health status using the drop-down list for **Good Performing Applications**, **Fair Performing Applications**, and **Poor Performing Applications**.

Click **View Details** to open the **Monitor** > **Applications** window.

View Admin-Tech Files

You can perform any of the following operations after the admin-tech file is generated:

- View the list of the generated admin-tech files.
- Copy the selected admin-tech files from your device to Cisco SD-WAN Manager.
- Download the selected admin-tech files to your local device.
- Delete the selected admin-tech files from Cisco SD-WAN Manager, the device, or both.

1. From the Cisco SD-WAN Manager menu, choose **Tools** > **Operational Commands**.
2. For the desired device, click **. . .** and choose **View Admin Tech List**.

   A tar file appears that contains the admin-tech contents of the device that you selected earlier. This file has a name similar to `*ip-address*-*hostname*-20210602-032523-admin-tech.tar.gz`, where the numeric fields are the date and the time.

   You can view the list of the generated admin-tech files and decide which files that you want to copy to Cisco SD-WAN Manager.
3. Click the **Copy** icon to copy the admin-tech file from the device to Cisco SD-WAN Manager.

   A hint appears letting you know that the file is being copied from the device to Cisco SD-WAN Manager.
4. After the file is copied from the device to Cisco SD-WAN Manager, you can click the **Download** icon to download the file to your local device.

   You can view the admin-tech file size after the file is copied to Cisco SD-WAN Manager.
5. After the admin-tech file is successfully copied to Cisco SD-WAN Manager, you can click the **Delete** icon and choose which files to delete from Cisco SD-WAN Manager, the device, or both.

For more information on admin tech and technical support commands, see request admin-tech and show tech-support.

View Device Interfaces

To view information about interfaces on a device:

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

2. Choose a device by clicking its name in the **Hostname** column.

3. Click **Interface** in the left pane. The right pane displays interface information for the device.

The upper part of the right pane contains:

- Chart Options bar—Located directly under the device name, this bar includes:
  - Chart Options drop-down—Click **Chart Options** to choose how the data should be displayed.
  - IPv4 & IPv6 drop-down—Click **IPv4 & IPv6** to choose the type of interfaces to view. The information is displayed in graphical format. By default, the graph is Combined, showing interfaces on which both IPv4 and IPv6 addresses are configured. To view IPv4 and IPv6 interfaces in separate graphs, select the Separated toggle button.
  - Time periods—Click either **Real Time**, a predefined time period, or a custom time period for which to view the data.
- Interface information in graphical format.
- Interface graph legend—Choose an interface to display information for just that interface.

The lower part of the right pane contains:

- Filter criteria.
- Interface table, which lists information about all interfaces. By default, the first six interfaces are displayed. The graphical display in the upper part of the right pane plots information for the selected interfaces.
  - Check the check box to the left to select and deselect interfaces. You can select and view information for a maximum of 30 interfaces at a time.
  - To rearrange the columns, drag the column title to the desired position.
  - For cellular interfaces, click the interface name to view a detailed information about the cellular interface.

To view interface status and interface statistics, see show interface and show interface statistics.

View Device Status in the Overlay Network

You have the following options to view the status of a device in the overlay network.

Use the Dashboard Screen

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Overview**.

Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Dashboard** > **Main Dashboard**.

2. For releases before Cisco vManage Release 20.6.1, click the upward or downward arrow next to **WAN Edge**.

   For Cisco vManage Release 20.6.1 and later, click the number representing the number of **WAN Edge** devices.

3. To know the status of the WAN edge device, see the **Reachability** column in the dialog box that opens.

Use the Geography Screen

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Geography**.
2. Click **Filter** and choose **WAN Edge** under **Types**.
3. Click the router icon to check its status.

Use the Network Screen

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

2. Locate the WAN edge router that you want to view the status for. You can either scroll through the list of devices in the device table or enter a keyword in the search bar.
3. Click the relevant WAN edge router under the **Hostname** column. The **System Status** screen opens by default.

View the Geographic Location of Your Devices

Use the **Geography** window in Cisco SD-WAN Manager to view information about the Cisco Catalyst SD-WAN devices and links in the overlay network. The **Geography** window provides a map displaying the geographic location of the devices in the overlay network.

Note The browser on which you are running Cisco SD-WAN Manager must have internet access. If you do not have internet access, ensure that the browser has access to "*.openstreetmaps.org."

To view the geographic location of the devices in the overlay network:

1. From the **VPN Group** list, choose a VPN group.
2. From the **VPN Segment** list, choose a VPN segment.
3. Set filters.

Set Map Filters

To select the devices and links you want to display on the map:

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Geography**.
2. Click **Filter**.
3. From the options that display, choose the device group. By default, the group **All** is selected and displays all devices in the overlay network. The group **No Groups** displays devices that are not part of a device group. If all devices are in a group, the **No Groups** option is not displayed.
4. Choose the devices you want to view. By default, the map displays all device types including edge devices, Cisco SD-WAN Validator, Cisco SD-WAN Controller, and Cisco SD-WAN Manager.
5. Choose the state of control and data links. By default, the map displays all control and data connections.
6. Close the **Filter** box by moving the cursor outside the box.

The map dynamically updates to display your selections.

View Device Information

To view basic information for a device, hover over the device icon. A pop-up box displays the system IP, hostname, site ID, device type, and device status.

To view detailed information for a device, double-click the device icon. Click **Device Dashboard**, **Device Details**, **SSH Terminal**, **Site Topology**, or **Links** to view more details for the device.

Note the following about links:

- A thin blue line displays an active control connection between two devices.
- A bold blue line displays multiple active connections between devices.
- A dotted red line displays a control connection that is down.
- A bold dotted red line displays multiple control connections that are down.
- A thin green line displays an active data connection between two devices.
- A bold green line displays multiple active data connections.
- A dotted red line displays a data connection that is down.
- A bold dotted red line displays multiple data connections that are down.
- A thick gray line displays an active consolidated control and data connection between two devices.

  If you hover over the line, a hover box tells you if the connection is up or down.

Configure and View Geographic Coordinates for a Device

To configure the geographic coordinates for a device, use the **System Feature** template under **Configuration** > **Templates**.

If the Cisco Catalyst SD-WAN device is not attached to a configuration template, you can configure the latitude and longitude directly on the device:

1. From the Cisco SD-WAN Manager menu, choose **Tools** > **SSH Terminal**.
2. Choose a device from the left pane. The SSH Terminal window opens in the right pane.
3. Enter the username and password to log in to the device.

4. Use the `show system status` command to determine whether the device is attached to a configuration template:

   ```
   Device# show system status...
       Personality:            vedge
       Model name:             vedge-cloud
       Services:               None
       vManaged:               false
       Commit pending:         false
       Configuration template: None
   ```

   In the output, check the values in the `vManaged` and `Configuration template` output fields. If the `vManaged` field is false, the device is not attached to a configuration template, and the `Configuration template` field value is `None`. For such a device, you can configure the GPS coordinates directly from the CLI. If the `vManaged` field is `true`, the Cisco SD-WAN Manager server has downloaded the device configuration, and the `Configuration template` field value displays the name of the configuration template. For such a device, you cannot configure the GPS coordinates directly from the CLI. If you attempt to do so, the `validate` or `commit` commands fails with the following message:

   ```
   Aborted: 'system is-vmanaged': This device is being managed by the vManage. Configuration
    through the CLI is not allowed.
   ```

5. Enter configuration mode:

   For Cisco vEdge devices:

   ```
   Device# config
       Device(config)#
   ```

   For Cisco IOS XE Catalyst SD-WAN devices:

   ```
   Device# configure-transaction
       Device(config)#
   ```

6. Configure the latitude and longitude for the device.

   ```
   Device(config)# system gps-location latitude
                           degrees.minutes.seconds
       Device(config-system)# gps-location longitude
                           degrees.minutes.seconds
   ```

7. Save the configuration.

   ```
   Device(config-system)# commit
       Device(config-system)#
   ```

View Network Site Topology

Table 29: Feature History

Feature Name	Release Information	Description
Site Topology Visualization in Cisco SD-WAN Manager	Cisco IOS XE Catalyst SD-WAN Release 17.8.1a Cisco vManage Release 20.8.1	You can now view the topology diagram of a site in Cisco SD-WAN Manager.

Feature Name	Release Information	Description
Site Topology Visualization in Cisco SD-WAN Manager (Phase II)	Cisco IOS XE Catalyst SD-WAN Release 17.9.1a Cisco vManage Release 20.9.1	You can view information about the health of devices and tunnels in the topology.

You have the following options to view the topology of a site.

Use the Devices Window

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.
2. Find the corresponding Cisco IOS XE Catalyst SD-WAN device in the table and click the value in the **Site ID** column adjacent to this device name.

   Alternatively, click the device name in the **Hostname** column, and then click the **Site ID** value in the device dashboard.

Cisco SD-WAN Manager displays the topology of the site.

Use the Geography Window

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Geography**.
2. Click the corresponding Cisco IOS XE Catalyst SD-WAN device in the map.
3. Click the **Site ID** value.

Cisco SD-WAN Manager displays the topology of the site.

View Network-Wide Path Insight

Table 30: Feature History

Feature Name	Release Information	Description
Network-Wide Path Insight in Cisco SD-WAN Manager	Cisco IOS XE Catalyst SD-WAN Release 17.4.1a Cisco vManage Release 20.4.1	This feature lets you view network-wide path tracing information using Cisco SD-WAN Manager.
Network-Wide Path Insight in Cisco SD-WAN Manager Enhancements	Cisco IOS XE Catalyst SD-WAN Release 17.6.1a Cisco vManage Release 20.6.1	You can configure network-wide path insight options to include additional filters and parameters for traces and DNS domain discovery, and view new displays for application flows, trace views, and app trends.

Feature Name	Release Information	Description
Network-Wide Path Insight in Cisco SD-WAN Manager Enhancements	Cisco IOS XE Catalyst SD-WAN Release 17.9.1a Cisco vManage Release 20.9.1	This feature provides enhancements to the Network-Wide Path Insight feature to include the collection and display of insight information, trace-level insight information, path insight information, and detailed application trace information.
Network-Wide Path Insight in Cisco SD-WAN Manager Enhancements	Cisco IOS XE Catalyst SD-WAN Release 17.12.1a Cisco Catalyst SD-WAN Manager Release 20.12.1	This feature provides enhancements to the Network-Wide Path Insight feature to include support for multiple VPNs for traces, the ability to generate synthetic traffic for traces, options for grouping trace information, support for auto-on tasks, new information on insight displays, and expanded insight summaries.

Information About Network-Wide Path Insight

Network-wide path insight provides on-demand end-to-end application-tracing serviceability in the Cisco Catalyst SD-WAN network. You can obtain and view detailed information at the packet level, application level, domain level, flow level, and network level. This information provides comprehensive insights into the operations of your network and can assist with performance analysis, planning, and troubleshooting.

Supported Devices

This feature is supported on Cisco IOS XE Catalyst SD-WAN devices.

Overview

With the Network-Wide Path Insight feature, Cisco SD-WAN Manager lets you initiate application tracing and displays the trace results collected from multiple devices in a consolidated view.

Benefits of Network-Wide Path Insight

- End-to-end bidirectional network path visibility for applications over Cisco Catalyst SD-WAN fabric
- Real-time network performance measurement and visibility for applications
- Feature execution insight on Cisco Catalyst SD-WAN device. Example: QoS, SD-WAN Policy, SAIE flow, and SD-WAN overlay tunneling

Note In Cisco vManage Release 20.7.x and earlier releases, the SD-WAN Application Intelligence Engine (SAIE) flow is called the deep packet inspection (DPI) flow.

- Validation of application policies

Use Cases for Network-Wide Path Insight

- Verification of network and policy design when deploying a new site, VPN, or application
- Daily monitoring of network, application, and policy operations
- Collection of information for diagnosing operational issues

Restrictions for Network-Wide Path Insight

- Support for this feature on Cisco vEdge devices is limited to interoperation with Cisco IOS XE Catalyst SD-WAN devices.
- Only UDP and TCP can be traced using the Network-Wide Path Insight feature.
- This feature is not supported on VPN 0 or the transport VPN.
- This feature is not supported when extranet VPNs or service chain policies are configured in your Cisco Catalyst SD-WAN deployment.
- Not all packet traces are captured per flow. The system takes samples for the most typical packets automatically.
- Flow records do not display the complete history of flow path and hop information for releases before Cisco vManage Release 20.6.1.
- Mixed application and default policies are not supported for releases before Cisco vManage Release 20.6.1.
- You can monitor a maximum of two traces per device, and 10 concurrent active traces per Cisco SD-WAN Manager tenant.
- The following table shows the number of active flows that can be monitored, and the supported number of completed flows. Tracing stops when the monitoring limit is reached.

Release	**Number of Supported Active Flows**	**Number of Supported Number of Completed**
Releases before Cisco vManage Release 20.6.1	50 to 100 per device, depending on the Cisco IOS XE Catalyst SD-WAN device	1,000
Cisco vManage Release 20.6.1 through Cisco vManage Release 20.8.x	50 to 100 per device, depending on the Cisco IOS XE Catalyst SD-WAN device	10,000
Cisco vManage Release 20.9.1 and later releases	50 to 100 per device, depending on the Cisco IOS XE Catalyst SD-WAN device	60,000

- In releases before Cisco vManage Release 20.6.1, flow trace does not show the complete network path if the following optimizations are enabled:
  - UTD
  - TCP

  - SSL
  - DRE

- In the **Application Stats** graphs that are available in the **Insight Summary** > **Overview** tab, you cannot choose a WAN color for Cisco ASR 1000 Series Routers and Cisco Catalyst 8500 Series Edge Platforms.

Prerequisites for Network-Wide Path Insight

Ensure that the **Data Stream** option is enabled in Cisco SD-WAN Manager. To enable this option, follow these steps:

1. From the Cisco SD-WAN Manager menu, choose **Administration** > **Settings**.
2. For the **Data Stream** option, click **View**.
3. Click **Edit** and choose **Enable**.
4. Click **Save**.

Note If you try to set up a trace path when **Data Stream** is not enabled, you are prompted to enable it.

View Network-Wide Path Insight for Releases Before Cisco vManage Release 20.6.1

This section describes how to perform network-wide path insight tracing in releases before Cisco vManage Release 20.6.1. To start a trace, follow these steps:

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network Wide Path Insight**.
2. In the **Policy** area, choose **Site ID(*)** from the drop-down list. Ensure that you only choose a site that you have access to.
3. In the **VPN(*)** field, choose a VPN ID from the drop-down list. Only VPNs associated with the chosen site are listed.
4. (Optional) Enter the **Source/ Destination IP Addresses**.
5. (Optional) Choose the **Application** from the drop-down list.
6. (Optional) Specify the required **Trace Duration** in minutes. The default trace duration is 60 minutes and the maximum duration supported is 1440 minutes.
7. (Optional) Choose **Device** and **Source Interface** from the drop-down list.
8. (Optional) Choose **Protocol** from the drop-down list. **TCP** and **UDP** protocols are supported. The **All** option indicates both UDP and TCP protocols.
9. (Optional) Choose **DSCP** from the drop-down list.
10. Click **Start** to initiate a path trace. A dialog box displays the Trace ID, Start time of the trace, and all the details such as their IP addresses and trace status of the started devices.

Note To stop an ongoing trace before the timer expired, click **Stop**. You can also stop a trace from the **Trace** section.

View Network-Wide Path Insight for Cisco vManage Release 20.6.1 and Later Releases

This section describes how to perform network-wide path insight tracing from Cisco vManage Release 20.6.1.

Tracing provides detailed information about application issues and can discover domains and applications that run in domains. You can configure a variety of options to specify the tracing that you need and view detailed information about trace flows.

To start a trace, follow these steps:

1. From the Cisco SD-WAN Manager menu, choose **Tools** > **Network Wide Path Insight**.

   From Cisco Catalyst SD-WAN Manager Release 20.12.1, you can also start a trace by choosing **Create a Trace** from the **Monitor** > **Overview** page.

   Note In Cisco vManage Release 20.6.x and earlier releases, **Network Wide Path Insight** is part of the **Monitor** menu.

2. Perform one of the following actions:

   - From Cisco vManage Release 20.6.1 through Cisco vManage 20.11.x:

     a. (Optional) In the **Trace** area, check the **Enable DNS Domain Discovery** check box to enable DNS domain discovery for network-wide path insight.

     b. Click **New Trace**.

   - From Cisco Catalyst SD-WAN Manager Release 20.12.1:

     a. Click **New Trace**.

     b. (Optional) In the **Trace** area, check the **Enable DNS Domain Discovery** check box to enable DNS domain discovery for network-wide path insight, or continue to Step 3.

   Note When **Enable DNS Domain Discovery** is enabled, DNS snooping is used to discover DNS domains and the apps that are running in the discovered domains. You can then monitor the domains under the **Application** option to obtain information about health, trends, and metrics. When this option is disabled, the trace monitors the application flows based on the criteria and filters that you specify.

   Enabling this option provides deep insight information for DNS domains, especially in Cisco Catalyst SD-WAN Cloud OnRamp for SaaS and Direct Internet Access (DIA) deployments. You can check the discovered domains for information about DNS domain queries that are running, and then start a trace to probe the traffic in these domains.

3. (Optional) In the **Trace Name** field, enter a name for the trace.

If you do not enter a name, the system assigns the name trace_*ID*, where *ID* is the system-generated identifier of the trace.

4. In the **Trace Duration** field, enter the number of minutes for which the trace lasts.

   The minimum value is 1. The maximum value is 1440 (24 hours). The default value is 60.

5. In the **Filters** area, perform these actions:

   a. In the **Site ID** field, enter the ID of the Cisco Catalyst SD-WAN network site in which to perform the trace.

   b. From the **VPN** drop-down list, choose the service VPN for the trace to monitor. From Cisco Catalyst SD-WAN Manager Release 20.12.1, you can choose up to 64 VPNs.

   c. (Optional. This option is applicable only if DNS domain discovery is disabled.) In the **Source Address/Prefix** field, enter the source IPv4 or IPv6 IP address and the prefix of flows for the trace to monitor. If you leave this field blank, the trace monitors flows with any source address or prefix.

   d. (Optional. This option is applicable only if DNS domain discovery is disabled.) In the **Destination Address/Prefix** field, enter the destination IPv4 or IPv6 IP address and prefix of flows for the trace to monitor. If you leave this field blank, the trace monitors flows with any destination address or prefix.

   e. (Optional. This option is applicable only if DNS domain discovery is enabled.) In the **Client Address/Prefix** field, enter the source IPv4 or IPv6 IP address or prefix of flows for the trace to monitor. If you leave this field blank, the trace monitors flows with any source address or prefix.

   f. (Optional. The **Application** option applies only if DNS domain discovery is disabled.) Click one of the following options, then click the field under the option and use the check boxes that appear to choose the applications or application groups for the trace to monitor:

      - **Application**: Choose this option to designate specific applications for the trace to monitor.

      - **Application Group**: Choose this option to designate specific application groups for the trace to monitor. The trace then monitors all the applications that an application group includes.

        For example, if you choose the application group ms-cloud-group, all the applications that this group includes are monitored. These applications are ms-office-365, ms-services, ms-teams, and more.

      If you do not choose an option, the trace monitors all the applications.

      To remove an application or application group from this field, click **X** adjacent to the corresponding application or application group name.

6. (Optional) If DNS domain discovery is not enabled, click the **Expand** icon to expand the **Advanced Filters** area and perform the following actions, as needed, to configure specific items for the trace to monitor.

   a. From the **Device** drop-down list, choose one or more devices for the trace to monitor by checking the check box for each device.

      If you do not choose a device, the trace monitors all devices for the site that you specified in Step 5, on page 102.

   b. From the **Source Interface** drop-down list, choose the source interface of traffic for the trace to monitor.

If you do not choose a source interface, the trace monitors traffic from all source interfaces in the VPN that you specified in Step 5, on page 102.

c. In the **Source Port** field, enter the source port number of traffic that the trace should monitor. The trace monitors traffic that flows from this port number.

   If you do not choose a source port, the trace monitors traffic for all source ports.

d. In the **Destination Port** field, enter the destination port number of traffic for the trace to monitor. The trace monitors traffic that flows to this port number.

   If you do not choose a destination port, the trace monitors traffic for all destination ports.

e. From the **Protocol** drop-down list, choose the traffic protocol type for the trace to monitor.

   If you do not choose a protocol, the trace monitors traffic for all supported protocols.

f. From the **DSCP** drop-down list, choose the DSCP type for the trace to monitor. The **DEFAULT** selection indicates **DSCP0**.

   If you do not choose a DSCP type, the trace monitors traffic for all DSCP types.

7. (Optional) Click the **Expand** icon to expand the **Monitor Settings** area and perform these actions:

a. (From Cisco vManage Release 20.9.1) Click **QoS Insight** to have the trace include application, VPN, interface, and queue-level throughput and drop-rate metrics for all traffic.

   This option is enabled by default.

b. Click **ART Visibility** to have the trace include the application response time (ART) metrics for TCP traffic. These metrics include client network delay (CND) and server network delay (SND) information.

   This option is enabled by default.

c. Click **App Visibility** to have the trace use the SD-WAN Application Intelligence Engine (SAIE) flow to discover applications and application groups.

Note In Cisco vManage Release 20.7.x and earlier releases, the SAIE flow is called the deep packet inspection (DPI) flow.

   If you chose applications or application groups in Step 5, on page 102, this option is enabled automatically.

   If DPI is not enabled, we recommend that you enable **App Visibility** to ensure that flows are mapped to the correct applications. Enabling this option authorizes Network-Wide Path Insight to enable DPI in the first hop router of the trace for the duration of the trace.

d. Click **DIA Visibility** to enable the viewing of downstream information from direct internet access flows, beginning with the first flow.

   This option is enabled by default if DNS domain discovery is enabled.

   This option does not affect the applications that are transported over a Cisco Catalyst SD-WAN tunnel.

If you do not enable this option, the device discovers direct internet access traffic automatically, but it can take some time for this discovery to begin.

e. Click **Hub WAN Visibility** (or WAN Visibility for releases from Cisco Catalyst SD-WAN Manager Release 20.12.1.) when starting a trace to have the trace includes flows that are initiated in the WAN to LAN direction.

   By default, a trace monitors flows that are initiated in the LAN to WAN direction.

   For releases before Cisco Catalyst SD-WAN Manager Release 20.12.1, if DNS domain discovery is enabled, this option is enabled by default and cannot be disabled. For releases from Cisco Catalyst SD-WAN Manager Release 20.12.1, this option is disabled by default in all cases and can be enabled as needed.

   ~~

Note Because traffic typically flows from a spoke to a hub, we recommend that you start a trace from a spoke site.

f. Click **Sampling** to enable sampling when tracing, which causes the trace to capture flows at the specified interval.

   In the **Sampling Interval** field that appears, enter the time interval, in seconds, between samples. For example, if you enter 100, one flow will be traced every 100 seconds even if there are multiple other flows.

   The minimum sampling interval value is 1 second. The maximum value is 86400 seconds (24 hours). The default value is 60.

   The sampling options can help extend the monitoring period of a trace by increasing the time that it takes it to reach the maximum number of flows in a trace.

8. (Optional) From Cisco Catalyst SD-WAN Manager Release 20.12.1, click the **Expand** icon and perform the following actions in the **Synthetic Traffic** area to enable synthetic traffic.

   Synthetic traffic helps verify network design. When a new site is onboarded or an existing site configuration is changed, it is important to validate whether applications work as designed and as intended. Enabling synthetic traffic generates sample user traffic that you can evaluate with other network-wide path insight features to check whether applications are working as expected.

   Synthetic traffic starts when the trace starts and stops when the trace stops. After the trace stops, you can see the information about synthetic traffic flows in the **Completed Flows** tab, and filter information on that tab to see information that only relates to synthetic traffic.

   a. In the **URL** field, enter the URL to which a router should send synthetic traffic, for example, https://www.cisco.com.

   b. In the **VPN** field, choose a service VPN on which to start synthetic traffic. The VPNs that are available are based on the VPNs that you chose in the **Filters** area.

   c. In the **DNS Server** field, enter the IP address of the DNS server for translating the URL.

      We recommend that you enter the IP address of your organization’s DNS server so that that the synthetic traffic flows to the same destination as the actual user traffic.

   d. From the **DSCP** drop-down list, choose the DSCP to use for the synthetic traffic.

e. In the **Interval** field, enter how often, in minutes, the synthetic traffic is sent to the URL during the duration of the trace. For example, if you enter an interval of **2**, synthetic traffic is sent every 2 minutes. The minimum values is **1**.

f. (Optional) Click the plus sign icon and repeat these steps to add another synthetic traffic instance.

g. Click **Save**.

9. (Optional) From Cisco Catalyst SD-WAN Manager Release 20.12.1, click the **Expand** icon to expand the **Grouping Fields** area and configure the following options.

   By default, information on the **App Performance Insight** tab on the **Insight Summary** display is grouped by application. Additional options area let you group information into smaller groups so that you can refine the display of information to meet your needs.

   - Check the **Client Prefix** check box to additionally group information by client prefix.
   - Check the **Server Prefix** check box to additionally group information by server prefix.
   - Check the **Source SGT** check box to additionally group information by source security group tag (SGT).

10. Click **Start** to initiate the trace.

    The **Start Trace** window displays information about the trace, including the trace ID, the start time of the trace, and related details such as the IP addresses and trace status of the started devices.

11. Close the **Start Trace** window.

    The trace is displayed in the list of traces in the **Tools** > **Network Wide Path Insight** window.

Note In Cisco vManage Release 20.6.x and earlier releases, the list of traces is available in the **Monitor** > **Network Wide Path Insight** page.

Create Auto-On Task

Note The auto-on task feature is available from Cisco Catalyst SD-WAN Manager Release 20.12.1.

An auto-on task monitors your network for events that you choose and automatically runs a trace if an event is detected.

An auto-on task monitors the network for a period that you specify. Each trace that a task runs lasts for 5 minutes. To avoid congestion from multiple traces running simultaneously, for each site that is monitored, there is a ½ hour interval after a trace starts before the next one begins.

Options for traces that an auto-on task generates are preconfigured and cannot be changed.

An auto-on task is useful if you have identified or suspect a potential or intermittent issue in your network. For example, if you have identified intermittent SLA violations, instead of manually monitoring the network and manually starting a trace when you see an SLA violation, you can create a task that automatically starts traces when SLA violations are detected.

1. From the Cisco SD-WAN Manager menu, choose **Tools** > **Network Wide Path Insight**.
2. Click **New Auto-on Task**.
3. In the **Task Name** field, enter a name for the task.
4. From the **Select Event** drop-down list, choose either or both of the following events that, when detected, start a trace:
   - **QoS Congestion**: Congestion on the nondefault QoS queue of an interface.
   - **SLA Violation**: Traffic outside of the parameters that are defined by a service level agreement (SLA), for example, traffic latency exceeding predefined criteria.
5. (Optional) From the **Select Site** drop-down list, choose the name of one or more Cisco Catalyst SD-WAN network sites in which to perform the trace.

   If you do not choose a network site, the task monitors all the sites.
6. In the **Select Duration** field, enter the number of hours the task lasts for.

   The task monitors your network for the selected events during this duration.

   Enter a number from **1** through **168**.
7. Click **Start**.

   The task appears in the table of auto-on tasks. This table provides the following information and options for each task and each trace that the task starts:
   - **Task name**: Task trace name. This field also includes the **Insight Summary** link, which lets you see more information about the traces that the task started. See Insight Summary, on page 116.
   - **Task ID**: System-generated identifier of the task or trace.
   - **Event(s)**: The event or events that you configured to start a trace, or the events that triggered a trace.
   - **Site(s)**: The name of each site that the task monitors, or the name of the site in which a trace ran.
   - **State**: **Active** means that the task is live or a trace is running. **Finished** means that the task or trace has completed.
   - **Start Time**: Date and time at which you started the task or that a trace started.
   - **Duration**: Number of hours that a task or trace is live or ran.
   - **Stop Time**: Date and time at which the task or trace ended.
   - **Actions**:
     - Click **Delete** to remove a task or trace from the table.
     - Click **Stop** to stop an active task. Note that a stopped task cannot be restarted.

Trace

The path trace instances appear with unique trace IDs in the **Trace History** area (in releases before Cisco vManage Release 20.6.1) or in the **Trace** area (in Cisco vManage Release 20.6.1 and later releases). Information about each instance is also displayed, including its state and the actions that you can perform.

From Cisco Catalyst SD-WAN Manager Release 20.12.1, the **Trace** area includes the following tabs:

- **All Trace**: Provides information about the traces that you start manually.
- **Auto-On Task**: Provides information about the traces that are generated by an auto-on task.

You can perform the following actions in the **Trace History** area or **Trace** area:

- In releases before Cisco vManage Release 20.6.1:
  - To stop an active trace, click **Stop**. If you have specified the trace duration, the trace stops automatically when the timer expires.
  - To navigate to the **Flow Path and Metrics** section, click **Detail**.
- From Cisco vManage Release 20.6.1:

Action	Procedure	Tab (from Cisco Catalyst SD-WAN Manager Release 20.12.1)
Stop a trace that is in progress.	Click **Stop** in the **Action** column for the trace, and then click **Confirm** in the **Stop Trace** dialog box.	**All Trace** and **Auto-On Task**
Delete a trace that is completed.	Click **Delete** in the **Action** column for the trace, and then click **Confirm** in the **Delete Trace** dialog box.	**All Trace** and **Auto-On Task**
Display trace-level insight summary information (from Cisco vManage Release 20.9.1).	See Insight Summary, on page 116.	**All Trace** and **Auto-On Task**
Display detailed information about the flows in a trace in the **Insight** area.	Click **Insight Summary** for the trace in the **Trace Name** column.	**All Trace**
View the filters and settings for a trace.	Click the name of the trace in the **Trace Name** column.	**All Trace**
View information about the source of a trace.	Click the corresponding value in the **Src Site** column.	**All Trace**
View information about the applications or application groups that a trace monitors.	Click the corresponding value in the **Application/App Group** column.	**All Trace**
View the status of a trace and error messages, if any, that have been generated.	Click the corresponding value in the **Trace State** column.	**All Trace**
View statistics for a task (from Cisco Catalyst SD-WAN Manager Release 20.12.1).	Click the name of the corresponding task.	**Auto-On Task**

Action	Procedure	Tab (from Cisco Catalyst SD-WAN Manager Release 20.12.1)
View the filters and settings for a trace in a task (from Cisco Catalyst SD-WAN Manager Release 20.12.1).	Expand the task that you want, and then click the name of the trace in the **Trace Name** column.	**Auto-On Task**

Flow Path and Metrics

This section applies to releases before Cisco vManage Release 20.6.1.

In the **Flow Path and Metrics** section, view bidirectional flow path table with hop-by-hop metrics. You can expand any trace instance in the log to view the following details:

Column	Description
Last Update Time	The flow path instances in running state are refreshed every 10 seconds and the time of the update is displayed.
Flow ID	Flow IDs differentiate two identical flow path instances occurring at different times.
State	This state helps you visualize potential issues with the flow. Only SLA state of the flow is supported.
Direction	Directions could be upstream or downstream. The direction in which the first packet flow is identified is considered as upstream.
Local Color, Remote Color	Local edge (source) and the remote edge (destination) colors indicate different WAN interfaces.
Local Drop(%), Remote Drop(%), WAN Drop(%)	Packet drop is measured at local and remote edge routers. The packet drop is also measured on the complete WAN network.
Jitter(ms), Latency(ms)	Jitter and latency metrics of the flow. These metrics help with evaluating the application performance in real time.
Total Packets, Total Bytes	For each direction of the flow, total number of packets and total byte count are displayed.

Insight

This section is applicable to Cisco vManage Release 20.6.1 and later.

Click **View Insight** in the **Actions** column in the list of traces to display detailed information about the flows in the corresponding trace. This detailed information appears in the **Insight** area. The following information is displayed in this area:

- The **DNS Domains** tab is available only when DNS domain discovery is enabled and displays information about each domain that the trace discovers. You can expand any row in the list to display detailed information about the application.

  From Cisco vManage Release 20.9.1, click **Discovered Domains** to display information for every domain that the trace discovered but that are not yet traced. Click **Monitored Domains** to display information only for domains that the trace monitored.

Note In Cisco vManage Release 20.6.1 through Cisco vManage Release 20.8.x, the **DNS Domains** tab is called the **Applications** tab.

- (From Cisco vManage Release 20.9.1) The **Applications** tab displays information about applications that were traced. You can expand any row in this list to display bidirectional path information with hop-by-hop metrics for each application.
- The **Active Flows** tab displays information about the flows that are in the Running state. You can expand a flow instance to display bidirectional flow path information with hop-by-hop metrics.
- The **Completed Flows** tab shows information about the flows that are in the Stopped state. You can expand a flow instance to display bidirectional flow path information with hop-by-hop metrics.
- In the **DNS Domains** tab, start or stop flow monitoring of the applications in the selected domain for an active trace. Starting flow monitoring also deploys an HTTP probe (through Cisco vManage Release 20.8.x) or an HTTPS probe (from Cisco vManage Release 20.9.1) for the domain on the WAN. A dialog box indicates that monitoring has started. Monitoring information is displayed in the **Active Flows** and **Completed Flows** tabs.
  - In Cisco vManage Release 20.6.1 through Cisco vManage Release 20.8.x, click **Start Flow Monitor** and **Stop Flow Monitor**, as needed, to start or stop monitoring for the selected domains.
  - From Cisco vManage Release 20.9.1, to start flow monitoring, click **Discovered Domains**, check the corresponding check box for one or more domains to start monitoring, and click **Start Flow Monitor**. In the confirmation dialog box that appears, click **Confirm**. You can change the domain selections in this dialog box before you click **Confirm**.

    From Cisco vManage Release 20.9.1, to stop flow monitoring, click **Monitored Domains**, check the check box for each domain for which you want to stop monitoring, and click **Stop Flow Monitor**. In the confirmation dialog box that appears, click **Confirm**.

- Use the **Search** option to find specific flow instances.

  From Cisco vManage 20.6.1, you also can cut and paste the following keywords to search for flows that include corresponding the events:

  - **Local Drop**
  - **WAN Loss**
  - **TCP Reset**
  - **NAT Translation**
  - **DPI First Packet Unclassified**
  - **SLA Violation**

  - **QoS Congestion**
  - **WAN Color Inconsistency**
  - **Flow Asymmetry**
  - **Policy Bypass**
  - **Server No Response**
  - **AppQoE Diverted**
  - **UTD Diverted**

- For completed flows, use the **Filter** option to display only flow instances that meet specified criteria.
- For completed flows, you can limit the display to flows that occurred within a specified period.

  In releases through Cisco vManage Release 20.8.x, you can choose a period of 1, 10, or 30 minutes, or 1, 2, or 5 hours. You also can click **Custom** and enter a date and time range.

  From Cisco vManage Release 20.9.1, you can drag the ends of the time bar to designate the start and end dates and times for a certain period.

The following tables describe the information that appears for each application and each instance in a flow, and, if DNS domain discovery is enabled, for each domain.

Note The **DNS domains** tab (called **Applications** tab in Cisco vManage Release 20.6.1 through Cisco Manage 20.8.x) is available only when DNS Domain Discovery is enabled for a trace.

Table 31: DNS Domains Tab (Called Applications Tab in Cisco vManage Release 20.6.1 Through Cisco Manage 20.8.x)

Column	Description
Check box	Check the check box for the domains for which you want monitoring to be enabled or disabled and click **Start Flow Monitor** or **Stop Flow Monitor**.
Domain	Name of the domain that the trace discovered.
Update Time	Date and time at which the information was last refreshed. Instances are refreshed every 30 seconds by default.
Application	Name of the application that the trace discovered in the domain.
Application Group or **App Group**	Name of the application group that the trace discovered in the domain.
VPN Id	Available from Cisco Catalyst SD-WAN Manager Release 20.12.1. Identifier of the VPN in which the application flow was traced.

Column	Description
DNS Server	Destination of DNS packets sent from clients.
DNS Redirect	DNS resolver to which a device redirects DNS traffic if a resolver is configured by a centralized policy or by Cisco Umbrella.
Resolved IP	DNS-resolved IP address for the application.
DNS Transport	Transport type used by the domain.
DNS Egress	Egress interface and type used by the domain.
TTL (sec)	DNS time to live, in seconds.
Request	Number of DNS packets sent.
Monitor State	Status of flow monitoring for the domain.

Table 32: Applications Tabs (Available from Cisco vManage Release 20.9.1)

Column	Description
Columns Displayed in Cisco vManage Release 20.9.1 through Cisco vManage Release 20.11.x	
Last Update Time	Date and time at which the information was last refreshed. Instances are refreshed every 10 seconds by default.
App Name	Name of the application.
App Group	Application group to which the application belongs.
Upstream Flow Count	Number of upstream flows that were counted for the application.
Downstream Flow Count	Number of downstream flows that were counted for the application.
Upstream Bytes (K)	Number of KBs in the upstream traffic of this application.
Downstream Bytes (K)	Number of KBs in the downstream traffic of this application.
Columns Displayed From Cisco Catalyst SD-WAN Manager Release 20.12.1	
Last Update Time	Date and time at which the information was last refreshed. Instances are refreshed every 10 seconds by default.
App Name	Name of the application.

Column	Description
App Group	Application group to which the application belongs.
VPN Id	Identifier of the VPN in which the application flow was traced.
Total Bytes (K)	Number of KBs in the upstream and downstream flows of this application.
Total packets	Number of packets in the upstream and downstream flows of this application.
KBPS	Number of KBs per second in the upstream and downstream flows of this application during the past minute.
PPS	Number of packets per second in the upstream and downstream flows of this application during the past minute.
Total Flows	Number of flows that were counted for the application.
Active Flows	Flows that had activity during the past 1 minute.
Flow Setup Rate	Average number of new flows per second during the past 1 minute.
Flow Live Time (ms) Max/Min/Avg	Maximum, minimum, and average number of milliseconds of detectable flow activity during the duration of the trace.
Sampled Flows	Number of flows that were sampled in the upstream or downstream traffic of this application. Click the up arrow icon next to the column name to display information for upstream traffic. Click the down arrow icon to display information for downstream traffic.
Sampled Bytes (K)	Number of KBs in the upstream or downstream traffic of this application. Click the up arrow icon next to the column name to display information for upstream traffic. Click the down arrow icon to display information for downstream traffic.

Table 33: Active Flows and Completed Flows Tabs

Column	Description
Last Update Time or **Start - Update Time**	In releases through Cisco vManage 17.8.x: Date and time at which the information was last refreshed. In releases from Cisco vManage 20.9.1: Date and time at which the flow started, and date and time at which the information was last refreshed. Instances are refreshed every 10 seconds by default.
Flow ID	System-assigned identifier of the flow.
Readout	Information that the flow contains (error, warning, or information). Click an icon to display detailed information about the flow in a dialog box (in releases before Cisco vManage Release 20.9.1) or a slide-in pane (in releases from Cisco vManage Release 20.9.1). If the flow identifies an application issue, you can use this information to assist with a root-cause analysis. The dialog box or slide-in pane includes the following information: • **Overview**: Includes details about flow asymmetry, bidirectional WAN color inconsistency, QoS congestion, LAN or WAN packet drops, SLA violation, path change, flow reset, SAIE packet classification status, TCP server response, and so on. • **Path Insight** (available from Cisco vManage Release 20.9.1): Provides information about how a forwarding path was determined for a flow. This information includes the edge router name; destination IP address; IP address lookup and matched route information; route-receiving source protocol, preference, and metrics; flow path-routing candidates; method for deciding the flow path; NAT translation detail; and the flow path used. (You may have to scroll to the bottom of the **Path Insight** tab to access the horizontal scroll bar.) **Note** In Cisco vManage Release 20.7.x and earlier releases, the SD-WAN Application Intelligence Engine (SAIE) flow is called the deep packet inspection (DPI) flow.

Column	Description
VPN Id	From Cisco Catalyst SD-WAN Manager Release 20.12.1, identifier of the VPN in which the application flow was traced.
Source IP	Source IP address of the traffic that the trace monitors.
Source Port or **Src Port**	Source port of the traffic that the trace monitors.
Destination IP	Destination IP address of the traffic that the trace monitors.
Destination Port or **Dest Port**	Destination port of the traffic that the trace monitors.
Protocol	Protocol of the traffic that the trace monitors.
DSCP Upstream/Downstream	DSCP type that the trace monitors for upstream traffic and downstream traffic.
Application	Application that the flow monitors.
Application Group	Application group that the flow monitors.
Domain	Domain that the flow belongs to. Click a domain name to display the protocol from which the domain was recognized. **Note** This field shows information only for DNS and HTTPS protocol flows. For other flow types, this field displays **Unknown**.
ART CND (ms)/SND (ms)	Application response time, in milliseconds, for client network delay (CND) and server network delay (SND).
Security Group Tag	From Cisco Catalyst SD-WAN Manager Release 20.12.1, security group tag that is assigned to the flow.

Table 34: Expanded DNS Domains Information (Called Expanded Application Information in Cisco vManage Release 20.6.1 Through Cisco Manage 20.8.x)

Column	Description
Egress Interface	Egress interface type used by the domain.
Local Edge, Remote Edge	Names of the local edge (source) and the remote edge (destination) of the flow.
Local Color	Color of the local edge (source) of the flow, which indicates the egress WAN interface.

Column	Description
Remote Color	Color of the remote edge (destination) of the flow, which indicates the ingress WAN interface.
App CND (ms)/App SND (ms)	Application response time, in milliseconds, for client network delay (CND) and server network delay (SND).
HTTP Probe Response Time (ms)	Response time, in milliseconds, of an HTTP probe ping from the device to the application server.
HTTP Probe Loss (%)	Packet loss percentage of an HTTP probe ping from the device to the application server.
Path Score	Path score of an HTTP probe ping from the device to the application server.

Table 35: Expanded Application Information (Available from Cisco vManage Release 20.9.1)

Column	Description
Direction	Direction of the application flow (**upstream** or **downstream**). The first packet that the flow identifies is shown as a flow in the upstream direction.
HopIndex	Hop index number for each direction of the application.
Local Edge	Name of the local edge device (source) of the application.
Remote Edge	Name of the remote edge device (destination) of the application.
Local Color	Color of the local edge device (source) of the application, which indicates the egress WAN interface.
Remote Color	Color of the remote edge device (destination) of the application, which indicates the ingress WAN interface.
Local Drop (%), WAN Drop (%), Remote Drop (%) or **Local Drop (%), WAN Loss (%), Remote Drop (%)**	Packet drop, as measured in the local and remote edge routers. Packet drop is also measured in the complete WAN network.
Jitter (ms), Latency (ms)	Jitter and latency metrics of the application during the past minute. These values help with evaluating the application performance in real time.

Column	Description
ART CND (ms)/SND (ms)	Application response time, in milliseconds, for client network delay (CND) and server network delay (SND) during the past minute.
Total Packets, Total Bytes, or **Sampled Total Packets and Sampled Total Bytes**	For each direction of the application flow, the total number of packets and the total byte count of packets.

Table 36: Expanded Flow Instance Information

Column	Description
Direction	Direction of the flow (**upstream** or **downstream**). The first packet that the flow identifies is considered to flow in the upstream direction.
HopIndex	Hop index number for each direction of the flow.
Local Edge	Name of the local edge (source) of the flow.
Remote Edge	Name of the remote edge (destination) of the flow.
Local Color	Color of the local edge (source) of the flow, which indicates the egress WAN interface.
Remote Color	Color of the remote edge (destination) of the flow, which indicates the ingress WAN interface.
Local Drop (%), WAN Drop (%), Remote Drop (%) or **Local Drop (%), WAN Loss (%), Remote Drop (%)**	Packet drop, as measured in the local and remote edge routers. The packet drop is also measured in the complete WAN network.
Jitter (ms), Latency (ms)	Jitter and latency metrics of the flow. These values help with evaluating the application performance in real time.
ART CND (ms)/SND (ms)	Application response time, in milliseconds, for client network delay (CND) and server network delay (SND).
Total Packets, Total Bytes	For each direction of the flow, the total number of packets and the total byte count of packets.
Queue Id	Identifier of the QoS queue for the flow.
QDepthLimit/Max/Min/Avg	Limit, maximum, minimum, and average values of the QoS queue depth for the flow.

Insight Summary

Minimum release: Cisco vManage Release 20.9.1.

An insight summary provides trace-level insight information for application traffic and flows. This information appears in a slide-in pane. The following table describes how to display the various insight summaries that are available.

Table 37: Display Insight Summary Information

Insight Summary Information	Procedure
For Manually Generated Traces	
Insight summary for a single manually generated trace	In the **All Trace** tab, click **Insight Summary** in the **Trace Name** column for the trace that you want.
Consolidated insight summary for selected manually generated traces (from Cisco Catalyst SD-WAN Manager Release 20.12.1)	In the **All Trace** tab, check the check box for each trace that you want, and then click **Insight Summary** above the **Trace Name** column.
For Auto-On Task Traces (from Cisco Catalyst SD-WAN Manager Release 20.12.1)	
Insight summary for a single trace generated by an auto-on task	In the **Auto-On Task** tab, expand a task and click **Insight Summary** next to the trace that you want.
Consolidated insight summary for all the traces generated by an auto-on task	In the **Auto-On Task** tab, click **Insight Summary** next to the name of the task.

- **Overview** tab: Displays the following information.

  From Cisco Catalyst SD-WAN Manager Release 20.12.1, click **Sampled Flow Insight** to see the **Applications** graph, **Events** graph, and **Hotspot Issues**. Information for all the VPNs that the trace detects is selected by default. You can remove a VPN by unchecking it in the corresponding drop-down list, and add a VPN by choosing it in the corresponding drop-down list.

  The information in this **Sampled Flow Insight** area is based on sampled data, which comes from a subset of the total number of flows that were monitored. The number of flows that are sampled is determined by an internal algorithm. For example, if the trace monitors 1,000 flows, this tab might show information for only 10 of those flows.

  - **Applications** graph: Displays the number of flows that the trace detects in each application in the monitored traffic. Hover your cursor over the data points in the graph to display the percentage of total flows that the corresponding application flow represents.

    From Cisco Catalyst SD-WAN Manager Release 20.12.1, check the **Application** check box to display information for all flows that include application traffic. Check the **DNS** check box to display information for all the flows with DNS resolution.

  - **Events** graph: Displays the events that the trace detects in the monitored traffic and the number of application flows that each event affects. Hover your cursor over the data points in the graph to display the percentage of total application flows that the corresponding event affected.

    From Cisco Catalyst SD-WAN Manager Release 20.12.1, check one or more severity check boxes (**Critical**, **Warning**, and **Informational**) to display information for events that have the corresponding severity level.

  - **Hotspot Issues**: For each event, provides information about each application flow that was affected, including the traffic path in which the event occurred and the duration of the event.

This information is displayed for each event that appears in the **Events** field. By default, all the events that the trace detects appear in this field. You can remove an event by clicking **X** next to its name and add an event by choosing the event from the **Events** drop-down list.

From Cisco Catalyst SD-WAN Manager Release 20.12.1, when viewing the **Overview** tab for a single trace, click **Application Stats** to see the following graphs. These graphs provide information for the top 10 applications with the most flows. Hover your cursor over the data points in a graph to display more detailed information for the corresponding item.

- **Applications (top 10) - Total Flows**: Total number of application flows for the duration of the trace. The selected color is for the egress WAN interface on which flows were initialized.
- **Applications (top 10) - Total Bytes**: Overall application bidirectional bandwidth for the duration of the trace. Upstream and downstream flow bandwidths are counted on the egress WAN on which flows were initialized.
- **Applications (top 10) – Flow Setup Rate**: New incoming flows per second, calculated at 1-minute intervals.
- **Applications (top 10) – Active Flow**: Number of active flows, calculated at 1-minute intervals.
- **Applications (top 10) – Bandwidth**: Number of KB per second, calculated at 1-minute intervals.
- **Applications (top 10) – Flow Live Time**: Overall lifetime of application flows, based on the flows completed within the monitor interval and calculated at 1-minute intervals.

The **Applications (top 10) - Total Flows** and **Applications (top 10) - Total Bytes** graphs provide information for each item that is selected in the **VPN**, **Device**, and **WAN Color** fields. All the items that the trace detects are selected by default.

The other graphs provide information only when only one item is selected in the **VPN**, **Device**, and **WAN Color** fields.

You can remove an item from these fields by unchecking it in the corresponding drop-down list, and add an item by choosing the item from the corresponding drop-down list.

Note You can view detailed information about an event in the **Event Insight** tab.

- **App Performance Insight** tab (not available for consolidated insight summaries): Displays the following performance information for the selected items.

  From Cisco Catalyst SD-WAN Manager Release 20.12.11, the **Score** graph appears when you expand **Hop Metrics**. The other graphs appear when you expand **Detailed Metrics** under the expanded **Hop Metrics**.

  - **Score** graph: Provides an evaluation of application performance.
  - **Loss** graph: Provides information about packet loss.
  - **Delay** graph: Provides information about delays in the traffic flows.
  - **Jitter** graph: Provides information about the inconsistencies in latency in traffic flows.
  - **CND/SND** graph: Provides information about client network delay (CND) and server network delay (SND).

  - **Applications Path & Performance** Sankey chart: Provides a snapshot of bandwidth used and loss information at a particular time. You can choose the time by clicking a dot on a timeline in a metrics graph.

  The graphs display information for each application that appears in the **Application** field and the hop that is displayed in the **Hop** field. From Cisco Catalyst SD-WAN Manager Release 20.12.1, the **Application** field appears when you expand **Group Fields**. The Sankey chart displays information for each application that appears in the **Application** field and for all the hops, regardless of the hop that is displayed in the **Application** field.

  The five applications with the most hotspot issues appear in the **Application** field by default. You can remove an application by clicking the **X** next to its name, and add an application by choosing the application from the **Application** drop-down list. You can choose a hop from the **Hop** drop-down list.

  From Cisco Catalyst SD-WAN Manager Release 20.12.1, information for all the VPNs that the trace detects are selected by default. You can remove a VPN by unchecking it in the corresponding drop-down list, and add a VPN by choosing the item from the corresponding drop-down list.

  From Cisco Catalyst SD-WAN Manager Release 20.12.1, you can arrange the information that displays into groups, according to the items that you choose in the **Group Fields** area. The fields that are displayed depend on the **Grouping Fields** options that you chose when you started the trace. You can remove a grouping item by clicking **X** next to its name, and add an item by choosing it from the corresponding drop-down list.

  Click **Upstream** to display information for upstream traffic in the graphs and chart. Click **Downstream** to display information for downstream traffic in the graphs and chart.

  Hover your cursor over a data point in a graph to display more detailed information. Click a data point in a graph to update the Sankey chart for that data point. Hover your cursor over a data point in the Sankey chart to display more detailed information.

- **Event Insight** tab (not available for consolidated insight summaries): Displays the following information about application flows that were affected during each minute of the duration of an event. You can use this information to assist with a root-cause analysis.

  - **Flows** graph: Provides information about the number of flows at a particular time.
  - **Applications Path & Event** Sankey chart: Provides detailed information about the effect of designated events at a particular time. Hover your cursor over a data point to see more information.

  The graph displays information for each application that appears in the **Application** field and the hop that is displayed in the **Hop** field. From Cisco Catalyst SD-WAN Manager Release 20.12.1, the **Application** field appears when you expand **Group Fields**. The Sankey chart displays information for each application that appears in the **Application** field, for all the hops regardless of the hop that is displayed in the **Hop** field, and for the events that are displayed in the **Events** field.

  The five applications with the most hotspot issues appear in the **Application** field by default. You can remove an application by clicking **X** next to its name, and add an application by choosing the application from the **Application** drop-down list. You can choose a hop from the **Hop** drop-down list.

  Hotspot events that the trace detects appear in the **Events** field by default. You can remove an event by clicking **X** next to its name and add an event by choosing the event from the **Application** drop-down list.

  From Cisco Catalyst SD-WAN Manager Release 20.12.1, information for all the VPNs that the trace detects is selected by default. You can remove a VPN by unchecking it in the corresponding drop-down list, and add a VPN by choosing the item from the corresponding drop-down list.

From Cisco Catalyst SD-WAN Manager Release 20.12.1, you can use the fields in the **Group Fields** area to group the information that displays by the selected items. The fields that are displayed depend on the **Grouping Fields** options that you chose when you started the trace. You can remove a grouping item by clicking **X** next to its name, and add an item by choosing it from a drop-down list.

Click **Upstream** to display information for upstream traffic in the graph and chart. Click **Downstream** to display information for downstream traffic in the graph and chart.

Hover your cursor over a data point to display detailed information about the events that affect the flow at that point. Click a data point to update the Sankey chart for that data point. Hover your cursor over a data point in the Sankey chart to display more detailed information.

- **QoS Insight** tab (not available for consolidated insight summaries): Displays network-wide information about which application traffic entered which QoS queues on the devices that the trace detects. This information includes all the hops for the traffic.

  To display information on this tab, enable the **QoS Insight** option when you start the trace.

  - **QoS Drop Rate** graph: Provides information about the packet or byte drop rates for the selected devices over the period of the trace.
  - **QoS - Applications Distribution** Sankey chart: Provides detailed information about the traffic spectrum and QoS processing at a particular time. The chart illustrates forwarded or dropped traffic that occurs in a flow that goes from an application to a VPN to a physical interface to a queue.

  To provide complete information about bandwidth consumers that cause dropped packets, this tab displays information for all the applications on a device, regardless of the applications that you choose by using the **Application** filter when you start a trace. It also displays information for **VPN0** and all the service VPNs, regardless of the service VPNs that you choose by using the **VPN** filter when you start the trace.

  The graph and chart display information for each device that appears in the **Devices** field.

  The chart displays information for each item that appears in the **Applications**, **VPNs**, **Interfaces**, **Queues**, and **Forward/Drop** fields. All the items that the trace detects are displayed in these fields by default, except items with a packet per second (PPS) rate of less than 0.05. You can remove an item by clicking the **X** next to its name, and add an item by choosing the item from a corresponding drop-down list.

  Click **Packet** to display packet drop rate information in the graph and packets per second (PPS) information in the Sankey chart. Click **Byte** to display byte drop rate information in the graph and kilobits per second (Kbps) information in the Sankey chart.

  Hover your cursor over a data point in the graph to display more detailed information. Click a data point in the graph to update the Sankey chart for that data point. Hover your cursor over a data point in the Sankey chart to display more detailed information.

Trace Views

In releases before Cisco vManage Release 20.6.1, you can view the trace flow from three sections—**Geography View**, **Feature View (Upstream)**, and **Feature View (Downstream)**.

From Cisco vManage Release 20.6.1, you can view the trace flow information from these tabs in the **Insight - Advanced Views** area after expanding a flow in the **Insight** area—**Domain Trend**, **Flow Trend**, **Upstream Feature**, **Downstream Feature**, and **Geography**.

Note In Cisco vManage Release 20.6.1 through Cisco vManage 20.8.x, **Domain Trend** is called **App Trend**.

Domain Trend

The **Domain Trend** tab is available from Cisco vManage Release 20.6.1. It was called **App Trend** in In Cisco vManage Release 20.6.1 through Cisco vManage 20.8.x. This tab appears only when DNS discovery is enabled and displays trends for metrics and events in an application flow. Hover your cursor over the data points in the tab to see detailed information.

The client network delay (CND) and server network delay (SND) information that appears on this tab are measured by the applications' TCP traffic. DNS request frequency shows how often a SaaS application is visited. HTTP probe response time and loss rate are measured by probes that are sent by a router to the SaaS application server to detect a reachable direct internet access (DIA) network path and help evaluate the benefit of deploying a DIA traffic policy.

From the **Chart Metrics** drop-down list, you can choose the metric types for which you want to view information. From the **Devices** drop-down list, you can choose specific devices for which you want to view data. By default, trend information appears for all metric types and all devices.

You can limit the display to trends that occurred within a specified time, or those that occurred within a specified period. You can choose a period of 1, 10, or 30 minutes, or 1, 2, or 5 hours. You also can click **Custom** and enter a date and time range, or click **Real Time** to display information as it is collected.

Flow Trend

The **Flow Trend** tab is available from Cisco vManage Release 20.6.1. This tab displays trends for metrics and events in a trace flow. Hover your cursor over data points to see detailed information.

From the **Chart Metrics** drop-down list, you can choose specific metric types for viewing information. From the **Flow Direction** drop-down list, you can choose the traffic flow direction for viewing data. By default, trend information appears for latency, jitter, WAN loss, and average queue depth, and for all the flow directions.

Use the **Navigate to Event** drop-down list to choose information about a specific event.

You can limit the display to trends that occurred within a specified time, or those that occurred within a specified period. You can choose a period of 1, 10, or 30 minutes, or 1, 2, or 5 hours. You also can click **Custom** and enter a date and time range, or click **Real Time** to display information as it is collected.

Geography View

In the **Geography View** section for releases before Cisco vManage Release 20.6.1 or the Geography tab in releases beginning with Cisco vManage Release 20.6.1, you can view the end-to-end trace flow and metrics plotted on the map for a selected trace. The topology graph displays the geographic information about the devices included in the flow.

- The geography view supports "Automatic Network Path Discovery," where you input only the Site and VPN to trace the complete **bidirectional, end-to-end** real-traffic network flow path.
- Each node in the topology is connected with two lines. One line represents upstream direction and the other represents downstream direction.
- Issues (example: SLA violation) detected in the flow metric are shown in different colored lines.

Feature View (Upstream and Downstream)

In the **Feature View** section for releases before Cisco vManage Release 20.6.1 or the **Upstream Feature** and **Downstream Feature** tabs in releases beginning with Cisco vManage Release 20.6.1, view the upstream and downstream feature trace with associated policy details.

To view the upstream and downstream details of the flow, expand a flow record in the flow path and metrics table.

- The feature view provides a list of ingress and egress features that are applied to the flow, and the execution result of each feature.
  - Typical ingress features include: SD-WAN ACL, NBAR, SD-WAN data policy, SD-WAN app-route policy, SD-WAN forwarding, and so on.
  - Typical egress features include: NBAR, IPsec, SDWAN QoS Output, QoS, Transmit report, and so on.
- For releases before Cisco vManage Release 20.6.1, in the Ingress or Egress view, click a policy to view detailed configuration in a pop-up window and validate policy behavior. For releases beginning with Cisco vManage Release 20.6.1, click **View Policy** to view this information and validate behavior for the corresponding policy. (**View Policy** does not apply to policies that are configured by using a CLI template.)

Note The downstream feature view shows similar information but organized from a downstream direction.

Troubleshooting Network-Wide Path Insight

Problem

No information is displayed when you view the results of a trace.

Solution

Check the following:

- Data stream collection might not be operating properly. To resolve this issue, choose **Administration** > **Settings** > **Data stream**, click **Disabled**, then click **Save**. Click **Data stream** again, click **Enabled**, choose **System** for the IP address type, then click **Save**.
- You may have enabled DNS domain discovery for the trace, and the monitored traffic may not be from DNS domains. To resolve this issue, choose **Tools** > **Network Wide Path Insight**, uncheck the **Enable DNS Domain Discovery** check box in the **Trace** area, and run the trace again.

Problem

The location of devices does not appear in the **Geography View** section for releases before Cisco vManage Release 20.6.1 or the **Geography** tab in Cisco vManage Release 20.6.1.

Solution

Ensure that GPS is configured for the device.

Monitor Performance of Cloud OnRamp for SaaS

View Application Performance

In vManage NMS, select the **Configuration** > **Cloud OnRamp for SaaS** screen. The Cloud OnRamp for SaaS Dashboard displays the performance of each cloud application in a separate pane.

Each application pane displays the number of Cisco IOS XE Catalyst SD-WAN devices accessing the application and the quality of the connection:

- The bottom status bar displays green for devices experiencing good quality.
- The middle status bar displays yellow for devices experiencing average quality.
- The top status bar displays red for devices experiencing bad quality.

The number to the right of each status bar indicates how many devices are experiencing that quality of connection.

View Application Details

1. In vManage NMS, choose the **Configuration** > **Cloud OnRamp for SaaS** screen. The Cloud OnRamp for SaaS Dashboard displays each cloud application in a separate pane.
2. Click in an application's pane. vManage NMS displays a list of sites accessing the application.
3. Click a graph icon in the vQoE Score column to display vQoE history for that site:
    - Click a predefined or custom time period for which to display data.
    - Hover over a point on the chart to display vQoE details for that point in time.

View ARP Table Entries

The Address Resolution Protocol (ARP) is used to resolve network layer addresses, such as IPv4 addresses) into link layer addresses (such as Ethernet, or MAC, addresses). The mappings between network and physical addresses are stored in an ARP table.

To view the entries in the ARP table:

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

    Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.
2. Choose a device from the list of devices that displays.
3. Click **Real Time** in the left pane.
4. From the **Device Options** drop-down list in the right pane, choose **ARP**.

CLI equivalent: **show arp**

View BFD Session Information

Bidirectional Forwarding Detection (BFD) sessions between routers start automatically when the devices come up in the network. BFD which runs on secure IPsec connections between the routers, is used to detect connection failures between the routers.

To view BFD information for a router:

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

2. Choose a device from the list of devices that displays.
3. Click **Real Time** in the left pane.
4. From the **Device Options** drop-down list, choose one of the following commands as relevant:
   - **BFD Sessions** (to view real-time BFD sessions)
   - **BFD History** (to view BFD session history)

View BGP Information

You can configure the Border Gateway Protocol (BGP) on routers to enable routing on the service side (site-local side) of the device, thus providing reachability to networks at the devices' local sites.

To view BGP information on a router:

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

2. Choose a device from the list of devices that displays.
3. Click **Real Time** in the left pane.
4. From the **Device Options** drop-down list, choose one of the following commands as relevant:

Option	Description
BGP Summary (**show bgp summary**	View BGP connection status.
BGP Neigbors (**show bgp neighbor**)	View BGP neighbors.
BGP Routes (**show bgp routes**)	View routes learned by BGP.

View Cflowd Information

Table 38: Feature History

Feature Name	Release Information	Description
Flexible NetFlow Support for IPv6 and Cache Size Modification	Cisco IOS XE Catalyst SD-WAN Release 17.4.1a Cisco vManage Release 20.4.1	Configure Cflowd traffic flow monitoring on Cisco IOS XE Catalyst SD-WAN devices.
Log Packets Dropped by Implicit ACL	Cisco IOS XE Catalyst SD-WAN Release 17.5.1a Cisco vManage Release 20.5.1	To enable logging of dropped packets, check the **Implicit ACL Logging** check box and to configure how often the packet flows are logged, enter the value in the **Log Frequency** field.
Flexible NetFlow Enhancement	Cisco IOS XE Catalyst SD-WAN Release 17.6.1a Cisco vManage Release 20.6.1	Configure Cflowd traffic flow monitoring to collect ToS, sampler ID, and remarked DSCP values in netflow records.
Flexible NetFlow for VPN0 Interface	Cisco IOS XE Catalyst SD-WAN Release 17.7.1a Cisco vManage Release 20.7.1	Configure this feature using the CLI template and also add-on CLI template.
Flexible NetFlow Export Spreading	Cisco IOS XE Catalyst SD-WAN Release 17.9.1a Cisco Catalyst SD-WAN Control Components Release 20.9.x Cisco vManage Release 20.9.1	This feature enables export spreading to prevent export storms that occur when a burst of packets are sent to external collector. The export of the previous interval is spread during the current interval to prevent export storms. When NetFlow packets are sent over a low-bandwidth circuit, the export spreading functionality is enabled to avoid packet drops.
Flexible NetFlow Export of BFD Metrics	Cisco IOS XE Catalyst SD-WAN Release 17.10.1a Cisco Catalyst SD-WAN Control Components Release 20.10.1	With this feature, you can export Bidirectional Forwarding Detection (BFD) metrics to an external collector for generating BFD metrics of loss, latency, and jitter. This feature provides enhanced monitoring and faster collection of network state data.

Feature Name	Release Information	Description
Real-Time Device Options for Monitoring Cflowd and SAIE Flows	Cisco IOS XE Catalyst SD-WAN Release 17.10.1a Cisco vManage Release 20.10.1	With this feature, you can apply filters for monitoring specific Cflowd and SD-WAN Application Intelligence Engine (SAIE) applications or application families running within a VPN on the selected Cisco IOS XE Catalyst SD-WAN device. This feature was already available on Cisco vEdge devices and is being extended to Cisco IOS XE Catalyst SD-WAN devices in this release.

Cflowd monitors traffic flowing through routers in the overlay network and exports flow information to a collector, where it can be processed by an IPFIX analyzer. For a traffic flow, Cflowd periodically sends template reports to a flow collector. These reports contain information about the flow and data extracted from the IP headers of the packets in the flow.

To configure Cflowd in a router, use centralized data policy to define a Cflowd template that specifies the location of a Cflowd collector and timers that control the flow collection.

To view Cflowd flow information for a router:

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

2. Choose a device from the list of devices displayed.

3. Click **Real Time** in the left pane.

4. From the **Device Options** drop-down list, choose one of the following commands or options, as relevant:

Option	Description
Cflowd Template (**show app cflowd template**)	View the Cflowd template. Device option is displayed on Cisco vEdge devices.
Cflowd Collector (**show app cflowd collector**)	View Cflowd Collector information. Device option is displayed on Cisco vEdge devices.
Cflowd Flows (**show app cflowd flows**, **show app cflowd flow-count**)	View Cflowd flows. Device option is displayed on Cisco vEdge devices.
Cflowd Statistics (**show app cflowd statistics**)	View Cflowd statistics. Device option is displayed on Cisco vEdge devices.

Option	Description
cFlowd Flows/DPI (**show cflowd flows**)	View Cflowd traffic flow information and SAIE flow information. From Cisco IOS XE Catalyst SD-WAN Release 17.10.1a and Cisco vManage Release 20.10.1, the **cFlowd Flows/DPI** field is added for applying filters for monitoring specific SAIE applications or application families running within a VPN on the selected Cisco IOS XE Catalyst SD-WAN device. Device option is displayed on Cisco IOS XE Catalyst SD-WAN devices.
cFlowd ipv6 Flows/DPI (**show cflowd flows**)	View Cflowd IPv6 traffic flow information and SAIE flows. From Cisco IOS XE Catalyst SD-WAN Release 17.10.1a and Cisco vManage Release 20.10.1, the **cFlowd ipv6 Flows/DPI** field is added for applying filters for monitoring specific SAIE applications or application families running within a VPN on the selected Cisco IOS XE Catalyst SD-WAN device. Device option is displayed on Cisco IOS XE Catalyst SD-WAN devices.

View Device Templates

View a Template

1. From the Cisco SD-WAN Manager menu, choose **Configuration** > **Templates**.
2. Click **Device Templates** or **Feature Templates**, and select a template you wish to view.

Note In Cisco vManage Release 20.7.x and earlier releases, **Device Templates** is titled **Device**, and **Feature Templates** is titled **Feature**.

3. Click **…**, and then click **View**.

View Device Templates Attached to a Feature Template

1. From the Cisco SD-WAN Manager menu, choose **Configuration** > **Templates**.
2. Click **Feature Templates**, and select a template you wish to view.

Note In Cisco vManage Release 20.7.x and earlier releases, **Feature Templates** is titled **Feature**.

3. Click **...**, and click **Show Attached Device Templates**.

   Device Templates dailog box opens, displaying the names of the device templates to which the feature template is attached.

View Devices Attached to a Device Template

For a device template that you created from feature templates:

1. From the Cisco SD-WAN Manager menu, choose **Configuration** > **Templates**.
2. Click **Device Templates**, and select a template you wish to view.

   Note In Cisco vManage Release 20.7.x and earlier releases, **Device Templates** is titled **Device**.

3. Click **...**, and click **Attach Devices**.
4. From **Attach Devices**, click **Attached Devices**.

For a device template that you created from a CLI template:

1. From the Cisco SD-WAN Manager menu, choose **Configuration** > **Templates**.
2. Click **Device Templates**, and select a template you wish to view.

   Note In Cisco vManage Release 20.7.x and earlier releases, **Device Templates** is titled **Device**.

3. Click **...**, and then click **Show Attached Devices**.

View and Monitor Cellular Interfaces

This topic describes how to monitor the status of cellular interfaces in Cisco Catalyst SD-WAN devices.

Monitor Cellular Interfaces

You can verify signal strength and service availability using either Cisco SD-WAN Manager or the LED on the router. You can view the last-seen error message for cellular interfaces from Cisco SD-WAN Manager.

Verify Signal Strength

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

2. From the **Device Groups** drop-down list, choose a group that the device belongs to.
3. Choose a device by clicking its name in the **Hostname** column.
4. Click **Real Time** in the left pane.

5. From the **Device Options** drop-down list in the right pane, choose **Cellular Radio**.

   The values for the different cellular signals are displayed. If signal strength is poor, or there is no signal, see Troubleshoot Common Cellular Interface Issues.

CLI equivalent: **show cellular status**

Verify Radio Signal Strength Using the Router LED

To check signal strength and service availability of a cellular connection from the router, look at the WWAN Signal Strength LED. This LED is typically on the front of the routers, and is labeled with a wireless icon.

The following table explains the LED color and associated status:

Table 39:

Color	Signal Strength	State	Description
Off	—	—	LTE interface disabled (that is, admin status is down) or not configured
Green	Excellent	Solid	LTE interface enabled and in dormant mode (no data being received or transmitted)
		Blinking	LTE interface enabled and in active mode (data being received and transmitted)
Yellow	Good	Solid	LTE interface enabled and in dormant mode (no data being received or transmitted)
		Blinking	LTE interface enabled and in active mode (data being received and transmitted)
Orange	Poor	Solid	LTE interface enabled and in dormant mode (no data being received or transmitted)
		Blinking	LTE interface enabled and in active mode (data are being received and transmitted)
Red	Critical Issue	Solid	LTE interface enabled but faulty; issues include no connectivity with the base transceiver station (BTS) and no signal

View Error Messages for Cellular Interfaces

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

2. Choose a device by clicking its name in the **Hostname** column.

3. Click **Real Time** in the left pane.

4. From the **Device Options** drop-down list in the right pane, choose **Cellular Status**.

   The output displayed includes a column for Last Seen Error

CLI equivalent: **show cellular status**

View a Signed Certificate

Signed certificates are used to authenticate Cisco SD-WAN devices in the overlay network. To view the contents of a signed certificate using Cisco SD-WAN Manager:

1. From the Cisco SD-WAN Manager menu, choose **Configuration** > **Certificates**.
2. Click **Controllers**.
3. For the desired device, click **...** and choose **View Certificate** to view the installed certificate.

View Cisco Umbrella Information

To view Cisco Umbrella information on a device, perform the following steps:

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.
2. Choose a device from the list of devices that is displayed.
3. Click **Real Time** in the left pane.
4. Click **Device Options**, and choose the following.

Device Option	Command	Description
Umbrella Device Registration	show umbrella deviceid	Displays Cisco Umbrella registration status for Cisco IOS XE Catalyst SD-WAN devices.

View Cisco Catalyst SD-WAN Validator Information

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.
2. Choose a device from the list of devices that is displayed.
3. Click **Real Time** in the left pane.
4. From the **Device Options** drop-down list, choose one of the following commands:

Device Option	CLI Command	Description
Orchestrator Reverse Proxy Mapping	show orchestrator reverse-proxy-mapping	Displays the proxy IP addresses and port numbers that are configured for use by reverse proxy.

Device Option	CLI Command	Description
Orchestrator Statistics	show orchestrator statistics	Displays statistics about the packets that a Cisco Catalyst SD-WAN Validator has transmitted and received in the process of establishing and maintaining secure DTLS connections to a Cisco IOS XE Catalyst SD-WAN devices in the overlay network.
Orchestrator Valid vManage ID	show orchestrator valid-vmanage-id	Lists the chassis numbers of the valid Cisco SD-WAN Manager instance in the overlay network.

View Cloud Express Information

To view Cloud Express information on a device, perform the following steps:

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

2. Choose a device from the list of devices that is displayed.

3. Click **Real Time** in the left pane.

4. From the **Device Options** drop-down list, choose one of the following commands:

Device Option	Command	Description
Cloud Express Applications	show sdwan cloudexpress applications	Displays the best path that Cloud onRamp for SaaS has selected for each configured SaaS application on Cisco IOS XE Catalyst SD-WAN devices.
Cloud Express Gateway Exits	`show sdwan cloudexpress gateway-exits`	Displays the Quality of Experience (QoE) measurements received from gateway sites, for Cloud onRamp for SaaS on Cisco IOS XE Catalyst SD-WAN devices.
Cloud Express Local Exits	`show sdwan cloudexpress local-exits`	Displays the list of applications enabled for Cloud onRamp for SaaS probing on Cisco IOS XE Catalyst SD-WAN devices, and the interfaces on which the probing occurs.

View Control Connections

To view all control connections for a device:

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Geography**.
2. Choose a device to view its control connections.

   If you select a controller device—a Cisco Catalyst SD-WAN Validator, Cisco SD-WAN Manager, or a Cisco Catalyst SD-WAN Controller, the **Control Connections** screen opens by default.
3. If you choose an edge device, the System Status screen displays by default. To view control connections for the device, click **Control Connections** in the left pane. The right pane displays information about all control connections that the device has with other controller devices in the network.

The upper area of the right pane contains the following elements:

- Expected and actual number of connections.
- Control connection data in graphical format. If the device has multiple interfaces, Cisco SD-WAN Manager displays a graphical topology of all control connections for each color.

The lower area of the right pane contains the following elements:

- Search bar—Includes the Search Options drop-down, for a Contains or Match.
- Control connections data in tabular format. By default, the first six control connections are selected. The graphical display in the upper part of the right pane plots information for the selected control connections.

View Data Policies

A centralized data policy is configured and applied on Cisco SD-WAN Controllers, and is then carried in OMP updates to the edge devices in the site-list that the policy is applied to. Centralized data policy examines fields in the headers of data packets, looking at the source and destination addresses and ports, and the protocol and DSCP values, and for matching packets, it modifies the next hop in a variety of ways or applies a policer to the packets. The policy match operation and any resultant actions are performed on the router as it transmits or receives data traffic.

Localized data policy, also called access lists (ACLs), is configured directly on a local router and affects data traffic being transmitted between the routers on the Cisco Catalyst SD-WAN overlay network.

To view ACL information on a router, do the following:

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.
2. Choose a device from the list of devices that appears.
3. Click **Real Time** in the left pane.
4. Click **Device Options**, and choose one of the following commands:

Command	Description
show policy access-list-names	View names of configured ACLs

Command	Description
show policy access-list-associations	View Interfaces to which ACLs are applied
show policy access-list-associations	View count of packets affected by ACLs

View Cisco Catalyst SD-WAN Controller Policy

To view policy information from Cisco Catalyst SD-WAN Controller on a device, perform the following steps:

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

2. Choose a device from the list of devices that appears.
3. Click **Real Time** in the left pane.
4. Click **Device Options**, and choose one of the following commands:

Device Option	Command	Description
Policy from vSmart	show sdwan policy from-vsmart	Displays a centralized data policy, an application-aware policy, or a cflowd policy that a Cisco Catalyst SD-WAN Controller has pushed to the Edge devices.

View Devices Connected to Cisco Catalyst SD-WAN Manager

1. From the Cisco SD-WAN Manager menu, choose **Administration** > **Cluster Management**.
2. Under **Service Configuration**, click the hostname of the desired Cisco SD-WAN Manager server. The **vManage Details** screen appears.
3. Or alternatively:

   Under **Service Configuration**, for the desired Cisco SD-WAN Manager instance, click **...** and choose **Device Connected**.

View Device Information

You can view basic or detailed information for a device in the overlay network.

To view basic information:

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Geography**.
2. Hover over the device icon.

A pop-up box displays the system IP address, hostname, site ID, device type, and device status. To view more information for a device, double-click the device icon to open the **View More Details** pop-up box. Click **Device Dashboard**, **Device Details**, **SSH Terminal**, or **Links** to get further details for the device.

To view detailed information:

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

2. Locate the WAN edge router to view the status. You can either scroll through the list of devices in the device table or enter a keyword in the search bar.

3. Click the relevant device under the **Hostname** column. The right pane displays System Status by default. To view more detailed information for the device, choose one of the categories from the left pane.

Note Starting from Cisco vManage Release 20.9.2, the **Monitor** > **Devices** page displays the devices that are newly added or synced to Cisco SD-WAN Manager using the options available on the **Configuration** > **Devices** page.

View Device Health in Table View

Minimum supported release: Cisco vManage Release 20.10.1

You can view details about the device health for the last one hour in the table view by default in the **Monitor Device** window.

The table displays:

- Device model
- Site ID
- System IP address
- Device health
- Device reachability
- Memory utilization
- CPU load

You can also view the health of all the devices on a single site by clicking **All Sites** and selecting the site ID to enter the single site view.

Devices Health Metrics

The devices health is calculated as follows:

Health State	Reachability	Control Plane	Data Plane	Resources	Evaluation Logic
Good	Device reachable	All control connections up	All BFD tunnels up	CPU usage < 75% Memory usage < 75%	All attributes met
Fair	Device reachable	> = 1 control connections up	> = 1 BFD tunnels up	CPU usage > 75% Memory usage > 75%	Any attributes met
Poor	Device not reachable	No control connections up	No BFD tunnels up	CPU usage > 90% Memory usage > 90%	Any attributes met

For a single device record the health is calculated as follows:

Health	QoE
Good	10
Fair	5
Poor	0

The average health metric of devices is calculated as follows:

Health	QoE
Good	QoE >= 6.67
Fair	3.34 <= QoE < 6.67
Poor	0 < QoE < 3.34

View Device Health in Heatmap View

Minimum supported release: Cisco vManage Release 20.10.1

In the heatmap view, the grid of colored squares displays the device health as **Good**, **Fair**, or **Poor**. You can hover over a square or click it to display additional details of a device at a specific time. Click the time interval drop-down list to change the time selection and filter the data for a specific interval.

You can view the health of all the devices on a single site by clicking **All Sites** and selecting the site ID to enter the single site view.

View DHCP Server and Interface Information

When you configure a tunnel interface on a device, several services are enabled by default on that interface, including DHCP. The device can act as a DHCP server for the service-side network to which it is connected, assigning IP addresses to hosts in the service-side network. It can also act as a DHCP helper, forwarding requests for IP addresses from devices in the service-side network to a DHCP server that is in a different subnet on the service side of the device.

To view DHCP server and interface information:

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

2. Choose the device by clicking its name in the **Hostname** column.
3. Click **Real Time** in the left pane.
4. From the **Device Options** drop-down list in the right pane. choose one of the following to view specific DHCP server and interface information:

Device Option	Command	Description
DHCP Servers	show dhcp server	View information about the DHCP server functionality that is enabled on the device
DHCP Interfaces	show dhcp interface	View information about the interfaces on which DHCP is enabled on an edge device or a Cisco SD-WAN Controller

View SAIE Flows

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.1 and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

   Starting from Cisco vManage Release 20.6.1, to view the detailed SD-WAN Application Intelligence Engine (SAIE) flow information such as source IP address, destination IP address, and port details, you need to add the devices to the on-demand troubleshooting list. Add the device to the on-demand troubleshooting list from **Tools** > **On Demand Troubleshooting**.

Note

- In Cisco vManage Release 20.6.1 and earlier releases, **On Demand Troubleshooting** is part of the **Monitor** menu.
- In Cisco vManage Release 20.7.1 and earlier releases, the SAIE flow is called the deep packet inspection (DPI) flow.
- Ensure that no Cisco or third-party APIs that instruct on-demand troubleshooting to stop are called. These APIs prevent on-demand troubleshooting from compiling information.

To enhance the application visibility, the data collection process on the device generates aggregated application statistics usage data, which in turn reduces the size of the statistics data files that are processed by default on the management plane. This enhancement allows Cisco SD-WAN Manager to collect SAIE data efficiently and reduce the processing time of the management plane.

2. Under **Applications** in the left pane, click **SAIE Applications**. The right pane displays SAIE flow information for the device.

Note

- When displaying the SAIE flow usage, peak usage is shown to be higher from one time interval than for another for the same time period. This situation occurs because the data is not yet available from the statistics database to display in Cisco SD-WAN Manager. Cisco SD-WAN Manager displays only available data and then plots that data in the appropriate axis.
- In Cisco vManage Release 20.7.1 and earlier releases, **SAIE Applications** is called **DPI Applications**.

The upper part of the right pane contains:

- Filter option: Click the **Filter** option to view a drop-down menu to choose the desired VPN and Local TLOC. Click **Search**. Click a predefined or custom time period for which to view the data.

Note Filtering **Local TLOC : Dia** is supported only for Cisco vEdge devices.

- SAIE flow information in graphical format.
- SAIE flow graph legend—Select an application family to display information for just that flow. Click the **Total Network Traffic** check box to display flow information as a proportion of total network traffic.

The lower part of the right pane contains:

- Filter criteria.
- SAIE flow information table that lists all application families sorted by usage. By default, the top six application families are selected. The graphical display in the upper part of the right pane plots the flow and usage of the selected application families.
  - Click the check box on the left to select or deselect application families. You can choose to view information for a maximum of six application families at one time.
  - Click an application family to view applications within the family.
  - Click an application to view the source IP addresses of the devices accessing the application. The Traffic per TLOC pie chart next to the graph displays traffic distribution per TLOC (color).
  - To re-arrange the columns, drag the column title to the desired position.

View Interface MTU Information

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

2. Choose a device by clicking its name in the **Hostname** column.
3. Click **Real Time** in the left pane.
4. From the **Device Options** drop-down list in the right pane, choose **Interface Detail**.

View Interfaces in Management VPN or VPN 512

VPN 512 is commonly used for out-of-band management traffic. To display information about the interfaces in VPN 512 on a router:

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.
2. Locate the device that you want to view the status for. You can either scroll through the list of devices in the device table or enter a keyword in the search bar.
3. Choose the device by clicking its name in the **Hostname** column.
4. In the left pane, click **Real Time**.
5. From the **Device Options** drop-down list in the right pane, choose **Interface Detail**.
6. In the **Select Filter** dialog box, click **Show Filters** if you want to use filters. Otherwise click **Do Not Filter**.
7. In the **Search bar**, enter **512**, which is the management VPN.

CLI equivalent: show interface vpn 512.

View License Information

To view license information on a device, perform the following steps:

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.
2. Choose a device from the list of devices that is displayed.
3. Click **Real Time** in the left pane.
4. Click **Device Options**, and choose one of the following commands:

Device Option	Command	Description
Smart License <info>	show licenses	Display the licenses for the software packages used by Cisco Catalyst SD-WAN.

View Logging Information

To view logging information on a device, perform the following steps:

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

2. Choose a device from the list of devices that is displayed.
3. Click **Real Time** in the left pane.
4. Click **Device Options** and choose the following command:

Device Option	Command	Description
Logging	show logging	Displays the settings for logging syslog messages.

View Log of Certificate Activities

To view the status of certificate-related activities, use the Cisco SD-WAN Manager **Configuration** > **Certificates** window.

1. From the Cisco SD-WAN Manager toolbar, click the tasks icon. Cisco SD-WAN Manager displays a list of all running tasks along with the total number of successes and failures.
2. Click a row to see details of a task. Cisco SD-WAN Manager opens a status window displaying the status of the task and details of the device on which the task was performed.

View Log of Configuration Template Activities

To view a log of activities related to creation of configuration templates and the status of attaching configuration templates to devices:

1. From the Cisco SD-WAN Manager menu, choose **Configuration** > **Devices**.
2. Choose **WAN Edge List** or **Controllers**, and choose a device.
3. For the desired device, click **...** and choose **Template Log**.

View Loss Percentage, Latency, Jitter, and Octet Information for Tunnels

View the loss percentage, latency, jitter, and octets for tunnels in a single chart option in Cisco SD-WAN Manager.

Table 40: Feature History

Feature Name	Release Information	Description
View Loss Percentage, Latency, Jitter, and Octet Information for Tunnels	Cisco IOS XE Catalyst SD-WAN Release 17.5.1a Cisco SD-WAN Release 20.5.1 Cisco vManage Release 20.5.1	You can view the loss percentage, latency, jitter, and octet information for tunnels in a single chart option in Cisco SD-WAN Manager.

View Loss Percentage, Latency, Jitter, and Octets for Tunnels

You can choose the **Real Time** option or other time frames to view tunnel information in the graph.

To view loss percentage, latency, jitter, and octets in Cisco SD-WAN Manager:

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

2. Choose a device.

3. In the left pane, click **Tunnel** under the WAN area. The right pane displays information about all tunnel connections.

4. In the right pane, click **Chart Options** to choose the format in which you want to view the information. Click **Loss Percentage/Latency/Jitter/Octets** for troubleshooting tunnel information.

The upper part of the right pane contains the following elements:

- Data for each tunnel is graphed based on time.
- Legend for the graph—Choose a tunnel to view information for just that tunnel. Lines and data points for each tunnel are uniquely colored.

The lower part of the right pane contains the following elements:

- Search bar—Includes the Search Options filter to filter the table based on a Contains or a Match criteria.
- Tunnel Table—Lists the jitter, latency, loss percentage, and other data about all the tunnel end points. By default, the first six tunnels are selected. The graphical display in the upper part of the right pane plots information for the selected tunnels.
  - Click the column drop-down lists to enable or disable all of the descriptions.
  - Check the check box to the left to select and deselect tunnels. You can choose and view information for a maximum of six tunnels at one time.

View Multicast Information

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

2. Choose a device from the list of devices that displays.

3. Click **Real Time** in the left pane.

4. From the **Device Options** drop-down list, choose one of the following commands as relevant:

Device Option	Command	Description
Multicast Topology	show multicast topology	View topology information about the Multicast Domain
OMP Multicast Advertised Autodiscover or OMP Multicast Received Autodiscover	show omp multicast multicast-auto-discover	View peers that support Multicast
Multicast Tunnels	show multicast tunnel	View information about IPsec tunnels between Multicast peers
Multicast RPF	show multicast rpf	View Multicast reverse-path forwarding information
Multicast Replicator	show multicast replicator	View Multicast replicators
OMP Multicast Advertised Routes or OMP Multicast Received Routes	show omp multicast-routes	View Multicast routes that OMP has learned from PIM join messages

View NMS Server Status

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

2. Choose a Cisco SD-WAN Manager device from the list of devices that is displayed.

3. Click **Real Time** in the left pane.

4. From the **Device Options** drop-down list, choose **NMS Server Running**.

Device Option	Command	Description
NMS Server Running	show nms-server running	Displays whether a Cisco SD-WAN Manager NMS server is operational. This device option is available from Cisco vManage Release 20.6.1.

View Device Configuration

1. From the Cisco SD-WAN Manager menu, choose **Configuration** > **Devices** .

2. Click **WAN Edge List** or **Controllers**.

3. To view the running configuration, for the desired device, click **…** and choose **Running Configuration**.

   To view the local configuration, for the desired device, click **…** and choose **Local Configuration**.

View Routing Information

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

2. Choose a device from the list of devices that appears.

3. Click **Real Time** in the left pane.

4. Click **Device Options**, and choose one of the following commands as relevant:

Device Options	Command	Description
IP Routes	show ip routes show ipv6 routes	Displays information about the IP route table entries. Displays the IPv6 entries in the local route table.
IP FIB	show ip fib show ipv6 fib	Displays information about forwarding table entries. Display the IPv6 entries in the local forwarding table.
IP MFIB Summary	show ip mfib summary	Displays information about a summary of active entries in the multicast FIB.
IP MFIB OIL	show ip mfib oil	Displays information about outgoing Interfaces from the multicast FIB.
IP MFIB Statistics	show ip mfib stats	Displays information about statistics for active entries in the multicast FIB.
OMP Peers	show omp peers	Displays OMP peers and their peering sessions.
OMP Summary	show omp summary	Displays information about the OMP sessions running between Cisco SD-WAN Controller and the routers.

Device Options	Command	Description
OMP Received Routes or OMP Advertised Routes	show omp routes show sdwan omp routes	Displays OMP routes. From Cisco vManage Release 20.11.1, you can download OMP route details in JSON or CSV formats for Cisco IOS XE Catalyst SD-WAN devices.
OMP Received TLOCs or OMP Advertised TLOCs	show omp tlocs	Displays OMP TLOCs.
OSPF Interfaces	show ospf interface	Displays information about the Interfaces running OSPF.
OSPF Neighbors	show ospf neighbor	Displays information about the OSPF neighbors.
OSPF Routes	show ospf routes	Displays routes learned from OSPF.
OSPF Database Summary	show ospf database-summary	Displays a summary of the OSPF link-state database entries.
OSPF Database	show ospf database	Displays information about the OSPF link-state database entries.
OSPF External Database	Not applicable	Display OSPF external routes. External routes are OSPF routes that are not within the OSPF AS (domain).
OSPF Processes	show ospf process	Display the OSPF processes.
PIM Interfaces	show pim interface	Displays information about interfaces running PIM.
PIM Neighbors	show pim neighbor	Displays information about PIM neighbors.
PIM Statistics	show pim statistics	Displays information about PIM-related statistics.
Interface Detail	show ipv6 interface	Displays information about IPv6 interfaces on Cisco Cisco IOS XE Catalyst SD-WAN devices. From Cisco vManage Release 20.6.1, this device option is available on all Cisco IOS XE Catalyst SD-WAN devices and Cisco vEdge devices.

View Services Running on Cisco Catalyst SD-WAN Manager

1. From the Cisco SD-WAN Manager menu, choose **Administration** > **Cluster Management**.
2. Under **Service Configuration**, click the hostname of the desired Cisco SD-WAN Manager server. The screen displays the process IDs of all the Cisco SD-WAN Manager services that are enabled on Cisco SD-WAN Manager.

View SFP Information

To view SFP information on a router, perform the following steps:

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.
2. Choose a device from the list of devices that is displayed.
3. Click **Real Time** in the left pane.
4. Click **Device Options**, and choose one of the following commands:

Device Option	Command	Description
SFP Detail	show interface sfp detail	Displays detailed SFP status and digital diagnostic information.
SFP Diagnostic	show interface sfp detail	Displays SFP digital diagnostic information.
SFP Measurement Value	show interface sfp detail	Displays SFP measurement data.
SFP Measurement Alarm	show interface sfp detail	Displays SFP alarm information for the measurements.

View Site Health Dashlet

Minimum supported release: Cisco vManage Release 20.10.1

You can view the overall health across all sites in the **Site Health** dashlet on the **Monitor Overview** dashboard.

The **Site Health** dashlet displays the health, which is calculated by the average Quality of Experience (QoE) across all sites. The site health depends on the health metrics of devices, tunnels, and applications at that site.

Starting from Cisco Catalyst SD-WAN Manager Release 20.12.1, a bar graph displays the bandwidth usage information for each site, and changes in bandwidth from the last time period. You can filter the view based on health status using the drop-down list for **Good Performing Sites**, **Fair Performing Sites**, and **Poor Performing Sites**.

Click **View Details** to open the site table view window.

View Site Health in Table View

Minimum supported release: Cisco vManage Release 20.10.1

In the sites table view you can view the site health, tunnel health, device health, application health, and application usage.

The sites table view displays all the sites by default and the overall health scores for sites, devices, tunnels, and applications. The table also displays the application usage data for the last one hour.

Site Health Metrics

The average health metric of sites is calculated as follows:

Health	Condition
Good	All applications, WAN edge devices, and tunnels are in good state.
Fair	Any one application, WAN edge device, or tunnel in fair state.
Poor	Any one application, WAN edge device, or tunnel in poor state.

View Site Health in Heatmap View

Minimum supported release: Cisco vManage Release 20.10.1

In the heatmap view, the grid of colored squares displays the site health as **Good**, **Fair**, or **Poor**. You can hover over a square or click to display additional details of a site at a specific time. The data shown here in the aggregated dats for the last three hours. Click the time interval drop-down list to change the time selection and filter the data for a specific interval.

View the Software Versions Installed on a Device

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

2. Choose a device by clicking its name in the **Hostname** column.

3. Click **Real Time** in the left pane.

4. From the **Device Options** drop-down list in the right pane, choose **Software Versions**.

View and Open TAC Cases

Table 41: Feature History

Feature Name	Release Information	Description
Access TAC Cases from Cisco SD-WAN Manager	Cisco IOS XE Catalyst SD-WAN Release 17.9.1a Cisco vManage Release 20.9.1 Cisco SD-WAN Release 20.9.1	This feature allows you to access Support Case Manager (SCM) wizard using Cisco SD-WAN Manager. You can create, view, or edit the support cases directly from Cisco SD-WAN Manager without having to go to a different Case Manager portal.
SCM Integration Improvements	Cisco IOS XE Catalyst SD-WAN Release 17.11.1a Cisco vManage Release 20.11.1	This feature introduces various enhancements to the Settings page in Cisco SD-WAN Manager and the Support Case Manager (SCM) wizard.

Supported Devices

This feature is supported on both Cisco Catalyst SD-WAN and Cisco IOS XE Catalyst SD-WAN devices.

Overview

For any Cisco SD-WAN Manager troubleshooting issues, you raise a support case in the SCM portal. In Cisco SD-WAN Manager, there is a provision to upload an Admin-Tech File to a specific Service Request (SR) on the SCM server by providing the SR number and the token details.

Starting from Cisco vManage Release 20.9.1, you can access SCM portal from Cisco SD-WAN Manager. In the SCM portal, you can create, view, or upload an admin-tech file. For more information on Admin-tech files, see Admin-Tech File.

Prerequisites to Access TAC Cases

- You need active Cisco single sign-on (SSO) login credentials to access the SCM Wizard and the cloud server.

View TAC Cases

Perform the following steps to view TAC cases from Cisco SD-WAN Manager.

1. From the Cisco SD-WAN Manager menu, choose **Tools** > **TAC Cases**.
2. Login to the SCM portal using Cisco SSO login.

   The TAC Support Cases portal displays a list of cases.

Open a TAC Case

Perform the following steps to open a TAC Case from Cisco SD-WAN Manager.

1. From the Cisco SD-WAN Manager menu, choose **Tools** > **TAC Cases**.
2. In the **TAC Support Cases** page, click **Open a Case**.
3. Enter all the other relevant case details.
4. Click **Create**.

   The **TAC Support Cases** portal now displays the updated list of cases.

For more information about using SCM portal, refer Cisco TAC Connect.

View Template Log and Device Bringup

View Log of Template Activities

A log of template activities contains information that relates to creating, editing, and deleting configuration templates, and the status of attaching configuration templates to devices. This information can be useful for troubleshooting.

To view a log of template activities:

1. From the Cisco SD-WAN Manager menu, choose **Configuration** > **Devices**.
2. Click **WAN Edge List** or **Controllers**, and select the device.
3. Click **...**, and click **Template Log**.

View Status of Device Bringup

You can view the status of the operations involved in bringing a router or controller up in the overlay network. This information can help you monitor these operations.

To view the status of a device bringup:

1. From the Cisco SD-WAN Manager menu, choose **Configuration** > **Devices**.
2. Click **WAN Edge List** or **Controllers**, and select the device.
3. Click **...**, and click **Device Bring Up**.

View the Status of a Cisco Catalyst SD-WAN Validator

You have the following options to view the status of a Cisco Catalyst SD-WAN Validator.

Use the Dashboard Screen

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Overview**.

   Cisco vManage Release 20.6.1 and earlier: From the Cisco SD-WAN Manager menu, choose **Dashboard** > **Main Dashboard**.
2. For releases before Cisco vManage Release 20.6.1, click the upward or downward arrow next to **Cisco vBond**.

For Cisco vManage Release 20.6.1 and later, click the number representing the number of Cisco SD-WAN Validator orchestrators in your overlay network.

3. To know the status of the Cisco Catalyst SD-WAN Validator, see the **Reachability** column in the dialog box that opens.

Use the Geography Screen

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Geography**.
2. Click **Filter** and choose **vBond** under **Types**.
3. Click the Cisco SD-WAN Validator icon to check its status.

Use the Network Screen

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.1 and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

2. Locate the Cisco Catalyst SD-WAN Validator that you want to view the status for. You can either scroll through the list of devices in the device table or enter **vBond** as the keyword in the search bar.
3. Click the relevant Cisco Catalyst SD-WAN Validator under the **Hostname** column. The **Control Connections** screen opens by default and displays information about all control connections that the device has with other controller devices in the network.

View Device Status in the Overlay Network

You have the following options to view the status of a device in the overlay network.

Use the Dashboard Screen

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Overview**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Dashboard** > **Main Dashboard**.

2. For releases before Cisco vManage Release 20.6.1, click the upward or downward arrow next to **WAN Edge**.

   For Cisco vManage Release 20.6.1 and later, click the number representing the number of **WAN Edge** devices.

3. To know the status of the WAN edge device, see the **Reachability** column in the dialog box that opens.

Use the Geography Screen

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Geography**.
2. Click **Filter** and choose **WAN Edge** under **Types**.
3. Click the router icon to check its status.

Use the Network Screen

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

2. Locate the WAN edge router that you want to view the status for. You can either scroll through the list of devices in the device table or enter a keyword in the search bar.

3. Click the relevant WAN edge router under the **Hostname** column. The **System Status** screen opens by default.

View Top Applications Pane

The **Top Applications** pane in the Cisco SD-WAN Manager **Monitor** > **Overview** page displays the SD-WAN Application Intelligence Engine (SAIE) flow information for traffic transiting WAN Edge routers in the overlay network.

Note In Cisco vManage Release 20.7.1 and earlier releases, the SAIE flow is called the deep packet inspection (DPI) flow.

To list top applications by VPN, select a VPN from the drop-down list. To select a time period for which to display data, click the **Time** drop-down list.

To list top applications in a sidebar:

1. Click **View Details** to open the **Top Applications** sidebar. It displays a more detailed view of the same information.

2. In **SAIE Application**, from the **VPN** drop-down list, select the desired VPN, and then click **Search**.

   Note In Cisco vManage Release 20.7.1 and earlier releases, **SAIE Application** is called **DPI Application**.

   - Click **Chart** to list the applications.
   - Click **Details** to display more information about the applications.

3. Click **SSL Proxy**, from the **View by Policy Actions** drop-down list, select the policy action. All Policy Action, Encrypted, Un-Encrypted, Decrypted view are supported. From the **VPN** drop-down list, select the desired VPN, and then click **Search**. The **Hour** option displays statistics for the selected hour duration.

   - Click **Chart** to list the SSL applications.
   - Click **Details** to display more information about the SSL applications.

4. Click **X** to close the window and return to the **Monitor** > **Overview** page.

Note In Cisco vManage Release 20.6.1 and earlier releases, Cisco SD-WAN Manager has the following behavior:

- The **Top Applications** pane is part of the **Dashboard** > **Main Dashboard** page.
- A filter icon instead of a drop-down list lists the VPN options and indicates the time period for which to display data.
- An expand icon instead of the **View Details** button opens the **Top Applications** pop-up window.

Note Flow DPI data is collected by Cisco SD-WAN Manager on schedule but processed on user requests. Flow DPI based reports are available after data is processed.

View the Status of a Cisco Catalyst SD-WAN Controller

You have the following options to view the status of a Cisco Catalyst SD-WAN Controller.

Use the Dashboard Screen

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Overview**.

   Cisco vManage Release 20.6.1 and earlier: From the Cisco SD-WAN Manager menu, choose **Dashboard** > **Main Dashboard**.

2. For releases before Cisco vManage Release 20.6.1, click the upward or downward arrow next to **Cisco vSmart**.

   For Cisco vManage Release 20.6.1 and later, click the number representing the number of Cisco SD-WAN Controller in your overlay network.

3. To know the status of the Cisco Catalyst SD-WAN Controller, see the **Reachability** column in the dialog box that opens.

Use the Geography Screen

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Geography**.
2. Click **Filter** and choose **vSmart** under **Types**.
3. Click the Cisco SD-WAN Controller icon to check its status.

Use the Network Screen

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.1 and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

2. Locate the Cisco Catalyst SD-WAN Controller that you want to view the status for. You can either scroll through the list of devices in the device table or enter vBond as the keyword in the search bar.

3. Click the relevant Cisco Catalyst SD-WAN Controller instance under the **Hostname** column. The **Control Connections** screen opens by default and displays information about all control connections that the device has with other controller devices in the network.

View Tunnel Connections

To view details about the top 100 data plane tunnels between Cisco Catalyst SD-WAN devices with the lowest average latency, do the following:

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Tunnels**.

   The Tunnels table lists the following information about all tunnel end points:

   - Health
   - State
   - Quality of Experience (QoE) score. The QoE score rates the quality of experience of an application that a network can deliver for a period of time.
   - Local IP and remote IP
   - Average latency, loss, and jitter data

   The health of a tunnel is defined based on the following criteria:

   - Good: If the QOE score is between 8 and 10, and the tunnel status is 1/1.
   - Fair: If the QOE score is between 5 and 7, and the tunnel status is 1/1.
   - Poor: If the QOE score is between 1 and 4, or the tunnel status is 0/1.

Note The tunnel information is available in Cisco SD-WAN Manager as a separate menu starting from Cisco vManage Release 20.7.1.

To view tunnel connections of a specific device, do the following:

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

2. Choose a device from the list of devices that is displayed.
3. In the left pane, click **TLOC** under the **WAN** area. The right pane displays information about all tunnel connections.
4. (Optional) Click the **Chart Options** drop-down list to choose the type of data to view.

   You can also choose a predefined time period or a custom time period to sort the data.
5. (Optional) In the lower part of the right pane, use the filter option in the search bar to customize the table fields you want to view.

The tunnel table lists average latency, loss, and jitter data about all tunnel end points. By default, the first six tunnels are selected. The graphical display in the upper part of the right pane plots information for the selected tunnels.

6. (Optional) Click the check box to the left to select and deselect tunnels. You can select and view information for a maximum of 30 tunnels at one time.

7. (Optional) Click **Application Usage** to the right to view the SD-WAN Application Intelligence Engine (SAIE) flow information for that TLOC.

Note

- Beginning with Cisco vManage Release 20.8.1, the **Application Usage** column and the **Application Usage** links are removed from the **Monitor** > **Devices** > **WAN – Tunnel** window. After you have configured on-demand troubleshooting for a device, you can view SAIE usage data based on the selected filters or based on application families sorted by usage.

- In Cisco vManage Release 20.7.x and earlier releases, the SAIE flow is called the deep packet inspection (DPI) flow.

For more information on configuring on-demand troubleshooting, see On-Demand Troubleshooting. For more information on viewing SAIE flows, see View SAIE Flows.

View Tunnel Health in Table View

Minimum supported release: Cisco vManage Release 20.10.1

In the **Monitor Tunnels** window the table shows information about the health of tunnels created in the last hour, displaying a maximum of 10,000 tunnels.

The tunnel information includes the following:

- Tunnel health
- State
- Quality of Experience (QoE)
- Average latency
- Average loss
- Average jitter
- Local IP address
- Remote IP address

You can also view the tunnel health on a single site by clicking **All Sites** and selecting the site ID to enter the single site view.

Tunnel Health Metrics

The average health metric of tunnels is calculated as follows:

Health	QoE	Status	Evaluation Logic
Good	QoE >= 8	UP	All attributes met
Fair	5 <= QoE < 8	UP	All attributes met
Poor	0 < QoE< 5	DOWN	Any attributes met

View Tunnel Health in Heatmap View

Minimum supported release: Cisco vManage Release 20.10.1

In the heatmap view, a grid of colored squares displays the tunnel health as **Good**, **Fair**, or **Poor**. You can hover over a square or click to display additional details of a tunnel at a specific time. Click the time interval drop-down list to change the time selection and filter the data for a specific interval.

You can view the tunnel health on a single site by clicking **All Sites** and selecting the site ID to enter the single site view.

View Tunnel Health Dashlet

Minimum supported release: Cisco vManage Release 20.10.1

You can view details about the tunnel health on **Monitor Overview** dashboard.

The **Tunnel Health** dashlet lists the following information about all tunnel end points:

- Health
- Average latency, loss, and jitter data

You can view the tunnel health across all sites in a graphical format. You can also filter the tunnel information based on the health status using the drop-down list for **Good Tunnels**, **Fair Tunnels**, and **Poor Tunnels**, and **Latency**, **Loss**, and **Jitter**.

Starting from Cisco Catalyst SD-WAN Manager Release 20.12.1, a bar graph displays current status of the tunnel and the change in status from the last time period.

Click **View Details** to open the **Monitor > Tunnels** window to view the tunnel health in table view.

View Tunnel Loss Statistics

View Data Plane Tunnel Loss Statistics

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

2. Choose a device from the list of devices that displays.
3. Click **Real Time** in the left pane.
4. From the **Device Options** drop-down list, choose **Tunnel Statistics**.

View Traffic Loss for Application-Aware Routing

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Overview**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Dashboard** > **Main Dashboard**.

2. Scroll down to the **Application-Aware Routing** pane.

You can also use the **show app-route statistics** command to view traffic loss for application-aware routing.

View WAN Interfaces

Transport interfaces in VPN 0 connect to a WAN network of some kind, such as the Internet, Metro Ethernet network, or an MPLS network.

You can view information about WAN interfaces on a device using one of the following options:

Real Time Pane

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

2. Locate the device that you want to view the status for. You can either scroll through the list of devices in the device table or enter a keyword in the search bar.
3. Choose the device by clicking its name in the **Hostname** column.
4. In the window that opens, choose **Real Time** in the left pane.
5. From the **Device Options** drop-down in the right pane, choose **Control WAN Interface Information**.

Note Starting from Cisco Catalyst SD-WAN Manager Release 20.12.1, a new field **Bind Interface** is introduced to display mapping relationship between the loopback interfaces and the physical interfaces.

Interface Pane

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

2. From the **Device Groups** drop-down list, choose the device group to which the device belongs.
3. Choose the device by clicking its name in the **Hostname** column.
4. In the left pane, choose **Interface**.

View WAN Edge Health Dashlet

Minimum supported release: Cisco vManage Release 20.10.1

You can view the state for each WAN edge device and the number of WAN edge devices in that state in the **WAN Edge Health** dashlet on **Monitor Overview** dashboard.

You can view the state for each WAN edge device and the number of WAN edge devices in that state in the **WAN Edge Health** dashlet on **Monitor Overview** dashboard.

Starting from Cisco Catalyst SD-WAN Manager Release 20.12.1, a bar chart displays the CPU utilization of WAN edge devices at a site, and the changes in CPU utilization from the last time period.

You can filter the **WAN Edge Health** dashlet view based on the health status using the drop-down list for **Good Devices**, **Fair Devices**, and **Poor Devices** and also for **CPU Load** and **Memory Load**.

Click **View Details** to open the **Monitor > Devices** window to view the device health in table view.

View VRRP Information

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

2. Choose a device.
3. Click **Real Time** from the left pane.
4. Click **Device Options**, and choose **VRRP Information**.

View Device Interfaces

To view information about interfaces on a device:

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor** > **Network**.

2. Choose a device by clicking its name in the **Hostname** column.
3. Click **Interface** in the left pane. The right pane displays interface information for the device.

The upper part of the right pane contains:

- Chart Options bar—Located directly under the device name, this bar includes:
  - Chart Options drop-down—Click **Chart Options** to choose how the data should be displayed.
  - IPv4 & IPv6 drop-down—Click **IPv4 & IPv6** to choose the type of interfaces to view. The information is displayed in graphical format. By default, the graph is Combined, showing interfaces on which both IPv4 and IPv6 addresses are configured. To view IPv4 and IPv6 interfaces in separate graphs, select the Separated toggle button.
  - Time periods—Click either **Real Time**, a predefined time period, or a custom time period for which to view the data.
- Interface information in graphical format.
- Interface graph legend—Choose an interface to display information for just that interface.

The lower part of the right pane contains:

- Filter criteria.
- Interface table, which lists information about all interfaces. By default, the first six interfaces are displayed. The graphical display in the upper part of the right pane plots information for the selected interfaces.
    - Check the check box to the left to select and deselect interfaces. You can select and view information for a maximum of 30 interfaces at a time.
    - To rearrange the columns, drag the column title to the desired position.
    - For cellular interfaces, click the interface name to view a detailed information about the cellular interface.

To view interface status and interface statistics, see show interface and show interface statistics.